



Mercury Product Life-Cycle Model: Uses and Results

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Questions

- Are Products (Still) Important Sources of Mercury to the Environment?
 - Incinerators have been controlled
 - Mercury thermometers have become rare
- Which Products Contribute the Most?
- Which Pathways Contribute the Most?
- Which Interventions Will Reduce Mercury the Most?



Mercury Product Life-Cycle Release Estimation Project

- Minnesota PCA (Ed Swain)/Barr Engineering (Carol Andrews, Bruce Monson)– estimates for MN in 2001– Used to improve MPCA mercury emissions inventories
- Wisconsin DNR/Barr/Dane County– adapted for WI in 2003-2004
- 2004-5; EPA Region 5, WDNR (Randy Case), Dane County (John Reindl), Barr (Cliff Twaroski, Sarah Disch) develop national estimates



Life-Cycle Mercury Flow Approach

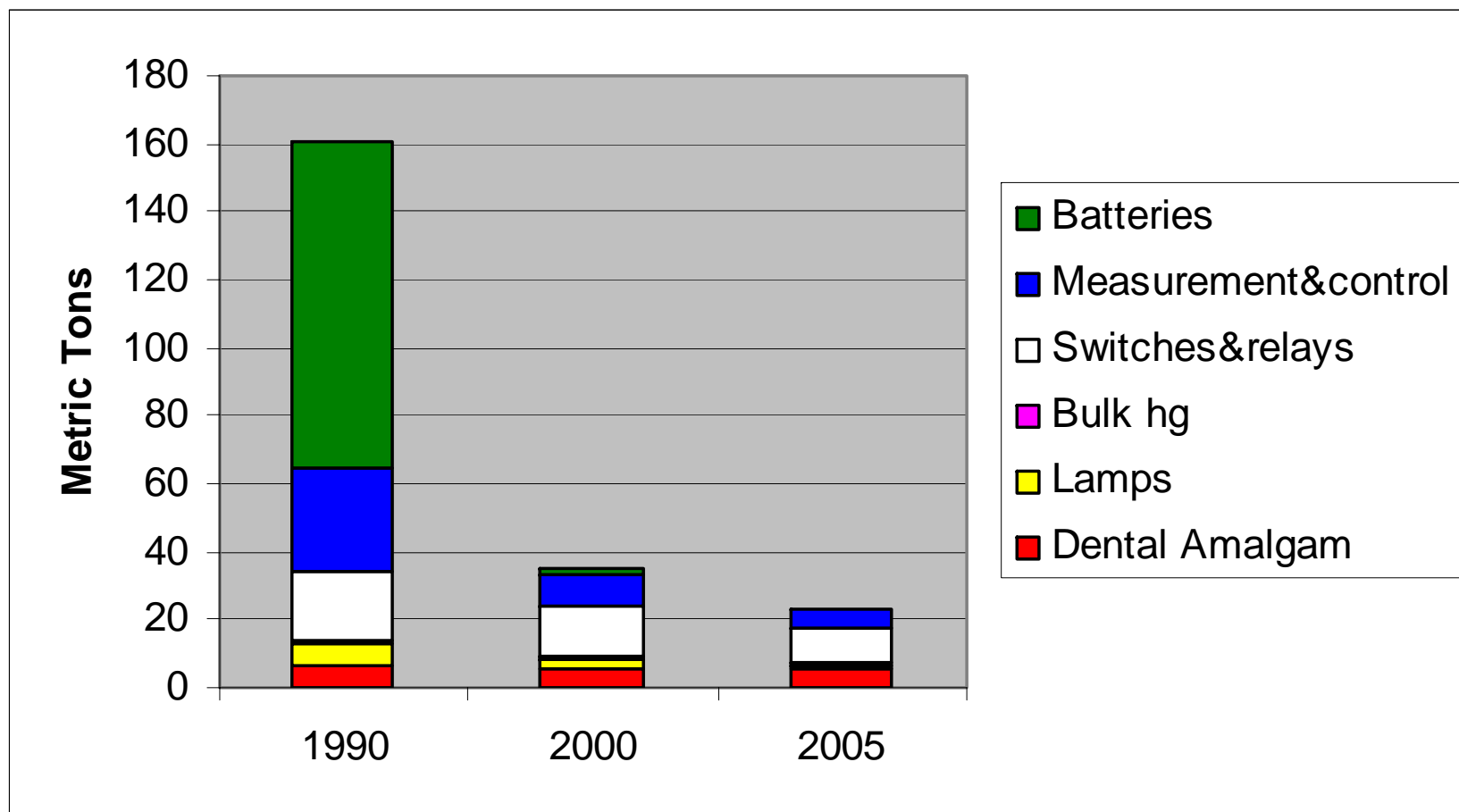
- Mass Balance
- Spreadsheets
- Distribution Factors
- Release Factors
- Estimated releases to air, water, land in 1990, 2000, 2005-10
- Mercury used in products is released, recycled, or maintained in inventory
- Estimates are rough, preliminary



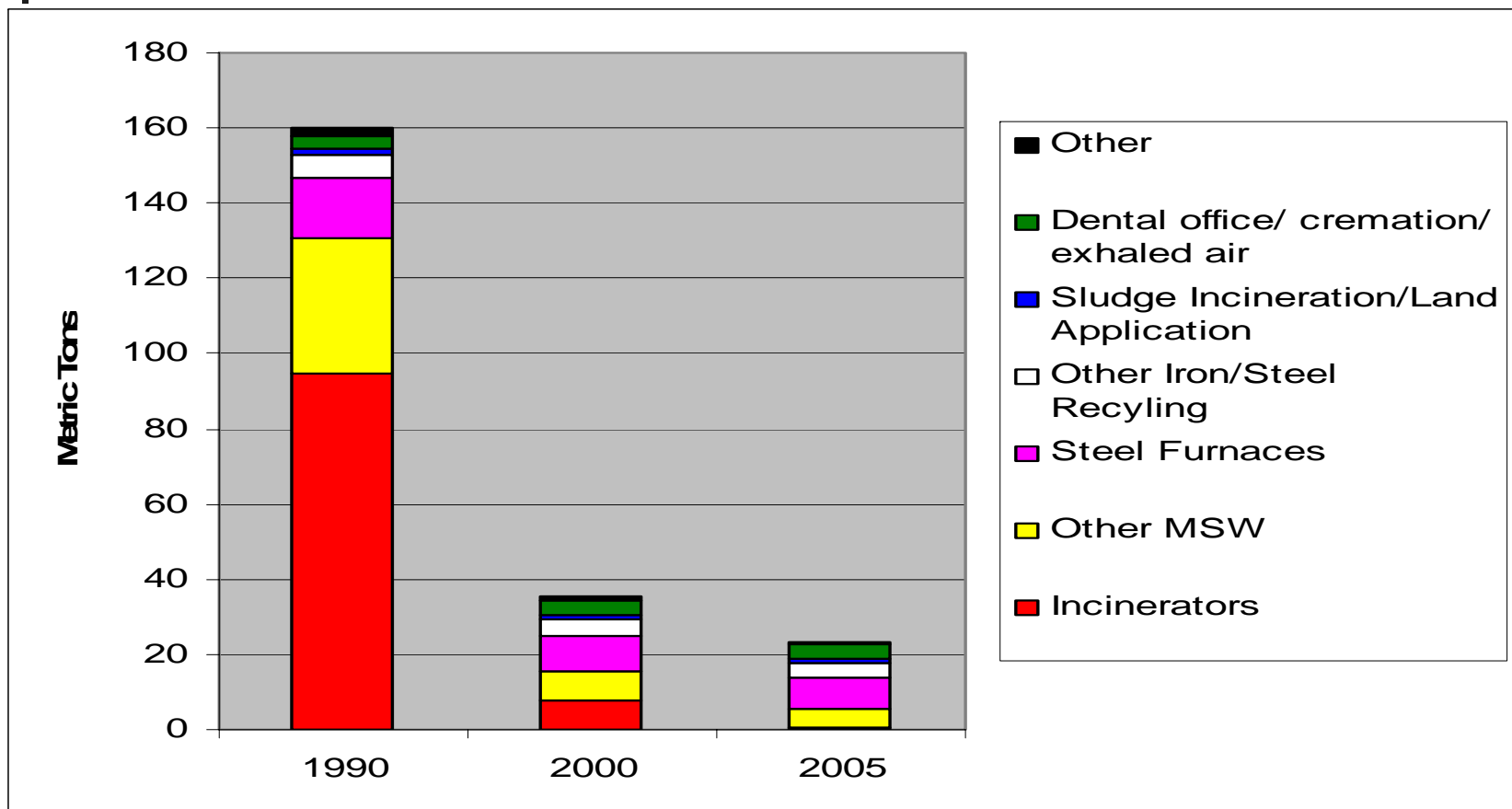
Products Covered

- Dental amalgam
- Fluorescent lamps, other lamps
- Bulk liquid mercury
- Switches and relays
 - Auto switches
 - Thermostats
- Measurement and Control Devices
 - Thermometers
- Batteries– a back of the envelope analysis
- Did not evaluate chemicals, paint, fungicides

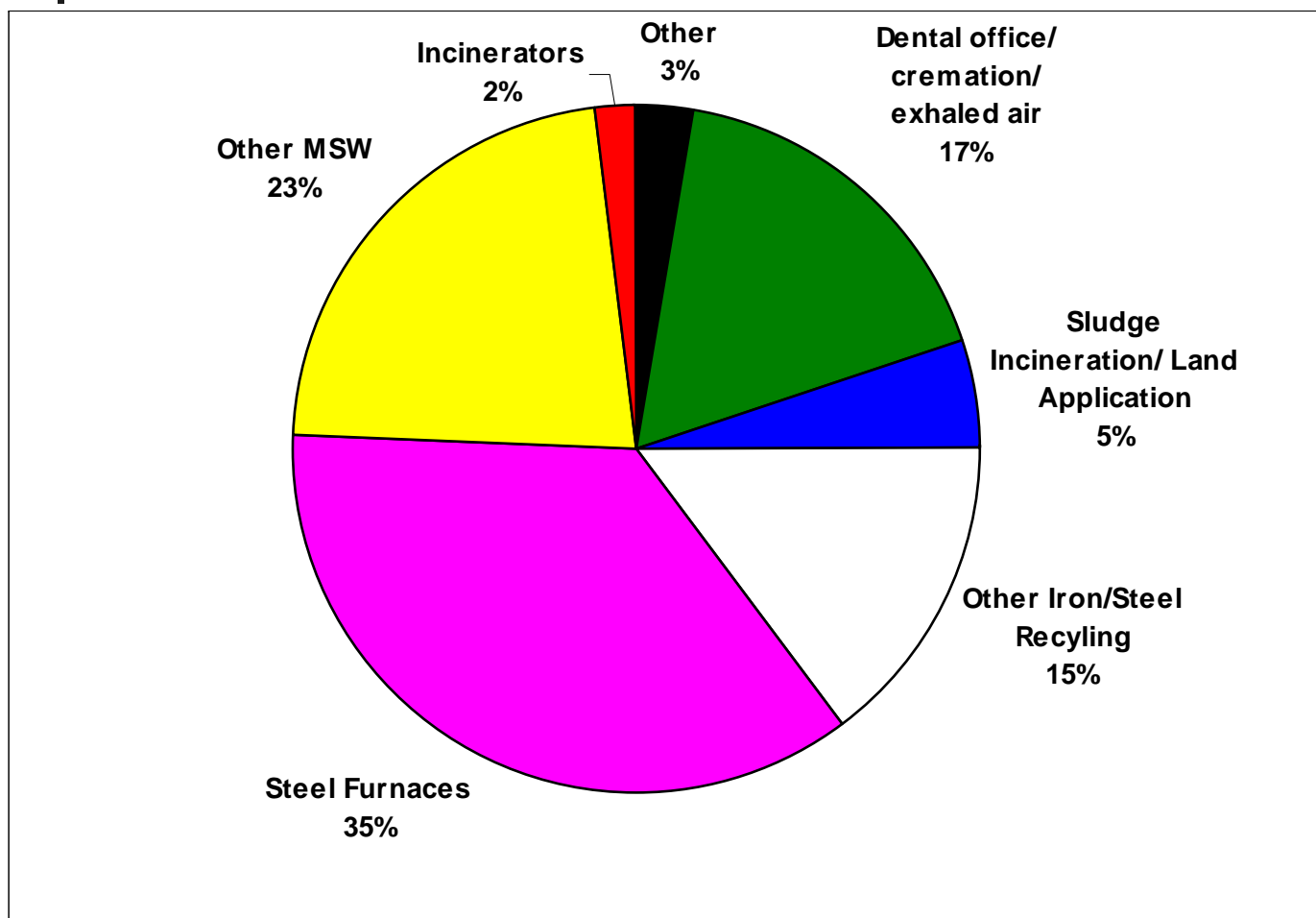
Product-Related Air Emissions, by Product



Product-Related Air Emissions, by Pathway



Product-Related Air Emissions by Pathway: 2005



**Total: 23
metric tons**



Selected 1999 NEI* Emissions Compared with Model (2000)

	NEI	Model
Medical/Municipal Incinerators	5.9	7.5
Burn Barrels	?	2.1
Lamp Breakage	1.4	1.6
Breakage of Products other than Lamps	?	3.0
Mercury Recycling	0.2	0.6
Iron and Steel Furnaces*	12.4	9.8
Zinc Production	?	2.0
Metal Shredders	?	1.7
Auto Fluff	?	0.3

NEI: EPA's National Emissions Inventory.

* Steel furnace estimate from regulation development for foundries and electric arc furnaces.



Iron and Steel Recycling

- Less decrease than in most other categories
- Not just autos– autos account for under 1/2 of steel furnace emissions (high uncertainty)
- Other switches and relays – commercial appliances? Industrial equipment?
- Not just steel furnaces: shredders, auto fluff and
- Secondary zinc production emissions (TRI, 2003)
 - Inmetco International Metals, Ellwood City, PA: 1900 lbs mercury air emissions
 - Horsehead Resource Development
 - Chicago: 210 lbs mercury air emissions
 - Palmerton, PA: 220 lbs mercury air emissions
 - Rockwood, TN: 99 lbs mercury air emissions



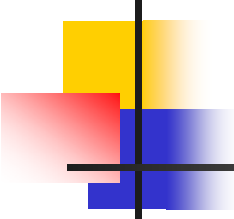
Solid Waste Management System

- Emissions declining rapidly
- Big impacts from battery P2; incinerator regulations
- Emissions could be significant for:
 - Burn barrels
 - Product breakage during use, transport to disposal sites
 - High uncertainty



Dental Amalgam

- Significant water releases (391 kg in 2005) >50% of product-related total
- Air releases from sludge incineration and land application, dental office vacuum system, cremation, exhaled air (high uncertainty)
- Potential BMP/Separator impact?



Evaluation of Potential Control Options: Dental Amalgam, 2005

	Inputs to Sludge	Water	Air
BMP Status quo, Zero separators	5,542	429	5,542
100% BMP adherence, Zero separators	4,391	330	5,088
100% adoption of BMPs and 95%-effective separators	1,360	102	4,538

In kg. Assumes that WWTPs are equally effective at removing dental amalgam and other mercury from sewage.



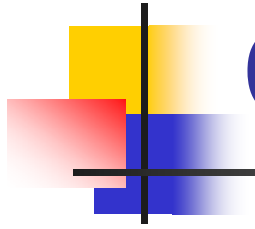
Evaluation of Potential Control Options—Air Emissions Impact

- Auto switches, 2005
 - 0 switch removal— 3,492 kg emissions
 - 20% removal— 2,829 kg
 - 80% recycling—838 kg
- Fluorescent lamps, 2005
 - 25% lamp recycling—1,142 kg emissions
 - 75% lamp recycling— 599 kg emissions



Conclusions

- Products Are Still Important Sources of Mercury to the Environment
 - Releases reduced significantly
- Important reduction opportunities in iron and steel production/recycling; dental, lamps
- Model provides opportunity to better understand release pathways and to test impact of potential control strategies
- Quantification is rough—many uncertainties
- Model can be adapted for state/local use



Questions?
