North Carolina Division of Air Quality - 2012 Report on Control of Mercury Emissions from Coal-Fired Electric Generating Units

In response to 15 NCAC 02D .2509(b)
Presented to
Environmental Management Commission
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By Steve Schliesser
DAQ Planning Section
Environmental Engineer

Topics Covered

- 15 NCAC 02D .2509(b) subjects:
  - Mercury emissions, including projections
  - Principal mercury emission sources
  - Mercury emission control technologies
  - Mercury deposition modeling results
  - Mercury levels in fish and related health issues
  - Rulemaking recommendations

ACRONYMS

EGU = Electrical generating unit

MATS = Mercury and Air Toxics Standards

PM = Particulate matter

ESP = Electrostatic precipitator, PM control

SO_2 = Sulfur dioxide

FGD = Flue gas desulfurization, SO_2 control

NOx = Nitrogen oxides

SCR = Selective catalytic reduction, NOx control

SNCR = Selective non-catalytic reduction, NOx control

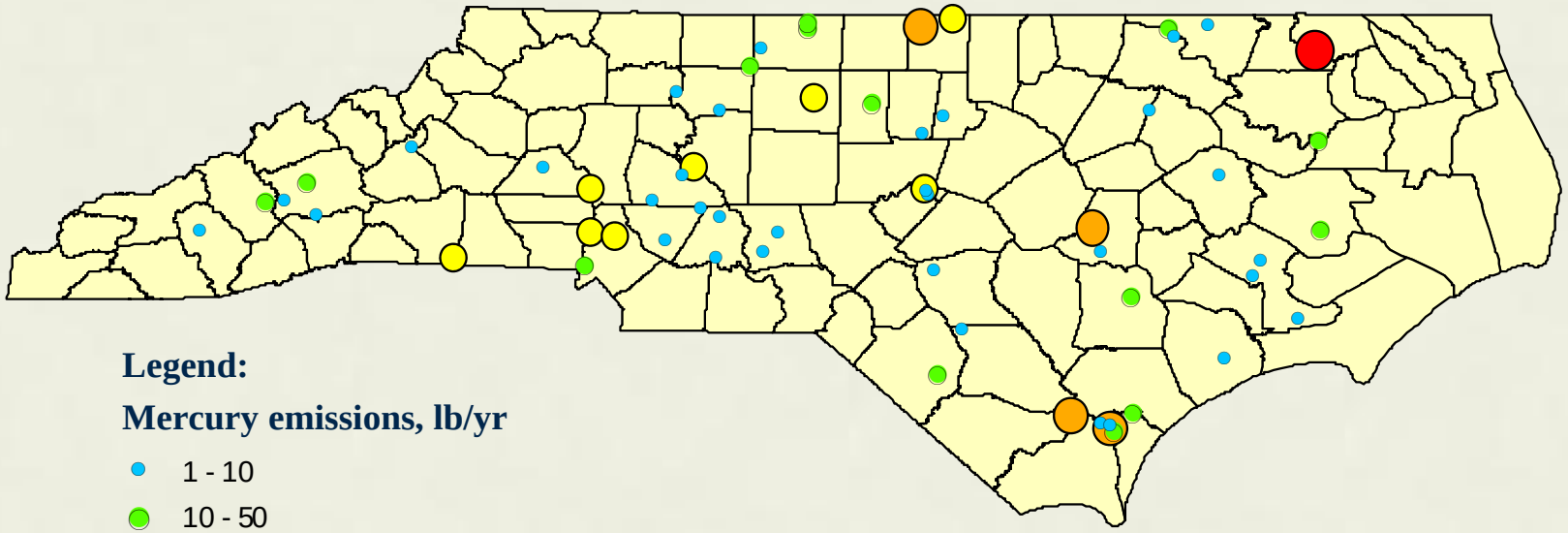
Why Interest for Mercury in North Carolina back in 2002?

- Mercury in fish tissue prompted NC fish advisories
- Coal-fired power plants released 3,200 pounds of mercury representing 2/3 of NC emissions
- Limited data available on speciated mercury emissions
- Mercury emission control varied from 0-90+% for U.S. power plants, prompting questions as to why
- Little known about relationship among emissions, deposition, and fish tissue level for mercury.

2010 Mercury Emission Inventory

- 1,850 lb/yr from largely same top 22 facilities
- 52% from 14 Electric Generating Units (EGUs)
  - Mercury emissions 3,350 lb in 2002, 960 lb in 2010
  - > 70% reduction over 8 years
- 33% from 8 industrial facilities firing coal, waste, or iron
  - Most with effective mercury controls
  - Mercury emissions 1,950 lb in 2002, 890 lb in 2010
  - > 50% reduction over 8 years
- Remaining industrial boilers subject to pending Boiler MACT
- Few industrial boilers switched from coal to gas, others expected
- 15% from 600 other low emitting facilities

Top 60 NC Mercury Emission Sources 2007-2010



Legend:

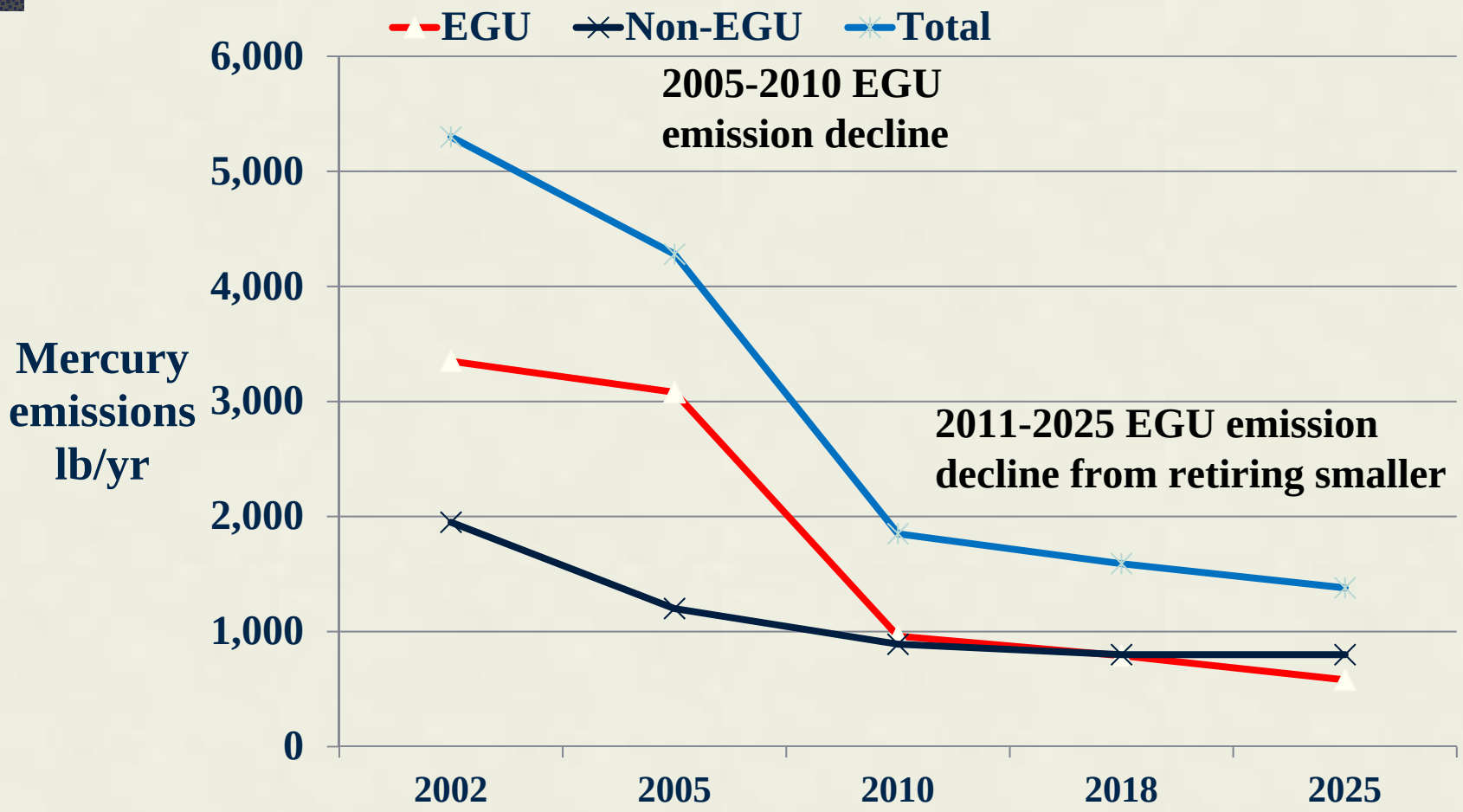
Mercury emissions, lb/yr

- 1 - 10
- 10 - 50
- 50 - 100
- 100 - 150
- >150

Electric Utilities Response to Clean Smokestack Act

- From 2003-2010 NC utilities spent $2.9 billion:
  - Selective catalytic reduction (SCR), or Selective non-catalytic reduction (SNCR) on NOx control
  - Flue gas desulfurization (FGD) on SO_2 control
- SCR/SNCRs reduce NOx by 80+% and condition mercury to be more collectable
- FGDs collect 99% SO_2 emissions, 70-85% mercury
- SCR- or SNCR-ESP-FGD combo removes 90+% mercury

North Carolina Mercury Emissions from 2002-2025



EPA Electrical Generating Units (EGU) Mercury and Air Toxics Standards Rule

- Maximum Achievable Control Technology Rule

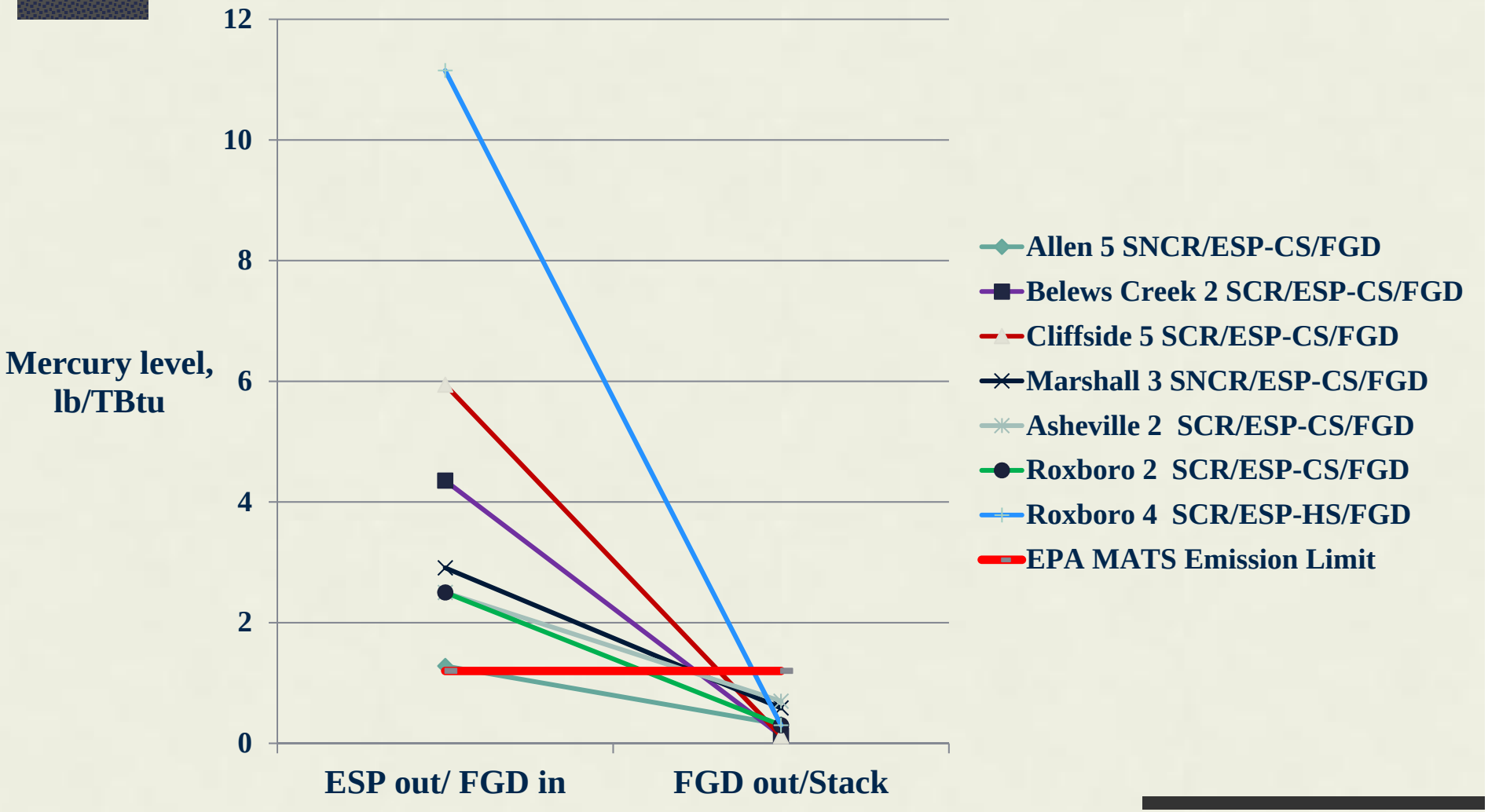
  aka EGU MATS (Mercury and Air Toxics Standards)
- Compliance April 2015 with 1 or 2-yr extension option
- Numerical emission limits and Continuous monitors
  - Mercury
  - Particulate matter (surrogate for 10 toxic metals)
  - Acid gases (SO_2 or Hydrogen chloride)

NC Coal-Fired Utility Boilers
EGU Pre-MATS 2010 Status

13 gigawatts of NC EGU coal-fired electrical capacity:

- **7 facilities with ¾ state capacity and 19 largest boilers**
  - **Most well-positioned to meet EGU MATS soon**
  - **All will continue to operate**
- **7 facilities with ¼ state capacity and 26 smallest boilers**
  - **10% - 30% mercury emission reduction**
  - **None can meet any EGU MATS standards**
  - **All 26 coal-fired units retire by 2015**
  - **Facilities also operate natural gas boilers**

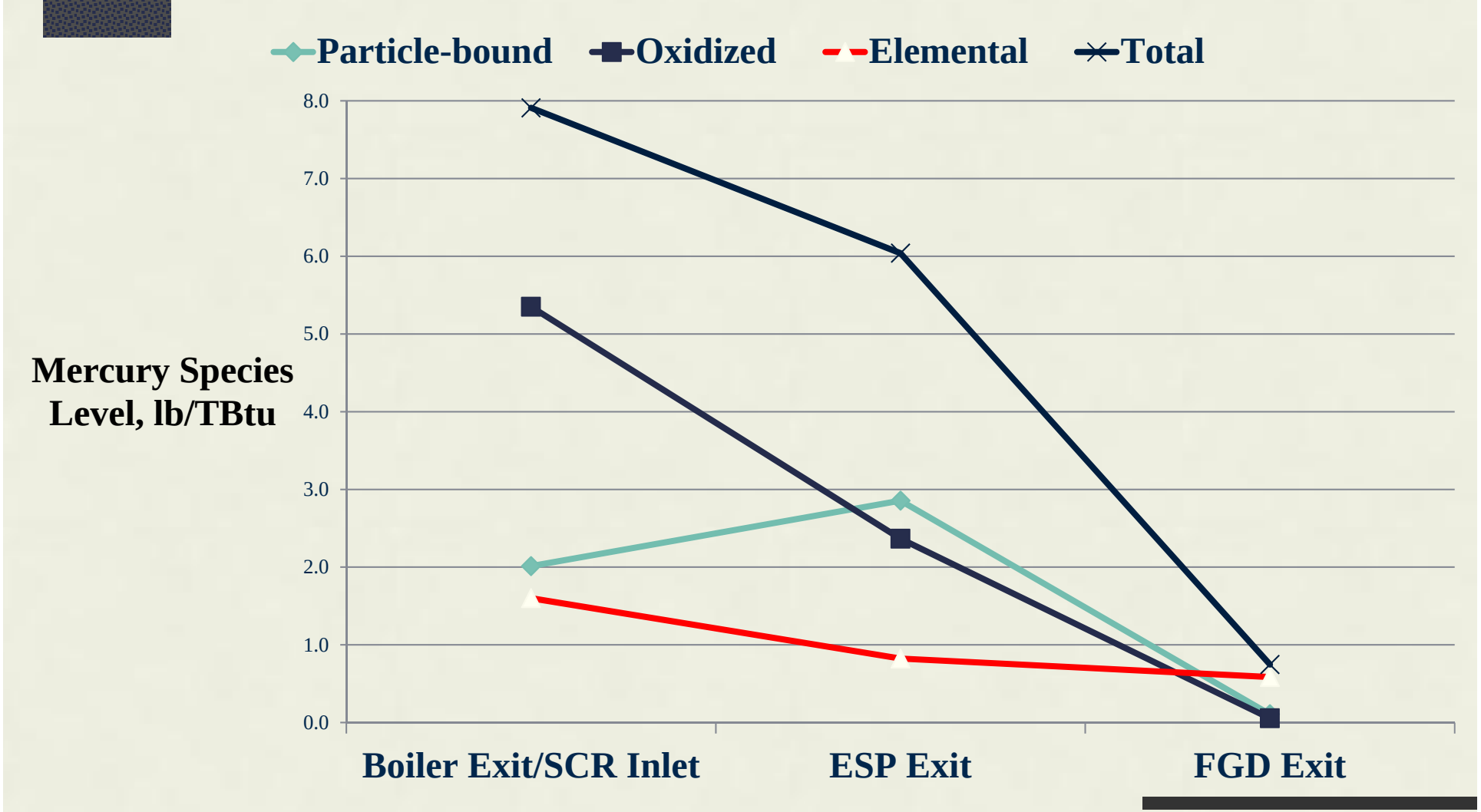
NC EGU Mercury Emission Performance Reported under 15 NCAC 02D .2511(d)



Three Airborne Mercury Species

Mercury Species	Characteristics		
	Physical/Chemical Properties	Atmospheric Transport	Emission controllability
Elemental	Gaseous, volatile, non-reactive, water insoluble	Long time and distance (weeks or months	0% by ESP or FGD, 50-90% by activated carbon, small portion converted to oxidized mercury by SCR
Oxidized	Gaseous, reactive, water soluble	Short time and distance (hours or days)	20-30% by cold-side ESP, 0-10% by hot-side ESP, 50-90% by FGD scrubber, 50-90% by activated carbon
Particle-bound	Attached to particles	Short time and distance (hours or days)	99% by ESP and FGD scrubber

Mercury Speciation Profile for NC Coal-Fired EGUs with SCR/ESP/FGD Emission Controls



EPA Airborne Mercury Deposition Modeling

- EPA performed deposition modeling for EGU MATS
- Community Multi-scale Air Quality (CMAQ) Model
- Modeled with 3 scenarios:
  1. Base year with 2005 emissions (Pre-rule)
  2. Projected 2016 emission data (Post-rule)
  3. Projected 2016 emissions without U.S. EGU emissions

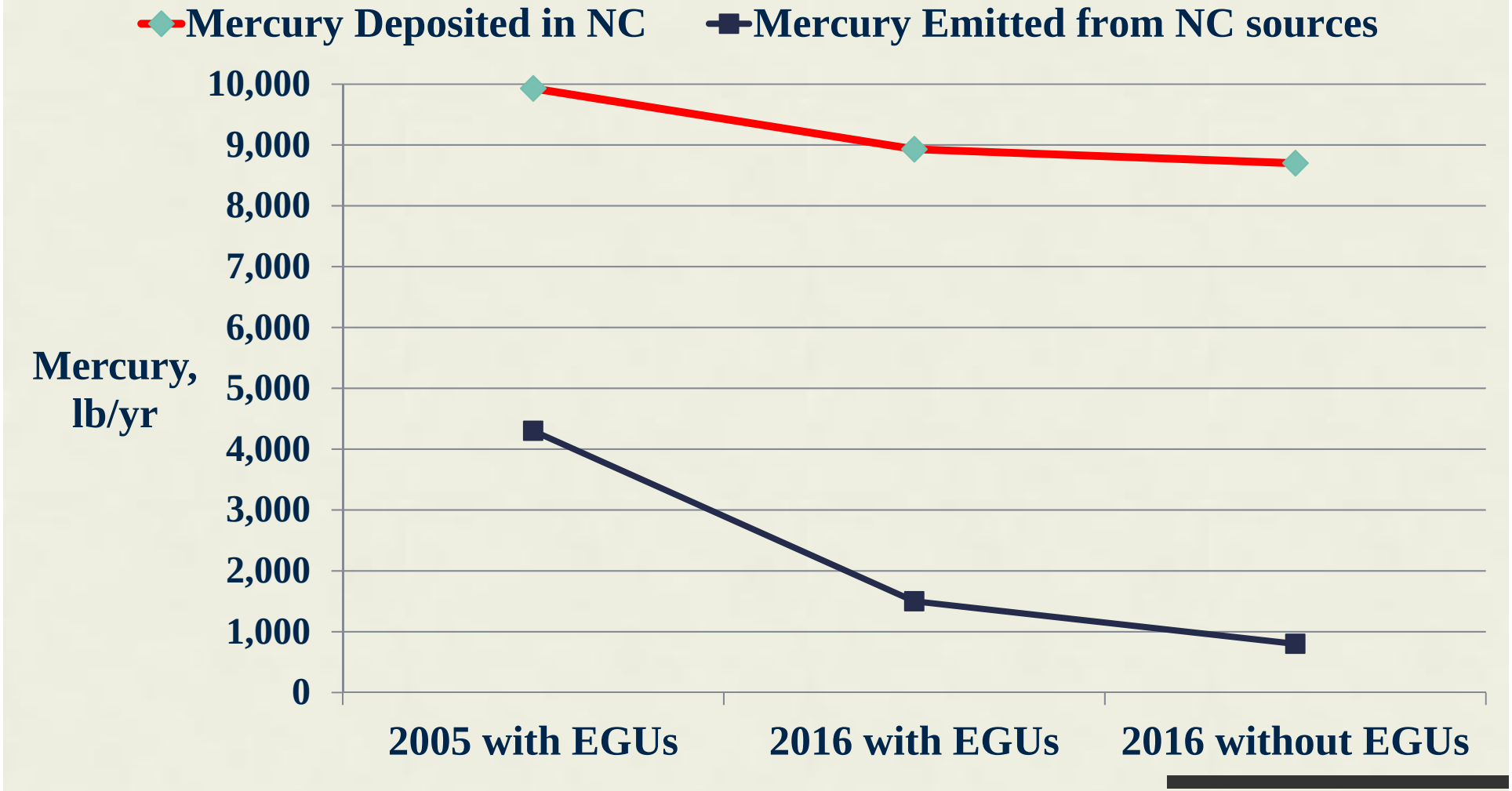
EPA Modeling Observations for U.S. Nationwide Deposition

- Patterns of total and U.S. EGU-related mercury deposition differ considerably: Elevated deposition areas distributed, several in eastern U.S. close to EGUs
- U.S. deposition dominated by sources other than EGUs
  - EGUs contribute 5% deposition for 2005, 2% for 2016
- In 2005, U.S. EGUs contributed 5% deposition in U.S., but up to 30% for certain watersheds
- NC DAQ conducted deposition modeling similar to EPA

Summary of Mercury Deposition Modeling

- EPA modeling suggests deposition in NC should decrease by 10% between 2005 and 2016
- DAQ modeling indicates 16% of NC deposition from NC sources in 2005, down to 3% by 2016
- 70% of mercury deposition in NC originates from outside the central and eastern U.S. in 2005, up to 90% by 2016.

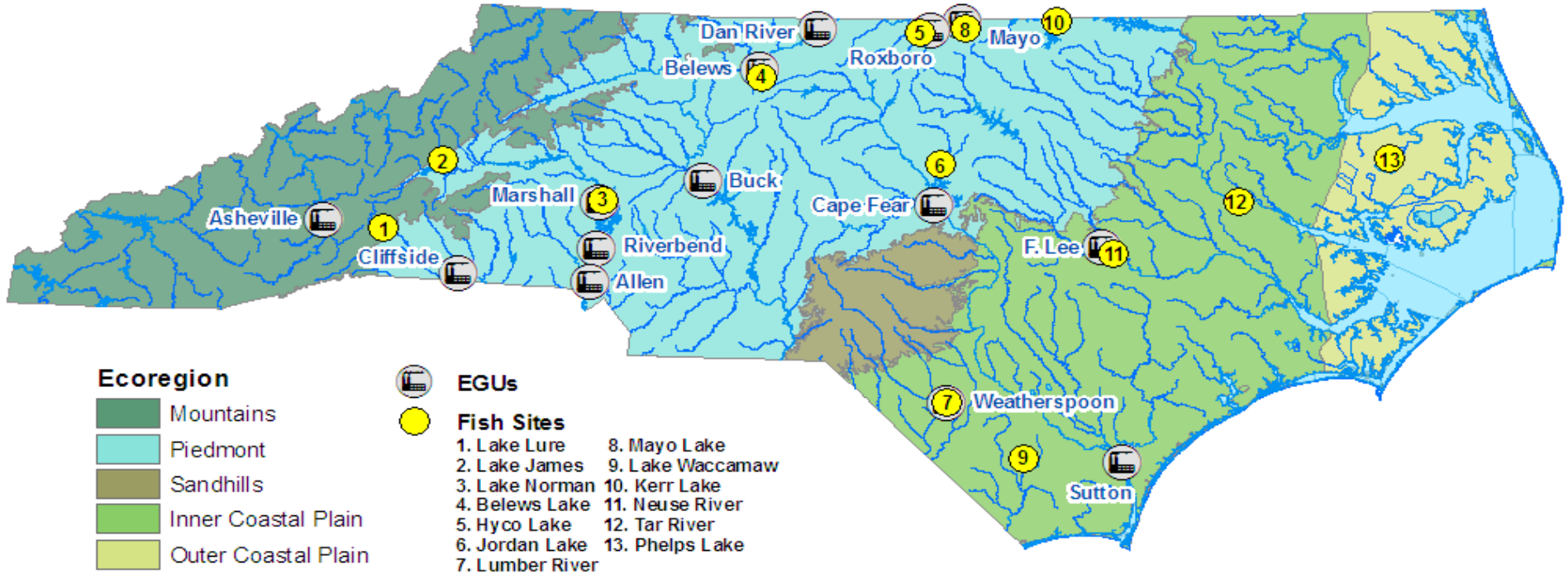
DAQ Deposition Modeling Results for NC Scenarios



Mercury Levels in Fish

- Statewide analysis of mercury in fish tissue since 1990
  - At 330 sites on rivers and lakes
  - Including 13 sites near EGUs since 2008
  - Results on largemouth bass show no significant change:
    - In fish tissue levels statewide,
    - Nor at sites near EGUs
  - Some studies indicate selenium released from EGUs may mitigate mercury in fish tissue levels

Annual Fish-Mercury Monitoring Sites near Coal-fired EGU Facilities



Mercury in Fish Related Health Issues

- U.S. Center for Disease Control / N.C. Health and Human Services study with locally-caught fish diet
- SE NC area with elevated mercury levels for
  - Fish tissue
  - Atmospheric deposition
  - Methylation conditions
- Blood analysis of 100 participants showed
  - No childbearing age women with unsafe blood
  - No correlation found between blood levels and fish eaten

DAQ Rulemaking Recommendations

- No new mercury control rules for existing facilities
- Additional controls beyond those required by CSA and EPA offer limited opportunities and benefits to further reduce mercury emissions from coal-fired EGUs
- Future reports required under 15 NCAC 02D .2509(e):
  - 2018 and 2023
  - State of mercury control technology
  - Cost of installation and operation
  - Changes in fish tissue data

Questions?

Steve Schliesser

NC DAQ Environmental Engineer

919-707-8701 Steve.Schliesser@ncdenr.gov

http://www.ncair.org

DAQ Clean Smokestack Act website:

http://daq.state.nc.us/news/leg/

EPA EGU MATS website:

http://www.epa.gov/airquality/powerplanttoxics/index.html