

# EPA's Control Strategy Tool (CoST)

David Misenheimer, US EPA  
Larry Sorrels, US EPA  
Darryl Weatherhead, US EPA

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# This Presentation Covers:

- Overview of EPA's Control Strategy Tool (CoST)

# Overview - Origin of CoST

- CoST was developed by:

  - Air Benefit and Cost Group (ABCG)

  - Health and Environmental Impacts Division (HEID)

  - Office of Air Quality Planning and Standards (OAQPS)

  - EPA's Office of Air and Radiation (OAR)

- CoST replaces AirControlNET

  - Both systems were designed to support the assessment of emissions reductions and engineering costs for control strategies

  - However, CoST is designed with **increased transparency, flexibility, and extensibility** over the older system



# Some Inventory Terminology

- **Base Year Inventory**
  - An emissions inventory for the current year or a recent year which relies largely on reported actual emissions
- **Future Year Base Case Inventory**
  - An emissions inventory for a future year that includes emission projections based on forecasts of growth, impacts of rules and regulations that are final but that will be implemented over time, planned plant closures, etc. (a 'business as usual' future case)
- **Future Year Control Case Inventory**
  - Future year base case inventory with additional controls applied. Such inventories are projections of what is possible in order to meet the requirements of new air quality rules or regulations.

# What does CoST do?

- Developed for performing **large-scale national or regional level analyses** - primarily Regulatory Impact Analyses (RIAs) for National Ambient Air Quality Standards (NAAQS)
- Supports preparation and analysis of future year **criteria pollutant** emissions control strategies for point, non-point, mobile sources



- Uses the National Emissions Inventory, projected to future yr
- Reports on emissions reductions and costs associated with:
  - target pollutant (e.g., NO<sub>x</sub> or VOC for Ozone NAAQS analyses)
  - co-impacts of the selected control measures on other criteria pollutants

# What does CoST do (cntd.)?

- Calculates annual costs of the control measures for a control strategy:
  - For point sources – uses cost equations when sufficient data are available, otherwise relies on less refined cost per ton of reduction estimates
  - For mobile sources – relies on cost per ton of reduction estimates
  - For non-point sources – relies on cost per ton of reduction estimates
- CoST was **NOT** designed for local-scale source by source analyses, although input data, not the software, is the primary limiting factor
- Does **NOT** currently include control measure information for HAPs and GHGs

# What questions are we trying to answer with CoST?

- Example Goal: reduce NO<sub>x</sub> emissions in 2020 for the Southeast by 100,000 tons/yr
- Use CoST to answer control questions for criteria air pollutants (CAPs) like:
  - What is the **maximum emissions reduction** achievable for NO<sub>x</sub> and what set of controls will achieve this reduction? (i.e., is my goal < maximum?)
  - What set of control measures can achieve the emissions reduction goal at the **least cost**?
  - What does the **cost curve** look like for other levels of reduction?

# Questions CoST Can Answer (cntd.)

- What **emissions reductions** for the target pollutant would be achieved?
- What are the emissions reductions **or increases** for **other pollutants** of interest?
- What are the **engineering costs** of applying the controls for a specific strategy?
- What **control measures** are available for specific source categories and pollutants; how much reduction do they provide and for what cost?
- Future goal: What is the optimum method for achieving simultaneous reductions of **multiple pollutants** (e.g., PM and toxics)?



# Control Strategies

- In CoST, Control Strategies are set up and run to help answer the questions posed above
- Running a control strategy causes control measures to be assigned to emissions sources via an algorithm (e.g., least cost)
- Estimates of the resulting emissions reductions (and/or increases) and costs are provided

# CoST Control Measures Database (CMDB)

- The CMDB and emission inventories are the two major input data sets for CoST
- CMDB contains information about control measures, their control efficiencies, engineering costs, and the emission sources to which they apply
- Was initially populated with data from AirControlNET, but there are some additions
- Currently the CMDB has data for the criteria pollutants (PM, VOC, NO<sub>x</sub>, SO<sub>2</sub>)
- We will add control information for HAPs and GHGs in the future, as resources allow and as data are available
- Control efficiencies and costs can vary by pollutant, state and/or county, source size, and year



# Data Stored for each Control Measure

**Control Measure:** A technology or program that reduces emissions

**The CMDB:** A set of related tables of control measure data

**Summary Info** – Describes each control measure (SCR, LNB, etc)

**Control Efficiency & Cost Info** – Varies by pollutant

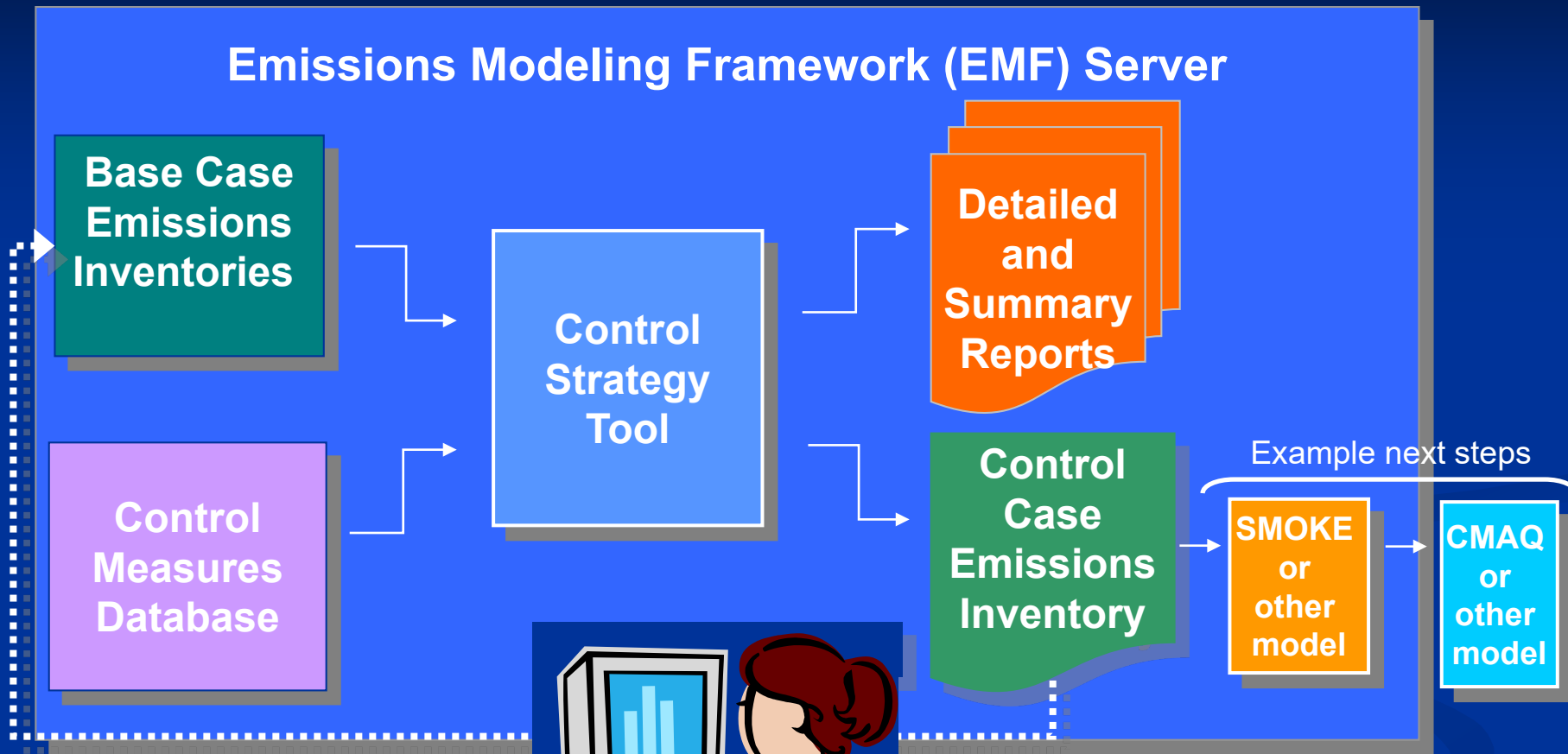
**Source Category Codes** – Links to the inventory

**Cost Equations** – Compute capital and O&M costs

**References** – Sources of information for measures



# CoST is a Client-Server System



The EMF Client-server architecture facilitates information sharing



**SMOKE** = Sparse Matrix Operator Kernel Emissions, a system for preparing emissions inputs for air quality modeling.

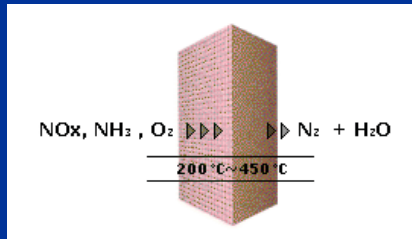
**CMAQ** = Community Multiscale Air Quality modeling system.



# Example Control Measure Application



Industrial Boiler



SCR

Plant:	International Paper
Industry:	Pulp & Paper Mill
SCC:	Indust. Boiler - Bit/Subbit Pulv Coal Dry Bottom
Pollutant:	NOx (177 tons/yr)
Control:	Selective Catalytic Redxn
CE:	75%
CPTon:	\$1,319
Reduction:	133 tons/yr (.75 x 177)
Final Emis:	44 tons/yr (177 - 133)
Cost:	\$175,000 (133 x 1,319)

# Creation of a Control Strategy

What emissions does this produce and what measures are available to control them???



# Creation of a Control Strategy

- Strategies assign measures to sources
  - Inventories are selected
  - Available measures for heavy duty trucks:



- Truck Stop Electrification
- Diesel Retrofits (selective catalytic reduction)
- Engine Rebuilds

- One or more measures can be applied to the inventory sources for HD trucks
- Measure assignments can vary geographically
- The cost of measure application is computed for a specified cost year, and emissions reductions

# Key Steps for Running a Control Strategy

## 1) Input Basic Parameters (e.g.):

- Name
- Cost Year for results
- Target Pollutant

## 2) Select Strategy Algorithm (e.g.):

- Max Emissions Reduction
- Least Cost
- Least Cost Curve

## 3) Select Inventory Dataset(s):

- Sectors (ptipm, ptnonipm, nonpt, onroad, nonroad)
- Filters for specific SCCs, geographic areas, etc.

## 4) Select Control Measures:

- Default is to include known measures
- Can select specific technologies

## 5) Select Constraints (e.g.):

- Max cost/ton controls (e.g., \$20K/ton)
- Min emissions reduction (e.g., 10 tpy)

## 6) Run Strategy Query

## Outputs:

Detailed Pairing of Measures to Sources

Control Case Emissions Inventory

Summaries (Automatic and On-Demand)



# Primary Strategy Algorithms to Assign Measures to Sources

- **Maximum Emissions Reduction**
  - For each source, finds the single measure that results in the maximum possible reduction of the target pollutant **regardless of cost**
- **Least Cost**
  - Determines the minimum **annual** cost way to achieve a specified reduction of the target pollutant (e.g., 100,000 tpy) using one measure per source
- **Least Cost Curve**
  - Runs least **annual** cost analysis for a series of reductions
- **Apply Measures in Series**
  - Applies independent measures in the specified order (e.g., I&M, commuter progs, retrofits)

# Other Algorithms

## ■ Annotate Inventory

- Tries to find measures that provide the control efficiencies specified in the **base year inventory**
- Can help identify holes in the CMDB or unrealistic levels of control in the inventory

## ■ Project Future Year Inventory

- Constructs the future year **base case inventory** from the **base year inventory** and a set of control programs (e.g., plant closures, growth projections, planned controls)
- Notes in the inventory which measures would best achieve the targeted levels of control

# Properties of Algorithms

- All algorithms assign one measure for each source in each run except Apply Measures in Series
- Typically, Maximum Emissions Reduction and Least Cost are applied to point and non-point sources, while Apply Measures in Series is applied to mobile sources

<b>Strategy Type</b>	<b>Multiple Inventories</b>	<b>Typical Sectors</b>	<b>Measure Assignment</b>	<b>Outputs</b>
<b>Maximum Emissions Reduction</b>	Processed independently	nonpt, <b>ptnonipm</b>	One per source	Standard
<b>Apply Measures in Series</b>	Processed independently	onroad, nonroad	Multiple per source	Standard
<b>Least Cost</b>	Can be merged	nonpt, <b>ptnonipm</b>	One per source	Standard, Least Cost Control Measure Worksheet
<b>Least Cost Curve</b>	Can be merged	nonpt, <b>ptnonipm</b>	One per source	Standard, Least Cost Control Measure Worksheet, Least Cost Curve Summary
<b>Annotate Inventory</b>	Processed independently	nonpt, <b>ptnonipm</b>	One per source	Standard
<b>Project Future Year Inventory</b>	Processed independently	Any	One per source	Standard



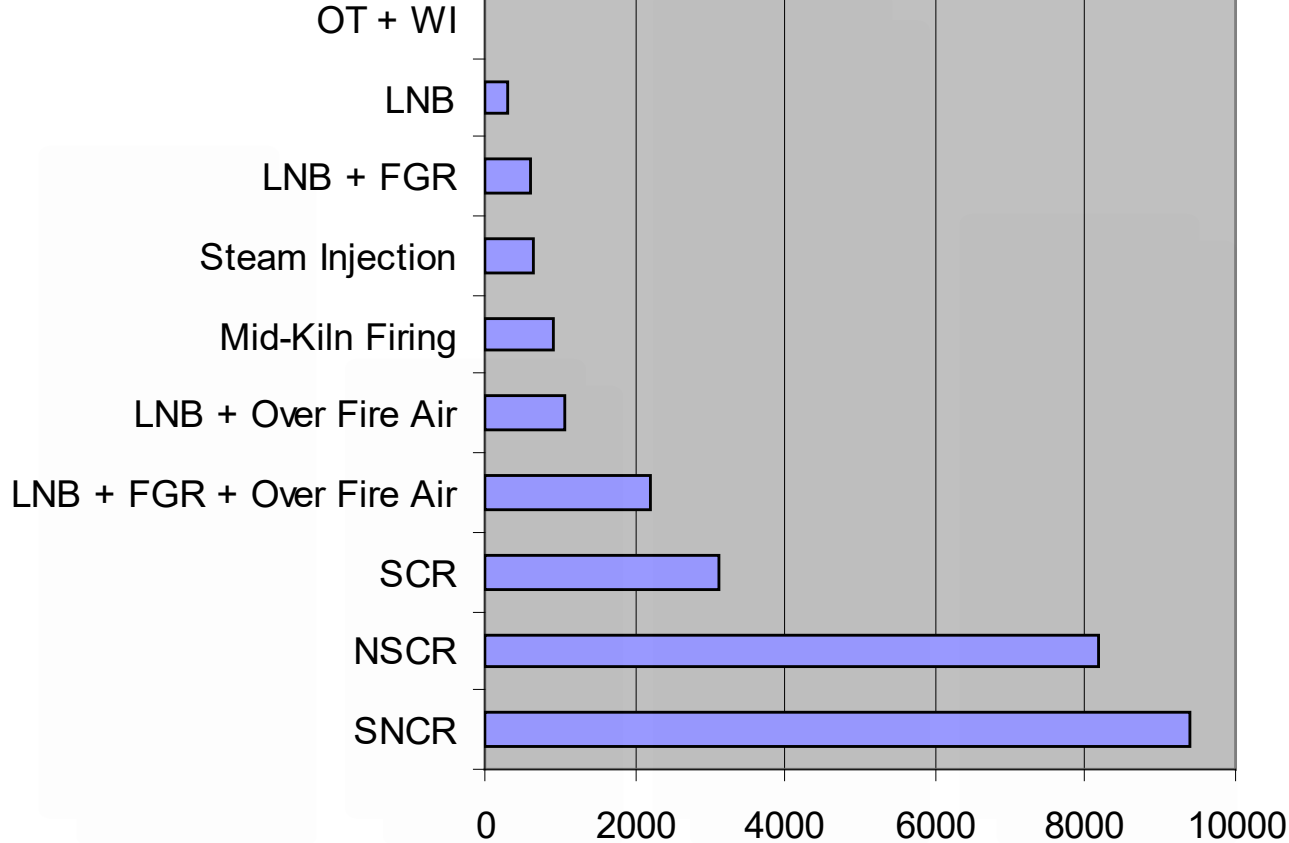
# Analyzing CoST Outputs

- CoST provides support for sorting, filtering, and summarizing outputs, and for creating some types of plots
- Output datasets can be exported to CSV files for use by spreadsheet and database software programs
- Summaries of the outputs can be exported to CSV files, Shapefiles for use in GIS/mapping tools, and .kmz files for use with Google Earth



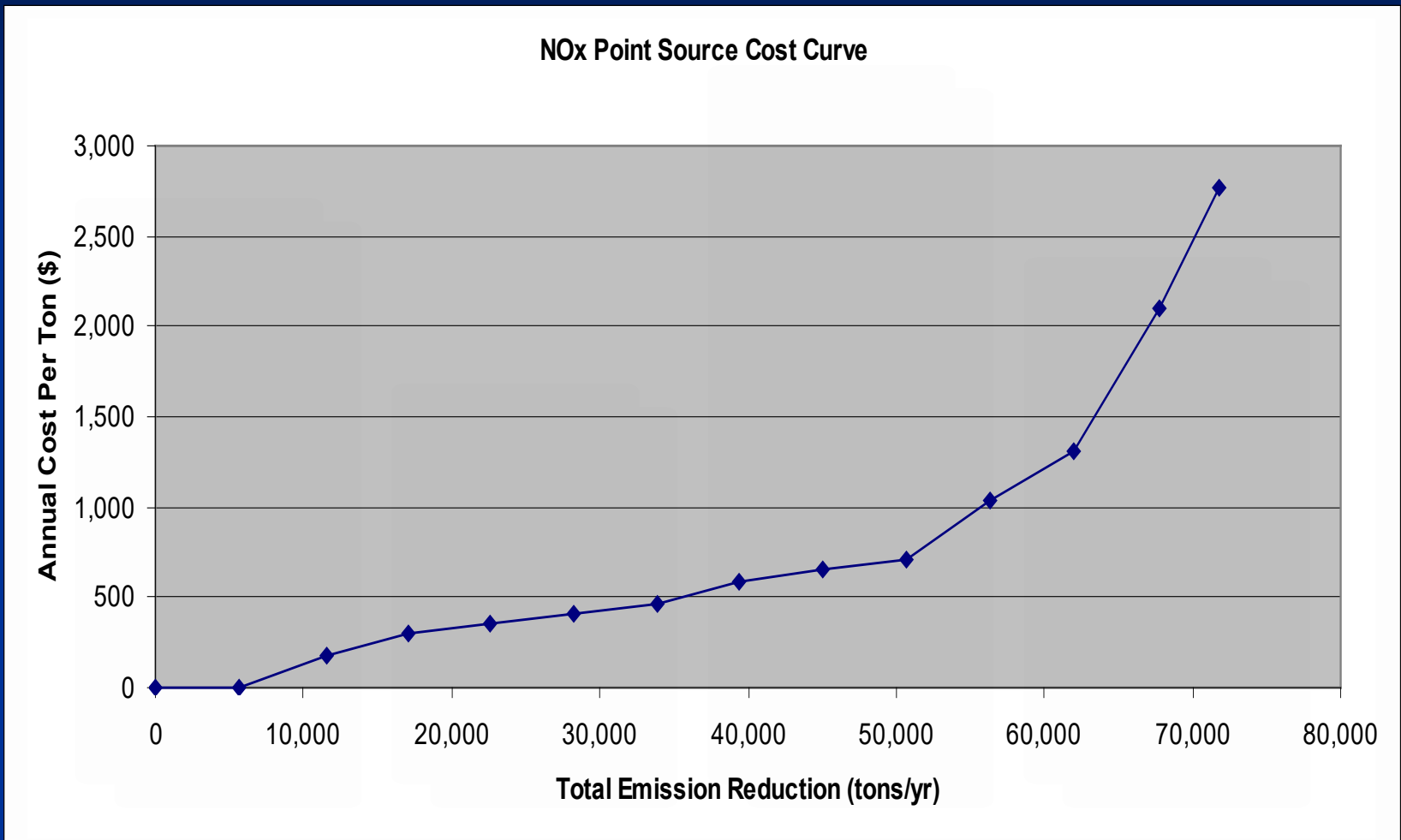
# Plot of a Summary by Control Technology

**NO<sub>x</sub>** Emissions Reduction as a function of Control Technology



OT = Oxygen Trim  
WI = Water Injection  
LNB = Low NO<sub>x</sub> Burner  
FGR = Flue Gas Recirc.  
SCR = Selective Catalytic Reduction  
NSCR = Nonselective Catalytic Reduction  
SNCR = Selective Noncatalytic Reduction

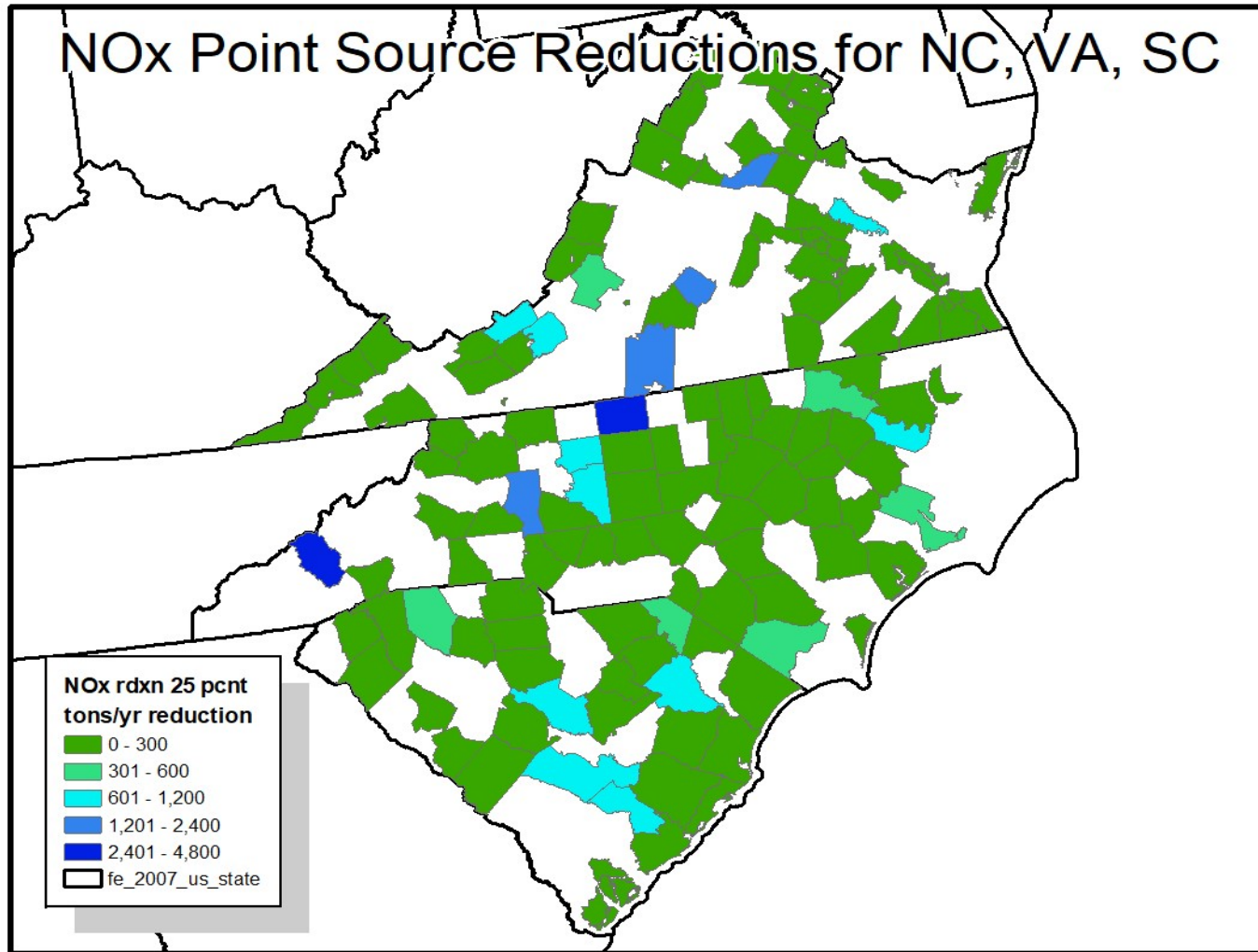
# CoST per Ton Cost Curve



\* Data generated by CoST, but plotted with Excel

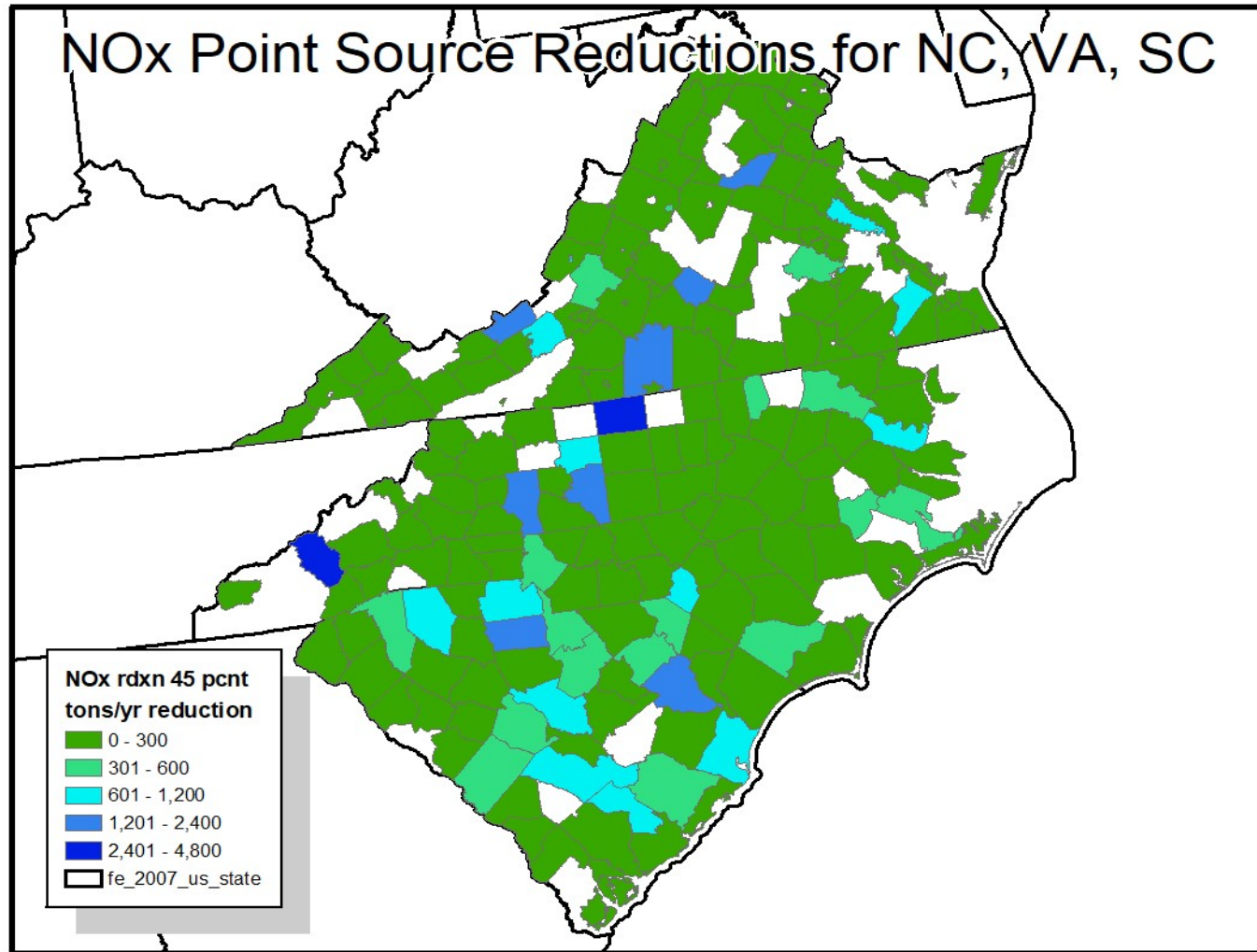


# CoST Outputs: Least Cost Control Strategy with Goal of 25% Reduction of NOx

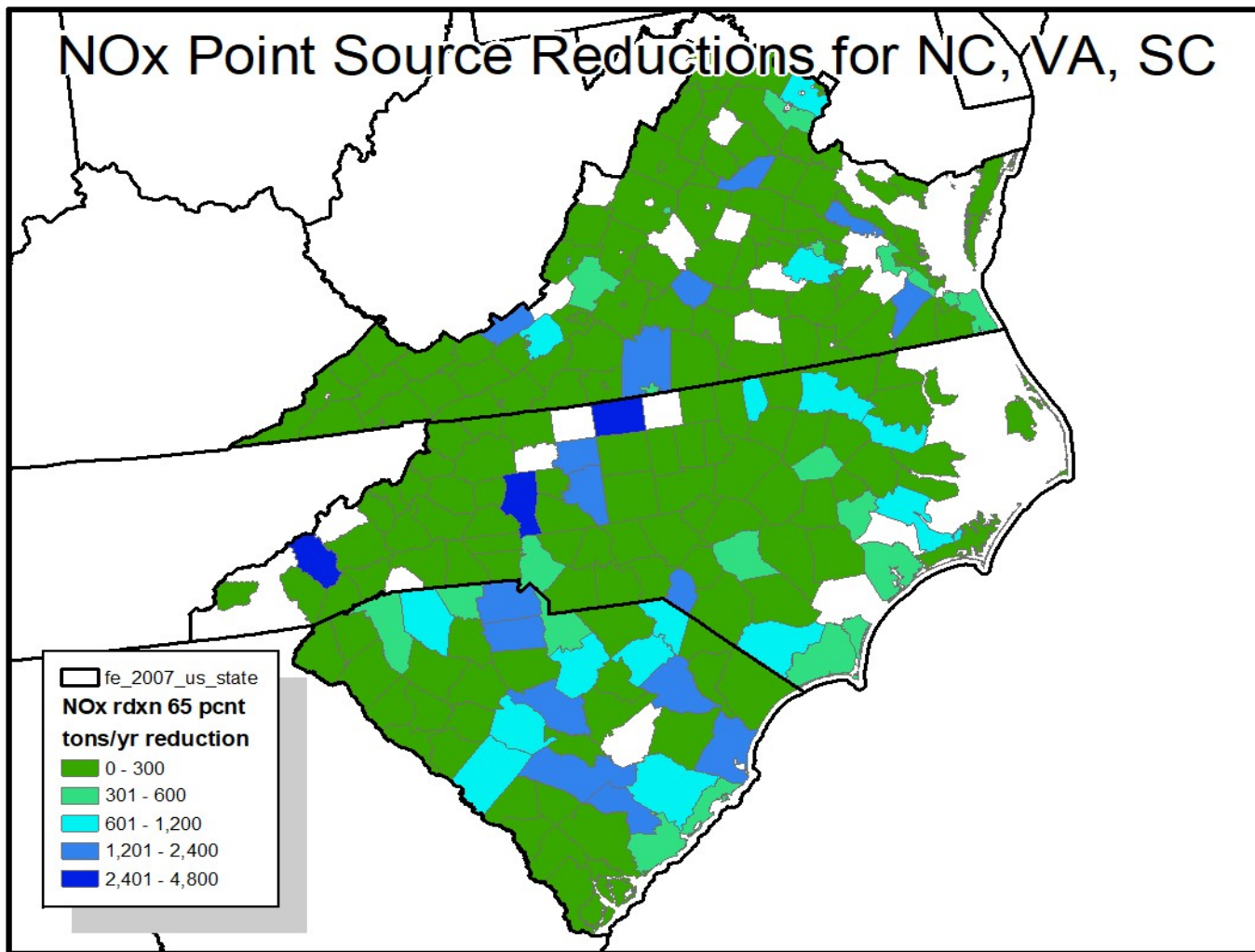




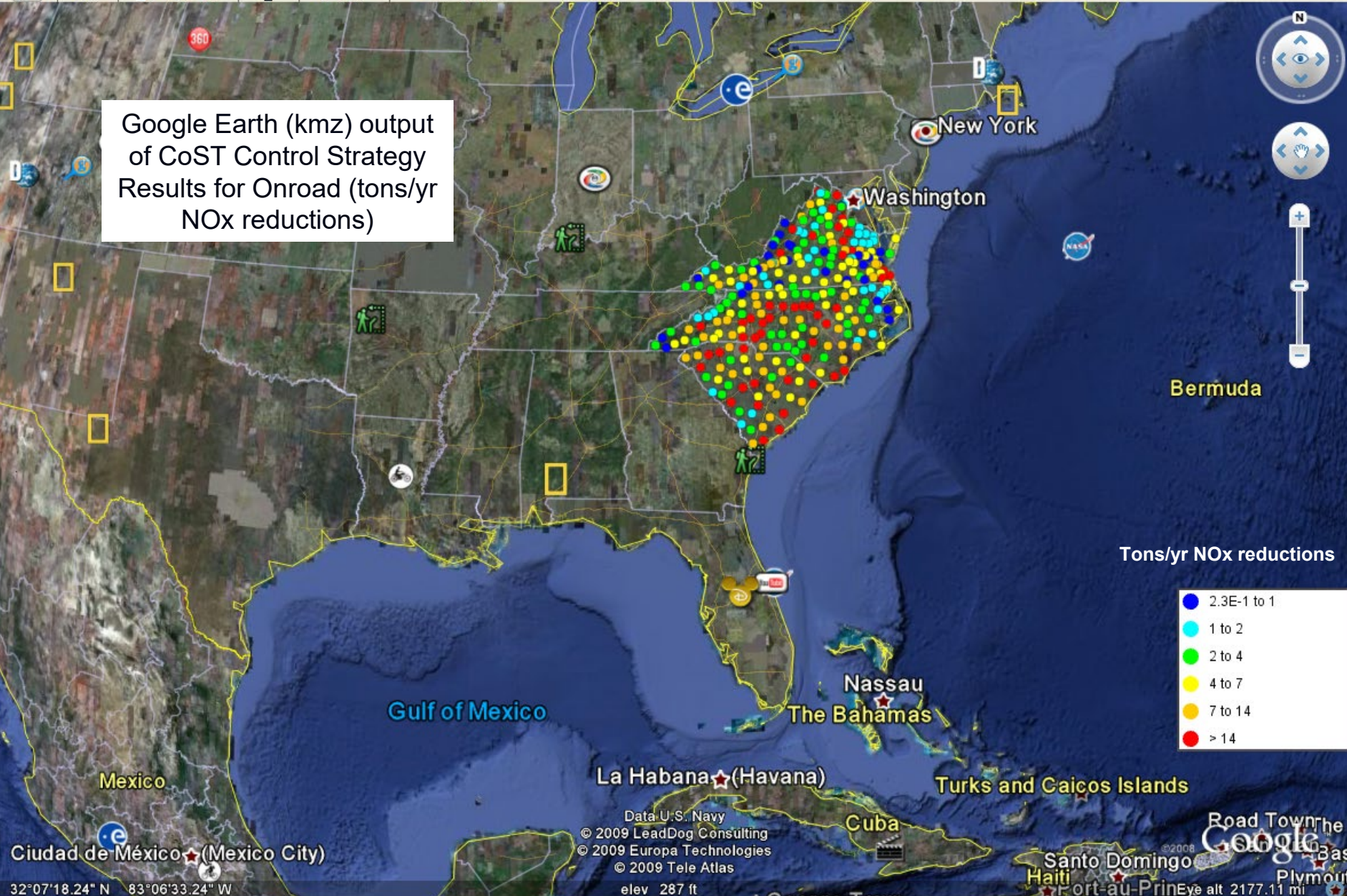
# CoST Outputs: Least Cost Control Strategy with Goal of 45% Reduction of NOx



# CoST Outputs: Least Cost Control Strategy with Goal of 65% Reduction of NOx



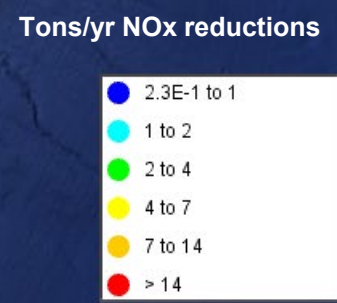
Google Earth (kmz) output of CoST Control Strategy Results for Onroad (tons/yr NOx reductions)



Google Earth allows the user to zoom in and 'mouse over' a point to see the descriptive information

**Alamance Co: 16**

Sector: onroad  
FIPS: 37001  
County: Alamance Co  
State Name: North Carolina  
State Abbr: NC  
Poll: EXH\_NOX  
Avg Cost Per Ton:  
4696.5900000000001  
Annual Cost: 75281.009999999995  
Final Emissions:  
57.759999999999998  
**Emis Reduction:  
16.030000000000001**  
Inv Emissions:  
73.790000000000006



# CoST Team

- David Misenheimer
- Darryl Weatherhead
- Larry Sorrels
- Alison Eyth
- Julia Gamas

Office of Air Quality Planning and Standards  
US EPA, RTP, NC

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