Assessment of Environmental Benefits (AEB) Modeling System

A coupled energy-air quality modeling system for describing air quality impact of energy efficiency

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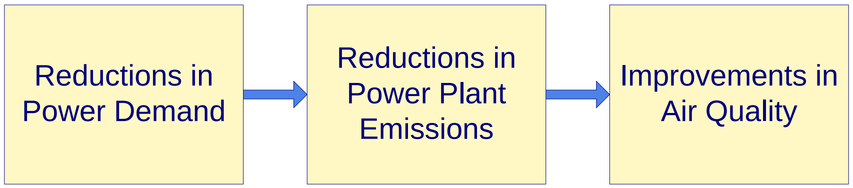
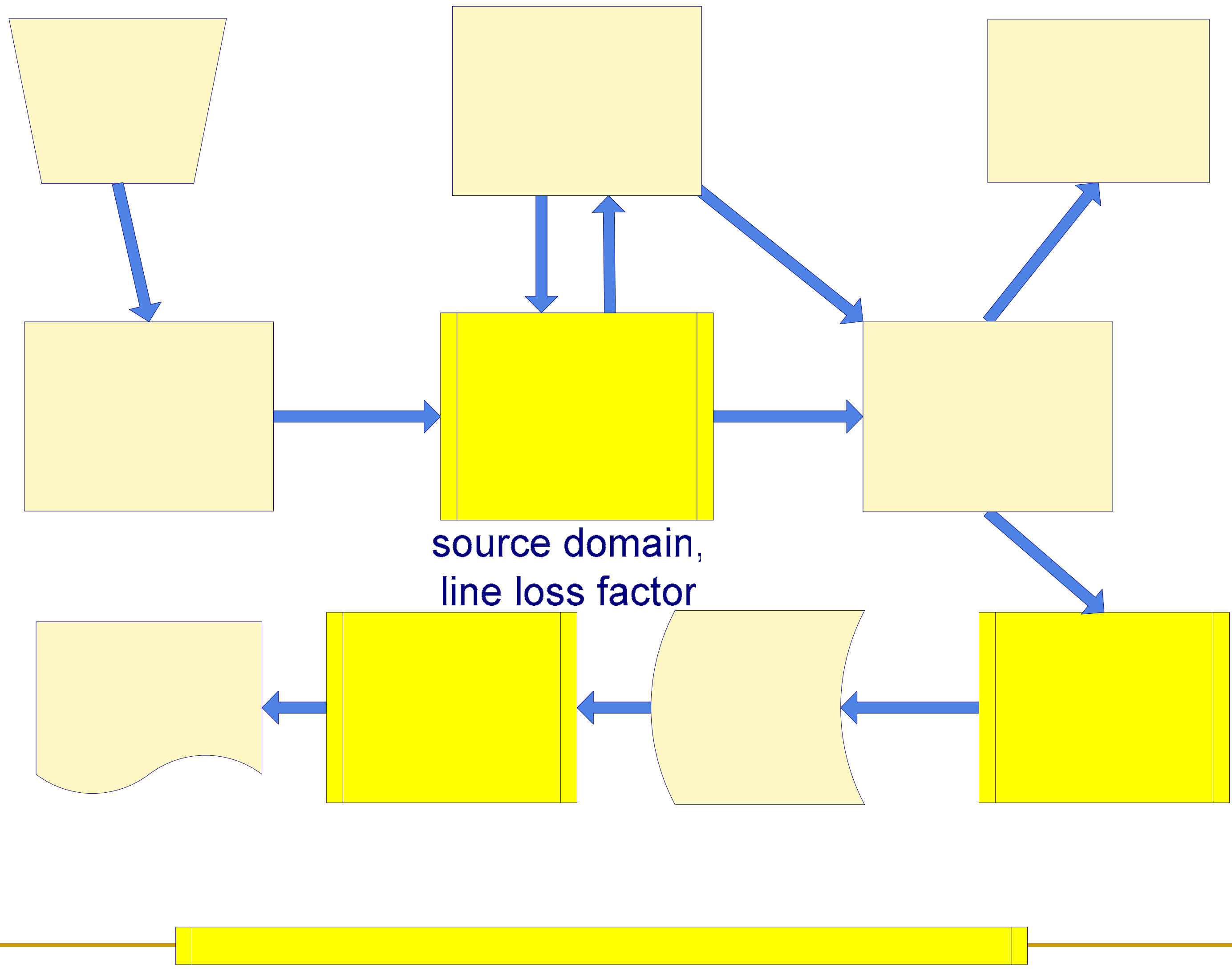
Assessment of Environmental Benefits Modeling System (AEB) Objective

- Get SIP Credit for Air Quality Benefits of Energy Efficiency Technologies:



- How do we make the case?
  - Link together accepted models using new S/W tools and new methods
    - ORCED
    - SMOKE
    - CMAQ
- Follow USEPA Guidance to ensure emission reductions will be: Quantifiable, Surplus, Enforceable, Permanent

AEB Modeling System - overview



SMOK
Emissio
processor s

AEB To
M3HDR disp
ORCED2EM

ORCED
Power dispatch

VISTAS: Essential Research Partner

- AEB relies on VISTAS Datasets
  - Quality-assured meteorological data
  - Quality-assured future emissions inventory driven by IPM
  - Quality-assured base case CMAQ output
- Relationship to VISTAS
  - Opportunity for testing assumptions, methodologies, and obtaining guidance on prospective research products
  - Collaboration
  - Ongoing technical assistance

Power Dispatch Modeling

- Simple definition: How much power from which units at what time
- Why important:
  - high voltage transmission enables movement of AC power over long distance, resulting in significant import/export
  - thus demand reductions, emission reductions, and air quality benefits are not coincident temporally or geographically

Working back from desired end product

- Air quality benefits spatially- and temporally- resolved
- Emissions reductions similarly resolved
- Which units in the domain affected by an EE program
- Predict power plant dispatch
  - Least cost basis typically, contingent on Operations

Capacity for Southeastern Electric Reliability Council (SERC) Sub-region of VACAR+Southern+TVA

Green = natural gas

Red = coal

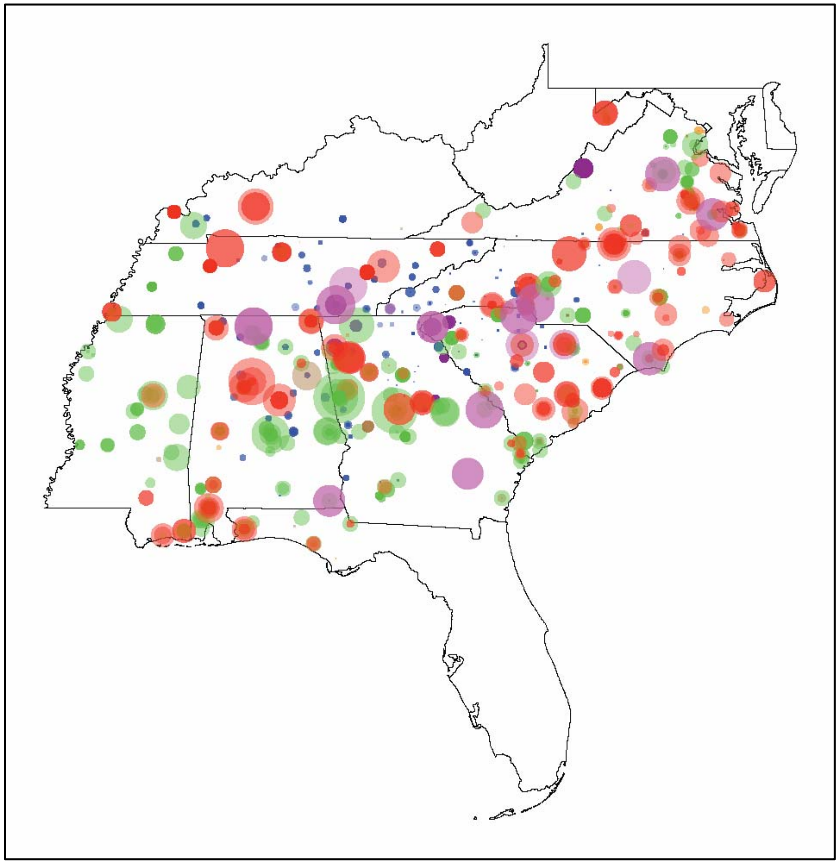
Brown = oil

Purple = nuclear

Blue = hydro

Tan = renewable

Area of circle is proportional to generation capacity

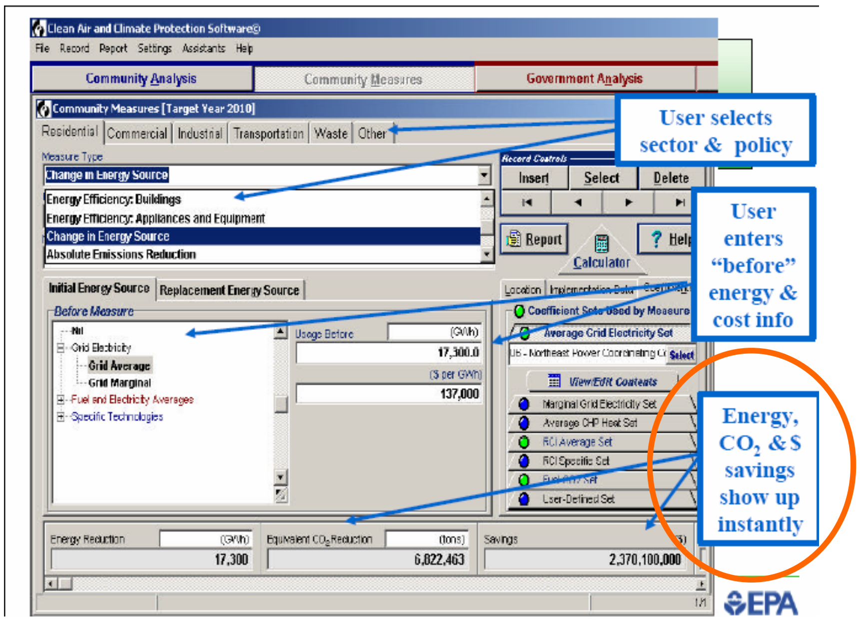


Power-gen Pictogram originated by Stan Hadley of Oak Ridge National Lab

AEB Responds to USEPA Guidance on SIP Credit for EERE Emission Reductions 8/5/04

- Estimate the energy savings
  - Reduction estimated by the states with tool like CACPS
    - Sens Matrix indicates emissions, AQ impact for range of reductions
- Convert the energy impact into emissions reductions
  - State-of-the-science approach using power dispatch model, ORCED, developed by Oak Ridge National Lab
- Determine the impact on air quality
  - State-of-the-science approach using SMOKE emissions processor and multiple runs of CMAQ
- Provide a mechanism to validate effectiveness
  - Deceleration of demand, and decrease in monitored concentration of Ozone and PM2.5 would indicate effectiveness

Relationship of AEB Sensitivity Matrix to Clean Air and Climate Protection Software (CACPS)



Sensitivity Matrix

Emission Reductions NOx, SO_2, $PM_{2.5}$

Air Quality Impacts [O_3] & [$PM_{2.5}$]

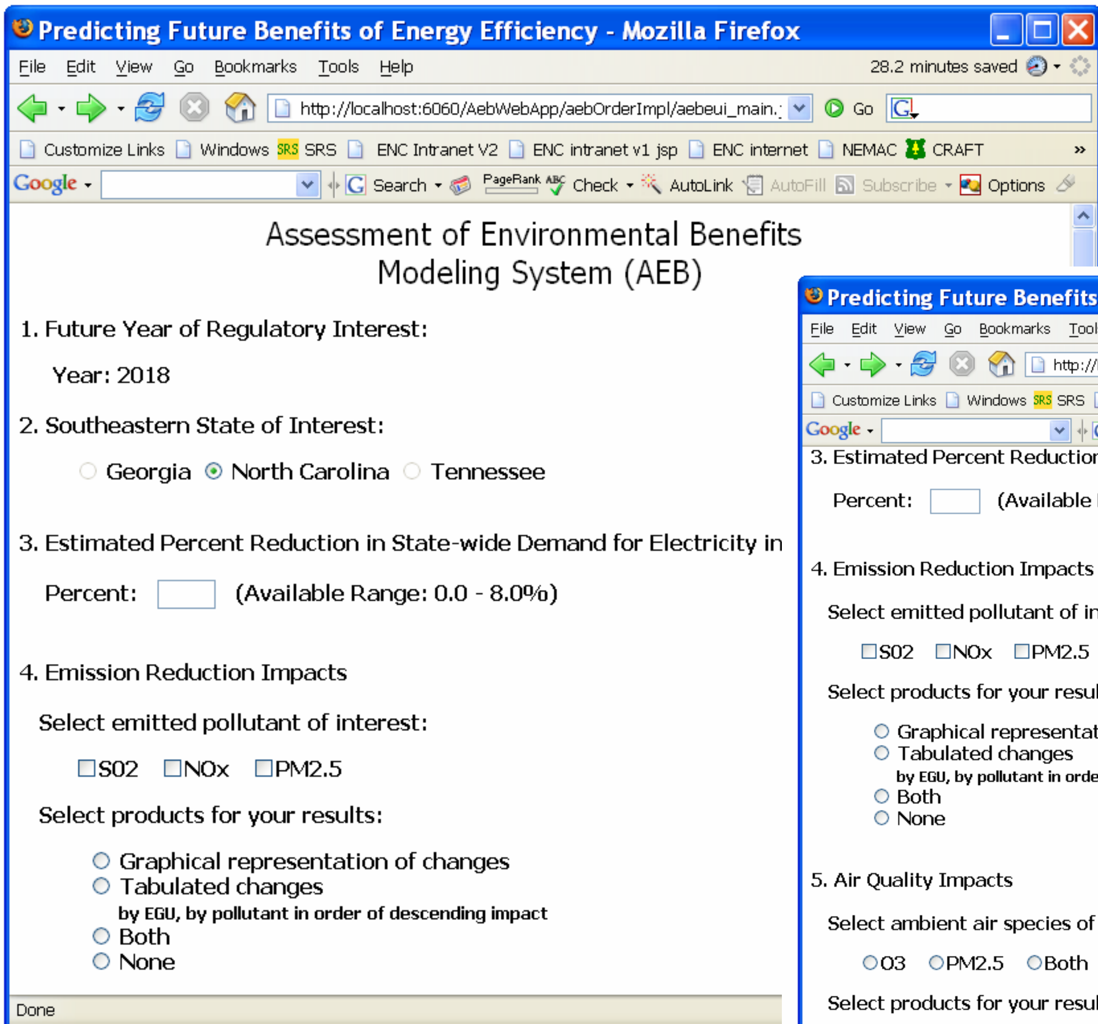
Process for Using AEB Sens Matrix

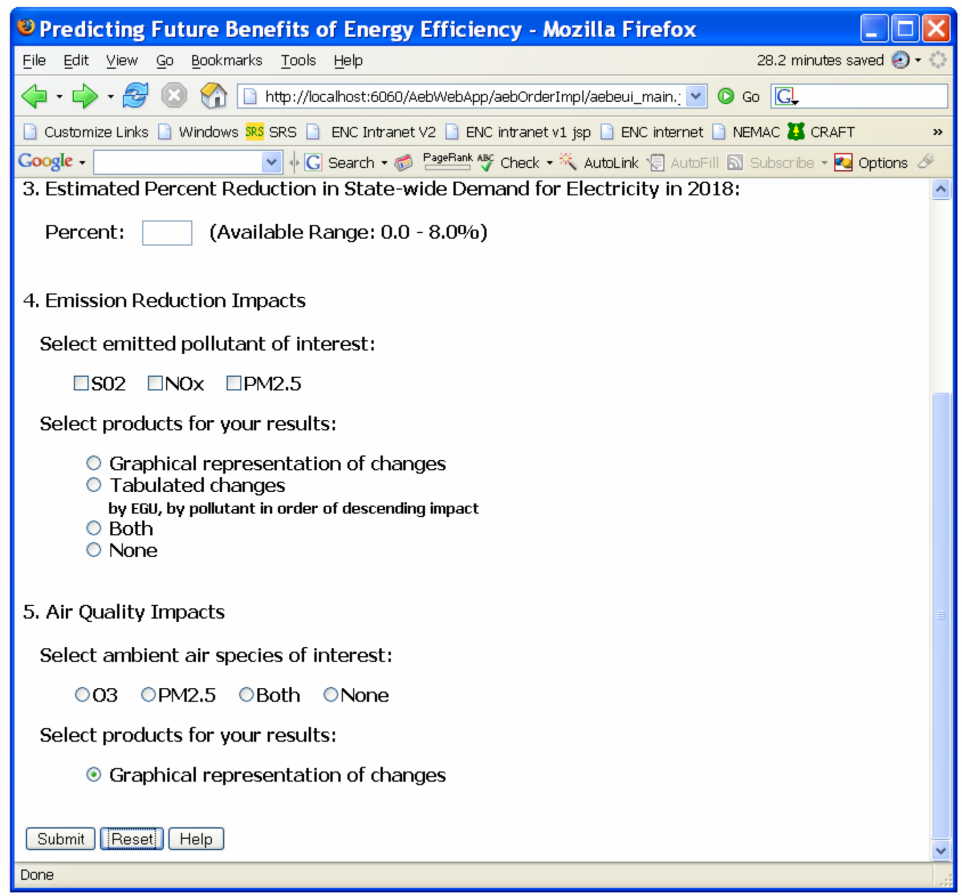
States estimate energy savings using tool like CACPS

States then query Sensitivity Matrix using the Server-based End-user Interface (EUI)

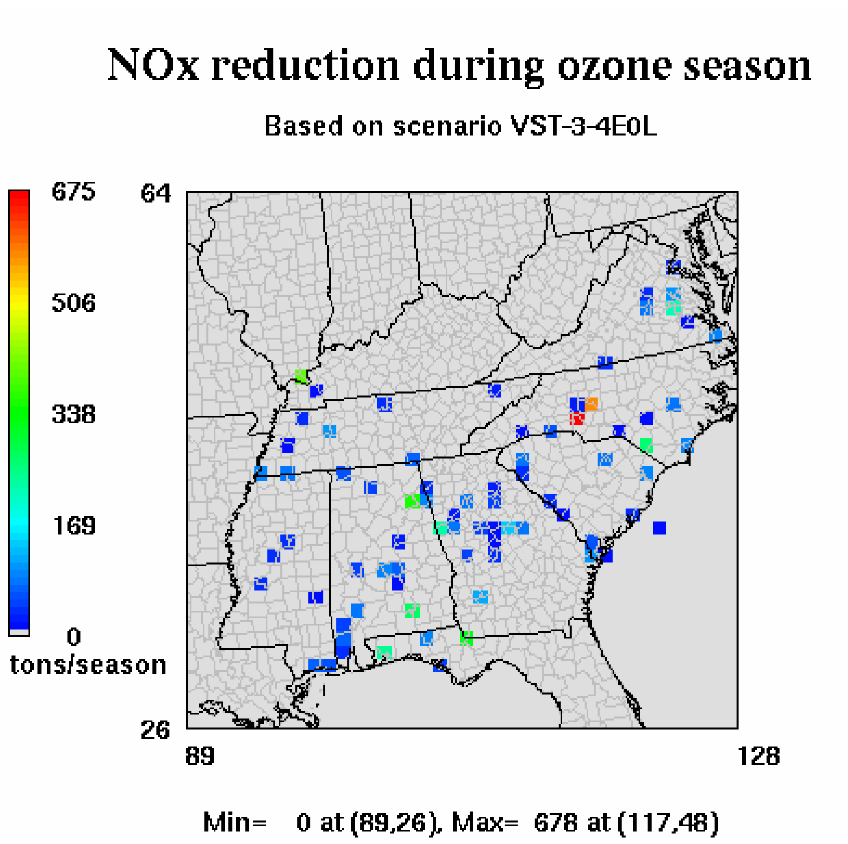
Sensitivity Matrix provides interpolated response in terms of emissions reduced and AQ changes per % unit of energy demand reduction

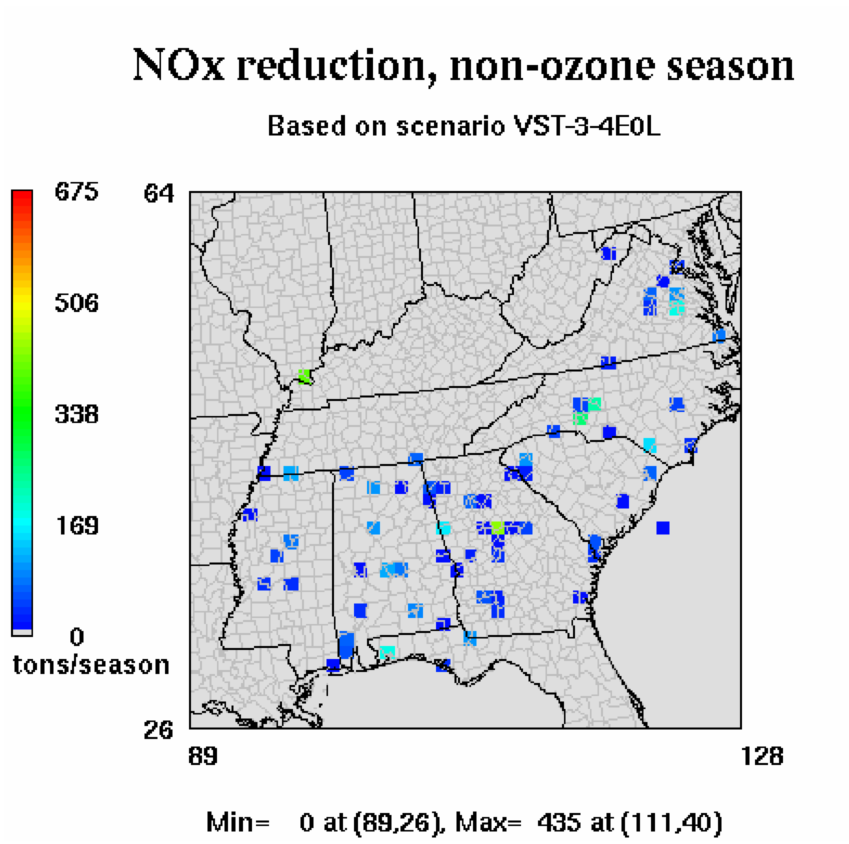
EUI: Preliminary Vers of Access Screens





Example Product: Changes to NOx Emissions – 36km grid

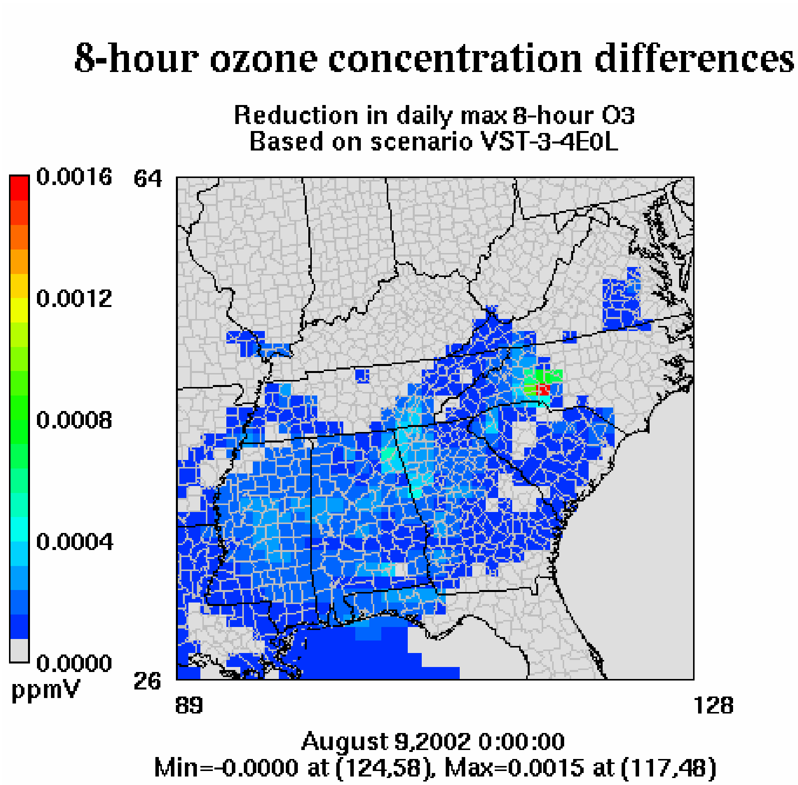




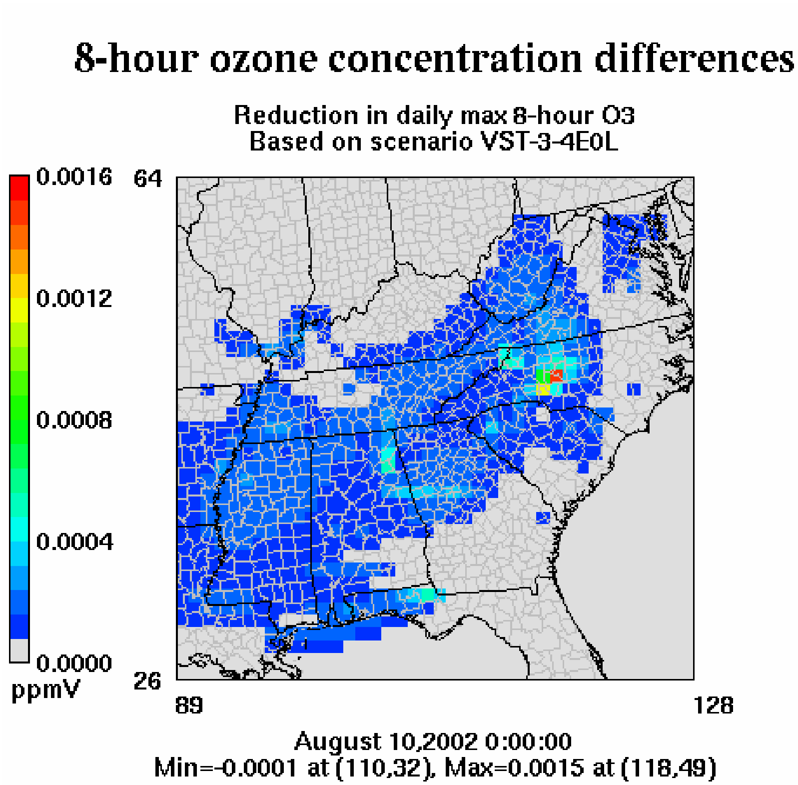
Example Product: Changes to NOx Emissions – tabulated (excerpt)

County	Plant Name	NOX Emission	NOX Emission	NOX Emission	Fuel Type	Plant Type
Rowan/NC		Reduction	Base	VST-3-4E0L		
		(tons/season)	(tons/season)	(tons/season)		
	Buck	238.6409	263.0000	24.3591	Natural Gas Interruptible	Oil/Gas Turbine
	Buck	230.1116	253.6000	23.4884	Natural Gas Interruptible	Oil/Gas Turbine
	Buck	63.0629	69.5000	6.4371	Natural Gas Interruptible	Oil/Gas Turbine
	Rowan	23.4169	51.3000	27.8831	Natural Gas Firm	Gas Combined Cycle
	Rowan	11.0890	13.8600	2.7710	Natural Gas Interruptible	Gas Turbine
	Rowan	9.6328	12.0400	2.4072	Natural Gas Interruptible	Gas Turbine
	Rowan	8.3287	10.4100	2.0813	Natural Gas Interruptible	Gas Turbine
	Buck	7.1576	117.3000	110.1424	Coal - Old - Mid Emissions	Coal Steam pre- 1965
	Buck	7.1576	117.3000	110.1424	Coal - Old - Mid Emissions	Coal Steam pre- 1965
County total NOX		598.5983	908.3099	309.7119		

Example Product: Changes in CMAQ Predictions of Daily Max 8-hr Avg Ozone

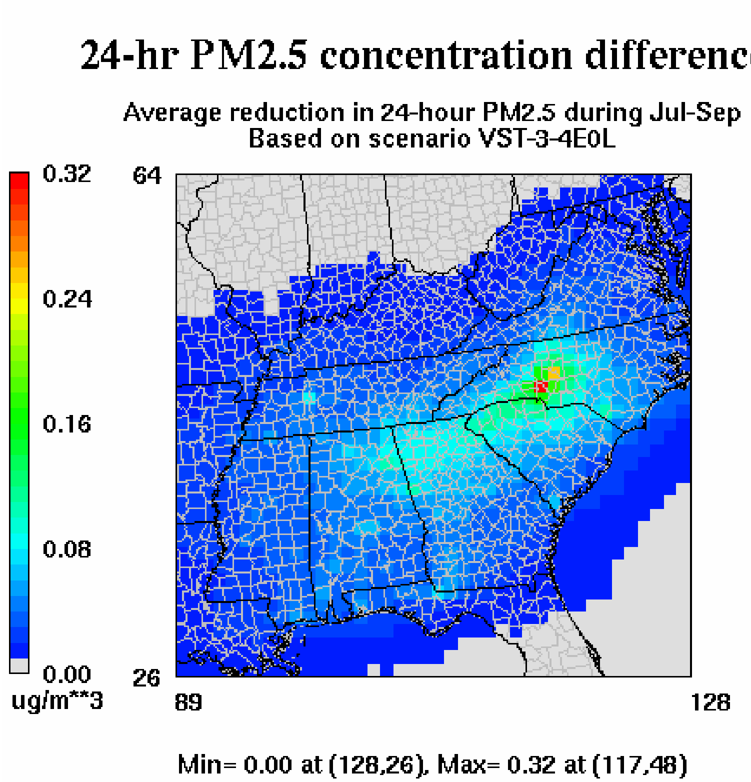


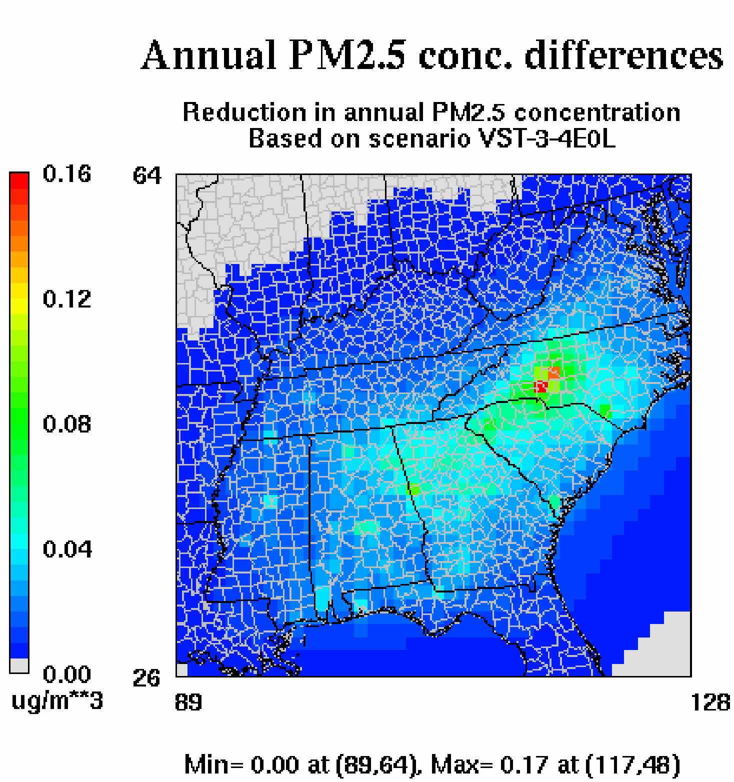
August 8



August 9

Example Product: Changes in CMAQ Predictions of Ambient PM2.5



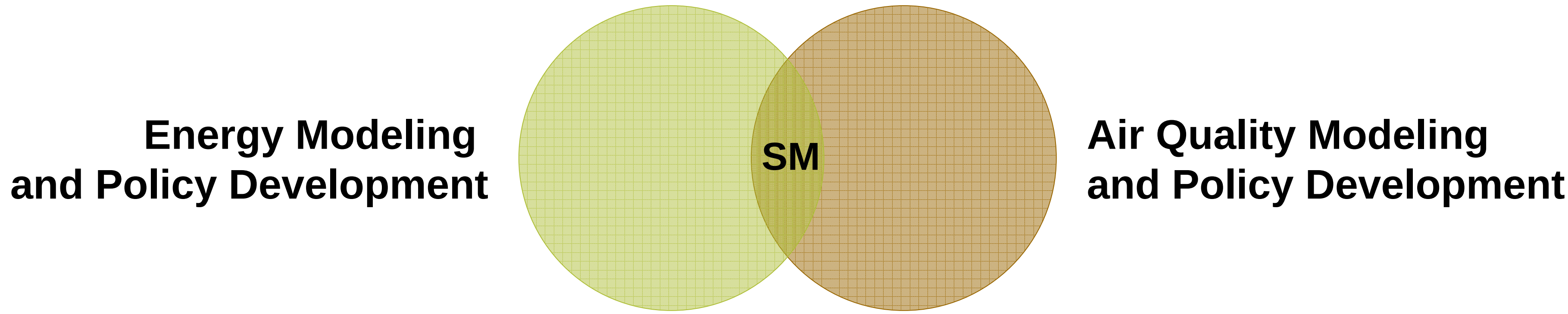


65 ug/m^3
24-hr average

15 ug/m^3
annual average

Linkage Between Energy Modeling and Air Quality Modeling with AEB

Intersection is
Sensitivity Matrix (SM)



Sensitivity Matrix captures the intelligence of CMAQ modeling runs with pollutant-specific, gridded, hourly sensitivity factors.

Expresses the modeled sensitivity of emissions and the ambient air in response to changes in power demand

Principal benefit: states' tool for characterizing emissions and air quality benefits from EERE technologies / programs.

Summary: Uses of the AEB Modeling System

- Software tools are ready to be used, and are directly applicable to attainment demonstration modeling in North Carolina, Tennessee, Georgia
- AEB provides the policy research community an opportunity to study the linkage between power consumption and air quality
- States could use this system of analysis to bolster their "weight of evidence" arguments in modeling demonstrations
- Modeling system developed to be consistent with USEPA August 5, 2004 Guidance – emission reductions may be creditable for SIP purposes

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