Future Year Emission Inventory Development to Support Fine Particulate Mass and Visibility Modeling in the VISTAS Region

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Introduction

- Describe the production of comprehensive VISTAS future year annual emission inventories
  - Used to support the modeling and assessment of speciated particulate matter (PM-2.5)
    - VISTAS Base Year 2002 inventory
    - Assumptions for 2018 projections
    - Comparison of VISTAS projections to EPA's recent projections
    - Procedures for collecting and manipulating inventories for other regions

Background

- The Regional Haze Rule defines regulations to improve visibility in 156 national parks and wilderness areas across the country
  - Require States to develop long-term strategies including enforceable measures designed to meet reasonable progress goals
  - First long-term strategy will cover 10 to 15 years, with reassessment and revision of those goals and strategies in 2018 and every 10 years thereafter
  - States strategies should address their contribution to visibility impairment in Class I areas both within and outside the State

VISTAS Class I Areas
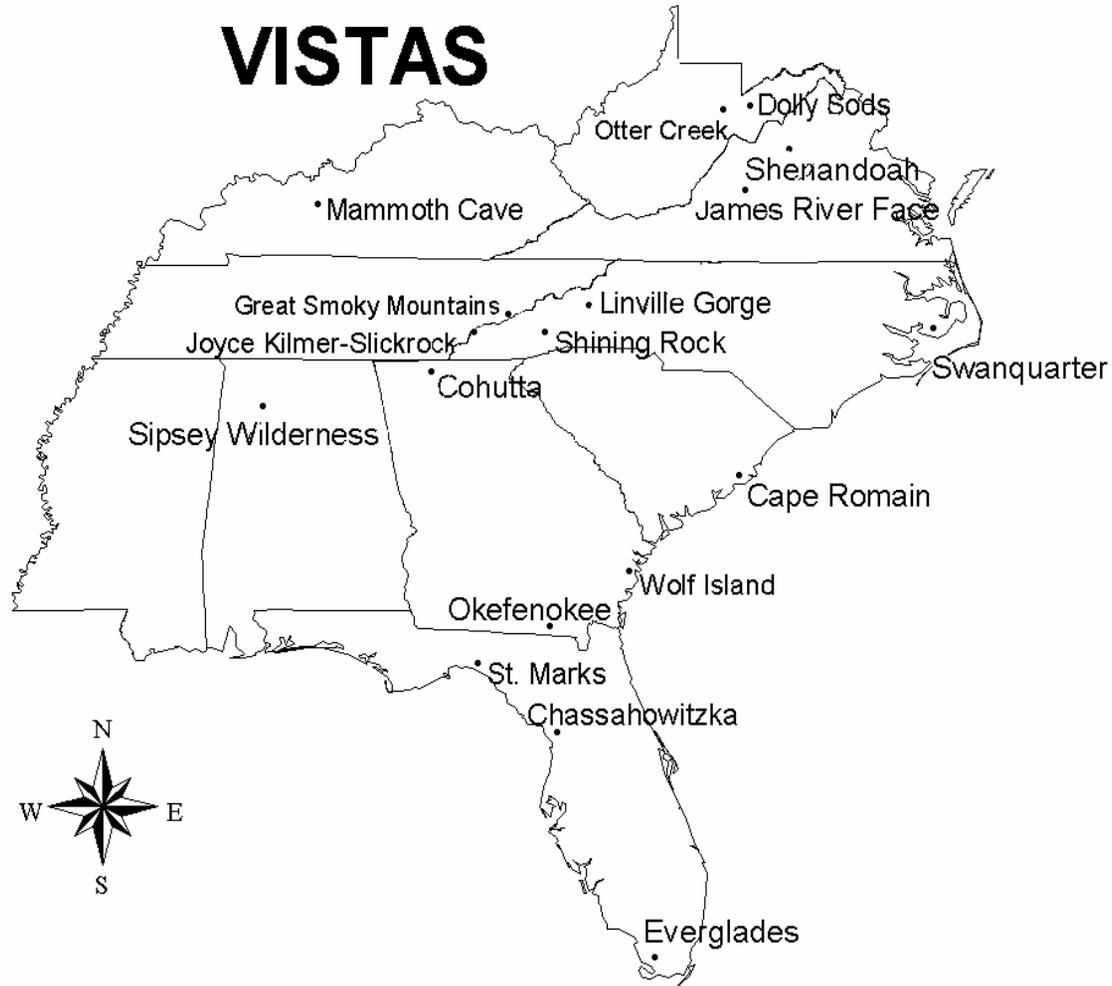
Base Year Emissions Inventory

○ VISTAS delivered a base year 2002 emission inventory in Jan 2004

- Annual emissions of VOC, NOX, CO, SO2, PM-10, PM-2.5, and NH3
- EGU, non-EGU point, stationary area, onroad and nonroad mobile, and fires
- NIF 3.0 format available for CERR submittal

Base Year Emissions Inventory (2)

○ Originated from EPA 1999 NEI

○ Augmented and updated with State, local and Tribal emissions from the 1999 through 2002

- States and stakeholders reviewed draft inventories in fall 2003

- Recommended methods to represent 2002 emissions using non-2002 data
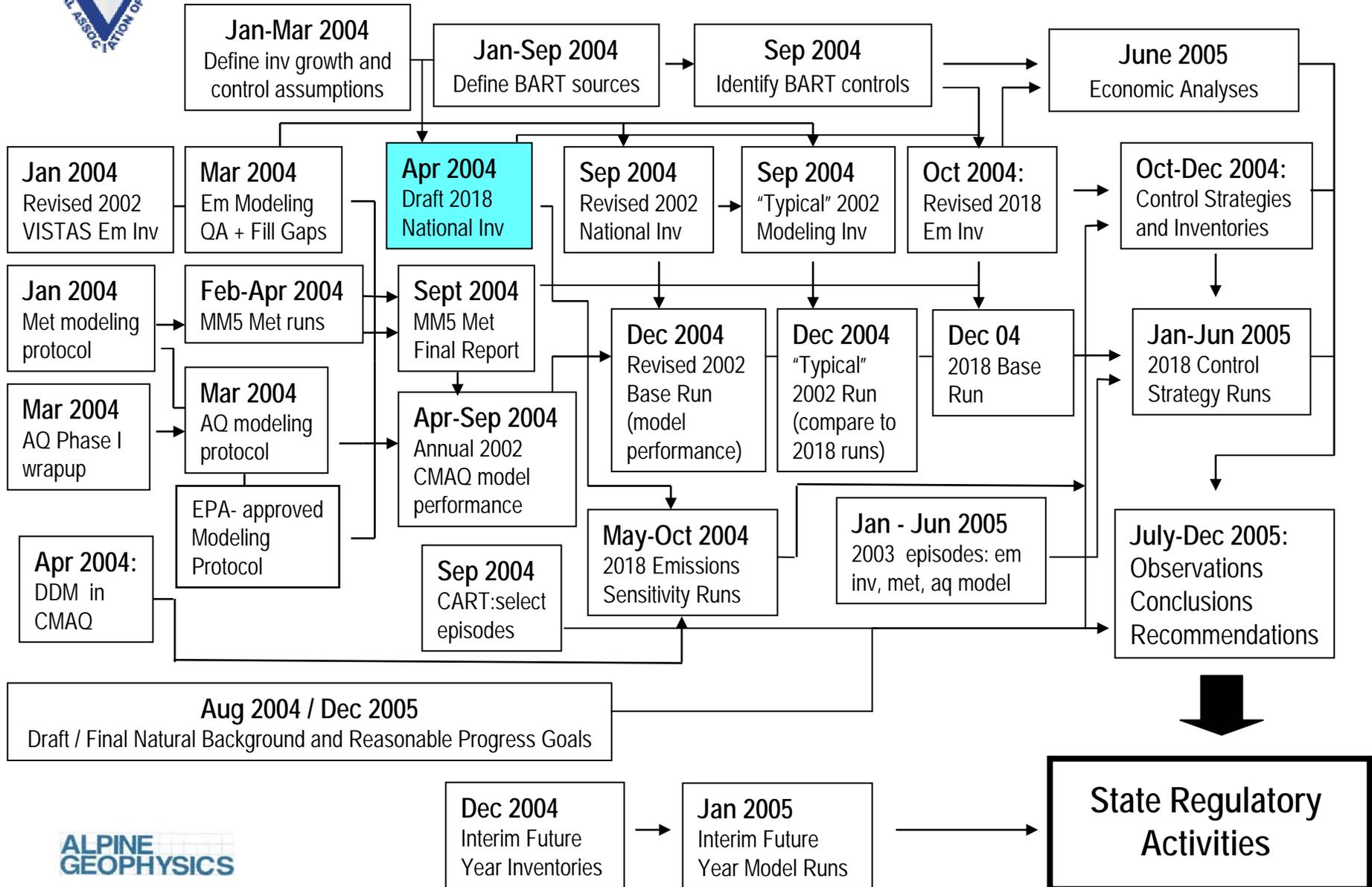
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Emission Projection Process

- Two VISTAS states (North Carolina and Virginia) have two year regulatory approval processes

- VISTAS needs to complete modeling and recommendations by Dec 2005
  - allow these States the two years necessary to complete a formal SIP submittal to EPA

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Emissions, Meteorological, Air Quality Modeling Deliverables

Draft 5/19/04

VISTAS — VISIBILITY IMPROVEMENT · STATE and TRIBAL ASSOCIATION OF THE SOUTHEAST

Jan-Mar 2004
Define inv growth and control assumptions

Jan-Sep 2004
Define BART sources

Sep 2004
Identify BART controls

June 2005
Economic Analyses

Jan 2004
Revised 2002 VISTAS Em Inv

Mar 2004
Em Modeling QA + Fill Gaps

Apr 2004
Draft 2018 National Inv

Sep 2004
Revised 2002 National Inv

Sep 2004
"Typical" 2002 Modeling Inv

Oct 2004:
Revised 2018 Em Inv

Oct-Dec 2004:
Control Strategies and Inventories

Jan 2004
Met modeling protocol

Feb-Apr 2004
MM5 Met runs

Sept 2004
MM5 Met Final Report

Dec 2004
Revised 2002 Base Run (model performance)

Dec 2004
"Typical" 2002 Run (compare to 2018 runs)

Dec 04
2018 Base Run

Jan-Jun 2005
2018 Control Strategy Runs

Mar 2004
AQ Phase I wrapup

Mar 2004
AQ modeling protocol

Apr-Sep 2004
Annual 2002 CMAQ model performance

EPA- approved Modeling Protocol

Apr 2004:
DDM in CMAQ

Sep 2004
CART:select episodes

May-Oct 2004
2018 Emissions Sensitivity Runs

Jan - Jun 2005
2003 episodes: em inv, met, aq model

July-Dec 2005:
Observations Conclusions Recommendations

Aug 2004 / Dec 2005
Draft / Final Natural Background and Reasonable Progress Goals

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Dec 2004
Interim Future Year Inventories

Jan 2005
Interim Future Year Model Runs

State Regulatory Activities

Emission Projection Methodology

○ Initial 2018 projection inventory designed to be used in emissions sensitivity modeling

- For this application, ultimate accuracy of the inventory was not required
- Intent to closely represent emissions produced by subsequent, more thorough emission projection process

Emission Projection Methodology (2)

○ Initial 2018 inventory relied on existing information available in early 2004

- EPA's Clean Air Interstate Rule (CAIR) future year forecasts
- VISTAS states and stakeholders reviewed and revised these factors

Emission Projection Scenarios

- VISTAS Planning Workgroup developed list of "Base Case" assumptions for 2018
  - based on recently promulgated emission reductions
    - Federal
    - State
    - Local
    - Site-specific

Emission Projection Scenarios (2)

- Base 1 (Promulgated as of January 1, 2004)
  - Atlanta / Northern Kentucky / Birmingham 1-hr SIPs
  - Gulf Power (Crist 7) SCR application
  - Heavy Duty Diesel (2007) Engine Standard (HDD)
  - Large Spark Ignition and Recreational Vehicle Rule
  - North Carolina Clean Smokestacks Act
  - NOx RACT in 1-hr NAA SIPs
  - NOx SIP Call (Phase I- except where states have adopted II already e.g. NC)
  - Petroleum Refinery Initiative (October 1, 2003 notice; MS & WV)
  - RFP 3% Plans where in place for one hour plans
  - TECO & VEPCO Consent Agreements
  - Tier 2 Tailpipe
  - Title IV for Phase I and II EGUs
  - VOC 2-, 4-, 7-, and 10-year MACT Standards
  - Combustion Turbine MACT

Emission Projection Scenarios (3)

- Base 2a
  - Base 1 assumptions
  - 8-hr attainment plans (e.g., NOx RACT)
  - Industrial Boiler/Process Heater/RICE MACT
  - Nonroad Diesel Rule (Tier 4)
  - NOx SIP Call (Phase II – remaining States & IC engines)
  - TVA scrubber application
  - Interstate Air Quality Rule (IAQR) (Now CAIR)

- Base 2b
  - Base 2a assumptions
  - Excludes IAQR

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Special Interest Workgroup Process

- Special Interest Workgroups were assembled to review and assess initial emission forecast data
  - EGU, Non-EGU Point, Stationary Area, Mobile, Agriculture, Fire
  - reviewed growth rates, control technologies, reduction potential, and affected sources
- Each group identified its own list of issues to address

Common Workgroup Issues

○ Method for projection
- Model or ad hoc calculation

○ Available growth & control information
- Federal, Regional, or Local Regulation
- Growth Rates
- Model specific input data
- Source specific data

EGU Projections

○ EGU workgroup recommended two options for base case inventories

○ Choosing two options provided complementary data to inform decisions on the final "Base Case"

EGU Projections – Option 1

○ Modify EPA's IAQR IPM runs

● Extract VISTAS sources from the final IPM parsed files and integrate data modifications provided and approved by VISTAS States and EGU workgroup

EGU Projections – Option 2

○ Projections calculated from VISTAS 2002 base year inventories

- Used VISTAS 2002 planning year inventory (e.g., "typical") as the basis
- Economic Growth Analysis System (EGAS) 4.0 or the Energy Information Administration (EIA)
- Estimates of reduction percentages as calculated from EPA's IAQR files
- Refined future emission rates from stakeholder input regarding utilization rates, capacity, retirements, and new units

Non-EGU Point, Area, and Agricultural Projections

- EGAS Version 4.0
  - VISTAS specific modifications
    - e.g., Moratorium on hog farms in NC

- Other stakeholder provided modifications to IAQR control factors to simulate VISTAS "Base Cases"

Onroad Mobile Projections

- Initial 2018 VMT estimates were developed at the vehicle class (i.e., LDGV, LDGT1, LDGT2, etc.)
  - Specific growth factors for county and vehicle class derived from linear growth estimates of VMT from EPA's Heavy Duty-Diesel Engine Rulemaking inventories

- Based on Mobile workgroup review, 2002 MOBILE input files were revised to reflect appropriate factors (i.e., I/M, fuel programs, etc.) in the forecast year
  - MOBILE input files run through SMOKE for episode-specific meteorological conditions

Nonroad Mobile Projections

- NONROAD model sources
  - Four seasonal NONROAD model runs at the county level for each scenario and for each VISTAS state
    - Seasonal runs account for differences in average seasonal temperature, as well as RVP

- Locomotives/Aircraft/CMV
  - 2002 emissions projected to 2018 using growth rates developed at the county-SCC-pollutant level from EPA's Nonroad Diesel and IAQR modeling inventories
    - These forecasts are described as already considering economic growth and in-place control measures
    - Additional adjustments for large spark ignition and recreational vehicle rule

Fire Emission Projections

- 2018 fire emissions based on "typical year" fire acreage
  - Acreage estimates collected from States and federal agencies for recent time periods representative of "typical" conditions or readily available
  - "Typical" based on a minimum of five years of data where possible
  - State or county level of aggregation for each fire type
- These data were then used to "normalize" the 2002 base year inventory to "typical" conditions
  - Wildfire acreage: 7 VISTAS States
  - Prescribed fire acreage: 6 VISTAS States

Comparison to EPA Forecasts

- It was not expected that this initial emission projection to 2018 would exactly replicate those previously completed by other agencies

- In fact, due to the regionally-specific information provided through VISTAS stakeholder groups, this projection should be unique

- Not only has VISTAS chosen to use a set of growth factors slightly different that EPA's most recent set, we have attempted to incorporate regional, State, local, and facility-based responses to recent Federal, State, and local pollution reduction actions into the forecast

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Comparison to EPA Forecasts (2)

○ However, the resulting emission changes track very closely on a percentage and tonnage basis to most pollutants and source sectors when compared to recent EPA projections

● An exception is seen for PM and CO increases largely attributed to fire emissions
○ EPA held Rx fire constant, excluded wildfire

○ Note: Because of estimation of onroad mobile emissions using MOBILE6 module in SMOKE for two particular episodes, onroad emissions are not included in these results and comparisons.

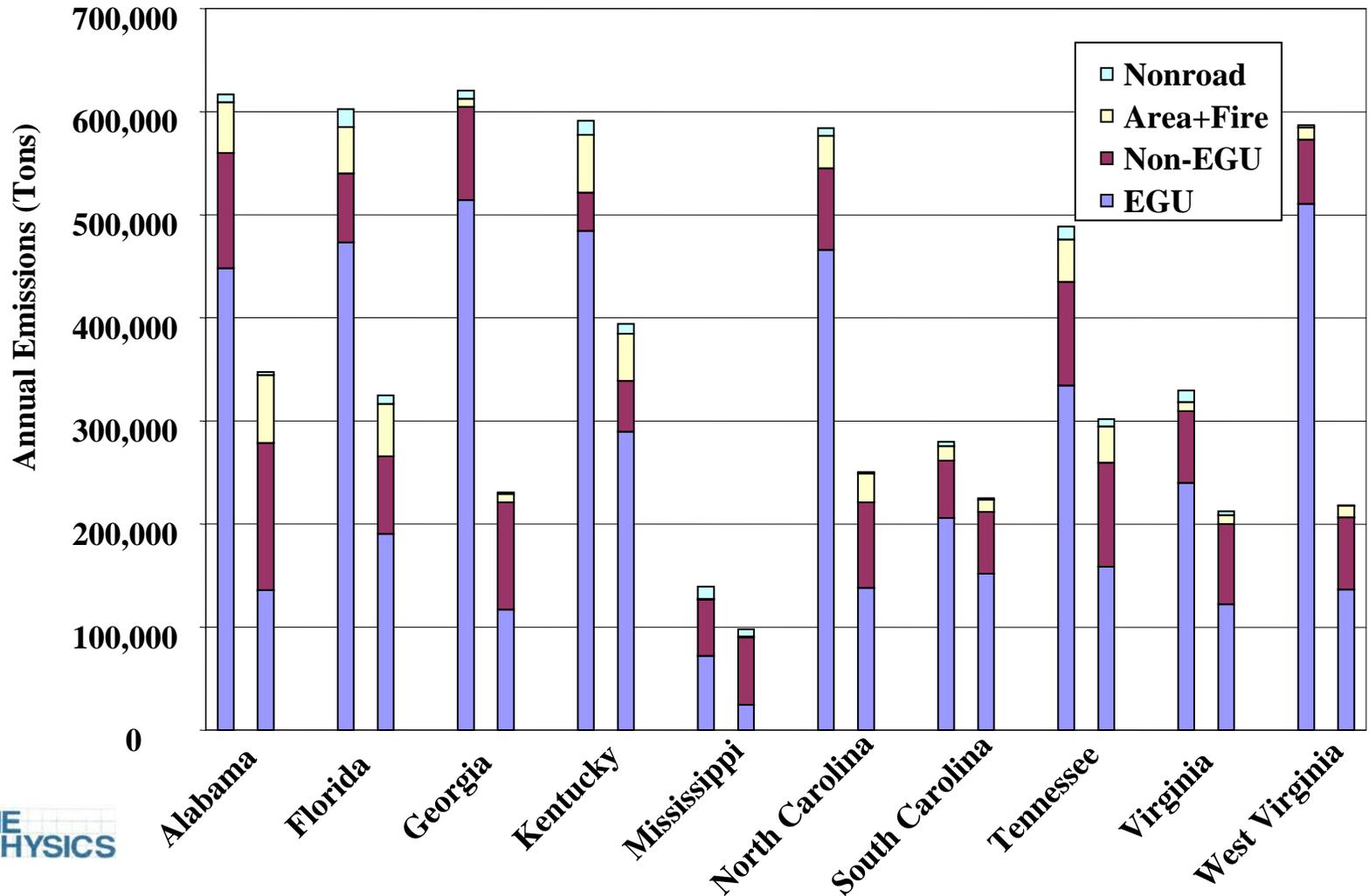# Emissions Change With Comparable Reduction Programs (Base2a vs. IAQR)
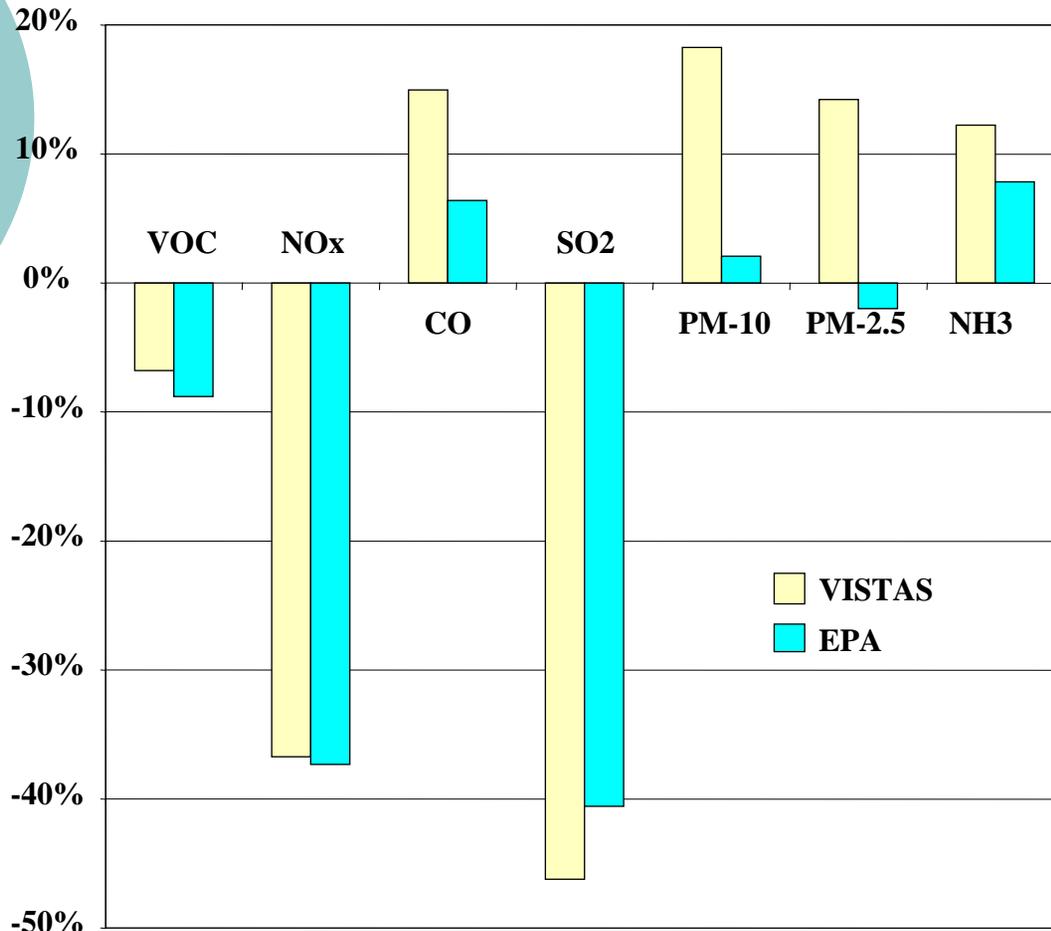
Pollutant	Percent Change in Annual Emissions	
	VISTAS	**EPA**
VOC	-7%	-9%
NOx	-37%	-37%
CO	15%	6%
SO2	-46%	-41%
PM-10	18%	2%
PM-2.5	14%	-2%
NH3	12%	8%

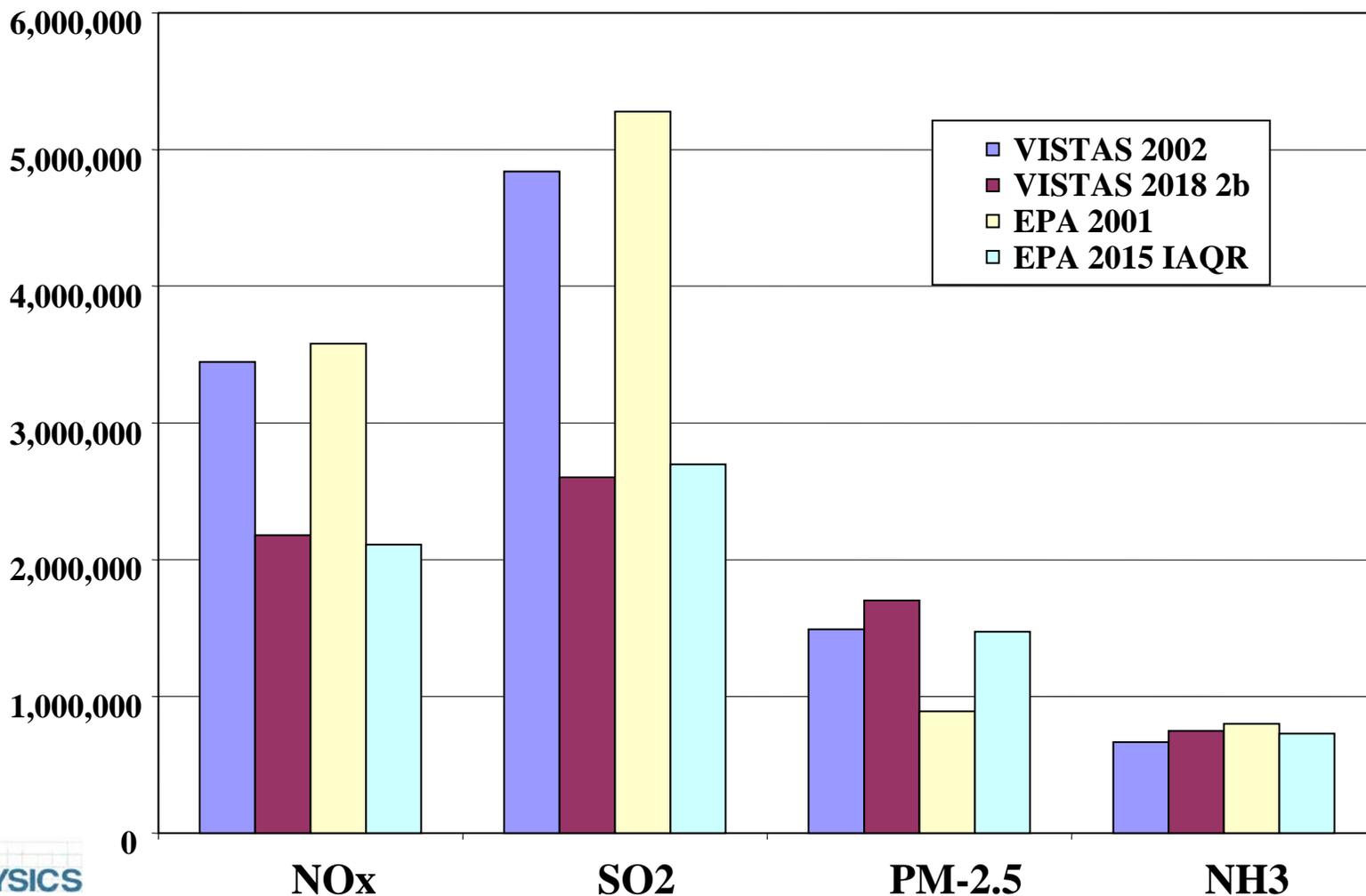# NOx Emission Changes Resulting from 2018 Base Case 2a in VISTAS States
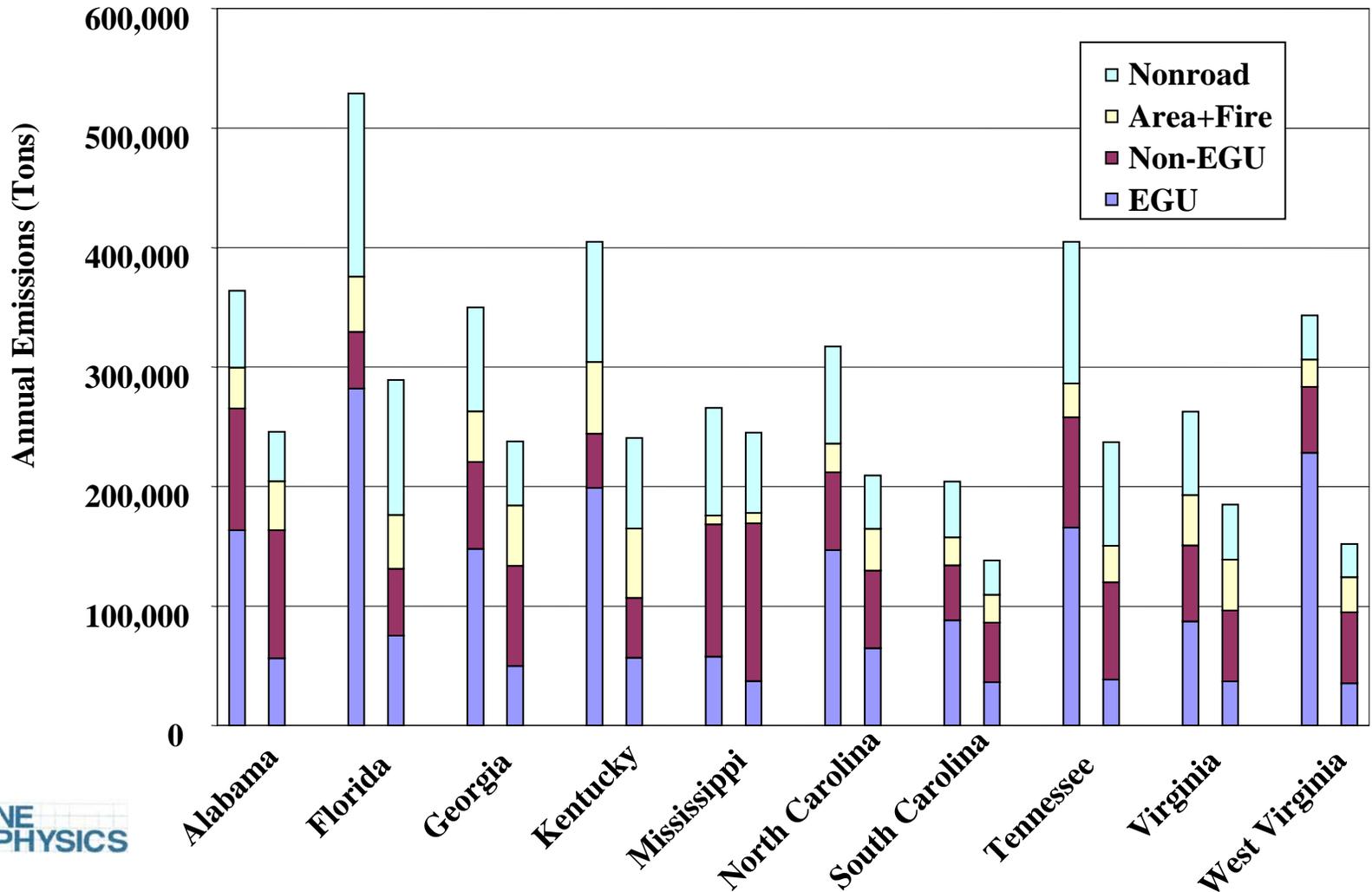
SO2 Emission Changes Resulting from 2018 Base Case 2a in VISTAS States

Annual Emissions Change Comparison Between VISTAS and EPA Projections

(VISTAS States Only; Units in Tons/Year)

Non-VISTAS Emission Projections

- Modeling domain covered an area much larger than the VISTAS States
  - Inventories for the U.S., Canada, and Mexico were required for each of the future year scenarios

Non-VISTAS Emission Projections (2)

○ WRAP
  - Provided 2002 point and area
  - Point source based agricultural fire emissions

○ CENRAP
  - Provided 2002 area source ammonia

○ For the remaining U.S. domain
  - Point source projections based on EPA's 2001 modeling inventories
  - Area source and fire emissions based on EPA's preliminary 2002 NEI

Non-VISTAS Emission Projections (3)

- EGU emissions from EPA IPM 2015 forecasts

- All non-VISTAS non-EGU point and area emissions were forecast to 2018 using
  - EGAS 4.0 growth rates
  - DOE energy efficiency factors for combustion sources
  - other control strategies modeled by EPA for CAIR

- Onroad and nonroad mobile emissions used interpolation of annual, county-level inventories developed for the Heavy Duty Diesel and CAIR Rulemakings

Non-VISTAS Emission Projections (4)

○ Canadian nonpoint sources were based on interpolated inventories of Canadian area and mobile sources available and modeled by EPA during the Clear Skies Act analyses

○ Canadian point sources and Mexican emissions were held constant from base year to future year
  ● Canadian point data are confidential, no forecast data available for Mexican emissions

Conclusions

- Goal was to generate a set of emission inventories to support the modeling of speciated PM-2.5
  - Projection inventories were provided on time
  - Revisions to better meet the needs of VISTAS emissions sensitivity runs
  - Direct comparison to recent EPA CAIR projections show significant correlation to achieved emission reductions within VISTAS domain

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Conclusions (2)

○ Continued inventory improvements are always warranted

- Base year, growth rates, and control factor improvements already underway
- Improvements are largely based on the lessons learned from the initial projection efforts and stakeholder contribution

Acknowledgements

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- MACTEC Engineering and Consulting, Inc. Team
  - Bill Barnard, Ed Sabo, Dan Meszler

- VISTAS State, local, and Tribal air quality agencies and participating stakeholders

- Other National RPOs and U.S. EPA

Additional Information

○ VISTAS-SESARM Main Website

  ● http://www.vistas-sesarm.org/

○ VISTAS Phase II Visibility Modeling Website

  ● http://pah.cert.ucr.edu/vistas/vistas2/

○ Personal Contact

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