New Hampshire
Regional Haze SIP Revision

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Air Resources Division

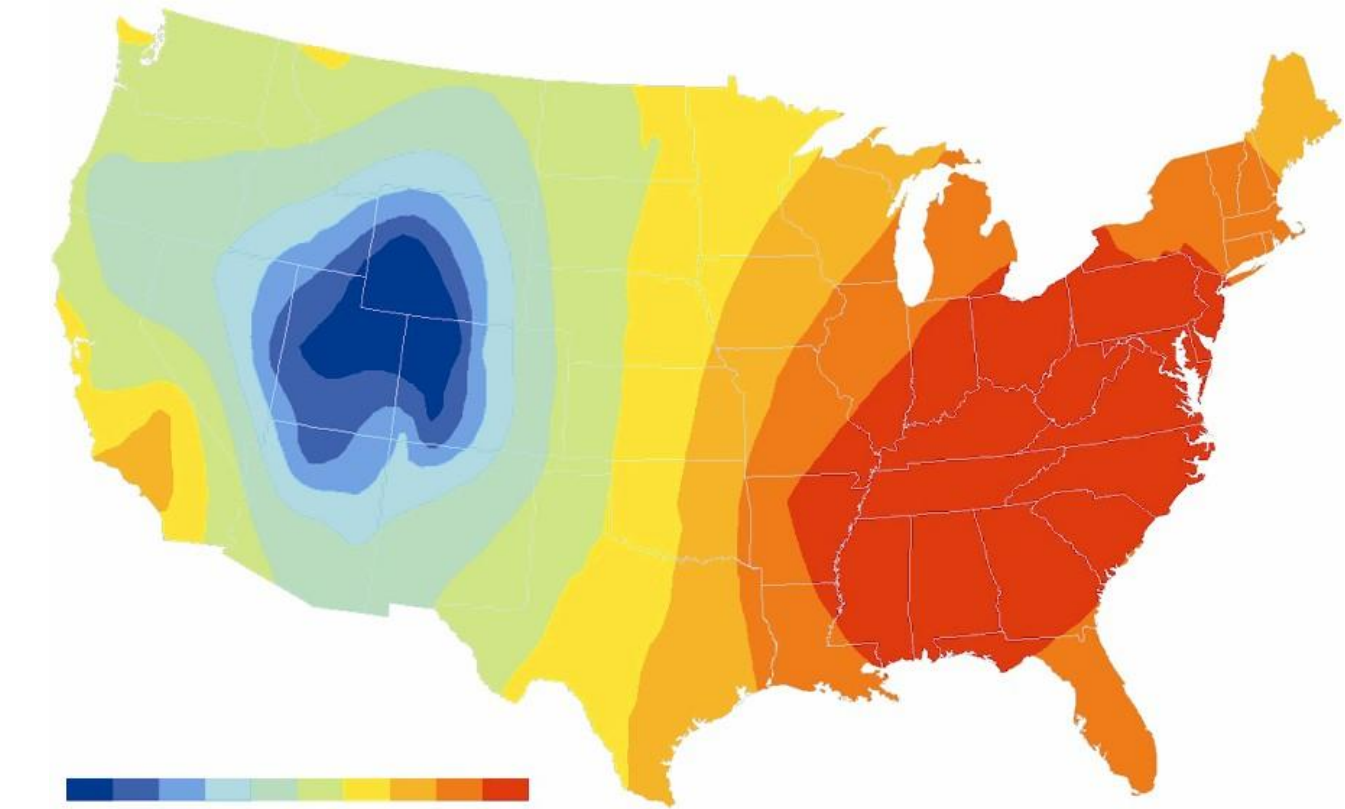
What is regional haze?

- Visibility impairment caused by the cumulative emissions of air pollutants from many sources over a wide geographic area.
- The result of light scattering and absorption by fine particles suspended in the atmosphere (aerosols).

Great Gulf Wilderness 35.8 Mm-1
8 μg/m3
13 dv

Great Gulf Wilderness 125 Mm-1
21 µg/m3
25 dv

Where does regional haze occur?



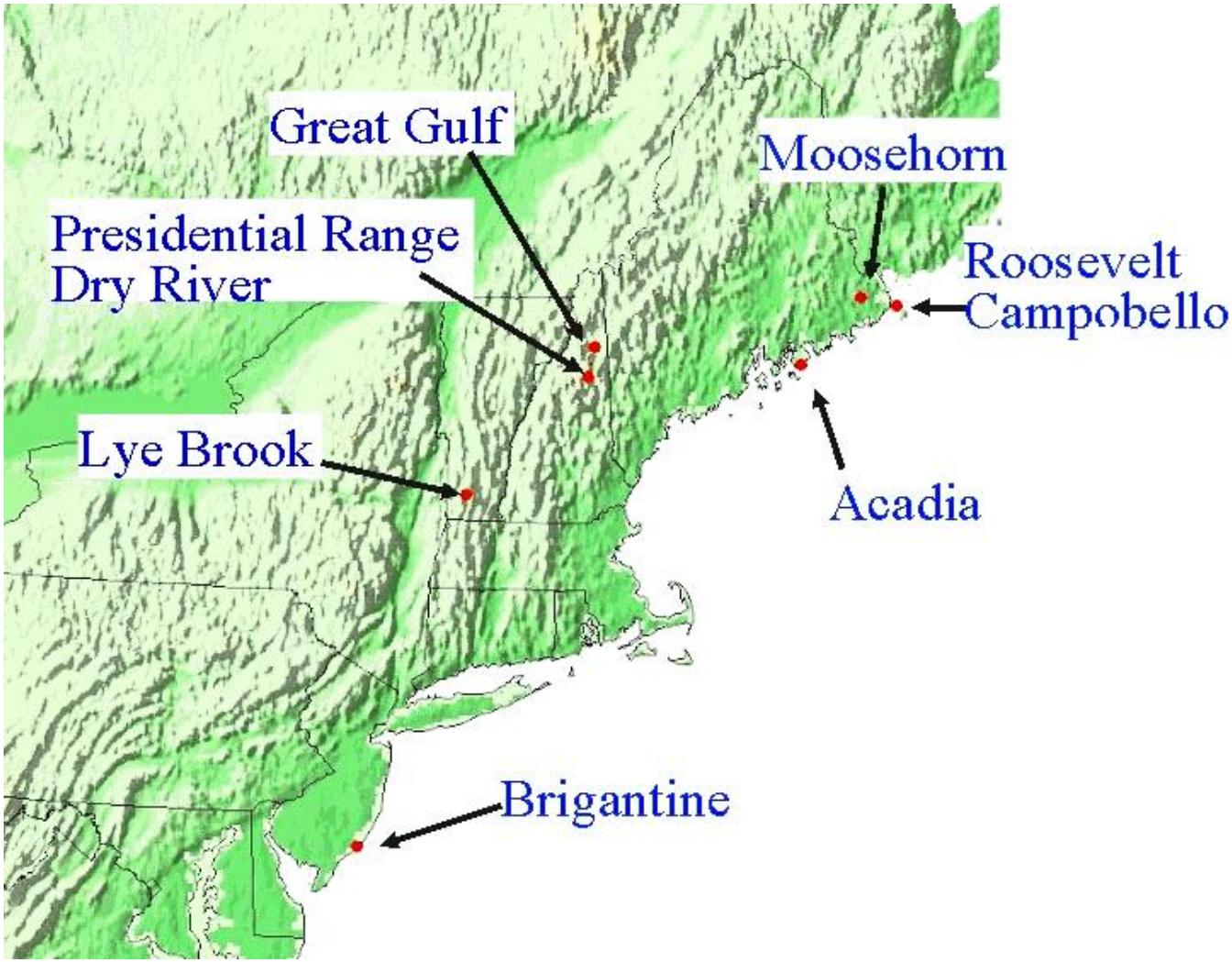
Source: USEPA, “How Air pollution Affects the View”

What is the goal of the regional haze program?

- Visibility protection requirements are established under Section 169A of the Clean Air Act.
- Goal is to achieve natural background visibility conditions (pristine conditions) in all Class I areas by 2064.
- Class I areas include 156 national parks and wilderness areas, of which 7 are in the MANE-VU region.*

* MANE-VU members are the 6 New England states plus Delaware, Maryland, New Jersey, New York, Pennsylvania, and the District of Columbia.

Class I Areas in the MANE-VU Region

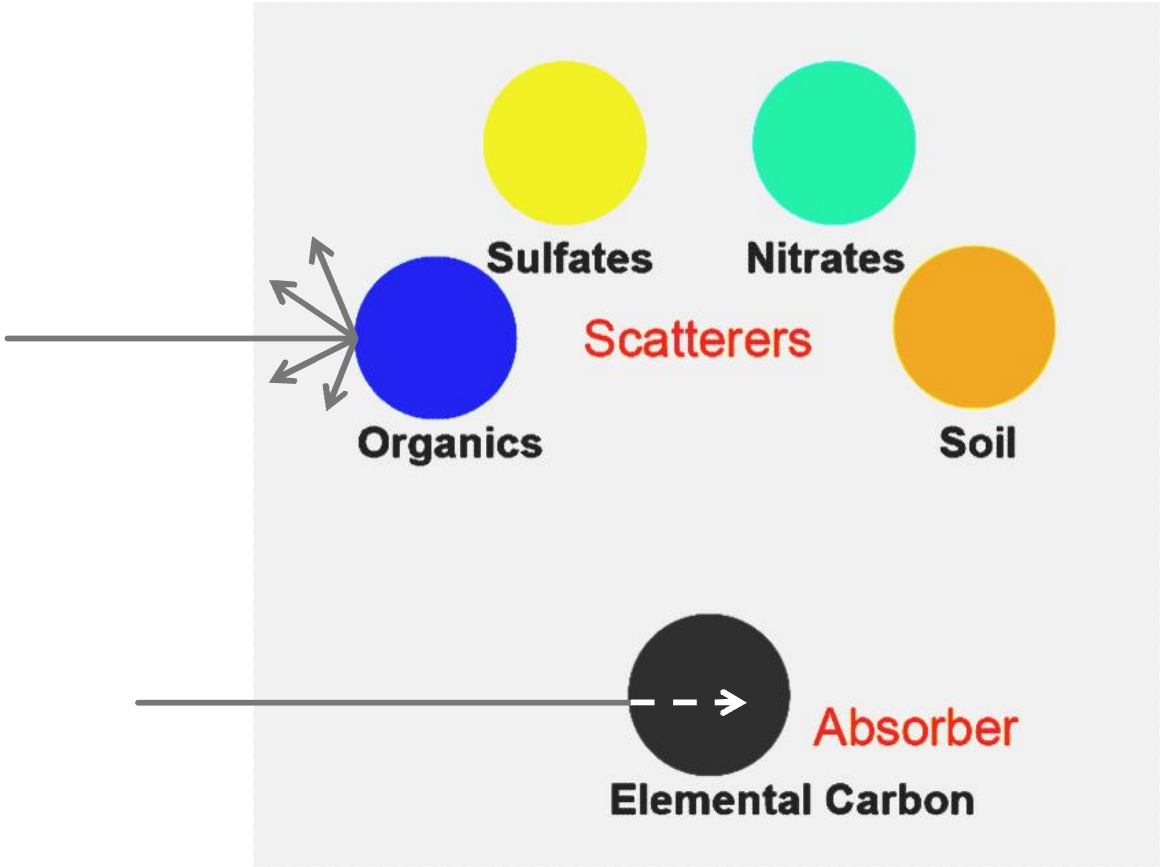


Where does fine-particle pollution* come from?

- Local emission sources, including stationary, mobile, and area sources
- Transported pollutants, especially from large SO_2 emission sources
- Secondary pollutants, formed by atmospheric chemistry and incorporated into fine particles

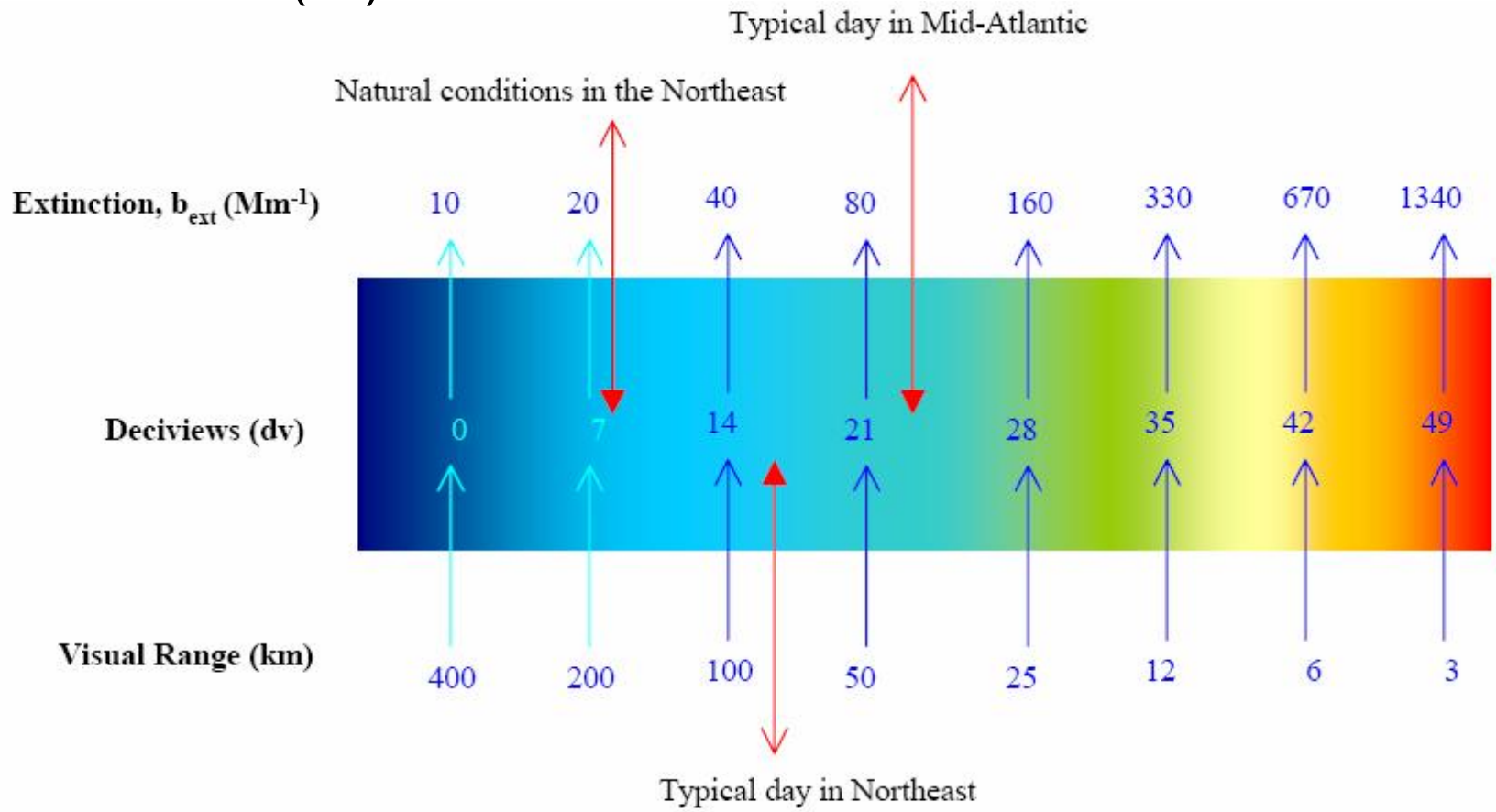
*Commonly measured as $PM_{2.5}$
(particulate matter with a diameter $\leq$ 2.5 micrometers)

What is fine-particle pollution made of?



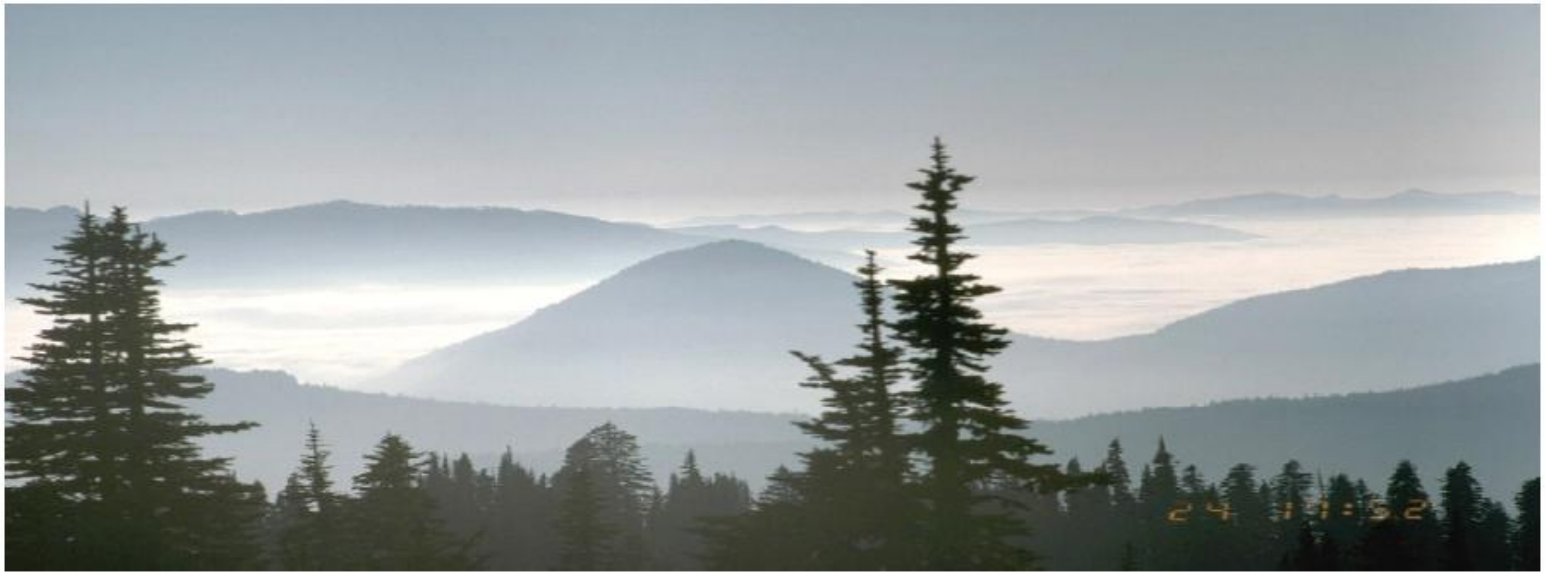
Measures of Visibility

- Extinction Coefficient, b_{ext} (Mm^{-1})
- Visual Range (km)
- Deciviews (dv)



The Regional Haze Rule

40 CFR 51.308, published July 1, 1999



Core Requirements of Regional Haze Rule

- Calculation of baseline and natural visibility conditions
- Reasonable progress goals
- Long-term strategy (i.e., emission control measures needed to achieve reasonable progress)
- Monitoring strategy and other requirements (i.e., a plan for monitoring visibility progress)
- (Best Available Retrofit Technology)

Baseline and Natural Visibility Conditions in MANE-VU Class I Areas

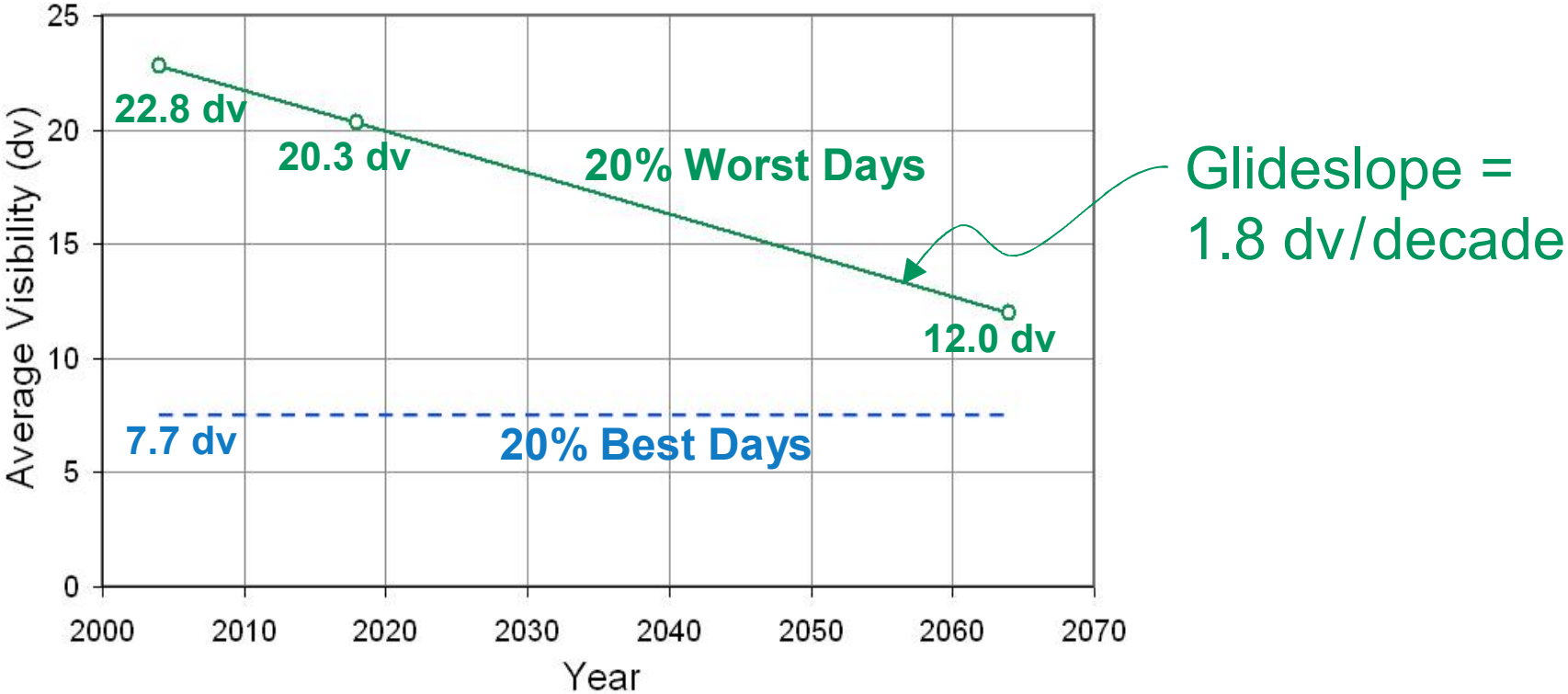
Class I Area(s)	2000-2004 Baseline		Natural Conditions		Difference	
	Best 20%	Worst 20%	Best 20%	Worst 20%	Best 20%	Worst 20%
Acadia	8.8	22.9	4.7	12.4	4.1	10.5
Moosehorn and Roosevelt Campobello	9.2	21.7	5.0	12.0	4.1	9.7
Great Gulf and Presid. Range - Dry River	7.7	22.8	3.7	12.0	3.9	10.8
Lye Brook	6.4	24.5	2.8	11.7	3.6	12.7
Brigantine	14.3	29.0	5.5	12.2	8.8	16.8

All values in ***deciviews***

Reasonable Progress Goals

- Determine visibility improvements required to reach natural visibility conditions by 2064 for the 20% haziest days (presumptive goal).
- Calculate uniform rate of progress to reach goal.
- Estimate emission reductions required to meet or exceed the uniform rate of progress by 2018.
- Ensure no degradation in visibility for the 20% clearest days.

Great Gulf and Presidential Range - Dry River
Uniform Rate of Progress (Visibility in Deciviews)



Visibility Condition (20% Worst Days)	Year	Average Visibility	Visibility Improvement
Baseline Visibility	2002-04	**22.8 dv**	—
10-Year Goal @ Uniform Rate of Progress	2018	**20.3 dv**	2.5 dv
Long-Term Goal = Natural Visibility	2064	**12.0 dv**	10.8 dv

Reasonable Progress Goals (continued)

- Goals are set by the Class I states in consultation with contributing states and the Federal Land Managers.
- Uniform rate of progress is the presumptive goal.
- Four-step process is applied:
  1. Identify pollutants and source categories.
  2. Identify possible emission control measures.
  3. Perform four-factor analysis.
  4. Assess visibility impacts to Class I areas.

Technical Analyses for RPG

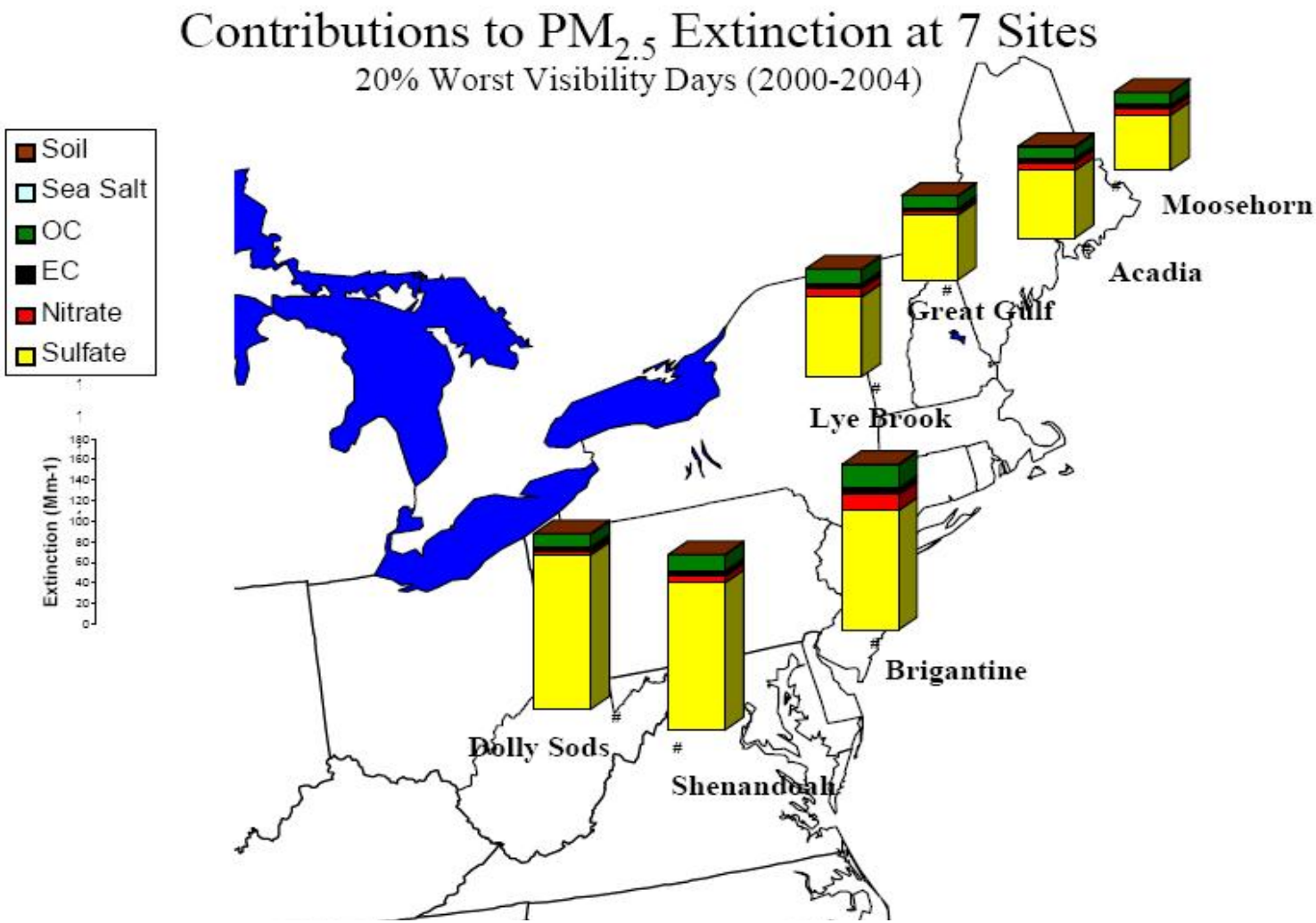
- Emission inventories (2002 and 2018) for:
  - Stationary point sources
  - Mobile sources
  - Area sources
  - Biogenic sources
- Modeling to evaluate:
  - Pollutant contributions by states, regions, and provinces, i.e., geographic allocation (REMSAD, CALPUFF)
  - Visibility impacts of emission control strategies (CMAQ)
- Other analyses for contribution assessment:
  - Emissions evaluation
    - ✓ Q/d ratios
    - ✓ Emissions × upwind probability
  - Data analysis techniques
    - ✓ Trajectories
    - ✓ Source apportionment models (e.g., PMF, UNMIX)

Major Pollutants of Concern

- Sulfates (formed from SO_2)
  - Account for ~70% of visibility extinction
  - Sources and chemistry well understood
- Organic Carbon
  - Account for ~10-15% of visibility extinction
  - Sources and chemistry less well understood (many variables and complex interactions)

	percent contributon to particle extinction					
Site	Sulfate	Nitrate	Org C	Elem C	Soil	Coarse Mass
Acadia	72	9	11	5	0.6	2
Moosehorn	70	8	14	5	0.5	3
Lye Brook	72	9	12	5	0.6	2
Brigantine	68	11	13	5	0.6	4
Washington DC	61	14	15	7	0.7	2
Great Gulf	76	3	13	4	0.6	3

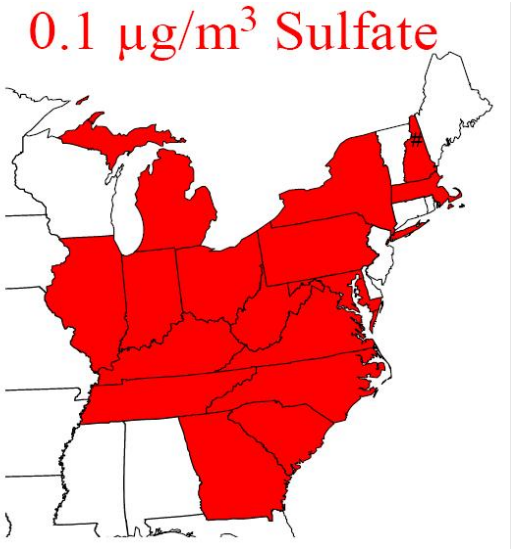
RPG Step 1 – Identify pollutants and source categories (cont'd).

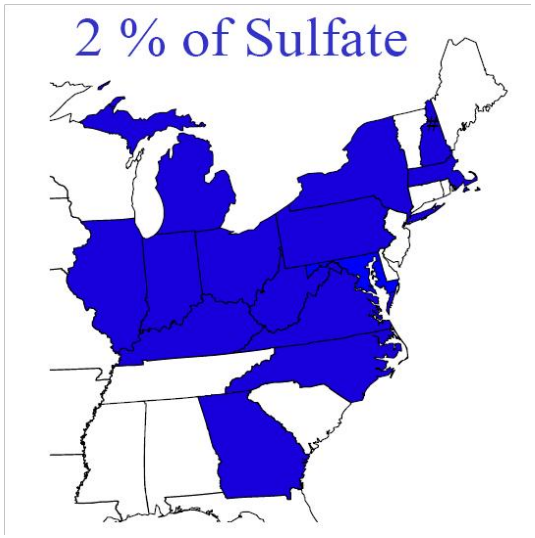


Source: MANE-VU Contribution Assessment, 2006

Contribution Assessment: In which states do haze-causing pollutants originate?

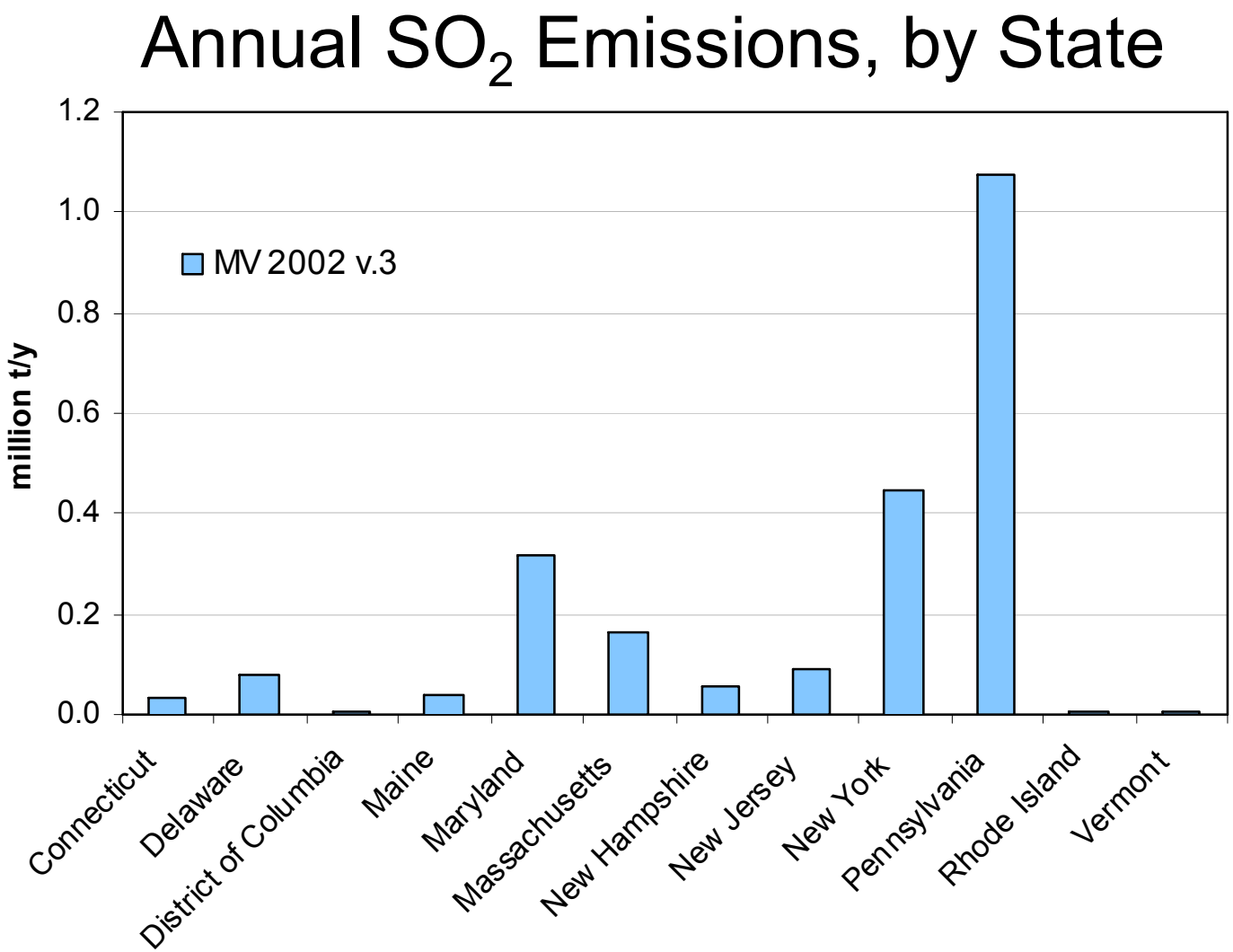
Great Gulf and Presidential Range - Dry River
20% Worst Days REMSAD-Modeled 2002 Contributions to Sulfate





Source: MANE-VU Contribution Assessment, 2006

RPG Step 1 – Identify pollutants and source categories (cont'd).

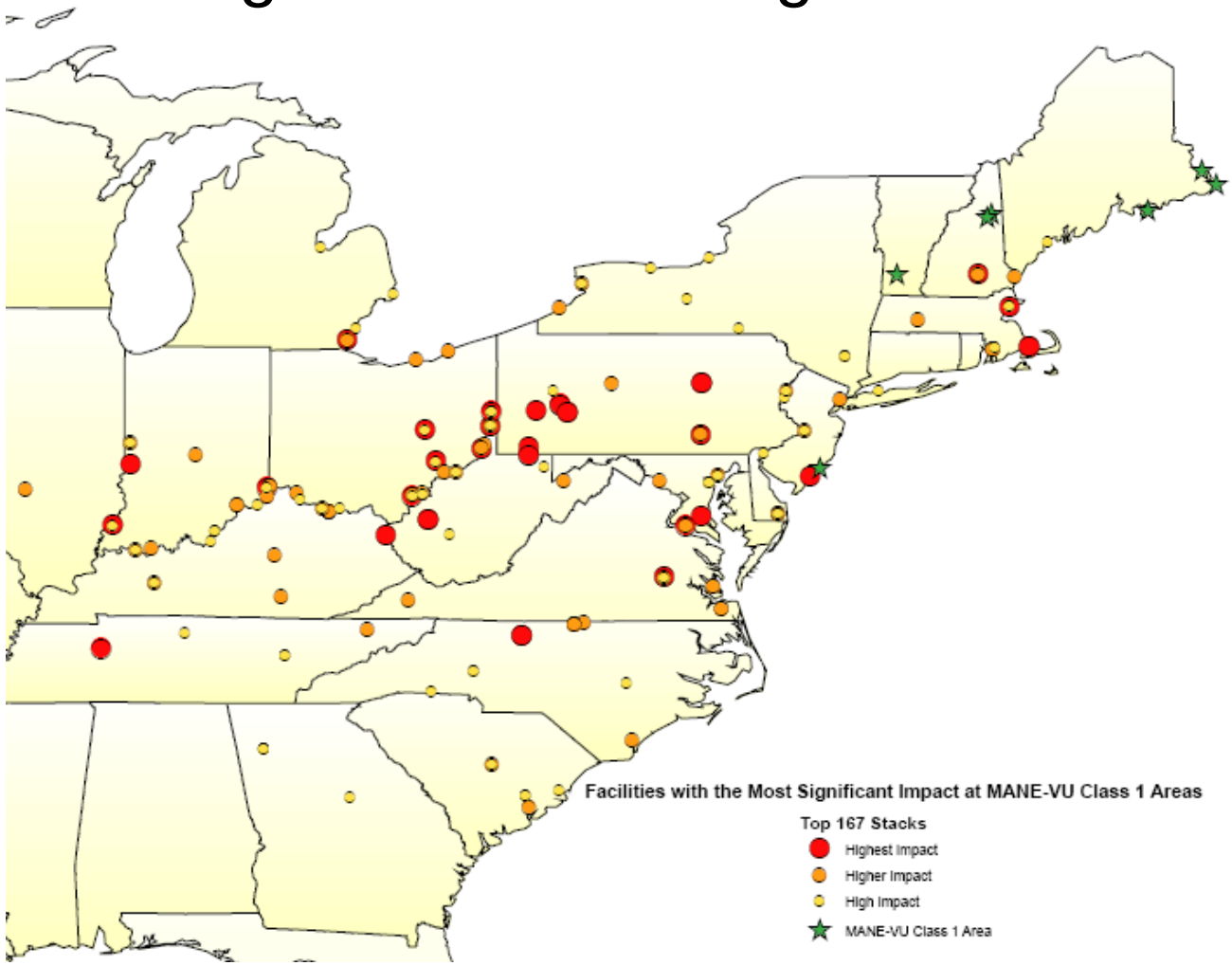


Source: MANE-VU Contribution Assessment, 2006

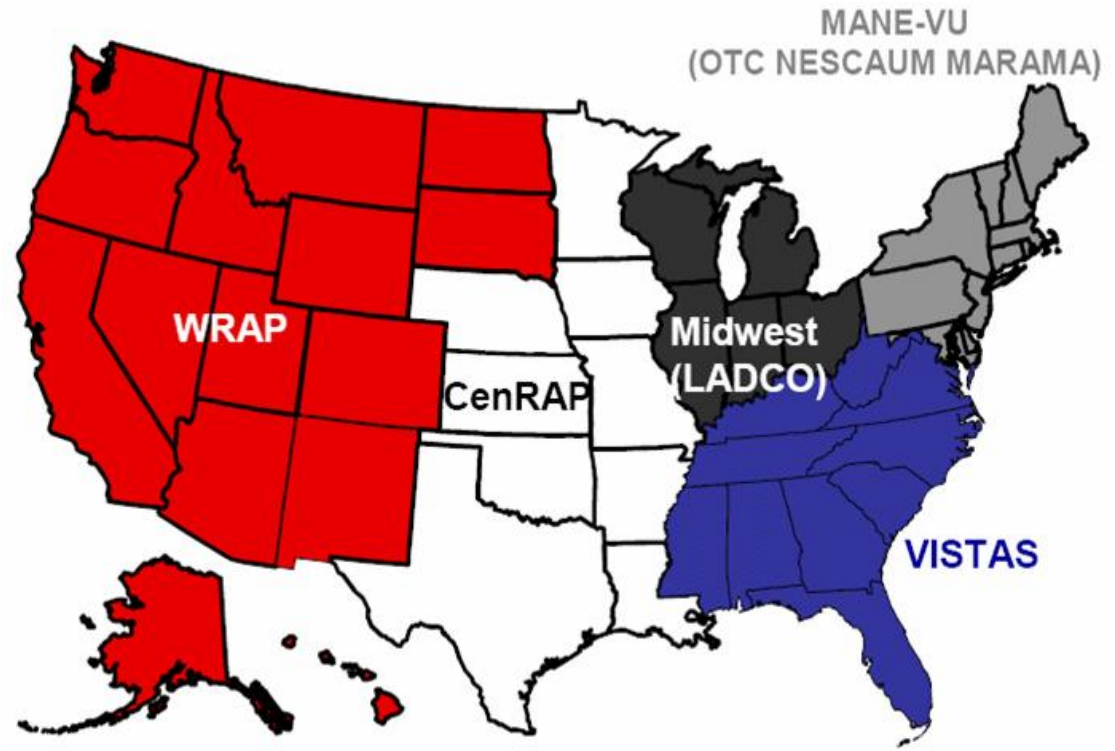
Major Contributing Sources

- Electrical generating units (EGUs), which accounted for 70% of SO_2 emissions in the region in 2002 (the base year)
  - EGUs located within MANE-VU
  - EGUs located outside MANE-VU
- Wood smoke from within the MANE-VU region and from Canada

Highest Contributing EGUs



Regional Planning Organizations



Mid-Atlantic/Northeast Visibility Union
MANE-VU

OZONE TRANSPORT COMMISSION

NESCAUM

MARAMA

Federal Land Managers

NATIONAL PARK SERVICE

U.S. FISH & WILDLIFE SERVICE

FOREST SERVICE
U.S.
DEPARTMENT OF AGRICULTURE

Control Measures Considered

- Cost-effective emission control measures beyond those already "on the books" or "on the way."
- Emphasis on SO_2 as dominant contributor to regional haze.
- Measures applicable to all states contributing 2% or more of haze-causing sulfate aerosol at MANE-VU Class I Areas.
- Major source categories:
  - Electrical generating units (EGUs)
  - Industrial, commercial, and institutional (ICI) boilers
  - Cement and lime kilns
  - Users of heating oil
  - Residential wood stoves
- Rationale, methods, and analyses documented in MANE-VU Reasonable Progress Report, 2007.

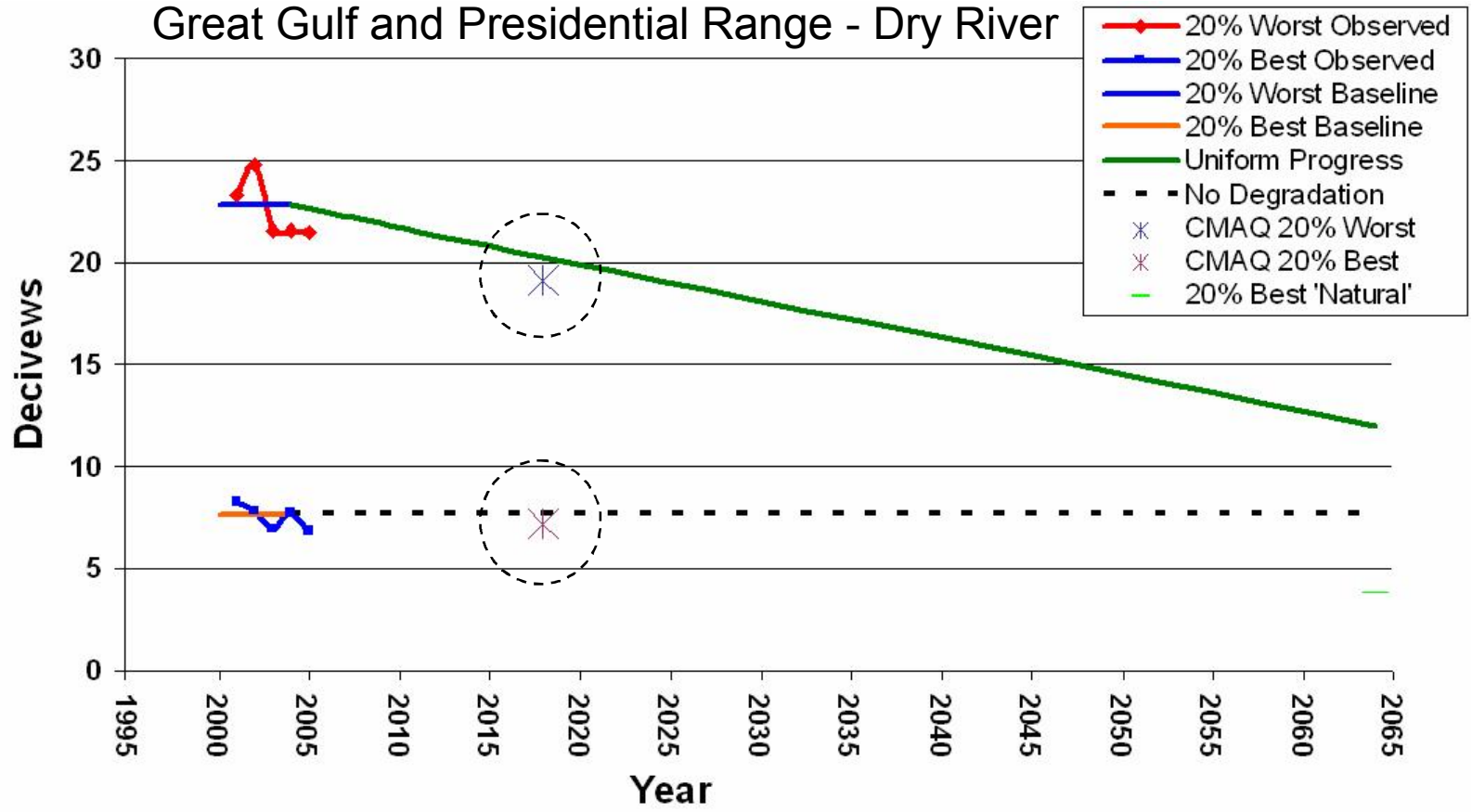
Four-Factor Analysis
(Evaluation of Control Measures and Strategies)

1. Costs of compliance
2. Time required for compliance
3. Energy and non-air-quality impacts of compliance
4. Remaining useful life of any existing source subject to requirements

(Selected control measures described later …)

Visibility Impacts of Control Measures

(Air quality modeling performed by NESCAUM for MANE-VU)



BART
(Best Available Retrofit Technology)

These provisions of the Clean Air Act and the Regional Haze Rule apply to any major stationary source from among 26 identified source categories that:

- Has the potential to emit 250 tons/year or more of any air pollutant.
- Commenced operation in the period from August 8, 1962, to August 7, 1977.
- Emits any pollutant that may reasonably be expected to cause visibility impairment in any Class I area (primarily NO_X, SO_2, and $PM_{2.5}$).

BART Sources in New Hampshire

The state has only two BART-eligible sources, both of which are electrical generating units:

- Merrimack Station Unit MK2, a 320-MW, coal-fired power plant (base load); and
- Newington Station Unit NT1, a 400-MW, oil-fired and/or natural-gas-fired power plant (peak load)

BART Engineering Analyses

With assistance from MANE-VU, New Hampshire performed BART determinations for each source based on:

- The “best systems of continuous emission control technology available and associated emission reductions achievable.”
  -- Regional Haze Rule
- Evaluation of five specific factors:
  1. Costs of compliance.
  2. Energy and non-air quality environmental impacts of compliance.
  3. Existing pollution control technology in use at the source.
  4. Remaining useful life of the source.
  5. Degree of visibility improvement which may reasonably be anticipated from the use of BART.

BART for Merrimack Station Unit MK2

Pollutant	Emission Controls
SO_2	Flue gas desulfurization (scrubber) to achieve greater than 90% emission reduction (consistent with state law for 80% reduction of mercury emissions)
NO_X	Selective catalytic reduction (current controls)
PM	Electrostatic precipitators (current controls)

BART for Newington Station Unit NT1

Pollutant	Emission Controls
SO_2	Use of 1.0%-sulfur residual fuel oil to reduce emissions by approximately 33%
NO_X	Low-NO_X burners (current controls)
PM	Electrostatic precipitators (current controls)

CORE REQUIREMENT

Long-Term Strategy
(control measures to achieve visibility goals)

- Required for each affected Class I area.
- Based on consultations with other states and regional planning organizations.
- Takes into account existing air pollution control programs and anticipated changes in emissions from all sources.
- Includes enforceable emission control measures and compliance schedules as part of SIP.
- Shows that New Hampshire is meeting its share of emission reductions.

Long-Term Strategy: The MANE-VU "Ask"

- New Hampshire and the other MANE-VU states determined that certain emission control strategies for achieving visibility goals were reasonable to implement by 2018 or earlier. Requested control measures are known as the "Ask."
- The Ask represents MANE-VU's long-term strategy as necessitated by the Regional Haze Rule.
- The proposed control measures go beyond programs that are already "on the books" or "on the way."
- The Ask was developed in two slightly different versions: one for the MANE-VU states, and one for non-MANE-VU states.

The “Ask” for MANE-VU States

- Timely implementation of BART controls.
- A 90% or greater reduction in SO_2 emissions from the 167 largest contributing EGU point sources affecting visibility in MANE-VU Class I Areas (or equivalent reductions by other means).
- Mandatory use of low-sulfur distillate and residual fuel oils, representing a 28% reduction in SO_2 emissions from the burning of these fuels.
- Continued evaluation of other measures, e.g., energy efficiency improvements, use of alternative (clean) fuels, further controls on SO_2 and NO_X emission sources, and controls on wood smoke emissions.

The “Ask” for non-MANE-VU States

- Timely implementation of BART controls.
- A 90% or greater reduction in SO_2 emissions from the 167 largest contributing EGU point sources affecting visibility in MANE-VU Class I Areas (or equivalent reductions by other means).
- Reasonable control measures on non-EGU sources equivalent to MANE-VU’s low-sulfur oil strategy.
- Continued evaluation of other measures, e.g., energy efficiency improvements, use of alternative (clean) fuels, further controls on SO_2 and NO_X emission sources, and controls on wood smoke emissions.

Targeted EGUs in New Hampshire

Facility Name	Fuel Type	2002 SO_2 Emissions (tons)	Proposed Control Method	SO_2 Emission Reductions		2018 SO_2 Emissions (tons)
				(%)	(tons)	
Merrimack Station MK1	coal	9,754	scrubber	90	8,779	975
Merrimack Station MK2*	coal	20,902	scrubber	90	18,812	2,090
Newington Station NT1*	fuel oil/ nat gas	5,226	1.0%-S fuel oil	33	1,742	2,613
TOTALS		**35,882**		**81.7**	**29,333**	**5,678**

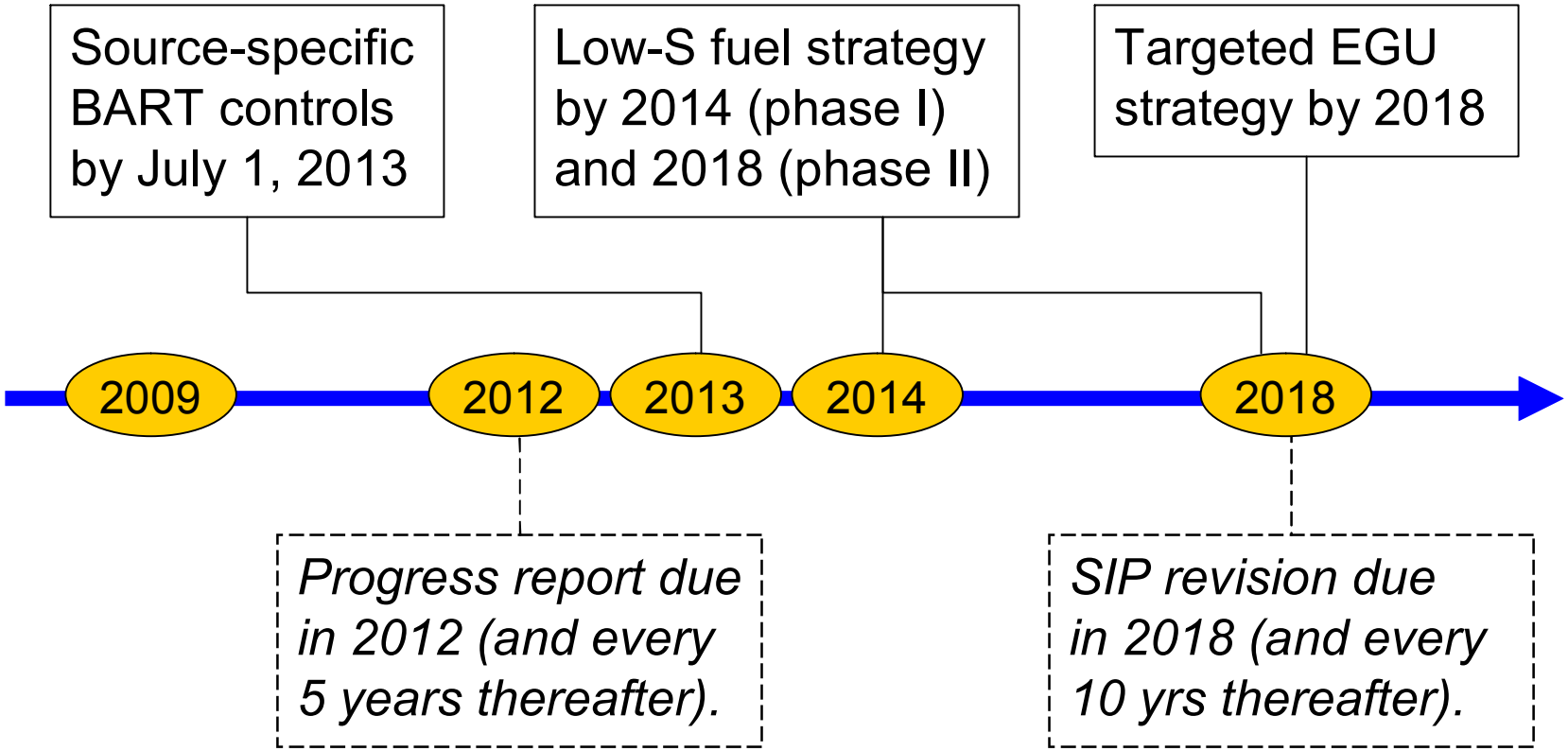
* BART-eligible facility

New Hampshire's Share of Emission Reductions (SO_2 from All Sources)

State/Region	2002 Baseline (tons)	2018 Projected (tons)	2002 - 2018 % Reduction
New Hampshire	55,300	13,605	**75.4**
MANE-VU Total	2,291,902	607,211	73.5

Monitoring Strategy and Other Requirements

NHDES will (contingent on EPA funding):

- Continue to compile and analyze air quality data from the existing network of IMPROVE monitor sites (no changes to the network are proposed).
- Continue to maintain and operate the IMPROVE monitor site at Great Gulf Wilderness.
- Continue participation in the Visibility Information Exchange Web System (VIEWS).
- Evaluate data for visibility trends on a periodic basis.
- Maintain statewide emission inventories for all source categories, with major updates on a 3-year cycle (the 2008 inventory is currently being assembled).

MANE-VU Regional Haze SIP Timeline