Case Studies of Recent EPA Regulatory Impact Analyses

Understanding the analytical objectives, methods and results of the NAAQS RIA and Petroleum Refineries RIAs

Presentation to the Ozone Transport Commission

September 28th, 2012

Overview

- Comparing and contrasting technology-based and NAAQS RIAs
- NAAQS case study
- Refineries NSPS case study

There are Critical Differences in the Policy Goals and Implementation of NAAQS and Technology Standards…

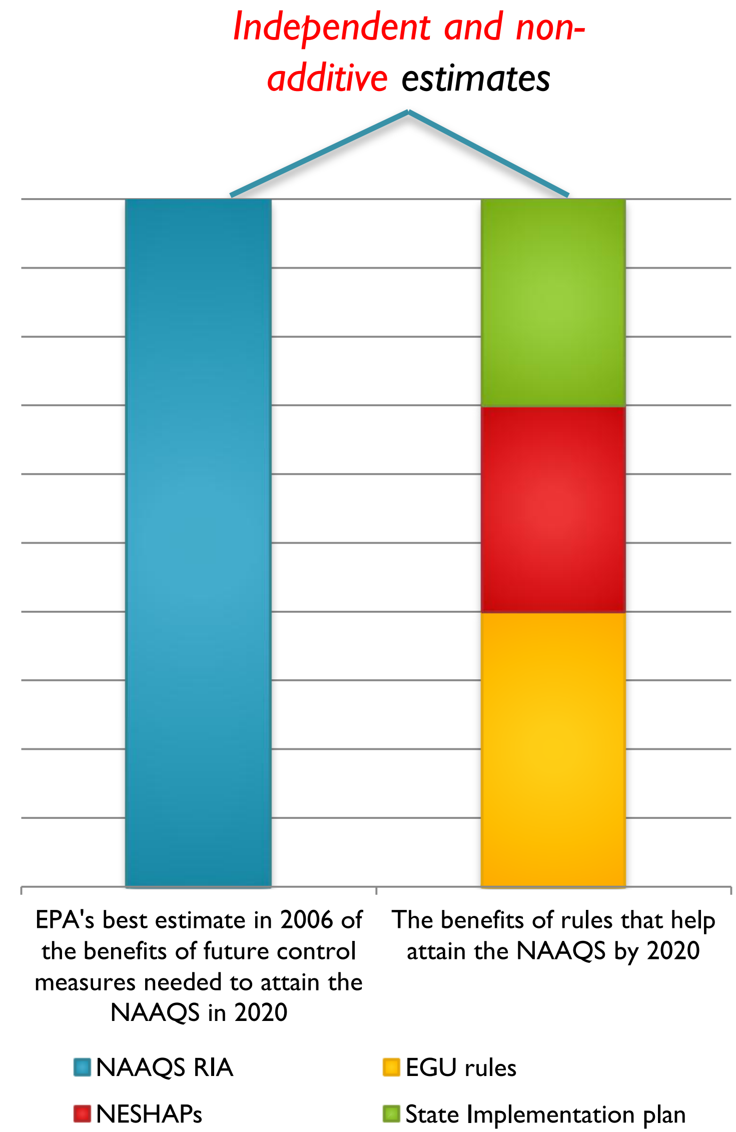
Key attribute	**National Ambient Air Quality Standards**	**Technology Standards (MACT/NSPS)**
Policy goal	Establish criteria pollutant national ambient air quality levels sufficient to protect public health with an adequate margin of safety	Reduce emissions of HAP and criteria pollutants through the installation of pollution control equipment or by meeting performance standards
Implementation approach	States develop implementation plans detailing their approach to achieving the standard	Generally, affected facilities are required to install control equipment or adopt work practices
Time horizon	Generally within 5-10 years of EPA promulgating the standard	Generally within 3 years of EPA promulgating the rule

…that Affect Our Analytical Approach…

Key attribute	National Ambient Air Quality Standards	Technology Standards (MACT/NSPS)
Analytical question	What are the benefits and costs of attaining alternative ambient standards?	What are the benefits and costs of the technology-based standard?
Approach	Analyze **illustrative** attainment scenarios	Analyze **prescriptive** emission control scenarios
Sectors affected	Many	Generally one
Role of cost/benefit analysis	Informs the public and satisfies the requirements of E.O. 12866. Cost estimates cannot be considered when setting standards.	Inform policy options, inform the the public, and satisfy E.O. 12866.

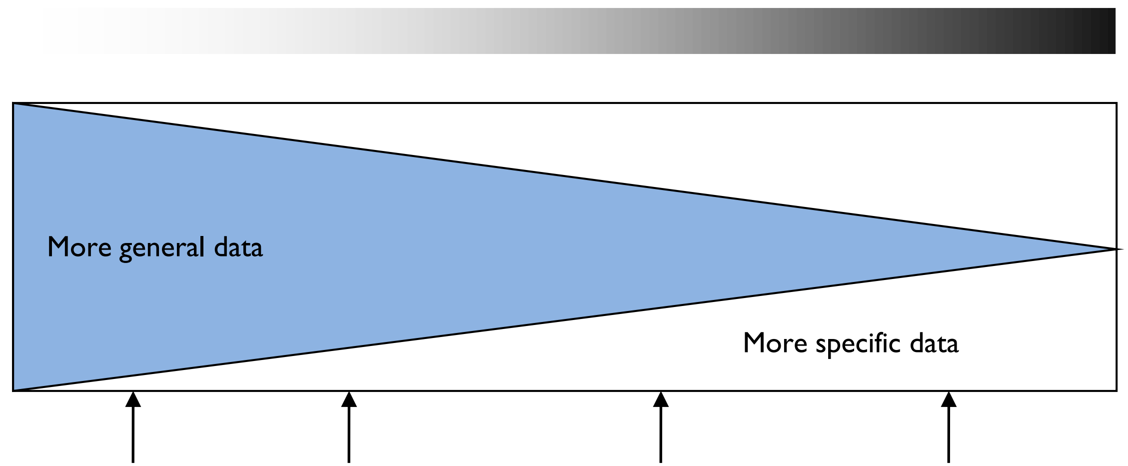
…and the Interpretation of those Results

- Benefits and costs of NAAQS and technology standards are non-additive:
  - NAAQS assess hypothetical attainment many years before standards are implemented
  - Technology-based rules implemented after the NAAQS may help ease attainment



Trade-off Between Data Quality and Ability to Answer Policy Questions

Confidence in/availability of emissions, air quality, health and cost data



Examples of data used:

(A) Emission changes by source type; benefit per ton estimates

(B) Source-level dispersion modeling; national-level health and demographic data

(C) Regional photochemical air quality modeling; county-level health data; benefits uncertainty characterization

(D) Local-scale air quality modeling; ZIP or tract-level health data; city-level effect coefficients; projected incidence rates

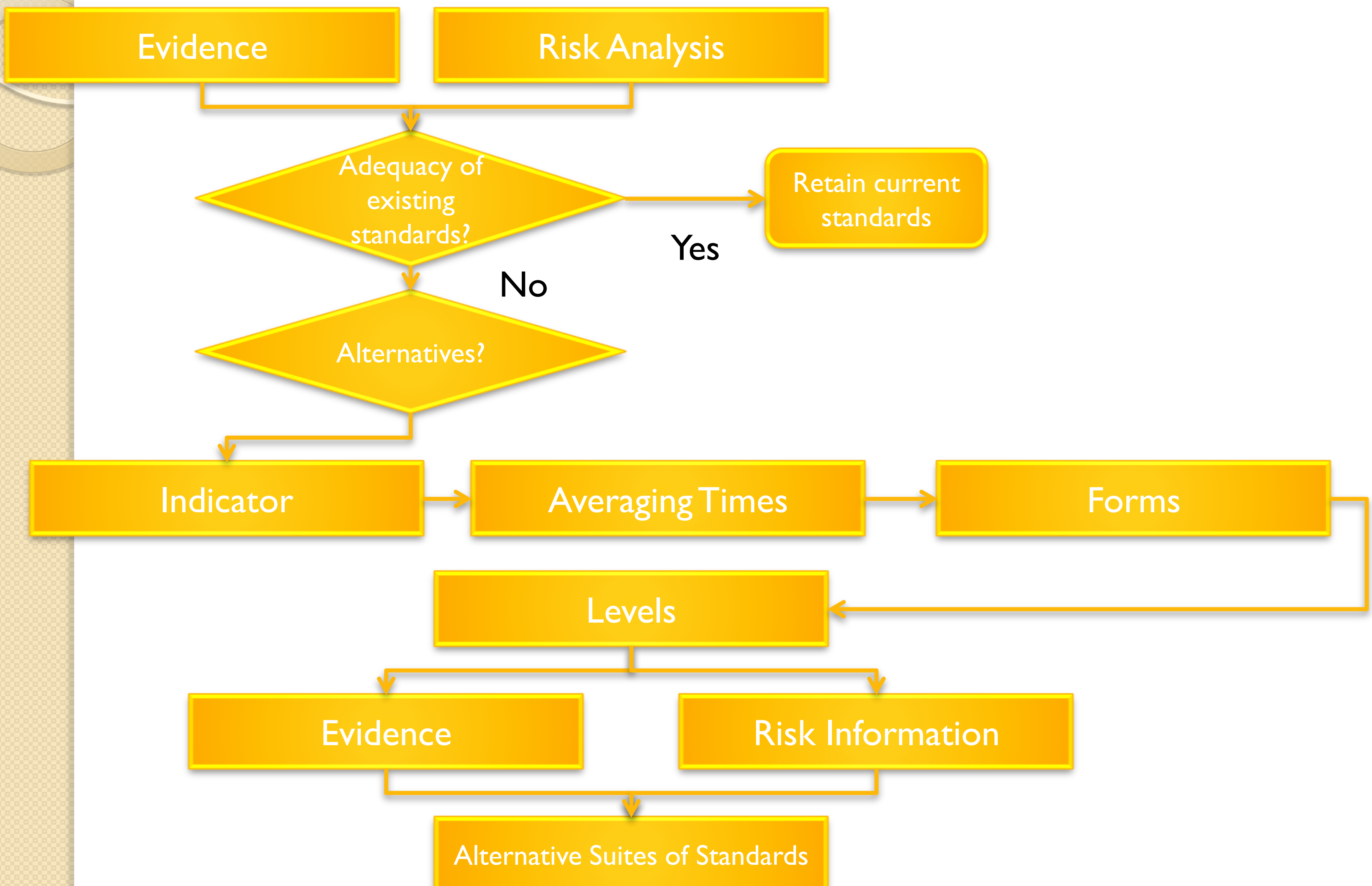
Presentation to the Ozone Transport Commission

CASE STUDY: NATIONAL AMBIENT AIR QUALITY STANDARDS

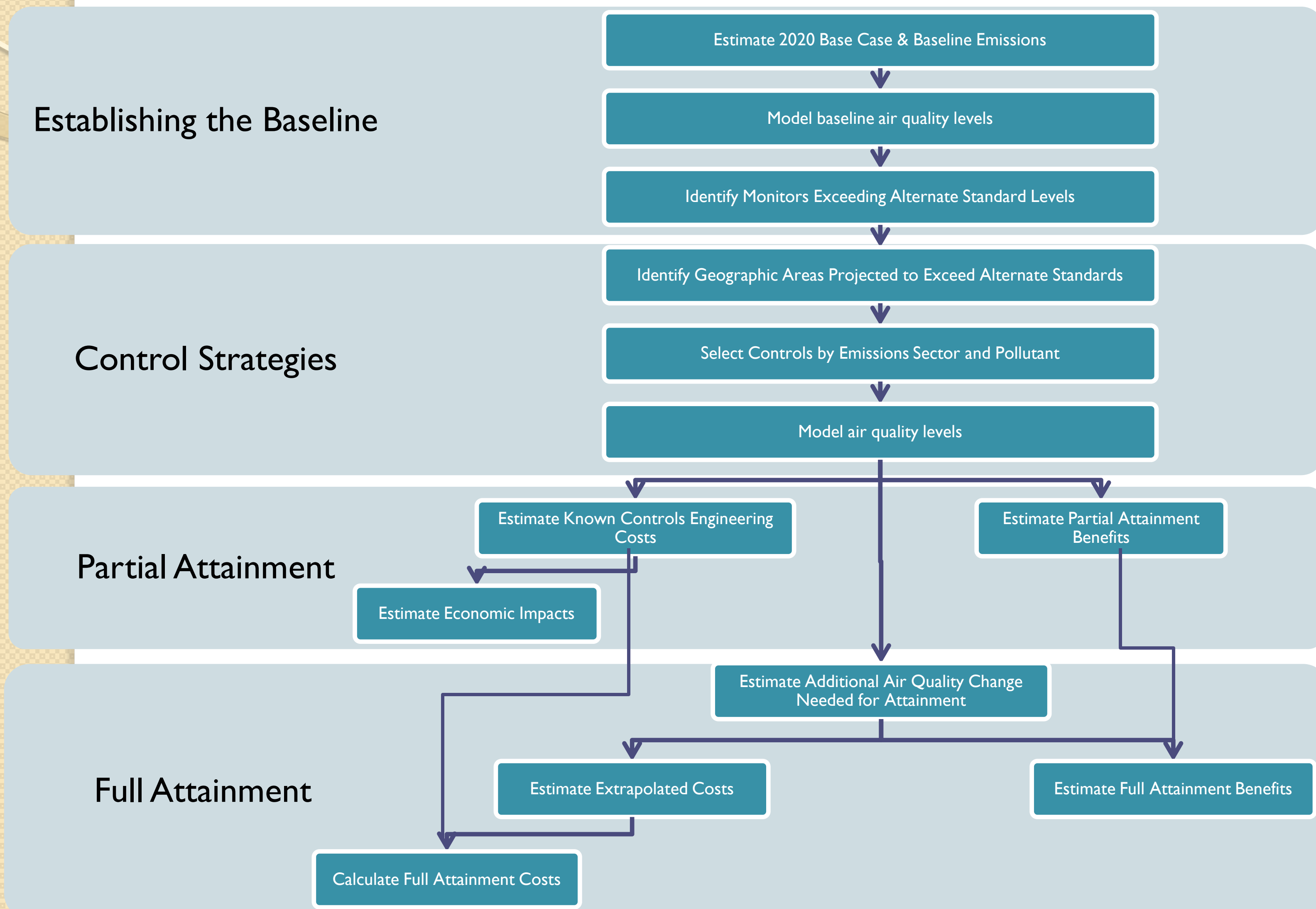
Overview

- Sequence of steps in a NAAQS RIA analysis
- Establishing the baseline
- Developing illustrative emission control strategies
- Estimating engineering costs, extrapolated costs and economic impacts
- Estimating benefits

Identifying Standard Alternatives



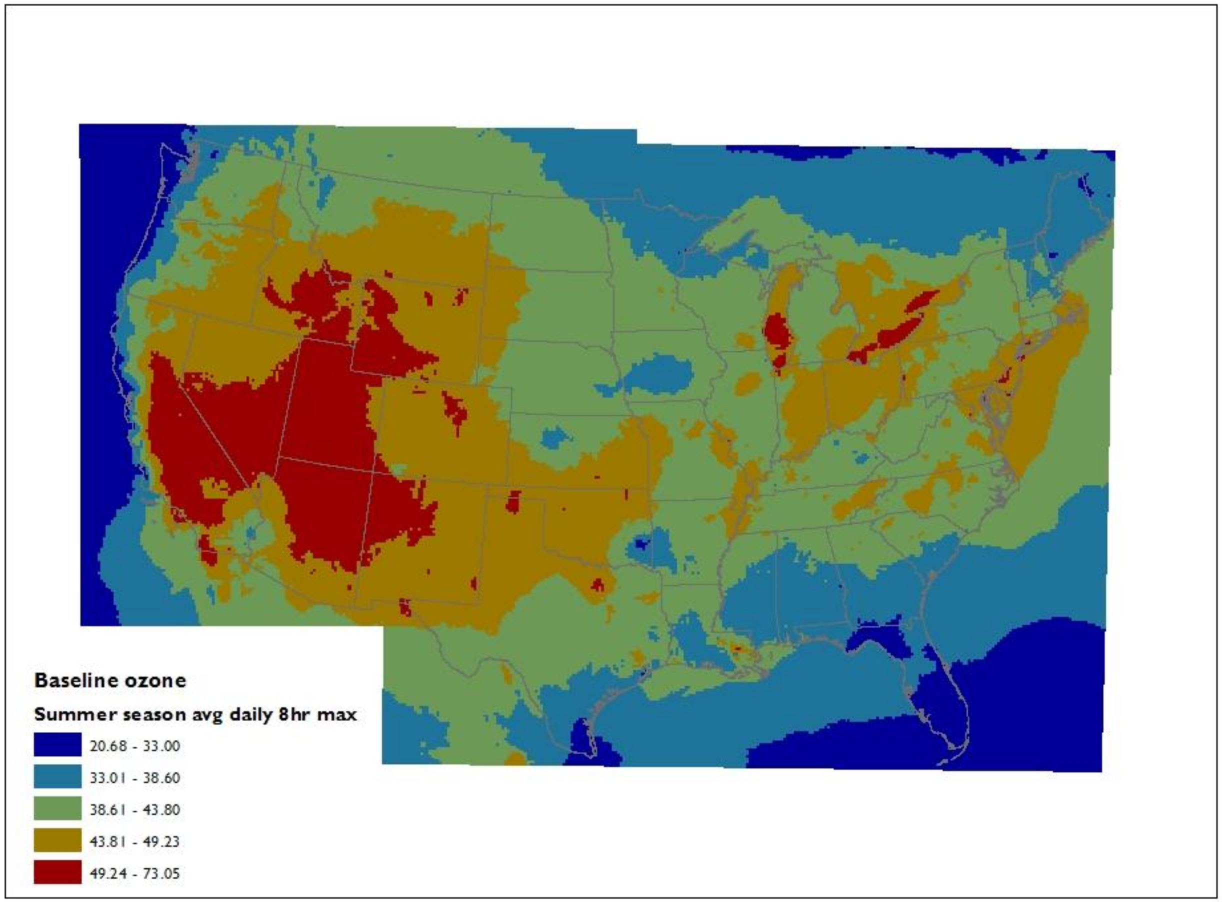
Analytical Flowchart



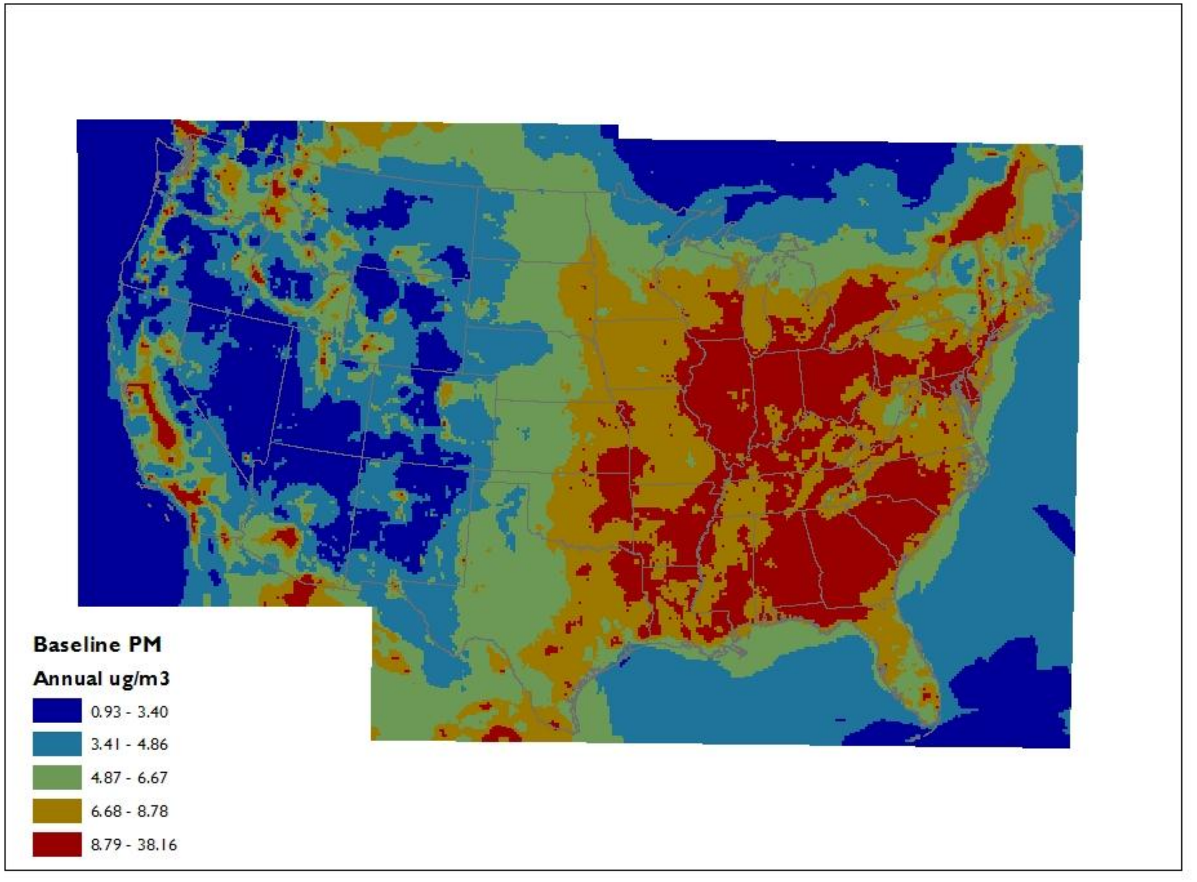
Establishing the Baseline

- **Goal: Ensure that we account for emission reductions from rules with future implementation dates**
- *Base year* emissions projected to future attainment year
  - Emissions platform and modeling based upon NEI emissions estimates
- *Base case* future year controls/projections could include:
  - EGUs
    - Projections of EGU emissions using the Integrated Planning Model
    - On the books EGU rules
  - Stationary & Area Sources
    - Emissions growth for sectors including residential wood combustion, livestock emissions and portable fuel containers
    - Consent decrees, plant closures, DOJ Settlements
    - National and facility-level NESHAP Rules, RTRs, etc
  - Mobile Sources
    - Projections using MOVES model and NONROAD model
    - On the books mobile rules
- *Regulatory Baseline* includes base case and:
  - Illustrative control strategy to attain the current standard

Illustrative Future Base Case: Projected Baseline Ozone Levels

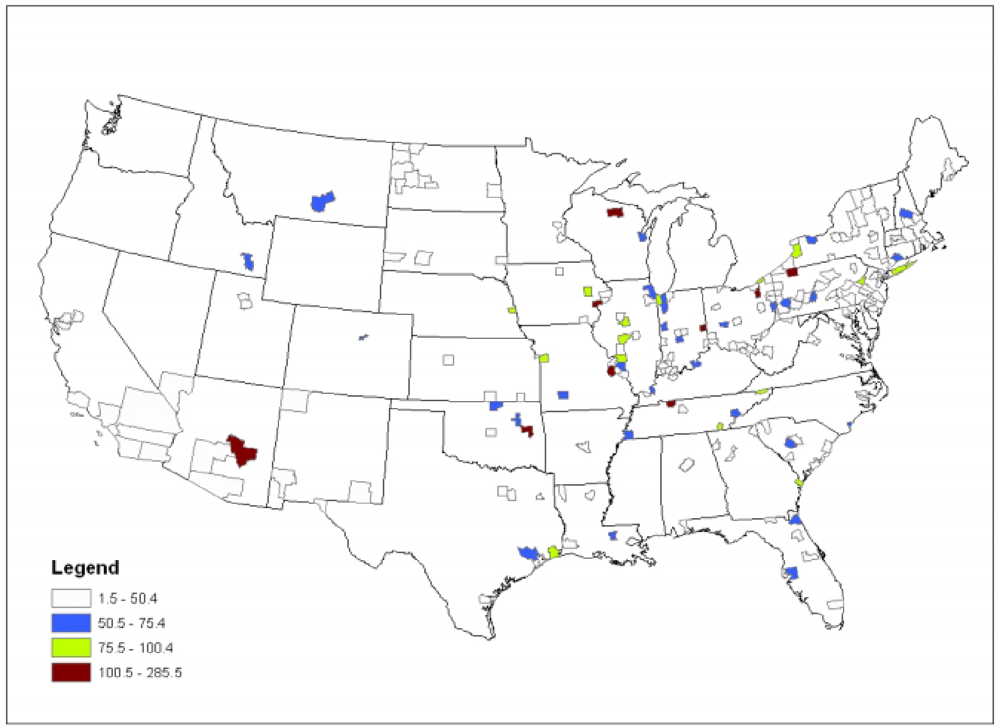


Illustrative Future Base Case: Projected Baseline $PM_{2.5}$ Levels



Illustrative Future Base Case: Projected SO_2 Design Values

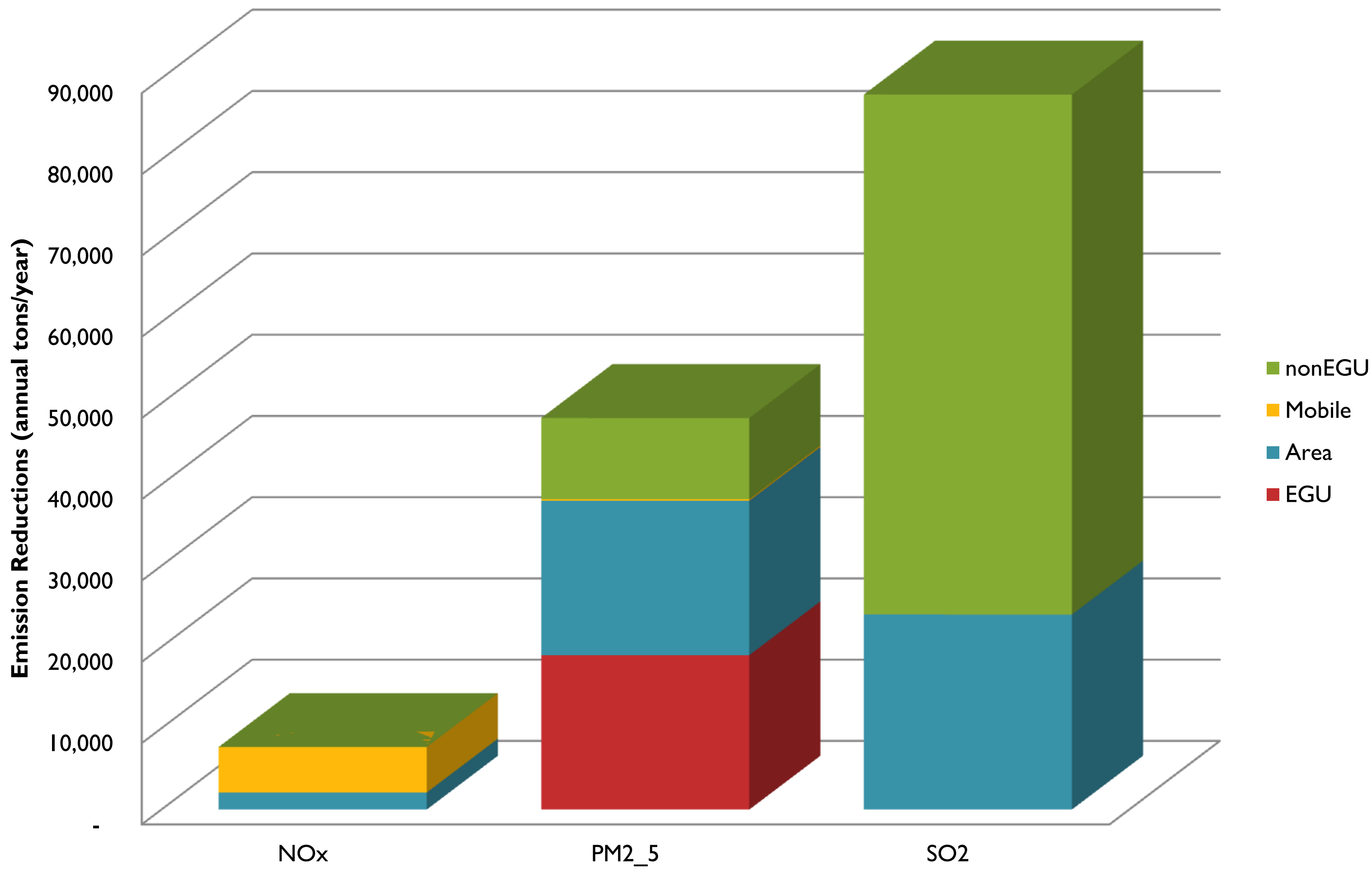
Figure 3.7. 2020 design values (ppb) for 99th percentile daily 1-hour maximum SO_2 concentrations. Values shown are county maxima.



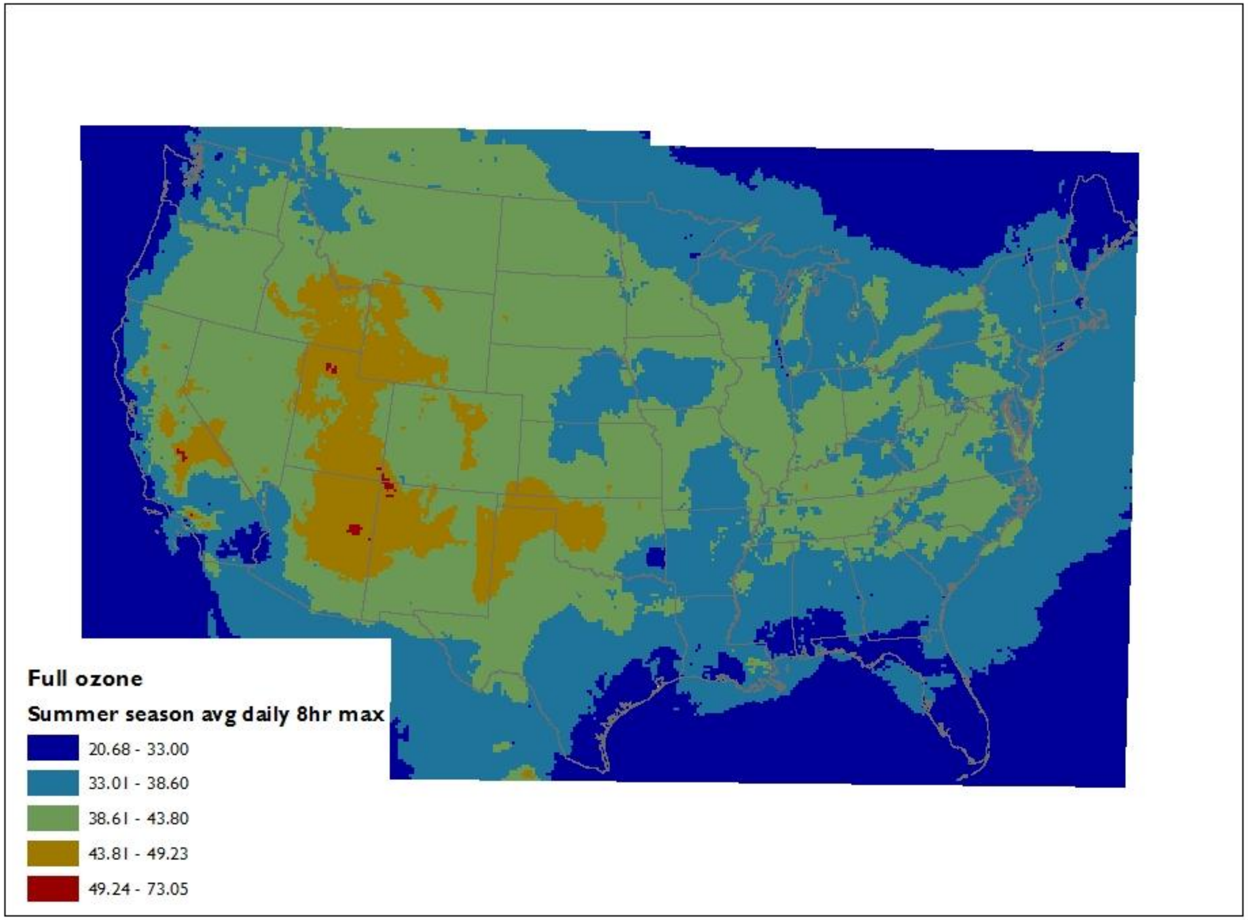
Example Approach for Constructing Control Scenarios

- Identify counties exceeding standard alternative
- Examine monitoring data to establish which components of pollutant being analyzed would be most effective to control
- Apply control measures (examples of control measures listed below)
  - Stationary Source
    - ESP upgrades for EGUs
    - Fabric Filters, Dry ESPs and Wet ESPs applied to: Iron & Steel production, Mineral Products, Industrial Boilers, Cement, Chemical Manufacturing
    - Wet FGDs and SDA applied to: Industrial Boilers, Coke Manufacturing, Cement, Petroleum Refining
    - SCR, NSCR applied to: Cement, IC Engines, ICI Boilers, Glass Manufacturing, Process heaters
  - Area Source
    - Commercial cooking controls – ESPs and catalytic oxidizers
    - Fireplace inserts and woodstove controls
    - Low-sulfur home heating oil
    - Substitute chipping for burning
  - Mobile Source Control Measures
    - Local Measures (applied to metropolitan areas exceeding 12/35 but not included in 14/35 run)
    - Onroad: Elimination of Long Duration Idling
    - Onroad: Continuous Inspection & Maintenance
    - Onroad: Diesel Retrofits
    - Nonroad: Diesel Retrofits & Engine Rebuilds

Example Emission Reductions Needed for Illustrative Scenario



Illustrative Future Base Case: Projected Reduction in Summer Season O_3

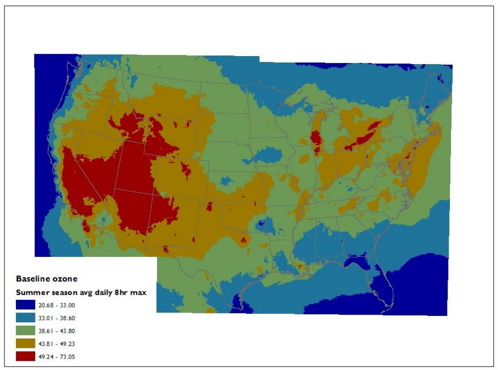


Extrapolated Cost Methodologies

- Used to estimate cost of emissions reductions needed to attain the alternative standard when uncertainties about availability and/or application of control measures are particularly significant.
  - Emission reductions needed beyond those achieved by readily identifiable controls must be calculated and costed.
  - These reductions are not tied to any specific technologies.
- Different methodologies have been used in previous NAAQS RIAs to estimate the costs of these additional emission reductions
  - Fixed cost methods
    - Uses one cost/ton for every ton of emissions needed to be reduced
  - Hybrid cost methods
    - Includes increasing incremental costs and degree of difficulty for a geographic area to attain.

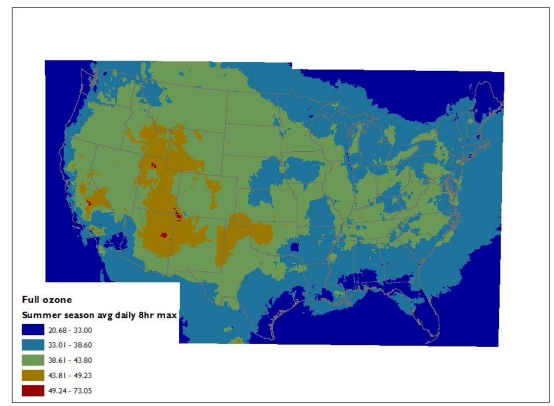
Simulating Full Attainment Air Quality Changes

Emission control scenario partially attains standard



"Roll back" air quality monitors to simulate full attainment

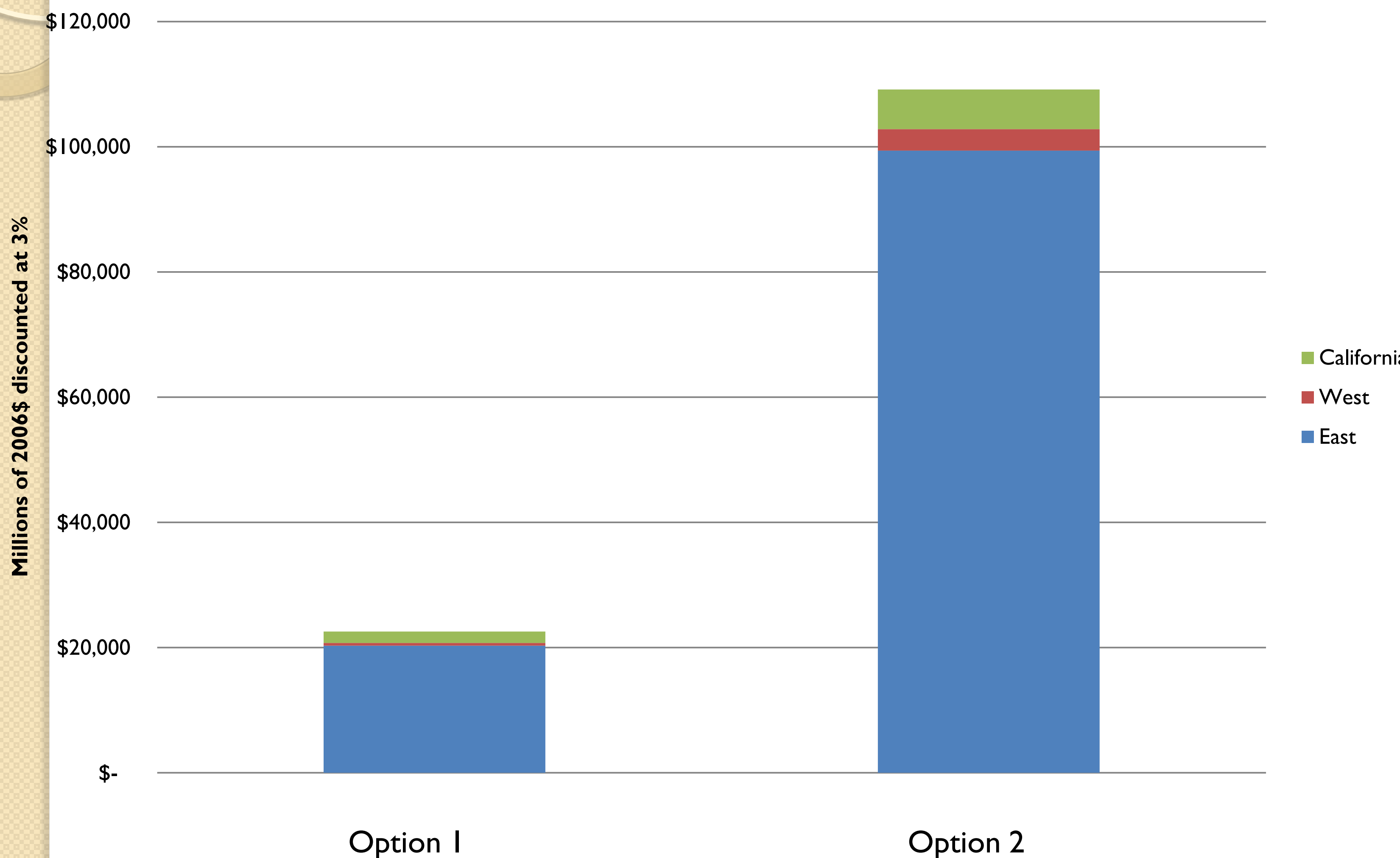
Adjust the air quality surface to simulate full attainment



Illustrative Health Benefits

Health Endpoint	**Alternative 1**	**Alternative 2**	**Alternative 3**
Premature deaths avoided	66 to 170	320 to 810	3,900 to 10,000
Other health effects avoided			
Non-fatal heart attacks	9 to 79	40 to 350	520 to 4,400
Respiratory and cardiovascular hospital admissions	51	230	3,100
Emergency room visits	36	220	2,800
Acute bronchitis	100	580	6,500
Lower and upper respiratory symptoms	2,300	13,000	150,000
Minor restricted activity days	18,000	310,000	3,400,000
Work loss days	8,600	52,000	580,000
Asthma exacerbation	1,900	11,000	290,000
Total Monetized Health Benefits (3% discount rate)	**$540 to $1,400 million**	**$2.6 to $6.6 billion**	**$32 to $82 billion**
Total Monetized Health Benefits (7% discount rate)	**$490 to $1,300 million**	**$2.3 to $6 billion**	**$29 to $74 billion**

The Geographic Distribution of Illustrative Health Benefits



Visibility Benefits

- Visibility benefits quantified for studied areas
  - Recreational – 86 Class I areas in SW, SE, and CA only
  - Residential – 8 cities only

- Sensitivity analysis – Geographic extrapolation
  - Recreational – extrapolated to 70 additional Class I areas
  - Residential – extrapolated to 351 additional cities

- Qualitative analysis for materials damage and ecosystem effects

Example Monetized Visibility Benefits By Alternate Standard

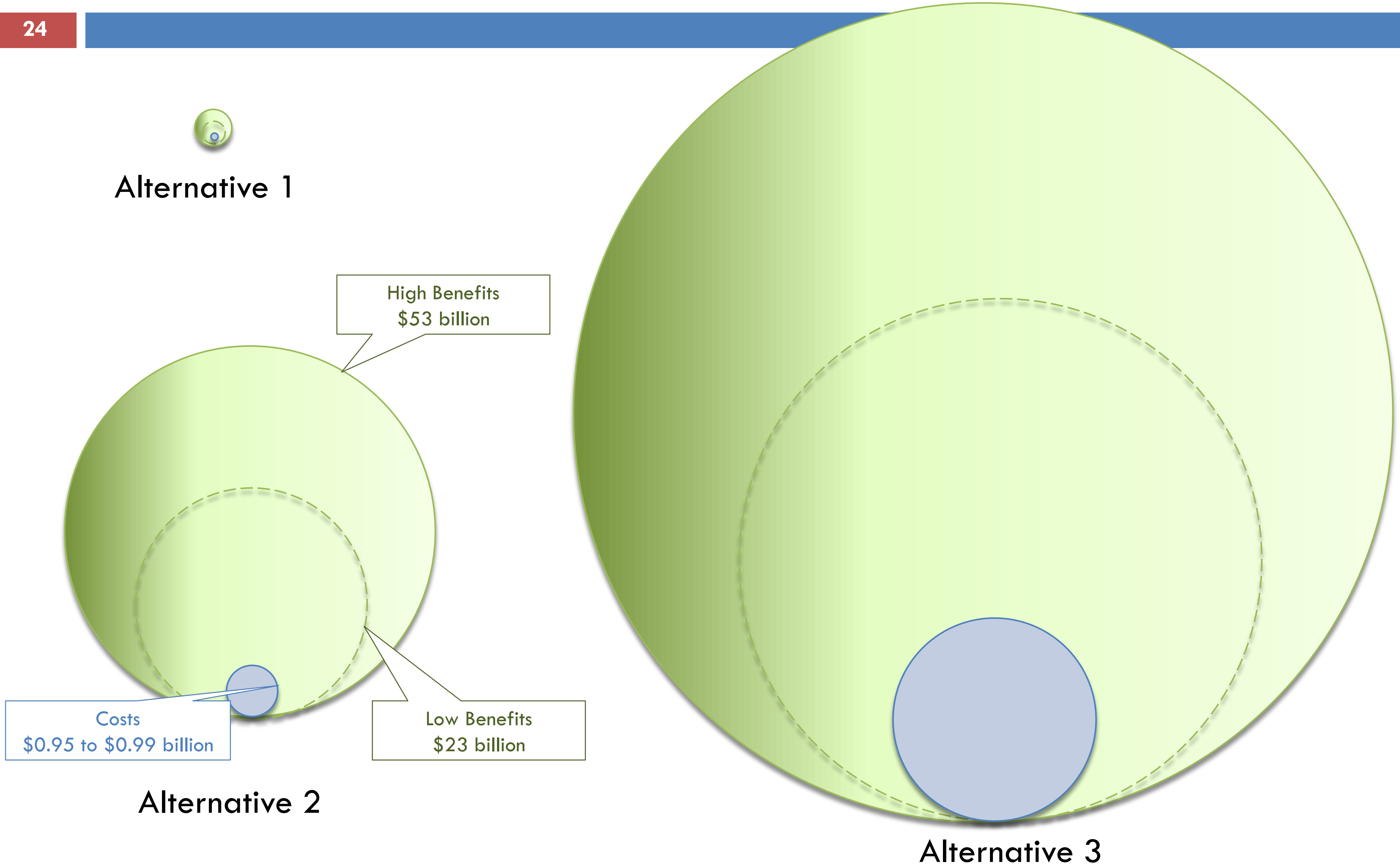
Visibility Benefits by Region in 2020 (millions of 2006$)								
	Option 1		**Option 2**			**Option 3**		
	East	**West**	**East**	**West**	**CA**	**East**	**West**	**CA**
Recreational Visibility	-	-	$110	$13	$14	$1,800	$230	$250
Residential Visibility	-	-	$170	$0.1	$9	$1,200	$98	$13
Total Monetized Visibility Benefits	**-**			**$310**			**$3,600**	

Sensitivity Analysis - Extrapolated Visibility Benefits by Region in 2020 (millions of 2006$)								
	Option 1		**Option 2**			**Option 3**		
	East	**West**	**East**	**West**	**CA**	**East**	**West**	**CA**
Extrapolated Recreational Visibility	-	-	$87	$13	$14	$540	$76	$81
Extrapolated Residential Visibility	$12	-	$1,100	$15	$0.8	$7,800	$420	$120

Sensitivity Analysis indicates that we are potentially missing a lot of residential visibility benefits due to our lack of confidence in geographic extrapolation to areas that haven't been studied

Example NAAQS Benefit-Cost Comparison

(Full attainment, 7% Discount Rate)



Presentation to the Ozone Transport Commission

CASE STUDY: PETROLEUM REFINERIES NSPS (SUBPART JA)

Overview

- Background
- Industry Profile
- Regulatory options
  - Engineering costs
  - Emissions reductions
- Economic impacts
  - Markets
  - Small Entities
- Benefits
  - Health
  - Environmental
  - Climate
- Net benefits
- Employment analysis
- Executive orders

Background

- New Source Performance Standards (NSPS) are technology-based standards that apply to new, modified and reconstructed affected facilities in *specific* source categories, e.g., petroleum refining
- NSPS primarily focus on criteria pollutant emissions
  - Some NSPS also target non-criteria pollutants, such as sulfuric acid mist, landfill gas, and fluorides
- NSPS establish the minimum control requirements, known as "best demonstrated technology" for all facilities within a specified category
- The NSPS focused on in this case study is the final rule on revisions to petroleum refineries subpart Ja signed in May 2012.

Industry Profile

- RIAs typically contain an Industry Profile
- Profile typically seek to provide a brief introduction to the industry being examined to provide context for economic analyses
- Often survey:
  - Products of industry
  - Processes
  - Markets
  - Costs
  - Firm characteristics

Engineering Costs, Emissions Reductions & Regulatory Options

- For an NSPS amendment, the *baseline* is the existing regulatory requirement
- Costs are calculated as incremental differences between the *baseline* and the impacts of the regulatory amendments
- To calculate costs, estimate number of potential new, modified, or reconstructed sources
  - For NSPS Ja, estimated 400 affected flares over the next 5 years and most of the flares would become affected due to modification provisions
- Also, estimate costs of and emissions reductions from technology changes or work practice standards for new, modified, or reconstructed sources
  - For NSPS Ja, estimated costs and emissions reductions for
    - 400 flares to comply with the flare management plan and root cause and corrective action analyses requirements, and
    - 280 flares to comply with the sulfur and flow monitoring requirements (120 flares are considered emergency flares and would not have to meet these requirements)

Economic Impacts (Markets)

- An economic welfare analysis
  - estimates social costs and consumer and producer surplus changes
  - identifies how the regulatory costs are distributed across two broad classes of stakeholders -- consumers and producers
- Depending on the magnitude of costs and/or benefits, as well as length of time for rule implementation, to complete welfare analysis we select appropriate model
  - Models include single-sector approaches (e.g. , partial equilibrium and linear programming models) and multi-sector approaches (e.g. , computable general equilibrium, models)
  - For NSPS Ja, estimated annual savings from natural gas purchases and product recovery credits offset estimated engineering compliance costs, so no welfare analysis was conducted

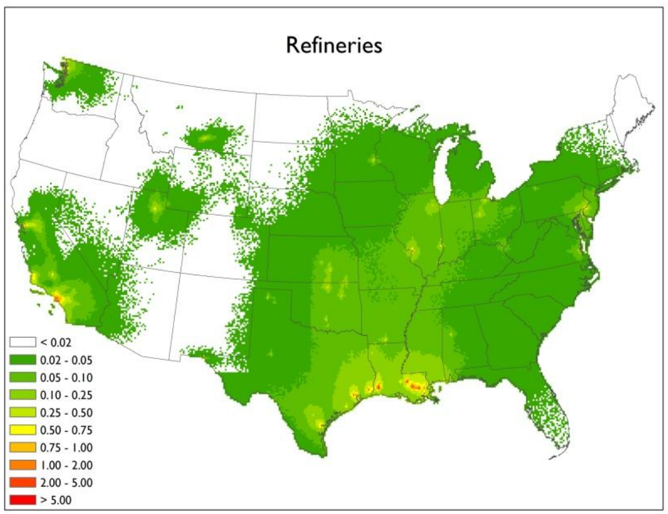
Economic Impacts (Small Entities)

- Regulatory Flexibility Act* generally requires agency to prepare a regulatory flexibility analysis, unless the agency certifies that the rule will not have a *significant economic impact on a substantial number of small entities* (SISNOSE)
- To determine whether a regulatory flexibility analysis is needed, EPA typically performs a screening analysis for impacts on all affected small entities
  - Screening analysis frequently performed by comparing compliance costs to revenues at parent company level
  - For NSPS Ja, we compared compliance costs to revenues for ALL refineries, assuming no firms adopted cost-saving technology option (a maximum cost scenario)
  - Screening analysis indicated no SISNOSE for any size firm; no regulatory flexibility analysis needed

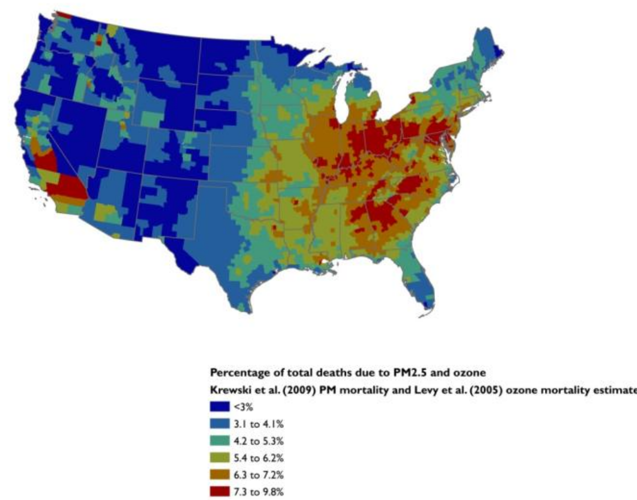
As amended by the Small Business Regulatory Enforcement Fairness Act.

Estimating and Applying Benefit per Ton Estimates

(1) Model source contribution



(2) Estimate health benefits



(3) Calculate benefit/ton

$$\frac{Human\ health\ benefits}{Sector\ emissions} = {}^{Benefit}/_{1\ ton}$$

Calculating Total Benefits

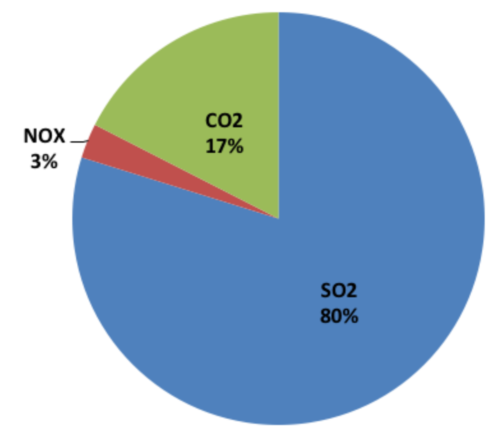
$PM_{2.5}$-related benefits

	Pollutant	Emissions Reductions (tons)	Benefit per ton (Pope, 3%)	Benefit per ton (Laden, 3%)	Benefit per ton (Pope, 7%)	Benefit per ton (Laden, 7%)	Total Monetized Benefits (millions of 2006$ at 3%)	Total Monetized Benefits (millions of 2006$ at 7%)
Small Flares	**$PM_{2.5}$ Precursors**							
	SO_2	2,600	$65,000	$160,000	$58,000	$140,000	$170 to $410	$150 to $370
	NO_X	50	$6,400	$16,000	$5,700	$14,000	$.32 to $.79	$.29 to $.71
						Total	**$170 to $410**	**$150 to $370**
Large Flares	**$PM_{2.5}$ Precursors**							
	SO_2	660	$65,000	$160,000	$58,000	$140,000	$43 to $100	$38 to $94
	NO_X	1,100	$6,400	$16,000	$5,700	$14,000	$6.80 to $17.00	$6.10 to $15.00
						Total	**$49 to $120**	**$44 to $110**
All Flares	**$PM_{2.5}$ Precursors**							
	SO_2	3,200	$65,000	$160,000	$58,000	$140,000	$210 to $510	$190 to $460
	NO_X	1,100	$6,400	$16,000	$5,700	$14,000	$7.1 to $18.0	$6.4 to $16
						Total	**$220 to $530**	**$190 to $480**

CO_2-related benefits

Discount Rate and Statistic	Monetized Climate Benefits with flare gas recovery (millions of 2006$)	Monetized Climate Benefits without flare gas recovery (millions of 2006$)
Tonnes of CO_2	1,900,000	110,000
5% (Average)	$11	$0.6
3% (Average)	$46	$2.6
2.5% (Average)	$73	$4.2
3% (95^{th} percentile)	$140	$8.1

Distribution of benefits by pollutant



Calculating Net Benefits

	3% Discount Rate			7% Discount Rate		
Total Monetized Benefits[2]	\$260	to	\$580	\$240	to	\$520
Total Compliance Costs[3]		-\$79			-\$79	
Net Benefits	\$340	to	\$660	\$320	to	\$600
Non-monetized Benefits	Health effects from ozone, SO_2, NO_2 exposure Health effects from $PM_{2.5}$ exposure from VOCs Ecosystem effects Visibility impairment					

Employment Impacts Analysis

- A standalone employment impacts analysis is typically not included in a standard cost-benefit analysis
  - However, employment-related issues are of high concern in the current economic climate of sustained high unemployment
  - In response to Executive Order 13563, depending on the regulation, the industry, and the available information we sometimes include either a qualitative or quantitative discussion of employment impacts of a regulatory action
    - E.O. 13563 states, "Our regulatory system must protect public health, welfare, safety, and our <u>environment</u> while promoting economic growth, innovation, competitiveness, and <u>job creation</u>" (emphasis added)
    - For NSPS Ja, estimated net annual savings from offsetting natural gas purchases and product recovery credits – no employment analysis conducted

Other Executive Orders

- Other Executive Orders that may require economics input include:
  - Unfunded Mandates Reform Act of 1995
  - Executive Order 12898 on Environmental Justice
  - Executive Order 13211 on Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use