# Regulatory Impact Analyses: A State Perspective

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# TCEQ's Toxicology Division

- 15 toxicologists (not economists)
  - Specialties in toxicology, chemical risk assessment, public health, epidemiology
- Derive risk-based toxicity factors for
  - Remediation
  - Air quality assessments (air toxics)
  - Water quality assessments
  - Air permit applications
- Conduct, coordinate, and publish human health risk assessments
- Comment and testify on federal initiatives related to chemical risk assessment and public health

# RIAs: What They Are

- Very important
- Required by Executive Order for all major proposed regulations
- Directed toward decision makers
- Used to help determine if the benefits of an action justify the costs (non-NAAQS rules)
  - Compares three regulatory options, including the proposed rule, to allow decision makers to determine the most cost-effective alternative (non-NAAQS rules)

# RIAs: What They Are Not

- Cookie cutter
- Typically inclusive of macroeconomic or quantitative uncertainty analyses
- Anything more than informational for NAAQS rules
- Subject to peer or public comment

# RIA Sections of Particular Note

- Executive Summary
- Baseline Analysis
- Control Strategies
- Costs
- Benefits
  - Quantitative and qualitative
  - Health and welfare

# Costs

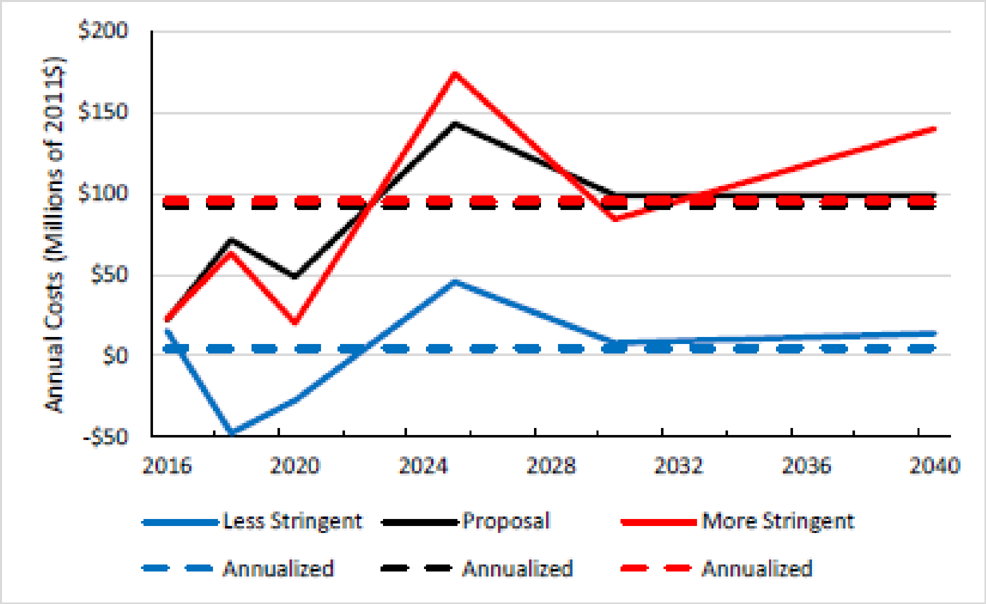
- Typically only based on technological costs to industry, though costs to society (“social costs”) are sometimes included

| Policy | Cost Basis* | Annualized Cost* |
|---|---|---|
| Cross-State Air Pollution Rule Update | Uniform NOx costs of $1300 per ton based on existing technology | $93 M (2011$) 2016-2040 |
| Brick and Structural Clay Product NESHAP | Cost to install/retrofit control devices | $28 M (2011$) |
| Emission Standards for Oil and Natural Gas Sector | Engineering costs minus product recovery sales | $320-420 M (2012$) 2016-2025 |

*Costs provided are for the proposed rule, not the other two options provided in the RIA

# Costs

- Typically use annualized costs with a 7% discount rate, which can be different than annual costs




RIA for the Proposed CSAPR Update for the 2008 Ozone NAAQS (2015)

**Figure 5-2. Time Series of Annual Costs and Annualized Costs for the Proposal and More and Less Stringent Alternatives**

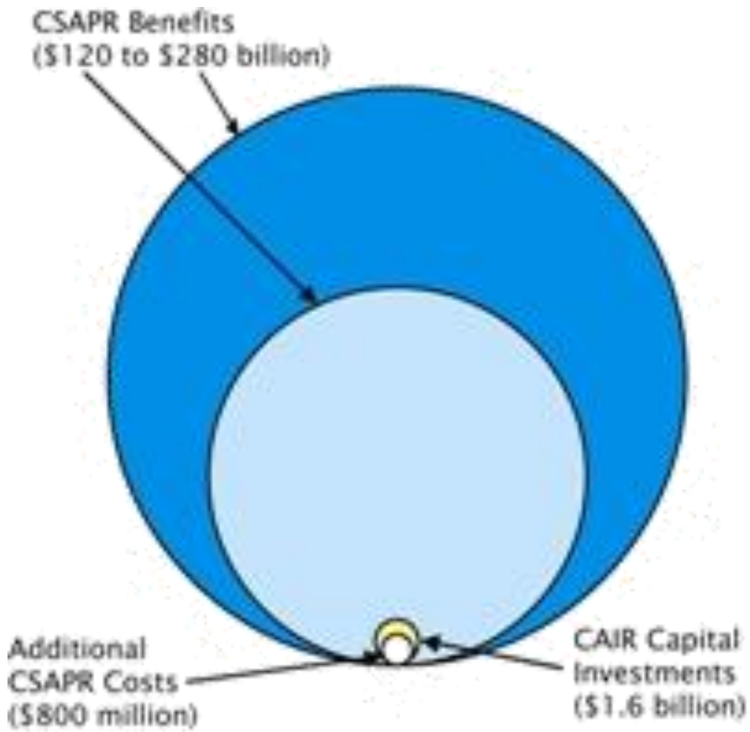
# State Perspective on Costs

- Can sometimes include estimates of technology that does not yet exist ("unidentified" or "unknown" controls)
- Does not include costs to other organizations
  - A moderate ozone nonattainment area in Central Texas is estimated to cost
    - State - $1 M for modeling, emission reduction projects, numerous staff hours for SIP revision development and public meetings
    - Local area - $22.3 – 41.6 B in loss of manufacturing, delayed infrastructure improvements, and federal funding for construction projects

CAPCOG. 2015. The potential costs of an ozone nonattainment designation to Central Texas. Available at: <http://www.capcog.org/documents/airquality/reports/2015/Potential_Costs_of_a_Nonattainment_Designation_09-17-15.pdf>

# State Perspective on Costs

- Costs do not directly compare to benefits
  - Capital investment in NOx control device - $1300/ton
    - Cost to purchase, install, and operate control technology, changes in fuel costs, changes in generation mix
  - Cost of a premature death - $9.9 million (2011$)
    - Value of a statistical life (VSL) (marginal reductions in probability across a population)




https://www3.epa.gov/crossstaterule/

# Benefits: What Pollutant?

- Both quantitative and qualitative benefits
  - When possible, monetized based on willingness to pay or accept, value of a statistical life (VSL), or cost of a health endpoint (e.g., hospital admission)
- Benefits are not restricted to the pollutant being regulated in the rule (co-pollutants can be considered)
- Co-pollutants were raised in the MATS litigation, though the Supreme Court didn’t rule on it

# Use of $PM_{2.5}$ in RIAs

- EPA uses estimates of benefits from reducing $PM_{2.5}$ in its RIAs for rulemakings under the Clean Air Act
- Trend towards using $PM_{2.5}$ as primary source of benefits in most RIAs since 1997
  - Even when regulation is not intended to protect public health from exposures to ambient $PM_{2.5}$
  - This is called "co-benefits" because a $PM_{2.5}$ reduction is expected from efforts to reduce other air pollutants

**Table 2. Summary of Degree of Reliance on $PM_{2.5}$-Related Co-Benefits in RIAs Since 1997 for Major Non-$PM_{2.5}$ Rulemakings under the CAA**
(RIAs with no quantified benefits at all are not in this table. Where ranges of benefit and/or cost estimates are provided, percentages are based on upper bound of both the benefits and cost estimates. Estimates using the 7% discount rates are used in all cases.)

| Year | RIAs for Rules NOT Based on Legal Authority to Regulate Ambient $PM_{2.5}$ | $PM_{2.5}$ Co-Benefits Are >50% of Total | $PM_{2.5}$ Co-Benefits Are Only Benefits Quantified |
|---|---|---|---|
| 1997 | Ozone NAAQS (.12 1hr=>.08 8hr) | × | |
| 1997 | Pulp&Paper NESHAP | | |
| 1998 | NOx SIP Call & Section 126 Petitions | | |
| 1999 | Regional Haze Rule | × | |
| 1999 | Final Section 126 Petition Rule | × | |
| 2004 | Stationary Reciprocating Internal Combustion Engine | × | |
| 2004 | Industrial Boilers & Process Heaters NESHAP | × | × |
| 2005 | Clean Air Mercury Rule | × | |
| 2005 | Clean Air Visibility Rule/BART Guidelines | × | |
| 2006 | Stationary Compression Ignition Internal Combustion | | |
| 2007 | Control of HAP from mobile sources | × | × |
| 2008 | Ozone NAAQS (.08 8hr =>.075 8hr) | × | |
| 2008 | Lead (Pb) NAAQS | × | |
| 2009 | New Marine Compress'n-Ign Engines >30 L per | × | |
| 2010 | Reciprocating Internal Combustion Engines NESHAP | × | × |
| 2010 | EPA/NHTSA Joint Light-Duty GHG & CAFES | | |
| 2010 | SO2 NAAQS (1-hr, 75 ppb) | × | > 99.9% |
| 2010 | Existing Stationary Compression Ignition Engines | × | × |
| 2011 | Industrial, Comm, and Institutional Boilers NESHAP | × | × |
| 2011 | Indus'l, Comm'l, and Institutional Boilers & Process | × | × |
| 2011 | Comm'l & Indus'l Solid Waste Incin. Units NSPS & | × | × |
| 2011 | Control of GHG from Medium & Heavy-Duty | | |
| 2011 | Ozone Reconsideration NAAQS | × | |
| 2011 | Utility Boiler MACT NESHAP (Final Rule's RIA) | × | ≥ 99% |
| 2011 | Mercury Cell Chlor Alkali Plant Mercury Emissions | × | |
| 2011 | Sewage Sludge Incineration Units NSPS & Emission | × | × |
| 2011 | Ferroalloys Production NESHAP Amendments | × | × |

**2009 Change in Methodology**

From Smith, 2012 testimony

# $PM_{2.5}$ Benefits

- For the ozone rule, the EPA assumes that when $NO_x$ decreases, so does $PM_{2.5}$ – but only nitrate $PM_{2.5}$ would reliably decrease (that is the kind of PM that $NO_x$ produces)
- But, not all types of $PM_{2.5}$ have equal toxicity – there is little evidence that nitrate $PM_{2.5}$ is very toxic (healthy and asthmatic humans have been exposed to **mg**/$m^3$ with little effect)
- This affects the validity of assuming that decreasing any kind of $PM_{2.5}$ will result in 200-500 fewer deaths

# Mercury & Air Toxics Standard

| Control Technology | Benefits from HAPs (billions) | "Co-Benefits" from non-HAPs (billions of 2007$) |
|---|---|---|
| Mercury | $ 0.004-0.006 | $ 1-2 |
| Acid Gasses | $ 0 | $ 32-87 |
| Non-Hg Metals | $ 0 | $ 1-2 |
| **Total** | **≤$ 0.006** | **$ 33-90** |

- 73% of avoided premature deaths due to $PM_{2.5}$ were achieved below 7.5 µg/$m^3$ (well below the annual NAAQS of 12 µg/$m^3$)
- MATS is estimated to prevent 0.00209 IQ point loss per child (starting immediately)
- Each child will gain 0.0956 school days over their lifetime
- 0.00209 IQ points x 244,468 children = 511 IQ points per year
- Assuming a net monetary loss per decrease in one IQ point of between ~$8,000 and ~$12,000 (in terms of foregone future earnings)
- Benefit = $4.2M to $6.2M

*Table adapted from testimony by Anne E. Smith 2/2010 to Subcommittee on Energy and Power*

# Benefits: Where will the Benefits Occur?

- Benefits can be attributed to the public at any distance from the source of emission reductions
- Benefits can be displayed aggregated across the country or disaggregated

**Disaggregation of IWGs SCC values to U.S. and Non-U.S. (2007$/tonne emitted in 2020)**

| | U.S. SCC | Non-U.S. SCC |
|---|---|---|
| 5% DR | 2 | 10 |
| 3% DR | 7 | 35 |
| 2.5% DR | 11 | 54 |

Source: NERA IAM runs replicating IWG's 2020 SCC values for FUND and PAGE, reporting their regional SCC values. Exclusion of DICE alters resulting avg. global SCC estimates by only ~$1/tonne

# Benefits: When will the Benefits Occur?

- EPA can choose any future scenario they deem appropriate
  - 4 years (Federal Transport Rule)
    - Premature mortality, acute bronchitis, heart attacks, hospitalization for respiratory/cardiovascular disease, lost work days, restricted activity
  - 11 years (MATS)
    - IQ, premature mortality, acute bronchitis, heart attacks, hospitalization for respiratory/cardiovascular disease, lost work days, restricted activity

TCEQ

# An Illustrative Example – Final Ozone RIA

# The Ozone RIA

- In the NAAQS review EPA is not allowed to consider cost; executive orders dictate RIAs be conducted
- However, it is important to understand the basis of the numbers, because they are used by both detractors and supporters

**Table ES-5. Total Annual Costs and Benefits[a,b] for U.S., except California in 2025 (billions of 2011$, 7% Discount Rate)[c]**

| | Revised and Alternative Standard Levels | |
|---|---|---|
| | **70 ppb** | **65 ppb** |
| **Total Costs[d]** | $1.4 | $16 |
| **Total Health Benefits** | $2.9 to $5.9[e, f] | $15 to $30[e, f] |
| **Net Benefits** | **$1.5 to $4.5** | **-$1.0 to $14** |

**Table ES-9. Total Annual Costs and Benefits[a] of the Identified + Unidentified Control Strategies Applied in California, Post-2025 (billions of 2011$, 7% Discount Rate)[b]**

| | Revised and Alternative Standard Levels | |
|---|---|---|
| | **70 ppb** | **65 ppb** |
| **Total Costs[c]** | $0.80 | $1.5 |
| **Total Health Benefits** | $1.2 to $2.1[d] | $2.3 to $4.2[d] |
| **Net Benefits** | **$0.4 to $1.3** | **$0.8 to $2.7** |

Ozone Final RIA, 2015

# Costs in the Ozone RIA

- Illustrative costs
- Industry costs
- Doesn’t include the costs to States
  - ~$1 million for a moderate non-attainment area SIP
  - Texas has spent ~$1.4 billion on the Texas Emissions Reduction Program (TERP) – paid for by Texas drivers
- Does not include the economic impact (e.g. changes in electricity prices)

# Cost Assumptions

- All other rules are in place (CPP, MATS), **including attainment of the 2008 75 ppb ozone NAAQS**
- Costs for unknown/unidentified controls – all controls in the Control Strategy Tool with costs greater than  \$19,000/ton $NO_x$
- All unknown/unidentified controls assumed to cost \$15,000/ton NOx and do not escalate
- Costs calculated incremental to a 2025 baseline for all States except California (2037) – after marginal (2020) and moderate non-attainment deadlines (2023)

# Costs by Region

**Table ES-7. Summary of Total Control Costs (Identified + Unidentified Control Strategies) by Revised and Alternative Standard Levels for 2025 - U.S., except California (billions of 2011$, 7% Discount Rate)[a]**

| Revised and Alternative Standards Levels | Geographic Area | Total Control Costs (Identified and Unidentified) |
|---|---|---|
| **70 ppb** | East | 1.4 |
| | West | <0.05 |
| | **Total** | **$1.4** |
| **65 ppb** | East | 15 |
| | West | <0.75 |
| | **Total** | **$16** |

[a] All values are rounded to two significant figures. Costs are annualized at a 7 percent discount rate to the extent possible. Costs associated with unidentified controls are based on an average cost-per-ton methodology (see Chapter 4, Section 4.3 for more discussion on the average-cost methodology).

# Regions for Presentation of Costs

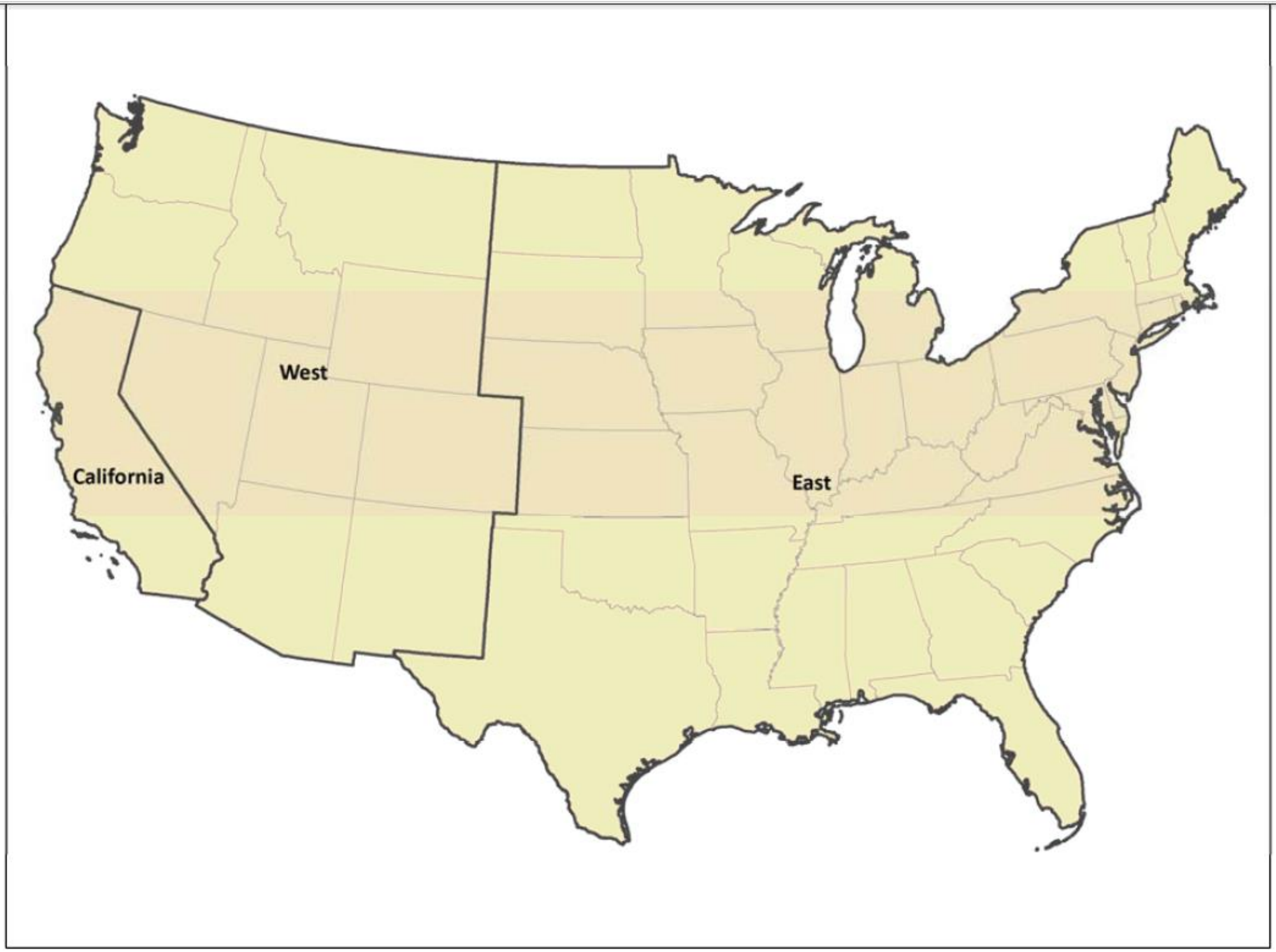



**Figure 4-3. Regions Used to Present Emissions Reductions and Cost Results**

# Costs: What to Look For

- What assumptions go into the costs?
  - All other rules are in place, previous standard was met
  - Year of attainment, year of capital spending
- How does the EPA monetize the unknown/unidentified costs?
  - Are they assumed to increase with increasing pollutant abatement, or not?
- Do the costs include those to the state and to the taxpayer?
- What regions are being combined to generate cost estimates?

# Benefits in the Ozone RIA

- Based on epidemiology studies
  - Administrator expressed less confidence in these studies in the final rule because of significant uncertainties
  - In the RIA, there is 100% confidence in the causal association between ozone and the health endpoints (several are only likely-causal in the ISA)
  - Assumes benefits to zero concentrations (well-below the health-protective standard level)
  - The National Academy of Sciences in 2002[1] identified concerns about uncertainty in the health benefits, including benefits being reported as absolute numbers of avoided deaths or adverse health outcomes

# Benefits

- Most of the *monetary benefits* are from a reduction in mortality – essentially because of the VSL calculation ($10M per statistical life)
- Most *number of people* affected by the morbidity endpoints
- Morbidity and mortality are based on a few key studies
  - Mortality: Smith et al. 2009 & Zanobetti & Schwartz 2008
  - Asthma attacks in children: Mortimer et al. 2002 & Schildcrout et al. 2006

# Mortality and Morbidity Estimates

**Table 6-20. Estimated Number of Avoided Ozone-Related Health Impacts for the Revised and Alternative Standard Levels (Incremental to the Baseline) for the 2025 Scenario (nationwide benefits of attaining the standards in the U.S. except California)** [a, b]

| Health Effectb | | Revised and Alterative Standard Levels (95th percentile confidence intervals) 70 ppb | 65 ppb |
|---|---|---|---|
| **Avoided Short-Term Mortality** | | | |
| multi-city studies | Smith et al. (2009) (all ages) | 96 (47 to 140) | 490 (240 to 740) |
| | Zanobetti and Schwartz (2008) (all ages) | 160 (86 to 240) | 820 (440 to 1,200) |
| **Avoided Long-term Respiratory Mortality** | | | |
| multi-city study | Jerrett et al. (2009) (30-99yrs) copollutants model ($PM_{2.5}$) | 340 (110 to 560) | 1,700 (580 to 2,800) |
| **Avoided Morbidity** | | | |
| | Hospital admissions - respiratory (age 65+)[d] | 180 (-42 to 400) | 920 (-220 to 2,000) |
| | Emergency department visits for asthma (all ages) | 510 (47 to 1,600) | 2,700 (250 to 8,300) |
| | Asthma exacerbation (age 6-18)[d] | 220,000 (-67,000 to 440,000) | 1,100,000 (-330,000 to 2,100,000) |
| | Minor restricted-activity days (age 18-65) | 450,000 (190,000 to 720,000) | 2,200,000 (920,000 to 3,500,000) |
| | School Loss Days (age 5-17) | 160,000 (57,000 to 360,000) | 790,000 (280,000 to 1,700,000) |

# Monetary Health Benefits

**Table 6-21. Total Monetized Ozone-Related Benefits for the Revised and Alternative Annual Ozone Standards (Incremental to the Baseline) for the 2025 Scenario (nationwide benefits of attaining the standards everywhere in the U.S. except California) (millions of 2011$) [a]**

| | Health Effectb | Revised and Alterative Standard Levels (95th percentile confidence intervals) 70 ppb | 65 ppb |
|---|---|---|---|
| **Avoided Short-Term Mortality - Core Analysis** | | | |
| multi-city studies | Smith et al. (2009) (all ages) | $1,000 ($99 to $2,900) | $5,300 ($500 to $15,000) |
| | Zanobetti and Schwartz (2008) (all ages) | 1,700 ($160 to $4,800) | 8,700 ($800 to $24,000) |

[a] All benefits estimates are rounded to whole numbers with a maximum of two significant digits. The monetized value of the ozone-related morbidity benefits are included in the estimates shown in this table for each mortality study.

# Smith et al. 2009

6 out of 95 cities showed a statistically significant effect of ozone on daily mortality, and those 6 did not have the highest design values

From Smith et al:
“We caution, again, that any national summary, even a population-weighted average, will conceal the still-unexplained heterogeneities. Further, we believe that the heterogeneity and sensitivity of ozone effect estimates to a variety of covariates leaves open the issue of whether or not ozone is causally related to mortality.”

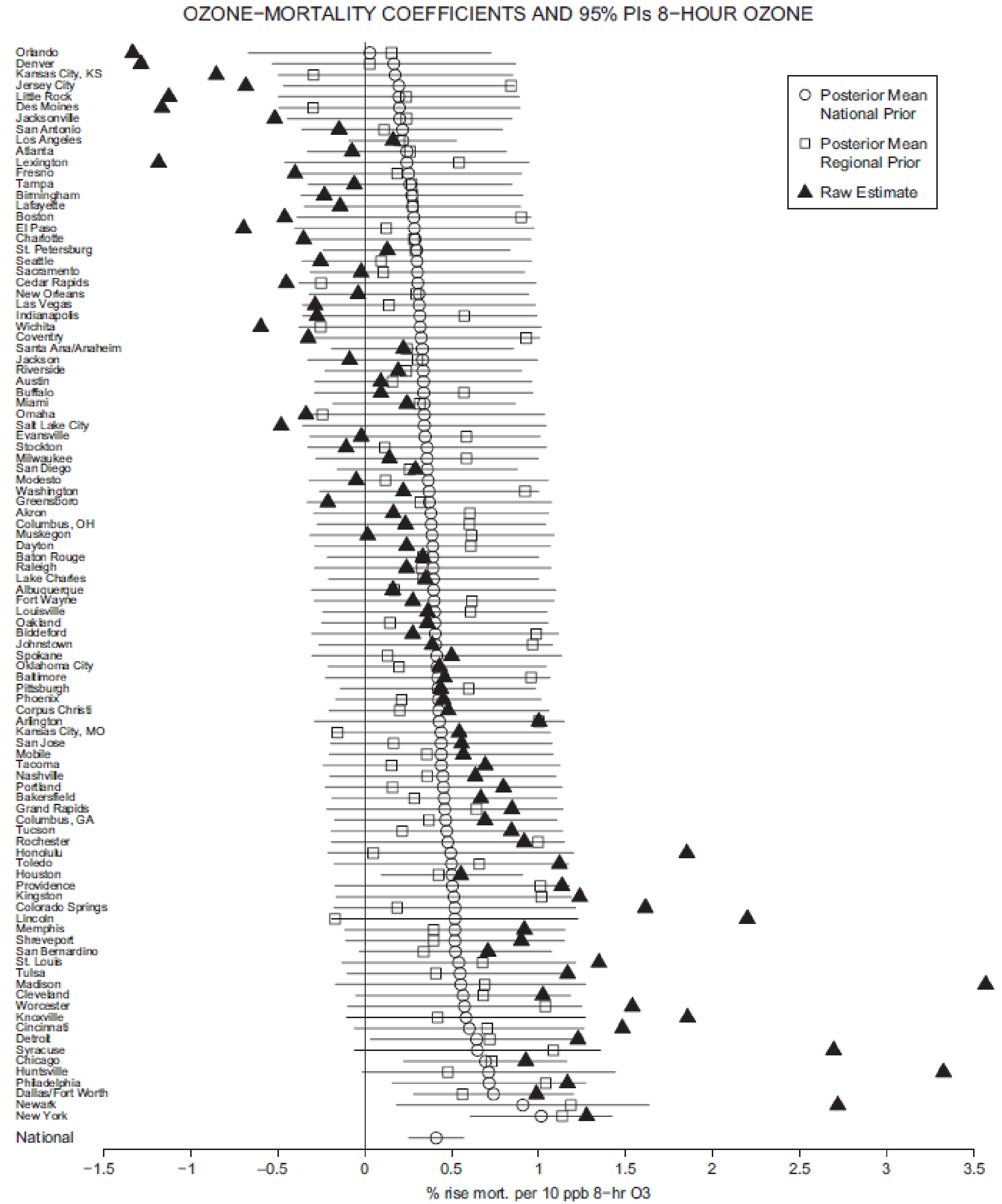



**Figure 4.** Ninety-five percent posterior intervals for the ozone-mortality coefficients, based on 8-h ozone, all-year data. The Bayesian posterior estimates under the “national prior” (circles) are shown alongside those for the “regional prior” (squares) and the raw maximum likelihood estimates (triangles).

# $PM_{2.5}$ Co-Benefits

**Table 6-23. Monetized $PM_{2.5}$-Related Health Co-Benefits for the Revised and Alternative Annual Ozone Standards (Incremental to Baseline) for the 2025 Scenario (Nationwide Benefits of Attaining the Standards in the U.S. except California) (millions of 2011$) [a,b,c]**

| Monetized Benefits | Revised and Alternative Standard Levels | |
|---|---|---|
| | 70 ppb | 65 ppb |
| 3% Discount Rate | | |
| Krewski et al. (2009) (adult mortality age 30+) | $2,100 | $10,000 |
| Lepeule et al. (2012) (adult mortality age 25+) | $4,700 | $23,000 |
| 7% Discount Rate | | |
| Krewski et al. (2009) (adult mortality age 30+) | $1,900 | $9,300 |
| Lepeule et al. (2012) (adult mortality age 25+) | $4,200 | $21,000 |

- Assumes that $PM_{2.5}$ (and ozone) causes mortality even at very low levels (far below the $PM_{2.5}$ NAAQS that was set to protect public health with an adequate margin of safety)

# Benefits: What to Look For

- What % of the benefits are attributed to $PM_{2.5}$?
  - Because most of the country is in attainment for the $PM_{2.5}$ NAAQS, most of the benefit is being attributed to $PM_{2.5}$ below the standard
- What kind of uncertainties did the EPA express in the studies that were the basis of the health benefits?
- Are the results shown statistically significant?

# Resources

- EPA's Science Advisory Board meeting on "Economy-wide Modeling of the Benefits and Costs of Environmental Regulation" (July 19-20, 2016)
- Professional societies and state partners (e.g. AAPCA)
- Trade organization and news articles
- Journals: *Risk Analysis, Regulatory Toxicology & Pharmacology*
- Economists, scientists, statisticians

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