IEc

Second Prospective Benefits Analysis: Health Benefits and Uncertainty Analyses

Presentation to EPA Science Advisory Board Council

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Acknowledgements

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- Jim Neumann, IEc
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- Lindsay Ludwig, IEc
- Nadav Tanners, IEc
- Mikael Gentile, IEc
- Leland Deck, Stratus Consulting (Air Quality Grids)
- Jonathan Levy, HSPH (Differential Toxicity Uncertainty Analysis)
- Lauraine Chestnut, Stratus Consulting (Reviewed Cessation Lag Uncertainty Analysis)

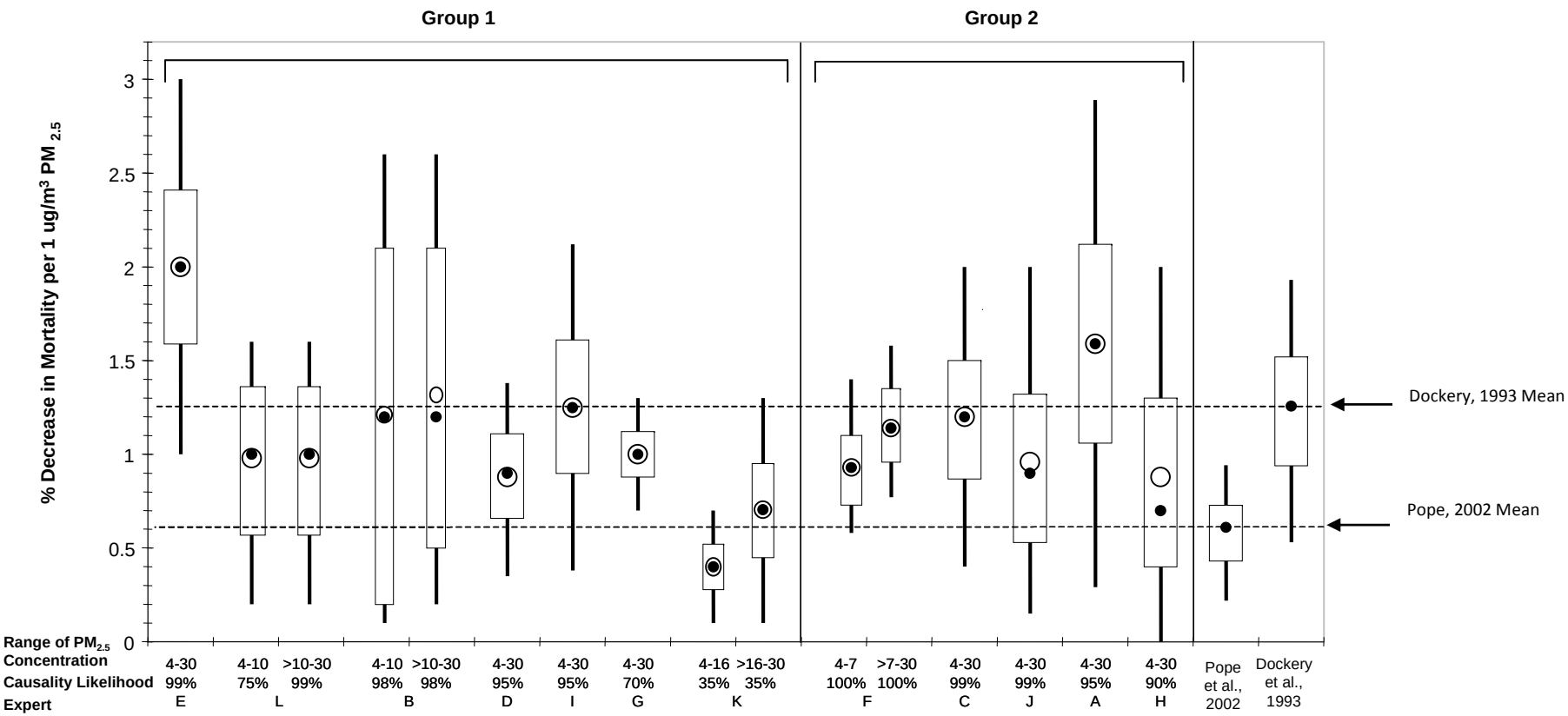
Key Challenges in Health Benefits Analysis

- Determining likely magnitude of Clean Air Act Amendment (CAAA)-related health benefits
  - Health effects to include
  - Concentration-response (C-R) functions for particulate matter (PM) and Ozone mortality
- Determining the timing of health benefits
  - PM/mortality cessation lag
  - Trajectory of benefits through time
- Possible alternative paradigms
  - Population simulation model
- Uncertainty in agents causing PM toxicity
  - Differential toxicity of PM components
- Determining how to value health benefits
  - Value of a statistical life

Health Effects Included in 812 Benefits Assessment

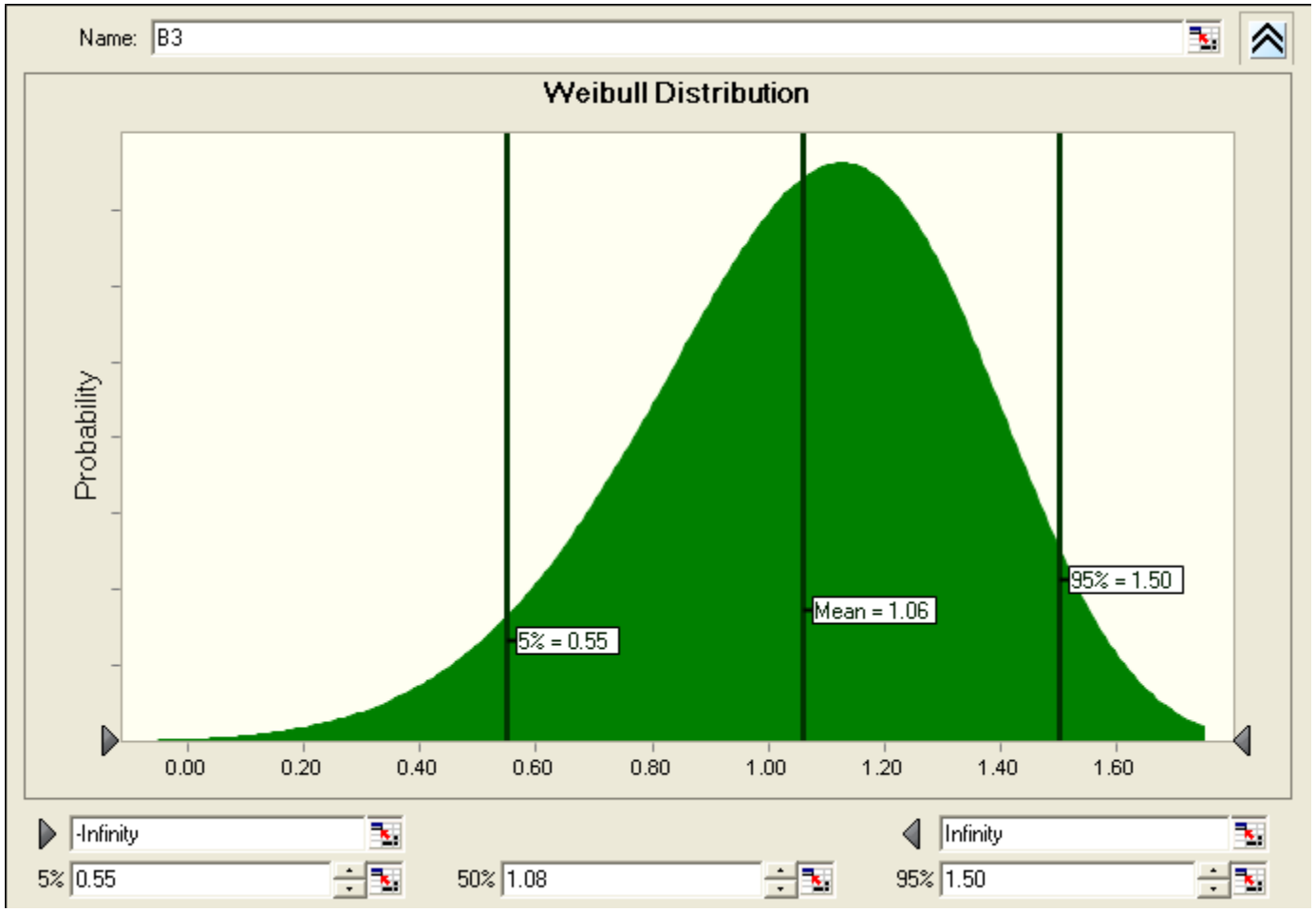
POLLUTANT/EFFECT	QUANTIFIED AND MONETIZED IN BASE ESTIMATES[A]
PM/Health[b]	Premature mortality based on both cohort study estimates and on expert elicitation[c,d] Bronchitis: chronic and acute Hospital admissions: respiratory and cardiovascular Emergency room visits for asthma Nonfatal heart attacks (myocardial infarction) Lower respiratory symptoms Minor restricted-activity days Work loss days Asthma exacerbations (asthmatic population) Upper Respiratory symptoms (asthmatic population) Infant mortality
Ozone/Health[f]	Premature mortality: short-term exposures Hospital admissions: respiratory Emergency room visits for asthma Minor restricted-activity days School loss days Outdoor worker productivity

Results of PM Expert Elicitation

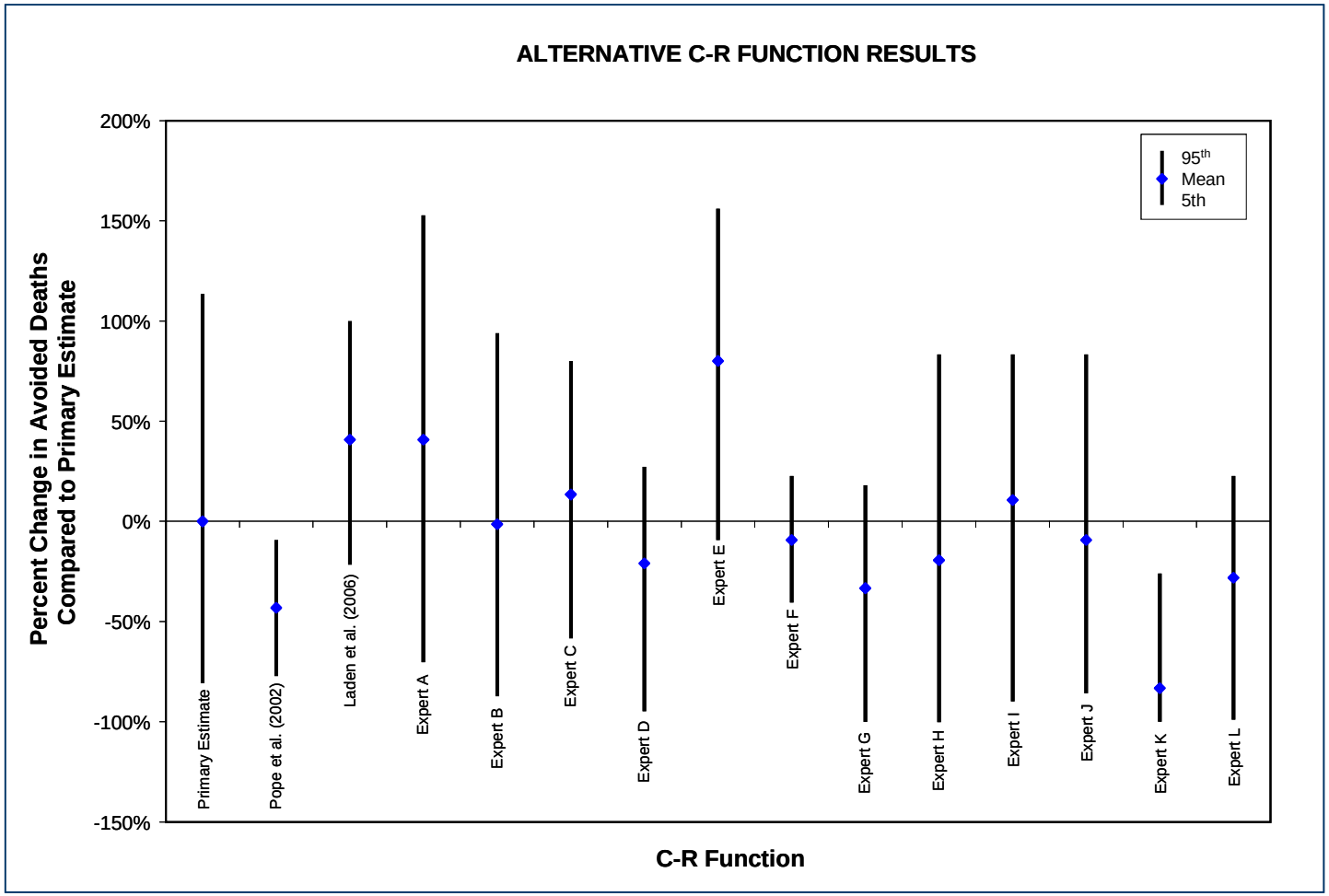


Key: Closed circle = median; Open circle = mean; Box = interquartile range; Solid line = 90% credible interval

PM/Mortality Concentration-Response Function



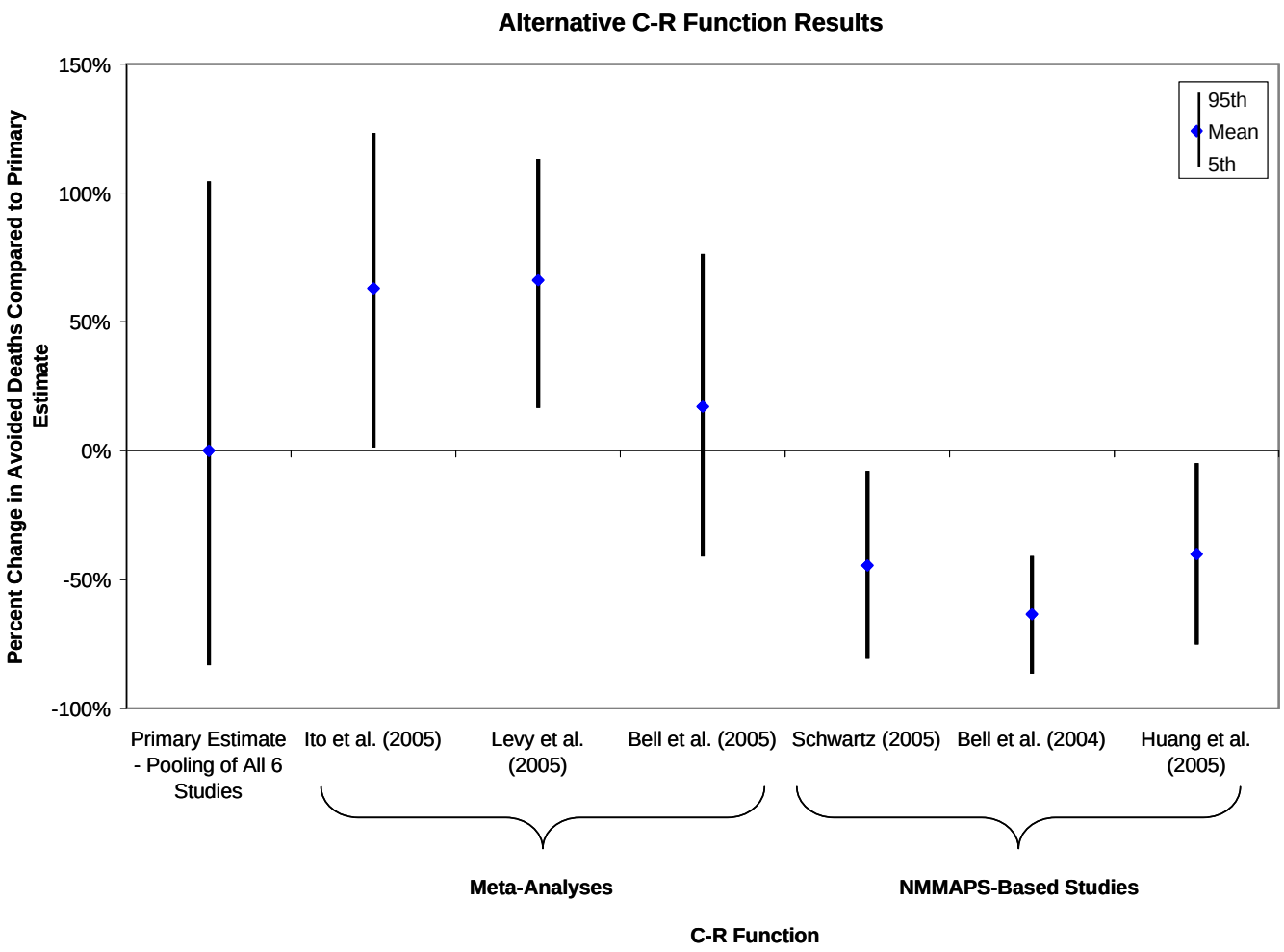
PM/Mortality C-R Function Uncertainty Analysis Results



Ozone/Mortality Concentration-Response Function

- Pooling of 6 studies with equal weights
  - Meta-analyses
    - Ito et al. (2005)
    - Levy et al. (2005)
    - Bell et al. (2005)
  - NMMAPS-Based Studies
    - Schwartz (2005)
    - Bell et al. (2004)
    - Huang et al. (2005)

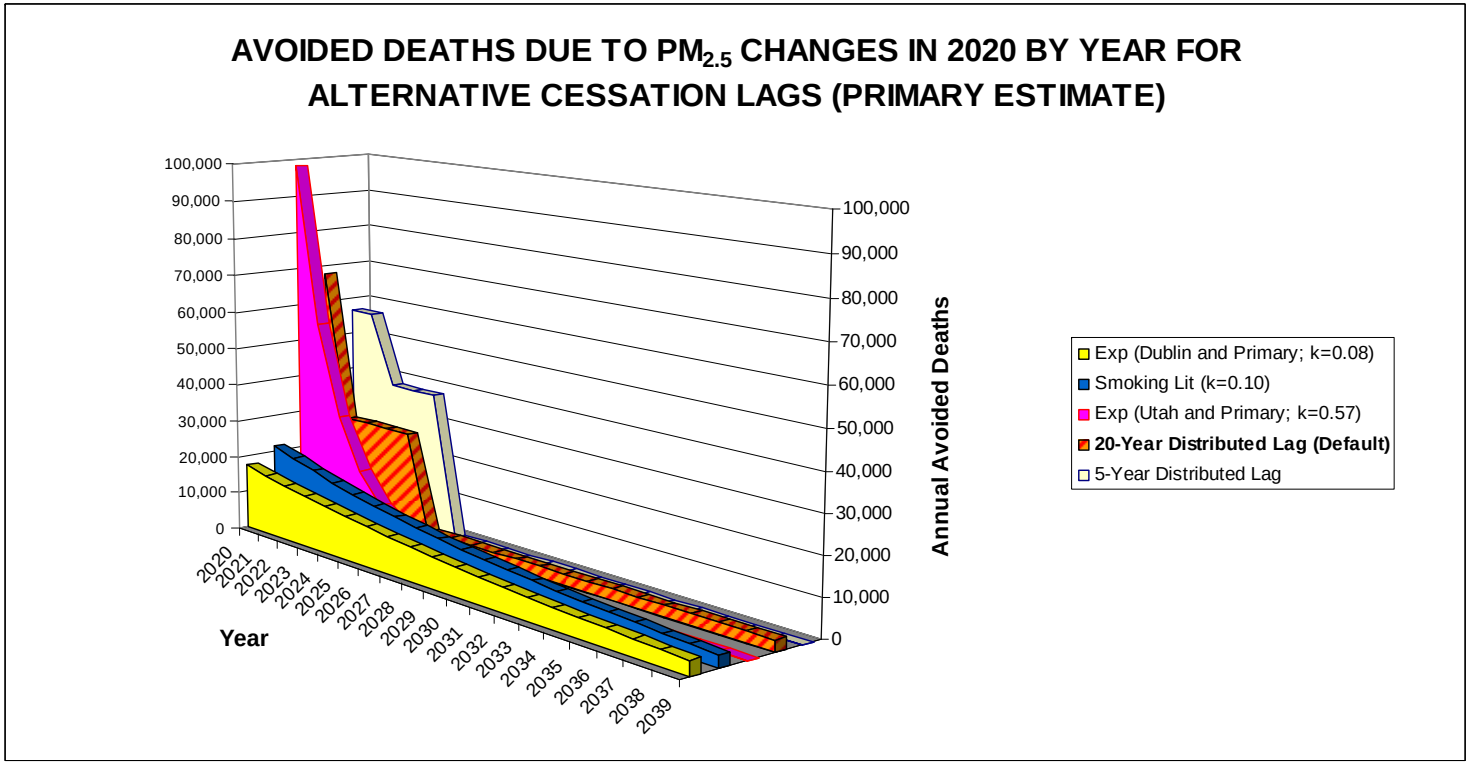
Ozone/Mortality C-R Function Uncertainty Analysis Results



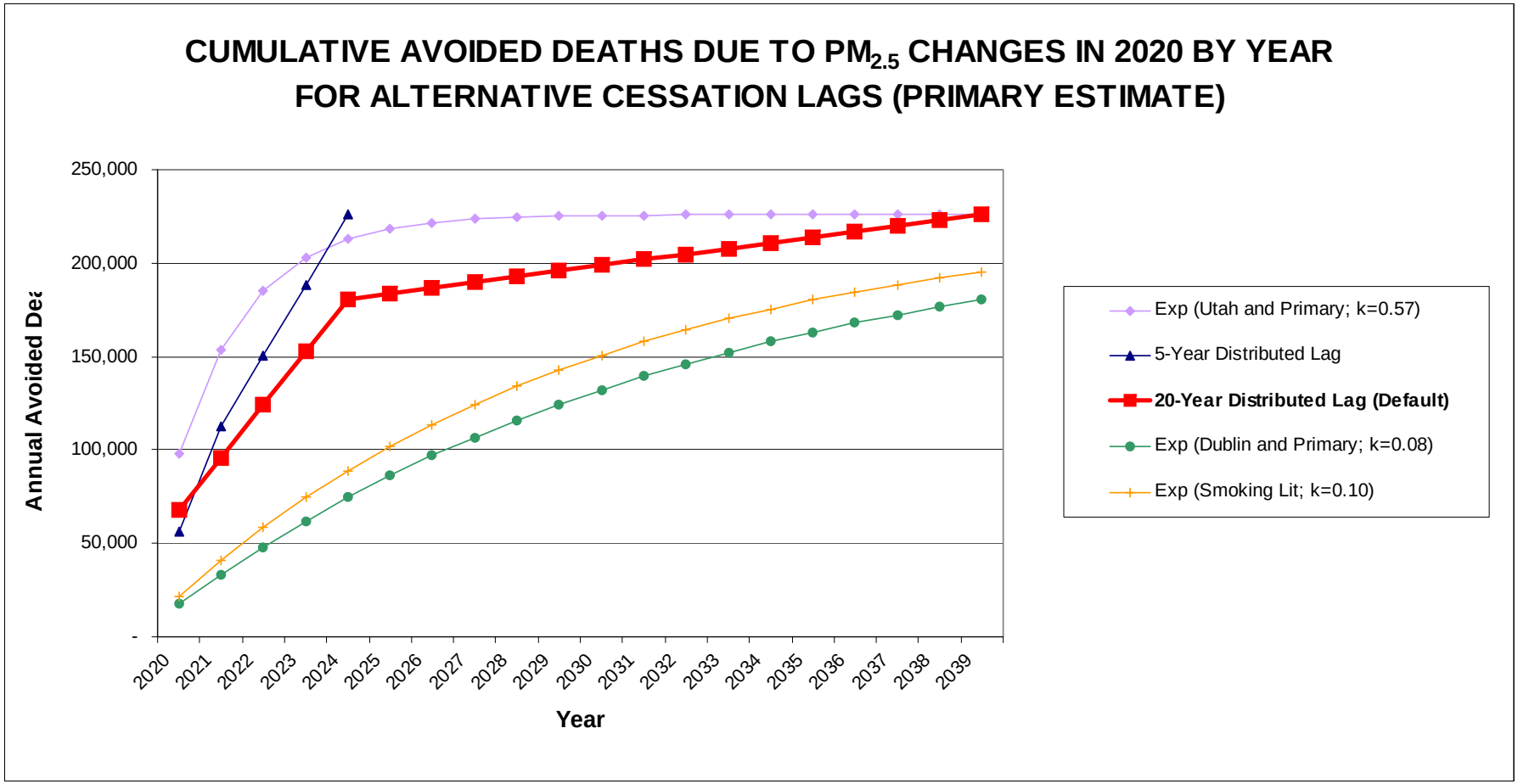
PM/Mortality Cessation Lag Uncertainty Analysis

- In addition to default 20-year distributed lag, applied two alternative structures.
  - The 5-year distributed lag used by EPA in the past (based on the smoking cessation literature)
  - An exponential decay "smooth" function adapted from Roosli et al. (2005)

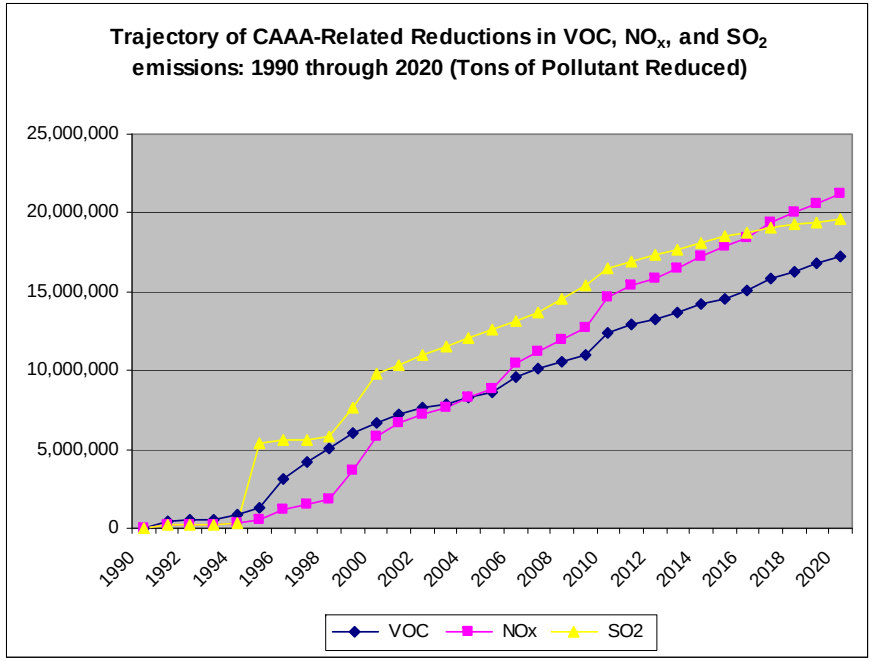
PM/Mortality Cessation Lag Uncertainty Analysis Results

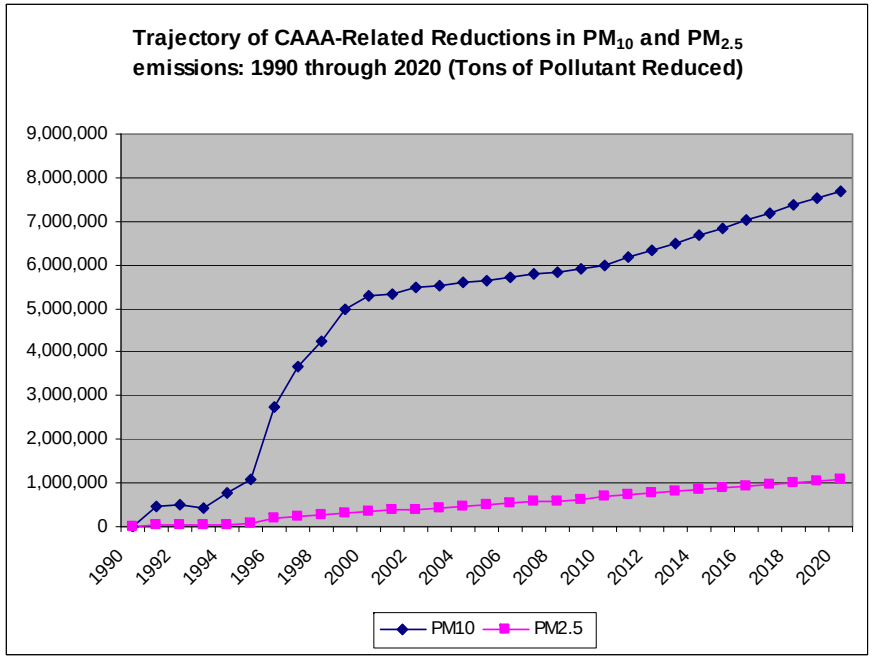


PM/Mortality Cessation Lag Uncertainty Analysis Results - Cumulative

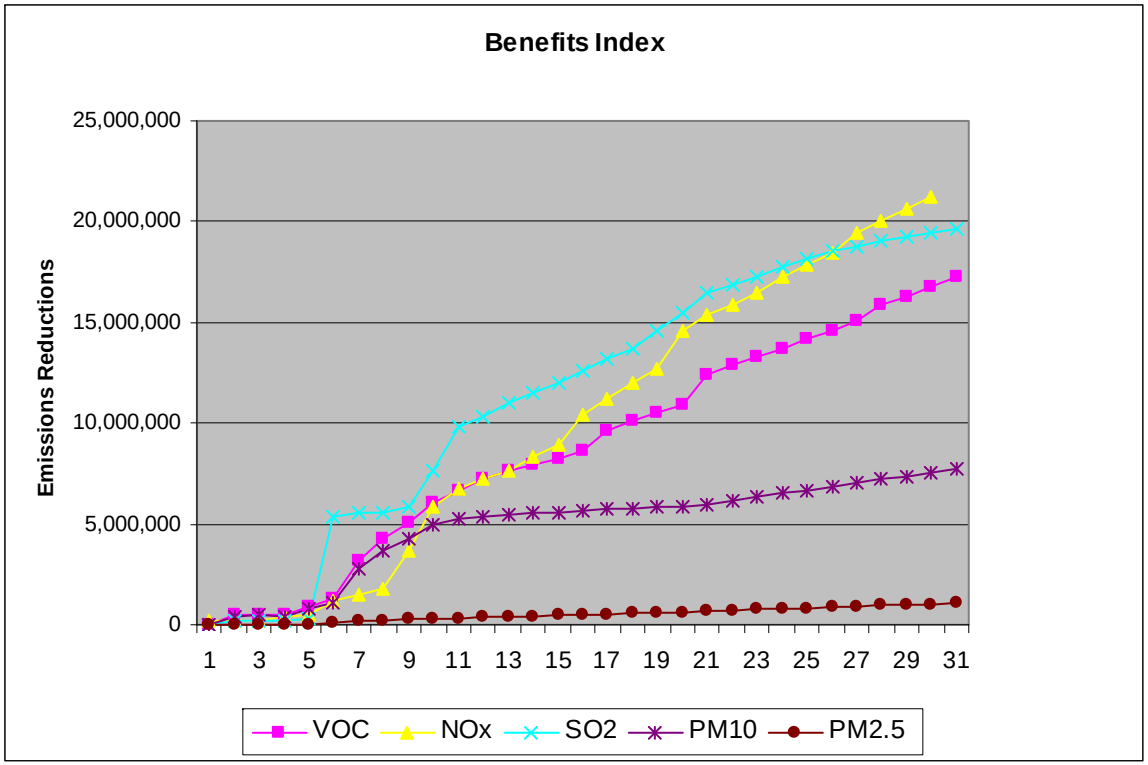


Emissions Reductions Trajectories

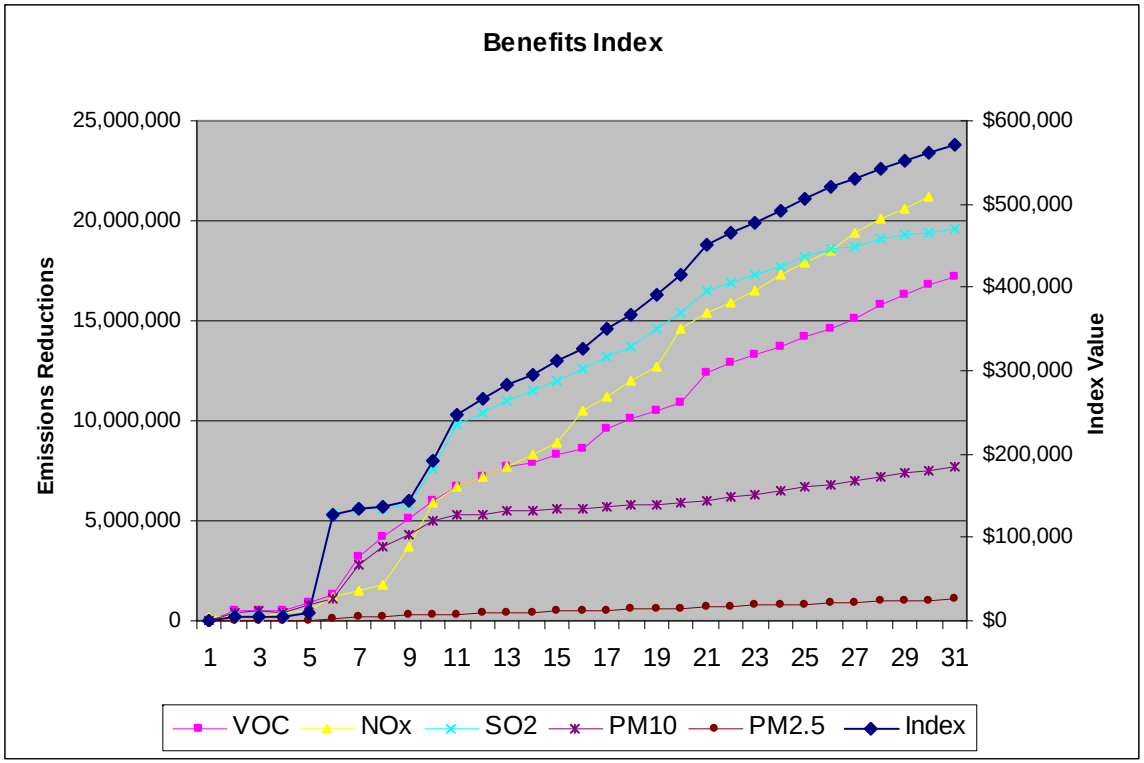




Benefits Index

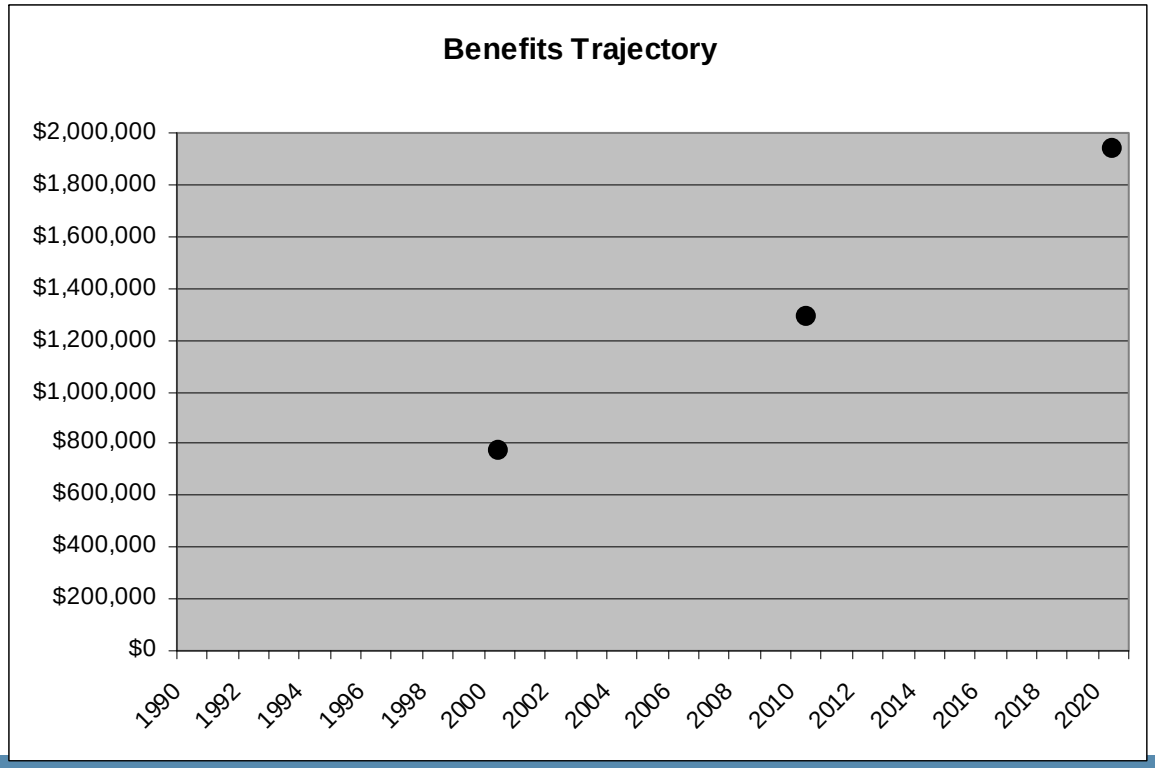


Benefits Index



Full Trajectory of Benefits

TARGET YEAR BENEFITS		
2000	2010	2020
$770,000	$1,300,000	$2,000,000



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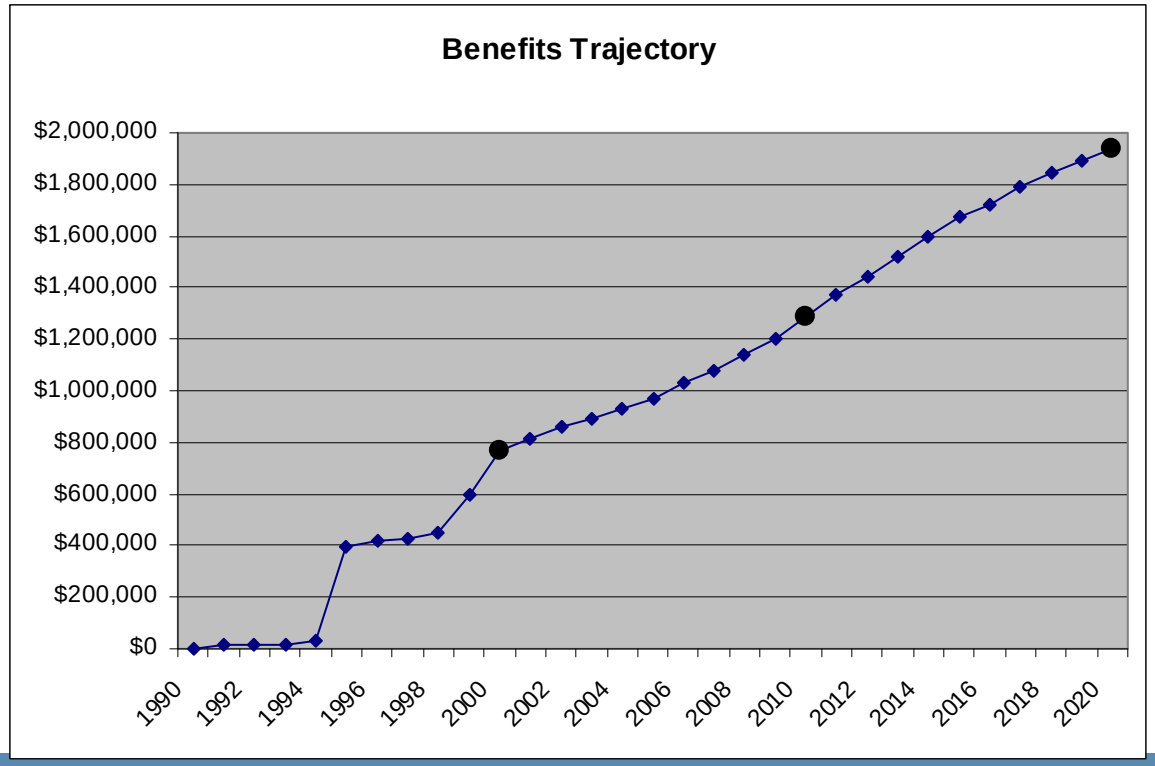


Population Simulation Model

- Primary results – Use of BenMAP with "static" population model
- Alternative approach – Population Simulation Model with "dynamic" population model

- Output from Population Simulation Model
  - Effect of air pollution changes on the population over time (not directly comparable to BenMAP output)
  - Life years gained from CAAA implementation
  - Increase in period life expectancy

- Results
  - Twice as many life years saved in Population Simulation Model results than BenMAP

Note: These results have not yet been updated to reflect the updated PM results.

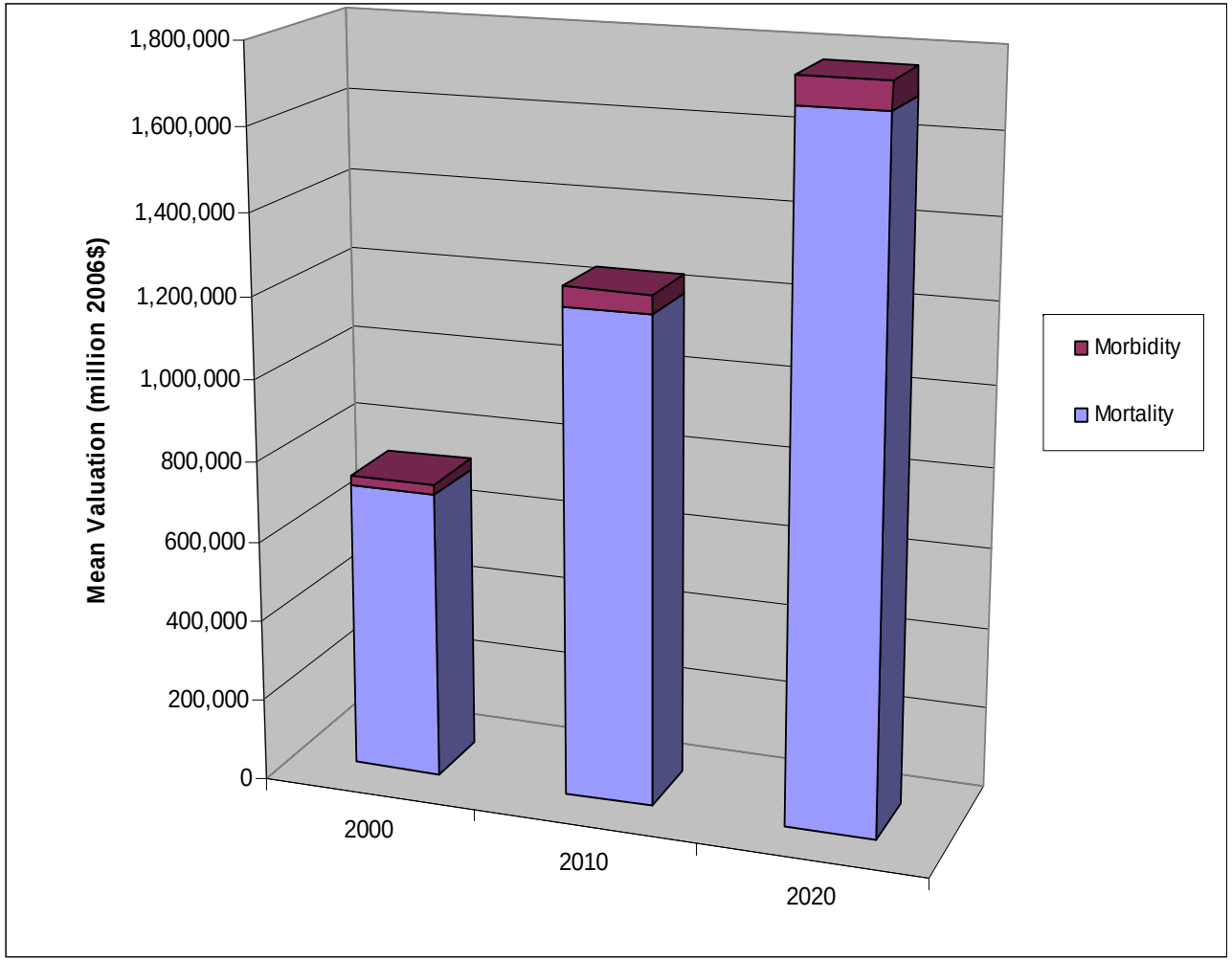
Differential Toxicity Uncertainty Analysis

- Decided not to pursue uncertainty analysis of differential toxicity of PM components
  - Current epidemiological evidence for relative potency of individual components is limited and inconsistent
  - Current epidemiological and toxicological evidence suggests complex system of particle interactions
- Characterization of "what if" potency scenarios would require
  - More support from epidemiological and toxicological literatures
  - More detailed air quality modeling data on metals and other PM components

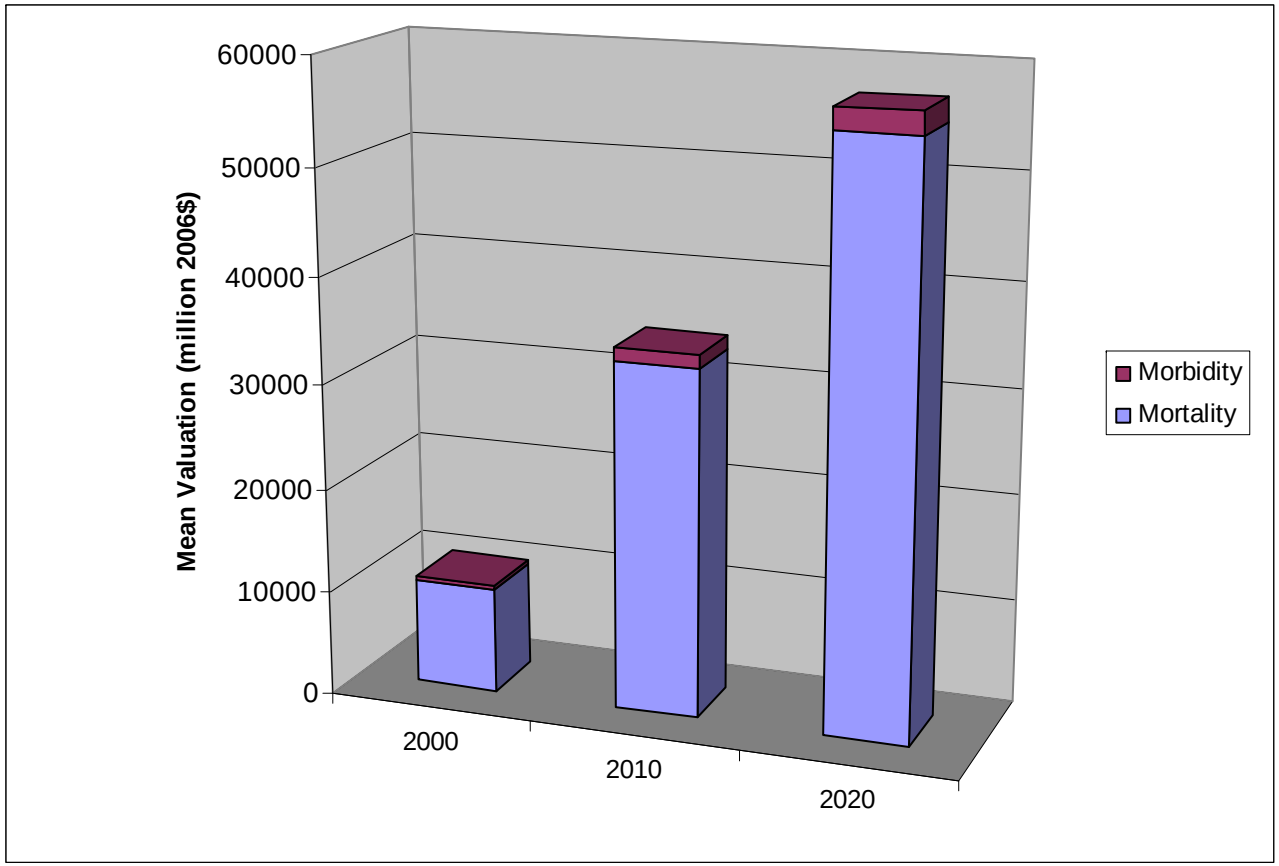
Premature Mortality Valuation (PM and Ozone)

- Applied a VSL derived from 26 studies (stated and revealed preference)
- Weibull distribution
- Mean of 7.4 million(2006$)
- Used by EPA currently for benefits analysis (e.g., Nitrogen Dioxide NAAQS RIA in 2010)

PM Valuation Estimates by Target Year



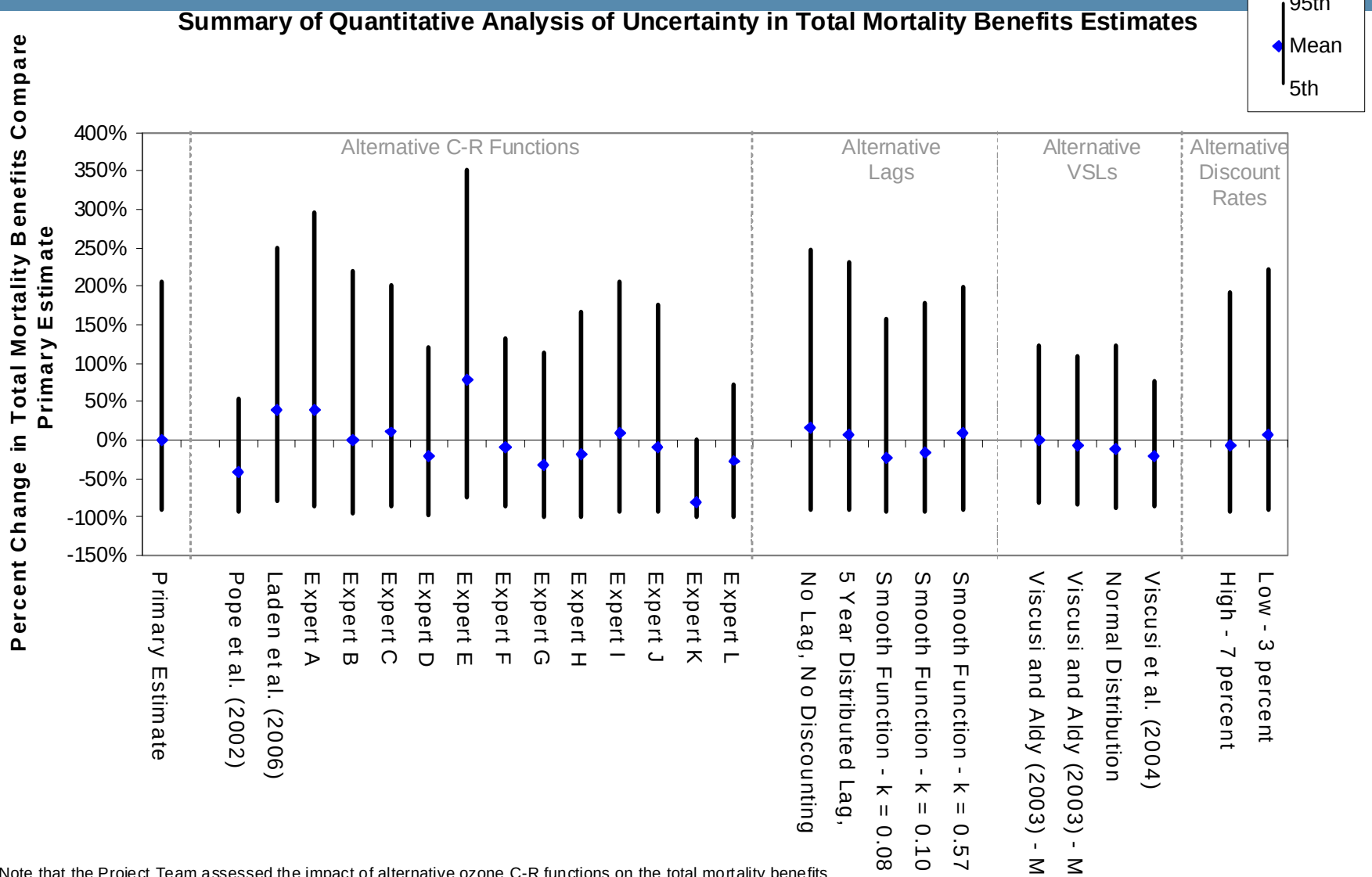
Ozone Valuation Estimates by Target Year



Total Monetized Health Benefits Estimates (Million 2006$)

	2000	2010	2020
PM Mortality	$710,000	$1,200,000	$1,700,000
PM Morbidity	$27,000	$46,000	$68,000
Ozone Mortality	$10,000	$33,000	$55,000
Ozone Morbidity	$420	$1,300	$2,100
Total Health Benefits	**$750,000**	**$1,300,000**	**$1,900,000**

Summary of Uncertainty Analyses Results



Note that the Project Team assessed the impact of alternative ozone C-R functions on the total mortality benefits and found that these did not alter the primary estimate. Therefore, alternative ozone C-R functions are not included in this graph.