Air Quality Benefits from Tier 3 Low Sulfur Gasoline Program

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Presentation Overview

- EPA's expected Tier 3 low sulfur gasoline proposal
- Need for additional NOx reductions in Mid-Atlantic region
- Projected emission reductions
- Monetized health benefits
- Impacts on oil industry
- Conclusions

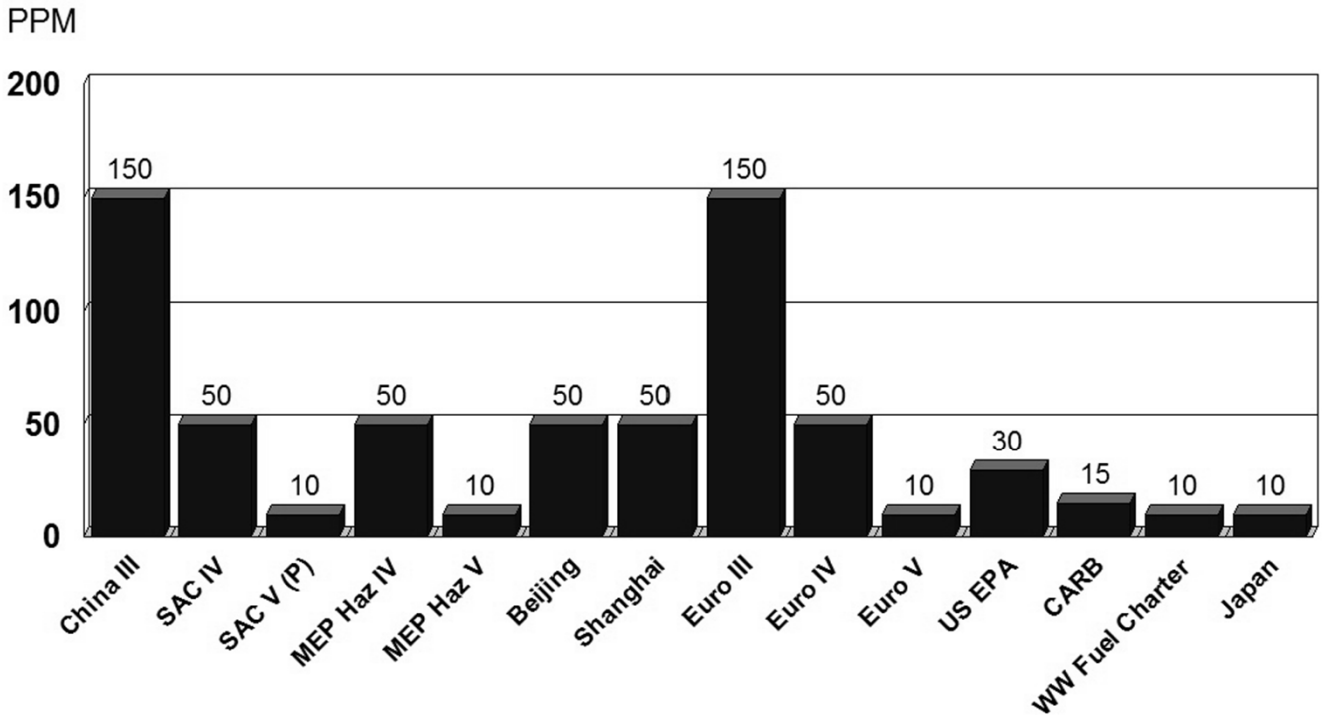
Tier 3 Rulemaking

- EPA expected to propose Tier 3 rule for cars and light-duty trucks in early 2013 and finalize by end of year
- Includes tailpipe standards for NOx, VOCs, and PM and evaporative emission standards, which they intend to harmonize with CA LEV III
- Expected to include a requirement to lower gasoline sulfur to an average of 10 ppm

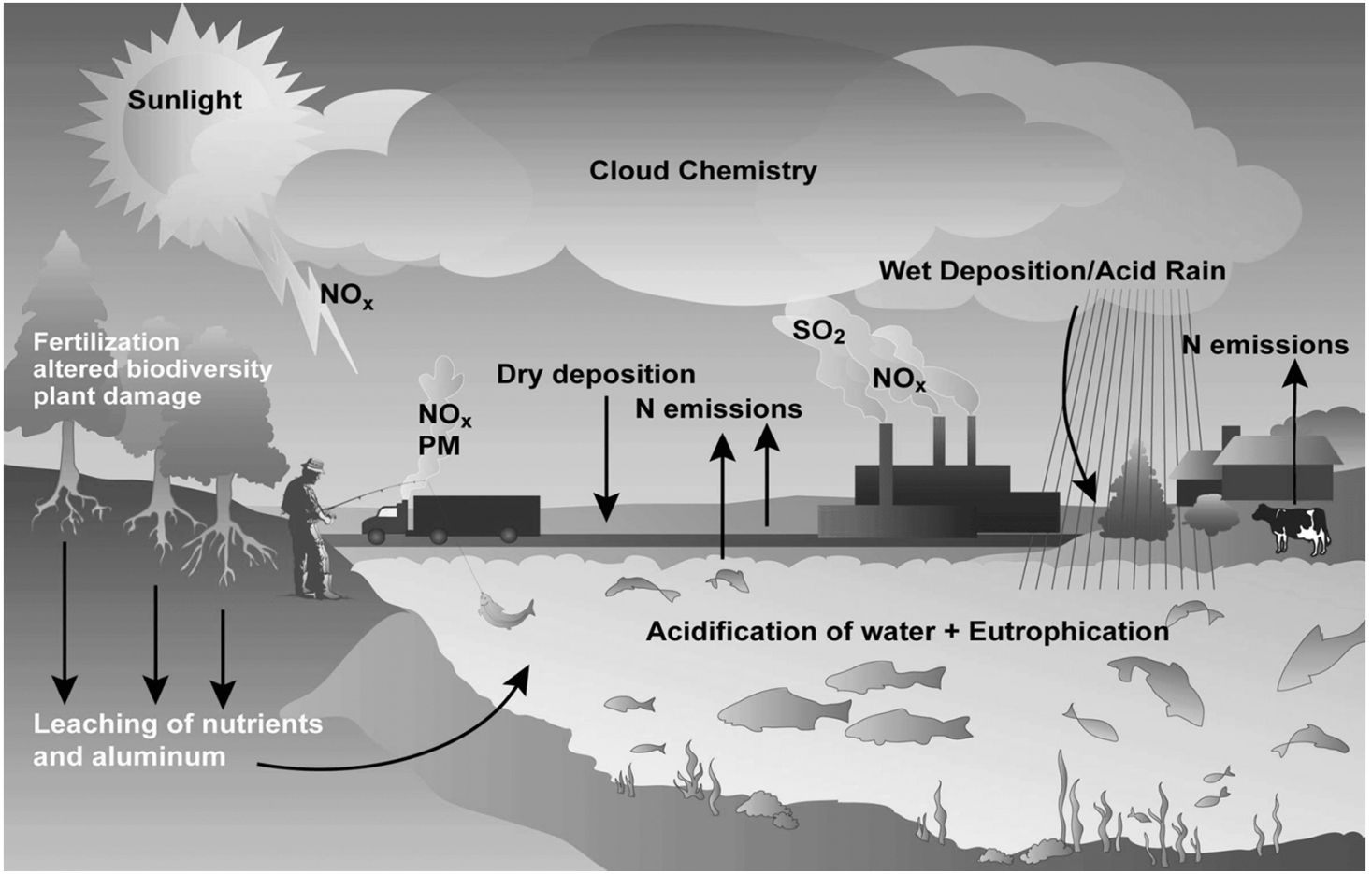
Lower Sulfur Gasoline

- Lowering the sulfur content of gasoline allows pollution control equipment (3-way catalysts) on cars and trucks to operate more effectively
- Will significantly reduce NOx and other emissions from all gasoline-powered vehicles by limiting “NOx creep” associated with sulfur builds up in catalyst
- Emission reductions from the in-use fleet would be achieved concurrent with the introduction of the cleaner fuel, without the need for fleet turnover

Sulfur Content in Gasoline Worldwide Comparison



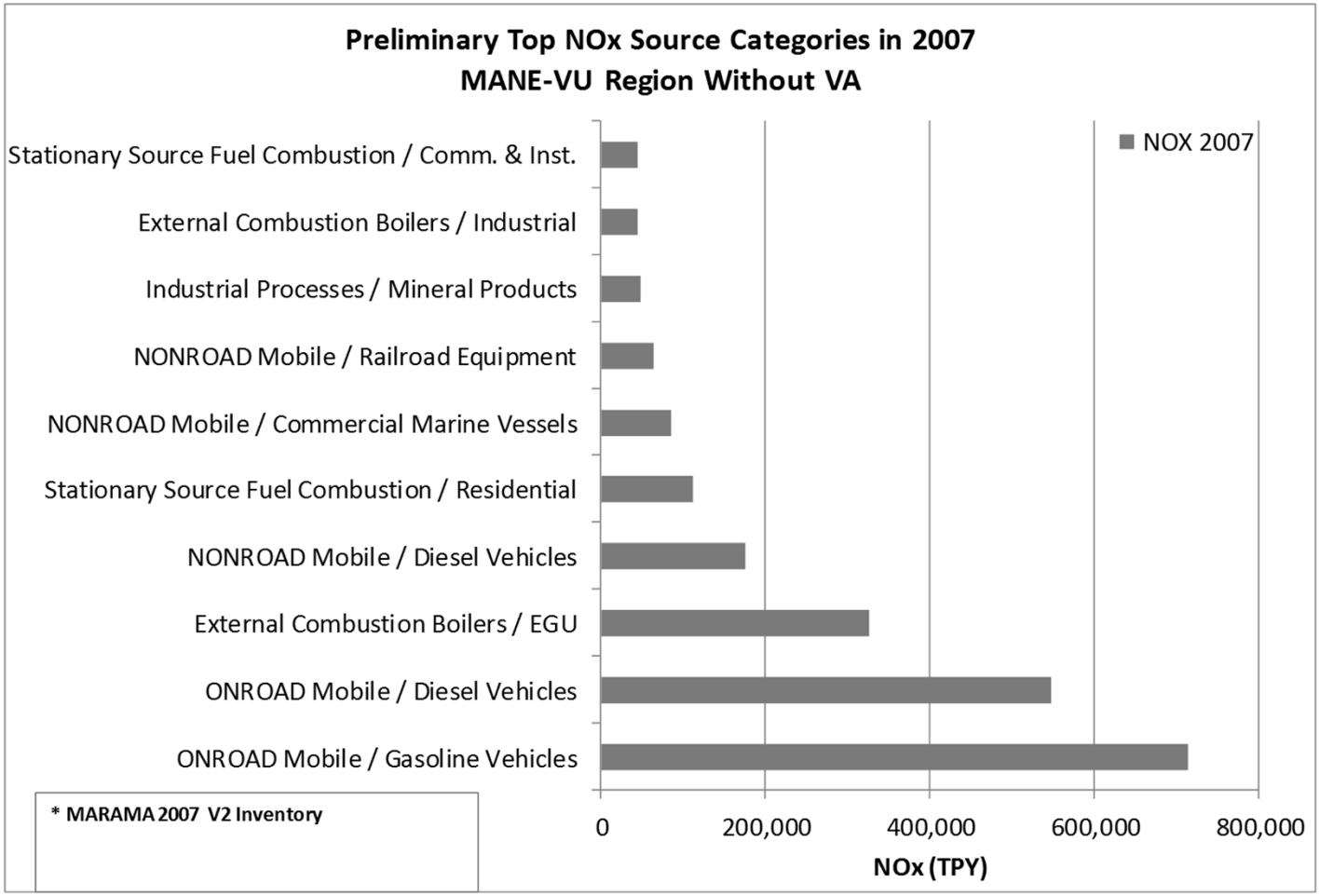
NOx Contributes to Wide Range of Health & Environmental Problems



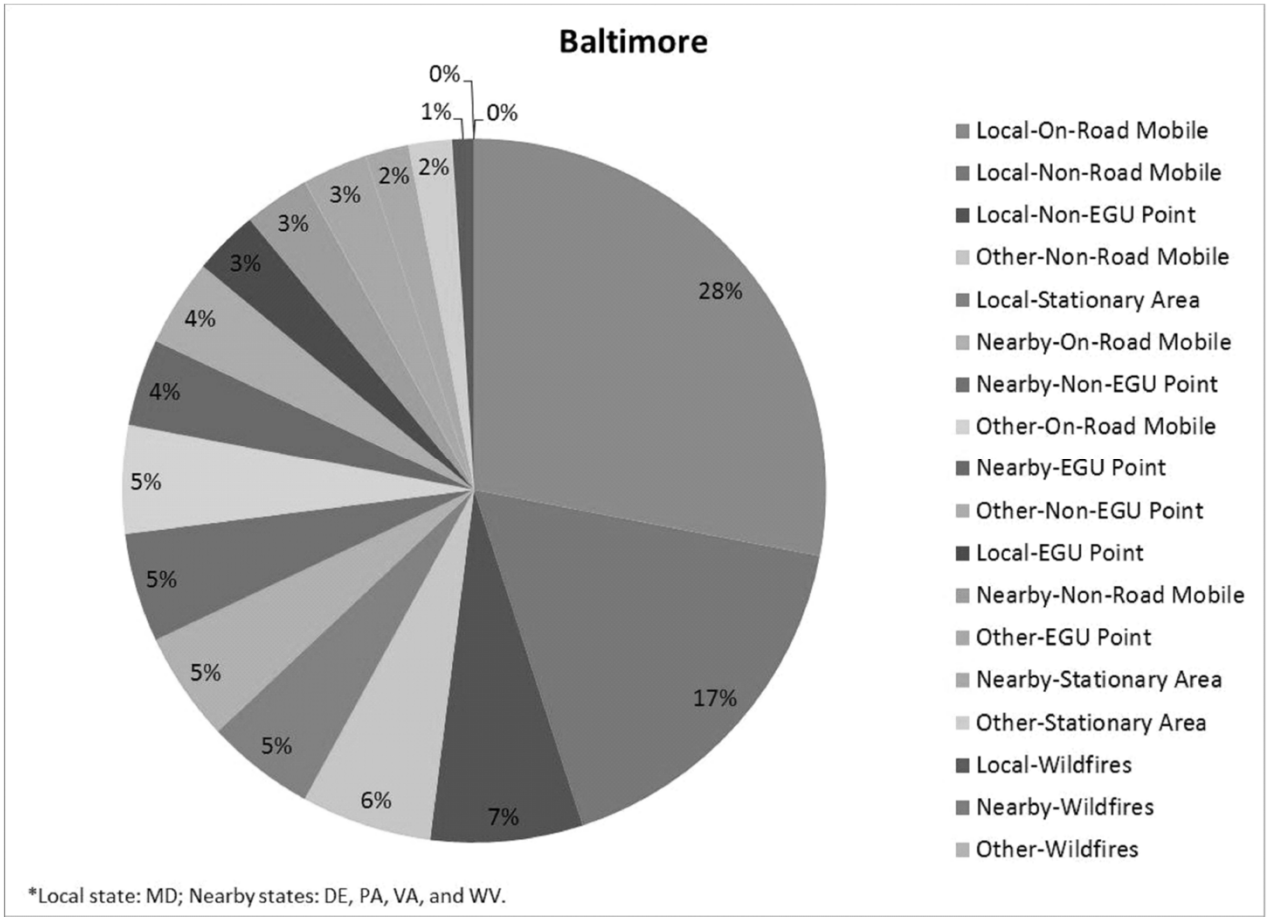
Need for Additional NOx Reductions

- **Ozone and PM2.5**
  - Reduces lung function, aggravates asthma and other chronic lung diseases
  - Can cause permanent lung damage from repeated exposures
  - Contributes to premature death
- **Acid Deposition**
  - Damages forests
  - Damages aquatic ecosystems
  - Erodes manmade structures
- **Coastal Marine Eutrophication**
  - Depletes oxygen in the water, which suffocates fish and other aquatic life in bays and estuaries, e.g., Chesapeake Bay
- **Visibility Impairment**
  - Contributes to regional haze that mars vistas and views in urban and wilderness areas, e.g., Shenandoah

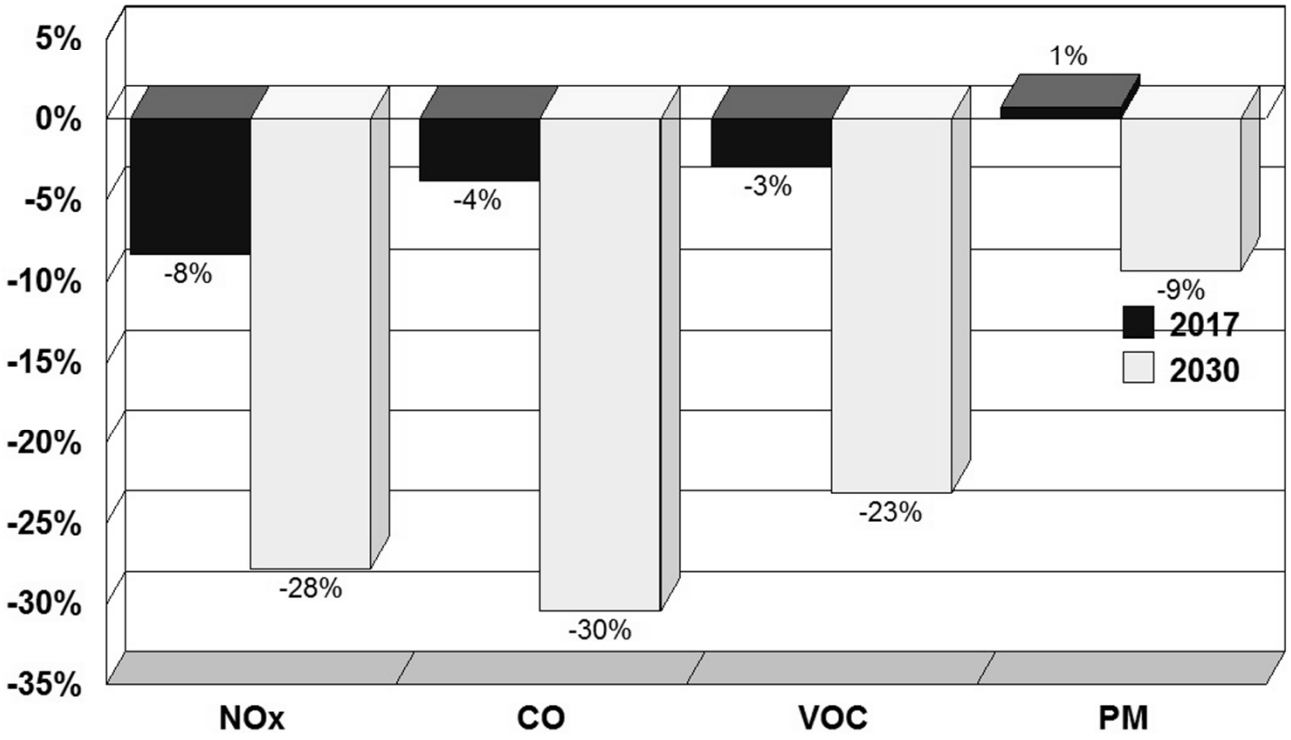
Source of NOx Emissions in the Northeast/Mid-Atlantic



Projected 2015 Average Contribution (%) by State/Sector to Exceedance-level Ozone



Overall Emissions Reductions From Onroad Mobile Sources



State Emissions and Estimated Reductions from 10 ppm Sulfur

State	2017 Gasoline On-road Base NOx (tpy)	Estimated NOx Reductions from 10 ppm Sulfur Gasoline	
		(tpy)	(tpd)
Connecticut	20,700	-3,100	-8
Delaware	5,400	-800	-2
District of Columbia	2,000	-300	-1
Maine	10,000	-1,500	-4
Maryland	32,600	-5,000	-14
Massachusetts	35,100	-5,300	-15
New Hampshire	8,400	-1,300	-4
New Jersey	44,300	-6,700	-18
New York	88,600	-13,500	-37
Pennsylvania	70,500	-10,700	-29
Rhode Island	5,600	-900	-2
Vermont	5,000	-800	-2
Virginia (Northern counties)	11,300	-1,700	-5
Northeast/Mid-Atlantic States Total	**339,500**	**-51,600**	**-141**

Regional Gasoline Vehicle Emissions and Estimated Reductions

Region	2017 Gasoline On-road Baseline NOx (tpy)	Estimated NOx Reductions from 10 ppm Sulfur Gasoline	
		(tpy)	(tpd)
Northeast/Mid-Atlantic States	339,500	-51,600	-141
Midwest States (IL, IN, IA, MI, MN, MO, OH, WI)	402,300	-61,000	-167
Southeast States (AL, FL, GA, KY, MS, NC, SC, TN, VA, WV)	427,800	-64,900	-178
3 Region Total	**1,169,600**	**-177,500**	**-486**

NOx Reductions from 10 ppm Sulfur & CSAPR

	2017 NOx Reductions from 10 ppm Sulfur Gasoline (tpy)	2014 NOx Reductions from CSAPR* *Does not reflect recent state budget changes by EPA* (tpy)
Northeast/Mid-Atlantic States Annual Total	**-51,600**	**-17,068**

Predicted Cost-Effectiveness of Tier 3/Low Sulfur Gasoline Requirements

Cost (cents per gallon)		Cost Effectiveness ($/ton NOx)
0.5 cents	**(MSAT)**	$2,500
0.8 cents	**(ICCT/MathPro) sensitivity case**	$4,000
1.4 cents	**(ICCT/MathPro) study case**	$7,000

Relative Cost-Effectiveness of Lower Sulfur Gasoline

Source	Cost Effectiveness ($/ton NOx)
ICI Boilers (area & point sources)	$750 - $7,500 (Low NOx Burners) $1,300 - $3,700 (SNCR) $2,000 - $14,000 (SCR)
Combustion Turbines – SCR	$2,010 - $19,120
Highway – Heavy-duty Diesel Engine Standards & Fuel Sulfur	$10,561
Tier 2 Light-duty Vehicle Emissions & Gasoline Sulfur	$6,297
10 ppm Sulfur Gasoline	**$2,500 – $7,000**

Annual Monetized Health Benefits in Northeast/Mid-Atlantic (2018)

	Value [millions of 2006$]		
	Ozone	**PM2.5**	**Total**
Morbidity	$20	$4	$23
Mortality	$196 – $877	$15 – $285	$210 – $1,162
Total Monetized Health Benefits	$215 – $896	$19 – $289	$234 – $1,186

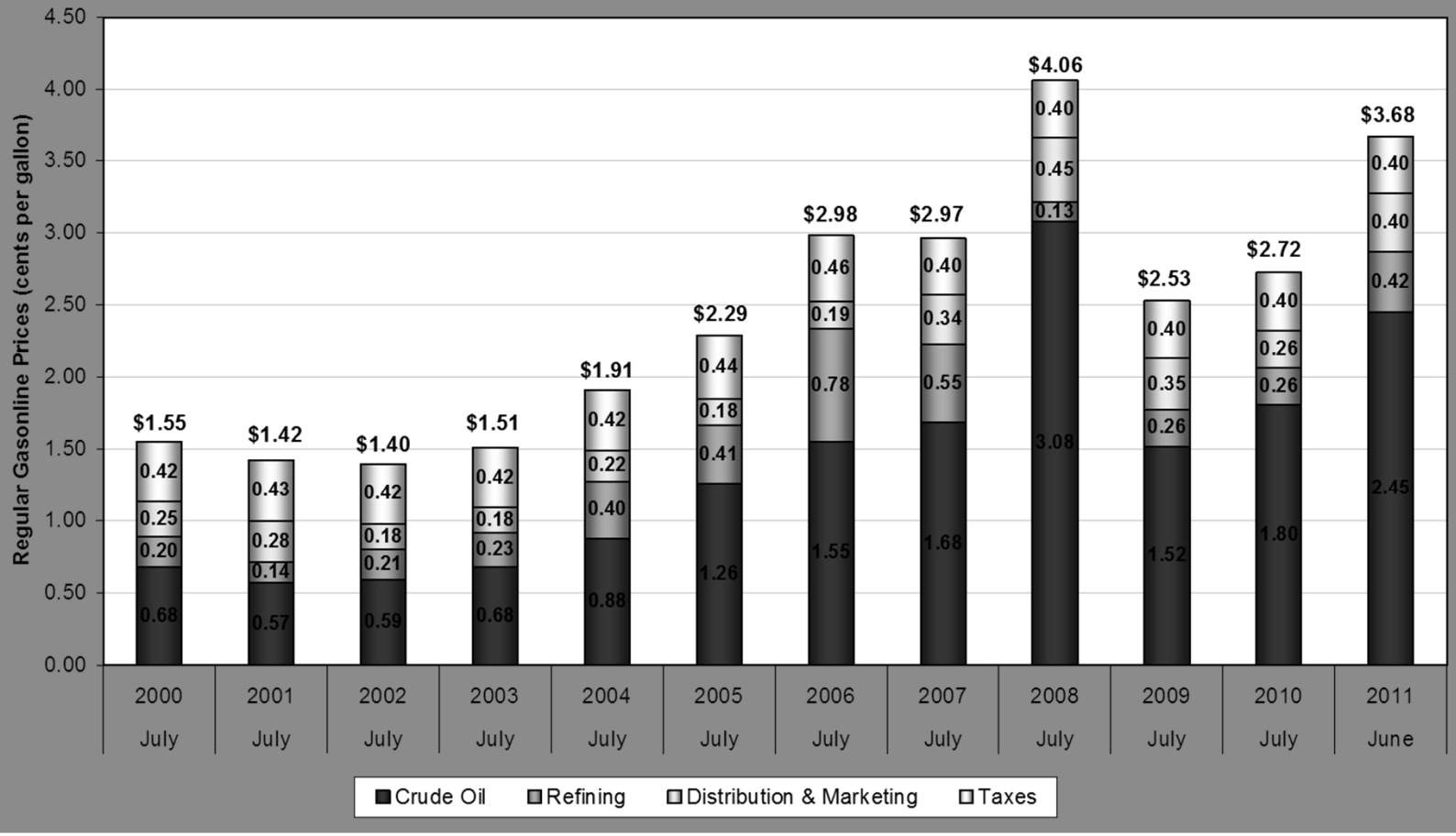
Cost vs. Health Benefits

	Value [millions of dollars]
Annual Cost at 0.5 cents/gal	$143
Annual Cost at 0.8 cents/gal	$229
Annual Cost at 1.4 cents/gal	$400
Total Monetized Annual Health Benefits	$234 – $1,186

Impact on Oil Industry

- 10 ppm sulfur gasoline proposal would represent the latest in a series of regulatory initiatives to remove sulfur from transportation fuels
  - Tier 2 (30 ppm) - *2000*
  - highway diesel (15 ppm) - *2001*
  - nonroad diesel (15 ppm) - *2004*
- U.S. refiners have already invested in desulfurization capacity
- Oil industry has historically generated conservative estimates of predicted cost of complying with fuel sulfur standards, but has found less costly ways to comply

Components of US Gas Prices



Impact on Oil Industry

- Low sulfur gasoline and diesel regulations have had little effect on the numbers or capacities of operable refineries in U.S.
- U.S. gasoline supply increased nearly 10 percent, comparing the year 2000 to the year 2007
- Early compliance was widespread and many refiners generated a surplus of credits
- Refining industry maintained profitability during the first decade of the 21st Century

Conclusions

- Lowering the sulfur content of gasoline to an average of 10 ppm would cost-effectively reduce NOx emissions
- Represents one of the most significant strategies available to protect public health by addressing ozone nonattainment in the Northeast/Mid-Atlantic
  - Help areas that need reductions to attain
  - Help other areas stay in attainment
  - Position states to be in attainment with any new NAAQS

Conclusions

- NOx reductions would also help lower fine particle concentrations and mitigate acid rain, water body eutrophication, and regional haze
- As a federal requirement, the low sulfur gasoline rule would result in very significant NOx reductions across the entire domain in the Eastern U.S. that contributes to pollutant burden in Northeast/Mid-Atlantic region
- Emission reductions not achieved through this and other federal measures would have to be accomplished by further controlling local sources in the region