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

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Tier 3 Rulemaking

- EPA expected to propose Tier 3 rule for cars and light-duty trucks in early 2012 and finalize in late 2012
- 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

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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 reduce NOx from existing vehicles by about 25%
- Emission reductions from the in-use fleet would be achieved concurrent with the introduction of the cleaner fuel, without the need for fleet turnover

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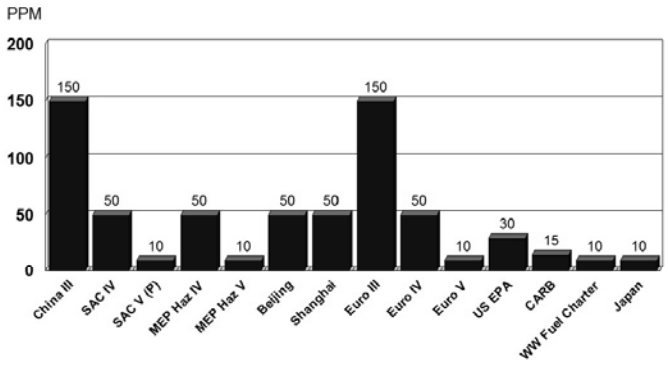
Sulfur Content in Gasoline Worldwide Comparison



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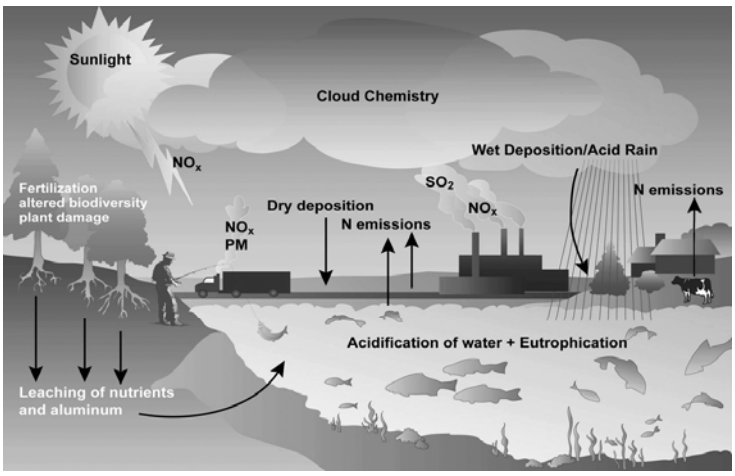
NOx Contributes to Wide Range of Health & Environmental Problems



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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

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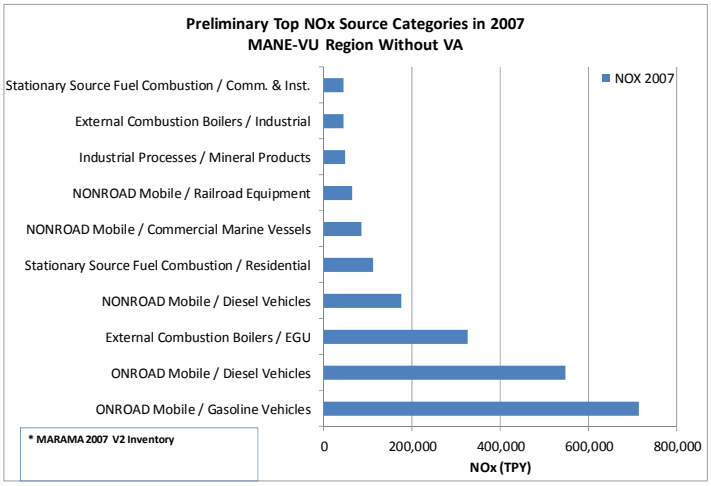
Source of NOx Emissions in the Northeast/Mid-Atlantic



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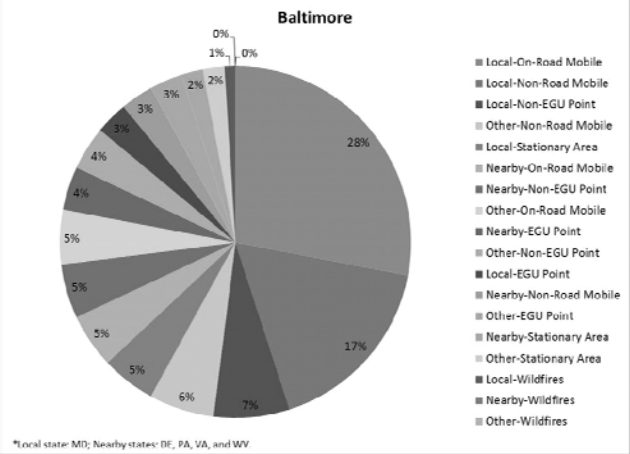
Projected 2015 Average Contribution (%) by State/Sector to Exceedance-level Ozone



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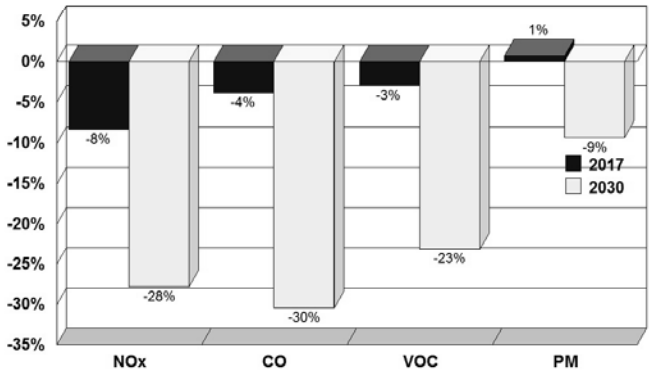
Overall Emissions Reductions From Onroad Mobile Sources



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**

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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**

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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**

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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

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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**

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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**

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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

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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

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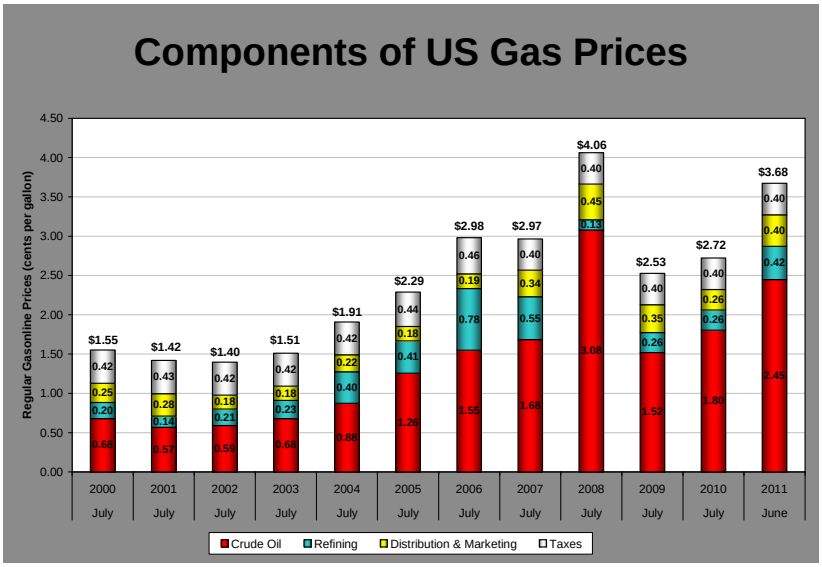
Components of US Gas Prices



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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

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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

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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

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