

US Experience with Advancing Vehicles Standards



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Common Transportation Challenges

- Growing Car and Truck Fleets
- Regional and Urban Air Quality
- Energy Security and Oil Consumption
- Economic Growth and Environmental Protection



U.S. Vehicle Emissions History

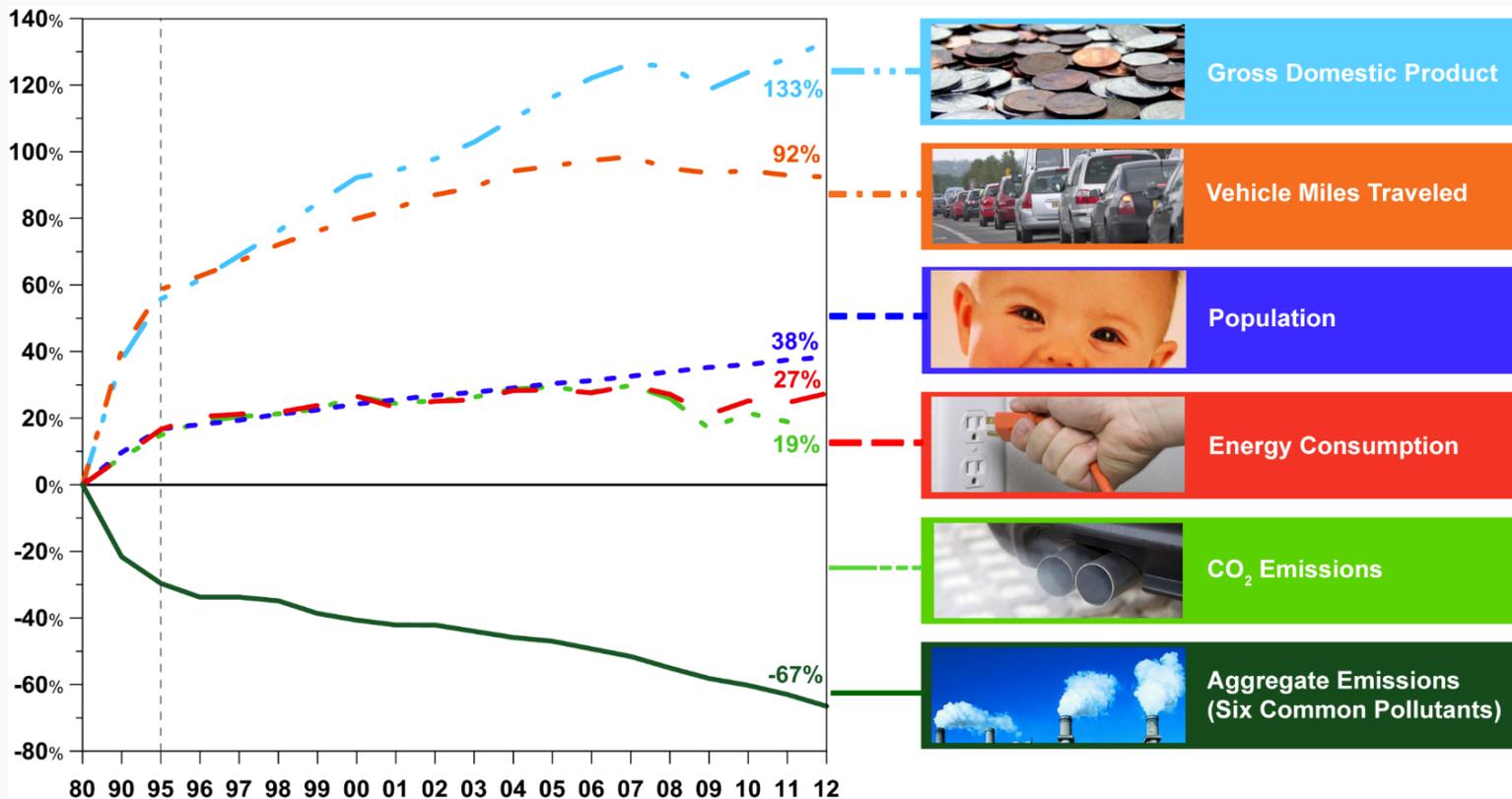
- U.S. was regulatory pioneer in 1970s
 - Major experiment sought to push the envelope on standards
 - Congress gave EPA “technology forcing” powers
 - Many feared economic risk and industry collapse
- EPA’s principles
 - Identify practical and cost-effective technology
 - Set performance standards to drive innovation and allow flexible compliance
 - Allow lead time to not disrupt investment cycles



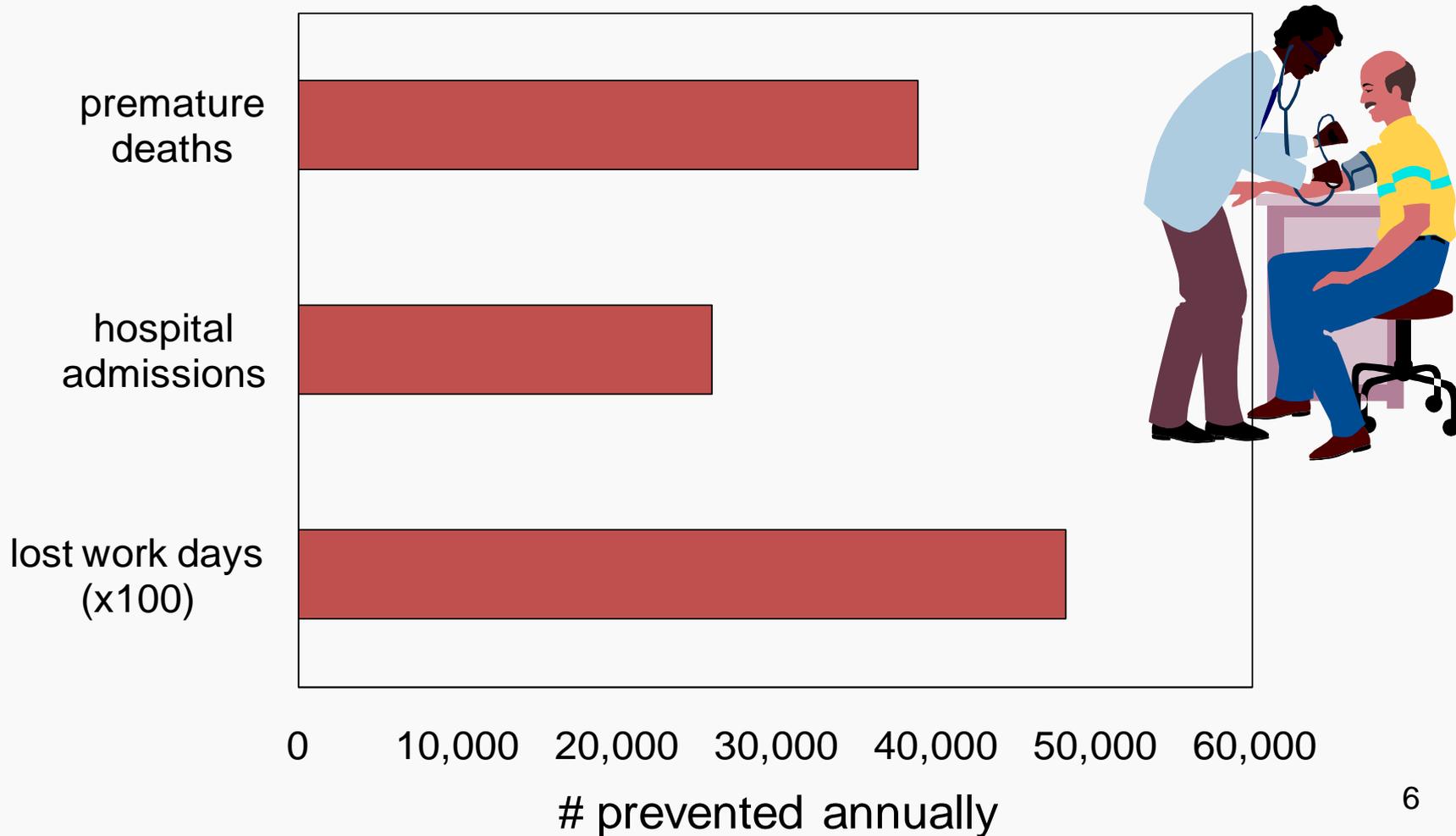
U.S. Clean Air Act: A Public Policy Success Story

- Cars cleaner and better
 - New cars are 98% cleaner
 - Monetized public health benefits far exceed the costs, often by 10:1 or more
 - Standards drove innovation, producing better vehicle quality, reliability, and durability
- Lower ambient pollution levels despite near tripling of U.S. GDP since 1970

Comparison of Growth Measures and Emissions 1990-2012



Snapshot of Health Benefits of Clean Diesel and Clean Car Programs in the last 15 years





Air Quality Benefits of EPA Mobile Standards by 2030

Annual Benefit in 2030	Light Duty Tier 2	Light Duty Tier 3	Heavy Duty 2007	Nonroad Diesel Tier 4	Locomotive & Marine Diesel	Ocean Vessel Strategy	2030 Total
NOx (tonnes)	2,540,117	299,371	2,358,680	669,502	721,212	1,088,622	7,674,783
PM2.5 (tonnes)	32,659	7,167	98,883	120,656	24,494	143,000	413,676
VOC (tonnes)	363,781	154,221	104,362	27,216	39,009	0	688,553
SOx (tonnes)	254,919	11,793	128,820	340,194	0	1,179,340	1,914,160
Total Cost (billion)	\$5.3	\$1.5	\$4.3	\$2.1	\$0.7	\$3.1	\$17
Net Monetized Benefits (billion)	\$25	\$9.2	\$66	\$83	\$11	\$110	\$304
Avoided Premature Mortality	4,300	960	8,300	12,000	1,300	13,000	40,000
Avoided Hospital Admissions	3,000	1,500	7,100	8,900	1,130	12,400	34,000
Avoided Lost Work Days	680,000	81,000	1,500,000	1,000,000	120,000	1,400,000	4,800,000

Notes: Totals may not sum due to rounding. All PM-related avoided premature mortality estimates based on the American Cancer Society cohort study and subsequent updates. For rules that include ozone-related premature mortality estimates (Locomotive & Marine, Ocean Vessel Strategy, and Light Duty Tier 3), an average across the range of mortality estimates was used. All rule-specific monetized values are presented in the dollar year in which they were estimated in their respective Regulatory Impact Analyses.



STRATEGIC APPROACH & LESSONS LEARNED



Three Point Strategy to Reduce Vehicle Emissions (GHGs & Air Quality)

1. **Clean Vehicles** - Develop technology-forcing performance standards for cars, buses, trucks, and nonroad engines, such as construction equipment, boats, lawn and garden equipment, and locomotives
2. **Clean Fuels** - Develop reformulated gasoline, diesel fuel, and nonpetroleum alternatives. Use of low sulfur fuels is critical to enable advanced vehicle technology as well as for the direct emissions benefits
3. **Clean Transportation Alternatives** - Develop strategies to encourage efficient transportation alternatives.



Lessons Learned from U.S. EPA Experience

- Our regulatory programs designed to promote innovation – well-formulated standards can be “win-win” for the economy and the environment.
- Predictable long term policies with clear measurable targets are critical for enabling industry to plan for and invest in advanced technologies.
 - Phased approaches achieve early reductions and long-term reductions
- Dialogue and Collaboration with stakeholders (industry, state/provincial governments, civil organizations) is critical to successful win-win policy.



Lessons Learned from U.S. EPA Experience

- Using a systems approach produces best results
 - Low sulfur fuel needed for advanced vehicle technologies & complete optimization.
 - Vehicle performance-based standards achieve the most cost-effective emissions reductions.
- A robust compliance regime is critical to achieving real-world benefits.
- Regulatory flexibilities and voluntary partnerships play important roles in reducing emissions and fuel consumption. They equitably reward technology leaders and early technology adopters.



KEY VEHICLE PROGRAMS



Light-Duty Vehicle/Tier Gasoline Sulfur Program: Tier 2, 2004+

- First time SUVs/pickups/vans subject to same standards as cars
- First time treating vehicles and fuels as a system
- Vehicles are 77% to 95% cleaner (depending on vehicle size), compared with model year 2003 and earlier
- Reduced sulfur in gasoline (from avg. 300 ppm to 30 ppm annual average)
- Equivalent to removing 164 million cars from road
- Health/environmental benefits of \$25 billion vs. \$5 billion in cost



Tier 3 Vehicle and Gasoline Sulfur Standards

- In March 2014 we finalized even tighter “Tier 3” standards for vehicles and gasoline sulfur which take effect in 2017
 - Part of comprehensive approach to create cleaner, more efficient vehicles
 - Coordinated with timing of vehicle greenhouse gas standards
 - Harmonized with California’s standards



Tier 3 Vehicle and Gasoline Sulfur Standards

- Tighter tailpipe standards for NMOG+NO_x, PM
- Tighter evaporative emissions standards
- Lower gasoline sulfur to 10 ppm annual average
 - Sulfur even at current levels (30 ppm average) degrades the performance of vehicle catalytic converters
 - Lower sulfur enables the tighter Tier 3 vehicle standards
 - Lower sulfur also immediately reduces NO_x and VOC emissions from the existing fleet



Heavy-Duty Diesel Program Overview

Applied new NO_x and PM standards to large trucks and buses

- 90%+ emission reductions—gasoline-like levels
- Based on high efficiency emission control devices (like passenger vehicle catalysts)
- Phased-in of NO_x standards 2007-2010
- Offered incentives for early technology introduction

Reduced diesel fuel sulfur levels nationwide

- Enabled use of advanced emission control technology
- Highway diesel fuel sulfur cap of 15 ppm
 - Phased in 80% by 2006
 - 100% by 2010



In summary ...Our experience...

Low Sulfur Fuel Programs Yield Huge Benefits

- Immediate improvement in air quality
 - Reduction of NO_x, PM and HCs
- Public health benefits
 - Avoided hospital visits
 - Avoided premature mortality
- Ability to utilize emerging pollution control technologies
 - Diesel particulate filters
 - Advanced NO_x technologies