

BRIEFING

AUGUST 2013

The Case for Early Implementation of Stricter Fuel Quality and Vehicle Emission Standards in India

BACKGROUND

The 2013 Auto Fuel Policy Committee is charged with establishing a roadmap for vehicle emission and fuel quality standards in India through 2025. While there is a general consensus that India eventually needs to move to 10 ppm sulfur fuels and Bharat Stage (BS) VI emission standards, there is still an ongoing discussion regarding the timeline of implementation of those stricter standards.

This briefing paper summarizes the public health and economic benefits of early implementation of stricter standards over 30 years. Economic benefits are compared to the costs of implementing stricter standards earlier.

SCENARIOS

We modeled two scenarios that differed on the timing of implementation of stricter standards in India. Both scenarios posited gradual moves to 10 ppm sulfur fuels and BS VI emission standards, but not beyond. Neither incorporated any changes in other types of vehicle emission regulations.

The ICCT Recommended scenario postulated a move to 10 ppm sulfur fuel by 2017 coupled with the implementation of BS VI standards by 2019, as outlined in a recent ICCT policy summary¹. The Delayed Timeline scenario assumed that 10 ppm sulfur fuels

¹ The International Council on Clean Transportation. *Policy Summary: India's Vehicle Emissions Control Program*. Available online at www.theicct.org/sites/default/files/publications/ICCT_Briefing_IndiaPolicySummary_20130703.pdf

were not mandated until 2020 and BS VI standards were not implemented until 2025, at the end of the Auto Fuel Policy Committee’s mandate. Figures 1 and 2 below show timelines of implementation for each scenario.

ICCT Recommended scenario	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	
Fuel Sulfur content (ppm)	50		10									
LDV Emission Standard	BS Va		BS Vb		BS VI							
HDV Emission Standard	BS V				BS VI							
2/3-Wheeler Emission Standard	BS IV				BS V				BS VI			

Figure 1: Assumed implementation timeline for ICCT Recommended scenario

Delayed Timeline scenario	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Fuel Sulfur content (ppm)	50+	50				10					
LDV Emission Standard	BS III/ BS IV	BS IV			BS Va			BS Vb			BS VI
HDV Emission Standard	BS III	BS IV				BS V					BS VI
2/3-Wheeler Emission Standard	BS IV					BS V					BS VI

Figure 2: Assumed implementation timeline for Delayed Timeline scenario

HEALTH AND ECONOMIC IMPACTS

The health and economic benefits from lower vehicle fine particulate matter (PM_{2.5}) emissions were estimated through the year 2045. Lower PM_{2.5} emissions were quantified as avoided PM_{2.5} emissions associated with earlier implementation of stricter vehicle emission standards.

Figure 3 below shows annual onroad vehicle PM_{2.5} emissions in India under the ICCT Recommended and the Delayed Timeline scenarios. The gap in PM_{2.5} emissions peaks in 2024, when the disparity between the two scenarios is the greatest. The gap begins to close after that as emission standards in the Delayed Timeline scenario catch up and BS VI vehicles penetrate into India’s vehicle fleet.

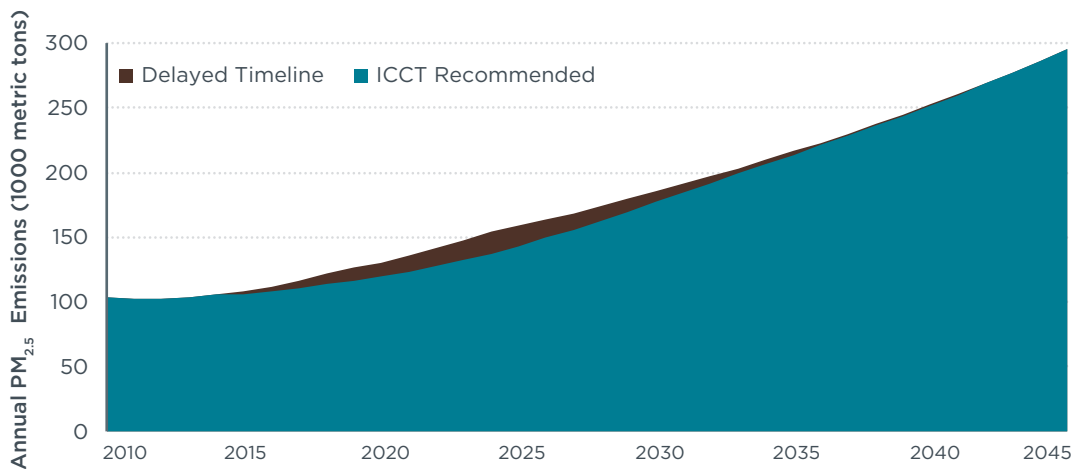


Figure 3: Annual PM_{2.5} emissions under the ICCT Recommended and the Delayed Timeline scenario

Health benefits were estimated in terms of avoided premature deaths from cardiopulmonary disease resulting from lower vehicle fine particulate matter (PM_{2.5}) emissions in urban areas. This was a conservative estimate of avoided premature mortality associated with reduced vehicle emissions, since neither rural health benefits nor benefits resulting from a reduction in emissions other than PM_{2.5} were considered.

Figure 4 shows annual avoided premature deaths. While avoided PM_{2.5} emissions peak in 2024, health benefits do not peak until 2027, because the positive impacts on air quality and public health are not felt immediately after reducing emissions. Through 2045, a total of 48,500 premature deaths could be avoided solely by mandating stricter standards earlier.

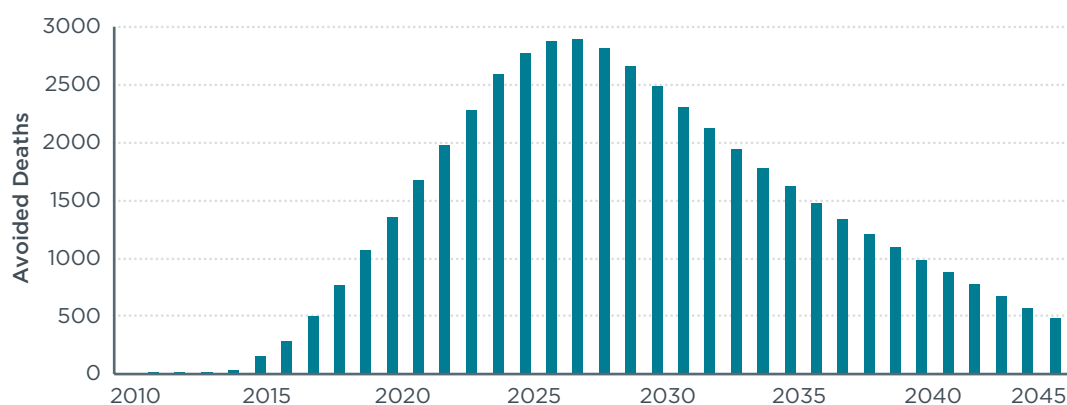


Figure 4: Annual avoided premature deaths attributable to early implementation of stricter vehicle emission standards, as envisioned by the ICCT Recommended scenario compared to the Delayed Timeline scenario

Economic benefits were quantified by multiplying avoided premature deaths by value of statistical life (VSL) estimates for India². Monetizing the avoided premature deaths cumulatively sums to about USD 90 million (INR 450,000 crore) through 2045.

COST-BENEFIT ANALYSIS

Costs associated with stricter standards include needed capital investment and increased operational costs for both low-sulfur fuel refining and clean vehicle manufacturing.

Low-sulfur refining costs were obtained from a study by the consultancies Hart Energy and MathPro, commissioned by the ICCT in 2012.³ Combining capital investments and increased operating costs, and normalizing them according to future fuel production estimates, the study found per liter costs in India to transition to 50 ppm and 10 ppm sulfur fuels to be about USD 0.005 (INR 0.30) and USD 0.0083 (INR 0.50), respectively.

Clean vehicle costs consist mainly of after-treatment technologies enabled by the availability of low-sulfur fuel and engine modifications necessary to reduce vehicle emissions. Per-vehicle costs were estimated for all vehicle types for each emission

² Madheswaran S. *Measuring the value of statistical life: estimating compensating wage differentials among workers in India*. Available online at <http://link.springer.com/article/10.1007%2Fs11205-006-9076-0>

³ Hart Energy, MathPro Inc. *Technical and economic analysis of the transition to ultra-low sulfur fuels in Brazil, China, India, and Mexico*. Available online at www.theicct.org/technical-and-economic-analysis-transition-ultra-low-sulfur-fuels-brazil-china-india-and-mexico

standard.⁴ Costs were highest for heavy-duty vehicles, compared to cars and two- and three-wheelers. The costs to upgrade diesel-powered cars to stricter emission standards were much higher than their gasoline-powered equivalents. Costs were lowest for two-wheelers.

Figure 5 shows the costs and benefits of implementing stricter emission standards earlier, as envisioned by the ICCT Recommended scenario instead of the Delayed Timeline scenario.

Costs vary from year to year, as low-sulfur fuel and clean vehicle investments shoot up when a standard envisioned by the ICCT Recommended scenario jumps ahead of the Delayed Timeline scenario. Costs fall to zero when both scenarios reach BS VI standards. On the other hand, benefits rise and fall much more smoothly. This is because the positive impacts of reduced emissions accrue over time.

Costs initially outweigh benefits, reflecting the higher prices of vehicle emission control components and low-sulfur fuels. Benefits peak about five years after costs peak. While costs decline rapidly to zero, benefits continue to accrue as cleaner vehicles resulting from the ICCT Recommended scenario's stricter standards continue to penetrate India's onroad vehicle fleet.

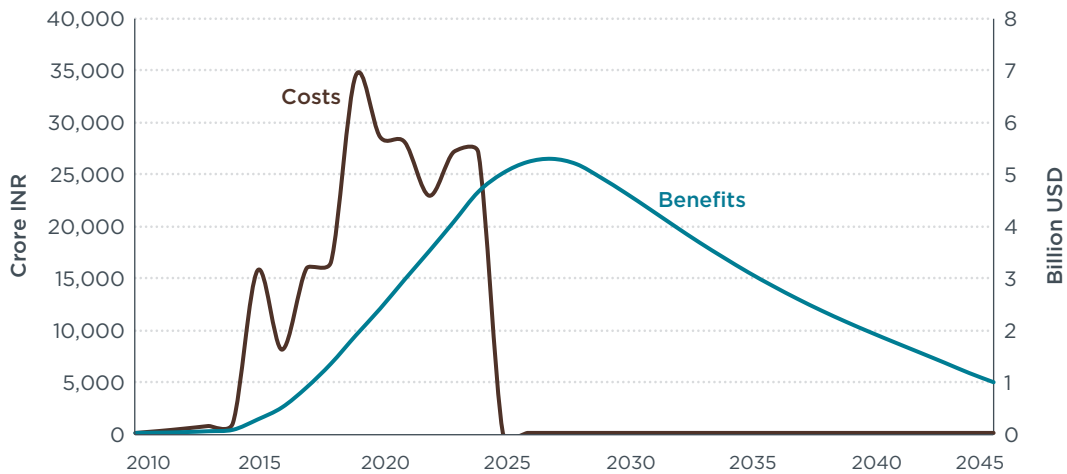


Figure 5: Costs and benefits of implementing the ICCT Recommended scenario instead of the Delayed Timeline scenario

Cumulatively, costs through 2045 totaled USD 45 billion (INR 226,000 crore), while benefits totaled USD 90 billion (INR 450,000 crore), for a benefit-to-cost ratio of almost 2:1. Furthermore, benefits continued to accrue even beyond 2045, while costs did not. This means the full benefit of implementing standards earlier would be greater than estimated in this analysis. It also highlights the importance of mandating strong regulations early on, as vehicles continue to operate for many years into the future.

CONCLUSION

The health and economic benefits of implementing stricter fuel quality and vehicle emission standards in India according to an accelerated timeline are clear. Moving to 10 ppm sulfur fuels by 2017 and BS VI standards by 2019, as opposed to 10 ppm sulfur

⁴ Posada F, Bandivadekar A, German J. *Estimated Cost of Emission Reduction Technologies for Light-Duty Vehicles*. Available online at www.theicct.org/sites/default/files/publications/ICCT_LDVCostsreport_2012.pdf

fuels in 2020 and BS VI standards in 2025, would result in an estimated 48,500 avoided premature deaths. The economic benefits of these avoided deaths would sum up to USD 90 billion (INR 450,000 crore) through 2045, while the costs of accelerated standards would sum up to half of that, or about USD 45 billion (INR 226,000 crore). Furthermore, benefits would continue to accrue beyond 2045, while costs would not. Additionally, it is important to note that for the purposes of this analysis benefits were calculated based only on avoided premature mortality resulting from lower vehicular PM_{2.5} emissions in urban areas. Benefits from reductions in other pollutants, reduced mortality in rural areas, and non-health benefits were not considered. These would all undoubtedly be significant.