

DIRECT PROGRESSION FROM BHARAT IV TO BHARAT VI NATIONAL VEHICLE EMISSION STANDARDS IN INDIA

Following the submission of the Saumitra Chaudhari committee report on Auto Fuel Vision and Policy,¹ the Ministry of Petroleum and Natural Gas (MoPNG) has been considering the possibility of leapfrogging from Bharat Stage (BS) IV emission standards in April 2017 to BS VI emission standards in April 2020. The Parliamentary Committee on Petroleum and Natural Gas has endorsed the idea.²

The case for expediting progress to Bharat VI standards, which are based on the European Euro 6/VI standards, is persuasive. It is supported by five main considerations.

1. Superior design of the Euro 6/VI emission standards. For heavy-duty vehicles, Euro V standards have not achieved hoped-for reductions for nitrogen oxide (NO_x) emissions.³ While Euro 5 standards have resulted in dramatic reductions in particulate matter (PM) emissions from light-duty diesels, real-world diesel NO_x emissions have continued to far exceed certification limits.⁴ The ICCT has published a briefing that describes the technical advantages Euro 6/VI standards over

Euro 5/V standards in detail.⁵ Given the regulatory improvements that Euro 6/VI standards provide, ICCT recommends that all countries following emission standards modeled after European regulations should move directly from Euro 4/IV to Euro 6/VI standards.

2. Measurement of in-use emissions reveal that Euro VI standards achieve a much greater reduction in NO_x emissions from Euro IV/V levels than the emissions limits alone would indicate. Heavy-duty vehicles built and certified in conformity to Euro IV and V emissions standards frequently do not achieve the real-world NO_x emissions required under those standards. Now data is becoming available to show whether new certification protocols in the Euro VI regulation resolve this problem. The evidence thus far indicates that under Euro VI, NO_x emissions are indeed meeting expectations, even in the most difficult operating conditions. Going directly from Euro IV (Bharat IV) to Euro VI (Bharat VI) will achieve a larger NO_x reduction than the 88% reduction in certification level would indicate. In practice this number is likely closer to 98%.⁶

3. By 2020, the emission control technology needed to meet Euro 6/VI standards will be in its fourth generation, with minimal impact on fuel efficiency. There is very little difference in the heavy-duty technologies needed to comply with Bharat IV and Bharat V emission standards. In the European experience, catalyst

1 Report of the Expert Committee on "Auto Fuel Vision and Policy 2025" (2014). <http://petroleum.nic.in/docs/reports/autopol.pdf>.

2 Standing Committee on Petroleum and Natural Gas, Sixteenth Lok Sabha. Fifth Report. National Auto Fuel Policy (2015). http://164.100.47.134/Isscommittee/Petroleum%20&%20Natural%20Gas/16_Petroleum_And_Natural_Gas_5.pdf.

3 Ligterink, N., de Lange, R., Vermeulen, R., and Dekker, H. (2009). On-road NO_x emissions of Euro-V trucks. http://www.researchgate.net/publication/235961441_On-road_nox_emissions_of_Euro-V_trucks.

4 Carslaw, D., Beevers, S., Tate, J., Westmoreland, E., and Williams, M. (2011). Recent evidence concerning higher NO_x emissions from passenger cars and light duty vehicles. *Atmospheric Environment*, vol. 45, no. 39, pp. 7053-7063.

5 Chambliss S., and Bandivadekar A. (2015). Accelerating progress from Euro 4/IV to Euro 6/VI vehicle emissions standards. <http://www.theicct.org/briefing-leapfrogging-to-euro-6-vi-mar2015>.

6 Muncrief R. (2015). Comparing real-world off-cycle NO_x emissions control in Euro IV, V, and VI. <http://www.theicct.org/comparing-real-world-nox-euro-iv-v-vi-mar2015>.

improvements were implemented, but most of the advancement came in calibration. Euro VI was a sizable change that required adoption of a diesel particulate filter (DPF). However, the U.S. experience in implementing both selective catalytic reduction (SCR) for NO_x control and DPFs for particulate matter significantly helped guide European implementation. By the end of this decade, U.S. and EU SCR+DPF systems will be fully mature, and perhaps in their fourth generation. This accumulated experience will inform Indian manufacturers as they move into consolidated SCR and DPF systems.

One outcome of this research is the improvement in engine efficiency to counteract the efficiency reduction that may accompany advanced aftertreatment. The DPF impacts fuel consumption by raising exhaust back-pressure, and by requiring intermittent injections of additional fuel to regenerate the filter when it is loaded with PM and not regenerating passively. Improvements in catalyst design and engine controls have reduced the need to regenerate, but augmenting the catalyst energy is still necessary for long periods of idling or low power operation. Manufacturers have mitigated the negative fuel impacts of DPFs by making efficiency improvements in other areas of the engine and vehicle.

By combining a move to Bharat VI with an engine-efficiency standard, India can ensure that any small fuel-consumption impacts associated with DPFs would be overshadowed by other engine-efficiency improvements. Since the Petroleum Conservation Research Association (PCRA) is already working with various stakeholders to come up with a heavy-duty efficiency standard for India, concerns about fuel consumption impact of Bharat VI will be moot.

The technologies used to meet Bharat VI light-duty standards are also well established. Euro 6 will require aftertreatment technologies for NO_x as well as particulate control. Such systems have been employed in the United States since 2007, and in Europe and Korea since 2014. As of 2015, millions of light-duty vehicles conforming to Euro 6 regulations have been manufactured, and extensive data are becoming available on the emissions performance of these vehicles. By the end of this

decade, these systems will also be in their fourth generation, and India will be poised to benefit from years of technological advances.

4. A scrappage program for heavy commercial vehicles can create economic incentives necessary to alleviate automobile industry concerns about impact on vehicle sales. Stringent vehicle emission standards can reduce tailpipe emissions of new vehicles, but phasing in new-vehicle standards across the entire vehicle fleet takes time. Complementing new-vehicle emission standards with policy efforts focused on reducing in-use vehicle emissions can shorten this time lag.

Manufacturers may want to delay introduction of the most stringent emission standards (Bharat VI) because they fear that buyers of heavy-commercial vehicles will either pre-purchase older-technology vehicles (Bharat V) or delay purchasing new vehicles as long as possible to avoid the additional cost of the diesel particulate filter in a Bharat VI vehicle.

Implementing a five-year program (2020 to 2024) to scrap older commercial vehicles and buses would allow the country to gradually adjust to higher vehicle costs while also reaping air-quality benefits.⁷ Under this scheme, heavy-duty vehicle owners can get a subsidy to replace their older (Bharat I, II or III), still-operational vehicle with a new Bharat VI vehicle at the price of a Bharat V-equivalent vehicle. Such an incentive could be offered through: (i) Lower excise tax rate on BS VI vehicles, so that the cost differential between a BS VI and BS V vehicle is minimal; (ii) Allowing companies to use the Corporate Social Responsibility (CSR) spend to promote modernization of bus fleets; (iii) Leveraging multilateral bank funding to promote climate co-benefits due to reduction of diesel black carbon, if that is consistent with India's climate policy.

On the economic front, subsidies to offset the price increase of Bharat VI vehicles would take the burden off transporters and goods carriers, and that would let the automobile industry produce Bharat VI vehicles without worrying about any detrimental effect on sales. On the environmental side,

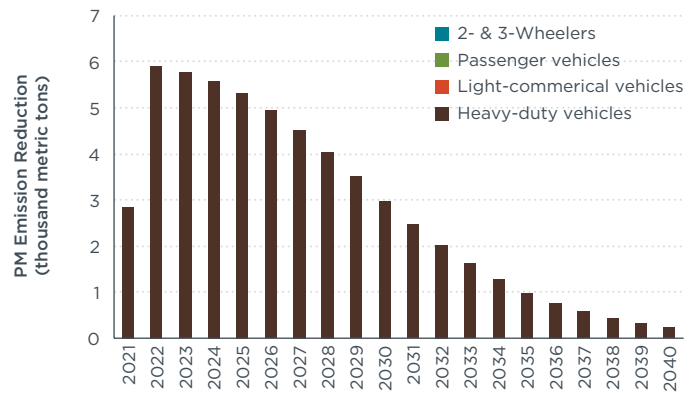
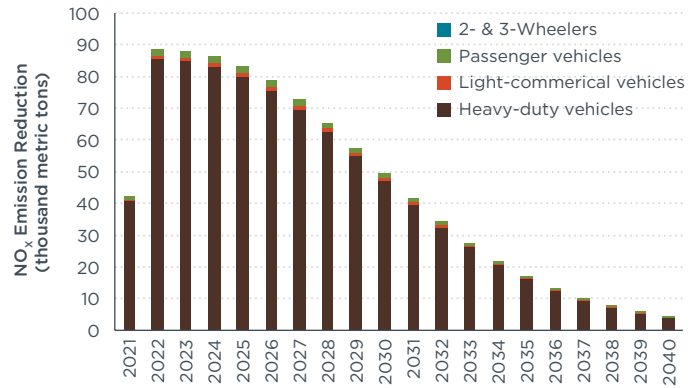
7 Bansal G. (2015). Making Bharat VI Affordable. <http://www.theicct.org/blogs/staff/making-bharat-vi-affordable>.

hastening the replacement of older heavy-vehicles with Bharat VI vehicles will reduce particulate matter emissions by more than 99%. Furthermore, considering that newer trucks are much safer on the road, additional road safety benefits themselves might justify the cost of the program.

The ICCT supports implementation of a program to scrap older commercial vehicles and buses to allow the country to gradually adjust to higher vehicle costs of BS VI vehicles while also reaping air-quality benefits.

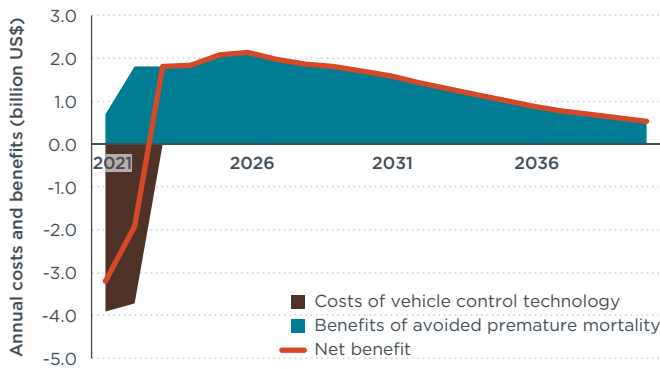
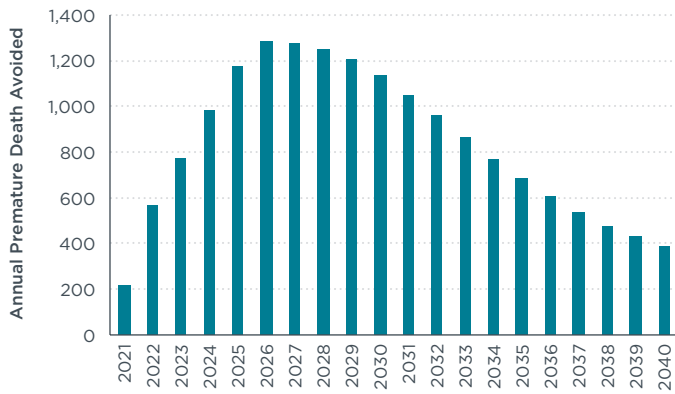
5. Economic benefits of advancing Bharat VI standards far outweigh costs, and fully justify investments made in supplying ultra-low sulfur fuel. Adoption of stringent emission standards such as Bharat VI requires investments in the near term that will generate tremendous health benefits over the long term. Our analysis indicates that the health benefits gained by earlier adoption of Bharat VI standards alone could save thousands of additional lives, as shown in charts below. Due to the long lifetime of heavy-duty vehicles, the early adoption of Bharat VI standards will continue to generate emission reductions and corresponding reduction in premature mortality well in to 2040s. These health benefits will fully offset the increase in costs in the first seven years of the program. When coupled with a scrappage scheme, such as described above, these benefits would be even greater.

The benefits in this analysis are derived solely from reduced mortality owing to reduced direct vehicular PM emissions. Benefits from lower emissions of other pollutants, such as NO_x and ozone, are not evaluated, though these have also been shown to have a negative impact on human health. Nor are benefits from reduced morbidity—such as lower health care costs and increased worker productivity—assessed.



Additional emission reductions of leapfrogging to BS VI standards.

Considering the fact that Bharat V and VI emission standards are both based on supply of ultra-low sulfur fuels (ULSF, ≤10 ppm sulfur), availability of these “clean” fuels nationwide by April 2020 would allow the country to take full advantage of the upfront refinery investments made to produce them.



Bharat emission standards are based on the European emission standards. Indian policymaking on vehicles and fuels should exploit lessons learned in the European market. This means acknowledging both the successes of these policies in leading to highly efficient control technology and the failings in intermediate policy stages. Since the adoption of Euro 5/V standards across the EU, several shortcomings of the regulation have been revealed, and these shortcomings have subsequently overcome to a large extent in the Euro 6/VI regulations. Instead of blindly following in European footsteps, policymakers in India should weigh these regulatory improvements, and move directly to BS VI standards instead of including the intermediate stages.

Additional health benefits of leapfrogging to BS VI standards.