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COST-EFFECTIVENESS OF ENGINE TECHNOLOGIES FOR A POTENTIAL HEAVY-DUTY VEHICLE FUEL EFFICIENCY REGULATION IN INDIA

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As policymakers and stakeholders in India begin the regulatory development process for fuel efficiency standards for new heavy-duty vehicles (HDVs), one of the key areas of debate has been whether or not separate performance standards for engines are an appropriate first step. Based on our most recent analysis,[1] the ICCT supports engine-based standards in the first phase HDV fuel efficiency regulation in India, for three reasons: (1) to realize fuel savings as soon as possible; (2) to leverage existing testing facilities and expertise; and (3) to limit complexity. Furthermore, our analysis indicates that regulatory experience and technology cost-effectiveness data from the United States provide evidence that engine technologies are quite cost-effective compared technology interventions in other vehicle areas.

In the U.S. Phase 1 regulation, tractor truck manufacturers have various ways of achieving compliance with the standard, including aerodynamics, tires, weight savings, idle reduction technology, and engines. Using the example compliance pathway that the agencies presented for high-roof sleepers in the regulation (see Table III-5),[2] the blue columns in Figure 1 represent the percent contribution of each technology area to the overall 23% reduction in fuel consumption required for this vehicle category.

Dividing the cost figures in the regulation (see Table III-7) by these individual percent reductions yields the $/[% reduction] values shown in the orange columns. As shown, engine technologies are second only to tires in terms of cost-effectiveness.

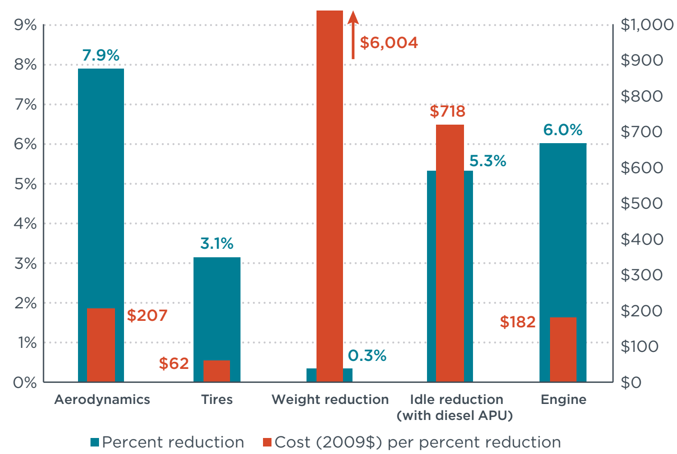

Figure 1: Example fuel reductions and cost-effectiveness for a high roof sleeper tractor truck in the U.S. Phase 1 heavy-duty vehicle regulation. Reductions are compared to a model year 2010 baseline.

Looking beyond the Phase 1 regulation, recent ICCT reports investigating tractor-trailer technology potential and costs provide evidence that in the post–2020 timeframe engine technologies will continue to yield cost-effective savings.[3] For this research, the most fuel efficient technology package

1 Sharpe, B. (2015). Testing methods for heavy-duty vehicle fuel efficiency: Trends from regulatory programs around the world and implications for India. Available at www.theicct.org/hdv-efficiency-test-procedures-trends-implications-india.

2 Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles. Available at www.gpo.gov/fdsys/pkg/FR-2011-09-15/pdf/2011-20740.pdf

3 Meszler D. et al. (2015). Cost-effectiveness of advanced efficiency technologies for long-haul tractor-trailers in the 2020-2030 timeframe. Available at www.theicct.org/us-tractor-trailer-tech-cost-effectiveness.

for high-roof sleeper tractors that was developed yielded more than a doubling in fuel economy, from roughly 5.3 mpg (2.3 km/l) to 11.6 mpg (4.9 km/l). As in Figure 1, the blue columns in Figure 2 represent the percent fuel consumption reduction from each technology area, and the orange columns show the cost-effectiveness values. As is the case of the Phase 1 regulation, engine improvements are again second only to tires in terms of cost-effective benefits. These results are further evidence that engine technologies are very cost competitive and often out-perform other HDV technology areas.

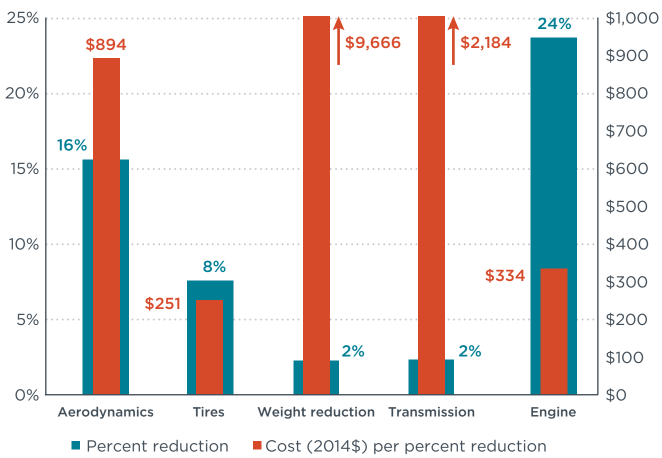

Figure 2: Fuel reductions and cost-effectiveness for the most fuel efficient tractor-trailer technology package for the 2025 timeframe developed by Meszler, Lutsey, and Delgado (2015). Reductions are compared to a model year 2010 baseline.

How well should these results translate to the Indian context? It's clear that trucking operations and configurations are very different between the two markets. Trucks in India typically travel much slower than trucks in the U.S., and as of April 1, 2014, India's Ministry of Road Transport is requiring that all new commercial vehicles be equipped with speed limiters set at a maximum of 80 kph.[4] This is in contrast to maximum highway speed limits in North America, which typically fall between 55 and 75 mph (89–121 kph). So what can this analysis tell us about the situation for Indian HDVs? To begin with, engines play a larger role in the overall losses for HDVs in India due to slower average speeds; thus, engine efficiency technologies are likely to be more impactful in India than in the U.S. This is more clearly understood by looking at a vehicle simulation energy balance example, which is taken from an Argonne National Laboratory report.[5] Figure 3 shows how the losses break down for a truck traveling at constant speed on a flat road. As the speed increases from 30 mph (48 kph) at 5 mph increments up to 70 mph (113 kph), we can see that aerodynamics become an increasingly important contributor to overall losses. Engine losses play a critical role, especially at lower speeds, but even at high speeds, engines account for well over half of the total energy losses.

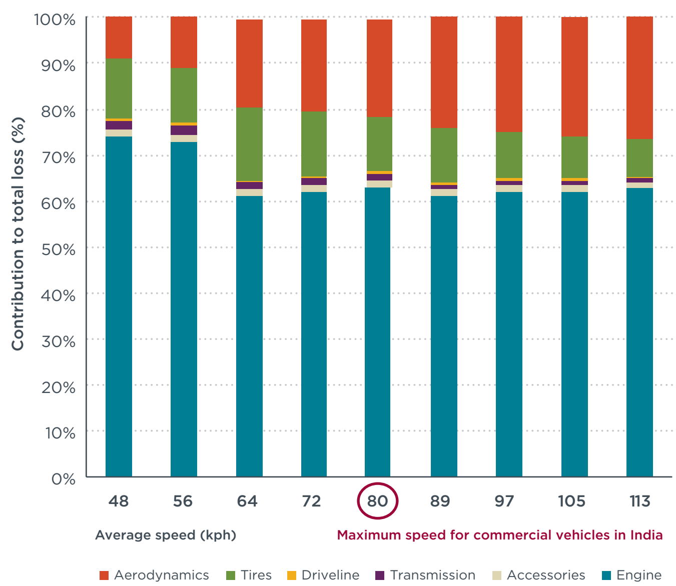

Figure 3: Distribution of losses for a HDV traveling at constant speed (derived from Delorme et al., 2009)

Engine technologies, in sum, should be cost-effective for the Indian market. Based on this economic benefit-cost result, the ICCT recommends that India move forward with mandatory performance standards for engines. An engine regulation in India will yield cost-effective fuel savings and environmental benefits for the trucking industry and the Indian economy as a whole. Nevertheless, the ICCT further recommends that in parallel with the regulatory development process for engines policymakers in India also embark on the

4 Ministry of Road Transport and Highways (2012). The Gazette of India, Part II—Sec. 3(i). Notification on December 31st, 2012. Available at http://morth.nic.in/writereaddata/linkimages/943-8362675062.pdf.

5 Delorme, A et al. (2009). Evaluation of Fuel Consumption Potential of Medium and Heavy Duty Vehicles through Modeling and Simulation. Available at www.autonomie.net/docs/6%20-%20Papers/nas_mediumheavyduty_2009.pdf.

technical and policy analyses required to move beyond engine-only standards to a regulatory approach that promotes improvements across the entire range of technologies available for HDV fuel savings.

In addition to policy action on engines, our analysis points to the significant opportunities for cost-effective fuel savings that tire technologies can provide in the Indian HDV sector. There is international precedent for regulatory measures to address the impact of tires on fuel efficiency, such as the European Union's tire labeling regulation.[6] Two of the most attractive aspects of a regulatory program targeting tires are that a policy can be developed independently of a regulation promoting HDV efficiency, and that fuel savings and environmental benefits extend beyond new vehicles to the entire in-use fleet.

Policy has an important role to play in accelerating the development and deployment of cost-effective technologies in the heavy-duty vehicle sector. Our assessment of the Indian context, bringing to bear both empirical data from the North American experience with heavy-duty vehicle efficiency regulation and additional modeling and analysis of engine and vehicle technologies, firmly supports a position in favor or setting separate engine standards in the first phase of an Indian HDV efficiency regulation.

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6 Regulation (EC) No 1222/2009 of the European Parliament and of the Council on the labeling of tyres with respect to fuel efficiency and other essential parameters. Available at http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009R1222&from=EN