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POLICY UPDATE

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SECOND-PHASE FUEL ECONOMY STANDARDS FOR ON-ROAD HEAVY-DUTY VEHICLES IN JAPAN

ICCT **POLICY UPDATES** SUMMARIZE REGULATORY AND OTHER DEVELOPMENTS RELATED TO CLEAN TRANSPORTATION WORLDWIDE.

On December 12, 2017, Japan's Ministry of Land, Infrastructure, and Transportation (MLIT) finalized new fuel economy standards for new on-road heavy-duty vehicles as part of the government's ongoing effort to reduce the country's petroleum usage and greenhouse gas (GHG) emissions.[1] In Japan, commercial trucks and buses account for 35% of carbon dioxide emissions from the transport sector and 42% of carbon emissions from on-road vehicles.[2] The Phase 2 regulation applies to model year (MY) 2025 diesel commercial vehicles with a gross vehicle weight (GVW) of 3.5 tonnes or more, as well as buses that can transport 10 or more passengers. The Phase 2 regulation follows the Phase 1 regulation[3], which was finalized in 2005 with a MY 2015 compliance deadline. Japan deserves credit as the first jurisdiction in the world to set a fuel efficiency performance regulation for commercial trucks and buses.

As with the Phase 1 regulation, the Phase 2 fuel economy requirements were determined using the 'Top Runner' method. In this approach, the vehicle model with the best fuel efficiency in each vehicle type and weight class for the baseline year (i.e., model year 2015 in the Phase 2 regulation) is designated as the "top runner." The fuel economy levels of the top runner models in each vehicle class are then set as the target fuel economy values for the remaining vehicle models. Hybrids, electric vehicles, alternative fuel, and other advanced technology vehicles are excluded from the top runner system. However, in the Phase 2 regulatory document, MLIT stated that it would be developing a measurement method for heavy-duty electric vehicles and exploring the possibility of creating efficiency standards for these and other types of advanced technology trucks and buses.

As part of the Phase 1 fuel economy regulation, Japan implemented a vehicle fuel efficiency certification program which used a combination of engine dynamometer

1 "合同会議 とりまとめ（重量車燃費基準等）(Joint conference summary, weight vehicle fuel economy standard)," Energy Conservation / New Energy Subcommittee of Integrated Resources and Energy Research Committee, Energy Conservation Subcommittee Automobile Judgment Standard Working Group, Transportation Policy Council Ground Transportation Subcommittee Automobile Subcommittee Automobile Fuel Economy Standard Subcommittee, December 29, 2018, http://www.mlit.go.jp/common/001212395.pdf

2 "Transportation Roadmap," International Council on Clean Transportation, accessed 24 January 2019, https://www.theicct.org/transportation-roadmap

3 "Japan: Heavy Duty Fuel Economy," TransportPolicy.net, accessed 24 January 2019, https://www.transportpolicy.net/standard/japan-heavy-duty-fuel-economy/

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testing and vehicle simulation modeling.[4] Under the Phase 2 standards, regulators in Japan refined the certification protocols and simulation model. Specifically, the standard:

- Increased the t steady-state engine fuel map test points from 31 points (6 RPM x 5 torque points plus one idle point) to 51 points (10 RPM x 5 torque points plus one idle point);
- Incorporated confirmed data for aerodynamic and rolling resistance into the simulation;
- Updated inter-urban driving share and load factors (mass and passengers) to real world values;
- Changed the manual transmission shifting algorithm by making minor adjustments to the engine rotation speeds;
- Calculates second-by second gear position of the AMT;
- Introduced a new function for drive system inertial mass to be used to estimate air resistance from the coast down test; and
- Introduced a 3% correction factor for the urban driving mode to capture the effects of transient engine operation.

Table 1 summarizes the average MY 2015 baseline fuel consumption values, the Phase 2 2025 requirements, and the percentage reduction between 2015 and 2025 for the major truck and bus categories. The fuel consumption values are calculations from the kilometers per liter values that are presented in the regulation. The average fuel efficiency values in Table 1 are converted directly from the kilometers per liter values given in the regulation and are based on weighting from 2014 sales data.

Table 1: Summary of 2025 fuel efficiency targets and percentage improvements by vehicle type and class

Vehicle type	Class	Fuel economy (liters / 100 km)		Improvement
		2015 baseline	2025 target	
Trucks	Tractor trucks	35.2	34.0	3.4%
	Other trucks	14.1	12.3	12.7%
	Total average	14.9	13.1	11.9%
Buses	Urban buses	21.0	20.0	4.8%
	Highway buses	16.5	13.9	15.5%
	Total average	17.5	15.3	12.4%

Table 2 shows the individual targets for each vehicle subcategory specified in the regulation. As with the Phase 1 regulation, compliance with the Phase 2 fuel economy targets will be measured by reference to individual standards that are disaggregated by vehicle class, gross vehicle weight, and, for lighter trucks, rated cargo load. Each manufacturer is required to meet the fuel efficiency target for each bin in which it sells vehicles.

4 More detailed information about Japan's testing and certification process for heavy-duty vehicle fuel economy can be found at "Japan: Heavy Duty Fuel Economy," TransportPolicy.net, https://www.transportpolicy.net/standard/japan-heavy-duty-fuel-economy/

Table 2: Summary of 2025 fuel efficiency targets by vehicle type, gross vehicle weight, and rated cargo capacity

Vehicle type	Gross vehicle weight (tonnes)	Rated cargo (tonnes)	Fuel economy target (liters / 100 km)
Other Truck	3.5 ≤ GVW < 7.5	cargo ≤ 1.5	7.4
		1.5 < cargo ≤ 2	8.4
		2 < cargo ≤ 3	9.4
		cargo < 3	10.1
	7.5 < GVW ≤ 8	-	11.9
	8 < GVW ≤ 10	-	13.4
	10 < GVW ≤ 12	-	13.4
	12 < GVW ≤ 14	-	15.6
	14 < GVW ≤ 16	-	17.0
	16 < GVW ≤ 20	-	20.5
	20 < GVW ≤ 25	-	22.6
Tractor truck	GVW ≤ 20	-	32.2
	20 < GVW	-	43.1
Transit bus	6 < GVW ≤ 8	-	14.0
	8 < GVW ≤ 10	-	15.9
	10 < GVW ≤ 12	-	17.2
	12 < GVW ≤ 14	-	19.0
	14 < GVW	-	22.1
Highway bus	3.5 < GVW ≤ 6	-	10.5
	6 < GVW ≤ 8	-	12.9
	8 < GVW ≤ 10	-	15.7
	10 < GVW ≤ 12	-	16.5
	12 < GVW ≤ 14	-	18.9
	14 < GVW ≤ 16	-	18.9
	16 < GVW	-	19.5

Figure 1 shows the 2002 baseline fuel consumption in relation to the 2015 and 2025 targets. Due to the updates in the testing procedures and simulation model, the 2025 values are not directly comparable to the values from the earlier years. Overall, the required fuel consumption reduction between 2002 and 2025 vary widely based on the vehicle subcategory, ranging from roughly 5% to 30%. This wide variability in stringency is due to the fact that the fuel economy value of the top runner in certain categories is very close to the other models (thus resulting in a relatively less stringent targets for the non-top runner vehicle models), while in other categories the efficiency gap between the top runner and the remaining models is more substantial.

Vehicle type	Gross vehicle weight (tonnes)	Rated cargo (tonnes)
Other Truck	3.5 < GVW < 7.5	cargo < 1.5
		1.5 < cargo < 2
		2 < cargo < 3
		cargo < 3
	7.5 < GVW < 8	-
	8 < GVW < 10	-
	10 < GVW < 12	-
	12 < GVW < 14	-
	14 < GVW < 16	-
	16 < GVW < 20	-
	20 < GVW < 25	-
Tractor truck	GVW < 20	-
	20 < GVW	-
Transit bus	6 < GVW < 8	-
	8 < GVW < 10	-
	10 < GVW < 12	-
	12 < GVW < 14	-
	14 < GVW	-
Highway bus	3.5 < GVW < 6	-
	6 < GVW < 8	-
	8 < GVW < 10	-
	10 < GVW < 12	-
	12 < GVW < 14	-
	14 < GVW < 16	-
	16 < GVW	-

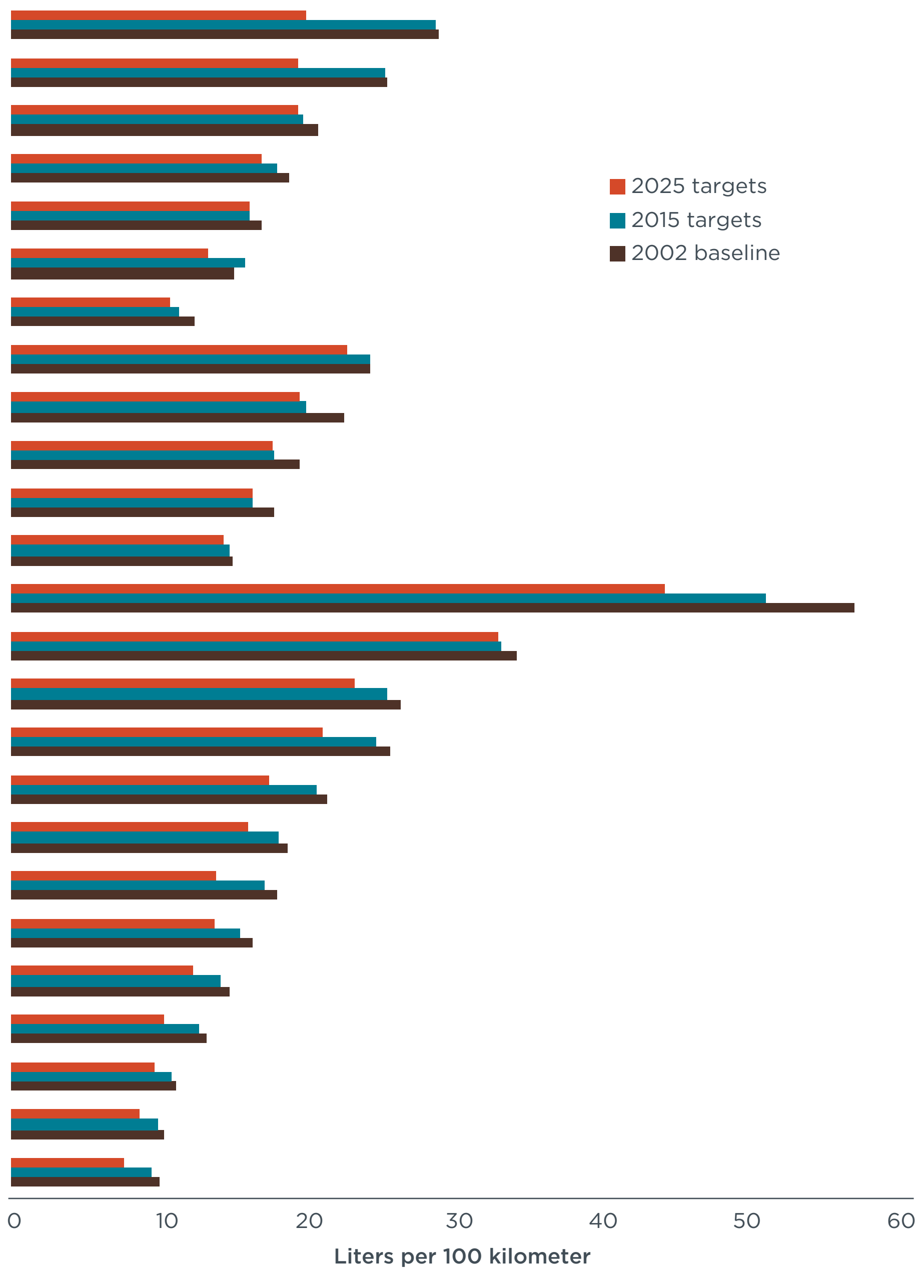

Figure 1: Fuel efficiency by vehicle subcategory – 2002 baseline, 2015 targets, and 2025 targets

While Japan deserves credit as the first country in the world to implement fuel efficiency standards for heavy-duty vehicles, the stringency of its first and second phase standards has lagged behind regulations in other major markets. Figure 2 shows the relative stringency of the different tractor-trailer efficiency standards with respect to the baseline defined when the standards were introduced. The figure does not show a direct comparison of stringency among the standards. The figure instead shows the efficiency targets by relating the reduction requirements to a fixed baseline. Note, however, that the technology baselines, testing methodologies, test cycles, allowed payloads, and evaluated metrics are country-specific. The figure is presented for illustrative purposes and does not capture all the underlying details that are common or different across regions.

For tractor trucks, Japan's requirements in 2015 and 2025—starting from a 2002 baseline—translate to annual improvements of around 1%. This is well below the annual efficiency gains in the U.S., China, and the E.U., which range from 3% to 5% per year. Given the trends evident in the figure, if Japan aims to be a leader in heavy-duty vehicle efficiency technology, it is likely that it will need to transition away from the Top Runner approach to a method for setting regulatory stringency that is more technology-forcing and requires manufacturers to push beyond current commercially available technologies.

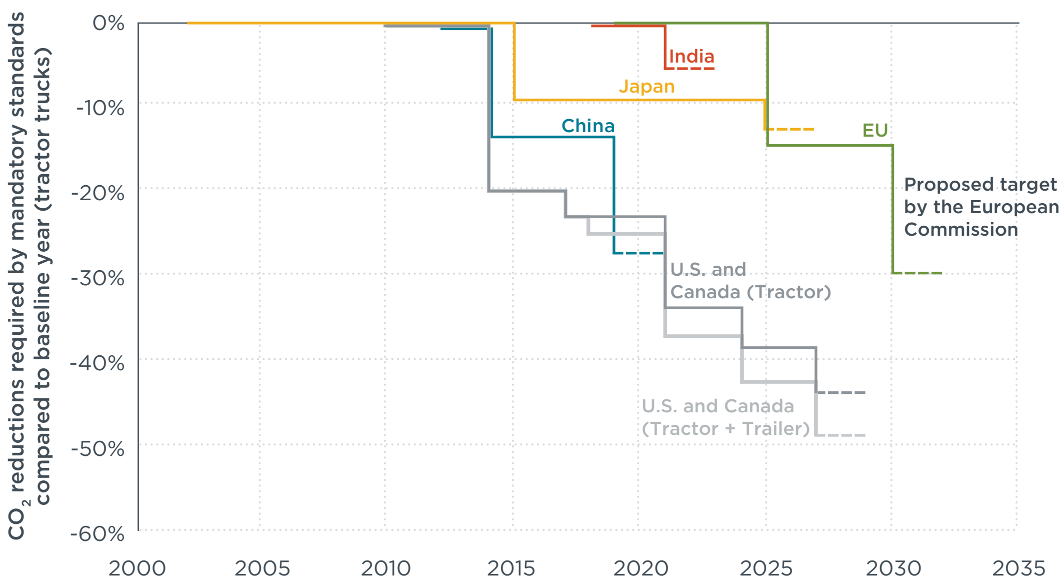

Figure 2: Tractor truck standards around the world relative to the baseline in the first phase of the standards