

China's Stage 4 fuel consumption standard for heavy-duty commercial vehicles

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On September 29, 2024, China's Ministry of Industry and Information Technology published the fourth stage of the fuel consumption standard for heavy-duty commercial vehicles (GB 30510-2024).¹ The standard limits heavy-duty commercial vehicles' per-vehicle fuel consumption (in L/100 km), and covers new tractor-trailers, straight trucks, dump trucks (including concrete mixers), coaches, and city buses with a gross vehicle weight (GVW) greater than 3,500 kg. Stage 4 regulates heavy-duty vehicles (HDVs) with diesel and gasoline engines and heavy-duty hybrid electric vehicles, and it will go into effect on July 1, 2025, for new type-approvals and on July 1, 2027, for new heavy commercial vehicles sold in China.

BACKGROUND

In China, the HDV segment consumes more than half of the total fuel used for on-road transport, even though it only represents about 15% of the nation's vehicle stock.² Before the Stage 4 standard, three stages of HDV fuel consumption standards were adopted over a decade, as detailed in Figure 1.

The Stage 1 standard, the first Chinese HDV fuel consumption standard, was implemented in July 2012 for three segments: tractor-trailers, straight trucks, and coaches. The Stage 2 standard, implemented in July 2014, expanded the coverage to include dump trucks and city buses and tightened the limits by 10.5%-14.5%, depending on vehicle type.³ The Stage 3 standard, implemented in July 2019, retained

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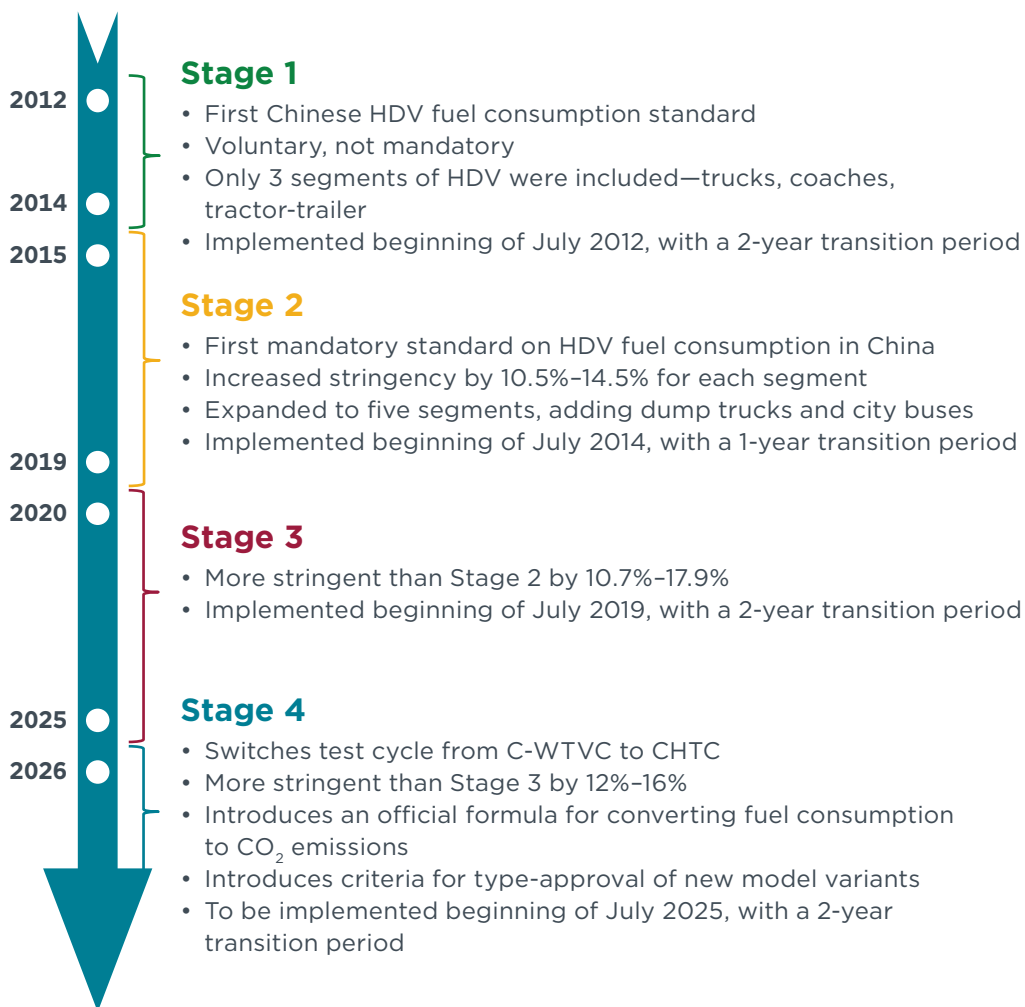
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- 1 Ministry of Industry and Information Technology of China, "重型商用车燃料消耗量限值 [Fuel consumption limits for heavy-duty commercial vehicles]," September 2024, <https://openstd.samr.gov.cn/bzgk/gb/newGbInfo?hcno=35651BC9CFA4506EB75F140E59A4F73D>.
- 2 China Automotive Technology and Research Center (CATARC), "重型商用车燃料消耗量限值国家标准征求意见稿编制说明 [Description of Proposal for Fuel Consumption Limits for Heavy-Duty Commercial Vehicles]," June 2022, https://www.miit.gov.cn/jgsj/zbys/gzdt/art/2022/art_fdbb7285735f46eb88d6128b2a7e95c1.html.
- 3 Jun Tu and Hui He, *Final Phase 2 China Fuel Consumption Standard for Commercial HDVs* (International Council on Clean Transportation, 2014), <https://theicct.org/publication/final-phase-2-china-fuel-consumption-standard-for-commercial-hdvs/>.

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the same regulated vehicle types as Stage 2 and increased the stringency by 10.7%–17.9% compared with Stage 2 limits.⁴

Figure 1
Timeline of China’s fuel consumption standards for heavy-duty vehicles



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STAGE 4 HIGHLIGHTS

Stage 4 introduces significant updates, including stricter fuel consumption limits, adjustments to testing procedures, and expanded coverage. Among other things, the Stage 4 standard:

- » Tightens fuel consumption limits by roughly 12%–16% compared with Stage 3, depending on the vehicle type⁵
- » Switches the test cycle from the China-World Transient Vehicle Cycle (C-WTVC) to the China Heavy-duty Commercial Vehicle Test Cycle (CHTC)
- » Expands the scope to include hybrid electric vehicles

⁴ Oscar Delgado, *Stage 3 China Fuel Consumption Standard for Commercial Heavy-Duty Vehicles* (International Council on Clean Transportation, 2016), <https://theicct.org/publication/stage-3-china-fuel-consumption-standard-for-commercial-heavy-duty-vehicles/>.

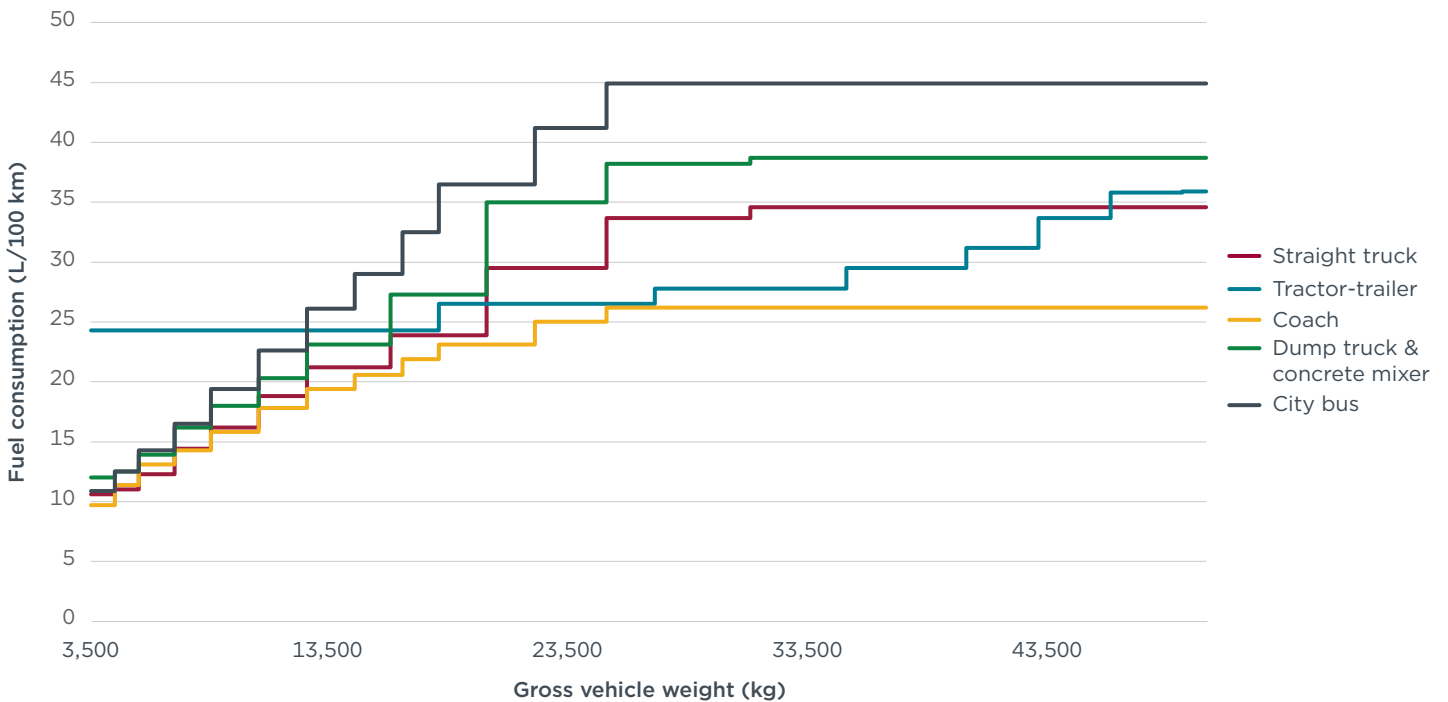
⁵ CATARC, “重型商用车燃料消耗量限值国家标准征求意见稿编制说明 [Description of Proposal for Fuel Consumption Limits for Heavy-Duty Commercial Vehicles].”

- » Introduces fuel consumption limits for concrete mixers
- » Adopts the conversion rate for carbon dioxide (CO₂) emissions of 2,600 g/L for diesel and 2,370 g/L for gasoline
- » Revises the conformity of production
- » Incorporates and clarifies the criteria for type-approval of new model variants

FUEL CONSUMPTION LIMITS

Like the previous stages, Stage 4 sets per-vehicle fuel consumption limits based on a step function that segments vehicle types by GVW. Figure 2 summarizes the fuel consumption limits under the CHTC for each range of GVW for the five covered vehicle types (concrete mixers have the same limits as dump trucks). The stringency of the final regulation did not change from the values that were proposed in June 2022. Although a previous ICCT publication summarizing the elements of the proposal presented the values in the older certification cycle, the C-WTVC, here we present the fuel consumption values in the new certification cycle, the CHTC.⁶

Figure 2
Stage 4 fuel consumption limits by vehicle category under CHTC cycles



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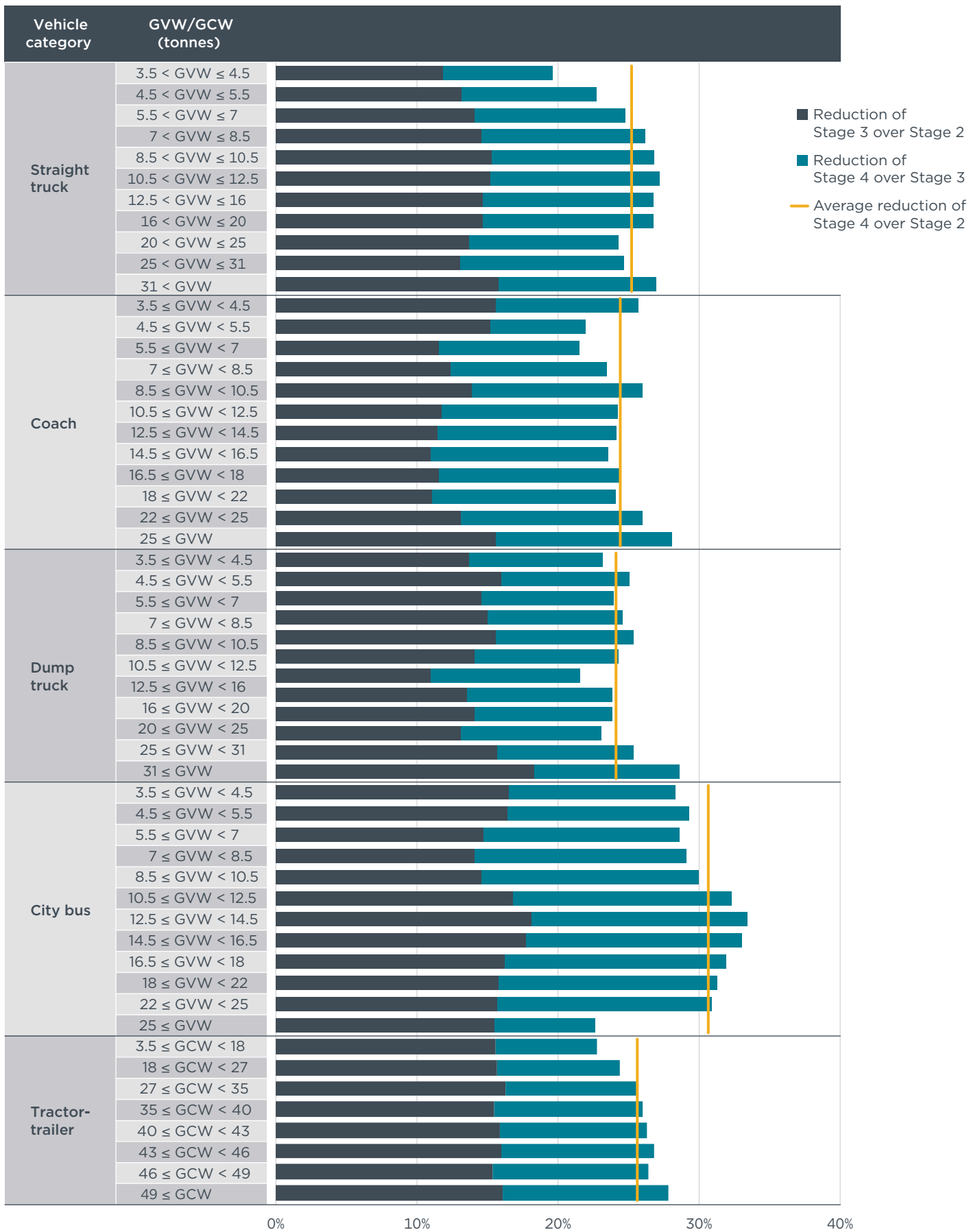
The stringency of the fuel consumption limits in Stage 4 is increased by 12%–16% compared with Stage 3, depending on the GVW and vehicle type. Figure 3 summarizes the differences in stringency in the Stage 4 standard over Stage 2 and Stage 3; to directly compare the standards, we used the conversion factors included in the proposal in June 2022 to convert the limits from CHTC to C-WTVC.⁷

⁶ Shiyue Mao, Liuhanzi Yang, and Yichen Zhang, *The Stage 4 Proposed Amendment to China's Heavy-Duty Vehicle Fuel Consumption Standard: ICCT Reflections* (International Council on Clean Transportation, 2023), <https://theicct.org/publication/china-hvs-stage-4-amend-reflections-jan23/>.

⁷ CATARC, “重型商用车燃料消耗量限值国家标准征求意见稿编制说明 [Description of Proposal for Fuel Consumption Limits for Heavy-Duty Commercial Vehicles].”

Figure 3

Stringency of each fuel consumption standard (Stage 2 to Stage 4), with all values normalized to C-WTVC



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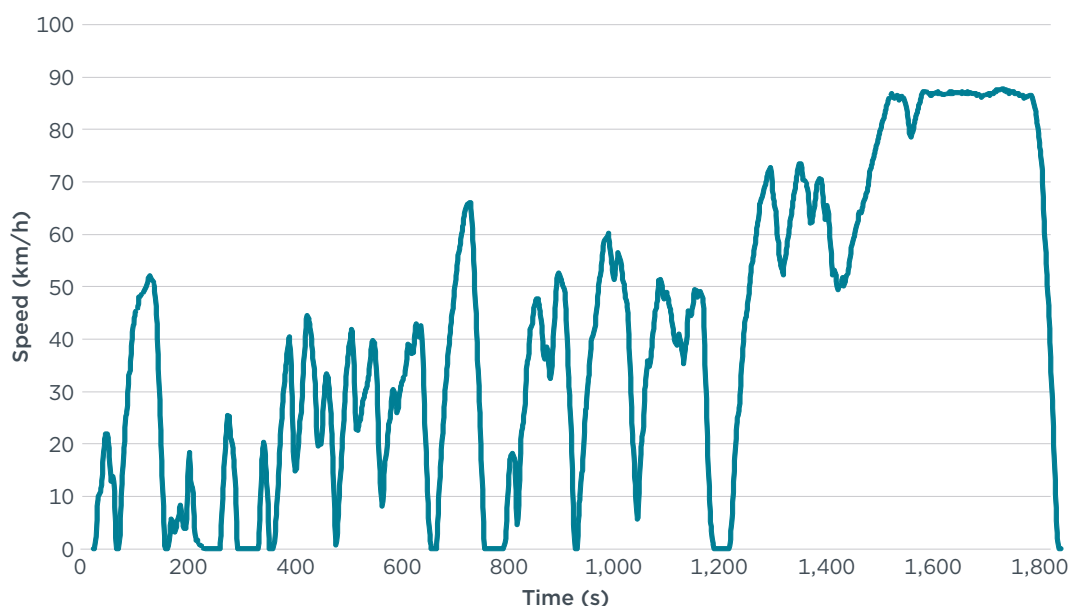
REGULATORY SCOPE

Previous HDV fuel consumption standards only regulated HDVs with gasoline and diesel engines. Stage 4 expands coverage to hybrid electric vehicles, including plug-in and non-plug-in hybrids. Hybrid electric HDVs are not assigned separate fuel consumption limits and must meet the same standards as their respective combustion engine counterparts. Stage 4 also introduces fuel consumption limits for concrete mixers, which should comply with the same fuel consumption limits set for dump trucks.

TEST CYCLE

The Stage 4 fuel consumption standard switches the test cycle from the C-WTVC to the CHTC. As discussed in a previous ICCT analysis,⁸ the C-WTVC (Figure 4) cannot fully represent real-world driving conditions in China, and it is difficult to reflect the real-world operating characteristics of multiple vehicle types using a uniform driving cycle. The CHTC cycle was developed for each vehicle type (Figure 5) and is a closer estimation and representation of the real-world driving of HDVs in the country.⁹ From Stage 4, CHTC will be applied to the chassis dynamometer test for base models and the simulation for model variants.¹⁰

Figure 4
C-WTVC time-speed profiles



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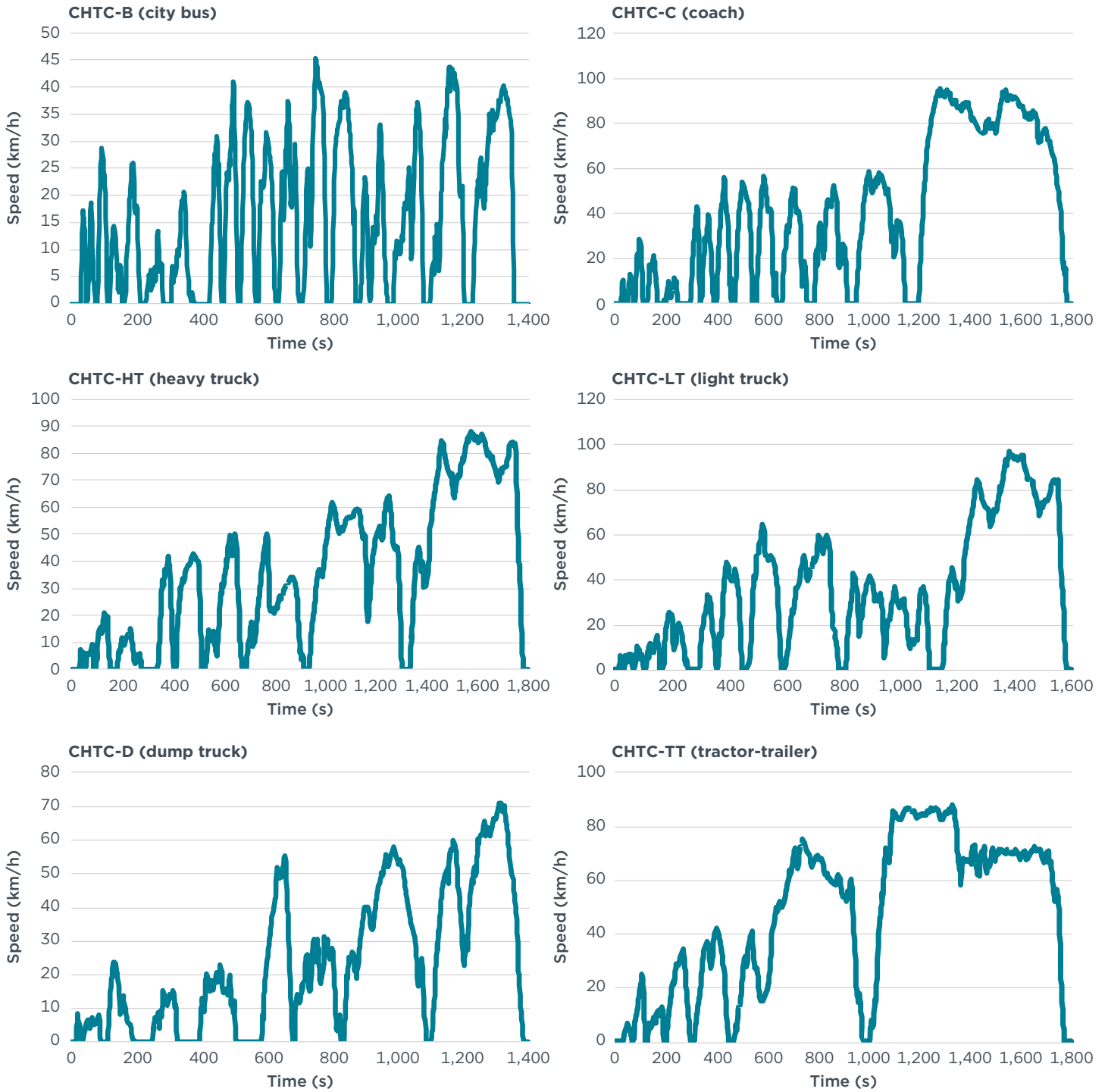
⁸ Mao, Yang, and Zhang, *The Stage 4 Proposed Amendment*.

⁹ China Automotive Technology and Research Center, “《中国汽车行驶工况》国家标准第 2 部分: 重型商用车辆征求意见稿编制说明 [Description of Proposal for China Heavy-Duty Commercial Vehicle Test Cycle],” August 2018, <http://www.catarc.org.cn/upload/201808/01/201808011134283811.pdf>.

¹⁰ Ministry of Industry and Information Technology of China, “GB/T 27840-2021: 重型商用车辆燃料消耗量测量方法 [Fuel consumption test methods for heavy-duty commercial vehicles],” May 2022, <https://openstd.samr.gov.cn/bz/gk/gb/newGbInfo?hcno=D91422B6B4CB611CE115EF416AA92047>.

Figure 5

CHTC time-speed profiles for each vehicle category



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CONVERSION RATE OF CO₂ EMISSIONS

The Stage 4 fuel consumption standard introduces an official formula to convert fuel consumption (L/100 km) to CO₂ emissions (g/km):

$$R_{\text{CO}_2} = K_{\text{CO}_2} \times FC_L / 100$$

Where:

- R_{CO_2} is the estimated CO₂ emissions in g/km calculated from the fuel consumption of the vehicle model
- K_{CO_2} is the conversion factor in g/L, which is 2.37×10^3 for gasoline and 2.60×10^3 for diesel vehicle models
- FC_L is the fuel consumption in L/100 km of the vehicle model

CONFORMITY OF PRODUCTION

Stage 4 stipulates that the results of the conformity of production tests must fall within a 6% margin of type-approval fuel consumption values. The results must also comply with the type-approval limits, which is a new requirement not specified in previous stages.

TYPE-APPROVAL OF NEW MODEL VARIANTS

Stage 4 introduces type-approval requirements for new model variants. It clarifies that the certified fuel consumption of a type-approved vehicle model can apply to a modified model (variant) if the modified model meets the following criteria:

- » The engine
 - a. is manufactured by the same manufacturer and has the same engine displacement, ignition type, fuel type, fuel intake system, cylinder number and layout, and engine control unit strategy, among other specifications
 - b. has 75%–100% of the engine power of the base model
 - c. has the same or less intake resistance (rated rotation speed, 100% payload)
 - d. has the same or less engine exhaust back pressure (rated rotation speed, 100% payload)
 - e. has the same or less maximum power absorbed by engine-driven equipment at rated speed
- » The vehicle body
 - a. is classified in the same vehicle category (in other words, tractor-trailer, dump truck, straight truck, city bus, or coach)
 - b. is of the same vehicle type and dimension (for example, single- or double-decker bus)
 - c. has the same driver cabin
 - d. has no more than 105% of the frontal area of the base model (excluding increases due to the installation of optional deflectors)
 - e. is no more than 105% of the width and height of the base model (excluding increases due to the installation of optional deflectors)

- f. is no more than 105% of the GVW of the base model
- » The powertrain
 - a. is the same as the base model
 - b. has the same transmission type and no fewer gears than the base model
 - b. has no more than 108% of the total gear ratio of the base model
- » The tires
 - a. have the same or larger static load radius
 - b. are considered identical for the purposes of type-approval, regardless of whether they are radial or diagonal tires

For hybrid electric vehicles, the modified model is also required to have the same:

- » hybrid system classification (series, parallel, series-parallel, with or without plug-in capability, with or without manual drive mode selection)
- » model and manufacturer of the energy storage unit cells
- » total nominal voltage and capacity of the energy storage assembly
- » model, location, quantity, cooling method, and manufacturer of the drive motor/generator
- » software and hardware model and manufacturer of the control systems
- » type of battery cooling system

INTERNATIONAL POLICY CONTEXT

EUROPEAN UNION

On May 13, 2024, the Council of the European Union ratified the agreement on the revision of HDV CO₂ standards.¹¹ Compared with the original standards adopted in 2019, the revision ramps up the stringency of targets and widens the scope of vehicles covered to include more types of trucks, buses, coaches, trailers, and vocational vehicles. The revised CO₂ standards kept the 2025 CO₂ reduction target of 15%, raised the 2030 target to 45%, and added a 65% reduction target for 2035 and a 90% reduction target for 2040 relative to a baseline reporting period. The reduction targets are further broken down to vehicle bins and groups based on type, axel configuration, and weight.

UNITED STATES

On April 22, 2024, the U.S. Environmental Protection Agency published the Phase 3 greenhouse gas emission standards for HDVs final rule, which set CO₂ emission limits for Class 2b–8 vehicles of model years (MYs) 2027 to 2032.¹² The Phase 3 standards require CO₂ emission reductions per ton-mile of freight moved by up to 60% for vocational trucks and up to 40% for tractor trucks in MY 2032 compared with the Phase 2 MY 2027 levels. As in previous phases, the Phase 3 standards retain the same fleet-average regulatory scheme. This does not require individual vehicles to meet the standards but instead allows manufacturers to meet the standards based on the average emissions within each weight class.

¹¹ Eamonn Mulholland, *The Revised CO₂ Standards for Heavy-Duty Vehicles in the European Union* (International Council on Clean Transportation, 2024), <https://theicct.org/publication/revised-co2-standards-hdvs-eu-may24/>.

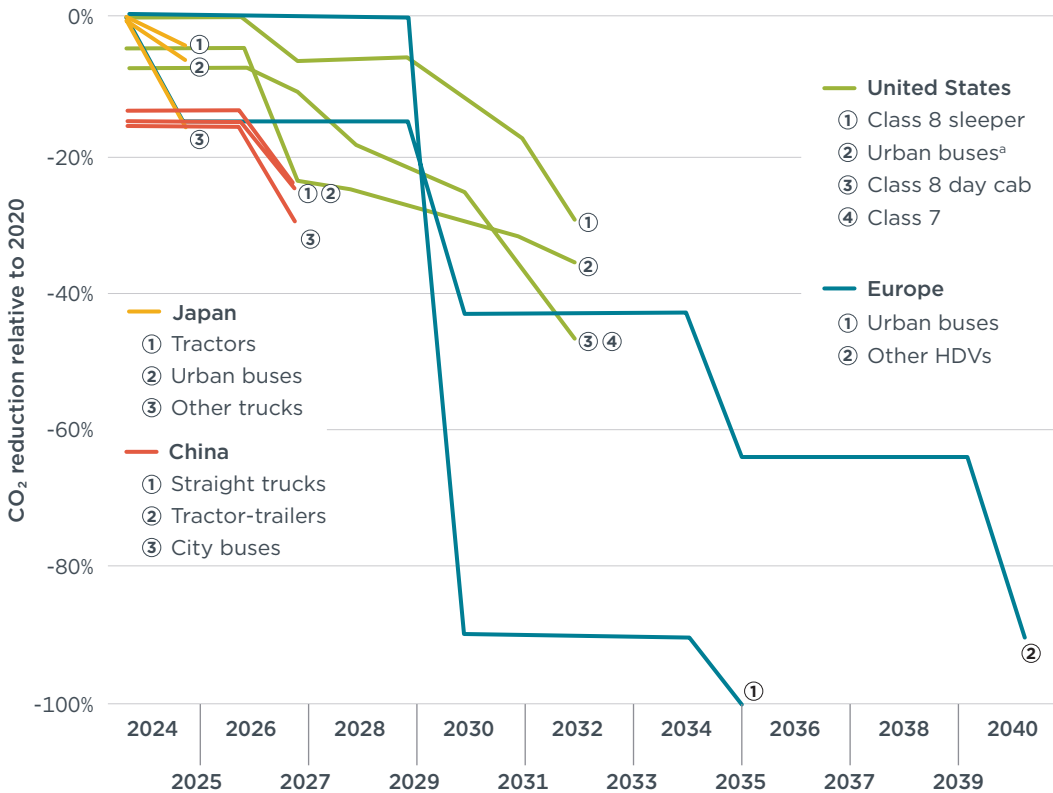
¹² Yihao Xie, *U.S. EPA Phase 3 Greenhouse Gas Emission Standards for Heavy-Duty Vehicles* (International Council on Clean Transportation, 2024), <https://theicct.org/publication/us-epa-phase-3-ghg-emission-standards-for-hdv-sept24/>.

JAPAN

On December 12, 2017, Japan's Ministry of Land, Infrastructure, and Transportation finalized Phase 2 fuel economy standards for new on-road HDVs, including MY 2025 diesel commercial vehicles with a GVW of 3.5 tonnes or more, as well as buses that can transport 10 or more passengers.¹³ As with the Phase 1 regulation, the Phase 2 fuel economy requirements use the "top runner" method, whereby the most fuel-efficient model of each vehicle type and weight class for the baseline year (MY 2015) sets the target fuel economy for other models. Hybrid, electric, alternative fuel, and other advanced technology vehicles are excluded from the top runner system. Additionally, Japan refined its certification protocols and simulation models under Phase 2. The required fuel consumption reductions from the MY 2015 baseline to the 2025 targets range from 3.4% to 15.5%, depending on the vehicle class.

Figure 6 compares the HDV greenhouse gas and fuel efficiency regulations in China, the European Union, the United States, and Japan in terms of the emission reductions they require.¹⁴

Figure 6
Comparison of improvements required for heavy-duty trucks from 2024 to 2040, relative to 2020 standard or baseline



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¹³ Benjamin Sharpe, *Second-Phase Fuel Economy Standards for on-Road Heavy-Duty Vehicles in Japan* (International Council on Clean Transportation, 2019), <https://theicct.org/publication/second-phase-fuel-economy-standards-for-on-road-heavy-duty-vehicles-in-japan/>.

¹⁴ Dale Hall, *Meeting the Mark: Aligning Regulations and Standards with ZEV Targets* (ZEV Transition Council, 2024), <https://theicct.org/publication/aligning-regulations-and-standards-with-zev-targets-sept24/>.



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