

CO₂ emissions reduction potential of an accelerated, global transition to zero-emission vehicles

Transportation is a significant source of climate-warming emissions: Cars, vans, buses, and trucks alone accounted for about 21% of global anthropogenic carbon dioxide (CO₂) emissions in 2020. The governments of the Zero-Emission Vehicles Transition Council (ZEVTC), which currently represent nearly 50% of the global car market, have committed to work together to accelerate the global transition to ZEVs.¹ To help understand both the likely impacts of current policies and the potential emissions reductions from more ambitious ZEV policies, a new ICCT study estimates well-to-wheel (WTW) CO₂ emissions from cars, vans, buses, and trucks from 2020 to 2050. It finds that an accelerated, global ZEV transition that goes beyond current government targets could put vehicle CO₂ emissions on a pathway compatible with limiting warming to 2 °C, assuming these vehicles use a share of the remaining global carbon budget to 2050 that is proportional to their 2020 share. Achieving this pathway will require transitioning 90% to 100% of global vehicle sales to ZEVs for cars, vans, and buses by 2035 and for medium and heavy trucks by 2040. For a 67% chance of limiting warming to 1.5 °C, though, vehicle CO₂ emissions would need to fall much more quickly by 2030 and to near zero by 2050.

EMISSIONS PROJECTIONS

Estimates were made using ICCT's Roadmap model 1.8.2, and each scenario covers 190 countries. The **Baseline scenario** projects WTW CO₂ emissions based on adopted policies and anticipated market developments and assumes that grid decarbonization follows the International Energy Agency (IEA)'s Stated Policies (STEPS) pathway.² Here, global ZEV sales increase from 2% of total sales in 2020 to 27% in 2050, but **WTW CO₂ emissions increase by 32%, because the emissions benefit from ZEV uptake is outpaced by growth in demand for passenger and freight activity** (Figure 1). The **Progress to Date scenario** builds on the Baseline and considers proposals and goals that have been announced by ZEVTC countries since the ZEVTC was launched in November 2020 and up until August 2021. Proposals and goals announced in China, the world's largest vehicle market, are also included, and grid carbon intensity follows the STEPS pathway, as in the Baseline. In Progress to Date, by 2050, the global ZEV

1 Members of the ZEVTC are the United Kingdom, Canada, Denmark, France, Germany, India, Italy, Japan, Mexico, Netherlands, Norway, Republic of Korea, Spain, Sweden, and the United States. In addition, the European Commission is an observer and California is separately a member.

2 "World Energy Model Stated Policies Scenario," International Energy Agency, accessed October 1, 2021, <https://www.iea.org/reports/world-energy-model/stated-policies-scenario-steps>.

sales share reaches 47%; however, global **vehicle CO₂ emissions still grow by 14% from 2020 to 2050.**

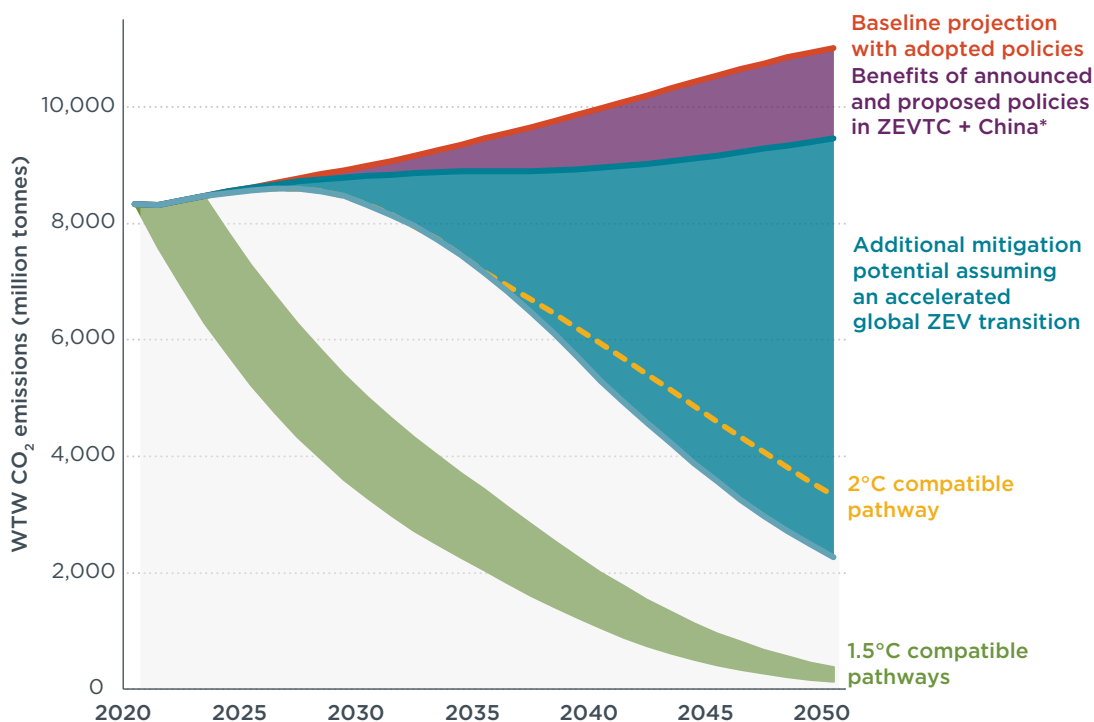


Figure 1. Global WTW CO₂ emissions from cars, vans, trucks, and buses compared to 1.5 °C and 2 °C compatible emissions pathways.

*The Progress to Date scenario considers proposals and goals that were announced by ZEVTC countries since the ZEVTC was launched in November 2020 and up until August 2021.

The **Ambitious scenario** assumes more ambitious policies are enacted by governments of the ZEVTC, China, and more than 100 other countries. It assumes more rapid progress in leading markets, driven by more stringent and comprehensive ZEV policies, and that resulting economies of scale reduce costs and help commercialize ZEV technologies in other countries that have supportive policies. Additionally, grid decarbonization follows IEA’s more aggressive Sustainable Development Scenario.³ ZEVTC members and China achieve ZEV sales shares between 90% and 100% for light-duty vehicles (LDVs) and buses by 2035 and for trucks by 2040; this is largely consistent with the Glasgow Declaration and the Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles.⁴ The **Ambitious scenario results in a considerable decline of vehicle CO₂ emissions in 2050—a 73% reduction compared to 2020—and reductions are in line with a 2 °C pathway.** Cumulative CO₂ emissions between 2020 and 2050 are reduced by nearly 100 billion tonnes (Gt) compared to the Baseline, equivalent to 12 years of vehicles’ CO₂ emissions at 2020 levels.⁵

3 “World Energy Model Sustainable Development Scenario,” International Energy Agency, accessed October 1, 2021, <https://www.iea.org/reports/world-energy-model/sustainable-development-scenario-sds>.

4 “COP26 Declaration on Accelerating the Transition to 100% Zero Emission Cars and Vans,” U.K. Department for Business, Energy & Industrial Strategy, December 2021, <https://www.gov.uk/government/publications/cop26-declaration-zero-emission-cars-and-vans/cop26-declaration-on-accelerating-the-transition-to-100-zero-emission-cars-and-vans>

5 “Global Energy Review 2021, CO₂ Emissions,” International Energy Agency, accessed October 1, 2021, <https://www.iea.org/reports/global-energy-review-2021/co2-emissions>.

MORE AMBITION FOR 1.5 °C

The shaded green area of Figure 1 illustrates the range of vehicle CO₂ emissions compatible with a 67% chance of achieving a 1.5 °C pathway, where the lower bound assumes these vehicles use a proportional share of the remaining budget and the upper bound assumes they use 50% more than that. As shown, to maintain a chance of limiting warming to 1.5 °C, vehicle CO₂ emissions would need to fall 40% to 60% by 2030 and to near zero by 2050. Actions to reduce the gap between the Ambitious scenario and a 1.5 °C compatible pathway could include accelerating replacement of the existing vehicle fleet with ZEVs, maximizing uptake of efficiency technologies for conventional vehicles and ZEVs, and large-scale avoid-and-shift measures.

KEY MARKETS AND SEGMENTS

Eliminating the gap between the Progress to Date scenario and a 2 °C pathway, and reducing the gap with 1.5 °C, requires ambitious actions in all regions and across vehicle types. Figure 2 illustrates the CO₂ emissions mitigation potential between 2020 and 2050 in the Ambitious scenario by region and vehicle type. The three largest vehicle markets—China, the United States, and the European Union—have the greatest mitigation potential, followed by regions such as the Association of Southeast Asian Nations (ASEAN), Latin America, the Middle East, Africa, and India. Importantly, ZEVTC countries' share of the global vehicle market is projected to shrink to 38% in 2050, while the combined market share of EMDEs is projected to grow from 20% in 2020 to 32% in 2050.

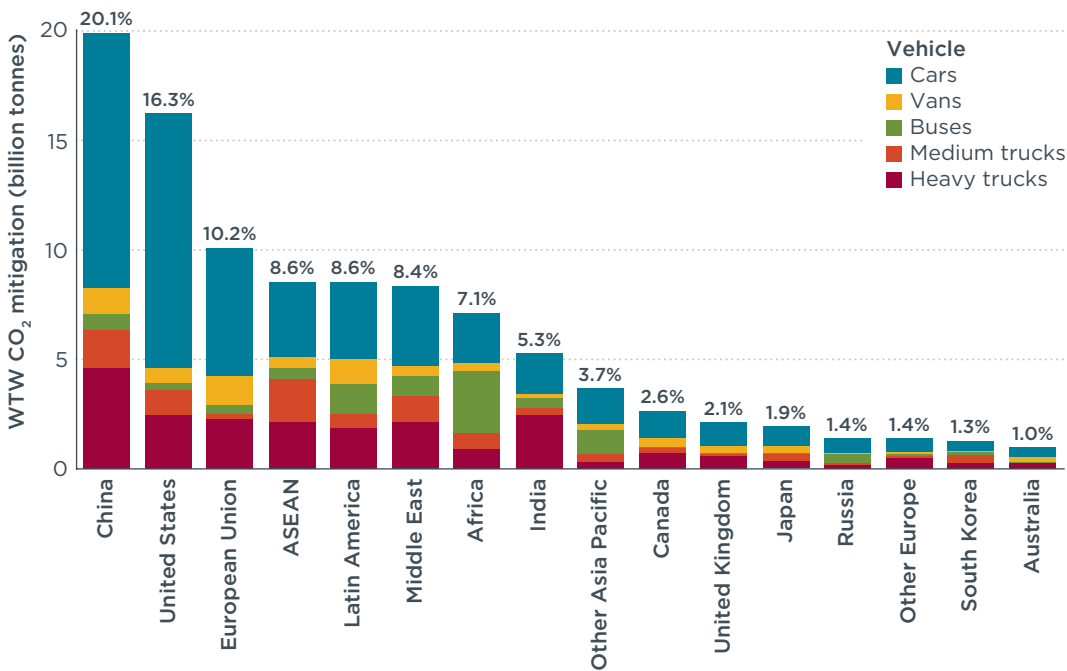


Figure 2. CO₂ mitigation potential in key markets under the Ambitious scenario, 2020–2050.

Passenger cars have the most mitigation potential, especially among the three largest vehicle markets. However, because most recent proposals and goals focus on passenger cars and vans, HDVs account for half of the remaining mitigation potential when comparing the Ambitious scenario with the Progress to Date scenario. In the Progress to Date scenario, global CO₂ emissions are projected to decline 14% for LDVs but increase 58% for HDVs from 2020 to 2050. The difference in emissions trends is driven by HDVs outpacing LDVs in projected vehicle activity growth (98% compared to 63% from 2020 to 2050) and significantly slower projected uptake of ZEVs for HDVs. Achieving the full mitigation potential of ZEVs requires a truly global transition and stepping up ambition, especially on HDVs.

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