Life-cycle greenhouse gas emissions of passenger cars and associated policy implications

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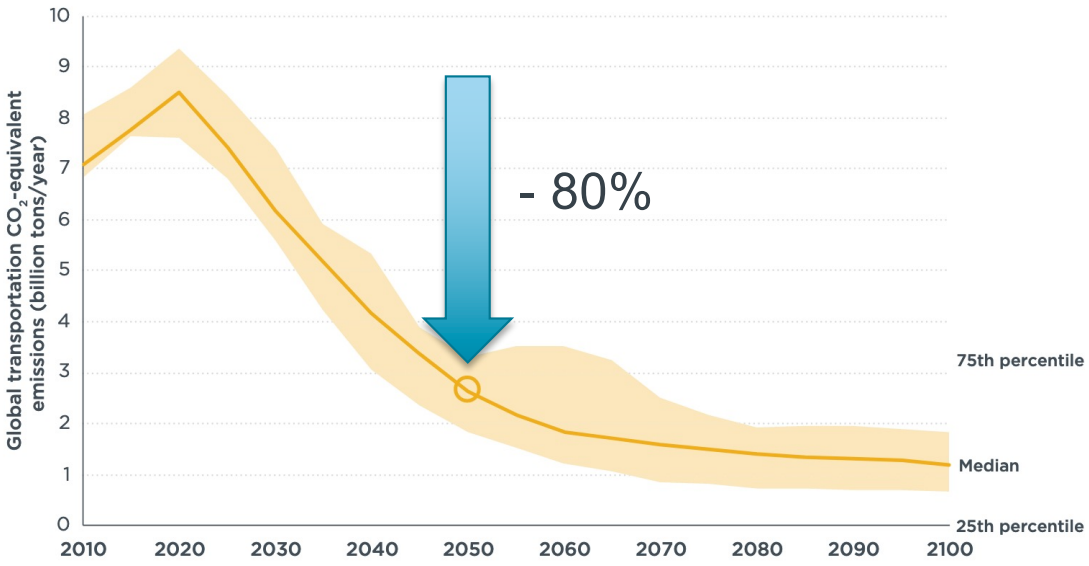
To be in line with Paris targets, an 80% reduction in global transportation emissions is needed in the next 3 decades

- To limit global warming to 1.5 °C, GHG emissions of **global transport** in 2050 need to be **80% lower.**

- **Which technologies** can deliver this deep reduction in the passenger cars fleet despite a growing number of vehicles?

Global transport sector GHG emissions in 1.5°C scenario



ICCT (2020). Vision 2050: A strategy to decarbonize the global transport sector by mid-century.

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ICCT recently published a study looking at the life-cycle GHG emissions of passenger vehicles in major markets

- Life-cycle GHG emissions: CO_2, methane (CH_4), nitrous oxide (N_2O)
  - **Vehicle cycle**:
    - Vehicle and battery production (incl. raw material)
    - Maintenance
    - End-of-life, recycling
  - **Fuel cycle** (well-to-wheel):
    - Fuel and electricity production
    - Indirect land use change (ILUC)
    - Fuel combustion in vehicle

- **Regional coverage:**
  - US
  - Europe
  - China
  - India

- **Vehicle Segments**
  - Most representative market segments by region

Link to report:
https://theicct.org/publications/global-LCA-passenger-cars-jul2021

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Average GHG emissions of the electricity mix are projected to decrease over the vehicle's lifetime

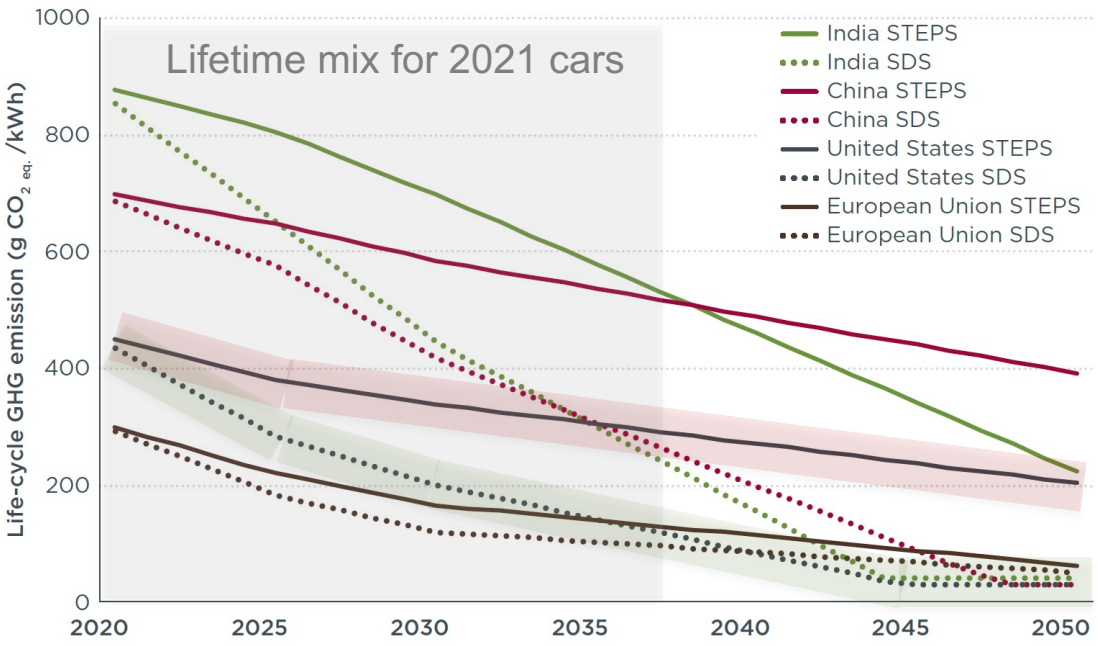
Vehicle lifetime average carbon intensity of fuel/electricity mix:

- Average **biofuel blend**
- Average **electricity mix**

Worst case: Projected future mix based on current policies

Best case: Paris Agreement-aligned development

Life-cycle GHG emissions of electricity consumption



Bieker (2021). A global comparison of the life-cycle GHG emissions of combustion engine and electric passenger cars.

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Real world fuel and electricity consumption tends to be higher than official certification values

Fuel and electricity consumption:

- Comparison of **segment average** values
- **Average real-world usage**
  - Especially important for **plug-in hybrid EVs**

Real-world vs. NEDC fuel consumption of PHEVs

- Plötz et al. (2020). Real-world usage of plug-in hybrid electric vehicles.
- Dornoff et al. (2020). On the way to "real-world" CO_2 values.
- ADAC Ecotest

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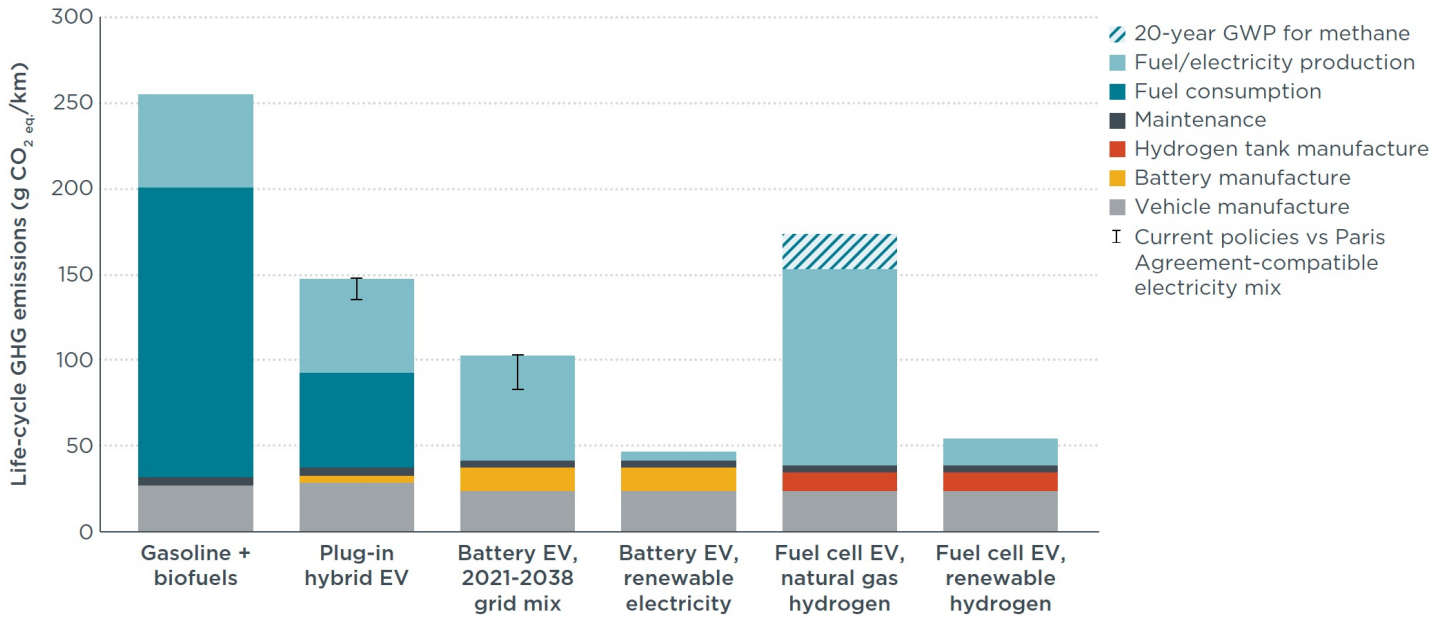
BEVs powered by renewable electricity and FCEVs powered by green hydrogen are the only technologies that can achieve GHG reductions in line with what is required for Paris targets

For the US case

- **Gasoline cars** include hybrid electric vehicles
- **Plug-in hybrid EVs:** 42%–46% lower emissions
- **Battery EVs:** 60%–68% lower emissions
- **Fuel cell EVs:** emissions vary with hydrogen source

United States: Life-cycle GHG emissions of average **passenger cars** registered in **2021**



Bieker (2021). A global comparison of the life-cycle GHG emissions of combustion engine and electric passenger cars.

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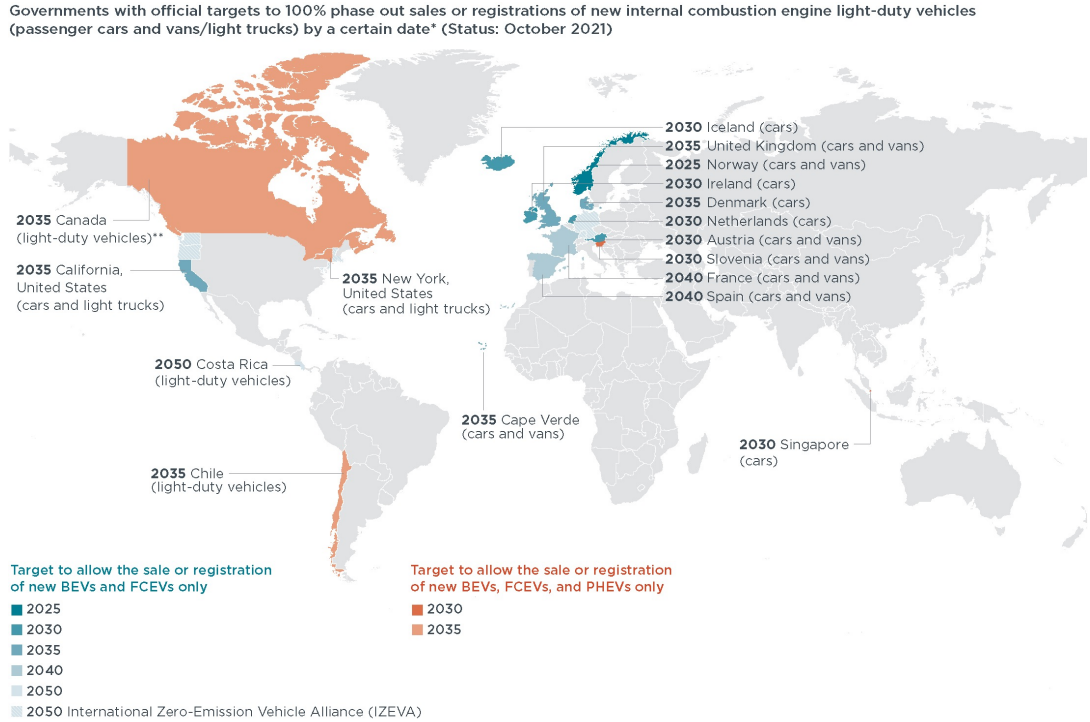
Phase out dates for fossil fuel vehicles set the pace for electrification

- Seventeen (17) governments have LDV phase out targets accounting for ~12% of global sales (see map).
- Not represented on the map are countries with ZEV targets at less than 100%, including US and China that together account for more than 40% of the global car market.

Governments with official targets to phase out 100% of sales or registrations of new internal combustion passenger cars by 2050 or earlier.



* Includes countries, states, and provinces that have set targets to only allow the sale or registration of new battery electric vehicles (BEVs), fuel cell electric vehicles (FCEVs), and plug-in hybrid electric vehicles (PHEVs). Countries such as Japan with pledges that include hybrid electric vehicles (HEVs) and mild hybrid electric vehicles (MHEVs) are excluded as these vehicles are non plug-in hybrids.
** The Canadian province of British Columbia has set its 2040 target into binding regulation; the Canadian province of Québec has also set a target for 2035.

Source: https://theicct.org/global-ice-phase-out-map

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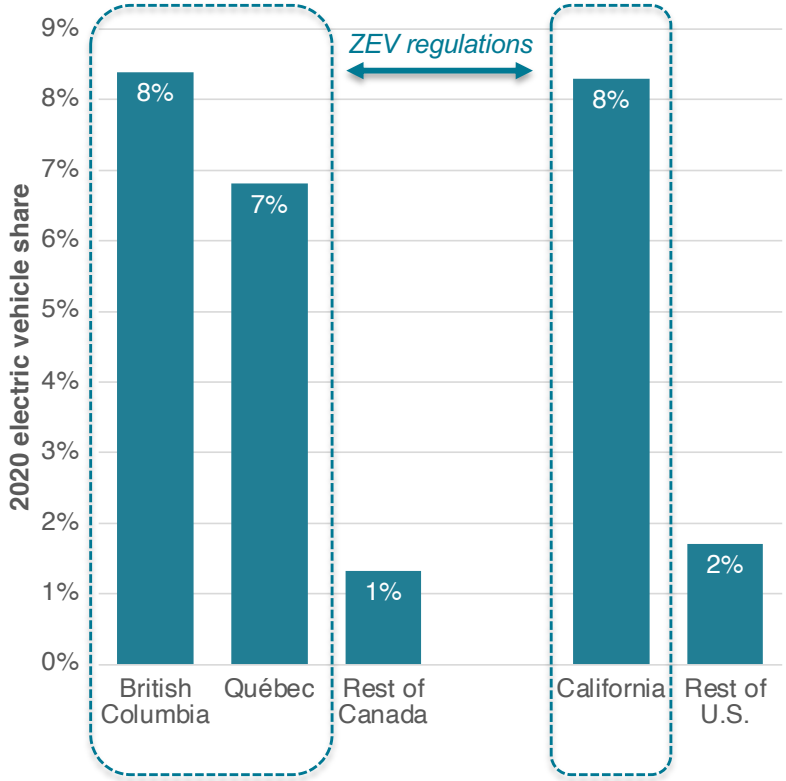
ZEV regulations: the most certain and effective policy to ensure auto makers produce a growing share of electric vehicles

- Markets with strong ZEV regulations tend to have higher ZEV uptake and greater model availability (e.g., California, British Columbia, Quebec, China).
- City level policies like zero emission zones have the potential to impact consumers behavior and accelerate adoption of ZEVs (e.g., Amsterdam, London, Oslo, Paris).

ZEV market share in British Columbia, Quebec and California are 4x to 8x the rest of Canada and United States.



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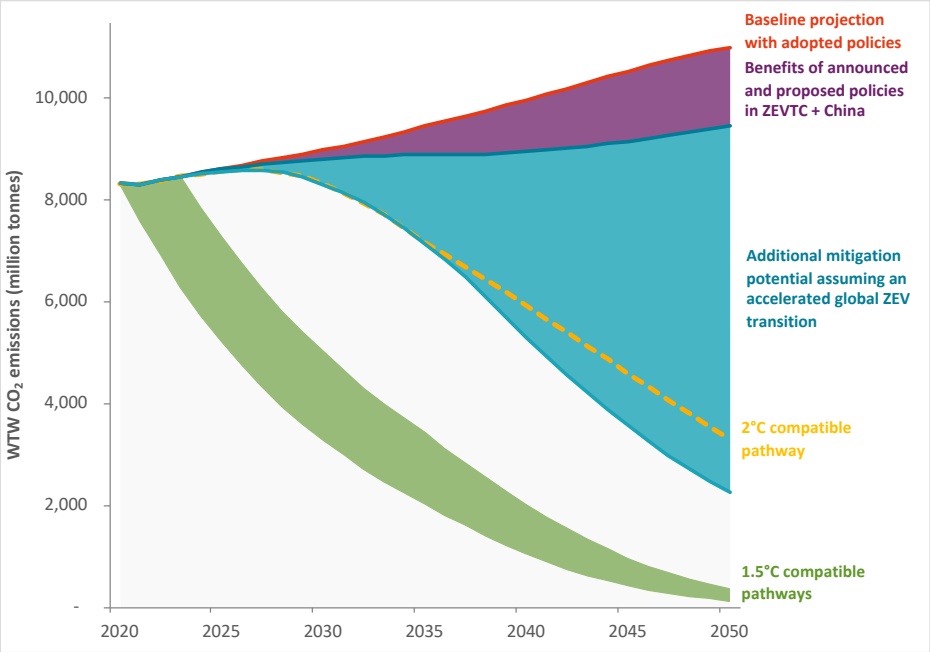
Addressing climate change requires accelerated phase out of combustion vehicles

- Global vehicle CO_2 emissions are still on a growth trajectory without further policy action
- Major markets could make a significant dent in emissions by implementing announced and proposed policies, such as US target for 50% sales of electric passenger vehicles by 2030, the U.K.'s phase out target for passenger cars by 2035, and Europe's proposed CO_2 standards for passenger cars with 100% ZEVs sales by 2035 (purple wedge).
- Accelerating electrification transition will require global collaboration between advanced economies, emerging markets and developing economies to set phase out targets along with interim goals in 2025 and 2030 (blue wedge).
- Closing the gap between a 2-degree trajectory and 1.5-degree trajectory (green wedge) will require complementary policies that accelerate ZEV fleet transitions and avoid and shift vehicle activity.



Global WTW CO_2 emissions from cars, vans, trucks, and buses compared to 1.5°C and 2°C compatible emissions pathways

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Thank you!

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