# The full climate impact of EVs - Assessing the life-cycle GHG emissions of electric and combustion-engine cars

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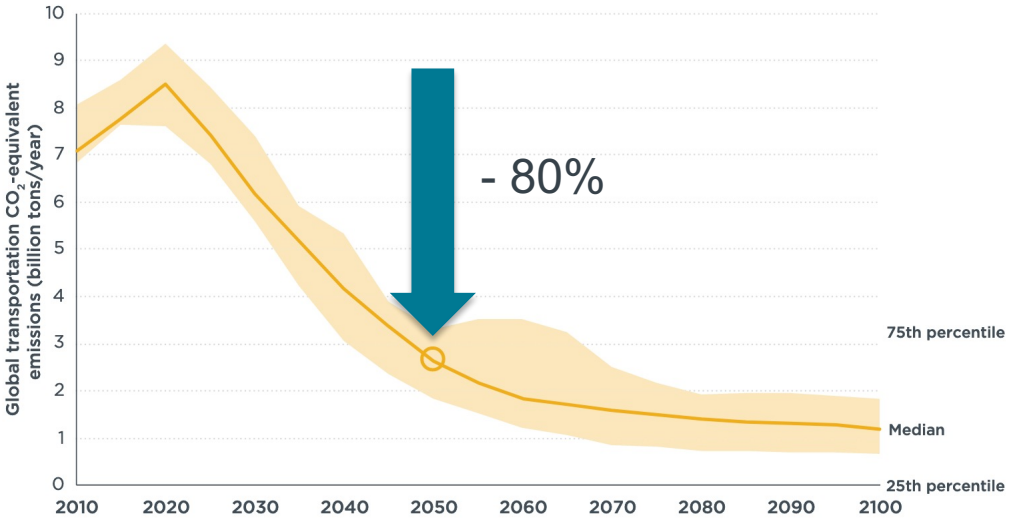
# Transport: 80% lower emissions by 2050

- 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 car fleet on a **life-cycle basis**?

## 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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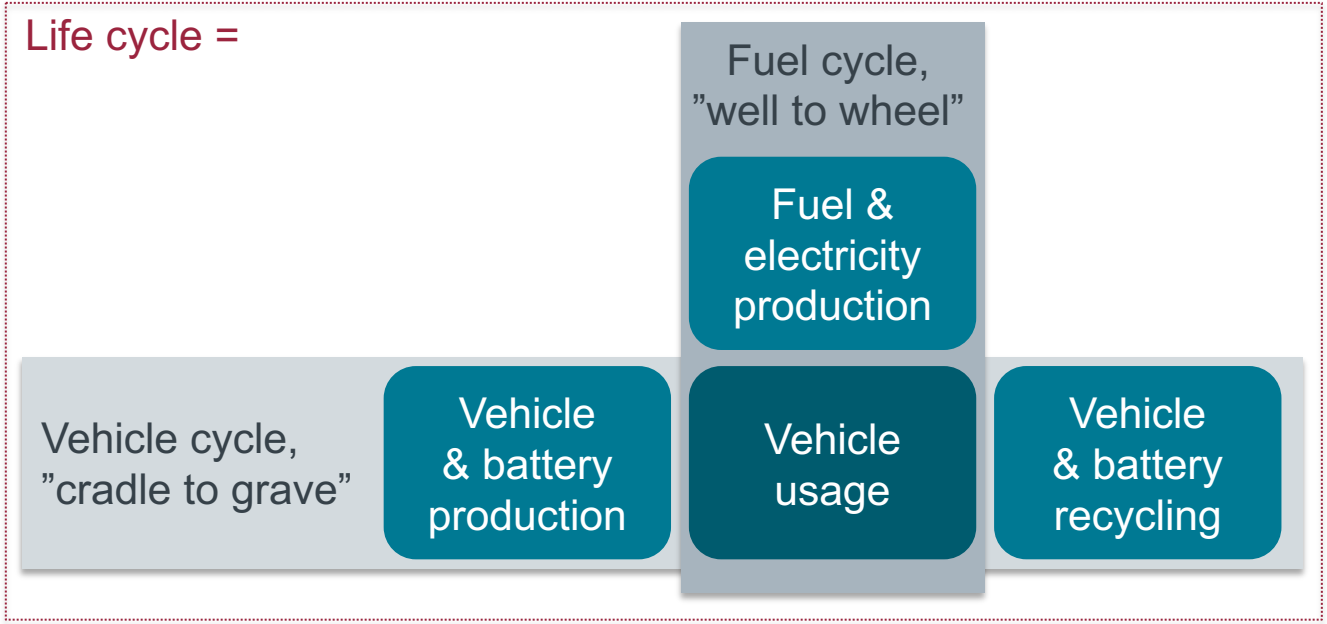
# This study: Life-cycle GHG emissions




GHG emissions = $CO_2$, methane ($CH_4$), nitrous oxide ($N_2O$)

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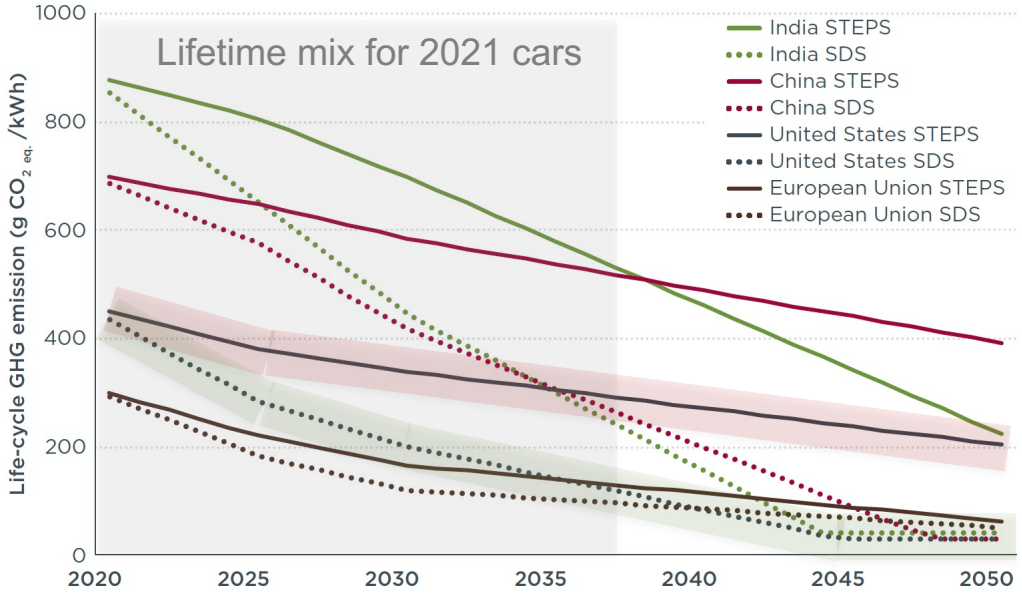
# Our methodology: Lifetime average electricity mix

- **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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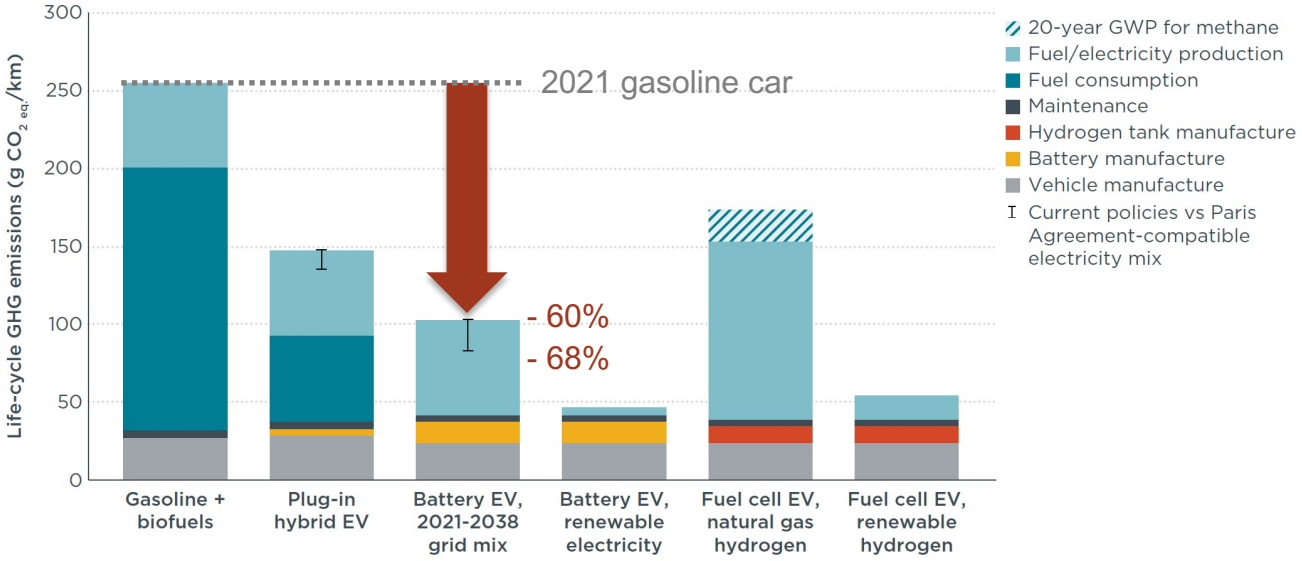
# Results: 2021 passenger cars in the U.S.

- **Gasoline cars** include hybrid electric vehicles
- **Plug-in hybrid EVs:** 42%–45% lower emissions
- **Battery EVs:** 60%–68% lower emissions
- **Fuel cell EVs:** emissions vary with hydrogen source

Life-cycle GHG emissions of average 2021 passenger cars




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

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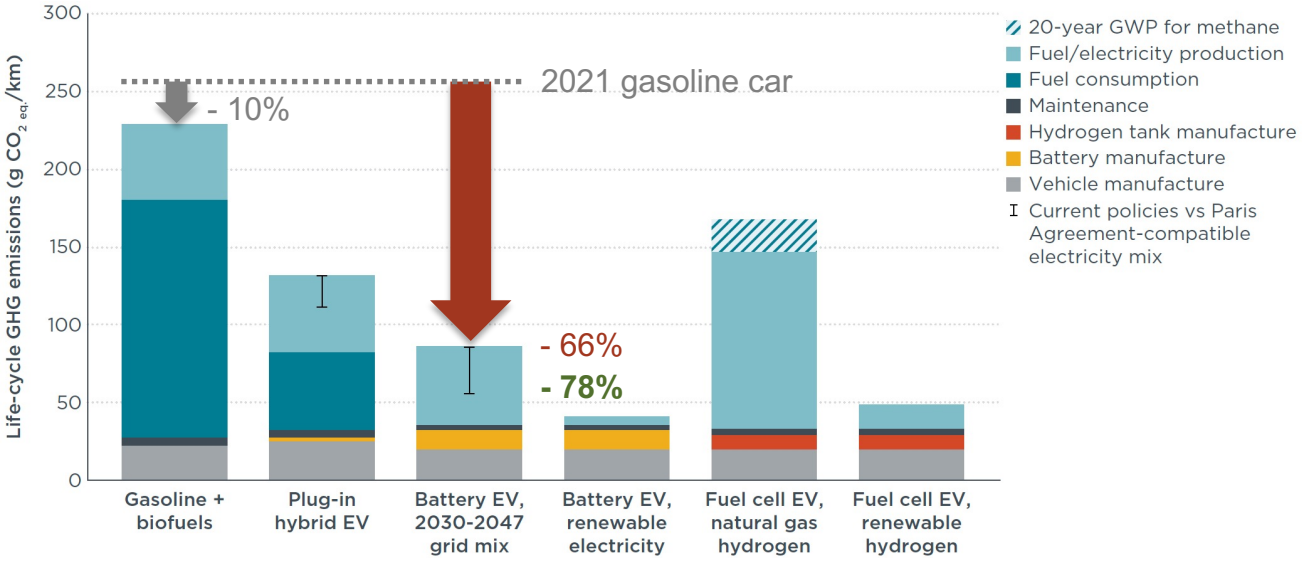
# Results: 2030 passenger cars in the U.S.

- **2030 gasoline cars**: 10% lower emissions
- **2030 plug-in hybrids:** 48%–56% lower emissions
- **2030 battery EVs:** 66%–78% lower emissions
- **2030 fuel cell EVs:** emissions vary with hydrogen source

Life-cycle GHG emissions of average 2030 passenger cars




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

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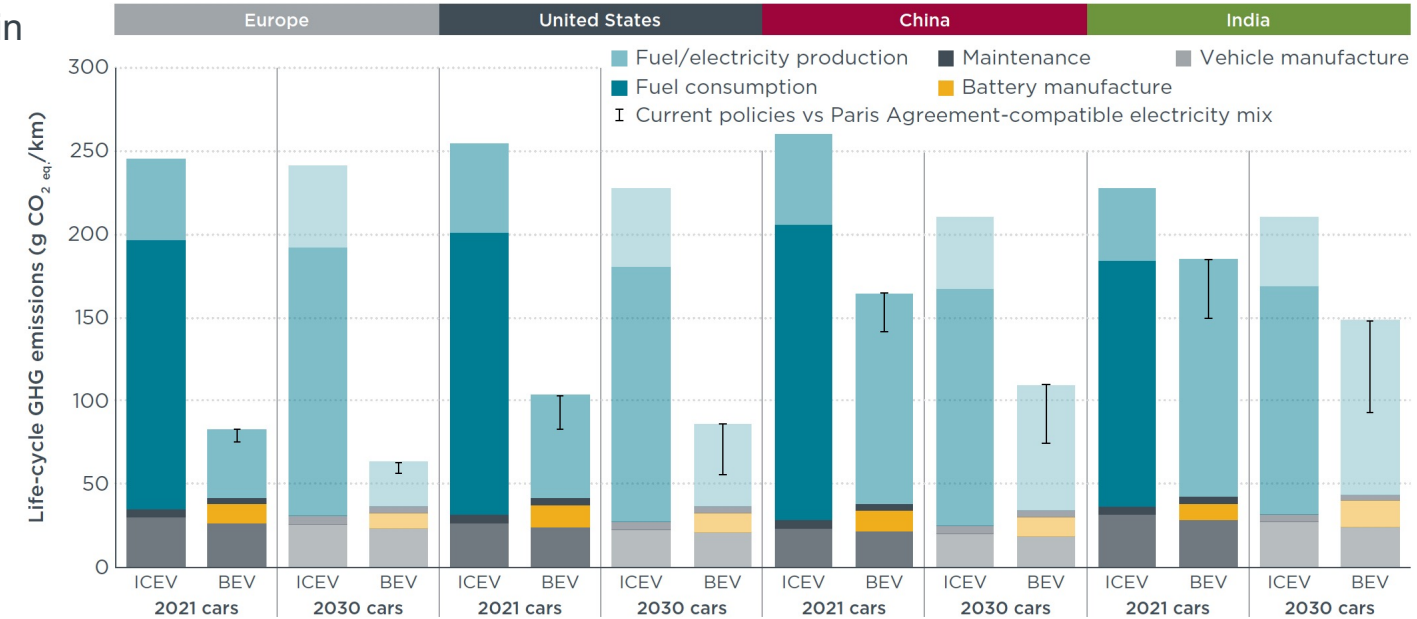
# Global: Battery EVs have lowest emissions

- **Battery EVs:** lowest emissions in
  - **Europe**
  - the **U.S.**
  - **China**
  - **India**
- The emission benefit increases for cars registered in **2030**

## Life-cycle GHG emissions of average 2021 and 2030 passenger cars




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

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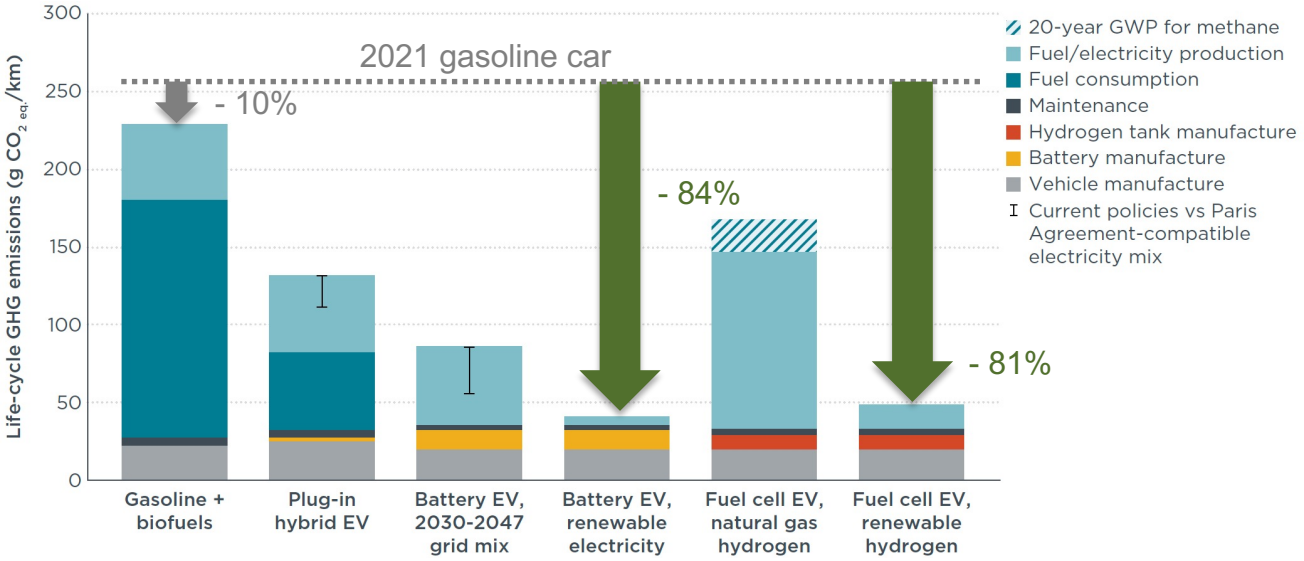
# Outlook: Passenger car fleet in 2050

- **Renewable electricity** powered battery EVs: 84% lower emissions
- **Green hydrogen** powered fuel cell EVs: 81% lower emissions
- Battery and fuel cell EVs allow to achieve the **2050 emission target**.

## Life-cycle GHG emissions of average 2030 passenger cars

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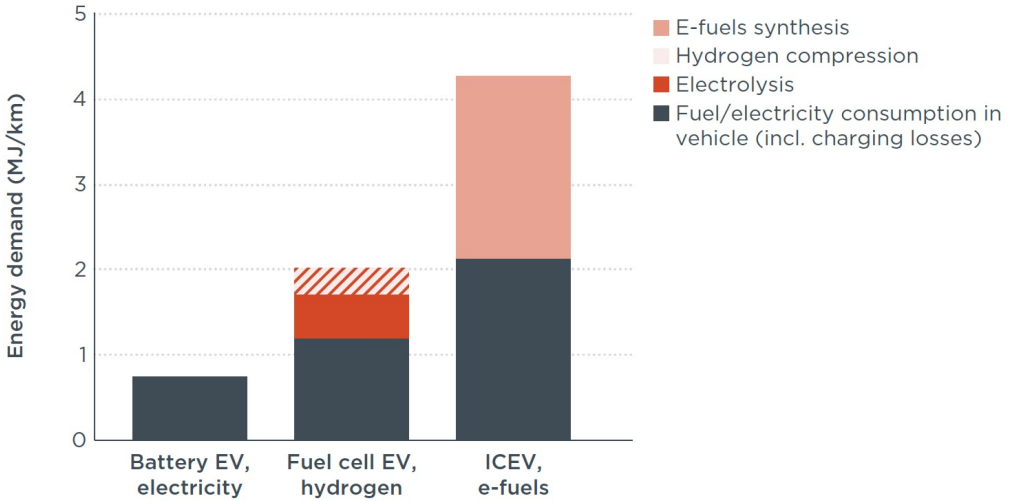
# Electricity, green hydrogen and e-fuels

- Driving on **renewable hydrogen** is **three times** more energy intensive than battery EVs.
- Driving on **e-fuels** is **six times** more energy intensive than battery EVs.
- E-fuels are **too expensive** and **too limited** to contribute to the decarbonization of road transport.

Energy demand of driving medium size cars with electricity, renewable hydrogen, and e-fuels

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# Key messages

- Already for cars registered today, battery EVs show lowest life-cycle GHG emissions.
- **Battery EVs** and **hydrogen fuel cell EVs** have the potential to be **near zero-carbon**, also on a life-cycle basis.
- There is **no realistic pathway to decarbonize combustion engine vehicles**: the availability of e-fuels and **low carbon biofuels** is too limited to substantially reduce the emissions of the fuel mix.
- To limit global warming to 1.5 °C, the **global passenger car fleet** needs to be **electric by 2050**.
- Vehicle lifetimes of 15-18 years require that the production of new **combustion engine vehicles** needs to be **phased out by 2030-2035**.

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# Thank you!

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