

The prospective environmental impacts of passenger cars under different energy and steel production scenarios

Supporting Information

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1 Vehicle modelling

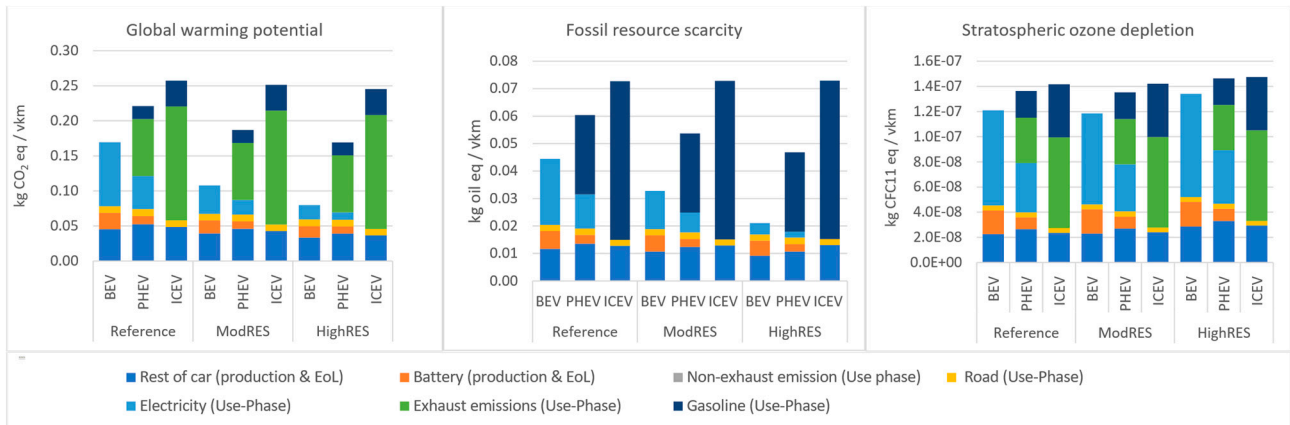
We modelled three different passenger car powertrains that are considered relevant now and in future operations in Europe.

Internal combustion engine vehicle (ICEV) has an internal combustion engine and uses gasoline as fuel to drive the wheels

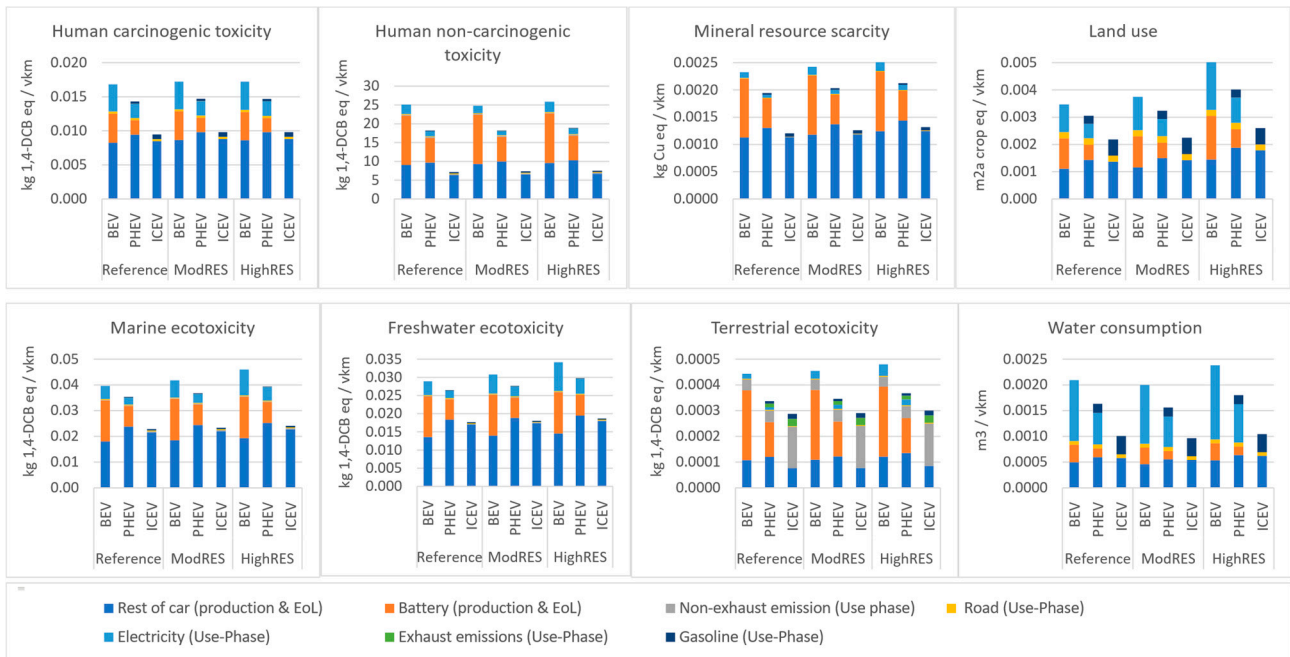
Battery electric vehicle (BEV) has an electric motor, rechargeable li-ion battery for energy storage, charges from the electricity grid and uses electricity the battery to drive the wheel.

Plug-in hybrid electric vehicle (PHEV) has an electric motor, rechargeable li-ion battery for energy storage, charges from the electricity grid and uses electricity the battery to drive the wheel. Additionally, has an internal combustion engine fuelled by gasoline that is used in hybrid configuration to power the wheels when the energy in the battery runs out.

2 Prospective life cycle impact assessment results



Figure_SI 1. Prospective life cycle assessment results of impact categories for which BEV performed better than ICEV: Global warming potential, stratospheric ozone depletion and Fossil resource scarcity.

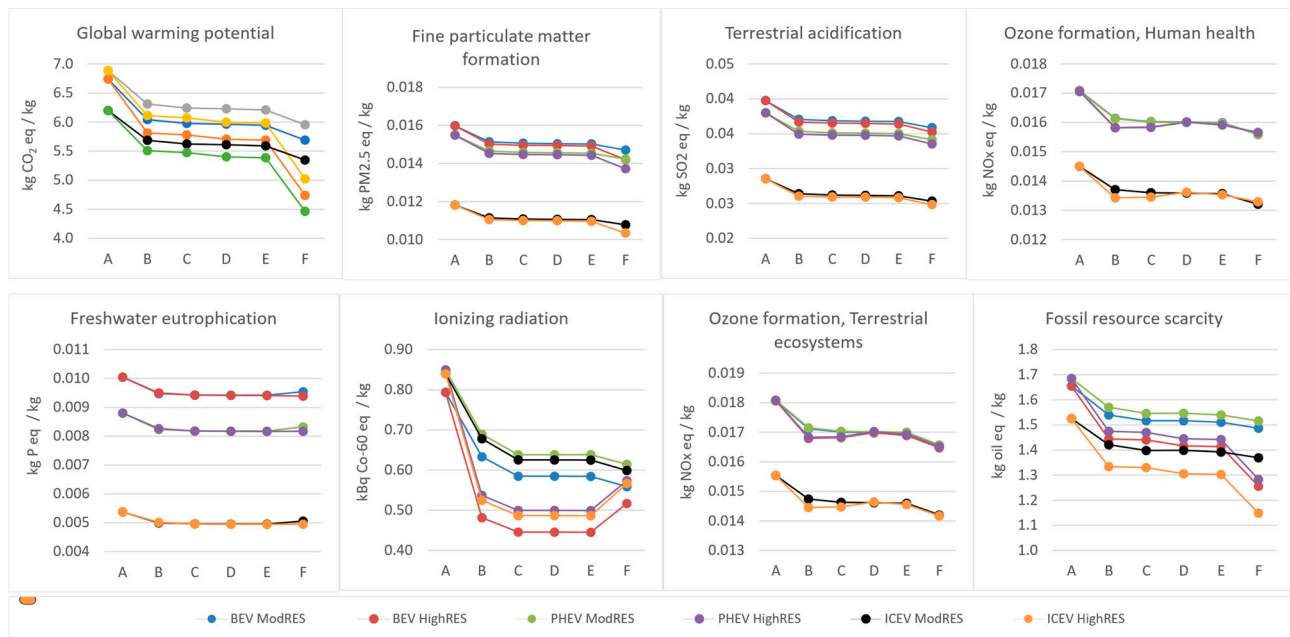


Figure_SI 2. Prospective life cycle assessment results of impact categories for which BEV performed worse than ICEV with no improvement in future BEV for all impact categories listed here. It can be observed that BEV continues to perform worse even in future scenarios.

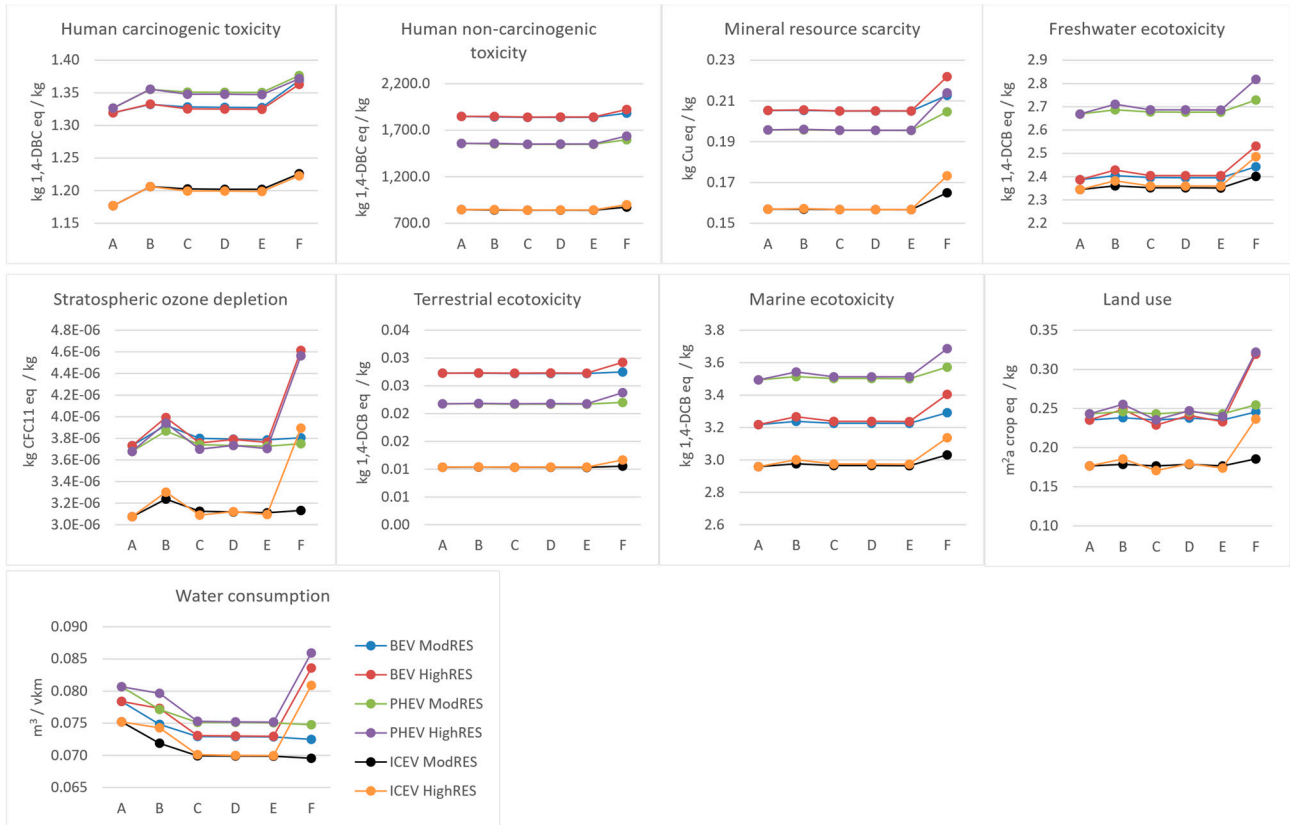


Figure_SI 3. Prospective life cycle assessment results of impact categories for which BEV performed worse than ICEV but shows improvement in future scenarios compared to the reference case BEV.

3 Prospective environmental impacts of vehicle production considering advances in future steel and electricity sectors

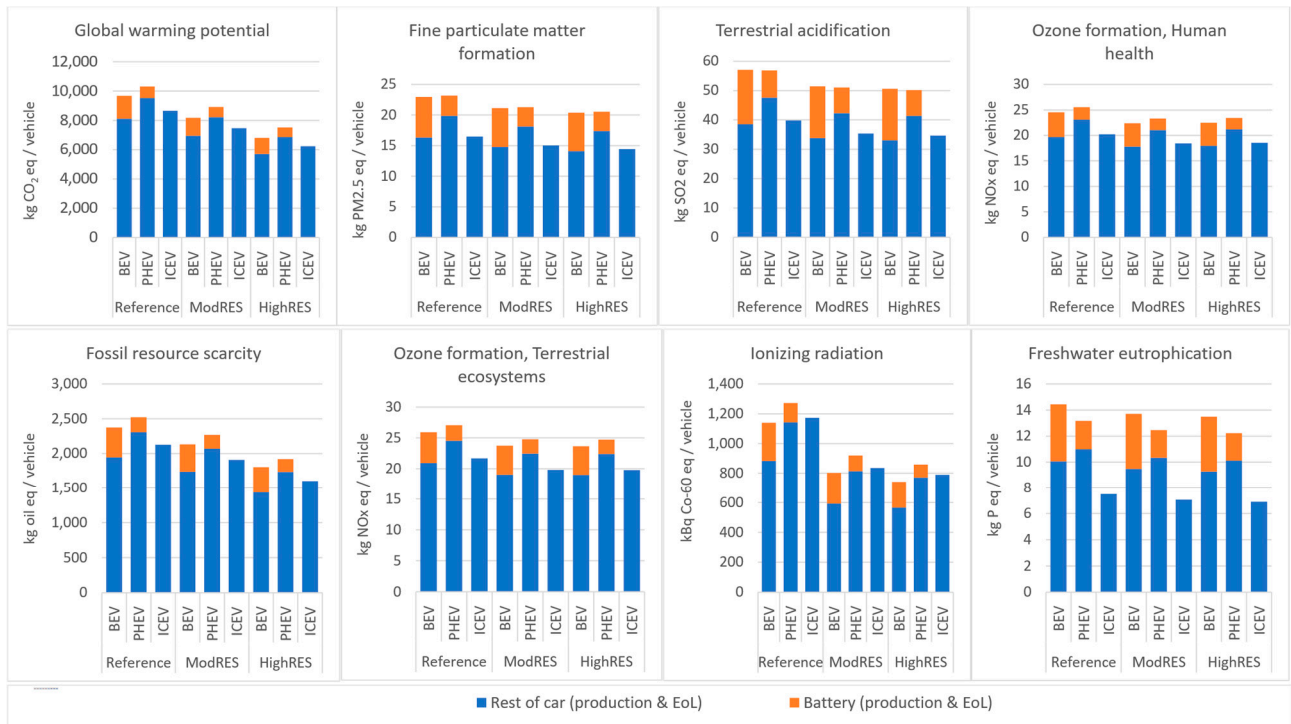


Figure_SI 4. Prospective environmental impact of producing 1 kilogram of BEV, PHEV and ICEV - for impact categories for which future vehicle production of all powertrain performed better than their counterpart in the reference scenario. For ModRES and HighRES, results are presented cumulatively, where A refers to the reference case, B refers to improvement due to scenario-based electricity mix for vehicle manufacture, C refers to changes in B plus efficiency improvement in electricity demand for vehicle manufacture, D refers to changes in C plus changes in heat mix in vehicle manufacture, E refers to changes in D plus efficiency improvement in heat demand for vehicle manufacture, and F refers to changes in E plus scenario-based steel.

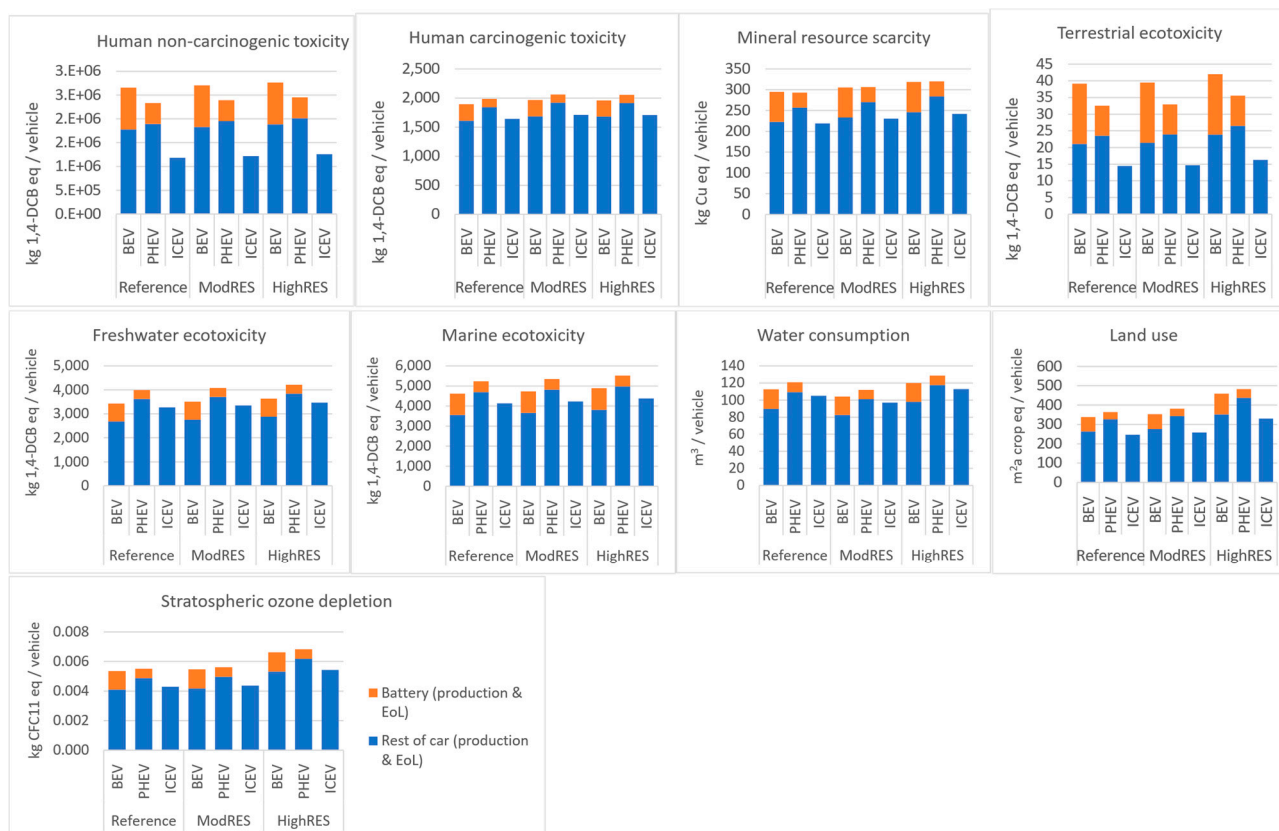


Figure_SI 5. Prospective environmental impact of producing 1 kilogram of BEV, PHEV and ICEV - for impact categories for which future vehicle production of all powertrain performed worse than their counterpart in the reference scenario. For ModRES and HighRES, results are presented cumulatively, where A refers to the reference case, B refers to improvement due to scenario-based electricity mix for vehicle manufacture, C refers to changes in B plus efficiency improvement in electricity demand for vehicle manufacture, D refers to changes in C plus changes in heat mix in vehicle manufacture, E refers to changes in D plus efficiency improvement in heat demand for vehicle manufacture, and F refers to changes in E plus scenario-based steel.

4 Prospective life cycle impact assessment results of vehicle production



Figure_SI 6. Prospective environmental impact of vehicle production for BEV, PHEV and ICEV. Environmental impact for impact categories listed here shows relative reductions in future vehicle production compared to their counterpart in the reference scenario.



Figure_SI 7. Prospective environmental impact of vehicle production for BEV, PHEV and ICEV. Environmental burden for impact categories listed here shows no reductions in future vehicle production, instead we noted relative increase in future scenarios compared to the reference scenario.