

Global Road Transport Emissions: Bottom-Up Insights for Inventory Improvement

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MOTIVATION

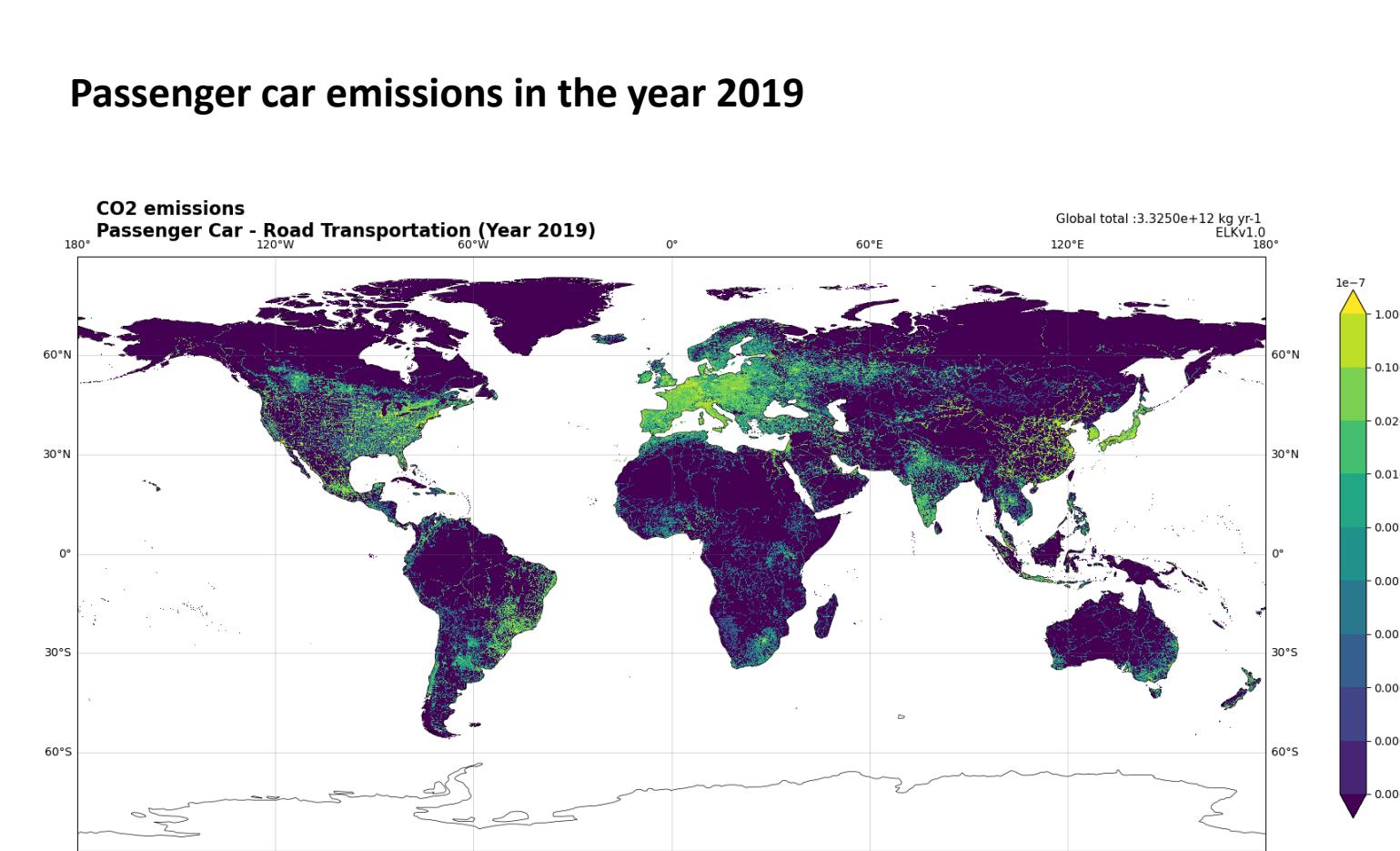
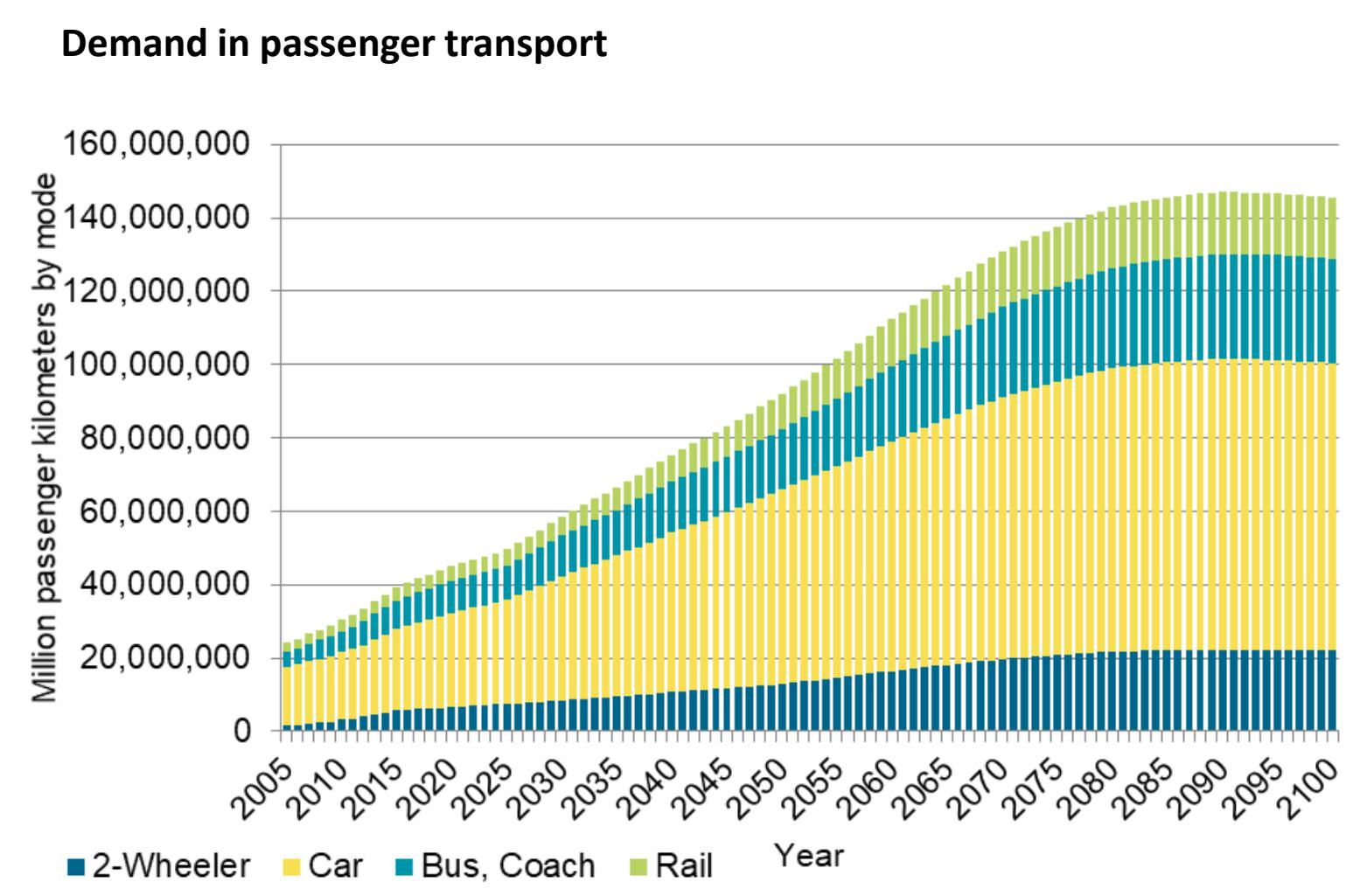
- Continuously growing transport demand complicates the reduction of emissions in the transport sector, highlighting the need for improved modelling
- Insufficiencies of available global emissions inventories in scope or scenario capability
- Typically, no coverage of all transport modes and limited information at subsector level



GOALS

- Bottom-up calculation of global emissions for the reference year 2019 using scenario-capable models and improved input data.
- Quantification of emissions for various species, including NOx, CH₄, CO, N₂O, NMVOC, NO₂, PM10, PM2.5, SO₂, black carbon, and non-exhaust emissions.
- Inclusion of transport-related scenario inputs and corresponding measures to quantify cumulative emissions through 2050, as well as sensitivity analyses to assess the impacts of changes in these inputs.

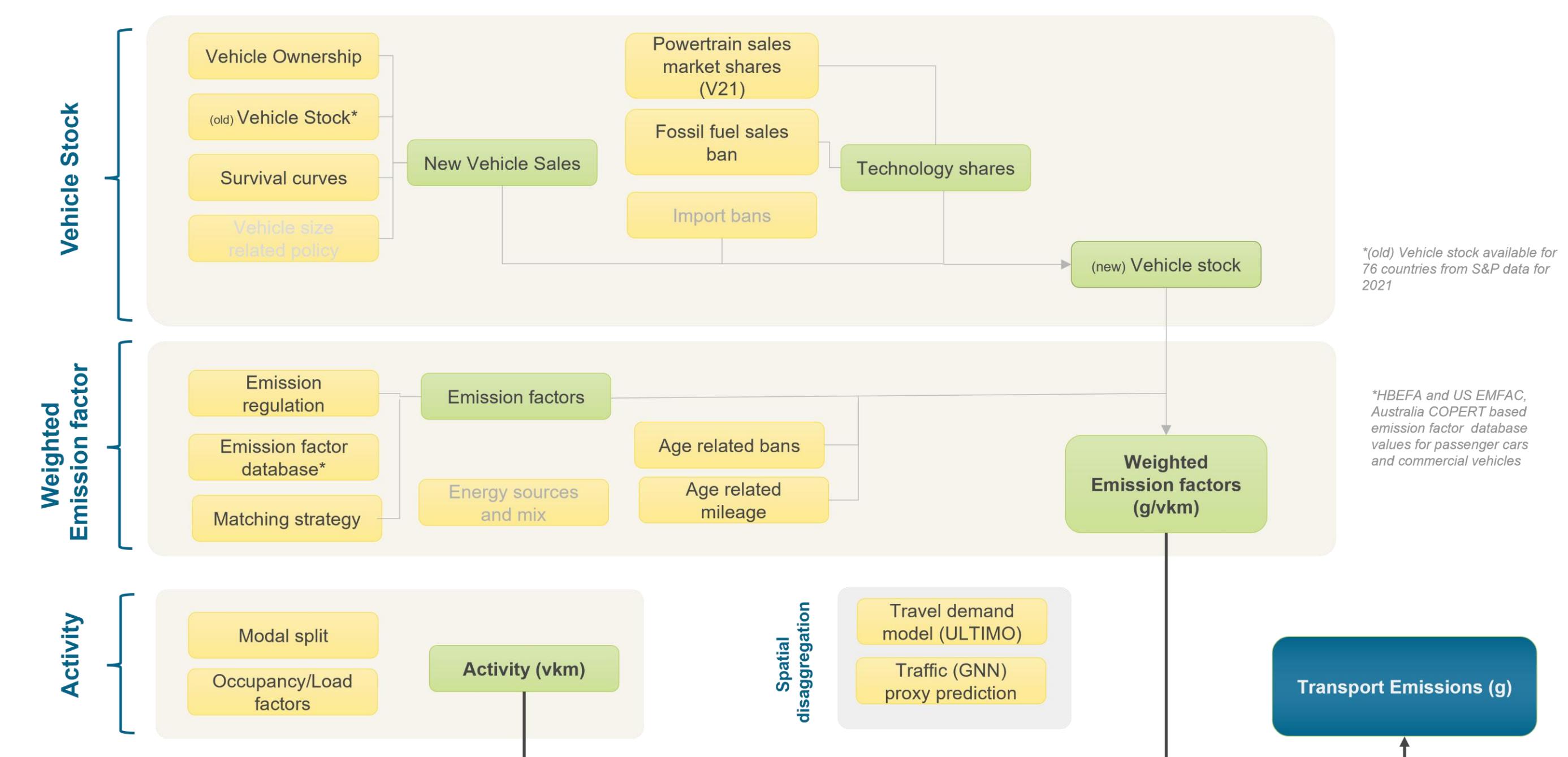
Global emissions of land transport



- Bottom-up modeling of vehicle fleets allows emissions to be allocated to the subsectors of passenger and freight transport, using the models TRAEM, ULTIMO and V21
- Detailed view of Europe by modeling traffic flows and validating them with observed link loads.
- High spatial and temporal resolution, compatible with existing inventories
- Calculation of exhaust and non-exhaust emissions for 20 species
- Approx. 7,390 Tg CO₂ emitted by road and rail transport in 2019

Methodology

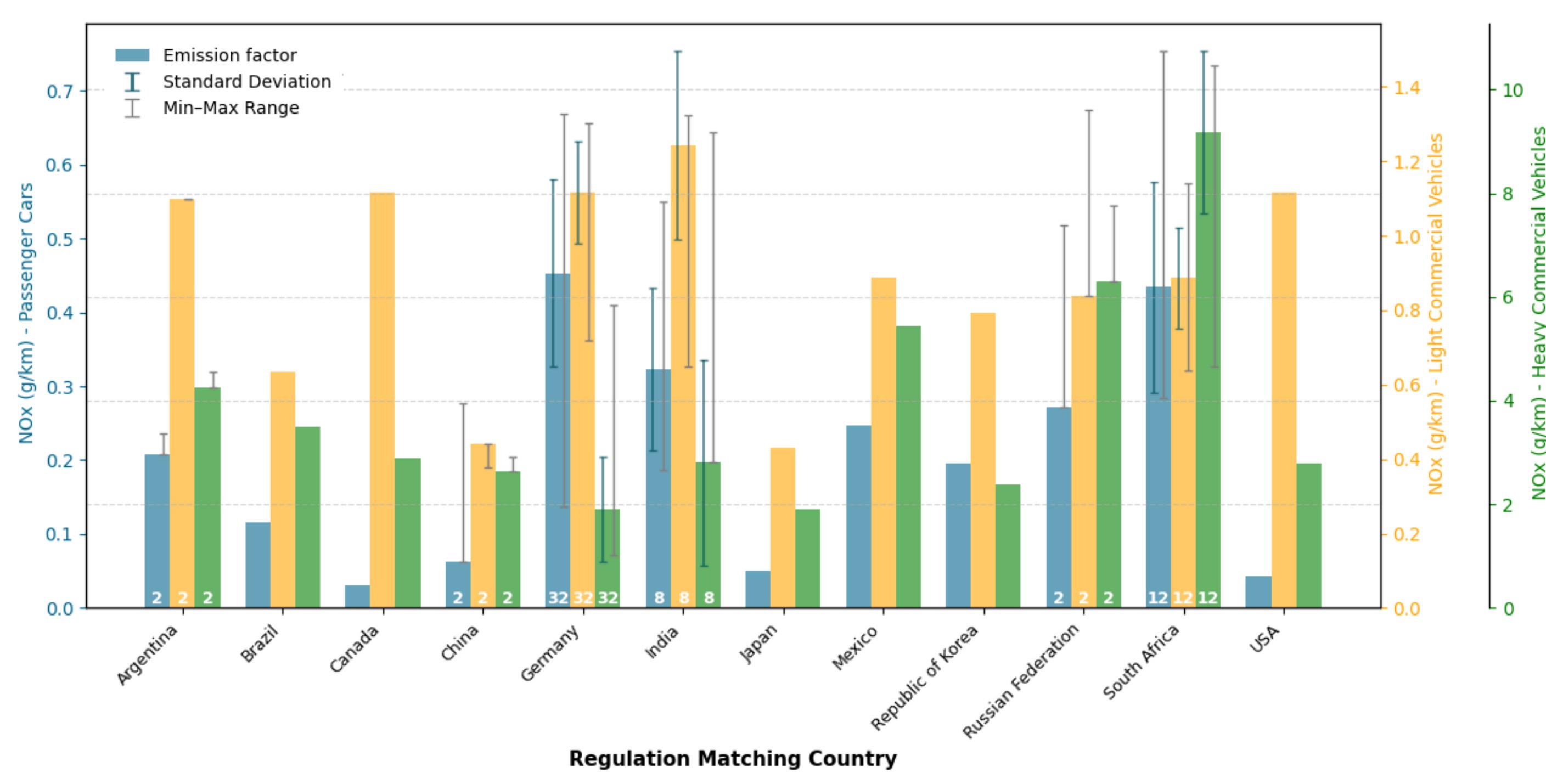
Land transport emission calculation methodology



- Methodology built on vehicle stock data for 76 countries for reference year and HBEFA, EMFAC and Australian COPERT database
- Emission regulation introduction years and Euro/US equivalents for representative countries are included
- For other countries with stock data, regulation timelines inferred by matching to representative countries with similar regulatory and technological profiles

Reference year insights

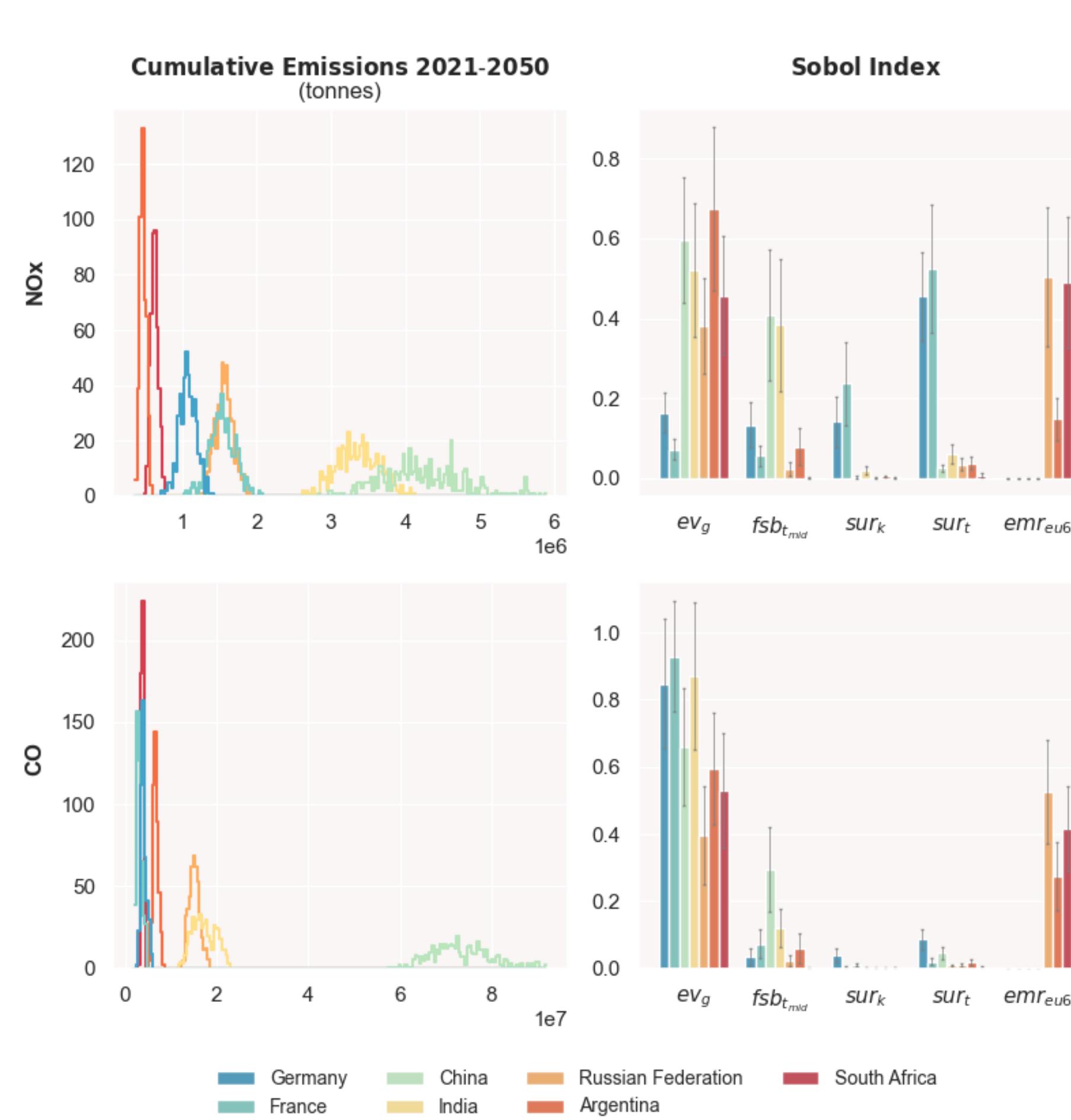
NOx weighted emission factor of countries compared to their regulation matched country in 2019



- A large difference in weighted emission factors among countries compared to their representative counterparts, when stock data is incorporated, reveals the strong influence of country-specific stock structures on non-CO₂ pollutant estimates.
- An optimal subset of countries with stock data can be identified to reduce data requirements while maintaining global emission uncertainty within acceptable limits
- Historical gasoline-diesel shares, age-related mileage driven relationships and survival curves are relevant for industrialized countries

Future scenarios and sensitivity

Cumulative passenger car emissions from 2021-2050 and sensitivity analysis for selected countries



- Sobol sensitivity analysis was conducted for selected countries to assess the influence of EV growth rate, fossil fuel vehicle sales bans, survival curve parameters, and shifts in emission regulations on cumulative emissions.
- Germany and France sensitive to parameters related to survival curves due to the large remaining stock of diesel vehicles
- Russia, Argentina and South Africa most sensitive to a delay in implementation of Euro 6

