

Preliminary results of G20 HDV air quality and health study

Lingzhi Jin and Joshua Miller, ICCT

7 October 2020

2020 Annual Meeting of the G20 Transport Task Group

Opening questions

- How many G20 countries have not yet adopted Euro VI equivalent standards for heavy-duty vehicles?
 - 2
 - 4
 - 6

Opening questions

- Compared to currently adopted policies, how much black carbon could be reduced in 2040 if all G20 countries implement Euro VI equivalent standards by 2023?
 - 65%
 - 75%
 - 85%

Scope and objectives

- **Objective:** Quantify and enhance understanding of the multiple benefits of key policies for reducing air pollutant emissions from heavy-duty vehicles (HDVs) in G20 economies.
- **Scope:** The scope covers all G20 countries. The study will include current and projected diesel HDV exhaust emissions, population-weighted exposure to ambient PM_{2.5} and O₃ from these emissions, associated premature deaths and years of life lost, valuation of health damages, and climate effects of HDV non-CO₂ emissions.

Policy scenarios

We incorporated four scenarios into our analysis. Each scenario builds upon the previous ones. For example, **Next-gen** assumes countries have already implemented adopted policies and Euro VI equivalent standards in 2023.

- **Adopted:** Policies adopted by August 2020.
- **Expanded world-class:** All G20 countries implement Euro VI equivalent standards by 2023. Used imports are required to meet new vehicle standards starting with Euro VI equivalent standards. Based on adopted policies, countries that have not implemented Euro VI by then are ARG, AUS, IDN, RUS, SAU, ZAF.
- **Next-gen:** EU in 2025; US, Canada and China in 2027; 2028 for countries that have adopted Euro VI by August 2020; and 2030 for all other G20 countries.
- **Accelerated fleet renewal:** 100% of in-use HDVs meet current world-class standards (Euro VI equivalents) and next-gen standards several years after they are applied to new vehicles. We include a sensitivity analysis of fleet renewal assumptions, including e.g. 12, 16 and 20 years.

Adopted policies

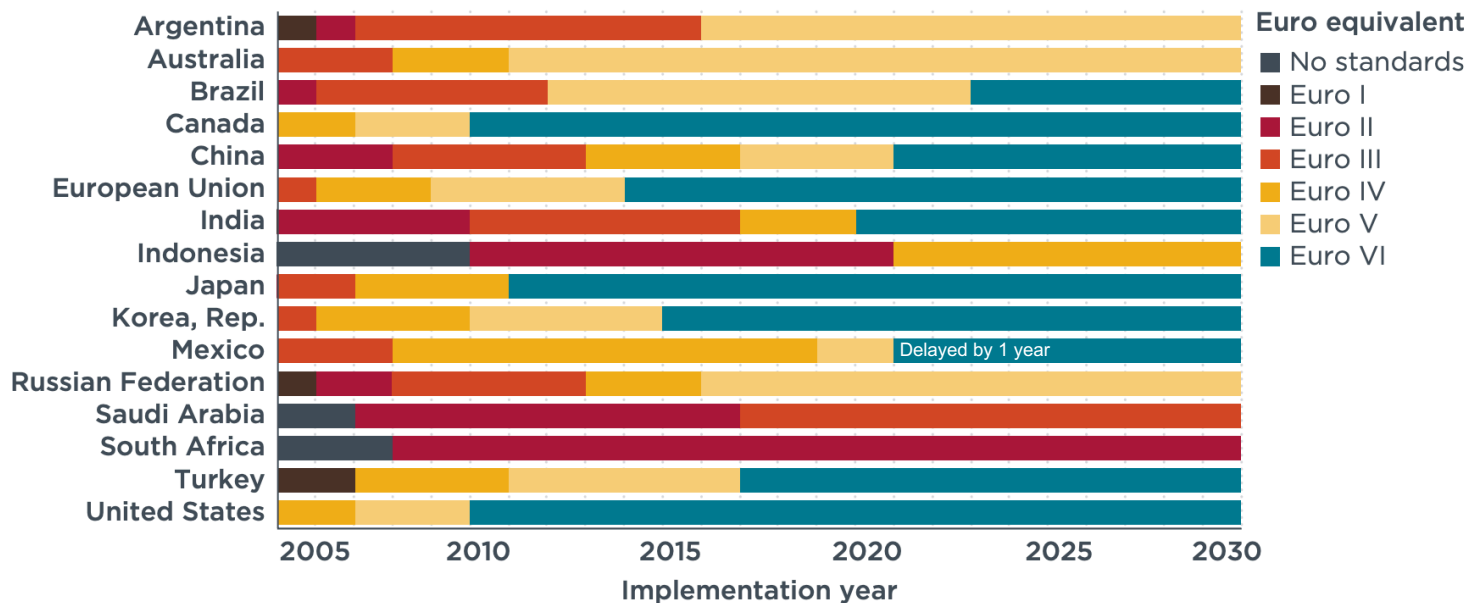


Figure 1. Implementation year (all sales and registration) of heavy-duty diesel engine emission standards in G-20 economies

Next-gen scenario

Country	Implementation year	NOx limit
US, CAN	2027	90% reduction from current limit
EU	2025	90% reduction from current limit
CHN	2027	90% reduction from China VI limit
BRA, IND, JPN, KOR, MEX, TUR	2028	90% reduction from Euro VI equivalent limit
ARG, AUS, IDN, RUS, SAU, ZAF	2030	90% reduction from Euro VI equivalent limit

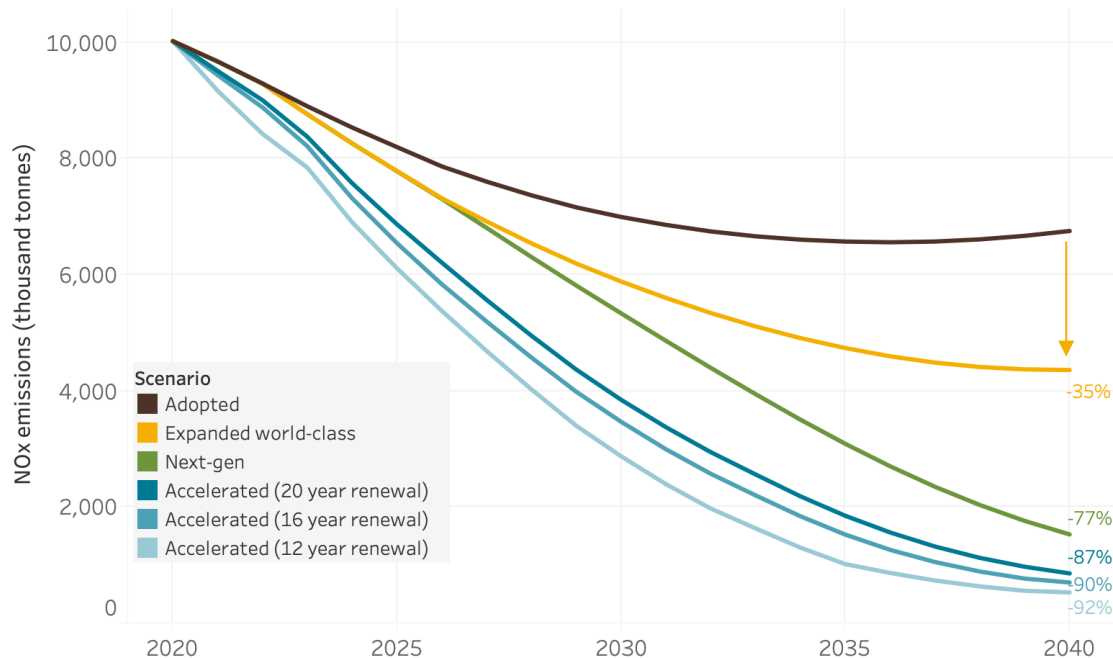
Figure 2. Implementation year (all sales and registration) of heavy-duty diesel engines next-gen emission standards in G-20 economies

Highlights of emissions methods

- Emissions are estimated using ICCT's [Roadmap model](#). The model considers factors such as energy consumption and efficiency, fuel quality, vehicle activity, sales, stock and emission controls by country/region, vehicle type, fuel type, and year.
- We consider the effects of [used vehicle imports](#) in countries that allow them, including Mexico, Saudi Arabia, and Russia.
- [Emission factors](#) are based on major emission factor models such as MOVES, EMEP and HBEFA. We adjust PM and NOx emission factors based on [real-world performance data](#), including remote sensing measurements, PEMS studies, and planned updates to MOVES.
- We consider the effects of [high-emitters](#), i.e. vehicles whose emissions control systems are malfunctioning as a result of tampering, poor maintenance, or failure, and produce emissions substantially higher than regulatory limits.
- We follow EMFAC and MOVES' approach to estimate [emission deterioration](#) from the end of the warranty period to the end of useful life.

Preliminary NOx emissions results

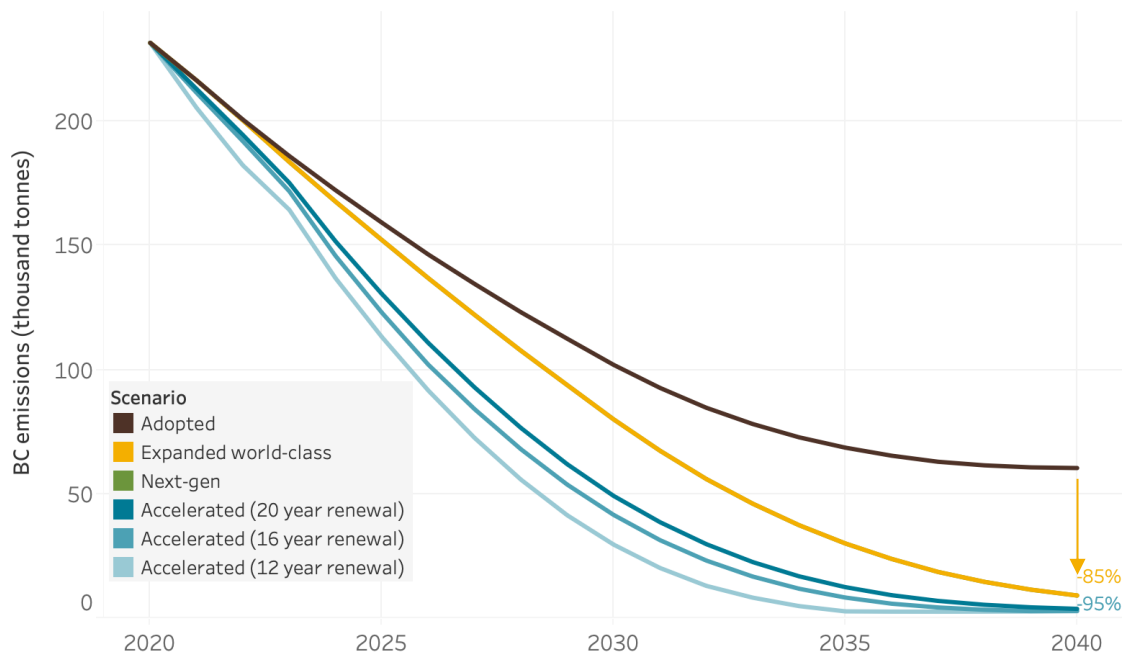
HDV exhaust NOx emissions in G20 countries, 2020–2040



Data labels show the percent change in NOx emissions compared to adopted policies in 2040.

Preliminary BC emissions results

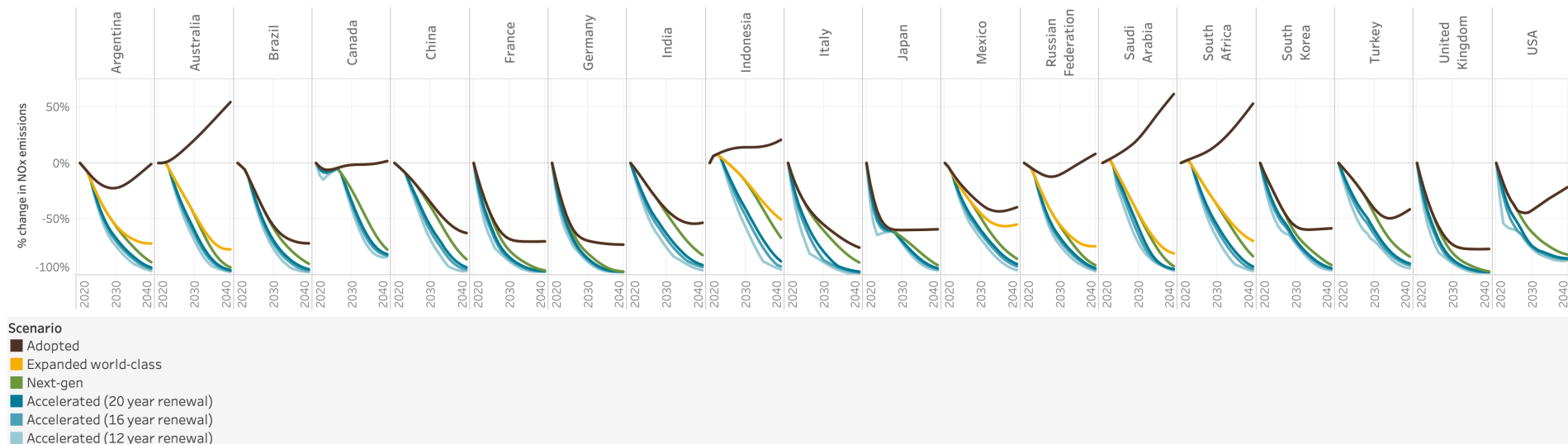
HDV exhaust BC emissions in G20 countries, 2020–2040



Data labels show the percent change in NOx emissions compared to adopted policies in 2040.

Preliminary NOx emissions results

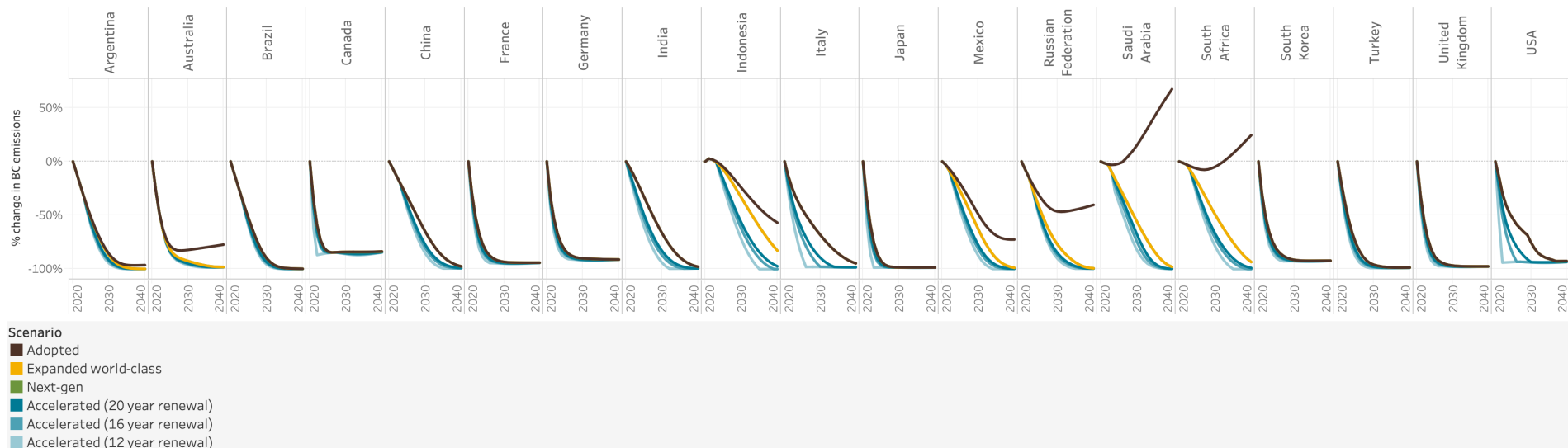
HDV exhaust NOx emissions in G20 countries, 2020-2040



Y-axis shows the % change in NOx emissions from 2020.

Preliminary BC emissions results

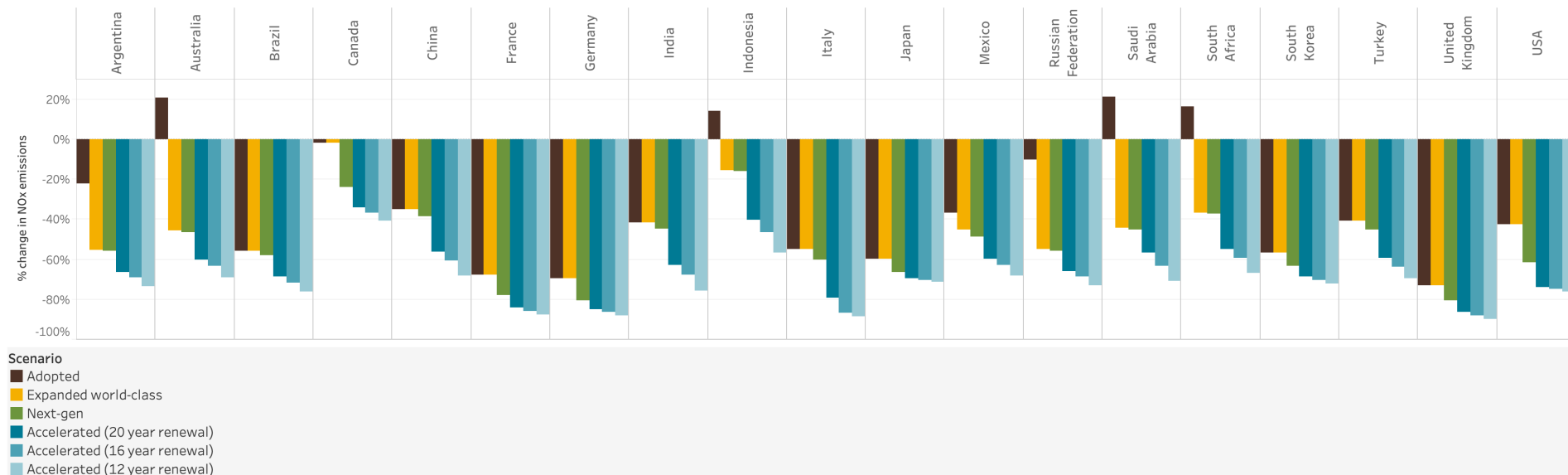
HDV exhaust BC emissions in G20 countries, 2020–2040



Y-axis shows the % change in BC emissions from 2020.

Preliminary NOx emissions results

HDV exhaust NOx emissions in G20 countries, 2030



Y-axis shows the % change in NOx emissions from 2020 in 2030.

Highlights of air quality and health methods

- To evaluate the specific disease burden resulting from emissions of vehicle exhaust pollutants, we developed the **Fast Assessment of Transportation Emissions (FATE) model**, in collaboration with researchers at CU Boulder and George Washington University.
- Uses **adjoint coefficients from the GEOS-Chem** atmospheric chemistry model to convert gridded BC, OC, NO_x, SO₂, NH₃ emissions to population-weighted average PM_{2.5} exposure by country.
- Applies field-leading **methods developed by IHME** for the Global Burden of Disease 2019 to estimate the global deaths and DALYs associated with PM_{2.5} emissions.
- Evaluates health impacts by specific **endpoint**, including stroke, ischemic heart disease, COPD, lower respiratory infection, lung cancer, and diabetes mellitus type 2.
- Estimates future impacts out to 2040.

Next steps in the study

- Estimating emissions impacts on population-weighted PM_{2.5} and ozone exposure.
- Estimating PM_{2.5} and ozone health effects and health damage valuation.
- Estimating climate effects of non-CO₂ emissions.

Closing questions

- When do you expect your country could implement next-generation HDV exhaust standards?
 - 2025 or earlier
 - 2026-2029
 - 2030 or later
 - I have no idea

Closing questions

- In your country, what ambition of HDV fleet renewal is realistic or worth trying for?
 - 12 years
 - 16 years
 - 20 years
 - More than 20 years
 - I have no idea

Questions?
Contact lingzhi.jin@theicct.org



THE INTERNATIONAL COUNCIL
ON CLEAN TRANSPORTATION

Share of total diesel HDV VKT, US

