Road Transport Emission Factors: 2021 NAEI

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Emissions from road vehicles depend on a number of influencing factors and require fairly detailed models to take them all into account. These include the age and composition of the fleet, the size or weight of the vehicle, the emission standards the vehicles complied with when sold new, abatement technologies used to reduce emissions, the type and quality of fuel used, the way the vehicle is driven, trip characteristics and temperature conditions.

The main sources of emission factors used by the NAEI are:

- COPERT v5.4 (COPERT is a software tool developed by the European Environment Agency and is used widely to calculate national emissions from road transport in Europe)
- EMEP/EEA Emission Inventory Guidebook 2019 - update October 2020

These are based on analysis of emissions test data for in-service vehicles measured over a range of different drive cycles. The factors are expressed in grams emitted per kilometre driven wherever possible as a function of average speed or road type.

The latest version of the COPERT model is available for download from here.

Both data sources are supplemented in the NAEI by factors taken from the EMEP/EEA Guidebook for emissions inventory reporting.

The NAEI uses these factors with detailed activity data (total vehicle km travelled each year, national fleet composition, fuel consumed etc.) in a methodology described in detail in the 2023 UK inventory reports for air pollutants and greenhouse gases covering the inventory up to 2021 at:

- UK Informative Inventory Report (1990 to 2021) - NAEI, UK
- National Inventory Submissions 2023 | UNFCCC (available from 15 April 2023)

The Department for Energy Security and Net Zero (DESNZ) provides greenhouse gas conversion factors for company reporting, which can be found here. **Please refer to this tool for CO_2 factors for road vehicles.**

Emission factors are provided here for a selection of pollutants of specific importance to road transport in a simplified form that reflects the composition of the UK fleet and journeys made in 2021. They are implied emission factors derived by taking the overall emissions in 2021 for each vehicle type, calculated by the national emissions inventory methodology, and dividing by total vehicle km travelled or number of vehicles or trips made in 2021. The emissions are taken from the 2021 version of the NAEI released in early 2023.

The factors vary from previous versions for various reasons. The main reason for changes is due to the gradual refreshing of the UK fleet with new, cleaner vehicles displacing older, high

emitting vehicles. This mostly leads to reduced emission factors relative to the previous version. An exception to this is for N_2O, where the emission factors for the modern vehicles typically higher emission factors compared to older vehicles. For SO_2, the emission factors are around 10% higher than in the previous version following the application of new data from UKPIA.

Factors are provided for each main process by which emissions occur and at different levels of detail in terms of emission type, vehicle category and road class. Users can then choose a set of factors that best matches the level of detail in their own traffic activity data.

The different emission processes are:

- **Hot exhaust emissions** - these are the tailpipe emissions in g/km from a vehicle with its engine warmed up to its normal operating temperature.
- **Cold start exhaust emissions** - these are the additional tailpipe emissions in g/trip from a vehicle starting a journey with its engine cold. Cold start emission factors are only available for cars and light goods vehicles and for certain pollutants.
- **Evaporative emissions** - these are the emissions of NMVOCs or benzene from the evaporation of fuel vapour from a vehicle. These occur only for petrol vehicles because diesel is a much less volatile fuel. There are emission factors for three different evaporative emission processes:
    - Diurnal loss emissions in g/day. These are emissions arising from expansion of fuel vapour in the petrol tank as temperature rises each day. These occur for all petrol vehicles regardless of whether or how much the vehicle travels
    - Hot soak emission in g/trip. These are the emissions occurring from the fuel system when the engine is turned off at the end of a trip. Emissions are due to the transfer of heat from the engine and hot exhaust to the fuel system where fuel is no longer flowing
    - Running loss in g/km. These are evaporative losses that occur while the vehicle is in motion

More detailed information can be found in the UK inventory report referred to above.

- **Tyre wear and brake wear** - these are the non-exhaust emissions of PM_{10} and $PM_{2.5}$ in g/km arising from the mechanical wear of tyre material and brake linings.
- **Road abrasion** - these are the non-exhaust emissions of PM_{10} and $PM_{2.5}$ in g/km arising from the abrasion and deterioration of road surfaces.

The emission factors are provided in different levels of detail:

1. Hot exhaust emissions by vehicle type, fuel type and by road type; these are the most detailed forms and should be used in conjunction with calculation of cold start and evaporative emissions (in the case of NMVOCs and benzene) if separate trip data are available.

2. Emissions combining hot exhaust, cold start and evaporative emissions in g/km for all cars and all LGVs by road type in g/km. These should be used if the user wants an average factor for cars and LGVs of all fuel types because details of the fuel split are not known, and the user has no way of calculating cold start and evaporative emissions independently.

3. Emissions combining hot exhaust, cold start and evaporative emissions in g/km for each main vehicle type averaged over all road types. These should be used if the user wants an average factor covering all road conditions and has no way of calculating cold start and evaporative emissions independently.

These factors will be updated annually after submission of each version of the NAEI's UK inventory figures.