Bottom-up calculation of cold start emissions in the Netherlands

Ir. E. van Eijk

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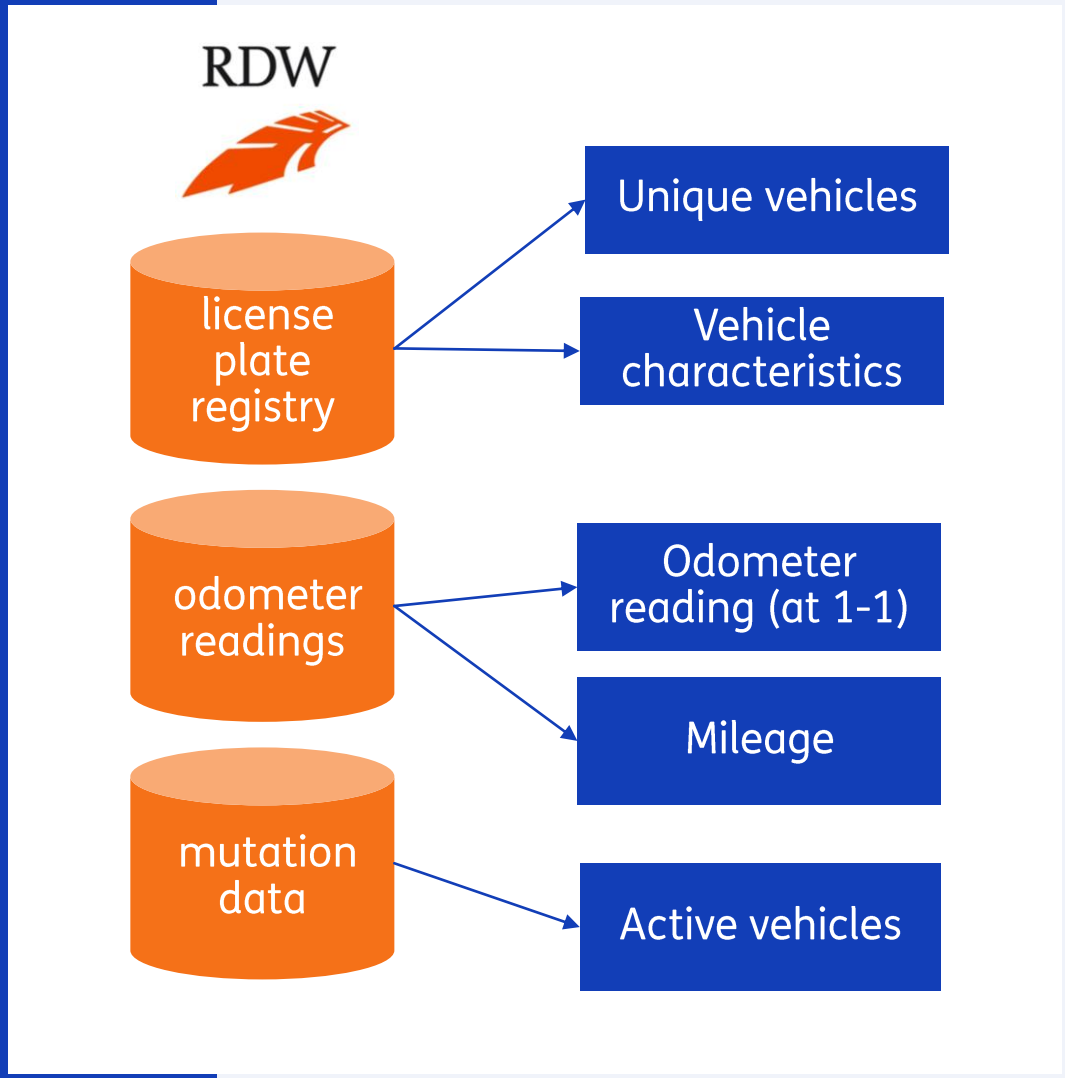
TNO innovation for life

Agenda

1. Bottom-up approach
2. VERSIT+ classes
3. Emission factors
4. Cold start emissions
5. Ageing
6. Spatial distribution

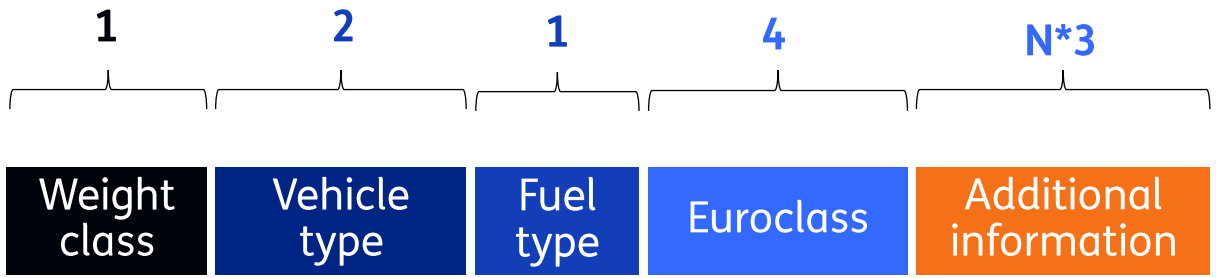
Bottom-up calculation of road transport emissions

- Emissions for Dutch road vehicles are calculated bottom-up (for each individual vehicle separately)
- We use registration data gathered by the Dutch Vehicle Authority (RDW)
  - License plate registry contains all active vehicles and vehicle characteristics (opendata.rdw.nl)
  - Odometer readings are registered at garages (legally required for light duty vehicles and motorcycles)
  - Mutation data includes all mutations like ownership, import, export or demolition
- This year's bottom-up calculation is based on **>20 million** unique vehicles



VERSIT+ classes

- For each vehicle a VERSIT+ class is added based on vehicle characteristics
- The VERSIT+ class includes all relevant information for estimation of emissions
- VERSIT+ classes are defined for all road vehicles but also for NRMM
- The latest bottom-up calculation included 470 different VERSIT+ classes



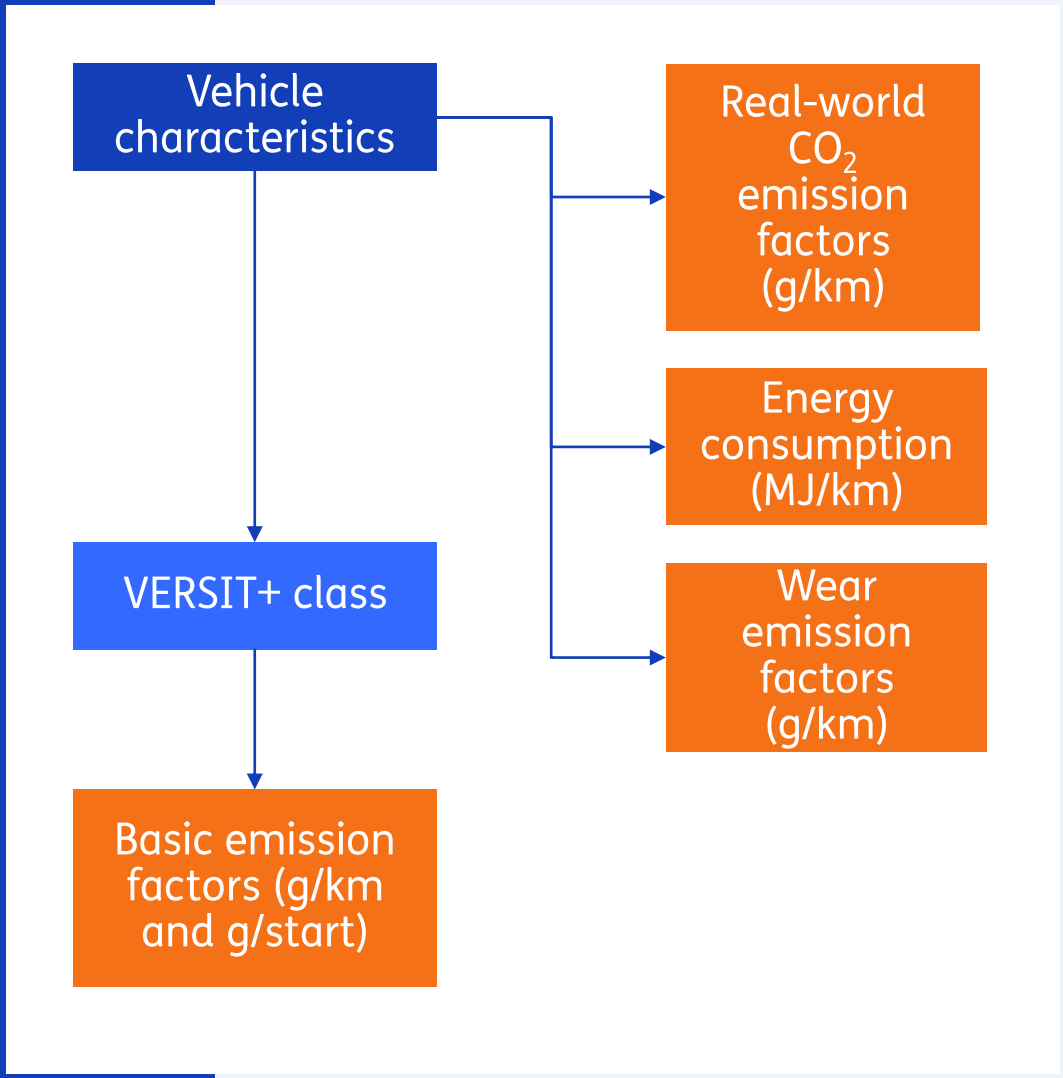
LPABEUR6 = Light passenger car petrol Euro 6

LBADEUR4CL1DPF = Light light commercial vehicle diesel Euro 4 Class 1 Diesel Particulate Filter

Emission factors

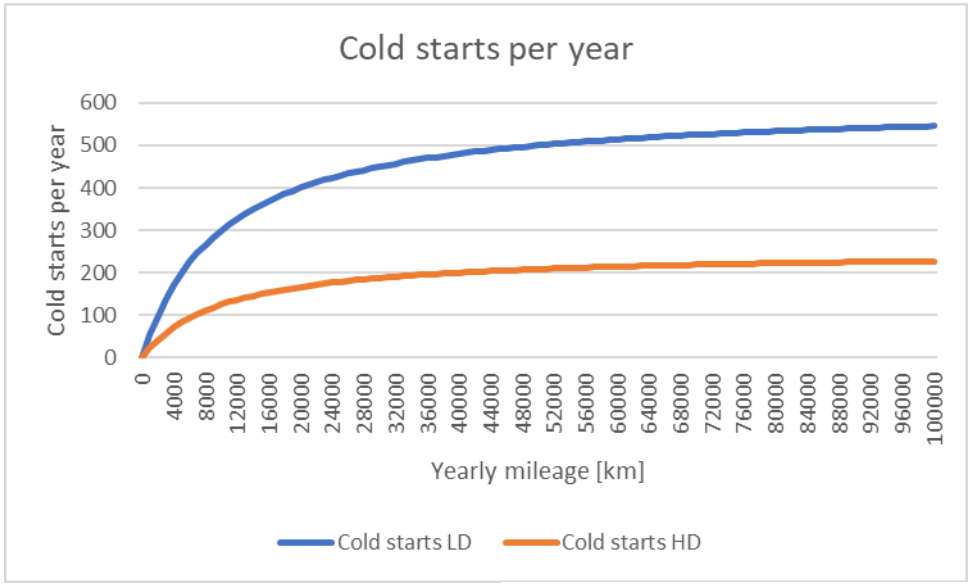
- Emission factors (g/km and g/start) added for each vehicle

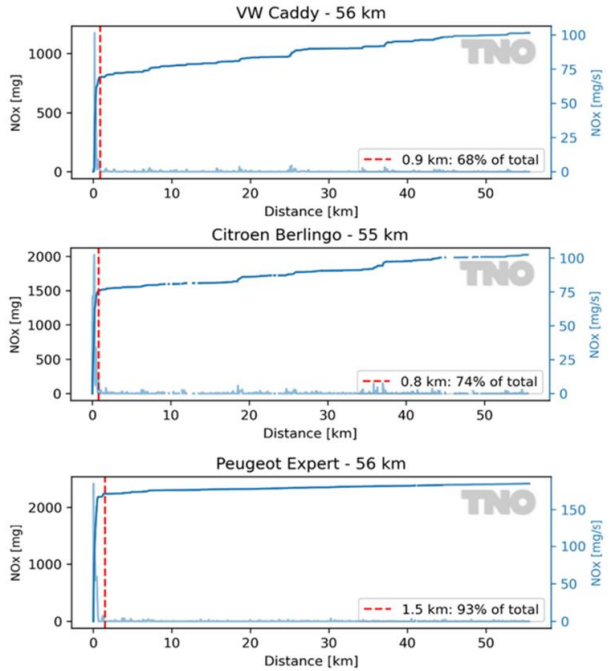
- Average NOx, N2O, PM, CO, THC, CH4, NH3, EC, emission factors based on VERSIT+ class
- Tyre, road and brake wear emission factors calculated based on vehicle mass and engine power
- Real-world CO_2 emission factors based on mass, engine power, build year and engine type
- Energy used (MJ/km) for electric vehicles based on brand-model combination and mass



Cold start emissions

- Cold starts set at > 2 hours parking
- Number of cold starts estimated from yearly mileage, and linked to Statistics Netherlands mobility research
- Light duty vehicles have a maximum of 600 cold starts per year (~2 per day)
- Heavy duty vehicles have a maximum of 250 cold starts per year (~1 per workday)

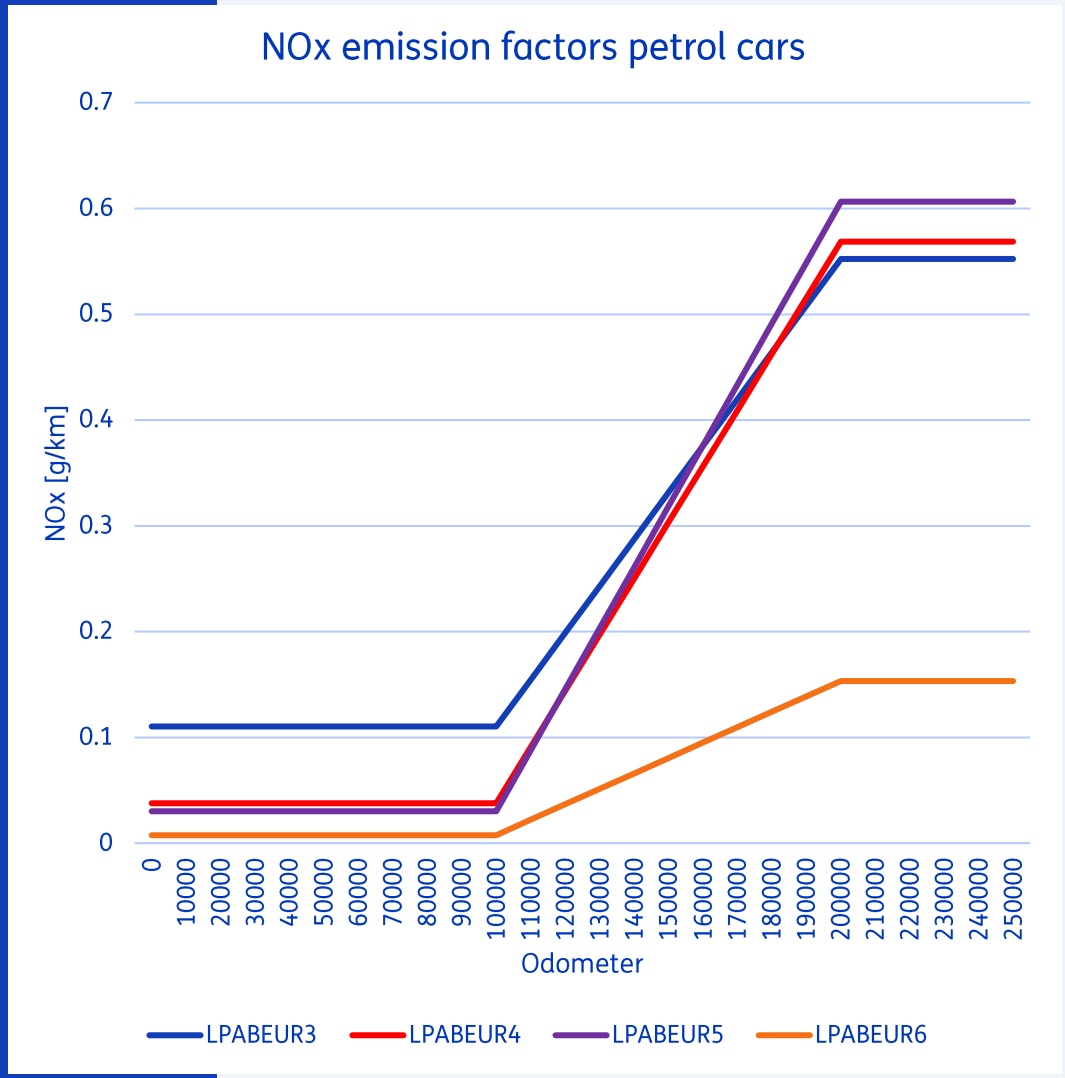




With modern catalytic technologies cold-start emission dominate to total emissions for trips up to 100 km.

Ageing

- Ageing factor added for specific VERSIT+ classes for NO_x, CO, HC and CH_4
- Factors based on known issues with tampering and defects of emission control systems
- Ageing factor is based on odometer reading
- Aging factor only applied to hot emission factors (emission factors in g/km)



Spatial distribution

- Emissions of hot emissions distributed over urban roads, rural roads and motorways
- Cold start emissions distributed over parking places (6 million), houses and job sites for light duty vehicles, and (logistics) businesses and 400 truck parking for heavy duty.
- The effect will be that a larger share of the total emissions is found in residential areas
- Spatial distribution performed on aggregated emissions (not per vehicle)