Bridging inventory and projection road transport emissions

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Why are road transport emissions important?

- Road transport sector:
  - Important sector in the overall emissions

- Actual emissions
  - International reporting obligations
  - Air pollutants: LRTAP and NEC reporting
  - Greenhouse gases: CRF and MM reporting

- Assessment of current ceilings, targets and standards:
  - E.g. NEC 2010 ceiling, non-ETS targets and Air Quality Standards.
Why are road transport projection emissions important?

- Road transport sector:
  - Tomorrow still an important sector in the overall emissions.

- Emission projections
  - Policy assessment of futures targets and new proposals of emission reduction programs:
    - Examples:
      - National Emission Ceilings (Goteborg Protocol (2020) – NEC (2030)) and Non-ETS obligations (2030 and beyond)
      - Adjustment proceeding (failure of real driving emission factor of diesel cars)
      - Air Quality Directives (AQD)
      - Environmental Impact Assessment of new projects (e.g. Infrastructure projects)
Impact of NOx vehicle emission standards failure on Belgian NOx Emissions

Comparison of NOx Removal Efficiencies of COPERT (real world emissions) vs. RAINS (Euro Emission standard)
Road Transport NOx Emissions
Dataset 2014 1990-2014 - Fuel Used
COPERT 4v11.3
Belgium
Example: Adjustment proceeding (failure of real driving emission factor of diesel cars)

Decision 2012/12 Guidance for adjustments under the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to emission reduction commitments or to inventories for the purposes of comparing total national emissions with them

ARTICLE 2.
A Party’s supporting documentation for an adjustment to its emission inventory or emission reduction commitments shall include:

(c) An estimation of whether and when the reduction commitment is expected to be met based on emission projections without the adjustment, thereby using best available science;
Example of air quality modelling nearby roads: Methodology

IFDM - Principle of bi-Gaussian Dispersion Plume model

Info about AQ-model:
http://ifdmtraffic.marvin.vito.be/faces/index.jsp
Example of air quality modelling nearby roads

Figures: For 2020 EC (figure left) and PM$_{2.5}$ (figure under) concentrations in the REFERENCE scenario. Air Quality Modelling performed with IFDM-traffic-model.
Example: Environmental Impact Assessment Study

E.g. Assessment of Air Quality Modelling of NO$_2$ concentrations from a infrastructure project (left without project/ right with project) (Vision year 2020) (Source: plan-MER - Derde Scheldekruising)
Historical and actual versus projection road transport emissions

- Emission Inventory Reporting
  - focus on reporting actual and historical emissions → Process is stringent (cfr. In depth reviews)
  - projections are less stringent → Less guidelines and no review process.

- Policy
  - Focus on actual and projection emissions:
  - Why? Assessment of
    - futures targets in current regulation
    - futures targets in new proposals and amendments
    - new regional/local measures (e.g. LEZ/ greening the vehicle tax)
Why a national/regional projection model?

- No model available on the European market to fulfill all purposes. (cfr. COPERT)
Why bottom up approach projections?

Why?
→ Complementary with the emission inventory.
→ Impact assessment of policy measures direct related to mobility projections.

vs PRIMES-TREMOVE-GAINS?
- EU-module not robust/ transparent for policy preparation and air quality forecasting.
- not in line with fleet and mobility assumptions in the actual/historical EIV reporting (COPERT methodology)
- not applicable for scenarios with measures
Criteria for a good evaluation and assessment of projections

- Bottom-up approach
- One robust model for
  - Greenhouse gasses and air pollutants
  - Inventory and projections
- Fleet module with new technology vehicle classes
- Valid assumptions about abatement potential of futures technologies
National Bottom-up model Methodology:
Mobility Model: Assumptions of vehicle kilometres (vkm)

Historical/actual data input
- fleet/mobility
- EF from COPERT IV

Air Quality Modelling nearby roads

Economics, geographical data
National Projection Model: Mobility Model

Sources or methodologies used to forecast the mobility:

- Strategic Traffic Propagation Models (with origin and destination matrices)
- Environmental energy cost model (cfr. PRIMES)
- Mobility assumptions from the Federal Forecasting Planning Bureau
Mobility (Model) (vkm)

Fleet module (number of cars and vkm per vehicle class)

Historical/actual data input
- fleet/mobility
- EF from COPERT IV

Air Quality Modelling nearby roads
National Projection Model: Fleet model combined with mobility

- Methodology based on survival rates
  - Survival Curves (General survival curve for BAU or REFERENCE scenario and yearly dependent curves for measure scenario’s (scrapage a old euro norm vehicles))
- Degree of detail is necessary for good projection calculations:
  - Same COPERT classes
  - Division in old/new and total number of vehicles
  - Expected vehicle classes
    - Hybrids CS+PHEV/ Full Electric/ H₂/ New Euro standards/ New Abatement (euro 6a and euro 6 c in two stages)
- CO₂ calculation for new vehicle fleet (validation of CO₂ targets of cars, in the future light duty vehicles)
Survival curves

Distribution of number of vehicles per euro class for scenario including default survival curves vs scenario including accelerated scrappage of 'old' cars (example for medium diesel cars)
CO$_2$ evaluation in emission projection model

- Upcoming CO$_2$ targets:
  - for CARS 2021: 95 gCO$_2$/km
  - for LCV 2020: 147 gCO$_2$/km
Economics, geographical data

Mobility (Model) (vkm)

Fleet module (number of cars and vkm per vehicle class)

Historical/actual data input
  - fleet/mobility
  - EF from COPERT IV

Futures abatement potential for technologies

Air Quality Modelling nearby roads
Economics, geographical data

Mobility (Model) (vkm)

Fleet module (number of cars and vkm per vehicle class)

Road Transport Projection Emission Model

Historical/actual data input
- fleet/mobility
- EF from COPERT IV

Futures abatement potential for technologies

Air Quality Modelling nearby roads
National Projection Model: Emission model for REFERENCE SCENARIO

- Degree of detail necessary for good projection calculations:
  - Methodology similar to COPERT
  - New ‘solid’ emission factor for new technologies
  - Possibility to change the current EF based on COPERT IV
  - Flexibility to change the default settings
National Projection Model: Emission model for POLICY SCENARIO

- Degree of detail necessary for good projection calculations:
  - See REFERENCE scenario
  - Extra tools for taking into account calculation of measures
    - in the fleet module (for e.g. scrappage, CO$_2$-target, LEZ),
    - in the mobility module (for e.g. traffic charging)
  - Extra tools for extra abatement calculation (for e.g. development of new policies (e.g. RDE-policy, new euro 7 standard, new CO$_2$ target))
  - Extra tool for AQ modelling, geographical distribution of total road transport emission
Room for improvement

- Guidelines for methodology and introduction of new technologies;
- Implementation of direct link with inventory;
- Methodology for meeting CO\(_2\) targets (95 g CO\(_2\)/km 2021 – and 70 g CO\(_2\) from 20XX);
- Simple model for REFERENCE scenario and more detailed model (with extra modules) for fine tuning the forecast with new measures;
- Implementation of a FS module (to equalize with the energy balance)
- Possibility to obtain quickly sensitivity calculations (e.g. change of EF)
- Validation and uncertainty of the model
- Comparison and tuning with Environmental Cost Benefit Energy model (PRIMES_TREMOVE_GAINS)
Example of fuel sold correction to equalize with the energy balance

**Figure.** Evolution of the Belgium energy statistic for road transport (FS), of the calculated energy for road transport (FU) and vehicle kilometers driven (FU-FS) in Belgium between 1990-2013.
Example of sensitivity analysis for NOx EF (euro 6 and beyond)
CONCLUSIONS & RECOMMENDATIONS

- Urgent need for a COPERT-like road transport projection model with the following characteristics:
  - robust and transparent
  - bottom-up approach
  - direct link between historical emissions and projections
  - reference scenario
  - guidance (in particular for new technologies)

- For policy approaches a more complicated model could be envisaged through add-in modules
LET’S MOVE FORWARD ..... STEP BY STEP

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