

copert⁴   **5**

New methodological elements

Outline of main revisions

➤ Fuel

- Fuel energy instead of fuel mass calculations
- Distinction between primary and end (blends) fuels
- Automated energy balance

➤ Vehicle Types

- Updated vehicle category naming
- New vehicle types
- Emission control technology level

➤ Emission factors

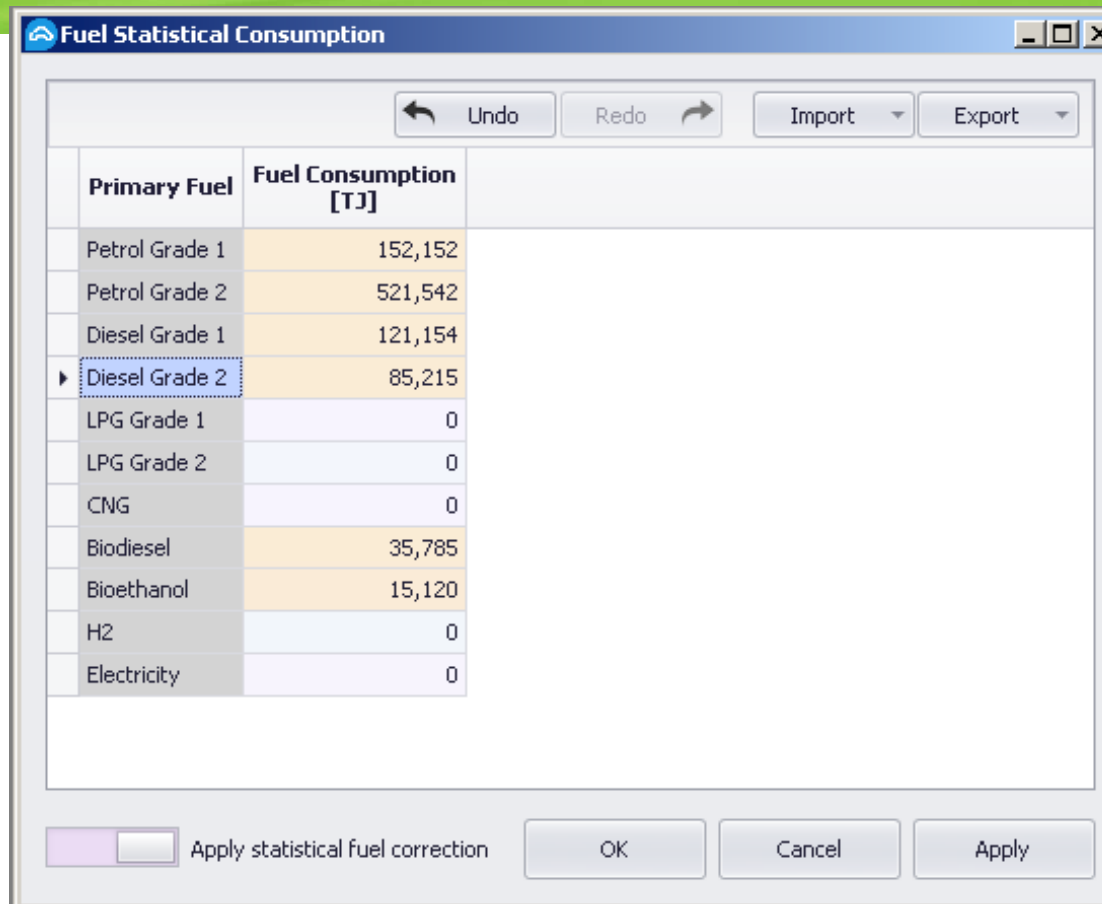
- One function type
- Possibility to distinguish between peak/off-peak urban

➤ *In the pipeline*

- *Tier 2 and Tier 3 methods*
- *Uncertainty estimations*



Primary fuels: energy consumption

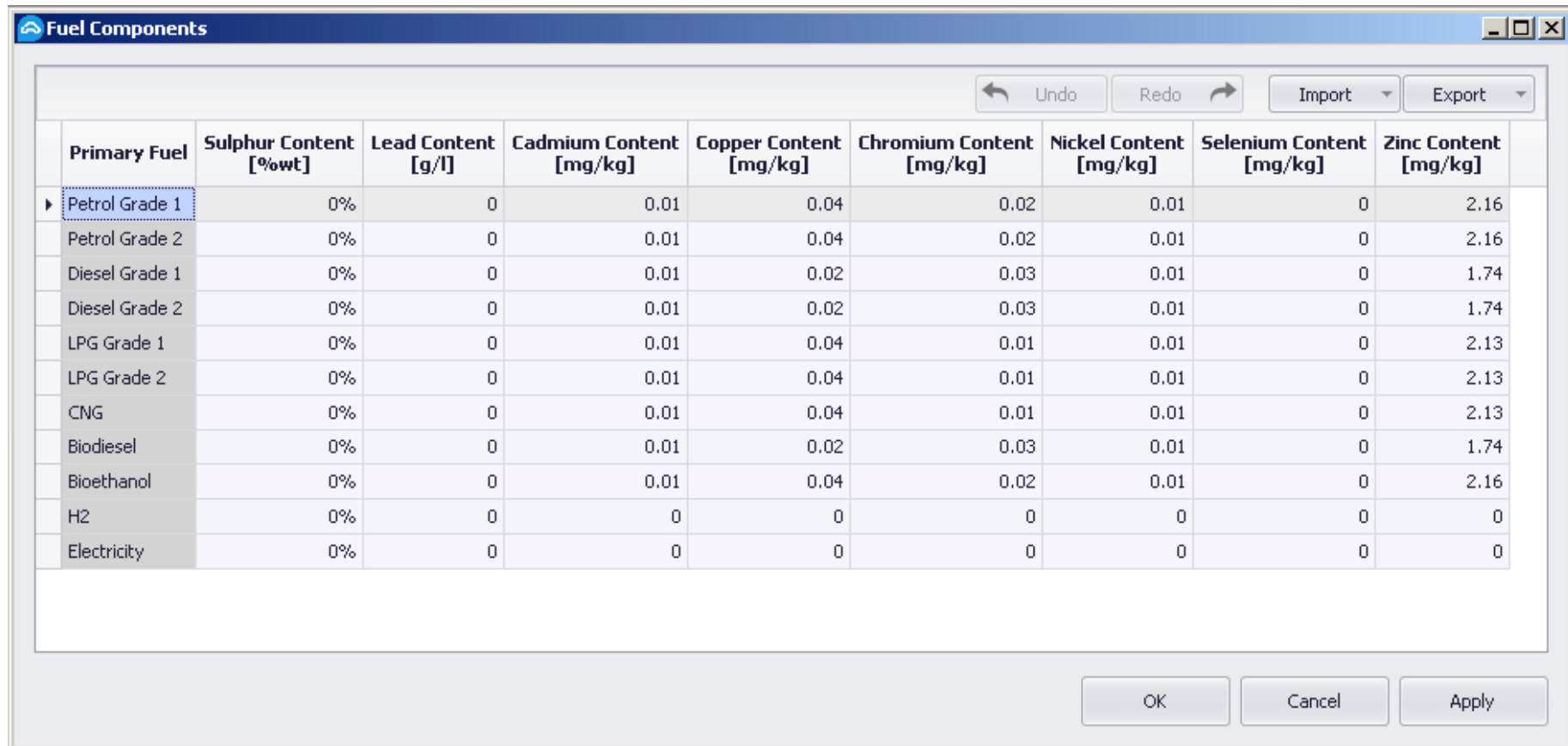


The screenshot shows a software window titled "Fuel Statistical Consumption". At the top, there are buttons for "Undo", "Redo", "Import", and "Export". Below these is a table with two columns: "Primary Fuel" and "Fuel Consumption [TJ]". The table lists various fuel types and their corresponding consumption values in TeraJoules (TJ). The "Diesel Grade 2" row is highlighted with a blue selection box. At the bottom of the window, there is a checkbox labeled "Apply statistical fuel correction" which is currently unchecked, and three buttons: "OK", "Cancel", and "Apply".

Primary Fuel	Fuel Consumption [TJ]
Petrol Grade 1	152,152
Petrol Grade 2	521,542
Diesel Grade 1	121,154
▶ Diesel Grade 2	85,215
LPG Grade 1	0
LPG Grade 2	0
CNG	0
Biodiesel	35,785
Bioethanol	15,120
H2	0
Electricity	0

- Consistent to IPCC: Fuel sales in TJ for each primary fuel
- Two grades for major fuels: User-specific properties
- Addition of electricity and H₂ as separate fuels

Primary fuels: Specifications



The screenshot shows a software window titled "Fuel Components" with a table of fuel specifications. The table has columns for various pollutants and their concentrations in different fuel types. The "Petrol Grade 1" row is highlighted with a mouse cursor.

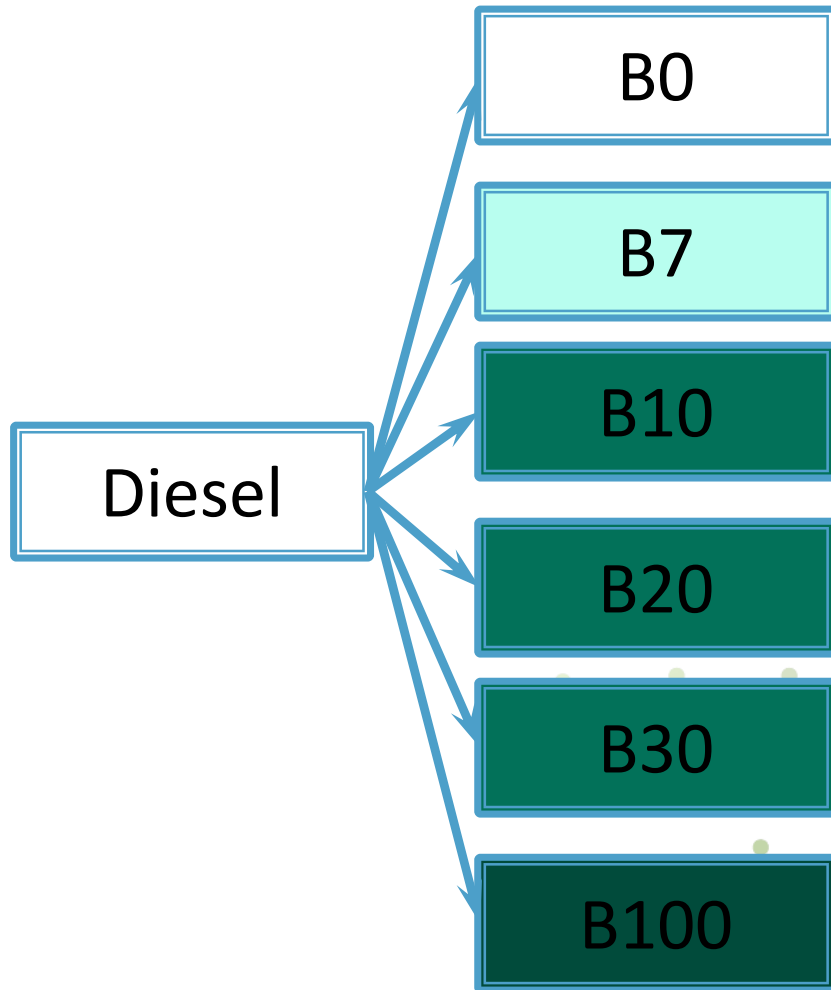
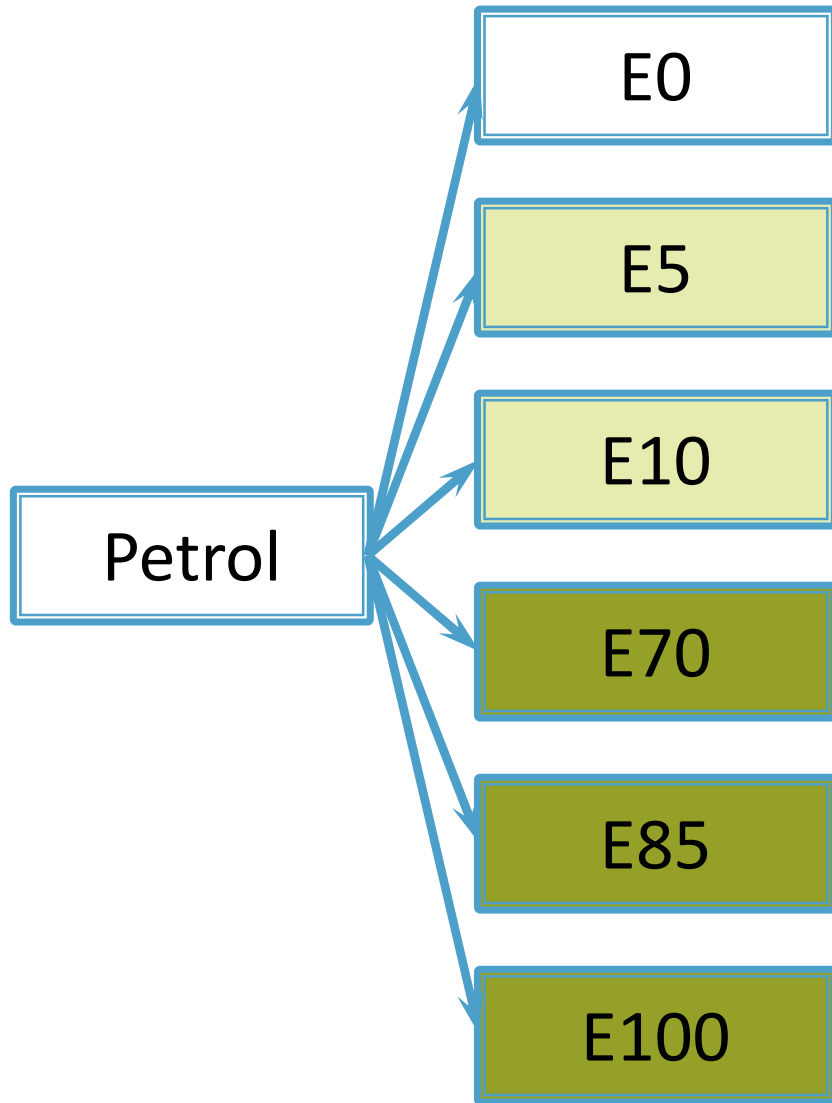
Primary Fuel	Sulphur Content [%wt]	Lead Content [g/l]	Cadmium Content [mg/kg]	Copper Content [mg/kg]	Chromium Content [mg/kg]	Nickel Content [mg/kg]	Selenium Content [mg/kg]	Zinc Content [mg/kg]
Petrol Grade 1	0%	0	0.01	0.04	0.02	0.01	0	2.16
Petrol Grade 2	0%	0	0.01	0.04	0.02	0.01	0	2.16
Diesel Grade 1	0%	0	0.01	0.02	0.03	0.01	0	1.74
Diesel Grade 2	0%	0	0.01	0.02	0.03	0.01	0	1.74
LPG Grade 1	0%	0	0.01	0.04	0.01	0.01	0	2.13
LPG Grade 2	0%	0	0.01	0.04	0.01	0.01	0	2.13
CNG	0%	0	0.01	0.04	0.01	0.01	0	2.13
Biodiesel	0%	0	0.01	0.02	0.03	0.01	0	1.74
Bioethanol	0%	0	0.01	0.04	0.02	0.01	0	2.16
H2	0%	0	0	0	0	0	0	0
Electricity	0%	0	0	0	0	0	0	0

- Similar to COPERT 4, each fuel has its own set of properties (example: HM content)

End fuels: Blends

- End fuels: User may define different fuel blends per vehicle type, e.g. EX blends, difference between winter-summer, etc.
- Example: Petrol passenger car, Small, EURO 1
 - Blends energy share: First order estimate by the user, e.g. 70% E5 and 30% E10 (up to two blends per vehicle type)
 - E5 consisting of
 - 5% vol. Bioethanol
 - 95% vol Petrol (Grade 1 and/or Grade2)
 - E10 consisting of
 - 10% vol Bioethanol
 - 90% vol Petrol (Grade 1 and/or Grade2)

Available Blends



Automated fuel balance

Assumptions

- Vehicle **efficiency does not** depend on fuel blend used (i.e. specific energy consumption independent of fuel blend)
- Fossil / Renewable statistical **ratio** per fuel type will also hold for the calculated consumption

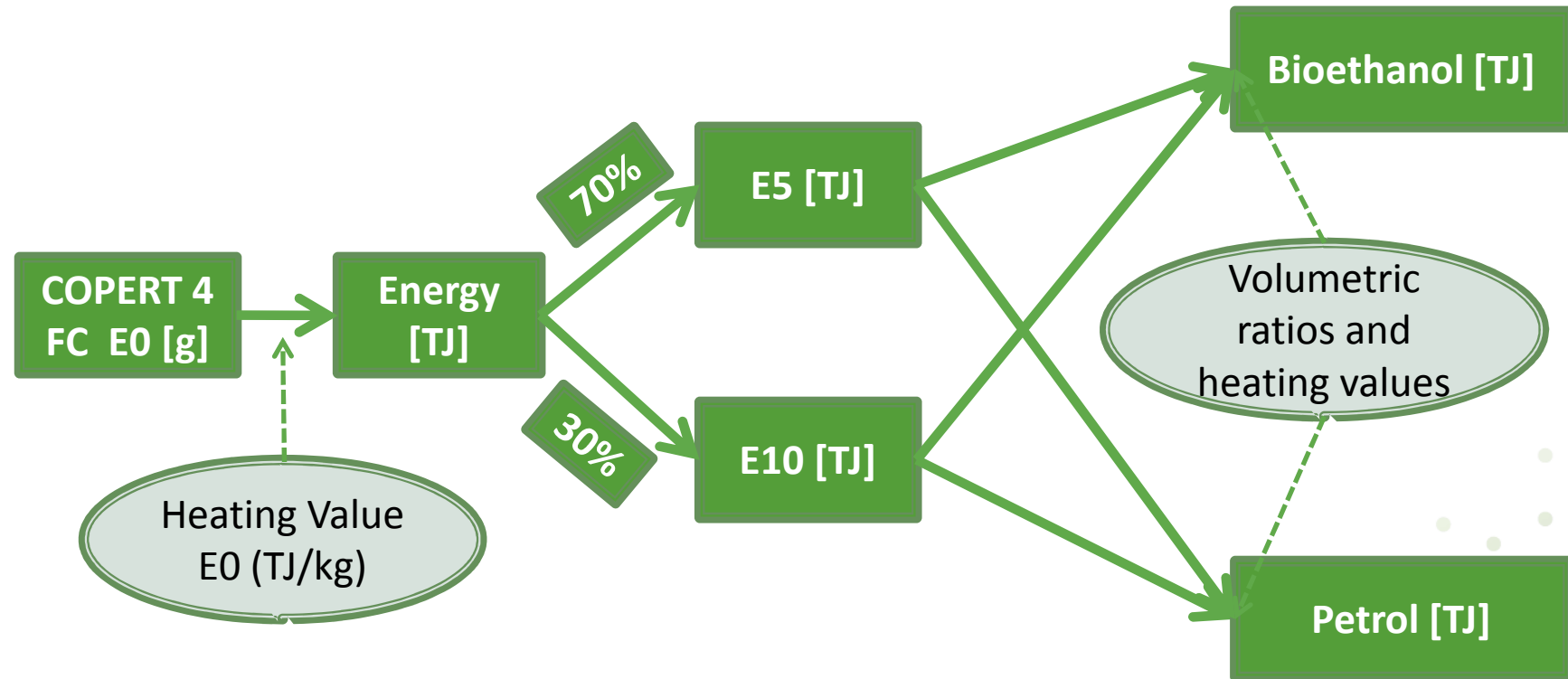
Adjustments

1. Blends energy share (e.g. 70/30 -> 72/28)
2. Blending ratio (e.g. E5 -> E4.5)
3. Mileage adjusted so that calculated energy per fuel type matches statistical energy per fuel type

Finally:

- Energy and pollutant emission based on the new mileage (and blends)

Energy allocation: From end to primary fuels



COPERT 4 original fuel consumption functions [g/km] converted to [GJ/km] by user specific heating values [TJ/kg]

Algorithm for adjustments of bio/fossil

➤ Ratio of sold (biofuel/fossil) fuel energy has to be respected by calculated consumption

➤ Algorithm steps:

1. The blend energy share reported by the user first modified if not enough

2. The blending ratio modified until solution is found



Last step of energy balance

Once bio/fossil ratio adjusted, mileage is adjusted to match total energy consumption:

$$MCF_i = \frac{Energy_sold_i}{Energy_calculated_i}$$

$$NewMileage_j = MCF_i \cdot Mileage_j$$

where

i is either petrol or diesel

j individual vehicle type

New and updated vehicle categories – 1(2)

Passenger Cars

COPERT 4	COPERT 5
<0.8 l	Mini
0.8 – 1.4 l	Small
1.4 – 2.0 l	Medium
>2.0 l	Large-SUV-Executive

- Engine capacity as such little relevant for consumption
- Segmentation may be found by ACEA or vehicle dealers



Light Commercial Vehicles

COPERT 4	COPERT 5
Gasoline	Petrol N1-I
	Petrol N1-II
	Petrol N1-III
Diesel	Diesel N1-I
	Diesel N1-II
	Diesel N1-III

- Categories relevant to fuel consumption calculation
 - N1-I: $RW \leq 1305$ kg
 - N1-II: $1305 \text{ kg} < RW \leq 1760$ kg
 - N1-III: $1760 \text{ kg} < RW$

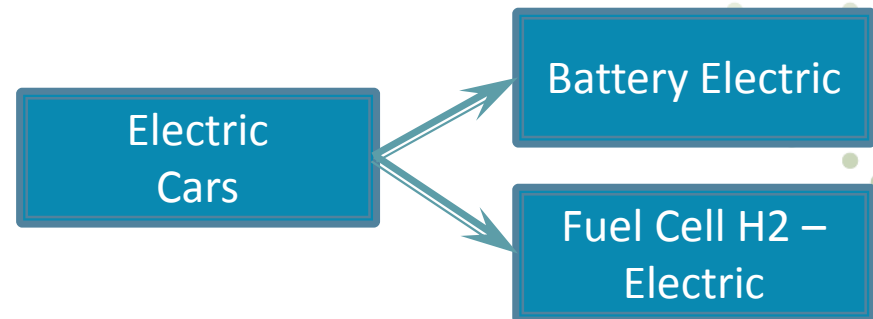
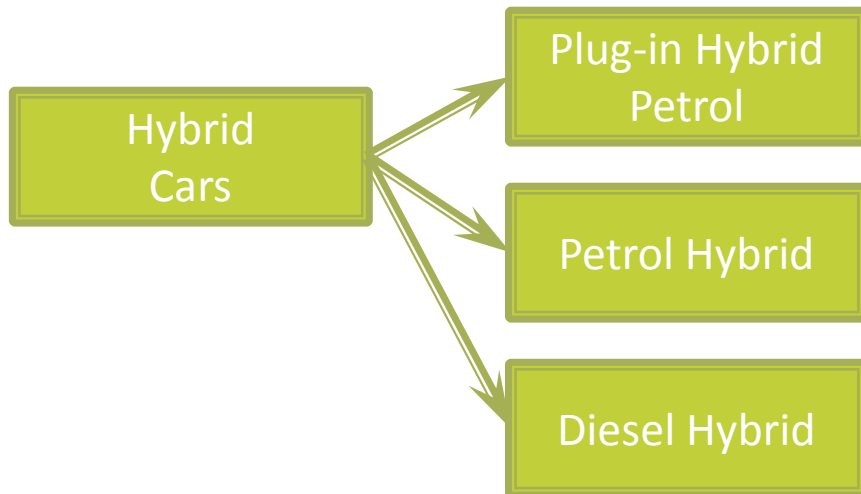
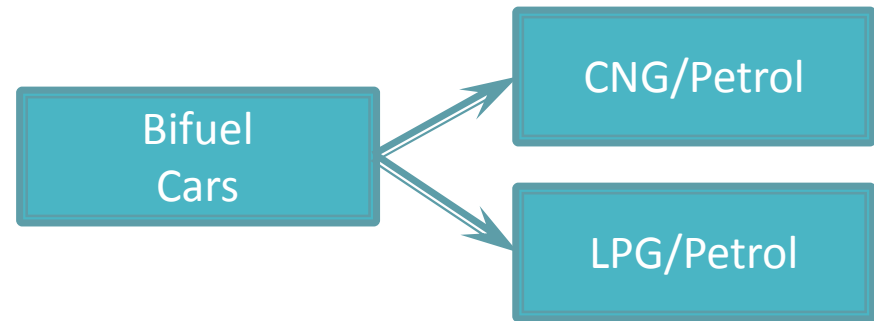
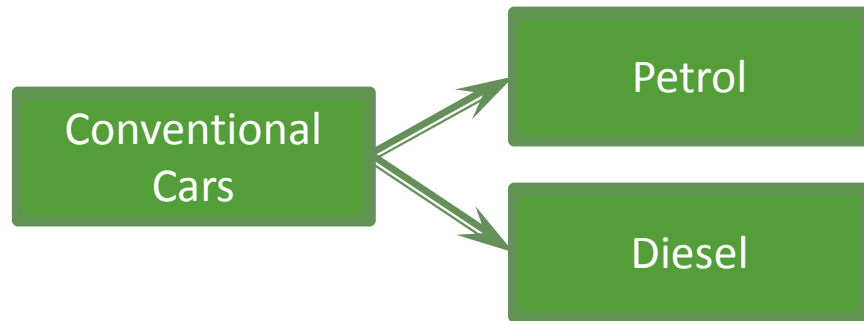
New and updated vehicle categories – 2

L-category vehicles

COPERT 4	COPERT 5	
Mopeds and Motorcycles	L-category vehicles	
-	Quads and ATVs	
-	Micro-cars	

- Two categories completely missing from COPERT 4:
 - Quads and ATVs: Petrol powered
 - Micro-cars: 500 cc diesel powered

Passenger car vehicle technologies



New layer per vehicle Euro standard: Technology level

Category	Fuel	Euro	Tech 1	Tech 2	Tech 3
Passenger Cars	Petrol	4, 5, 6	PFI	GDI	
Passenger Cars	Diesel	6	DPF	DPF+SCR	DPF+LNT
Heavy Duty Trucks	Diesel	V	EGR	SCR	

- Emission control technology layer to distinguish between concepts with distinct emission behavior in same Euro class
- Initial values proposed, can be modified by the user

Consolidated hot emission factor function

$$EF(v) = \frac{a \cdot v^2 + b \cdot v + c + \frac{d}{v}}{e \cdot v^2 + f \cdot v + g} (1 - RF_{EURO})(1 - RF_{FUEL}) \quad [\text{g/km}]$$

- Pollutants covered NO_x , PM, CO, VOC and fuel consumption
- New function adds flexibility
- Can accommodate fuel effects

New emission factors

- First 'official' version of COPERT 5 not expected to introduce substantially new EFs to COPERT 4
 - Emission factors for new vehicle types
- Peak/off-peak distinction
 - Software feature for the time being, methodology being developed
- Diesel Euro 6 NO_x under review in ERMES
 - Revision of EFs (if needed) not before mid Q4/2016

Tier 2 and Tier 3

➤ Tier 3 methodology (current):

- Depends on the vehicle technology
- Depends on speed
- Distinguishes to hot, cold, evap, non-exhaust PM
- Includes corrections for environmental, operating conditions

➤ Tier 2 methodology (new):

- Depends on the vehicle technology
- Uses one (bulk) emission factor per vehicle type



Inventory uncertainty estimation

- Methodology currently under development
- Quantified 'error' propagation calculations
 - Final expression may be quality rather than quantity indicator
- Uncertainty range to final inventory value to be given per pollutant
- Minimum user input to be required

