

copert⁴ 5

Methodology and Software

Outline of main methodology 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

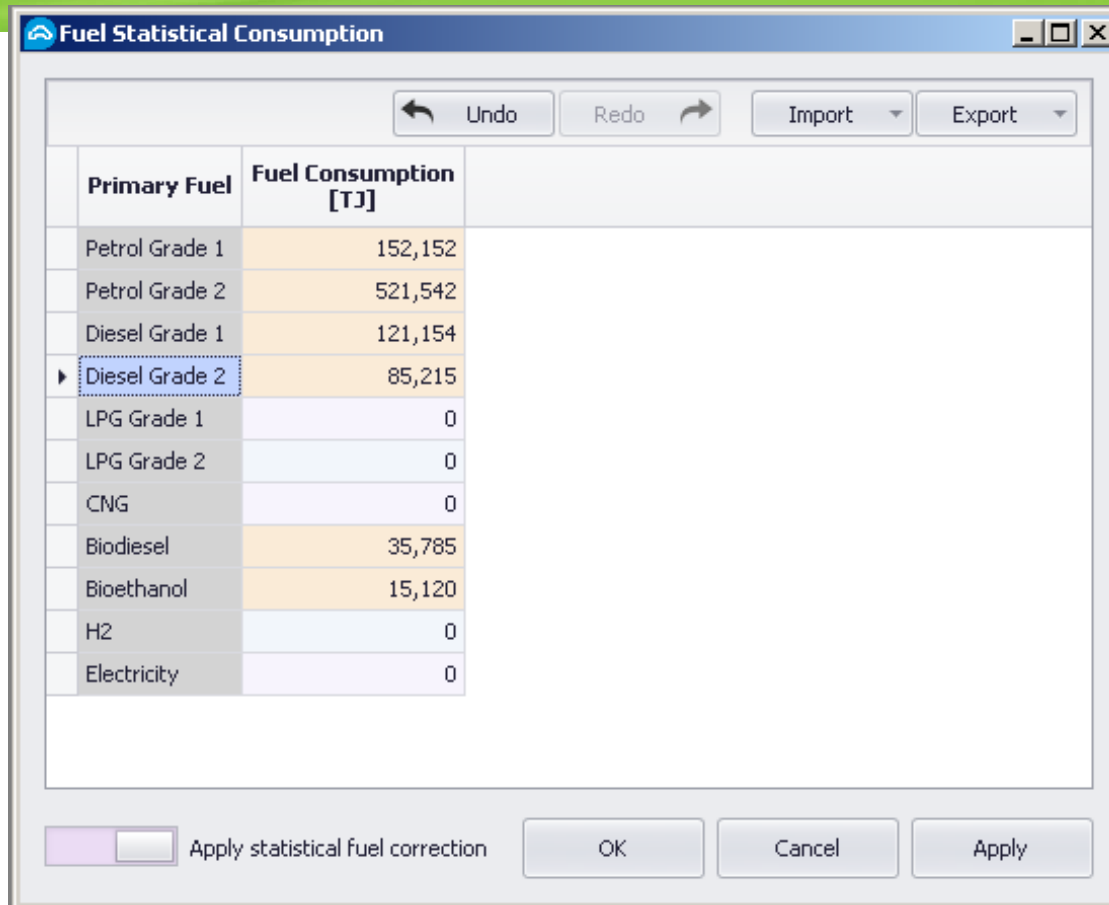
- One function type
- Possibility to distinguish between peak/off-peak urban

➤ *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. The "Diesel Grade 2" row is highlighted with a blue border and a small triangle icon to its left. 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".

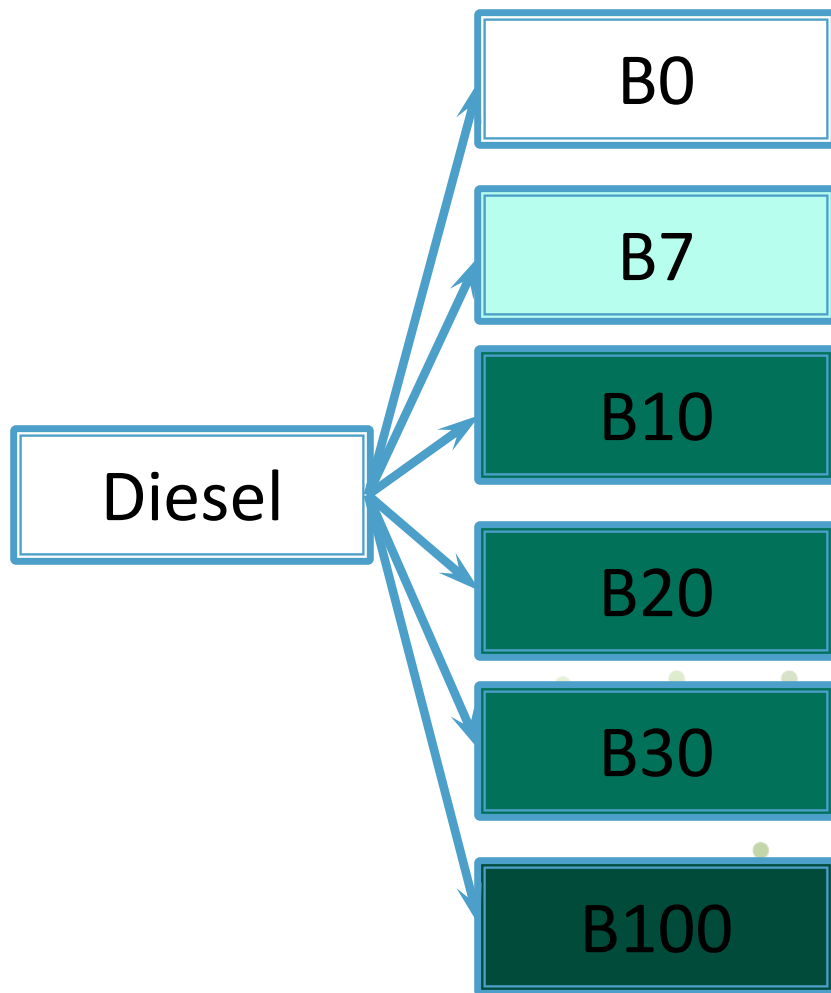
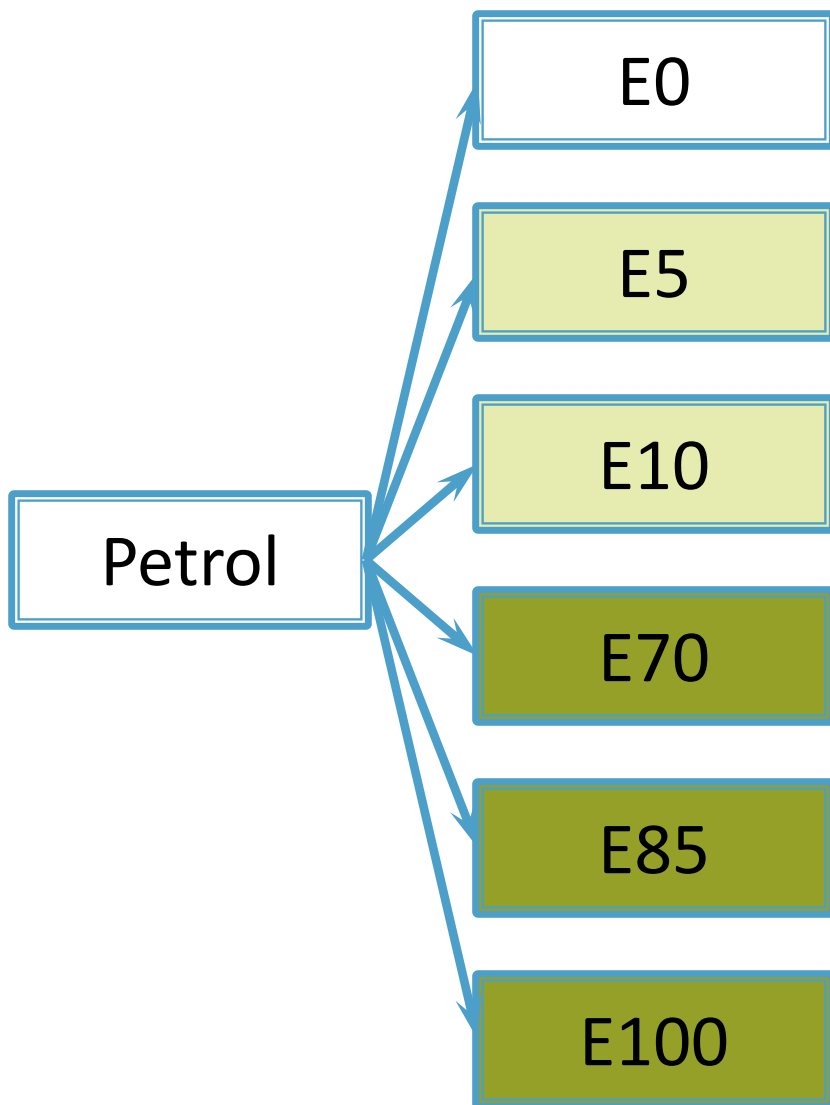
Primary Fuel	Fuel Consumption [TJ]
Petrol Grade 1	152,152
Petrol Grade 2	521,542
Diesel Grade 1	121,154
▶ Diesel Grade 2	85,215
LPG Grade 1	0
LPG Grade 2	0
CNG	0
Biodiesel	35,785
Bioethanol	15,120
H2	0
Electricity	0

- 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

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)

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: $1760 \text{ kg} < RW$

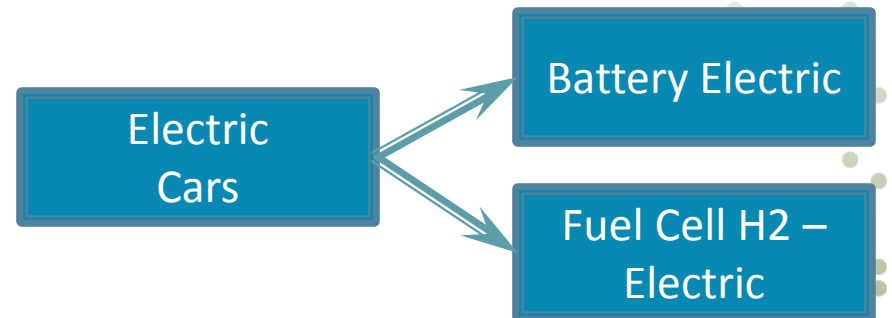
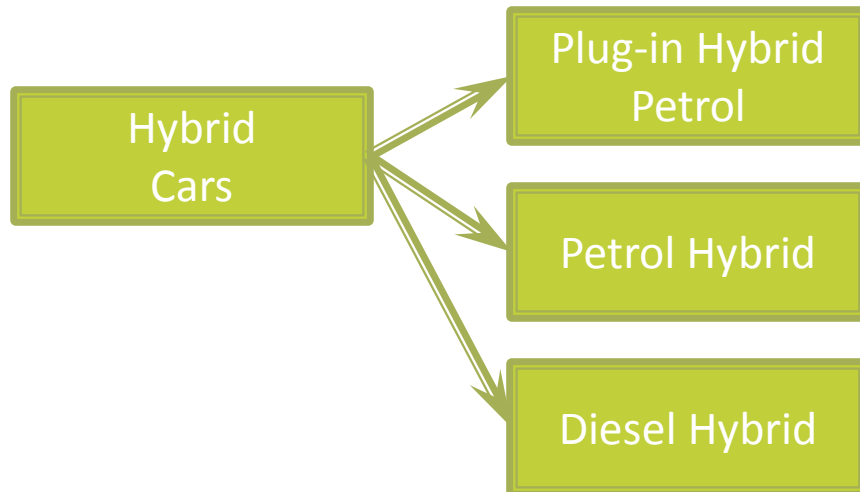
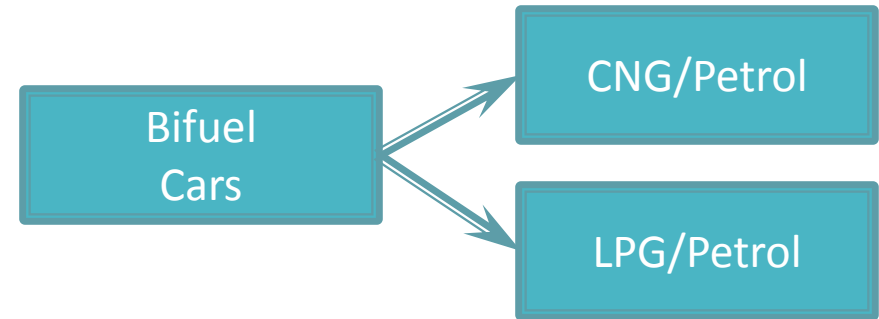
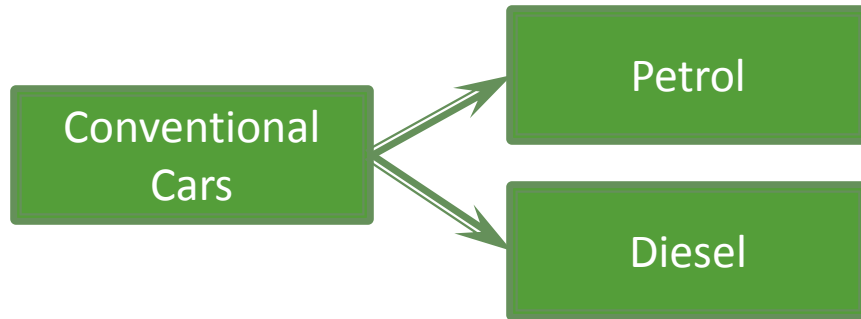
New and updated vehicle categories – 2

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	GDI+GPF
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 for shares 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

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



Major new software elements in COPERT 5

➤ Major

- Access mdb file → SQL compact edition
- Improved software interface
- Calculation of long time series in one file
- Significantly reduced calculation time
- Export extended to include all input and output information
- Calculation of Implied emission factors (hot and cold)
- Cancel button
- Cosmetic and operational changes

➤ Minor

- Advanced software update procedure
- Import/Export in different file types (xls,xlsx, csv)



Form design (1 of 3)

Vehicles Activity Data

All

Undo Redo Import Export

Category	Fuel	Segment	Euro Standard	Stock [n]	Mileage [km]	Mean Elect Mileage [km]	Fuel balance + Mileage [km]
Passenger Cars	Petrol	Mini	Euro 4	10,000	10,000	10,000	-10000
Passenger Cars	Petrol	Mini	Euro 5	10,000	10,000	10,000	-10000
Passenger Cars	Petrol	Mini	Euro 6	10,000	10,000	10,000	-10000
Passenger Cars	Petrol	Mini	Euro 6c	15,000	10,000	10,000	-10000
Passenger Cars	Petrol	Small	PRE ECE	25,000	10,000	10,000	-10000
Passenger Cars	Petrol	Small	ECE 15/00-01	10,000	10,000	10,000	-10000
Passenger Cars	Petrol	Small	ECE 15/02	10,000	10,000	10,000	-10000
Passenger Cars	Petrol	Small	ECE 15/03	10,000	7,000	10,000	-10000
Passenger Cars	Petrol	Small	ECE 15/04	10,000	10,000	10,000	-10000
Passenger Cars	Petrol	Small	Improved Conventional	10,000	10,000	10,000	-10000
Passenger Cars	Petrol	Small	Open Loop	10,000	10,000	10,000	-10000
Passenger Cars	Petrol	Small	Euro 1	10,000	10,000	10,000	-10000
Passenger Cars	Petrol	Small	Euro 2	10,000	10,000	10,000	-10000

OK Cancel Apply

Form design (2 of 3)

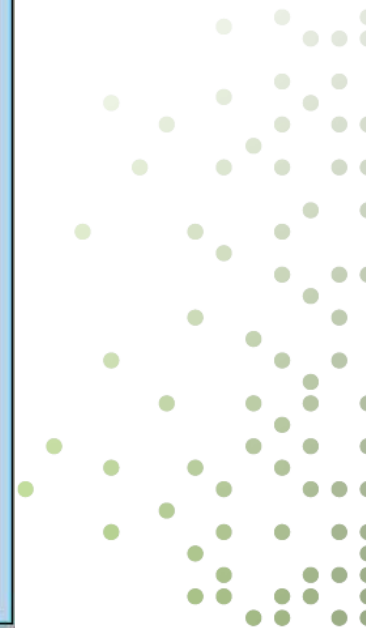
Pivot table in results

Emissions for year 2010

Pollutant Euro Segment Export

Category	Fuel	Emission					Cold
		Hot				Urban Pea...	
		Urban Peak [t]	Urban Off Peak [t]	Rural [t]	Highway [t]	Total [t]	Urban Pea...
Passenger Cars Total		100,746.6	100,746.6	269,392.4	285,419.0	756,304.5	26,025.!
Light Commercial Vehicles	Petrol Unleaded	23,366.4	23,366.4	51,978.8	49,442.2	148,153.9	8,652.0
	Petrol Leaded	3,456.3	3,456.3	7,522.8	7,004.4	21,439.8	1,056.0
	Diesel	22,538.0	22,538.0	58,711.1	68,847.7	172,634.9	4,369.0
Light Commercial Vehicles Total		49,360.8	49,360.8	118,212.7	125,294.4	342,228.6	14,077.0
Heavy Duty Trucks	Petrol Leaded	2,101.9	2,101.9	5,769.5	5,969.4	15,942.6	
	Diesel	311,528.6	311,528.6	727,703.7	661,416.9	2,012,177.7	
Heavy Duty Trucks Total		313,630.4	313,630.4	733,473.2	667,386.3	2,028,120.3	
Buses	Diesel	119,091.3	119,091.3	272,943.1	240,579.2	751,704.8	
	CNG	23,536.4	23,536.4	81,280.6	79,524.0	207,877.3	
	Biodiesel	21,489.4	21,489.4	52,455.9	48,568.0	144,002.7	
Buses Total		164,117.0	164,117.0	406,679.6	368,671.2	1,103,584.9	
L-Category	Petrol Unleaded	6,269.4	6,269.4	18,054.8	20,789.9	51,383.5	
	Petrol Leaded	8,555.7	8,555.7	25,554.4	29,125.4	71,791.3	
	Diesel	2,793.2	2,793.2	7,777.4	8,265.2	21,628.9	541.!
L-Category Total		17,618.2	17,618.2	51,386.7	58,180.5	144,803.7	541.!

Calculate all years Close



Other improvements

	COPERT 4	COPERT 5
Temporal analysis	7-10 years in one file	40 years
Calculation time	2 min per year	20 s per year
File size	Unzipped file	Zipped file

- Notification for software updates
- Import/Export for all input information
- Export for all results



Time plan

- 3 June 2016 COPERT 5.0.beta version available for the development support group
 - Primary target: Operability testing
 - Secondary target: New methodological items
- 1 July 2016 user feedback
- 23 September 2016 COPERT 5.1 available on EMISIA SA website
 - Good for reporting
 - No Tier 2 and Uncertainty
- December 2016 COPERT 5.2 including Tier 2 and Uncertainty