

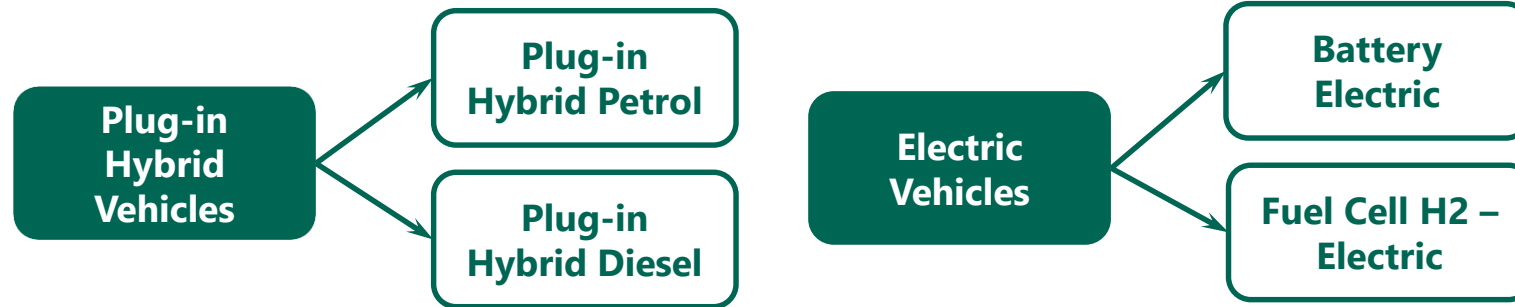
# COPERT Training

## 8.1 Fuel vs Energy



# Energy consumption calculation

- In order to facilitate new vehicle types COPERT 5 calculates energy and not fuel consumption



Hybrid vehicles do not require an external energy source



# COPERT 4 calculation

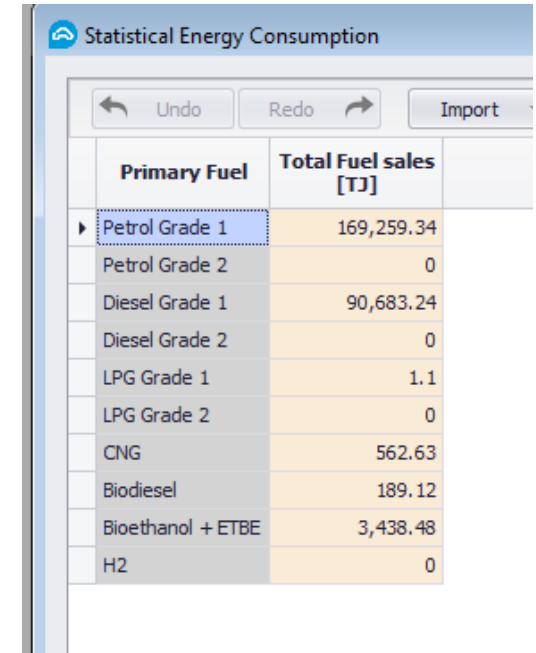
- Fuel consumption is calculated for each vehicle type by using specific functions, taking into account the vehicle speed, in grams of fuel per activity (Petrol, Diesel, LPG, CNG)
- The emission factor is multiplied with the activity to calculate the total consumption in grams
- It is assumed that fuel consumed is 100% fossil fuel



# COPERT 5 approach

## example of a vehicle

- Input data:
  - Vehicle type
  - Vehicle speed [km/h]
  - Primary fuel(s) consumption [TJ]
  - Primary fuel(s) energy content [MJ/kg]
  - Fuel blend(s) used
  - Fuel blend(s) energy share [%]

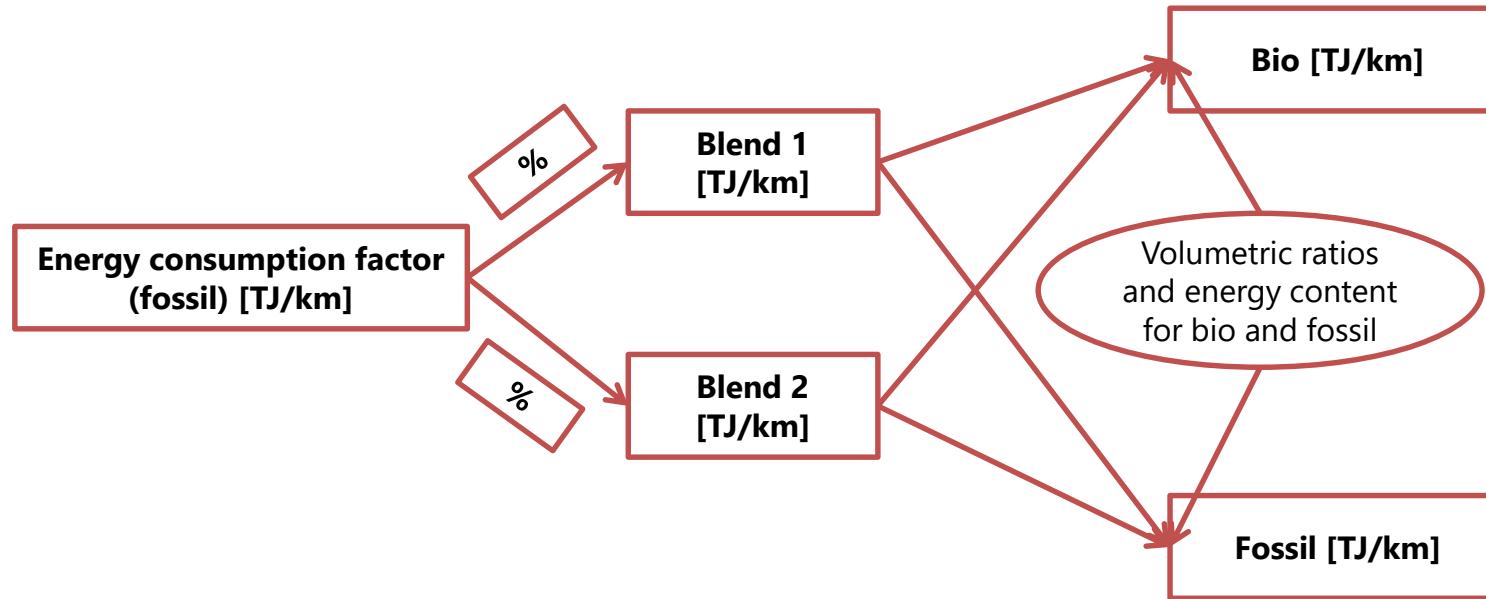


The screenshot shows a software window titled "Statistical Energy Consumption". It features a table with two columns: "Primary Fuel" and "Total Fuel sales [TJ]". The table lists various fuel types and their corresponding sales values. The "Petrol Grade 1" row is highlighted with a blue selection bar.

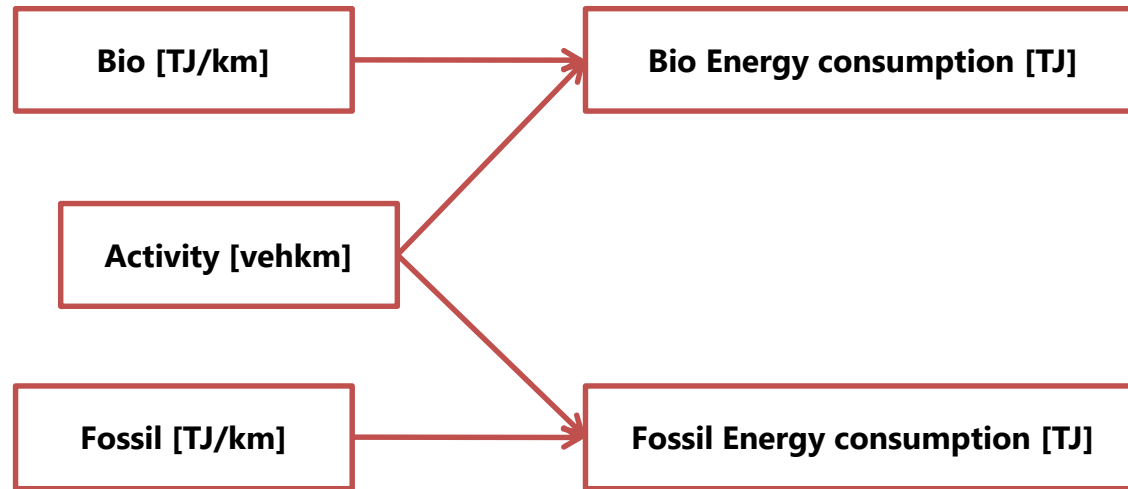
Primary Fuel	Total Fuel sales [TJ]
Petrol Grade 1	169,259.34
Petrol Grade 2	0
Diesel Grade 1	90,683.24
Diesel Grade 2	0
LPG Grade 1	1.1
LPG Grade 2	0
CNG	562.63
Biodiesel	189.12
Bioethanol + ETBE	3,438.48
H2	0



# Energy allocation to primary fuels



# Energy consumption calculation



# Pollutants affected

The use of biofuels in the fleet may have an impact on the following pollutants:

- CO<sub>2</sub>
- Heavy Metals
- Minor effect on Evaporative Emissions
- SO<sub>2</sub>

and the total energy consumption (under development)



# Energy Breakdown form

Energy Breakdown

Drop Filter Fields Here All digits   Export ▼

Category	Fuel	Segment	Euro Standard	Fossil Bio Fuel [TJ]						Grand Total
				Fossil Petrol	Fossil Diesel	LPG	CNG	Bio Diesel	Bio Ethanol	
Passenger Cars	Petrol	Medium	PRE ECE	0					0	0
			ECE 15/00-01	0					0	0
			ECE 15/02	0					0	0
			ECE 15/03	0					0	0
			ECE 15/04	0					0	0
			Improved Conventional	0					0	0
			Open Loop	0					0	0
			Euro 1	24.5093					1.2732	25.7825
			Euro 2	2,929.6197					152.1883	3,081.808
			Euro 3	9,015.948					468.3617	9,484.3097
			Euro 4	13,895.1942					721.8295	14,617.0237
			Euro 5	8,925.6488					463.6708	9,389.3196
			Euro 6 up to 2016	1,919.8663					99.7335	2,019.5998
			Euro 6 2017-2019	0					0	0
			Euro 6 2020+	0					0	0
Medium Total			36,710.7863				1,907.057	38,617.8434		

Close





# COPERT Training

## 8.2 Energy Balance



# Automated energy balance (1/3)

- COPERT 5 compares statistical and calculated energy consumption, modifies a number of input data (eg mileage, blend share) and recalculates emissions



# Automated energy balance (2/3)

- Assumptions
  - Fuel consumption calculated with COPERT 4 functions comes from 100% fossil fuel
  - 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

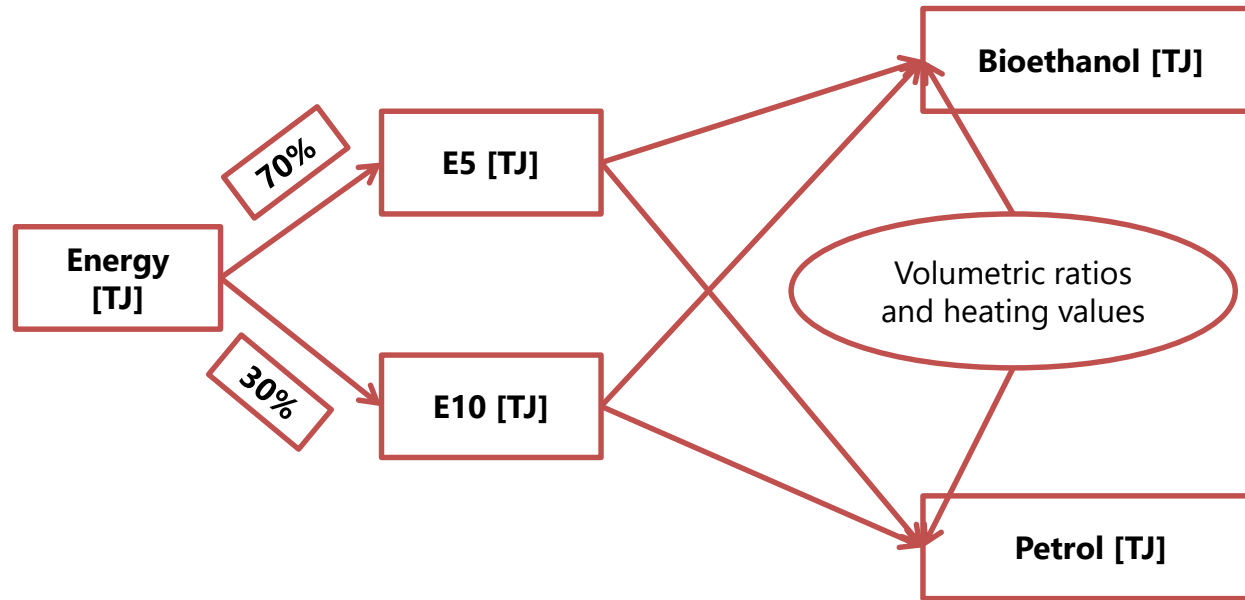


# Automated energy balance (3/3)

- 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



# 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:

$$MCF_i = \frac{Energy\_sold_i}{Energy\_calculated_i}$$

$$NewMileage_j = MCF_i \cdot Mileage_j$$

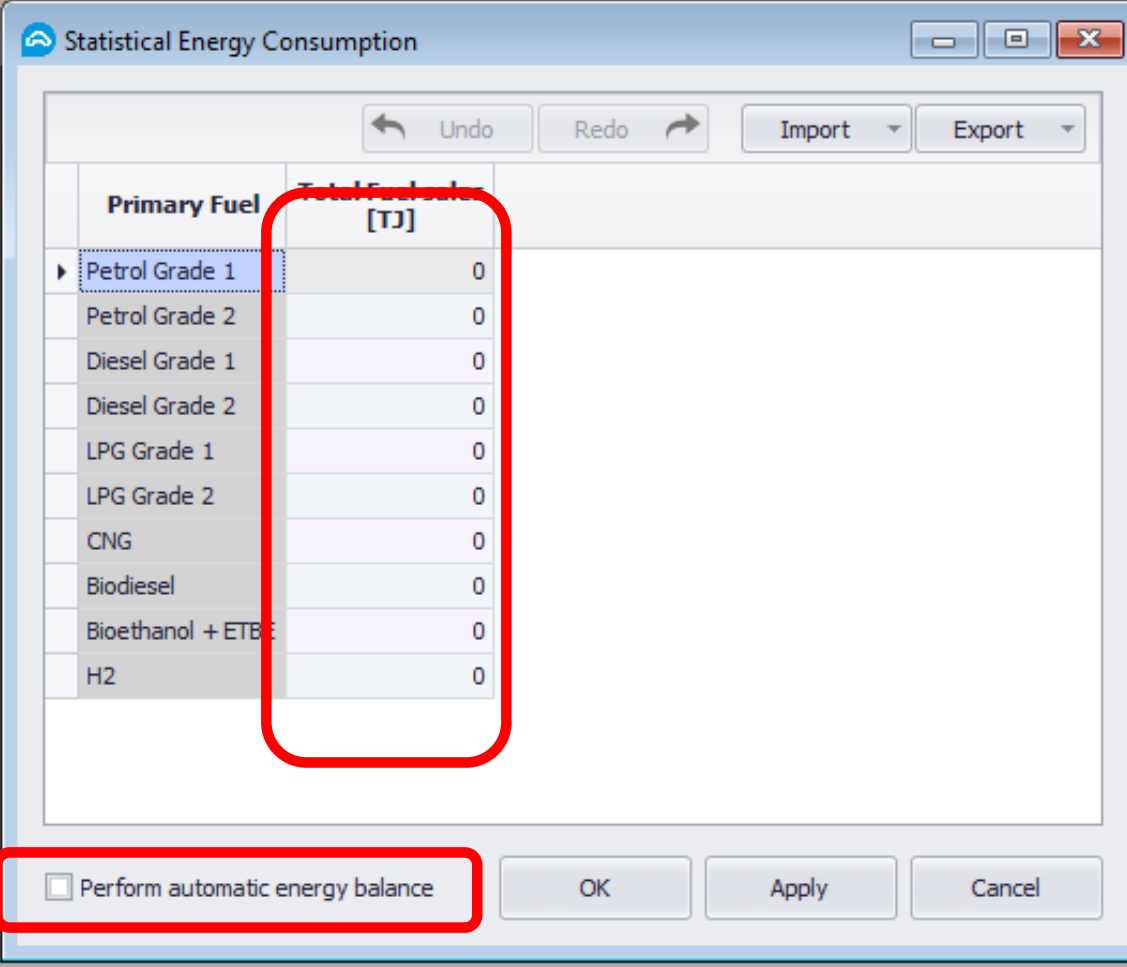
where

*i* is either petrol or diesel

*j* individual vehicle type



# Related forms in COPERT 5 (1/4)



Statistical Energy Consumption

Undo Redo Import Export

Primary Fuel	Total Fuel Use [TJ]
Petrol Grade 1	0
Petrol Grade 2	0
Diesel Grade 1	0
Diesel Grade 2	0
LPG Grade 1	0
LPG Grade 2	0
CNG	0
Biodiesel	0
Bioethanol + ETBE	0
H2	0

Perform automatic energy balance

OK Apply Cancel





# Related forms in COPERT 5 (2/4)

**Status**

File

Country : **Italy**  
Run Mode : **Timeseries**  
Created : **13 Oct 2016, 20:48**  
Saved : **Never**

Year : 2014

Fuel Balance : **YES**  
Improved Fuel Quality Year : **1996**  
Mileage Degradation : **No Effect**  
Lube-Oil CO2 Effect : **NO**  
A/C Effect : **NO**  
CO2 Effect : **NO**

Fuel Balance Calculated : **YES**  
Emissions Calculated : **NO**

Calculate Fuel Balance

Calculate Emissions

Calculate All Years

Cancel



# Related forms in COPERT 5 (3/4)

Stock & Activity Data

All

Category	Fuel	Segment	Euro Standard	Stock [n]	Mean Activity [km]	Lifetime Cumulative Activity [km]	Fuel Balanced ~ Mean Activity...	Fuel Balanced ~ Lifetime Cumulative Activity...
Passenger Cars	Petrol	Mini	Euro 4	0	0	0	0	0
Passenger Cars	Petrol	Mini	Euro 5	0	0	0	0	0
Passenger Cars	Petrol	Mini	Euro 6 up to 2016	0	0	0	0	0
Passenger Cars	Petrol	Mini	Euro 6 2017-2019	0	0	0	0	0
Passenger Cars	Petrol	Mini	Euro 6 2020+	0	0	0	0	0
Passenger Cars	Petrol	Small	PRE ECE	0	0	0	0	0
Passenger Cars	Petrol	Small	ECE 15/00-01	0	0	0	0	0
Passenger Cars	Petrol	Small	ECE 15/02	0	0	0	0	0
Passenger Cars	Petrol	Small	ECE 15/03	0	0	0	0	0
Passenger Cars	Petrol	Small	ECE 15/04	182,67...	511.4	291,518.88	511.6	291,632.12
Passenger Cars	Petrol	Small	Improved Conventional	0	0	0	0	0
Passenger Cars	Petrol	Small	Open Loop	57,330...	1,288.99	290,043.43	1,289.49	290,156.1
Passenger Cars	Petrol	Small	Euro 1	307,88...	3,880.64	282,005.36	3,882.15	282,114.9
Passenger Cars	Petrol	Small	Euro 2	368,19...	9,151.36	254,876.96	9,154.91	254,975.97
Passenger Cars	Petrol	Small	Euro 3	436,54...	13,555.2	209,799.34	13,560.47	209,880.84
Passenger Cars	Petrol	Small	Euro 4	259,41...	16,440.77	146,013.59	16,447.16	146,070.31
Passenger Cars	Petrol	Small	Euro 5	244,35...	17,666.6	48,291.67	17,673.46	48,310.42
Passenger Cars	Petrol	Small	Euro 6 up to 2016	0	0	0	0	0
Passenger Cars	Petrol	Small	Euro 6 2017-2019	0	0	0	0	0
Passenger Cars	Petrol	Small	Euro 6 2020+	0	0	0	0	0
Passenger Cars	Petrol	Medium	PRE ECE	0	0	0	0	0
Passenger Cars	Petrol	Medium	ECE 15/00-01	0	0	0	0	0
Passenger Cars	Petrol	Medium	ECE 15/02	0	0	0	0	0
Passenger Cars	Petrol	Medium	ECE 15/03	0	0	0	0	0



# Related forms in COPERT 5 (4/4)

Technology blends share

All

Undo Redo Import Export

Vehicle				Blend		Blend Energy Share		Fuel Balanced ~ Biofuel...		Fuel Balanced ~ Blend...	
Category	Fuel	Segment	Euro Standard	First Blend	Second Blend	First Blend [%]	Second Blend [%]	First Blend [%]	Second Blend [%]	First Blend [%]	Second Blend [%]
Light Commercial Vehicles	Petrol	N1-II	Euro 4	E5	E10	80%	20%	4.64%	0%	100%	0%
Light Commercial Vehicles	Petrol	N1-II	Euro 5	E5	E10	80%	20%	4.64%	0%	100%	0%
Light Commercial Vehicles	Petrol	N1-II	Euro 6 up to 2017	E5	E10	80%	20%	4.64%	0%	100%	0%
Light Commercial Vehicles	Petrol	N1-II	Euro 6 2018-2020	E5	E10	80%	20%	4.64%	0%	100%	0%
Light Commercial Vehicles	Diesel	N1-II	Conventional	B7	B20	80%	20%	7%	20%	98.18%	1.82%
Light Commercial Vehicles	Diesel	N1-II	Euro 1	B7	B20	80%	20%	7%	20%	98.18%	1.82%
Light Commercial Vehicles	Diesel	N1-II	Euro 2	B7	B20	80%	20%	7%	20%	98.18%	1.82%
Light Commercial Vehicles	Diesel	N1-II	Euro 3	B7	B20	80%	20%	7%	20%	98.18%	1.82%
Light Commercial Vehicles	Diesel	N1-II	Euro 4	B7	B20	80%	20%	7%	20%	98.18%	1.82%
Light Commercial Vehicles	Diesel	N1-II	Euro 5	B7	B20	80%	20%	7%	20%	98.18%	1.82%
Light Commercial Vehicles	Diesel	N1-II	Euro 6 up to 2017	B7	B20	80%	20%	7%	20%	98.18%	1.82%
Light Commercial Vehicles	Diesel	N1-II	Euro 6 2018-2020	B7	B20	80%	20%	7%	20%	98.18%	1.82%
Heavy Duty Trucks	Petrol	>3,5 t	Conventional	E5	E10	80%	20%	4.64%	0%	100%	0%
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Conventional	B7	B20	80%	20%	7%	20%	98.18%	1.82%
Heavy Duty Trucks	Diesel	Rigid <=7,5 t	Euro 1	B7	B20	80%	20%	7%	20%	98.18%	1.82%

Set main fuels

OK Apply Cancel



# Thank you for your attention!

