



*Explore sustainable European futures*

# Comprehensive database of EU vehicle fleet, broken down by country

---

**D2.1**

01/2018



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730459.

<b>Project Acronym and Name</b>	EU Calculator: trade-offs and pathways towards sustainable and low-carbon European Societies - EUCalc
<b>Grant Agreement Number</b>	730459
<b>Document Type</b>	Deliverable
<b>Work Package</b>	WP2
<b>Document Title</b>	A comprehensive database of EU vehicle fleet, broken down by country
<b>Main authors</b>	E.Taylor, M.Cornet, J.Pestiaux
<b>Partner in charge</b>	CLIMACT
<b>Contributing partners</b>	Imperial College, OGUT
<b>Release date</b>	
<b>Distribution</b>	<i>All involved authors and co-authors agreed on the publication.</i>

<b>Short Description</b>
<i>This report describes the sources and hypotheses used to build the historical database for the transport module. Some improvements could still be made to the database based on feedbacks from experts and reviewers.</i>

<b>Quality check</b>	
<b>Name of reviewer</b>	<b>Date</b>
Miklós Gyalai-Korpos	04/2018
Onesmus Mwabonje	04/2018

### **Statement of originality:**

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

## Table of Contents

<b>1</b>	<b>Introduction .....</b>	<b>5</b>
<b>2</b>	<b>Database for passenger transport .....</b>	<b>5</b>
<b>3</b>	<b>Database for freight transport.....</b>	<b>9</b>
	<b>References .....</b>	<b>11</b>

## List of abbreviations

BEV – Battery Electric Vehicle  
CE – Catenary Electric  
EU – European Union  
FCEV – Fuel Cell Electric Vehicle  
HDV – Heavy Duty Vehicle  
ICE – Internal Combustion Engine  
IWW – Inland WaterWays  
LDV – Light Duty Vehicle  
PHEV – Plug-in Hybrid Electric Vehicle  
pkm – Passenger-kilometer  
tkm – Ton-kilometer  
veh - Vehicle  
vkm – Vehicle-kilometer  
2W – 2-Wheelers

# 1 Introduction

The goal of this deliverable is to present the data sources and hypotheses used to build the historical [database](#) for the transport module.

The geographical scope of this database covers all EU28 member states plus Switzerland. We also included data from Norway when available in the consulted sources. This is not part of the EU-Calc scope but could be helpful in further developments.

The reference base year for the European Calculator currently being developed is 2015. Therefore, all data for this year are needed. Previous year's data have also been collected when available, in order to get a sense of past trends, stretching as far back as to the 1970s.

This report is accompanied with a [database](#) in Excel format which can be downloaded on the European calculator website<sup>1</sup>. The password is given in the ECAS submission comment. Each dataset is presented in a workbook, with a spreadsheet representing each subset (mode, vehicle type, or other). For each subset, a metadata table is attached with the sources along with data units for both the base year and the available historical data. Where necessary, the historical data is completed by computed data (either based on other collected data or by extrapolation). Table 1 presents colour coding used to complete the database.

*Table 1 – Legend for database filling*

<b>Legend</b>
Data from specified source
No data available
Computed data (based on other data, extrapolation, or other)

## 1.1 Foreseen improvements

Based on stakeholder consultations, on exchanges with experts and with other consortium members, the dataset we propose in this deliverable could still be improved. Here are a few improvements that could be considered in the next steps:

- Consultation of Gemis database to improve or complete some data<sup>2</sup>
- Consultation of IATA database for refinement of air distance data<sup>3</sup>
- Inclusion of water transport for passenger
- Diversification of types and fuels considered for 2-Wheelers

<sup>1</sup> Database is available here: [http://www.european-calculator.eu/?cdm\\_linkout=NzYx](http://www.european-calculator.eu/?cdm_linkout=NzYx)  
The password is provided in the ECAS submission comment

<sup>2</sup> <http://iinas.org/gemis.html>

<sup>3</sup> <http://www.iata.org/pressroom/media-kit/Documents/WATS-2017-mediakit-summary.pdf>

- Refinement of vehicle lifetime hypothesis based on European Parliament data<sup>4</sup> and on European Commission data<sup>5</sup>
- Refinement of hypothesis on biofuels and biogas<sup>6</sup>
- Inclusion of international transport and international vehicles delivering goods in Europe
- Refinement of the size definition for trucks based on EU definitions<sup>7</sup>

## 2 Database for passenger transport

The historic data collected for the passenger transport module, the hypothesis and the data sources are described in table 2.

The goal is to have, at least, all the data for the reference base year (2015).

Table 2 – Database for passenger transport

Dataset	Description	Main sources	Hypotheses
Passenger distance [pkm]	Distance travelled by passengers by mode (car, 2W, Bus, Metro & Tram, Rail, Air)	<ul style="list-style-type: none"> <li>• Car, Bus, Metro &amp; Tram, &amp; Rail distance from 1995 to 2015, by country: EU pocketbook 2017</li> <li>• 2W, &amp; Air distance from 2005 to 2010, by country: TRACCS database</li> <li>• Air passengers from 2005 to 2015: Eurostat</li> </ul>	<ul style="list-style-type: none"> <li>• 2W distance from 2011 to 2015, by country: linear extrapolation from TRACCS data, based on average growth during 2005-2010 period</li> <li>• Total land distance is assumed to be the sum of car, 2W, Bus, Metro &amp; Tram, and rail distances. Active mode distances are not considered here</li> <li>• Air distance from 2011 to 2015, by country: the same growth is assumed for distance travelled than for the number of air passenger given by Eurostat data. Air passenger distance is calculated as the ratio of air passenger and air distance.</li> </ul>
Modal share [%]	Share of total land distance by mode (car, 2W, Bus, Metro & Tram, Rail)	<ul style="list-style-type: none"> <li>• Not applicable</li> </ul>	<ul style="list-style-type: none"> <li>• Computed based on "Passenger distance" data here above</li> </ul>
Vehicle fleet (# vehicles)	Number of vehicles in service by mode (car, 2W, Bus, Metro & Tram, Rail, Air)	<ul style="list-style-type: none"> <li>• Cars, 2W, Buses, &amp; Rail from 1990 to 2015, by country: EU pocketbook 2017</li> <li>• Aircrafts, from 2007 to 2016, by country: Eurostat</li> </ul>	

<sup>4</sup> <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32009L0033>

<sup>5</sup>

[https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/ldv\\_mileage\\_improvement\\_en.pdf](https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/ldv_mileage_improvement_en.pdf)

<sup>6</sup> <https://www.eurobserv-er.org/biofuels-barometer-2017/>

<http://european-biogaz/wp-content/uploads/2016/05/BiomethInTransport.pdf>

<http://iet.jrc.ec.europa.eu/remea/nreaps-and-progress-reports-data-portal>

<sup>7</sup> <https://www.transportpolicy.net/standard/eu-vehicle-definitions/>

Vehicle fleet – technology share [%]	Share of vehicle fleet by technology (ICE diesel, ICE petrol, BEV, PHEV, FCEV, Gas, Others)	<ul style="list-style-type: none"> <li>Cars, Buses for 2015, by country: ACEA</li> <li>Cars, for 2015, Switzerland: Eurostat</li> <li>2W &amp; Trains, from 2005 to 2010, by country: TRACCS</li> </ul>	<ul style="list-style-type: none"> <li>Cars, for the EU countries that are not available in ACEA database (BG, CY, MT): considered equal to EU average</li> <li>2W, from 2011 to 2015, by country: Same technology share as in 2010 (100% gasoline)</li> <li>Trains, for 2011 to 2015: linear extrapolation from TRACCS data, based on average growth during 2005-2010 period</li> <li>Buses, for the EU countries that are not available in ACEA database (BG, CY, MT): considered equal to EU average</li> <li>Aircrafts: hypothesis that 100% of aircrafts are ICE-kerosene aircrafts in all countries</li> </ul>
Passenger car size [%]	Share of passenger car fleet by size <sup>8</sup> (small, lower-medium, upper-medium, executive)	<ul style="list-style-type: none"> <li># of cars by size, for 2005-2010, by country: TRACCS</li> </ul>	<ul style="list-style-type: none"> <li>Cars, for 2011 to 2015, by country: linear extrapolation from TRACCS data, based on average growth during 2005-2010 period</li> </ul>
Passenger vehicle lifetime [year] or [km]	Average lifetime of vehicles for the different types of vehicles (cars, 2W, Buses, Metros & Trams, Trains, Aircrafts)	<ul style="list-style-type: none"> <li>Cars, &amp; Buses average fleet age for 2015, by country: ACEA</li> <li>Trains average lifetime in years, 2015 EU level: IVL</li> <li>Aircrafts average lifetime, 2015 EU level: IATA</li> </ul>	<ul style="list-style-type: none"> <li>Cars average lifetime in km is considered equal to 180 000 km at EU level</li> <li>Cars average lifetime in km for each country is computed based on EU average lifetime and on average fleet age by country as follow:  <math display="block">EU\_average\_km \times (Country\_average\_fleet\_age / EU\_average\_fleet\_age)</math> </li> <li>2W average lifetime in km is considered equal to 100 000 km at EU level</li> <li>2W average lifetime in km for each country is computed based on EU average lifetime and on average fleet age by country as follow:  <math display="block">EU\_average\_km \times (Country\_average\_fleet\_age / EU\_average\_fleet\_age)</math> </li> <li>Buses average lifetime in km is considered equal to 400 000 km at EU level</li> <li>Buses average lifetime in km for each country is computed based on EU average lifetime and on average fleet age by country as follow:  <math display="block">EU\_average\_km \times (Country\_average\_fleet\_age / EU\_average\_fleet\_age)</math> </li> <li>Metros &amp; Trams average lifetime is considered equal to trains lifetime</li> </ul>
Passenger new sales of vehicles [# vehicles]	Number of new sales vehicles by mode (car, 2W, Bus)	<ul style="list-style-type: none"> <li>Car, 2W, &amp; Buses new sales, from 2007 to 2016, by country: Eurostat</li> </ul>	

<sup>8</sup> As defined in TRACCS database

New sales – technology share [%]	Share of new sales by technology (ICE, BEV, PHEV, FCEV, Gas, Others)	<ul style="list-style-type: none"> <li>Car, for 2015, by country: Eurostat, TRACCS &amp; ACEA</li> <li>2W, for 2005 to 2010, by country: TRACCS</li> <li>Bus, for 2013 to 2016, by country: Eurostat (only for countries for which it is available: BE, EE, FR, IT, CY, HU, MT, FI, SE, NO, CH)</li> </ul>	<ul style="list-style-type: none"> <li>Cars: Missing data for some countries is replaced by EU average</li> <li>2W: Technology share in 2015 is considered the same as technology share in 2010</li> <li>Buses: For the countries for which data is not fully available, the weighted average of countries with data is used</li> </ul>
Vehicle occupancy [pkm/vkm]	Average number of passenger in road vehicles <sup>9</sup> (car, 2W, bus)	<ul style="list-style-type: none"> <li>Car, 2W &amp; Bus, for 2005-2010, by country: TRACCS</li> </ul>	<ul style="list-style-type: none"> <li>Car, 2W &amp; Bus, for 2011 - 2015, by country: linear extrapolation from TRACCS data, based on average growth during 2005-2010 period</li> </ul>
Vehicle utilization rate [vkm/veh]	Average number of kilometres travelled by vehicle (car, 2W, bus)	<ul style="list-style-type: none"> <li>Car, 2W &amp; Bus, for 2005-2010, by country: TRACCS</li> </ul>	<ul style="list-style-type: none"> <li>Car, 2W &amp; Bus, for 2011 - 2015, by country: linear extrapolation from TRACCS data, based on average growth during 2005-2010 period</li> </ul>
Vehicle energy efficiency [MJ/km] or [MJ/pkm]	Energy consumption of new vehicles per mode & technology	<ul style="list-style-type: none"> <li>Cars energy consumption: VUB &amp; KUL (2017)</li> <li>Bus energy consumption: McMaster University (2015)</li> <li>Aviation, train &amp; 2W energy consumption: ICCT Calc (2012)</li> </ul>	<ul style="list-style-type: none"> <li>Energy consumption of new vehicles is considered to be the same in all countries</li> </ul>
Energy vector mix [%]	Share of different energy vectors in the energy mix (conventional, biomass, efuels <sup>10</sup> shares in diesel, gasoline, gas & kerosene, electricity)	<ul style="list-style-type: none"> <li>Share of renewable energy in transport, for 2007-2016, by country: Eurostat</li> <li>Share of biofuels in diesel and in gasoline, for 2015, EU-wide: USDA Foreign Agricultural Service</li> </ul>	<ul style="list-style-type: none"> <li>Share of efuels is considered null</li> <li>Share of bio-diesel in each country is computed as follow: <i>EU_average_share_Diesel</i> * <i>(Country_transport_renewable_share/ EU_transport_renewable_share)</i></li> <li>Share of bio-ethanol in gasoline in each country is computed as follow: <i>EU_average_share_gasoline</i> * <i>(Country_transport_renewable_share/ EU_transport_renewable_share)</i></li> <li>Share of bio-gas is considered equal to the share of renewable in transport</li> </ul>
Others	<ul style="list-style-type: none"> <li>Share of international &amp; Intra-EU aviation [%]</li> <li>Average number of vehicles necessary for a given transport demand [veh/pkm] (for rail &amp; aviation)</li> </ul>	<ul style="list-style-type: none"> <li>Share of international &amp; Intra-EU aviation energy demand: PRIMES EU Ref 16</li> <li>Average number of vehicles in EU: Eurostat (see here above)</li> <li>Transport demand: see passenger distance database here above</li> </ul>	<ul style="list-style-type: none"> <li>The share of international &amp; Intra-EU aviation activity is equal to the share of international &amp; Intra-EU aviation energy demand</li> <li>Average number of vehicles necessary for a given transport demand is considered equal to: Average number of vehicles in EU/ transport demand by mode</li> </ul>

<sup>9</sup> For aviation, the model computes energy consumption and emissions based on the consumption per passenger kilometre and not based on vehicle-kilometres. Therefore, we don't need vehicle occupancy data for this transport

<sup>10</sup> E-fuels are gaseous and liquid fuels such as hydrogen, methane, synthetic petrol, and diesel fuels generated from renewable electricity ([Dena, 2017](#))



	<ul style="list-style-type: none"> <li>• Renewal rate of vehicles [%] (rail &amp; aviation)</li> <li>• Emission intensity of fuels [tCO<sub>2</sub>/TJ, kgCH<sub>4</sub>/TJ, kgN<sub>2</sub>O/TJ] (Gasoline, Diesel, Gas, Kerosene)</li> </ul>	<ul style="list-style-type: none"> <li>• Renewal rate of vehicles: based on lifetime data here above</li> <li>• Emission intensity of fuels: IPCC</li> </ul>	
--	--	--	--

### 3 Database for freight transport

The historic data collected for the freight transport module, the hypothesis and the data sources are described here after.

The goal is to have, at least, all the data for the reference year (2015).

Dataset	Description	Main sources	Hypotheses
Freight distance [tkm]	Distance travelled for freight by mode (road, rail, IWW, sea, air)	<ul style="list-style-type: none"> <li>• Road, Rail, IWW demand from 1995 to 2015, by country: EU pocketbook 2017</li> <li>• demand from 1990 to 2015, by country: EU pocketbook 2017</li> <li>• Air, &amp; Sea demand from 1995 to 2015, EU-wide: EU pocketbook 2017</li> </ul>	<ul style="list-style-type: none"> <li>• Air demand by country is calculated as follow for EU28 countries: <math>\frac{Total\_EU28\_air\_demand}{Total\_EU28\_road\_demand} * (Country\_road\_demand)</math></li> <li>• Air demand by country is calculated as follow for Switzerland: <math>\frac{Total\_EU28\_air\_demand}{Total\_EU28\_road\_demand} * CH\_road\_demand</math></li> <li>• The same methodology is applied for Sea transport demand <u>Caveat</u>: this hypothesis means that not all sea shipping is allocated to countries that have sea shores, part of it is allocated to countries that don't have sea shores</li> </ul>
Modal share [%]	Share of total land distance by mode (road, rail, IWW, sea, air)	<ul style="list-style-type: none"> <li>• Not applicable</li> </ul>	<ul style="list-style-type: none"> <li>• Computed based on "Freight distance" data here above</li> </ul>
Vehicle fleet (# vehicles)	Number of vehicles in service by mode (trucks, trains, boats, aircrafts)	<ul style="list-style-type: none"> <li>• Trucks, from 1995 to 2015, by country: EU pocketbook 2017</li> <li>• Trains, from 2000 to 2015, by country: EU pocketbook 2017</li> <li>• Boats, &amp; Aircrafts 2016, by country: EU pocketbook 2017</li> </ul>	<ul style="list-style-type: none"> <li>• For boats and aircrafts, the number of vehicles in 2015 is considered equal to the number of vehicles in 2016</li> </ul>
Vehicle fleet – technology share [%]	Share of vehicle fleet by technology (ICE diesel, ICE petrol, BEV, PHEV, FCEV, Gas, Other)	<ul style="list-style-type: none"> <li>• Trucks, for 2015, by country: ACEA, Eurostat</li> <li>• Trains, for 2005 to 2010, by country: TRACCS</li> </ul>	<ul style="list-style-type: none"> <li>• Trucks, for the EU countries that are not available in ACEA database (BG, CY, MT): considered equal to EU average</li> </ul>

			<ul style="list-style-type: none"> <li>Trains, for 2011 to 2015: linear extrapolation from TRACCS data, based on average growth during 2005-2010 period</li> <li>Aircrafts &amp; Boats: hypothesis that 100% are ICE-conventional in all countries</li> </ul>
Trucks size [%]	Share of trucks fleet by size (small, medium, heavy)	<ul style="list-style-type: none"> <li># of trucks by size, for 2005-2010, by country: TRACCS</li> </ul>	<ul style="list-style-type: none"> <li>Trucks, for 2011 to 2015, by country: linear extrapolation from TRACCS data, based on average growth during 2005-2010 period</li> </ul>
Freight vehicle lifetime [year] or [km]	Average lifetime of vehicles for the different types of vehicles (Trucks, Boats, Trains, Aircrafts)	<ul style="list-style-type: none"> <li>Trucks average fleet age for 2015, by country: ACEA</li> <li>Trains average lifetime in years, 2015 EU level: IVL</li> <li>Aircrafts average lifetime, 2015 EU level: IATA</li> </ul>	<ul style="list-style-type: none"> <li>Trucks average lifetime in km is considered equal to 400 000 km at EU level</li> <li>Trucks average lifetime in km for each country is computed based on EU average lifetime and on average fleet age by country as follow: <math>EU\_average\_km \cdot (Country\_average\_fleet\_age / EU\_average\_fleet\_age)</math>*</li> <li>Boat average lifetime is considered equal to 30 years</li> </ul>
Freight new sales of vehicles [# vehicles]	Number of new sales vehicles by mode (Small & Medium trucks, heavy trucks)	<ul style="list-style-type: none"> <li>Trucks new sales, from 2015 to 2017, by country: ACEA</li> </ul>	
Vehicle load factor [tkm/vkm]	Average load of a vehicle (trucks)	<ul style="list-style-type: none"> <li>Trucks, for 2007-2016, by country: Eurostat</li> </ul>	
Vehicle utilization rate [vkm/veh]	Average number of kilometres travelled by vehicle (tucks)	<ul style="list-style-type: none"> <li>Trucks, for 2005-2010, by country: TRACCS</li> </ul>	<ul style="list-style-type: none"> <li>Trucks, for 2011 - 2015, by country: linear extrapolation from TRACCS data, based on average growth during 2005-2010 period</li> </ul>
Vehicle energy efficiency [MJ/km] or [MJ/tkm]	Energy consumption of new vehicles per mode & technology	<ul style="list-style-type: none"> <li>Diesel trucks and trains energy consumption: ICCT</li> <li>Boat energy consumption: TRACCS</li> </ul>	<ul style="list-style-type: none"> <li>Energy consumption of new vehicles is considered to be the same in all countries</li> <li>Energy consumption of alternative powertrains trucks is computed as follow: <math>E\_Diesel\_Truck \cdot (E\_Other\_Car / E\_Diesel\_car)</math>*</li> </ul>
Energy vector mix [%]  <i>Same data than for passenger transport</i>	Share of different energy vectors in the energy mix (conventional, biomass, efuels shares in diesel, gasoline, gas & kerosene)	<ul style="list-style-type: none"> <li>Share of renewable energy in transport, for 2007-2016, by country: Eurostat</li> <li>Share of biofuels in diesel and in gasoline, for 2015, EU-wide: USDA Foreign Agricultural Service</li> </ul>	<ul style="list-style-type: none"> <li>Share of efuels is considered null</li> <li>Share of bio-diesel in each country is computed as follow: <math>EU\_average\_share\_Diesel \cdot (Country\_transport\_renewable\_share / EU\_transport\_renewable\_share)</math>*</li> <li>Share of bio-ethanol in gasoline in each country is computed as follow: <math>EU\_average\_share\_gasoline \cdot (Country\_transport\_renewable\_share / EU\_transport\_renewable\_share)</math>*</li> <li>Share of bio-gas is considered equal to the share of renewable in transport</li> </ul>
Others	<ul style="list-style-type: none"> <li>Share of international &amp;</li> </ul>		<ul style="list-style-type: none"> <li>The share of international &amp; Intra-EU aviation activity is equal to the share</li> </ul>

	<p>Intra-EU aviation [%]</p> <ul style="list-style-type: none"> <li>• Average number of vehicles necessary for a given transport demand [veh/tkm] (for rail, boat &amp; aviation)</li> <li>• Renewal rate of vehicles [%] (rail, boat &amp; aviation)</li> <li>• Emission intensity of fuels [tCO<sub>2</sub>/TJ, kgCH<sub>4</sub>/TJ, kgN<sub>2</sub>O/TJ] (Gasoline, Diesel, Gas, Kerosene)</li> </ul>	<ul style="list-style-type: none"> <li>• Share of international &amp; Intra-EU aviation energy demand: PRIMES EU Ref 16</li> <li>• Average number of vehicles in EU: Eurostat (see here above)</li> <li>• Transport demand: see freight distance database here above</li> <li>• Renewal rate of vehicles: based on lifetime data here above</li> <li>• Emission intensity of fuels: IPCC</li> </ul>	<p>of international &amp; Intra-EU aviation energy demand</p> <ul style="list-style-type: none"> <li>• Average number of vehicles necessary for a given transport demand is considered equal to: Average number of vehicles in EU/ transport demand by mode</li> </ul>
--	--	---	--

## References

[EC, 2017] *Statistical Pocketbook 2017, European Commission, Luxembourg: Publications Office of the European Union, ISBN 978-92-79-62311-0, 2017*

[TRACCS, 2013] Emisia S.A (2013). TRACCS – Transport data collection supporting the quantitative analysis of measures relating to transport and climate change. European Commission, DG Climate Action

[Eurostat, 2018] Statistical Office of the European Communities (2018). *EUROSTAT: Regional Statistics*.

[ACEA, 2018] European Automobile Manufacturers Association (2018). ACEA: Statistics.

[IVL, 2010] H.Stripple, S.Uppenbergl (2010). Lifecycle assessment of railways and rail transport. Swedish Environmental Research Institute.

[IATA, 2018] Sustainable Alternative Fuels for Aviation, IATA (presentation at a stakeholder's dialogue on 13/03/2018)

[A.Hoeltl et al., 2017] A.Hoeltl, C.Macharis, K.De Brucker (2017). *Pathways to Decarbonise the European Car Fleet: A Scenario Analysis Using the Backcasting Approach. Energies, 11(1),20.*

[McMaster University, 2015] M.Mohamed, R.Garnett, M.R.Ferguson, P.Kanaroglou (2015). Electric Buses: A review of Alternative Powertrains. Renewable and Sustainable Energy Review.

[ICCT, 2012] *The International Council on Clean Transportation (2012). Global Transportation Roadmap – Model*

[USDA Foreign Agricultural Service] B.Flach, S.Lieberz, A.Rossetti (2017). EU Biofuels Annual 2017. USDA Foreign Agricultural Service

[E3M-Lab, 2016] P.Capros, et al. (2016) *EU Reference Scenario 2016 – Energy, transport and GHG emissions Trends to 2050. European Commission*

[IPCC] International Panel on Climate Change (2006). IPCC Guidelines for National Greenhouse Gas Inventories - Volume 2: Energy