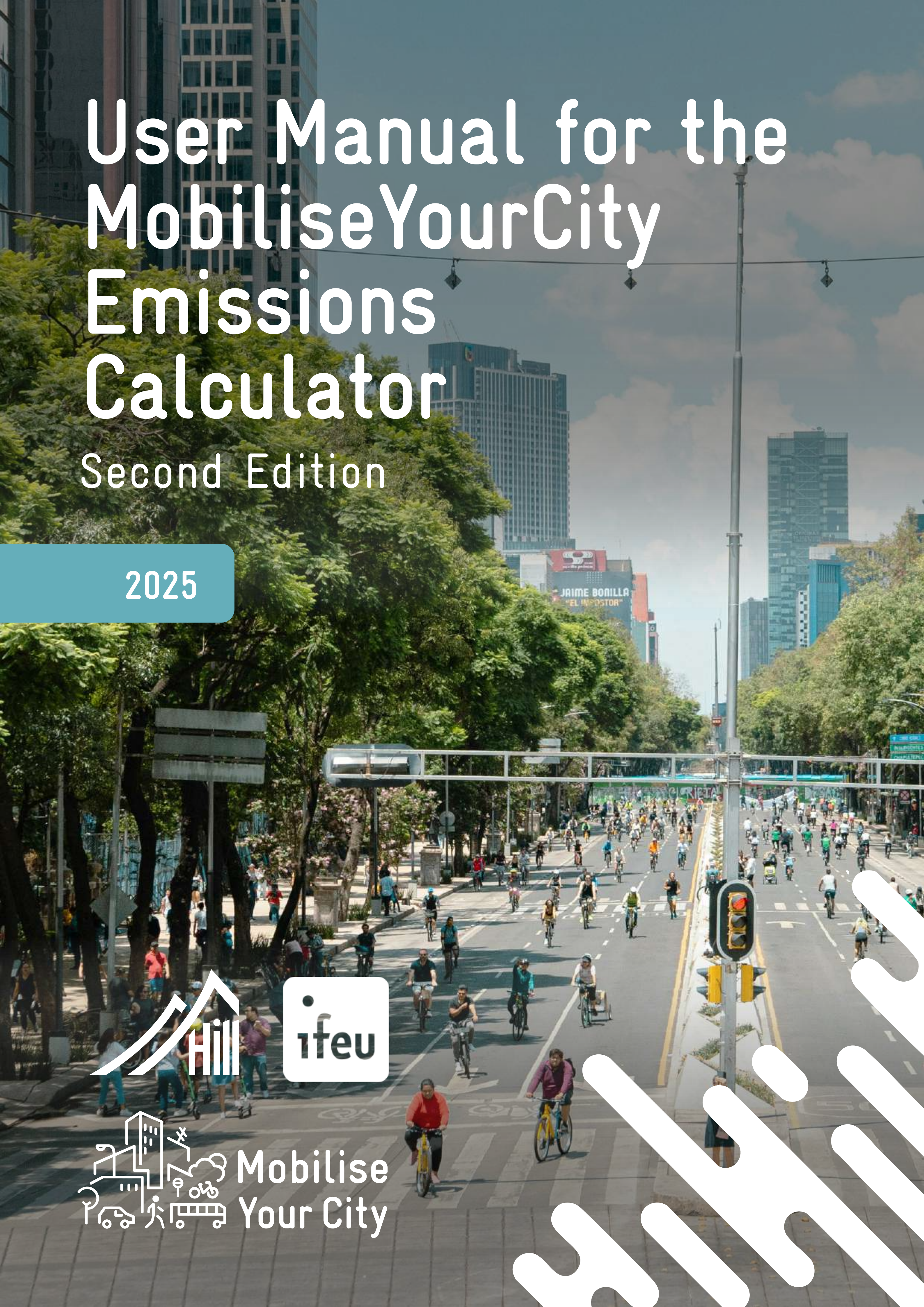
User Manual for the MobiliseYourCity Emissions Calculator

Second Edition

2025



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ifeu

Mobilise Your City

For more information:

MobiliseYourCity Partnership Secretariat, Brussels

https://mobiliseyourcity.net/

email: contact@mobilseyourcity.net

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Authors: Institut für Energie- und Umweltforschung Heidelberg (ifeu)

Contributors: ADEME, AFD, CEREMA, CODATU,

Reviewers: Florentino Marquez, Cristian Camilo Sarmiento Chaves - Hill Consulting; Nicolás Cruz González, Milnael Gómez, Jacopo Giavoli - CODATU, MobiliseYourCity Secretariat

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PLATFORMA LOCAL & REGIONAL INTERNATIONAL ACTION

SSATP Africa Transport Policy Program

UCLG United Cities and Local Governments

ITDP Institute for Transportation & Development Policy

CONCITO

In collaboration with

Global Gateway

tumi

SUSTAINABLE mobility FOR ALL

Digital Transport for Africa

Marrakech Partnership Global Climate Action

Context of the Publication

The MobiliseYourCity Monitoring and Reporting Approach for GHG Emissions recommends cities to track the evolution of transport-related GHG emissions (CO2 , CH4 and N2 O) at the city level rather than measure by measure. The SUMPs developed with the support of MobiliseYourCity usually propose measures packages that interact with each other; therefore, an urban transport GHG inventory approach captures the effect of the whole package of measures rather than looking at individual actions.

The MobiliseYourCity Emissions Calculator is an Excel-based ex-ante scenario modelling tool that supports cities and countries in projecting the GHG impact of their SUMPs or NUMPs. It was designed to quantify and monitor a package of mitigation actions according to the ASIF methodology (ASIF stands for Activity, Structure, Intensity and Fuels).

The MobiliseYourCity GHG Emissions Calculator has recently been updated. In 2023, the Institut für Energie- und Umweltforschung (Ifeu), under the support of the AFD, updated the Excel-based tool of the MobiliseYourCity Emission Calculator considering feedback from its practical implementation in real cases. The update of the MobiliseYourCity GHG Emissions Calcultor included improved user interface, more flexibility in the choice of vehicles for GHG inventory and scenarios, reference values for fuel consumption and vehicle occupancy to use in case of missing data, automatic bug fixes to improve user experience and integration of quality control and feedback.

Considering these modifications, adjusting and updating the User Manual for the MobiliseYourCity Emissions Calculator is necessary to assist practitioners in using the tool. This document is the second edition of the User Manual for the MobiliseYourCity GHG Emissions Calculator. This update considers the latest updates of the Excel-based tool and improves some further insights for practitioners to use it better.

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1.Background and purpose of the Tool

The MobiliseYourCity Greenhouse Gas (GHG) Emissions Calculator aims at helping developing countries and cities to calculate transport GHG emissions for a reference year and Business-as-usual scenario (BAU) as well as a climate scenario with emission reductions from mitigation measures – the so-called climate scenario. As a result, the tool provides data on the calculated transport demand, energy consumption and GHG emissions. These data give an overview of the relevance of each transport mode regarding the total GHG emissions within the defined territory. It also enables users to quantify and monitor the impact of a bundle of mitigation actions according to the "ASIF" methodology (Avoid, Shift, Improve and Fuel – see for more details the Monitoring and reporting approach for GHG emissions (MobiliseYourCity 2017)). This tool does not aim at calculating the impact of individual mitigation actions. For example, the impact of all measures concerning "avoiding" traffic i.e. reduce the need to travel such as home office, removing parking lots, toll systems etc. must be assessed together per designated year e.g. 2020 and 2030. The results of this bundle of measures may result in a reduction of 2% of car traffic and 3% of delivery truck (both in km). These data are the input required in the climate scenario input sheet.

Please note that the tool is not designed for transport GHG inventories in the framework of the UNFCCC even if it follows the IPCC guidelines (app. Tier 3 level of the 2006 IPCC guidelines). The results can be used for preparing the inventory for urban road and rail transport to deliver to the UNFCCC but certain aspects should be taken into account or completed beforehand:

1. It only covers GHG emissions (no pollutants included)
2. Biofuels are not included
3. Not all emissions required in the IPCC guidelines for road (1.A3b) and rail are assessed. The following are missing: evaporative emissions from vehicles (1A3bv) and urea-based catalysts (1A3bvi)
4. If the MobiliseYourCity GHG emissions calculator is used for reporting purposes, only Tank-to-wheel emissions should be considered (select this option in the "Overview of results" sheet)

1.1. Methodology and scope

The scope of the emissions to be taken into account is based on a territorial principle (see the Monitoring and reporting approach for GHG emissions (MobiliseYourCity 2017) for more details). Essentially, all traffic must be considered WITHIN the defined territory (traffic of inhabitants, incoming and outgoing traffic such as commuters, tourists, freight deliveries and so on).

The country or city's transport demand, energy consumption and GHG emissions, are calculated using a "Bottom-up" approach i.e. based on the real transport activity data.

Using the Bottom-up approach, the total GHG emissions from transport can be derived from multiplying transport demand (vehicle kilometres travelled – vkt) by the specific energy consumption and the specific GHG emission factor (see *Figure 1*).

GHG emissions of a transport activity = Transport demand x Specific energy consumption x Specific GHG emission factor

Figure 1. Bottom-up calculation methodology for transport GHG-emissions

Within the tool, road and rail transport - both for passengers and freight - can be calculated. Furthermore, different vehicle categories (e.g. private cars, taxis, motorcycles, long distance train, metro) and fuel types (e.g. diesel, gasoline, gas, hybrid and electric) can be distinguished. *Figure 2* describes the different vehicle types.

The results of the "bottom-up" calculation of the energy consumed can be compared with the "top-down" energy consumption, i.e. fuel sold for transport within the territory. At the national level this data is available in the energy balance.

All data inputs - shown through green cells - are mandatory to enable full use of the tool's functionalities, including the inventory for the base year, Business-as-usual (BAU) and climate scenario, as well as the Key Performance Indicators (KPI). If you do not wish to use all functionalities, you only need to provide the required data for the assessment you intend to perform (e.g. if you only need the inventory for the base year and the BAU scenario, no data is required for the climate scenario). Please note that the inventory is compulsory to calculate both BAU and climate scenarios.

Vehicle Category	Description
NMT	NMT = Non-Motorised Transport, includes walking and bicycling, using small-wheeled transport (skates, skateboards, push scooters and hand carts) and wheelchairs.
Private car	Any motor vehicle intended for passenger transport, the seat capacity does not exceed nine seats (including driver), the total permissible gross weight does not exceed 3,5t.
Individual taxi	Cars which transport passengers in return for payment of a fare and which are typically fitted with a taximeter.
Motorcycle	A two-wheeled vehicle with an engine.
Motorcycle taxi	Motorcycles which transport passengers in return for payment of a fare (e.g. Go-jek, Grab).
Minibus	Any motor vehicle intended for the collective transport of persons whose number of seats is less than nine, including hirings, collective taxis and rural transportation.
Bus	Any motor vehicle intended for the collective transport of persons, the number of seats of which is greater than nine or the permissible total weight exceeds 3,5t.
BRT	Bus Rapid Transit (BRT) is a high-quality bus-based transit system. It is typically specified with dedicated lanes, iconic stations, off-board fare collection, and fast and frequent operations.
Long distance train	Intercity Passenger train.
Urban train	Passenger train mainly travelling within the city territory – short distance train.
Metro	Passenger train mainly traveling within the city territory – Tram and Metro.
Very light LCV	A mostly three-wheeled motorized vehicle used for goods transport.

Vehicle Category	Description
LCV	Motor vehicle intended for the transport of freight, the permissible gross weight does not exceed 3,5t.
Solo truck	Motor vehicle intended for the transport of freight; the permissible load is up to 10t.
Articulated truck	Motor vehicle intended for the transport of freight and the total authorized load exceeds 10t. Trucks consist of trucks and tractors (truck with trailer).
Freight train	Any freight train, usually for long distance transport.
Custom vehicle type	Non-conventional vehicles. Users may define the characteristics of this vehicle.

Figure 2. Definition of different vehicle types

2. Step-by-step user guide

The MobiliseYourCity Emissions Calculator contains several sheets, each serving different purposes. The sheets “Get started”, "1A Input Base and BAU", "2A Input Climat Scen. Pass." and "2B Input Climat Scen. Freight" are the main sheets to be filled in by users. The sheet "1B Top-Down Validation" can be used to conduct a bottom-up versus top-down comparison. All remaining sheets are for informational purposes only. Each sheet will be explained in the sections below. The explanation of each sheet is split into two parts: the first part gives an overview of the purpose of the sheet and general information, and the second explains the inputs required for calculation.

Some input cells include embedded error checks within the tool. If a user input appears to be out of the realistic range or is in an incorrect data format they will be allerted by a pop-up menu. Within this menu, the user has the choice to either change or apply the input value (see *Figure 3*).

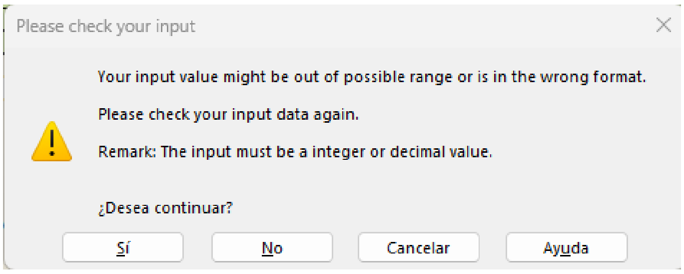


Figure 3. Example for an embedded error check

In the upper area of sheets 2A, 3A, 3B and 4, a brown-highlighted area displays the detected error and indicates the table where the issue should be reviewed.

Error message will be shown here if detected

	There is an error on sheet "3A Input Climate Scen. Pass."! Please check! The results below might be wrong!
There is an error on sheet "2A Input Base and BAU"! Please check! The results below might be wrong!	There is an error on sheet "3B Input Climate Scen. Freight"! Please check! The results below might be wrong!

Figure 4. Error message area

⚠ Important: Please activate macros after opening the file to ensure proper functioning of the tool.

2.1. Sheet "Get Started"

The "Get Started" sheet is the entry point of the MobiliseYourCity Emissions Calculator. It includes Important set-up options that must be configured before using the tool.

General information:

This sheet contains the defined colour code, which is used within all sheets of the MobiliseYourCity Emissions Calculator (see *Figure 5*). The colour code is designed to guide users by indicating which cells require user input and which cells are calculated automatically.

Colour code	
Data input	***Green***
Data input disabled	***Drak gray***
Calculated cell	***Light gray***
Error	***Pink***
Default values	***Purple***

Figure 5. Colour code within the MobiliseYourCity Emissions Calculator

- Cells and sheets highlighted in green indicate that user input is required.
- Dark grey cells are disabled and do not require input. These cells may change colour dynamically based on other inputs (by filling in the tool, you will notice that green cell or dark cells may change colour). This is an automatic guidance to prevent errors or missing data.
- Light grey cells display the results of calculations or additional information. These are for reference only and should not be modified.
- Purple cells represent national default values. They are given in the scenario sheets for indication (depending on whether MobiliseYourCity already has defaults data for the selected country). In the default value sheets, they refer to IPCC default values for energy content end emission factors. They should only be replaced if more precise and reliable local data is available.

User Inputs Required: In the green marked cells on the left side of the 'Get Started' sheet, the user must configure the following setup options:

- Select the type of location: Choose either country or city
- In the location name type the name of the selected country or city (e.g. Uganda)
- Enter the reference year for the analysis (e.g. 2016)
- Select the preferred language (choose between French, English and Spanish)
- Select the type of GHG emissions (choose between Wheel-to-Wheel – WTW or Tank-to-Wheel - TTW)

Type of location	**Country**
Location name	
Reference year	
Language	**English**
Choose the type of GHG	**WTW**

TTW: Tank-to-Wheel (without emissions from energy/fuel production); WTW: Well-to-Wheel (with emissions from energy/fuel production)

Figure 6. Required user input to set up the MobiliseYourCity Emissions Calculator

2.2. Sheet "1 Vehicles and fuels"

This sheet is used to define all combinations of vehicle and fuel types that will be included in the emissions calculations.

<u>Completion steps:</u>

Step 1) Vehicle type selection

Define the vehicle types to be included in the analysis. You may choose from a list of pre-defined vehicle types or select "custom vehicle type" from the dropdown menu. The vehicle types are categorised by type of transport (e.g. individual road passenger transport, collective road passenger transport, rail passenger transport, road freight transport, rail freight transport)

Vehicle type	Enter custom vehicle type here	CRF code custom vehicle type	Vehicle type used by the tool	CRF code used by the tool
Passenger car			Passenger car	1.A.3.b.i
Individual taxi			Individual taxi	1.A.3.b.i
Motorcycle			Motorcycle	1.A.3.b.iv
Custom vehicle type	Auto-Rickshaw	1.A.3.b.iv: road - motorcy	Auto-Rickshaw	1.A.3.b.iv

Figure 7. Vehicle type selection

Step 2) Fuel type selection

For each vehicle type selected, you must choose at least one corresponding fuel type from the dropdown menu. Ensure that all relevant combinations of vehicle type and fuel type are included in order to reflect the actual transport system accurately.

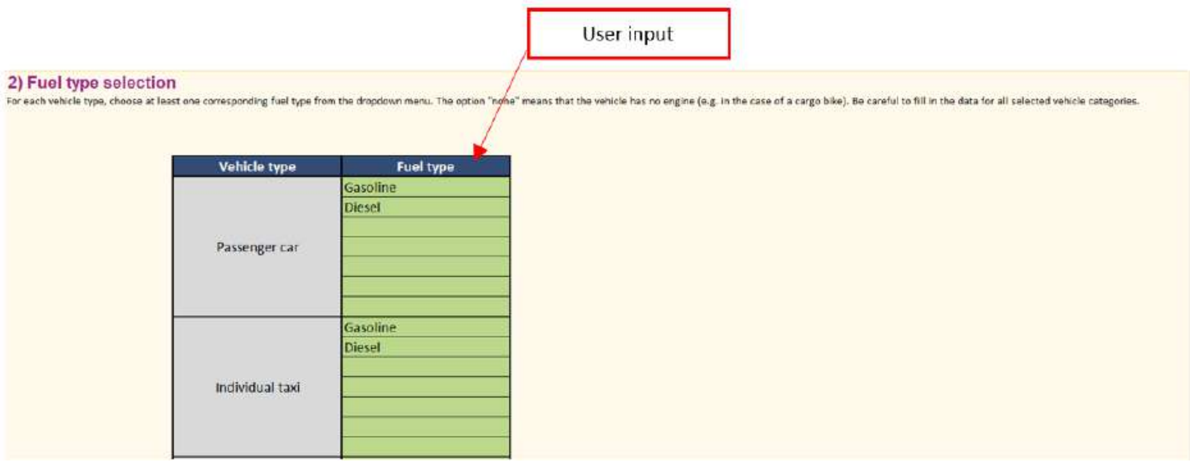


Figure 8. Fuel type selection

2.3. Sheet "2A Input Base and BAU"

The sheet is used to input transport activity data at the country or city level to calculate GHG-emissions for a specific reference year (GHG-inventory) and/or for a Business-as-Usual (BAU) scenario.

General information:

If you are calculating emissions only for the reference year, it is sufficient to input data in the green-marked cells for that year. In this case, the accompanying results sheet “2A Result Base_Bau” can be ignored.

If a BAU scenario needs to be calculated, the user should input additional data in the green-marked cells for future years, located on the right-hand side of the sheet. For quality check purposes, the results of the vehicle-kilometres travelled (vkt), modal split and emissions calculations are displayed on the sheet “2A Result Base_Bau”. Depending on the user input the results can be disaggregated between road and rail transport, different vehicle categories and fuel types.

Definition: Business as Usual (BAU)

A Business-as-usual (BAU) scenario is a projection of future conditions (in a future year) assuming no intervention is implemented. A Counter-factual baseline means a projection of what would have happened in the past without the intervention, but based on historical drivers other than the mitigation action (see Compendium on GHG Baselines and Monitoring Passenger and freight transport, GIZ et al., 2018). The input data for the BAU scenario i.e. annual vkt growth rate in 3), vkt break down according to fuel type in 4.ii) and energy efficiency in 4.iii) should follow this methodology.

1) Timeline

Description: Please define the target years for the project. You can choose up to 5 years for which GHG emissions are shown.

Target year	#	2019	2020	2025	2030	2040	2050

2) Socio-economic data

Description: Please enter the population and the gross domestic product (GDP) of your country/city for the reference year in the table below. For BAU scenario calculations please also enter corresponding annual growth rates.
Remark: Data input for the population in the reference year is mandatory, data input for the GDP is optional - applied for key performance indicators (KPIs) in the sheet "4 Overview of Results".

	Unit	Values						Annual growth rate [%]				
		2019	2020	2025	2030	2040	2050	2019-2020	2020-2025	2025-2030	2030-2040	2040-2050
Population	Number of inhabitants	3.461.731	3.472.116	3.524.511	3.577.697	3.686.489	3.798.588	0,3%	0,3%	0,3%	0,3%	0,3%
Gross domestic product (GDP)	Million dollars	61	62	67	73	85	100	1,6%	1,6%	1,6%	1,6%	1,6%
Source:												

3) Vehicle kilometers travelled (vkt)

Description: Please enter the vehicle kilometers of the base year and the annual growth rate. The user has to choose between the vkt approach or the fleet approach for each vehicle category. It is not possible to use both approaches at the same time. Without this information the calculation of GHG emissions cannot be done.
Remark 1: The total vkt (mileage approach) or average annual mileage (fleet approach) should comply with the actual transport activity within the city or country territory.
Remark 2: Definitions and short descriptions of each vehicle category can be found in the sheet "7 Sources and abbreviation".

	1. Vkt approach	2. Fleet approach						
Subcategory	Total vkt per vehicle category [Mio. km/year]	Vehicle stock [total number of vehicles]	Average annual mileage per vehicle [km/vehicle/year]	Annual growth of vkt per period [%]				
	2019	2019		2019-2020	2020-2025	2025-2030	2030-2040	2040-2050
NMT								
Passenger car		576.928	6.572	0,3%	0,3%	0,3%	0,3%	0,3%
Individual taxi		8.511	72.000	0,3%	0,3%	0,3%	0,3%	0,3%
Motorcycle		471.277	2.386	0,3%	0,3%	0,3%	0,3%	0,3%
Bus		5.449	64.488	0,3%	0,3%	0,3%	0,3%	0,3%
Light commercial vehicle		314.850	6.572	1,6%	1,6%	1,6%	1,6%	1,6%
Source:								

Figure 9. Overview of the upper part of sheet “2A input base and BAU”

Completion Steps:

Step 1) Timeline

Define the assessment period and the target years for the project, program or policy to be assessed. You can choose up to 5 years for which GHG emissions will be calculated.

1) Timeline

Description: Please define the target years for the project. You can choose up to 5 years for which GHG emissions are shown.

Target year	#	2019	2020	2025	2030	2040	2050

Figure 10. Years to be included in the assessment term

Step 2) Socio-economic data:

To calculate the GHG emissions for the reference year, enter data on **population** (total number of inhabitants) and **Gross Domestic Product GDP** (in USD Billion) in the reference year. If a Business-as-usual scenario is to be calculated, the annual growth rates for both population and GDP must be filled in the green cells on the right-hand side for the whole assessment period.

User input

2) Socio-economic data

Description: Please enter the population and the gross domestic product (GDP) of your country/city for the reference year in the table below. For BAU scenario calculations please also enter corresponding annual growth rates.
Remark: Data input for the population in the reference year is mandatory, data input for the GDP is optional - applied for key performance indicators (KPIs) in the sheet "4 Overview of Results".

	Unit	Values						Annual growth rate [%]				
		2019	2020	2025	2030	2040	2050	2019-2020	2020-2025	2025-2030	2030-2040	2040-2050
Population	Number of inhabitants	3.461.731	3.472.116	3.524.511	3.577.697	3.686.489	3.798.588	0,3%	0,3%	0,3%	0,3%	0,3%
Gross domestic product (GDP)	Million dollars	61	62	67	73	85	100	1,6%	1,6%	1,6%	1,6%	1,6%
Source:												

Figure 11. Socio-economic data input sample

Side note: Ensure the population (number of inhabitants) is entered as a whole number (not in millions or thousands) to guarantee valid crosschecks, which are implemented in the data input cells in the next steps! Where possible verify values with official data or academic research.

Step 3) Vehicle kilometre travelled (vkt):

The user can choose between two approaches depending on the format and type of data available concerning transport demand:

1. Vkt approach - the total mileage per vehicle category can be directly entered into the green cells in column C (named "1.Vkt approach").
2. Fleet approach (column D & E) – Enter both the total number of vehicles in use and their average annual mileage per vehicle category.

In both cases, the user should try to reflect in the best possible way the real vkt driven within the area of study (trips starting and ending in the territory, as well as outgoing and incoming trips).

To calculate the BAU scenario, the user must fill in data for annual growth rates for the total vehicle kilometres travelled (vkt) for the assessment period, regardless of the approach chosen.

User input

3) Vehicle kilometers travelled (vkt)

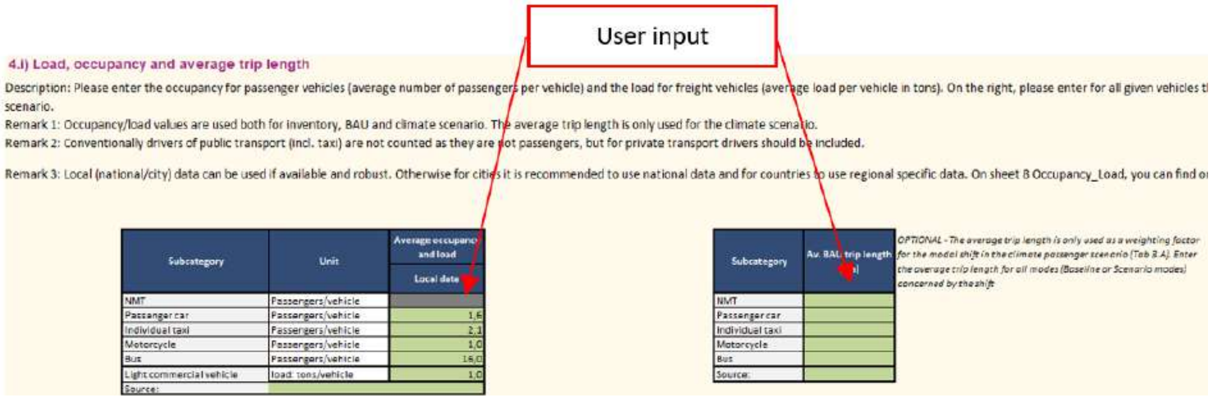
Description: Please enter the vehicle kilometers of the base year and the annual growth rate. The user has to choose between the vkt approach or the fleet approach for each vehicle category. It is n
GHG emissions cannot be done.
Remark 1: The total vkt (mileage approach) or average annual mileage (fleet approach) should comply with the actual transport activity within the city or country territory.
Remark 2: Definitions and short descriptions of each vehicle category can be found in the sheet "7 Sources and abbreviation".

	1. Vkt approach	2. Fleet approach						
Subcategory	Total vkt per vehicle category [Mio. km/year]	Vehicle stock [total number of vehicles]	Average annual mileage per vehicle [km/vehicle/year]	Annual growth of vkt per period [%]				
	2019	2019		2019-2020	2020-2025	2025-2030	2030-2040	2040-2050
NMT								
Passenger car		576.928	6.572	0,3%	0,3%	0,3%	0,3%	0,3%
Individual taxi		8.511	72.000	0,3%	0,3%	0,3%	0,3%	0,3%
Motorcycle		471.277	2.386	0,3%	0,3%	0,3%	0,3%	0,3%
Bus		5.449	64.488	0,3%	0,3%	0,3%	0,3%	0,3%
Light commercial vehicle		314.850	6.572	1,6%	1,6%	1,6%	1,6%	1,6%
Source:								

Figure 12. Vehicle kilometres travelled and growth input sample

Step 4.i) Load factor, occupancy rate and average trip length:

The user should gather reliable local or national data on occupancy rates, load factors and average trip length for each vehicle type. If no local data is available, the tool provides orientation values for the occupancy and load factors in countries/cities in Sheet 8 "Occupancy_Load" (you can contact the MobiliseYourCity Secretariat to verify whether such data is available for your country). Note that both average occupancy and average trip length must be entered for the tool to run a calculation.



Subcategory	Unit	Average occupancy and load Local data
NMT	Passengers/vehicle	
Passenger car	Passengers/vehicle	1,6
Individual taxi	Passengers/vehicle	2,1
Motorcycle	Passengers/vehicle	1,0
Bus	Passengers/vehicle	16,0
Light commercial vehicle	load: tons/vehicle	1,0
Source:		

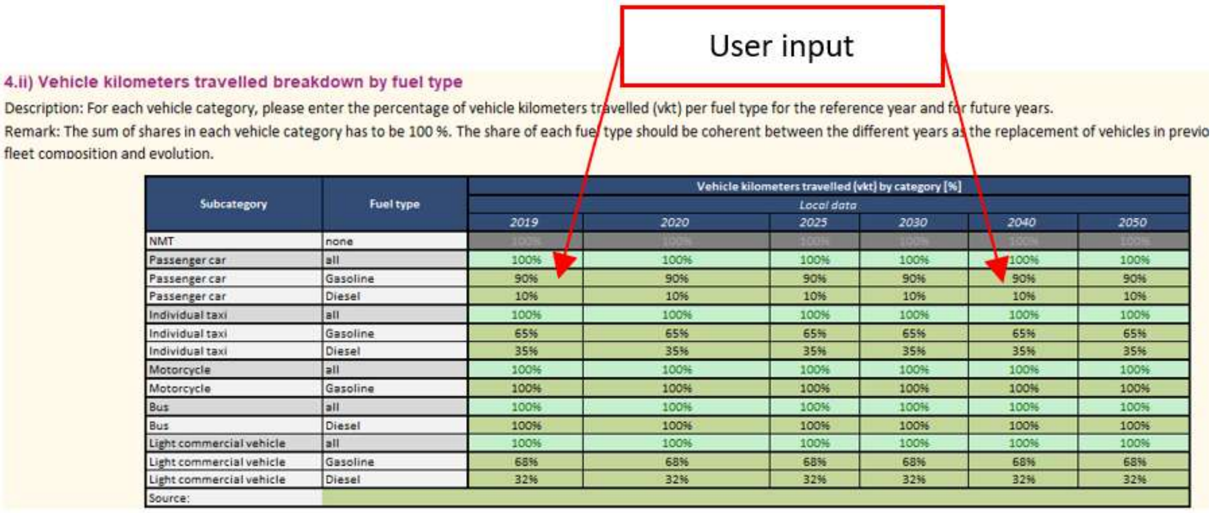
Subcategory	Av. BAU trip length
NMT	
Passenger car	
Individual taxi	
Motorcycle	
Bus	
Source:	

Figure 13. Occupancy, load and trip length input cells

Step 4.ii) Vehicle kilometre travelled breakdown by fuel type:

Vehicle kilometres travelled (vkt) should be disaggregated by vehicle category and fuel type (diesel, gasoline, electric, etc.) for both the reference year and future years (if a BAU scenario is to be calculated). If city level data is not available, national values from the orientation values can be used (please contact the MobiliseYourCity Secretariat to check if these are available for your country).

⚠ **Important:** Ensure that for each vehicle cathegory, the sum of the vkt shares equals 100%.



Subcategory	Fuel type	Vehicle kilometers travelled (vkt) by category [%] Local data 2019	2020	2025	2030	2040	2050
NMT	none	100%	100%	100%	100%	100%	100%
Passenger car	all	100%	100%	100%	100%	100%	100%
Passenger car	Gasoline	90%	90%	90%	90%	90%	90%
Passenger car	Diesel	10%	10%	10%	10%	10%	10%
Individual taxi	all	100%	100%	100%	100%	100%	100%
Individual taxi	Gasoline	65%	65%	65%	65%	65%	65%
Individual taxi	Diesel	35%	35%	35%	35%	35%	35%
Motorcycle	all	100%	100%	100%	100%	100%	100%
Motorcycle	Gasoline	100%	100%	100%	100%	100%	100%
Bus	all	100%	100%	100%	100%	100%	100%
Bus	Diesel	100%	100%	100%	100%	100%	100%
Light commercial vehicle	all	100%	100%	100%	100%	100%	100%
Light commercial vehicle	Gasoline	68%	68%	68%	68%	68%	68%
Light commercial vehicle	Diesel	32%	32%	32%	32%	32%	32%
Source:							

Figure 14. Vkt breakdown by fuel type input sample

Step 4.iii) Average energy/fuel consumption for the reference year and energy efficiency change in the BAU scenario:

Users must input the average energy/fuel consumption for each vehicle category and fuel type in the table "average energy /fuel consumption" (e.g. 8 l/100 km). If no data is available at the city level, national values can be applied (please contact the MobiliseYourCity Secretariat to check if these are available for your country). For the BAU scenario, annual energy consumption should be estimated for each year based on technological development and potentially on policies envisaged in the BAU that could impact energy efficiency.

User input

4.iii) Average energy/fuel consumption for the reference year and energy efficiency change in the BAU scenario

Description: Please enter the average fuel/energy consumption - for each vehicle category and per fuel type for the reference year (average fuel/energy consumption per vehicle per 100 km) as well

Remark: On sheet 7 Fuel Consumption, you can find orientation values for fuel/energy consumption.

Subcategory	Fuel type	Unit	Average energy consumption [l-kW-kg/100 km] Local data 2019	2020	2025	2030	2040	2050
NMT	none	-						
Passenger car	Gasoline	l/100km	8,0	8,0	8,0	8,0	8,0	8,0
Passenger car	Diesel	l/100km	7,0	7,0	7,0	7,0	7,0	7,0
Individual taxi	Gasoline	l/100km	8,0	8,0	8,0	8,0	8,0	8,0
Individual taxi	Diesel	l/100km	7,0	7,0	7,0	7,0	7,0	7,0
Motorcycle	Gasoline	l/100km	3,1	3,1	3,1	3,1	3,1	3,1
Bus	Diesel	l/100km	40,0	40,0	40,0	40,0	40,0	40,0
Light commercial vehicle	Gasoline	l/100km	8,0	8,0	8,0	8,0	8,0	8,0
Light commercial vehicle	Diesel	l/100km	7,0	7,0	7,0	7,0	7,0	7,0
Source:								

Figure 15. Average energy/fuel consumption and efficiency improvements input sample

Step 4.iv) Evolution of the CO_2 content of the electricity in both scenarios

To estimate the Well-To-Wheel CO_2 emissions from electric vehicles, users must input the CO_2 content from electricity production separately for road and rail transport (g CO_2/kWh – electricity grid emission factor).

It must be mentioned, that these values apply for both the BAU-scenario and climate scenario.

4.iv) Evolution of the CO2 content from electricity and hydrogen production in both scenarios

Description: Please enter the CO2 content of electricity and hydrogen for the reference year and for future years.

Remark 1: For scenario calculations, it is mandatory to enter the values for future years as well. These values are used for scenario calculations both for the BAU (this sheet) and the cli

Remark 2: GHG emissions from (battery and fuel cell) electric vehicles are zero when applying a TTW (tank-to-wheel) approach. If the WTW (well-to-wheel) approach is applied the ups

Remark 3: Please note that the unit for the CO2 content of electricity is g CO2/kWh electricity, whereas the unit for the CO2 content of hydrogen is g CO2/kg hydrogen.

Input data for the electricity mix		Local data 2019	2020	2025	2030	2040	2050
Road - Electric	g CO2/kWh	45	45	45	45	45	45
Rail - Electric	g CO2/kWh						
Source:							

Input data for hydrogen production		Local data 2019	2020	2025	2030	2040	2050
Road - Hydrogen	g CO2/kg						
Rail - Hydrogen	g CO2/kg						
Source:							

Figure 16. CO2 content from electricity production input table

2.4. Sheet "2B Top-Down Validation"

This sheet allows users to validate or compare the calculated energy consumption from the MobiliseYourCity Emissions Calculator inventory (bottom-up) with statistical data (top-down).

General information:

The bottom-up calculated energy consumption in the reference year is compared with statistical data, i.e. energy balance for countries (Top-down energy consumption). Locally, these statistics may be the cumulative sales of fuels from service stations within the area of study but not available. It is important to note that some discrepancy between the bottom-up and top-down GHG calculations is expected, as the two approaches rely on different data sets leading to different results. Despite these differences, the results from both approaches should be of similar order of magnitude. For a more detailed understanding of the sources of discrepancy, please see the *Compendium on GHG Baselines and Monitoring Passenger and freight transport* (GIZ et al. 2018).

Completion steps:

For the top-down validation, the user must enter the energy or fuel consumption values for all relevant energy types for both road and rail transport (based on their energy balance or statistics on fuel sales). The validation/comparison between Bottom-up and Top-down will be shown in the charts below the input tables, as shown in *Figure 17*.

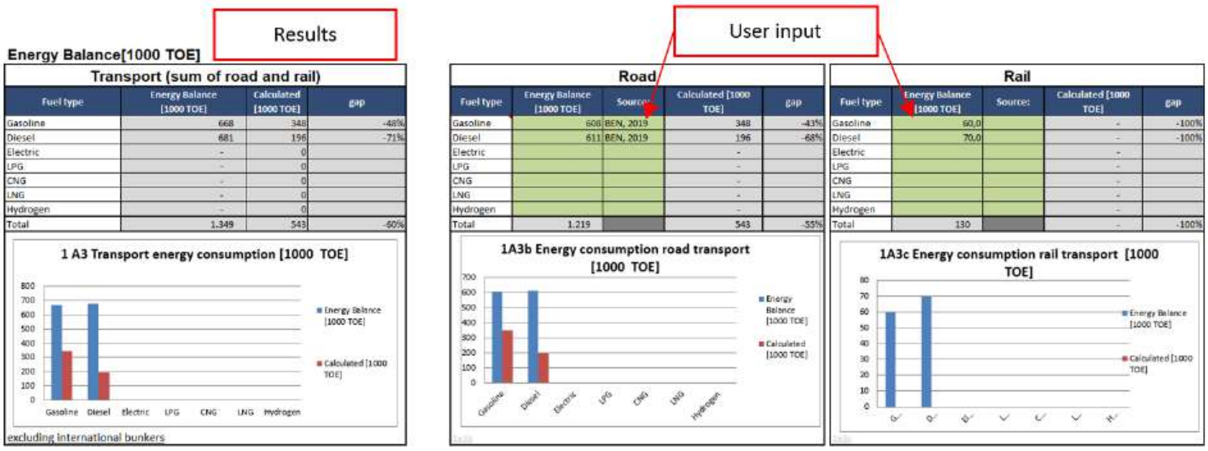


Figure 17. Bottom-up / Top-down Validation preview

2.5. Sheet "3A Input Climate Scen. Pass"

This sheet enables the calculation of a future scenario - called climate scenario - to estimate the impact of packages of mitigation measures on passenger transport-related GHG emissions.

General information:

This sheet offers two methods for entering transport demand data. The appropriate method should be selected based on the type of data available.

- Approach 1: With upstream calculations - If the future transport demand data for the total mileage (vkt) and transport performance (pkm) can be derived from a transport model, this data can directly entered in the table in the box "With upstream calculations" of the MobiliseYourCity tool.
- Approach 2: Without upstream calculations - If no transport model is available, the user can adjust the transport demand in a step-by-step approach in the section "Without transport upstream calculations" following the *Avoid, Shift, Improve approach* (ASI).

⚠ Important: It is highly recommended not to mix both methods to get robust results! Please choose only one approach and apply all required data only for the chosen approach. If both data types are available, consult a transport expert to ensure consistency.

Once the transport demand method is chosen, continue with Step 3) Improve: Penetration of alternative energies.

Completion Steps:

Approach 1: with upstream calculations - transport activity data from external transport planning tool:

First, enter the transport performances in Million Pkm (Person-km) and the vkt (in Million km) from a transport model tool into the two green tables. Proceed then to Step 3: Improve – Alternative Energies.

⚠ Important: If the entered values result in negative vkt within a vehicle category, an error message will be shown via a pop-up menu.

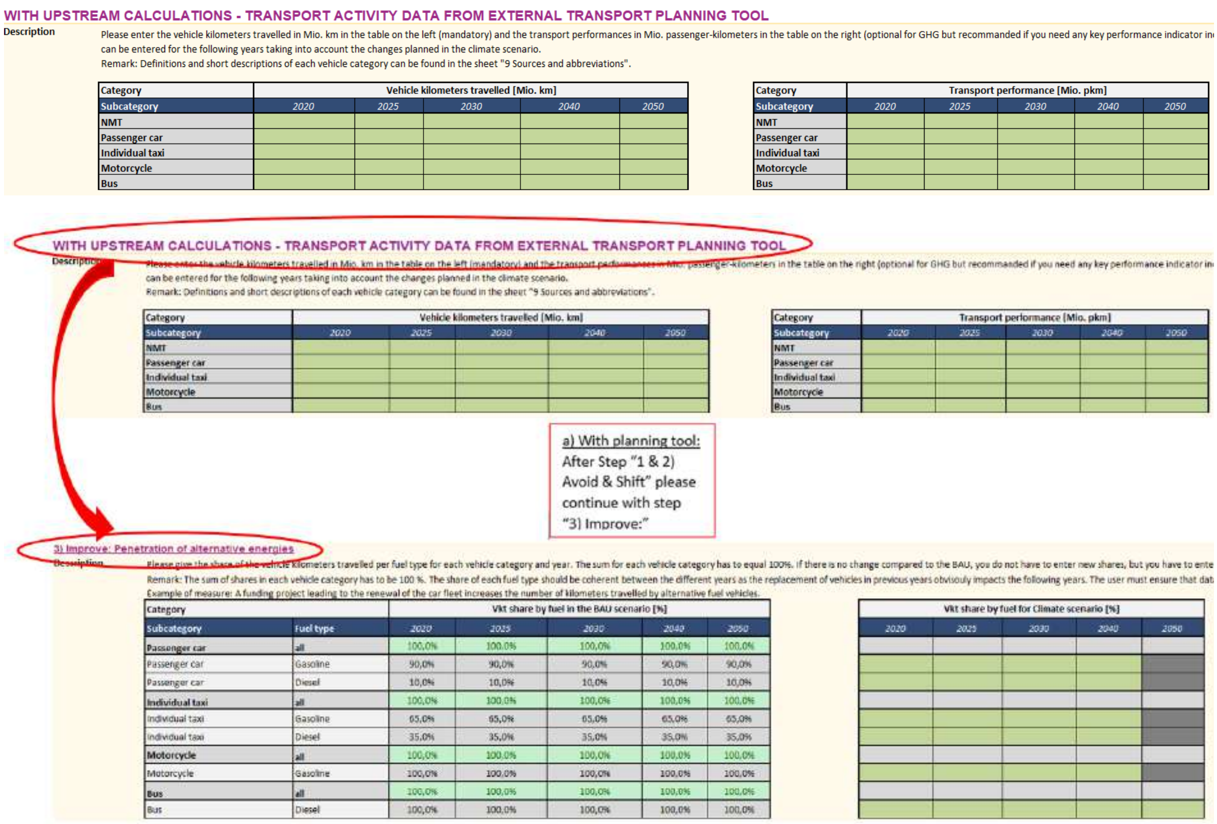


Figure 18. General approach for transport activity data in the climate scenario with data from an external transport planning tool

<u>Approach 2: without upstream calculations</u> - <u>transport activity data calculations within this tool:</u>

If no transport model is available, the avoided, shifted transport must be calculated using the step-by-step approach provided in the "Without upstream calculations" section. After completing this section, proceed to the third section to enter data on energy efficiency.

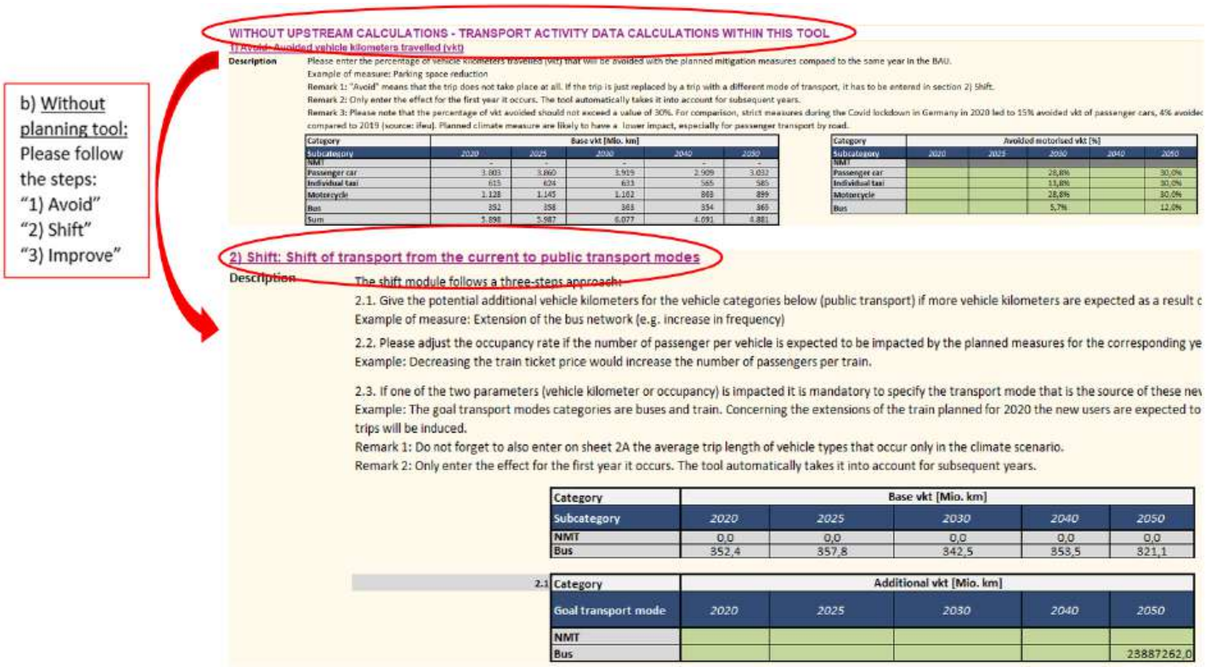


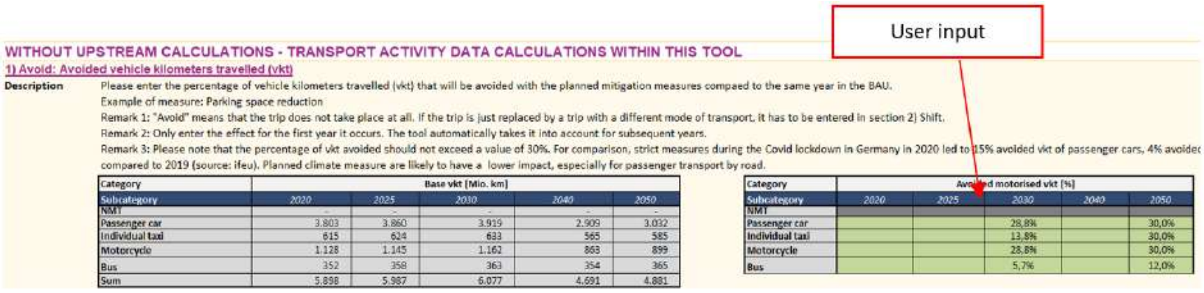
Figure 19. Step-by-step approach without transport planning tool

Step 1) Avoid: Avoided vehicle kilometres travelled (vkt):

In the table “Avoided motorised vkt (%)”, enter the percentage of the transport demand (vkt) avoided through mitigation actions. If traffic is not avoided by the policies planned in the climate scenario, please skip this section and go to *2) Shift: Shift of transport from the current to public transport modes.*

- *Positive values* represent a decrease in the transport demand (avoided kilometres) in the climate scenario.
- *Negative values* increase the transport demand (is not recommended for a climate scenario….).

⚠Important: If users enter values that lead to negative vkt within a vehicle category, an error check pop-up menu will appear.



WITHOUT UPSTREAM CALCULATIONS - TRANSPORT ACTIVITY DATA CALCULATIONS WITHIN THIS TOOL

1) Avoid: Avoided vehicle kilometers travelled (vkt)

Description: Please enter the percentage of vehicle kilometers travelled (vkt) that will be avoided with the planned mitigation measures compaed to the same year in the BAU.
Example of measure: Parking space reduction
Remark 1: "Avoid" means that the trip does not take place at all. If the trip is just replaced by a trip with a different mode of transport, it has to be entered in section 2) Shift.
Remark 2: Only enter the effect for the first year it occurs. The tool automatically takes it into account for subsequent years.
Remark 3: Please note that the percentage of vkt avoided should not exceed a value of 30%. For comparison, strict measures during the Covid lockdown in Germany in 2020 led to 15% avoided vkt of passenger cars, 4% avoidec compared to 2019 (source: ifeu). Planned climate measure are likely to have a lower impact, especially for passenger transport by road.

Category	Base vkt [Mio. km]				
Subcategory	2020	2025	2030	2040	2050
NMT	-	-	-	-	-
Passenger car	3.803	3.860	3.919	2.909	3.032
Individual taxi	615	624	633	565	585
Motorcycle	1.128	1.145	1.162	863	899
Bus	352	358	363	354	365
Sum	5.898	5.987	6.077	4.691	4.881

Category	Avoided motorised vkt [%]				
Subcategory	2020	2025	2030	2040	2050
NMT					
Passenger car			28,8%		30,0%
Individual taxi			13,8%		30,0%
Motorcycle			28,8%		30,0%
Bus			5,7%		12,0%

Figure 20. Without transport planning tool step 1) Avoid preview

Step 2) Shift: Shift of transport from the current to public transport modes:

In this step, the user can calculate the modal shift. The tables in the upper part of this section display the baseline transport demand and are provided for informational purposes only.

- If the planned measures lead to a reduction in vkt for one or more categories, enter the number of additional vkt in the corresponding green table. *Note: In climate scenarios, only public transport is expected to increase. Vkt for private transport should not increase*.
- Once the additional kilometres are entered, fill in the *“Origin mode of transportation of new PT passengers”* table. Specify the share of the new vkt according to the original vehicle category from which the passengers come (e.g. additional bus kilometres come 50% from car users and 50% from non-motorized transport). The area where the origin mode of transport must be entered should turn green in the corresponding table. *If users enter values that lead to negative transport demand within a vehicle category, an error check pop-up menu will be shown*.
- If the planned measures impact the occupancy rate, please enter the new occupancy rates. Similarly, as above, the share of trips made by new public transport users should be attributed to their former mode of transport (e.g. increased use of urban rail is assumed to come entirely from buses due to a corresponding bus line being replaced).
- The planned measures can affect both inputs: vkt and the number of people in these vehicles. Ensure that these values are aligned so that the resulting transport performance (person kilometre) and modal split reflect your scenario projections.

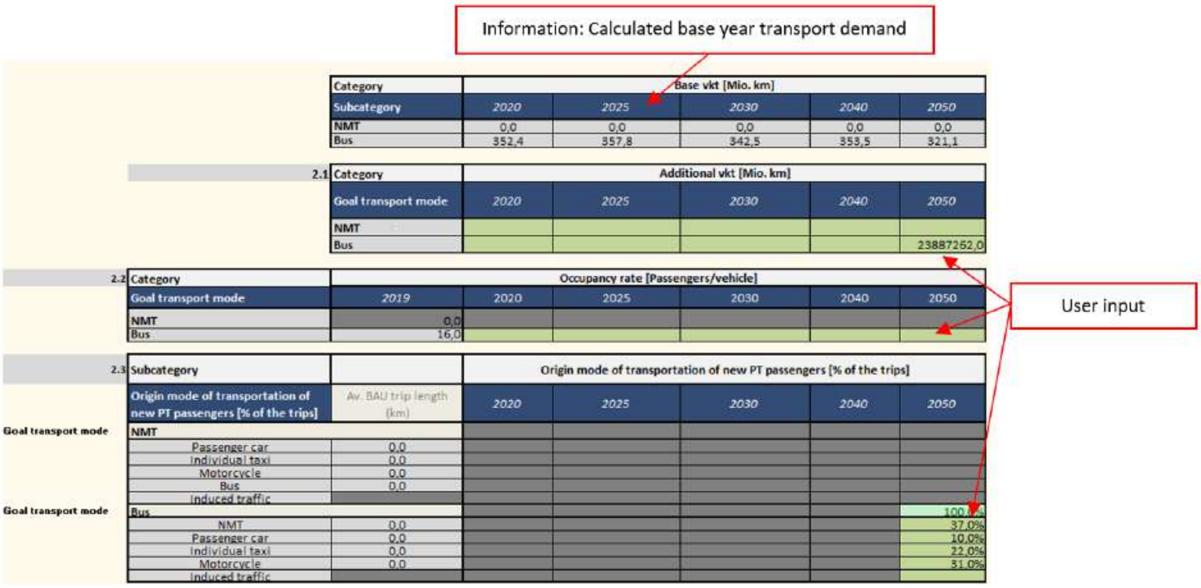


Figure 21. Without transport planning tool step 2) Shift – Overview

⚠Important: The input values must be expressed as a percentage (%) of the trips. Please make sure that the sum of values for each vehicle category is 100%. Also do not forget to consider induced transport.

<u>Results of the transport demand measures:</u> the results of the inputs concerning the climate scenario measures are displayed in the table "Scenario vkt" and "transport performance". These values are calculated based on both approaches "with upstream calculations" or "without upstream calculations". Regardless of which approach was chosen, these transport demand values were considered for all subsequent calculations of the energy demand and GHG-emissions in the climate scenario.

If the inputs lead to negative transport demand within a vehicle category, these values will be shown in red in the table. If this occurs, please review your previous inputs in this sheet and make sure no cells are red before continuing.

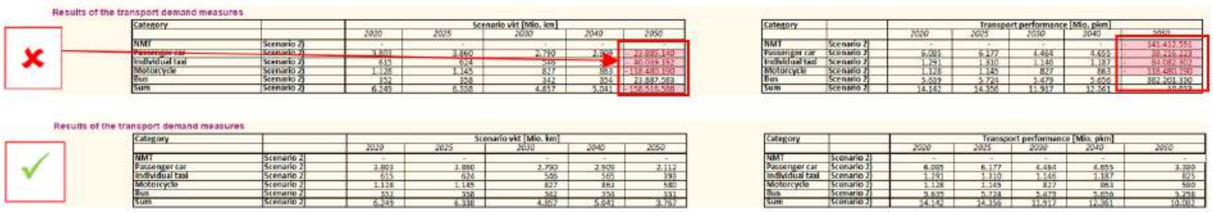


Figure 22. Sample results for the transport demand in the climate scenario

<u>Step 3) Improve: penetration of alternative energies:</u>

In this step, the climate scenario's calculated transport demand (vkt) for each vehicle type can be split into different fuel types. For reference, the shares from the BAU scenario are shown in the calculation. This input is necessary to calculate GHG emissions. If a certain type of energy is not used, the user can input 0 or leave the cell blank. If the fuel distribution does not change compared to the BAU scenario, the values from the BAU can be copied and pasted directly into the green input table.

3) Improve: Penetration of alternative energies

Description: Please give the share of the vehicle kilometers travelled per fuel type for each vehicle category and year. The sum for each vehicle category has to equal 100%. If there is no change compared to the BAU, you do not have to ent climate scenario.

Remark: The sum of shares in each vehicle category has to be 100 %. The share of each fuel type should be coherent between the different years as the replacement of vehicles in previous years obvisouly impacts the following

Example of measure: A funding project leading to the renewal of the car fleet increases the number of kilometers travelled by alternative fuel vehicles.

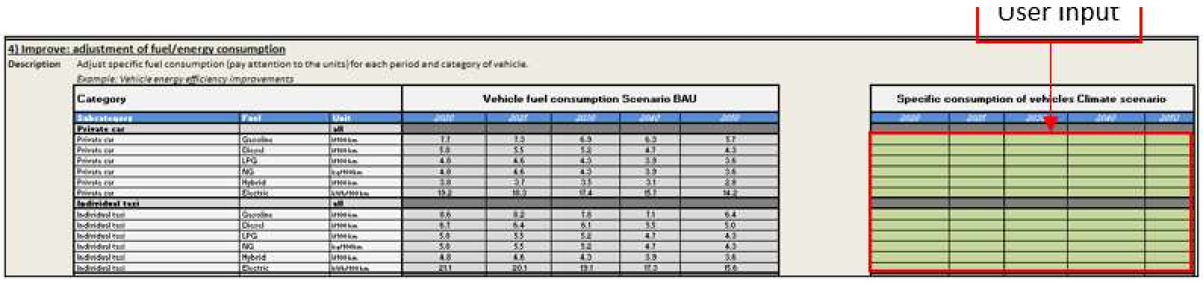
Category		Vkt share by fuel in the BAU scenario [%]					Vkt share by fuel for Climate scenario [%]				
Subcategory	Fuel type	2020	2025	2030	2040	2050	2020	2025	2030	2040	2050
Passenger car	**all**	100,0%	100,0%	100,0%	100,0%	100,0%					
Passenger car	Gasoline	90,0%	90,0%	90,0%	90,0%	90,0%					
Passenger car	Diesel	10,0%	10,0%	10,0%	10,0%	10,0%					
Individual taxi	**all**	100,0%	100,0%	100,0%	100,0%	100,0%					
Individual taxi	Gasoline	65,0%	65,0%	65,0%	65,0%	65,0%					
Individual taxi	Diesel	35,0%	35,0%	35,0%	35,0%	35,0%					
Motorcycle	**all**	100,0%	100,0%	100,0%	100,0%	100,0%					
Motorcycle	Gasoline	100,0%	100,0%	100,0%	100,0%	100,0%					
Bus	**all**	100,0%	100,0%	100,0%	100,0%	100,0%					
Bus	Diesel	100,0%	100,0%	100,0%	100,0%	100,0%					

⚠ Important: The total share for each vehicle category must equal 100%. If the sum is correct, it will be indicated in green.

Figure 23. Step 3) Improve: Penetration of alternative energies

<u>Step 4) Improve: Adjustment of fuel/energy consumption:</u>

In this last step, the user can adjust the average fuel/energy consumption for the climate scenario. For reference, the BAU scenario's consumption values are displayed in the table. This input is necessary to calculate GHG emissions. If one or more types of fuel are not in use, the corresponding cells can be set to 0 or left blank. If the parameters do not change in comparison to the BAU, please copy the BAU value in the green table.



4) Improve: adjustment of fuel/energy consumption

Description: Adjust specific fuel consumption (pay attention to the units) for each period and category of vehicle.

Example: Vehicle energy efficiency improvements

Category			Vehicle fuel consumption Scenario BAU					Specific consumption of vehicles Climate scenario				
Subcategory	Fuel	Unit	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Private car		**all**										
Private car	Gasoline	l/100 km	7.1	7.3	6.9	6.3	5.7					
Private car	Diesel	l/100 km	5.8	5.5	5.2	4.7	4.3					
Private car	LPG	l/100 km	4.8	4.6	4.3	3.9	3.6					
Private car	NG	kg/100 km	4.8	4.6	4.3	3.9	3.6					
Private car	Hybrid	l/100 km	3.8	3.7	3.5	3.1	2.9					
Private car	Electric	kWh/100 km	19.2	18.3	17.4	15.7	14.2					
Individual taxi		**all**										
Individual taxi	Gasoline	l/100 km	8.6	8.2	7.8	7.1	6.4					
Individual taxi	Diesel	l/100 km	6.7	6.4	6.1	5.5	5.0					
Individual taxi	LPG	l/100 km	5.8	5.5	5.2	4.7	4.3					
Individual taxi	NG	kg/100 km	5.8	5.5	5.2	4.7	4.3					
Individual taxi	Hybrid	l/100 km	4.8	4.6	4.3	3.9	3.6					
Individual taxi	Electric	kWh/100 km	21.1	20.1	19.1	17.2	15.6					

Figure 24. Step 4) Adjustment of fuel/energy consumption

2.6. Sheet "3A Results Climat Scen. Pass"

The sheet "3A Results Climate Scen. Pass" presents the results of both the BAU scenario and the climate scenario (total vkt and GHG emissions) (see Figure 25).

Before any inputs are entered onto this tab, the results of the two scenarios - BAU and climate scenario - should be the same (0% reduction). As users input emission reduction measures, the impact on vkt and GHG emissions will be reflected immediately in the corresponding figures.

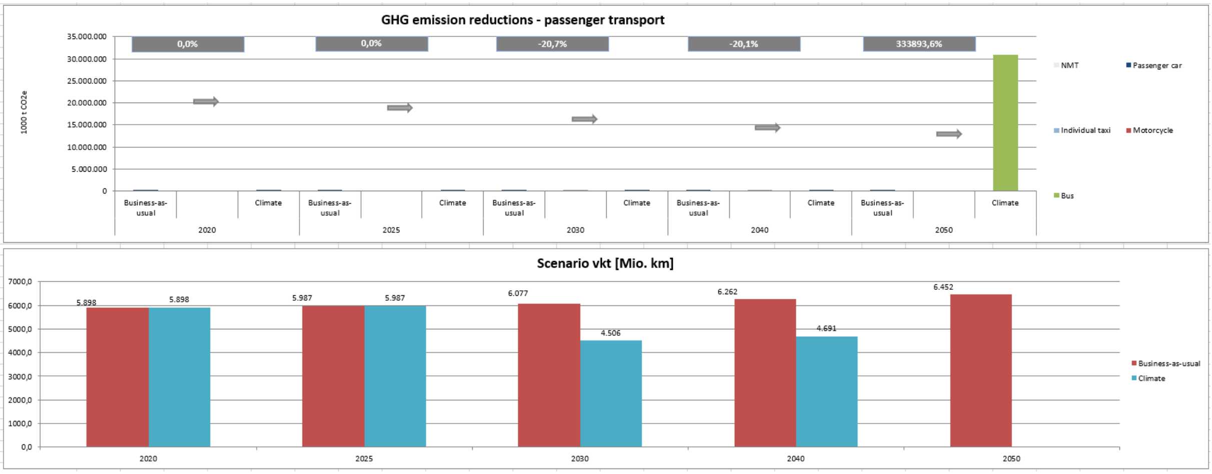


Figure 25. Results of the climate scenario in comparison to the BAU scenario – Passenger transport

2.7. Sheet "3B Input Climat Scen. Freight"

This sheet is used for the calculation of a climate scenario for freight transport, allowing users to assess the impact of mitigation actions.

General information:

The structure of the user input and the calculation methodology for freight transport (sheet 3B) follows the structure of the input and the calculation methodology presented for passenger transport (see Section 2.5. in this document).

Completion:

For guidance on how to complete this sheet, please refer to **Section 2.5**. of the document (Sheet "3A Input Climat Scen. Pass."). As mentioned before, the structure and calculation methodology for both freight and passenger transport are the same. All steps and considerations described in the passenger transport section apply equally to freight transport (sheet "3B Input Climat Scen. Freight").

2.8. Sheet "Overview of results"

This sheet provides a summary and overview of the calculated results from the GHG inventory, the BAU scenario and the climate scenario.

General information:

Section 1) of the sheet provides the GHG inventory. Section 2) displays the results from the BAU and climate scenarios for both passenger and freight transport. Section 3) shows the Key Performance Indicators (KPI´s) for the reference year and both the BAU and climate scenario. These indicators are useful for monitoring purposes as well as tracking progress over time.

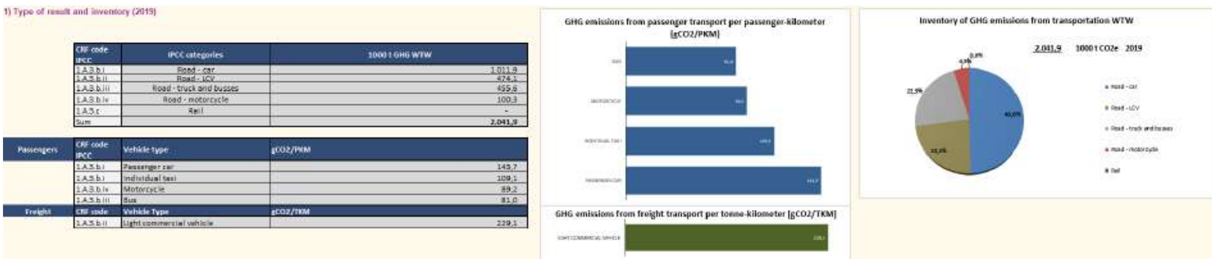


Figure 26. Type or result and inventory

Annex 1: List of data needs

This annex provides an overview of the data required to calculate transport GHG emissions in the MobiliseYourCity tool.

Methodology and scope

The scope of the transport GHG inventory and scenario calculation should be clearly defined. The assessment can be conducted at the national level, for example in the context of a NUMP, or at a local level (SUMP). Local assessment can be carried at the city level, but also at the metropolitan level.

The specific geographical boundaries of the assessment area must be clearly defined and remain consistent throughout the process for all data inputs. The **base year** for the inventory must also be selected. This should be a recent year for which data is as complete and reliable as possible, taking into account the number and quality of available datasets. **The projection time should also be defined**, the tool enables assessment until 2050, but the user can choose to limit his assessment to previous years (e.g. 2030).

All **data inputs** –shown through **green cells**- are mandatory to use all functionalities of the tool i.e. inventory for base year, BAU and climate scenario as well as Key Performance Indicators (KPI). If the user chooses not to use all functionalities, only the data relevant to the selected analysis must be provided. For example, if the user only wants to develop, it is not necessary to input data for the BAU or climate scenario. Please consider that the inventory is compulsory to calculate BAU and climate scenarios.

If the user wants to calculate a Business-as-usual (BAU) scenario (also called “do nothing scenario”), the definition provided in the Compendium on GHG Baselines and Monitoring Passenger and freight transport (GIZ et al., 2018) should be followed. According to this source “BAU means a projection of a future year assuming no intervention is implemented and Counter- factual baseline means a projection of what would have happened in the past without the intervention but based on historical drivers other than the mitigation action.”

An overview of the data required and the geographical scope at which they should be gathered is given in *Table 1. List and scope of input parameters; Legend / no data; + low; ++ medium; +++ high*. The more precise the data, the better the output quality. For local assessments, the recommended order of preference is to use city-level data first, then national-level data, and finally regional data if no national data is available.

It is recognized that not all data will be available at every level. The minimum data accuracy required depends on whether the tool is being used for a national or a city-level assessment. If national data for a specific parameter is not available, users can use regional data instead, such as average values for Asia. The MobiliseYourCity tool also includes default emission factors from IPCC. These can be used as they are, or replaced with more accurate national or regional data if available.

			Data collection recommendations for investigations on the national and city level			
			National level		City level	
Category/Parameter	**Data required for**	**Sensitivity for results**	**Scope**	**Data basis/ Data source**	**Scope**	**Data basis/ Data source**
Socio-economic data						
1) Population - Number of inhabitants	Inventory	/	National data	National authority, Surveys	City data	City authority, Surveys
Population growth rate	BAU, Climate scenario	/	National data	National authority, assumptions	City data	City authority, assumptions
Gross domestic product (GDP) or Gross market product (GMP) for cities	Inventory	/	National data	National authority	(City data)	City Authority if data available
GDP growth rate or Gross market product (GMP) for cities	BAU, Climate scenario	/	National data	National authority, assumptions	(City data)	City authority, assumptions if data available
Transport demand						
3a) Vkt approach						
Total annual vehicle kilometers travelled per vehicle category	Inventory	+++	National data	Transport model, surveys	City data	Transport model, surveys
Annual Vkt growth rate per vehicle category	BAU, Climate scenario	+++	National data	Transport model, assumptions	City data	Transport model, assumptions
Average Vkt share by fuel type	Inventory	++	National data	Statistics, Surveys, default values	National data	Statistics, Surveys, default values
Average Vkt share by fuel type in future years	BAU, Climate scenario	++	National data	Surveys, default values	National data	Surveys, default values
3b) Fleet approach						
Vehicle stock (total number of vehicles) per vehicle category	Inventory	+++	National data	Statistics, Surveys	City data	Statistics, Surveys
Average annual mileage per vehicle category	Inventory	+++	National data	Statistics, Surveys, default values	City data	Statistics, Surveys, default values
Annual Vkt growth rate per vehicle category	BAU, Climate scenario	+++	National data	Surveys, assumptions	City data	Surveys, assumptions
Average Vkt share by fuel type	Inventory	++	National data	National authority, surveys, default values	National data	City authority, surveys, default values
Average Vkt share by fuel type in future years	BAU, Climate scenario	++	National data	Literature, assumptions	National data	Literature, assumptions
Average occupancy/load per vehicle category	Inventory, BAU, Climate scenario	++	National (or regional data)	National authority, surveys, default values	National (or regional data)	City authority, surveys, default values
Average trip length per vehicle category	Inventory, BAU, Climate scenario	++	National data	National authority, surveys, default values	National data (or regional data)	National authority, surveys, default values
Energy consumption						
Average energy consumption per	Inventory	+++	National (or regional data)	National authority, surveys, default values	National (or	National authority, surveys, default values

Table 1. List and scope of input parameters; Legend / no data; + low; ++ medium; +++ high

Data inputs are described by sheet in the next paragraphs. Emission factors are not described here as IPCC defaults are provided and it is not expected that users have better data. If this is the case, the data can be updated in Sheet "6. Default parameters"

Sheet "2A Input Base and BAU"

1. Socio-economic data (used for the calculation of the KPI):

- **Population** of the defined area of study for base year and **annual growth rate** for following years (BAU)
- **GDP in USD Billion** for base year and **annual growth rate** for following years (BAU)

	Unit	Values						Annual growth rate [%]				
		2019	2020	2025	2030	2040	2050	2019-2020	2020-2025	2025-2030	2030-2040	2040-2050
Population	Number of inhabitants	3.461.731	3.472.116	3.524.511	3.577.697	3.686.489	3.798.588	0,3%	0,3%	0,3%	0,3%	0,3%
Gross domestic product (GDP)	Million dollars	61	62	67	73	85	100	1,6%	1,6%	1,6%	1,6%	1,6%
Source:												

Figure 27. Socio-economic data

2. Vehicle kilometre travelled

Two approaches are possible depending on the format and type of data available concerning transport demand.

- **Option 1: Vkt approach: total mileage within the territory per vehicle category in Mio km**
- **Option 2: Fleet approach: total number of vehicles in use and the average annual mileage** per vehicle category within the territory. The multiplication gives the annual mileage as in Option 1 (be careful to consider all trips within the territory incl. outgoing and incoming trips)
- **Vkt Annual growth rate in %** per period (base year-2020; 2020-2025; 2025-2030; 2030-2040; 2040-2050)

	1. Vkt approach	2. Fleet approach						
Subcategory	Total vkt per vehicle category [Mio. km/year]	Vehicle stock [total number of vehicles]	Average annual mileage per vehicle [km/vehicle/year]	Annual growth of vkt per period [%]				
	2019	2019		2019-2020	2020-2025	2025-2030	2030-2040	2040-2050
NMT								
Passenger car		576.928	6.572	0,3%	0,3%	0,3%	0,3%	0,3%
Individual taxi		8.511	72.000	0,3%	0,3%	0,3%	0,3%	0,3%
Motorcycle		471.277	2.386	0,3%	0,3%	0,3%	0,3%	0,3%
Bus		5.449	64.488	0,3%	0,3%	0,3%	0,3%	0,3%
Light commercial vehicle		314.850	6.572	1,6%	1,6%	1,6%	1,6%	1,6%
Source:								

Figure 28. Vehicle kilometres travelled

3. Load, occupancy rate and average trip length:

- **Occupancy rates in persons/vehicle** for the base year & the BAU (stays the same) for each passenger vehicle category (in passenger/vehicle)
- **Average trip length in km** for the base year & the BAU (stays the same) for each passenger vehicle (in km)
- **Load factors in tons/vehicle** for the base year & the BAU (stays the same) for each freight vehicle category

Subcategory	Unit	Average occupancy and load
		Local data
NMT	Passengers/vehicle	
Passenger car	Passengers/vehicle	1,6
Individual taxi	Passengers/vehicle	2,1
Motorcycle	Passengers/vehicle	1,0
Bus	Passengers/vehicle	16,0
Light commercial vehicle	load: tons/vehicle	1,0
Source:		

Subcategory	Av. BAU trip length (km)
NMT	
Passenger car	
Individual taxi	
Motorcycle	
Bus	
Source:	

OPTIONAL - The average trip length is only used as a weighting factor for the modal shift in the climate passenger scenario (Tab 3.A). Enter the average trip length for all modes (Baseline or Scenario modes) concerned by the shift

Figure 29. Occupancy, load and trip length

4. <u>Breakdown of Vehicle kilometre travelled by fuel type</u>

- **Share of the vkt travelled by type of fuel in %** (diesel, gasoline, electric etc) for each vehicle category for the reference year as well as BAU. The sum should equal 100%

Subcategory	Fuel type	Vehicle kilometers travelled (vkt) by category [%]					
		Local data					
		2019	2020	2025	2030	2040	2050
NMT	none	100%	100%	100%	100%	100%	100%
Passenger car	all	100%	100%	100%	100%	100%	100%
Passenger car	Gasoline	90%	90%	90%	90%	90%	90%
Passenger car	Diesel	10%	10%	10%	10%	10%	10%
Individual taxi	all	100%	100%	100%	100%	100%	100%
Individual taxi	Gasoline	65%	65%	65%	65%	65%	65%
Individual taxi	Diesel	35%	35%	35%	35%	35%	35%
Motorcycle	all	100%	100%	100%	100%	100%	100%
Motorcycle	Gasoline	100%	100%	100%	100%	100%	100%
Bus	all	100%	100%	100%	100%	100%	100%
Bus	Diesel	100%	100%	100%	100%	100%	100%
Light commercial vehicle	all	100%	100%	100%	100%	100%	100%
Light commercial vehicle	Gasoline	68%	68%	68%	68%	68%	68%
Light commercial vehicle	Diesel	32%	32%	32%	32%	32%	32%
Source:							

Figure 30. Vkt breakdown by fuel type

5. <u>Energy/fuel consumption</u>

- **Average energy/fuel consumption in liter, kg or kWh/100 km** for each vehicle category and fuel type in use
- **Annual fuel consumption rate of improvement in %** of the vehicle consumption in the BAU scenario per period (base year-2020; 2020-2025; 2025-2030; 2030-2040; 2040-2050)

Subcategory	Fuel type	Unit	Average energy consumption [l-kW-kg/100 km]					
			Local data					
			2019	2020	2025	2030	2040	2050
NMT	none	-						
Passenger car	Gasoline	l/100km	8,0	8,0	8,0	8,0	8,0	8,0
Passenger car	Diesel	l/100km	7,0	7,0	7,0	7,0	7,0	7,0
Individual taxi	Gasoline	l/100km	8,0	8,0	8,0	8,0	8,0	8,0
Individual taxi	Diesel	l/100km	7,0	7,0	7,0	7,0	7,0	7,0
Motorcycle	Gasoline	l/100km	3,1	3,1	3,1	3,1	3,1	3,1
Bus	Diesel	l/100km	40,0	40,0	40,0	40,0	40,0	40,0
Light commercial vehicle	Gasoline	l/100km	8,0	8,0	8,0	8,0	8,0	8,0
Light commercial vehicle	Diesel	l/100km	7,0	7,0	7,0	7,0	7,0	7,0
Source:								

Figure 31. Average energy/fuel consumption and efficiency improvements

6. <u>CO2 content of electricity/hydrogen</u>

- **The CO2 content of electricity in g CO2/kWh** for both road and rail for the base year and projected for the given years (2020,2025,2030,2040,2050)

These data are used for all scenarios

Input data for the electricity mix		Local data					
		2019	2020	2025	2030	2040	2050
Road - Electric	g CO2/kWh	45	45	45	45	45	45
Rail - Electric	g CO2/kWh						
Source:							

Input data for hydrogen production		Local data					
		2019	2020	2025	2030	2040	2050
Road - Hydrogen	g CO2/kg						
Rail - Hydrogen	g CO2/kg						
Source:							

Figure 32. CO2 content from electricity/Hydrogen production

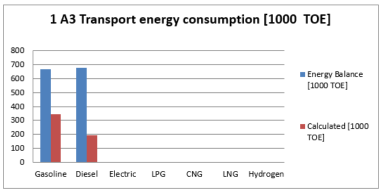
Sheet "2B Top-down-Validation"

- Fuel sales out of the energy balance in thousand TOE (Ton Oil Equivalent) for the base year and for road and rail sectors

Energy Balance[1000 TOE]

Transport (sum of road and rail)

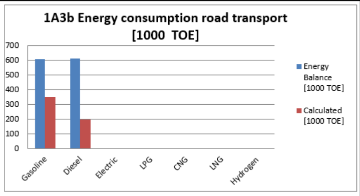
Fuel type	Energy Balance [1000 TOE]	Calculated [1000 TOE]	gap
Gasoline	668	348	-48%
Diesel	681	196	-71%
Electric	-	0	
LPG	-	0	
CNG	-	0	
LNG	-	0	
Hydrogen	-	0	
Total	1.349	543	-60%



excluding international bunkers

Road

Fuel type	Energy Balance [1000 TOE]	Source:	Calculated [1000 TOE]	gap
Gasoline	608	BEN, 2019	348	-43%
Diesel	611	BEN, 2019	196	-68%
Electric			-	
LPG			-	
CNG			-	
LNG			-	
Hydrogen			-	
Total	1.219		543	-55%



Rail

Fuel type	Energy Balance [1000 TOE]	Source:	Calculated [1000 TOE]	gap
Gasoline	60,0		-	-100%
Diesel	70,0		-	-100%
Electric			-	
LPG			-	
CNG			-	
LNG			-	
Hydrogen			-	
Total	130		-	-100%

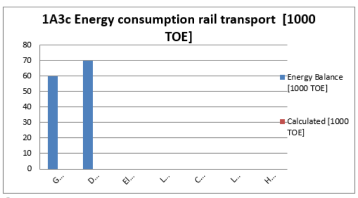


Figure 33. Bottom-up / Top-down validation

Sheet "3A Input Climat Scen. Pass"

Two approaches are possible depending on the format and type of data available concerning transport demand change in the climate scenario.

- Shift Option 1 (for example if results of a transport model are available)
  - New vkt for the climate scenario in Mio km for each vehicle category once all avoid and shift measures are implemented
  - New transport performance in Mio pkm for each vehicle category once all avoid and shift measures are implemented

Category	Vehicle kilometers travelled [Mio. km]				
Subcategory	2020	2025	2030	2040	2050
NMT					
Passenger car					
Individual taxi					
Motorcycle					
Bus					

Category	Transport performance [Mio. pkm]				
Subcategory	2020	2025	2030	2040	2050
NMT					
Passenger car					
Individual taxi					
Motorcycle					
Bus					

Figure 34. With transport planning tool step 2) Shift – overview

- Shift Option 2:
  - Avoided annual vkt in % of BAU values (as result of of the bundle of avoid measures)

Category	Avoided motorised vkt [%]				
Subcategory	2020	2025	2030	2040	2050
NMT					
Passenger car					
Individual taxi					
Motorcycle					
Bus					

Figure 35. Avoided motorized vkt passenger climate scenario

- Shifted vkt:
  - **Additional vehicle vkt in Mio km for the designated years 2020,2025,2030,2040,2050) for public transport modes** (ex: implementation of new bus lines)
  - **New occupancy for designated years 2020,2025,2030,2040,2050 for public transport modes** (ex. decrease of bus ticket price)

Category	Base vkt [Mio. km]				
Subcategory	2020	2025	2030	2040	2050
NMT	0,0	0,0	0,0	0,0	0,0
Bus	352,4	357,8	363,2	374,2	385,6

Category	Additional vkt [Mio. km]				
Goal transport mode	2020	2025	2030	2040	2050
NMT					
Bus					10,0

Figure 36. Without transport planning tool step 2) Shift – overview

- **Share of the new trips attributed to original transport mode** (ex: of new minibus users 80% are previous car drivers and 20% motorcycle drivers

2.3	Subcategory		Origin mode of transportation of new PT passengers [% of the trips]				
	Origin mode of transportation of new PT passengers [% of the trips]	Av. BAU trip length (km)	2020	2025	2030	2040	2050
Goal transport mode	NMT						
	Passenger car	0,0					
	Individual taxi	0,0					
	Motorcycle	0,0					
	Bus	0,0					
	Induced traffic						
Goal transport mode	Bus						100,0%
	NMT	0,0					37,0%
	Passenger car	0,0					10,0%
	Individual taxi	0,0					22,0%
	Motorcycle	0,0					31,0%
	Induced traffic						

Figure 37. Without transport planning tool step 2) Shift – Origin transport mode(s)

- **Share of the climate scenario vkt by fuel type in % for designated years 2020,2025,2030,2040,2050**

Category		Vkt share by fuel for Climate scenario [%]				
Subcategory	**Fuel type**	*2020*	*2025*	*2030*	*2040*	*2050*
Passenger car	**all**					
Passenger car	Gasoline					
Passenger car	Diesel					
Individual taxi	**all**					
Individual taxi	Gasoline					
Individual taxi	Diesel					
Motorcycle	**all**					
Motorcycle	Gasoline					
Bus	**all**					
Bus	Diesel					

Figure 38. Penetration of alternative fuels

- Average fuel consumption by fuel type in Liter, kg or kWh/100 km for designated years 2020,2025,2030,2040,2050

Category			Specific fuel/energy consumption in the climate scenario				
Subcategory	**Fuel type**	**Unit**	*2020*	*2025*	*2030*	*2040*	*2050*
Passenger car	Gasoline	l/100km					
Passenger car	Diesel	l/100km					
Individual taxi	Gasoline	l/100km					
Individual taxi	Diesel	l/100km					
Motorcycle	Gasoline	l/100km					
Bus	Diesel	l/100km					

Figure 39. Adjustment of fuel / energy consumption

Sheet "3B Input Climat Scen. Freight"

- Shift Option 1 (for example if results of a transport model are available)
  - new vkt in the climate scenario in Mio km for each vehicle category once all avoid and shift measures are implemented
  - New transport performance in Mio tkm for each vehicle category once all avoid and shift measures are implemented

Category	Vehicle kilometers travelled [Mio. km]				
Subcategory	*2020*	*2025*	*2030*	*2040*	*2050*
Light commercial vehicle					
Sum	0,0	0,0	0,0	0,0	0,0

Category	Transport performance [Mio. tkm]				
Subcategory	*2020*	*2025*	*2030*	*2040*	*2050*
Light commercial vehicle					
Sum	0,0	0,0	0,0	0,0	0,0

Figure 40. With transport planning tool step 2) Shift – overview freight

- Shift Option 2:
  - Avoided vkt in % of the BAU values (as result of the bundle of avoid measures)

Avoided motorised vkt [%]				
2020	2025	2030	2040	2050

Figure 41. Avoided motorized vkt for freight

- Shifted vkt:
  - Additional vehicle vkt in Mio km for the designated years 2020,2025,2030,2040,2050) for freight transport modes (ex: implementation of new bus lines)

Category	Additional vkt [Mio. km]				
Subcategory	2020	2025	2030	2040	2050
Light commercial vehicle					

Figure 42. Addition vkt in the shift climate scenario

  - New load per vehicle for designated years 2020,2025,2030,2040,2050 for (ex. Increase of articulated truck load factor)

2.2	Category	Load per vehicle [Tons/vehicle]					
	Subcategory	2019	2020	2025	2030	2040	2050
	Light commercial vehicle	1,0	5,0				

Figure 43. Load per vehicle in the climate scenario

- Share of the climate scenario vkt by fuel type in % for designated years 2020,2025,2030,2040,2050

Vkt share by fuel for Climate scenario [%]				
2020	2025	2030	2040	2050

Figure 44. Share of alternative fuels for freight climate scenario

Annex 2: Implementation of default values

Background

The MobiliseYourCity Emissions Calculator supports countries, regions, and cities in developing countries in calculating transport related GHG emission inventories, projecting Business-as-Usual (BAU) scenarios up to 2050, and quantifying potential GHG emission reductions from mitigation measures.

However, obtaining the required input data is often difficult in these contexts, due to limited data availability or lack of access to detailed information such as surveys or vehicle counts. To enable users to calculate results despite the lack of local data, it would be beneficial to implement regional, country, or city-specific default values within the MYC tool. Currently, the tool uses European default values, which are often not representative of developing countries.

This document gives an overview of different approaches as well as initial data sources for the implementation of more appropriate default values into the MYC-tool. Furthermore, the document provides good practice recommendations and suggests possible first steps for an implementation process.

Assessment of important input parameters

The first step is to identify and assess the input parameters required by the MYC-tool focusing on their sensitivity and relevance for inventory and scenario results (see *Table 1*). The assessment shows that most of the transport demand parameters (such as vehicle kilometres travelled, occupancy rates, and population growth) have a high sensitivity. By contrast, some emission parameters (such as fuel-specific GHG emission factors) tend to be less sensitive in terms of their influence on overall results.

One important consideration, when applying input data, is the geographical scope of the investigation To ensure results are meaningful for the specific country or city being assessed, the quality of highly sensitive parameters (such as population growth rate or number of vehicles) must be as accurate and location-specific as possible. Conversely, for less sensitive parameters, such as average energy consumption or fuel-specific GHG emission factors, it may be acceptable to use national or even regional defaults (e.g. for Asia or Africa), especially when local data are not available.

Table 2 shows IFEU's good practice recommendations on the minimum required geographical scope of input parameters, based on their type and their sensitivity. If no data are at the city level—for example, vehicle occupancy rates—users can fall back on national or regional averages. But this may have a quite negative impact on results accuracy. In case reliable data are available at different levels, the user should always select the most specific (local) level available.

Category/Parameter	Data required for	Sensitivity for results	Data collection recommendations for investigations on the national and city level: National level – Scope	National level – Data basis/ Data source	City level – Scope	City level – Data basis/ Data source
Socio-economic data						
1) Population - Number of inhabitants	Inventory	/	National data	National authority, Surveys	City data	City authority, Surveys
1.1) Population growth rate	BAU, Climate scenario	/	National data	National authority, assumptions	City data	City authority, assumptions
2) Gross domestic product (GDP) or Gross market product (GMP) for cities	Inventory	/	National data	National authority	(City data)	City Authority if data available
2.1) GDP growth rate or Gross market product (GMP) for cities	BAU, Climate scenario	/	National data	National authority, assumptions	(City data)	City authority, assumptions if data available
Transport demand						
3a) Vkt approach						
3a.1) Total vehicle kilometers travelled per vehicle category	Inventory	+++	National data	Transport model, surveys	City data	Transport model, surveys
3a.1.1) Vkt growth rate per vehicle category	BAU, Climate scenario	+++	National data	Transport model, assumptions	City data	Transport model, assumptions
3a.2) Vkt share by vehicle size	Inventory	+	National data	Statistics, Surveys, default values	National data	Statistics, Surveys, default values
3a.2.1) Vkt share by vehicle size in future years	BAU, Climate scenario	+	National data	Surveys, default values	National data	Surveys, default values
3a.3) Vkt share by fuel type	Inventory	++	National data	Statistics, Surveys, default values	National data	Statistics, Surveys, default values
3a.3.1) Vkt share by fuel type in future years	BAU, Climate scenario	++	National data	Surveys, default values	National data	Surveys, default values
3b) Fleet approach						
3b.1) Vehicle stock (total number of vehicles) per vehicle category	Inventory	+++	National data	Statistics, Surveys	City data	Statistics, Surveys
3b.1.1) Vehicle stock per vehicle category in future years	BAU, Climate scenario	+++	National data	National authority, assumptions	City data	City authority, assumptions
3b.2) Vehicle stock by vehicle size	Inventory	+	National data	Statistics, Surveys, default values	National data	Statistics, Surveys, default values
3b.2.1) Vehicle stock by vehicle size in future years	BAU, Climate scenario	+	National data	Literature, assumptions	National data	Literature, assumptions
3b.3) Vehicle stock shares by fuel types	Inventory	++	National data	Statistics, Surveys, default values	National data	Statistics, Surveys, default values
3b.3.1) Vehicle stock shares by fuel types in future years	BAU, Climate scenario	++	National data	Literature, assumptions	National data	Literature, assumptions

3b.4) Average annual mileage per vehicle category	Inventory	+++	National data	Statistics, Surveys, default values	City data	Statistics, Surveys, default values
3b.4.1) Average annual mileage per vehicle category in future years	BAU, Climate scenario	+++	National data	Surveys, assumptions	City data	Surveys, assumptions
3b.5) Average annual mileage by vehicle size	Inventory	+	National data	Statistics, Surveys, default values	National data	Statistics, Surveys, default values
3b.5.1) Average annual mileage by vehicle size in future years	BAU, Climate scenario	+	National data	Literature, assumptions	National data	Literature, assumptions
3b.6) Average annual mileage by fuel type	Inventory	++	National data	National authority, surveys, default values	National data	City authority, surveys, default values
3b.6.1) Average annual mileage by fuel type in future years	BAU, Climate scenario	++	National data	Literature, assumptions	National data	Literature, assumptions
4) Average occupancy/load per vehicle category	Inventory, BAU, Climate scenario	++	National (or regional data)	National authority, surveys, default values	National (or regional data)	City authority, surveys, default values
5) Average trip length per vehicle category	Inventory, BAU, Climate scenario	++	National data	National authority, surveys, default values	City data	National authority, surveys, default values
Energy consumption						
6) Average energy consumption per vehicle category and energy type	Inventory	+++	National (or regional data)	National authority, surveys, default values	National (or regional data)	National authority, surveys, default values
6.1) Annual change in average energy consumption in future years	BAU, Climate scenario	+++	National (or regional data)	Literature, assumptions	National (or regional data)	Literature, assumptions
Emissions/Pollutants						
7) Specific emission factor of electricity production	Inventory	++	National data	National authority, Literature, default values	National data	National authority, Literature, default values
7.1) Specific emission factor of electricity production in future years	BAU, Climate scenario	++	National data	National authority, assumptions	National data	National authority, assumptions
8) Share of biofuels (based on the energy content)	Inventory	++	National data	National authority, Literature, default values	National data	National authority, Literature, default values
8.1) Share of biofuels in future years	BAU, Climate scenario	++	National data	National authority, assumptions	National data	National authority, assumptions
9) Fuel specific GHG-emission values	Inventory	+	National (or regional data) or IPCC defaults	National authority, Literature, default values	National (or regional data) or IPCC defaults	National authority, Literature, default values

9.1) Fuel specific GHG-emission values in future years	BAU, Climate scenario	+	National (or regional data) or IPCC defaults	National authority, default values, assumptions	National (or regional data) or IPCC defaults	National authority, default values, assumptions
10) Further pollutants specific emission factors (e.g. NOx, PM)	Inventory	+	National (or regional data) or IPCC defaults	National authority, Literature, default values	National (or regional data) or IPCC defaults	National authority, Literature, default values
10.1) Further pollutants specific emission factors (e.g. NOx, PM) in future years	BAU, Climate scenario	+	National (or regional data) or IPCC defaults	National authority, default values, assumptions	National (or regional data) or IPCC defaults	National authority, default values, assumptions

Table 2. Assessment of scopes for input parameters; Legend: / no data; + low; ++ medium; +++ high

Potential data sources and data availability of default values

To check the availability of default input parameters five international and renowned tools and data banks were used: Curb tool, TEEMP, ForFits, Global Calculator, and Transport Data Bank. Although this list is not exhaustive, it it provides a useful overview of the current global availability of default transport-related data.

Most of the tools assessed were developed by development banks (e.g. CURB-tool developed by The World Bank) or global initiatives (e.g. TEEMP-Tool developed by the Clean Air Asia Initiative). An overview of the findings from this assessment is presented in *Table 3*, which summarizes the geographical scope at which each input parameter is available in these tools. The final column of the table provides a general assessment of data availability across the five sources.

It is important to note that the higher the level of precision required, the more effort will have to be invested in data search i.e. literature, local data bank etc.

	Tool					
Category/Parameter	**CURB**	**TEEMP**	**ForFits**	**Global Calculator**	**Transport Data Bank Model**	**Data availability in the tools**
Population						
Population growth rate				✓	✓	+
Transport demand						
Number of vehicles per category			✓			+
Average Mileage per vehicle category per year		✓ in %		✓ in %	✓	++
Mileage growth rate per vehicle category					✓	+
Occupancy per vehicle category	✓	✓	✓	✓	✓	+++
Capacity per vehicle category						
Mileage share per vehicle category and fuel type	✓			✓		+
Energy consumption						
Average energy consumption per vehicle category and fuel type	✓	✓	✓			++
Efficiency improvement per vehicle category and fuel type				✓		+
Emissions						
Specific emission factor of electricity production		✓		✓		+
Improvement of specific emission factor of electricity production				✓		+
Fuel specific GHG-emission values				✓		+
Improvement of fuel specific GHG-emission values						
Further emission factors						

Table 3. Default data availability of transport tools; Legend: + low; ++ medium; +++ high; - empty: no data available

	Effort for data collection		
Parameter	low	medium	high
Population			
Population growth rate			
Mileage			
Number of vehicles per category			
Average Mileage per vehicle category per year			
Mileage growth rate per vehicle category			
Occupancy per vehicle category			
Capacity per vehicle category			
Mileage share per vehicle category and fuel type			
Energy			
Average energy consumption per vehicle category and fuel type			
Efficiency improvement per vehicle category and fuel type			
Emissions			
Specific emission factor of electricity production			
Improvement of emission factor of electricity production			
Fuel specific GHG-emission values			
Improvement of fuel specific GHG-emission values			
XX-emissions factors			

Table 4. Corresponding effort for data collection

The default values in the analysed tools are available at different geographical scopes (see *Table 5*). CURB provides mostly regional values, while ForFits provides national values and Global calculator city specific values. *Figure 46* shows on a map the geographical scopes at which data are available in developing countries. The geographical scope of default values differs from continent to continent:

- in South America: city level
- in Asia: national level
- in Africa: regional level (South-, Central-, North- and West Africa)

	Tool				
	CURB	**TEEMP**	**ForFits**	**Global Calculator**	**Transport Data Bank Model**
Classification of available default values	mostly regional data	some regional data	national data	city data	national data

Table 5. Default data classification of the analyzed tools

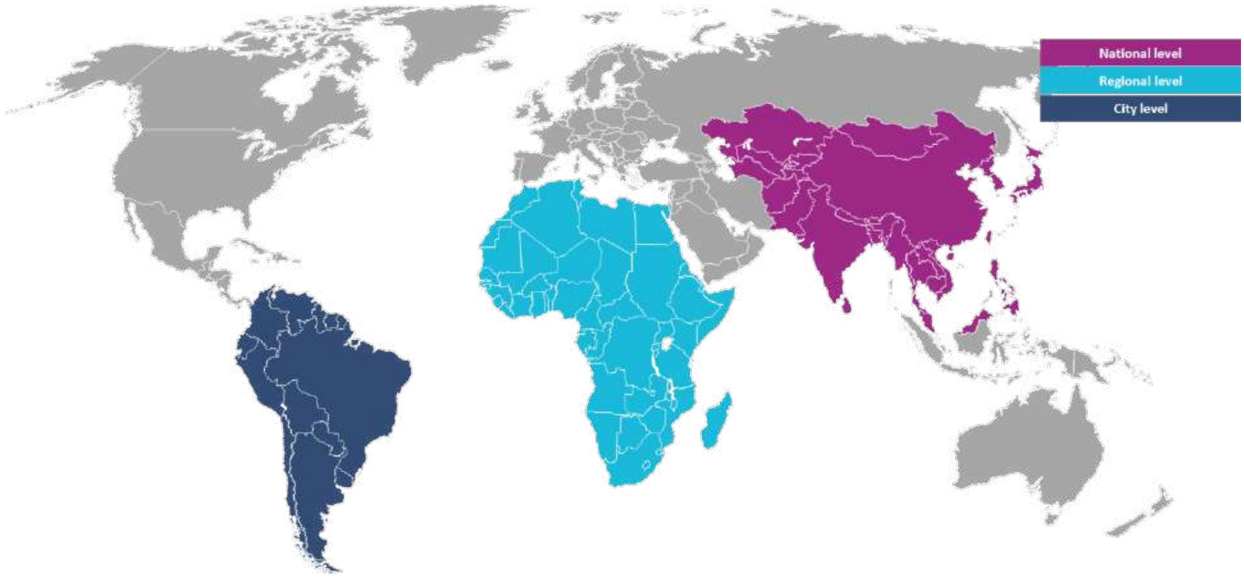


Figure 45. Classification of default values in the investigated tools

In conclusion within the investigated tools there is no standard classification pattern available, which could be applied for the implementation of default values for the MYC-tool.

Ifeu recommendations on default values collection

To minimize effort in the initial phase, ifeu recommends collecting and verifying the robustness of the default parameters that can be found in the sources listed in the previous section. Additional important sources may be suggested by the partners.

Ifeu suggests working first at the regional level i.e. continent wide as a minimum: Asia, Africa, South America (aggregated city data would need to be used as national defaults). A finer scope may be of relevance if data is available and shows important differences e.g. North and South Africa. The exact classification is to be assessed.

In a second and more advanced step, detailed values for sub-regions and for more countries can be searched for. This would require investigating further potential data sources like, for example, open databases (e.g. UITP - Mobility in Cities Database), literature from international projects (e.g. GIZ, AFD, MYC, international consultants) and research institutes (e.g. IGES, ITDP), typical city or county authorities (e.g. vehicle registry, ministry of transport, local transport authority).

It is also important to recognize that input parameters in the transport sector can change significantly over time. Therefore, regular updates of default values, especially for highly sensitive parameters such as those related to transport demand, are strongly recommended. To generate this database, it could be a good opportunity to integrate results of past and future GIZ-, AFD- and MYC-projects into this database, as soon as they are available and verified.

Technical implementation

Table 6 shows three main options available to provide default values to the users of the MobiliseYourCity Emissions Calculator.

- One approach is to implement all default values directly within the MYC-tool in the same way as the CURB tool. However, if there are many data implemented within the tool it may lead to slow operational speed.

- An alternative approach involves storing default values on an external server, where the default values can be stored in a separate databank on the internet, which could automatically be downloaded within the MYC-tool (e.g. via Java-script). This method allows for continuous updates and generally maintains a high operational speed, assuming users have access to a stable internet connection. However, it may be more technically complex and costly, and the data would not be embedded directly into the tool.
- Ifeu recommends a hybrid solution (highlighted in blue in *Table 6*). In this approach, users would download and locally store the most recent data file(s) for each region or country (as well as the latest version of the MYC-tool) in a separate file from an online server (e.g. MYC website). he calculator could then automatically integrate these default values via an Excel macro, similar to the approach used in the COPERT Tool. This solution offers several benefits: it supports faster tool operation by reducing internal memory use, allows for easy updates of the default data files, and does not require continuous internet access after initial download.

Approac h	**Default data integration method**	**Example tools**	**Operational speed**	**Up-to-date data**	**Complexity for user**	**System integration**	**Costs**
Local	Within the MYC-tool	CURB*	+	+	+	+++	+
Local/ Server based	Separately download file(s)	COPERT**	+++	++	++	++	++
Server based	Automatically downloaded from Databank		++	+++	+	+	++

Table 6. Assessment of different implementation approaches; Legend: + low; ++ medium; +++ high

*Available here: https://datacatalog.worldbank.org/search/dataset/0042029; **Available here: https://copert.emisia.com/copert-data/