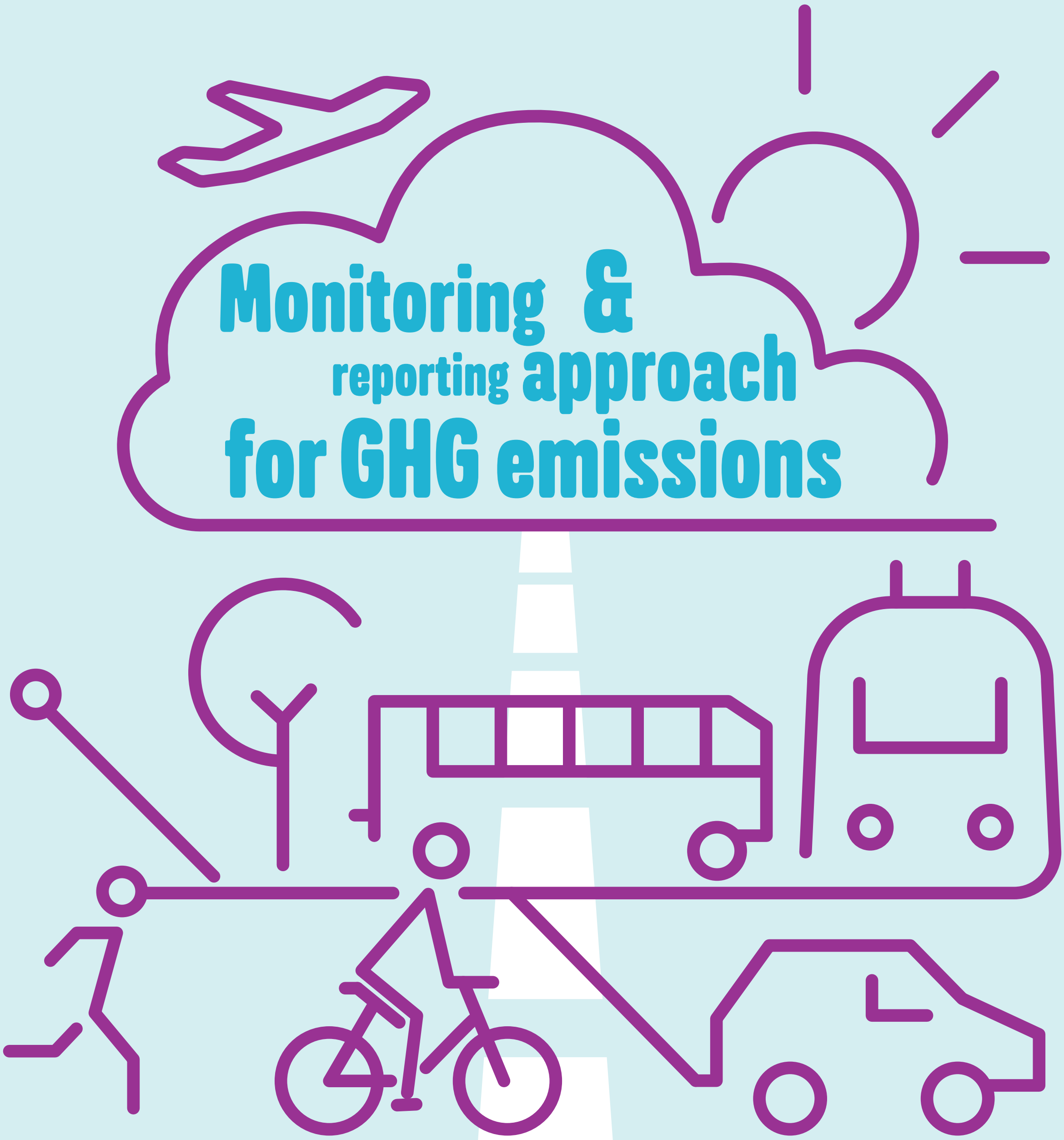
Mobilise Your City

Monitoring & reporting approach for GHG emissions



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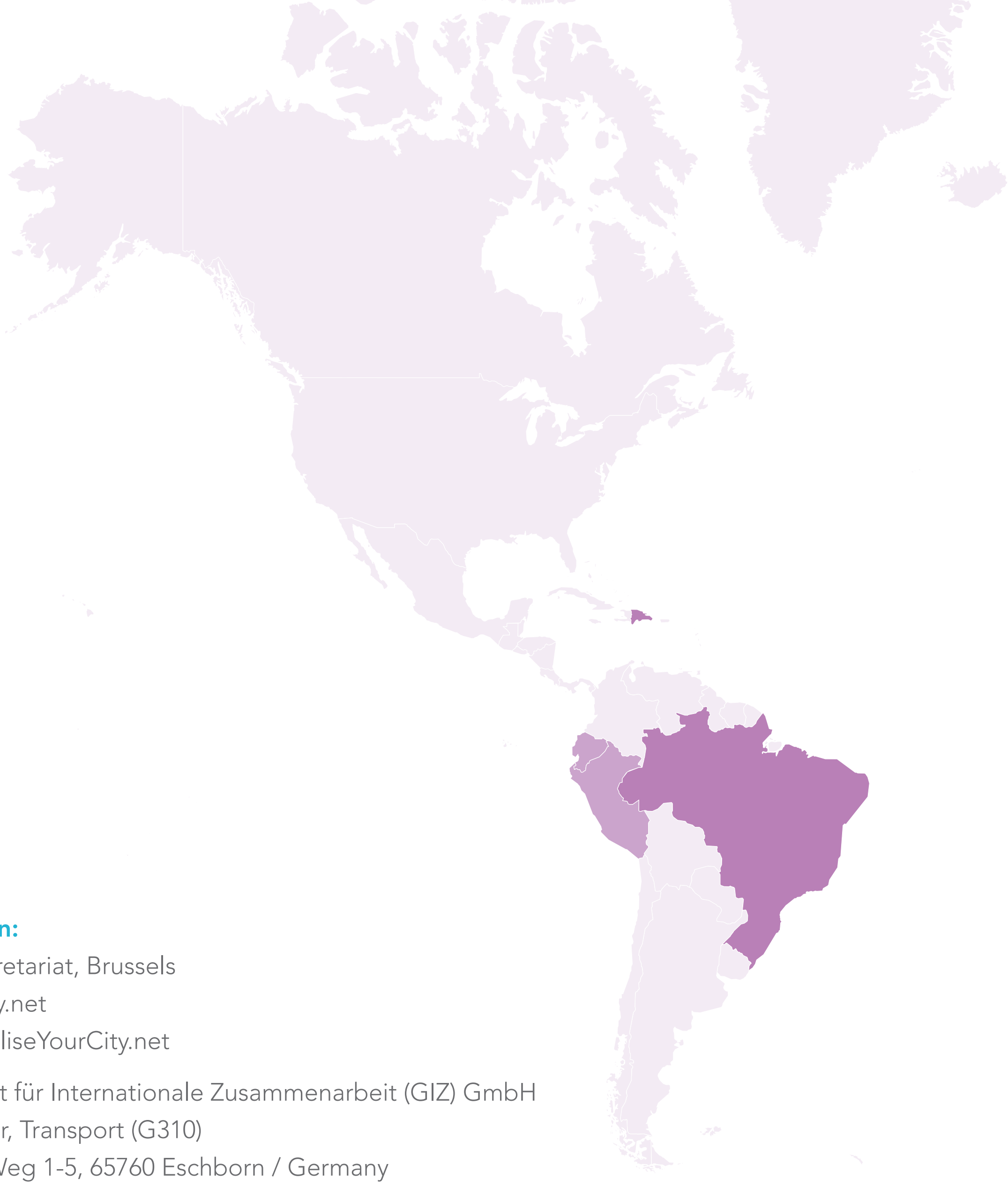

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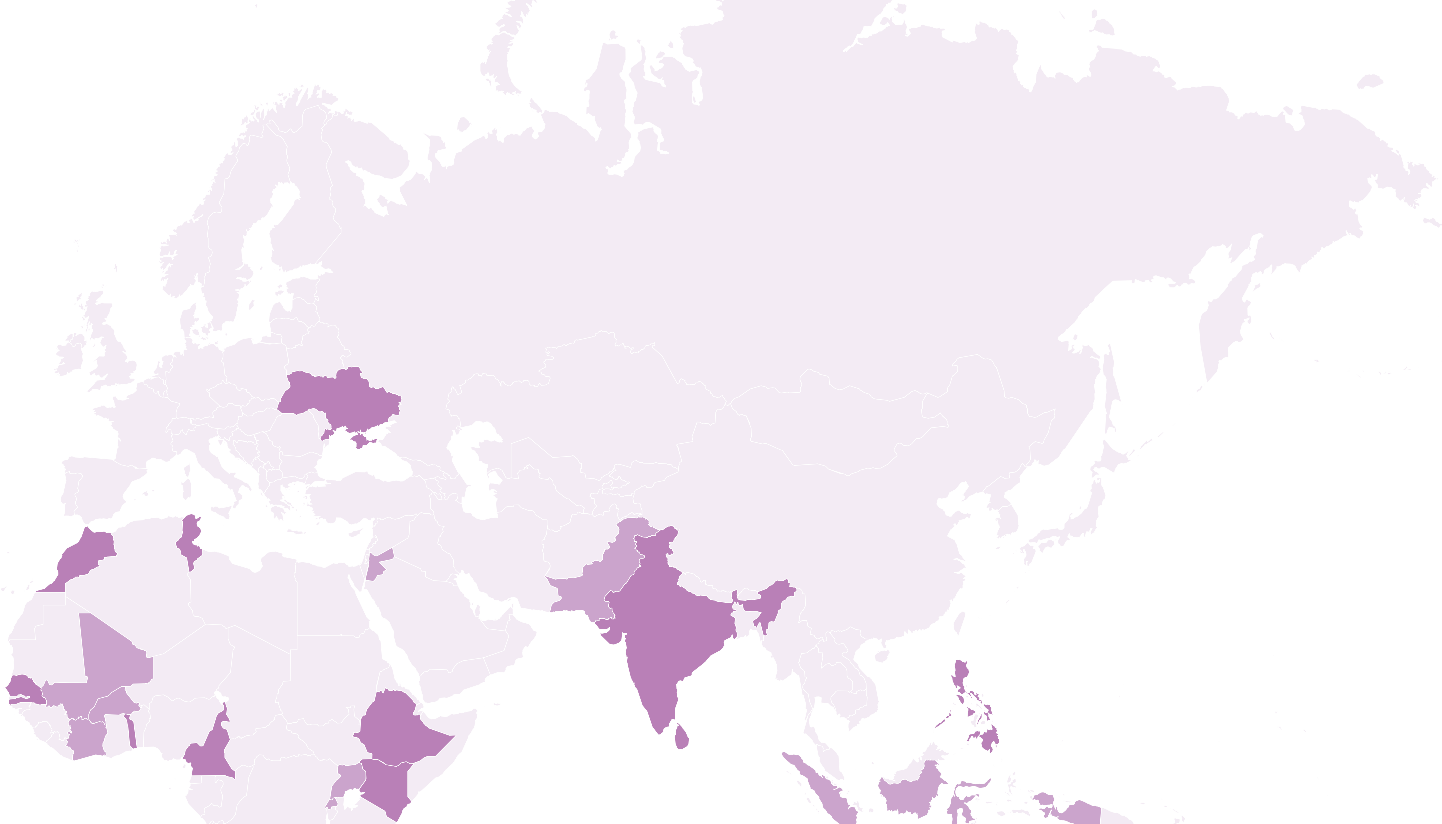


Context of the Publication

This publication has been developed within the MobiliseYourCity Partnership in collaboration with the project "Advancing climate strategies in rapidly motorising countries", funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety.

MobiliseYourCity is a partnership for integrated urban development planning in emerging and developing countries under the UN Marrakesh Partnership for Global Climate Action. MobiliseYourCity supports and engages local and national partner governments in improving urban mobility planning & finance by providing a methodological framework and technical assistance, through capacity building, and by enabling access to funding at both local and national levels. Particular attention has been paid to the methodological and advisory frameworks related to National Urban Mobility Policies and/or Programs (NUMPs) and Sustainable Urban Mobility Plans (SUMPs) that serve as the basis for the promotion of investments and development of attractive mobility services.

MobiliseYourCity is a multi-donor action, jointly co-financed by the European Commission's Directorate-General for International Cooperation and Development (DG DEVCO), the French Ministry of Ecological Transition and Solidarity (MTES), the French Facility for Global Environment (FFEM), and the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). The initiative is implemented by its founding partners ADEME, AFD, CEREMA, CODATU, and GIZ. Besides contribution to the international climate process, MobiliseYourCity contributes to the UN's Agenda 2030, specifically Sustainable Development Goal (SDG) 11: Make cities inclusive, safe, resilient and sustainable.

▶ The objectives:

- Enable transformational changes towards more inclusive, livable, and efficient cities.
- Foster more comprehensive, integrated and participatory urban mobility planning (local & national levels).
- Target reduction of transport-related GHG emissions in participating cities (>50% until 2050).
- Link planning with agreement on investments and optional use of financial assistance.
- Make use of innovative planning techniques and digitalization, and promote state-of-the-art mobility and transport technologies.

glossary

ASIF framework	Activity (trips in km per mode), Structure (model share), Intensity (energy intensity by mode in MJ/km), Fuel (carbon intensity of the fuel in kg CO_2/MJ) are the four different components that determine the transport sector's GHG emissions. The ASIF Framework helps to capture the characteristics of the current transport system. It can be used for emission calculation and measurement.
Baseline emissions	The emissions that would occur without any intervention in a business-as-usual scenario (i.e. case without a potential NAMA). Baseline estimates are needed to determine the effectiveness of emission reduction measures.
BAU scenario/ business-as-usual	Business-as-usual is a phrase that aims to describe what would happen if nothing changed from the current status quo. The intention is to show the difference compared to the situation when a strategy, policy, programme or project were to be introduced. The BAU scenario serves as a reference scenario (baseline emissions), which illustrates the results of current trends often in contrast to alternative scenarios that take into account specific interventions.
GHG	A greenhouse gas is a gas that absorbs infrared radiation (IR) and radiates heat in all directions. Greenhouse gases in the earth's atmosphere absorb IR from the sun and release it. Some of the heat released reaches the earth, along with heat from the sun that has penetrated the atmosphere. Both the solar heat and the radiated heat are absorbed by the earth and released; some is reabsorbed by greenhouse gases to perpetuate the cycle. The more of these gases that exists, the more heat is prevented from escaping into space and, consequently, the more the earth heats. This increase in heat is called the greenhouse effect. Common examples of greenhouse gases, listed in order of abundance, include: water vapour, carbon dioxide, methane, nitrous oxide, ozone, and any fluorocarbons.
HOV lanes	High-occupancy vehicle lanes are restricted traffic lanes often reserved at peak travel times or longer for the exclusive use of vehicles with a driver and one or more passengers, including carpools, vanpools, and transit buses.
I-M	Inspection and maintenance (programs).
IC Cards	A type of smart card - usually prepaid - used for public transport, especially when traveling with different transport companies and different methods of transport.
IPCC	The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for the assessment of climate change. It was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1998 to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and social-economic impacts. In the same year, the UN General Assembly endorsed the action by WMO and UNEP in jointly establishing the IPCC.
MRV	"Measurement", "Reporting" and "Verifying" are important aspects of turning for example a policy, project or programme into NAMA. • Measurement: collect relevant information on progress and impacts • Reporting: present the measured information in a transparent and standardized manner • Verification: assess the completeness, consistency and reliability of the reported information through an independent process.
NAMA	The Parties to the United Nations Framework Convention on Climate Change (UNFCCC) agreed to establish a registry to record Nationally Appropriate Mitigation Actions (NAMAs) and to facilitate matching of capacity-building, technology transfer and financial support for their implementation. Unilateral NAMAs are exclusively domestically financed voluntary mitigation actions as opposed to bilaterally or internationally supported NAMAs which contain both domestic and international financing elements. MRV is at the discretion of the respective countries. In the case of supported NAMAs, MRV is expected to be conducted domestically, but with international oversight and subject to international MRV procedures. International MRV can be mandated by donors/investors. Financial and technical support is expected to be recorded as well.
NUMP	A National Urban Mobility Policy or Programme (NUMP) is a strategic, action-oriented framework for urban mobility, developed by national governments, enacted to enhance the capability of cities to plan, finance and implement projects and measures designed to fulfil the mobility needs of people and businesses in cities and their surroundings in a sustainable manner. It builds on existing policies and regulations and aims at harmonizing relevant laws, norms, sector strategies, investment and support programs towards an integrated approach for the benefits of cities and their inhabitants. It takes due consideration of participation and evaluation principles.
pkm	Passenger kilometre is the unit to measure the distance travelled by a passenger in km (number of passengers multiplied by distance).
SUMP	A Sustainable Urban Mobility Plan (SUMP) is a strategic plan designed to satisfy the mobility needs of people and businesses in cities and their surroundings for a better quality of life. It builds on existing planning practices and takes due consideration of integration, participation, and evaluation principles.
VKT	Vehicle kilometres travelled.

contents

1 INTRODUCTION

This publication sets out the GHG monitoring and reporting principles for the MobiliseYourCity Partnership. A focus is placed on the ex-post monitoring of GHG emission developments in urban transport (Step 5 "implementation, monitoring and evaluation" of the SUMP cycle). That being said, a rough ex-ante estimate of the initiative's potential GHG emission reductions is already required in order to a) inform the prioritisation of measures and b) to make the implementation of SUMP attractive to international climate finance donors. Figure 1 illustrates how the MRV process aligns with the main steps of the SUMP process.

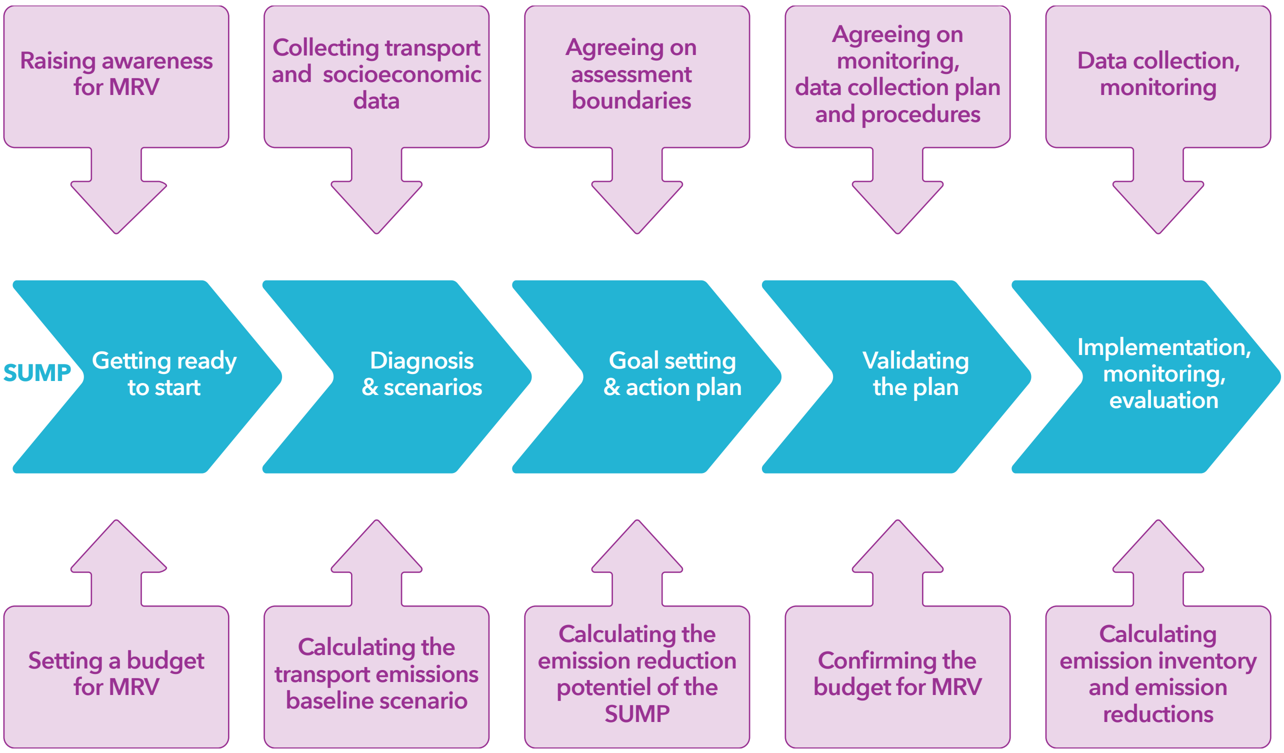


Figure no. 1: Overview of MRV steps in the SUMP process.

In principle, the ex-ante calculations follow the same approach as ex-post, but instead of using real-world (gathered) data assumptions have to be made on the likely future development of certain parameters (see Figure 2). Whenever assumptions are made, it is important to be transparent and state them explicitly in order to understand the results.

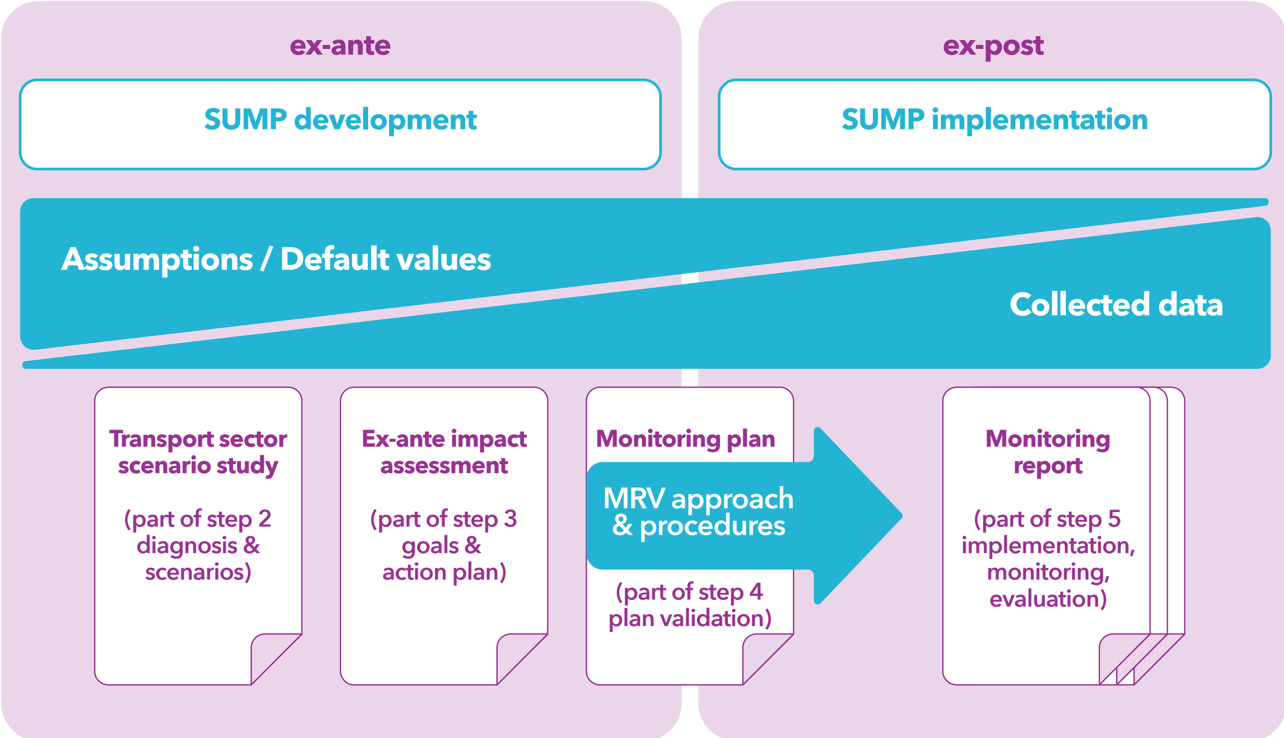


Figure no. 2: Emission quantification during SUMP development and implementation.

2 OVERVIEW OF MobiliseYourCity GHG MONITORING AND REPORTING APPROACH

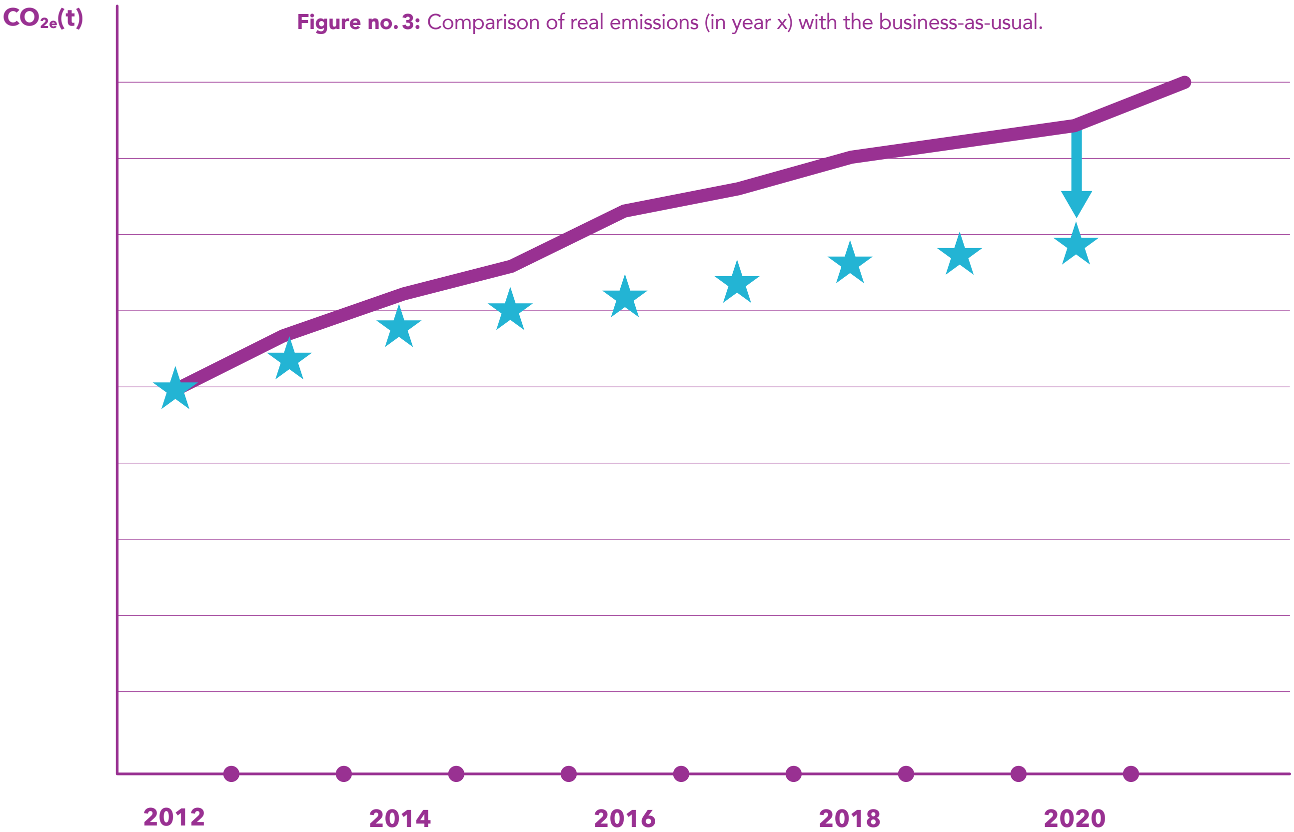
The MobiliseYourCity approach to monitoring and reporting proposes that participating cities track the development of transport related GHG emissions (CO2, CH4 and N2O) at city level rather than per measure. The SUMPs form packages of measures that interact with each other and consequently have a bigger impact on emissions than the sum of single measures. MobiliseYourCity cities are therefore required to develop transport GHG emission inventories for their territory, i.e. direct emissions from mobile sources (tank-to-wheel) – cars, motorbikes, trucks and buses – and indirect emissions from the use of electricity and potentially upstream emissions from fuels (well-to-tank). Accounting for upstream emissions from fuels is particularly relevant wherever measures in the territory affect the type of fuel that is consumed. Once established, the inventories should be updated annually as far as possible.

BOX 1: FOCUS ON GHG EMISSION ACCOUNTING IN MOBILISEYOURCITY

Note: Emission monitoring in MobiliseYourCity focuses on GHG emissions, in particular CO2, CH4 and N2O. Monitoring air pollutant emissions is not mandatory for MobiliseYourCity reporting. Cities that are interested in monitoring transport-related air quality, however, can use the data on transport related GHG emissions as a first step towards calculating local air pollutants. Air pollution assessments essentially follow the same methodology, but require more disaggregated data on vehicle fleets than the bottom-up calculation of GHG emissions (see below).

In order to assess the GHG effect of each SUMP, the overall transport GHG emissions associated with transport in each city territory are compared to a hypothetical business-as-usual scenario, which acts as the baseline (see Figure 3). This scenario describes the transport emissions that would have occurred in the absence of the SUMP based on assumptions on travel demand per mode, vehicle efficiency and fuel-related emissions. In particular, assumptions on travel demand are coupled with assumptions on GDP and population developments. This means the baseline needs to be updated each year of monitoring if the current context diverges from the original assumptions. This way emission inventories at the city level can be used to measure and report on the overall impact of the SUMP's measures rather than assessing individual measures, since the GHG impacts cannot easily be isolated from each other.

Figure no. 3: Comparison of real emissions (in year x) with the business-as-usual.



The citywide GHG emission accounting is one component of a set of sustainable mobility indicators (e.g. mode split, accident rates, etc.) to track progress and the wider sustainability benefits of the SUMP. The following four indicators are mandatory for all MobiliseYourCity cities:

- **1** GHG emission reductions (in tCO2e) against a 'without SUMP scenario' (baseline)[1]
- **2** Modal split (share of public transport and non-motorised modes in pkm – not trips)
- **3** Access (Proportion of the population living within 500 meters or less of a public transport stop with a minimum 20 minutes service at peak hour, or have access to a shared mobility system with comparable service for money)

1 In order to harmonise reporting, estimated emission reductions must be reported in accumulated form for every 10-year period, and as the average annual reduction over a 10-year reporting period. In addition, the expected annual emission reduction in the target years 2030 and 2050 should also be reported

4 Commercial speed (Average speed of a mode of transport between the two terminals, including all operational stops)

In addition, a safety indicator should also be monitored by all cities unless the cost for necessary data collection is prohibitive:

5 Safety (traffic fatalities (road, rail, etc.) in the urban area per 100.000 inhabitants. As defined by the WHO, a death counts as related to a traffic accident if it occurs within 30 days after the accident)

These indicators largely align with the transport related Sustainable Development Goals and indicator categories discussed under the Sustainable Mobility for All (Sum4All) initiative of the World Bank.

Additional sustainable mobility indicators are decided based on the specific objectives and measures set out in the city-specific SUMP. These indicators can build upon experiences and tools developed by the EU to assess SUMPs in Europe and in developing countries. Annex 1 provides an overview of existing indicator sets and can be used as orientation for city-specific indicators in participating cities.

Beyond tracking GHG emissions and progress towards sustainable mobility goals at city level, cities will also have to define implementation indicators that ensure the individual measures are on track. They can be monitored and reported on annually. Examples include total kilometres of bike lanes built, the number of low-carbon buses purchased, or the number of bus kilometres offered, as well as indicators that refer to the quality of implementation and use of service, such as parking space or bicycle flows on new routes (see Annex 2 for examples of implementation and sustainable mobility indicators). This should provide an evidence base of city level transport GHG emission developments, i.e. emission reductions compared to the BAU scenario, being directly related to the implemented measures. These indicators again depend on the measures set out in the SUMP.

At last, cities participating in MobiliseYourCity are required to monitor the amount of mobilised public and private funding for the implementation of the SUMP.

In summary, four types of indicators are monitored:

1 Mandatory sustainable mobility indicators ;

2 Additional sustainable mobility indicators according to the scope and objective of individual SUMPs;

3 Implementation indicators according to the scope of individual SUMPs;

4 Mobilised public or private funding.

At the national level – in case a national urban mobility policy or programme (NUMP) incentivises SUMP development or implementation – the total GHG emission reductions (compared to the baseline) in all participating cities can be aggregated into the impact of the national policy or programme. In addition, countries interested in developing NUMPs may want to provide national average emission factors, average fleet composition or average annual mileages as default values for cities. This helps cities develop their own inventories and track emission reductions, and also ensures comparability across cities.

The overall approach to MRV in MobiliseYourCity is summarised in the figure below.

This document focuses on monitoring and reporting on the impact of GHG emissions, which is highlighted by the red box.

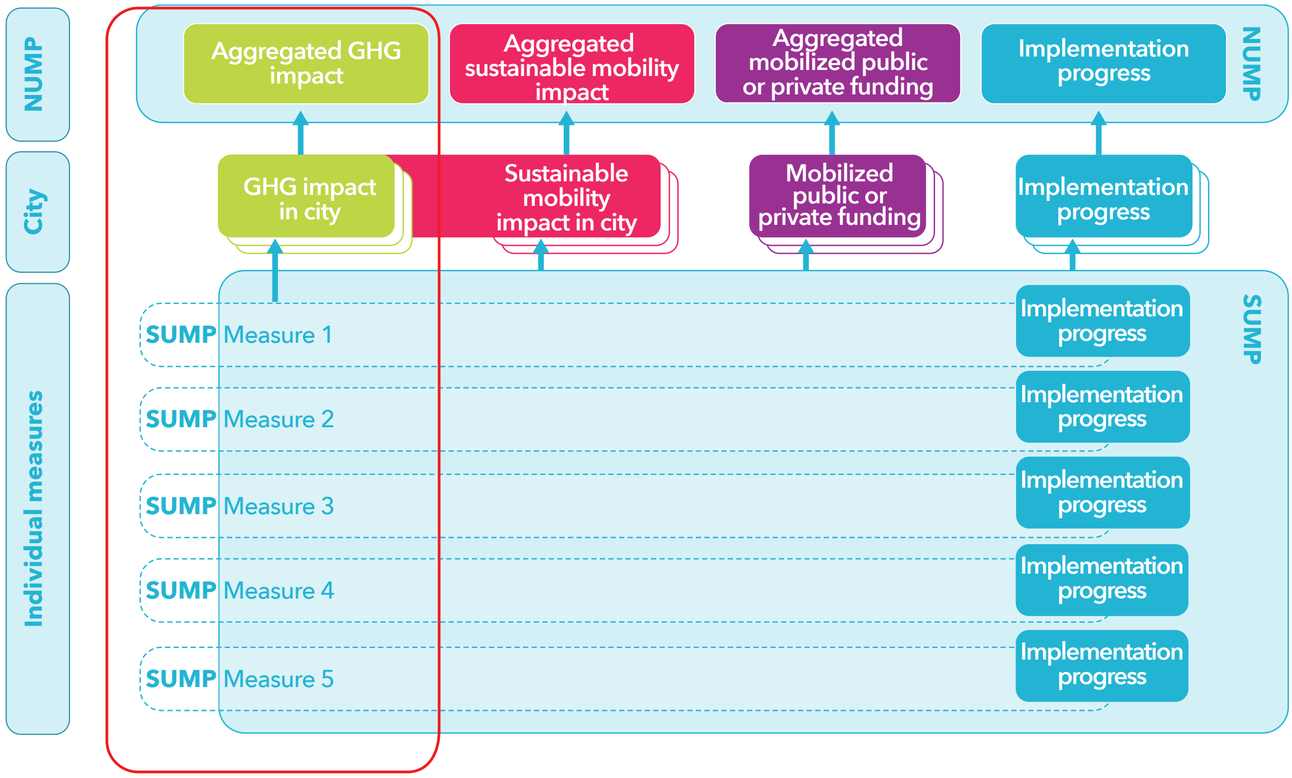


Figure no. 4: Overall logic of the monitoring and reporting approach in MobiliseYourCity.

3 Calculating transport related GHG emissions

The total transport related GHG emissions depend upon several parameters: Transport demand (travel activity by mode), respective specific energy consumption per mode per travel activity, and specific GHG conversion factor per energy carrier per mode. The emission inventory for the transport sector is calculated using a bottom-up approach that is based on the ASIF framework as described in Figure 5.

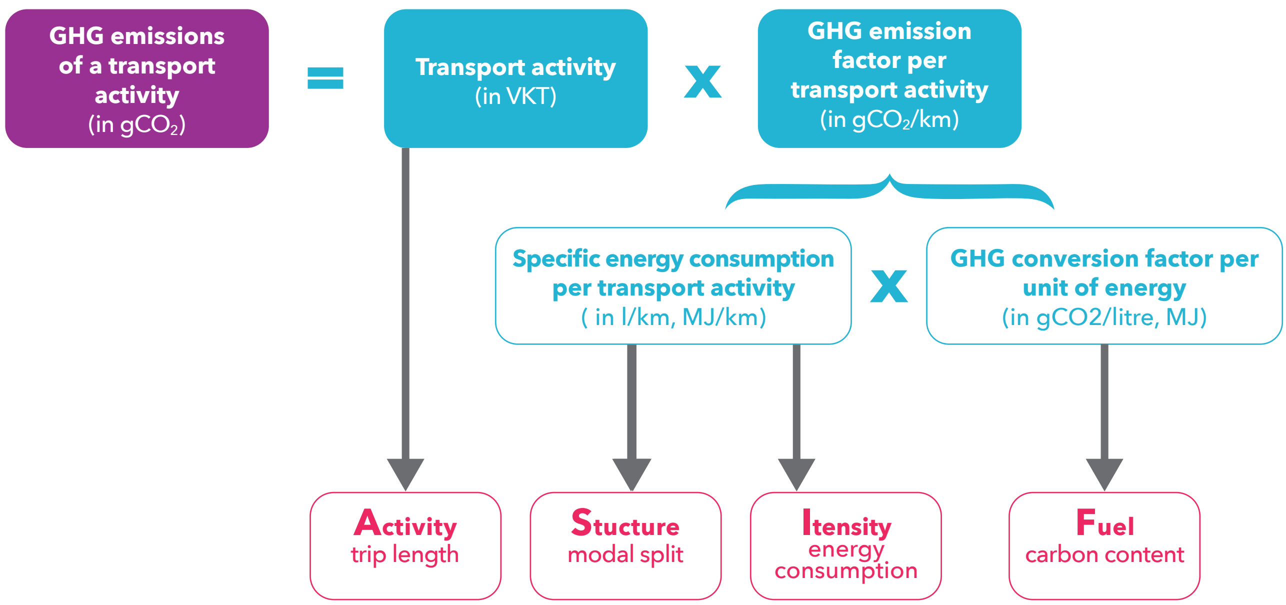


Figure no. 5: ASIF Framework for the calculation of transport emissions.

Ideally, the values for the parameters should be adapted to city-specific circumstances to calculate local transport GHG emission inventories. However, the availability of data and resources for data collection usually does not permit such a level of detail/local adaptation. At the same time, not all parameters are equally dependent on local contexts. For instance, travel activity and modal split usually vary greatly from city to city, depending on their size and level of urbanisation, as well as geographic, economic and demographic aspects. In contrast, the carbon content of fuels lies outside of the influence of cities, which means that national default factors or even IPCC default values can be used (IFEU, 2014).

The calculation approach must also account for local capacities. Depending on local data availability and resources, inventories can be based on simple calculations and more aggregated data, or on more advanced modelling approaches that allow for emissions from different sources to be monitored in great detail.

In principle, the inventory approach presented here also facilitates the calculation of local air pollutant emissions. However, this requires more information on vehicle characteristics than the calculation of GHG emissions. It is, therefore, more relevant in cities with good data availability.

4 System boundary for GHG emission accounting

The GHG emission inventory for urban transport is the sum of all transport-related activities that can be attributed to the city. This attribution can follow different rationales (see Dünnebeil et al., 2012:23f and Box 1). The MobiliseYourCity Partnership follows a territorial approach since the city's territory reflects the political and administrative sphere of influence and facilitates the assessment of each city's SUMP. It includes emissions from inhabitants and visitors alike, and addresses all the local stakeholders that influence transport within the city's territory (inhabitants, employers, public services, industry, trade etc.) (IFEU, 2014).

The territorial approach is also recommended by other international guidelines, such as the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (WRI, 2014) or the Covenant of Mayors[2], and is therefore in line with state-of-the-art international best practice.

BOX 2: SYSTEM BOUNDARIES FOR EMISSION ACCOUNTING IN URBAN TRANSPORT AND REASONS FOR A TERRITORIAL APPROACH

Transport activities can be attributed to a monitoring area using different approaches. This has consequences for the informative value and the further use of the monitoring results. The most common system boundaries for monitoring urban transport emissions are:

- **1 Territorial:** All transport activities of a means of transportation within the territory are covered. The territory can be defined in different ways, e.g. as the whole functional area of a city or city-governed districts only. With this approach, all transport activities within the political sphere of influence of municipal Government are covered. However, further differentiations (e.g. internal vs. origin/destination vs. transit traffic) can help understand the drivers of traffic flows and volumes, and identify fields of action. >>>

2 The Covenant of Mayors for Climate & Energy Initiative was launched in 2009. It brings together thousands of local and regional authorities who have voluntarily committed to implementing EU climate and energy objectives within their territory. http://www.covenantofmayors.eu/index_en.html

2 Inhabitants: All traffic related to city inhabitants is included, independent of the place where traffic occurs (e.g. including trips outside of the city or air travel). Contributions to traffic in the city from non-inhabitants (e.g. commuters, tourists, incoming freight transport) are not covered in this approach. Consequently, possible GHG emission reductions in commuter traffic or any other incoming transport are not covered in this monitoring system. At the same time, the inhabitants approach includes travel activities that cannot directly be influenced by municipal Government, such as long-distance travel.

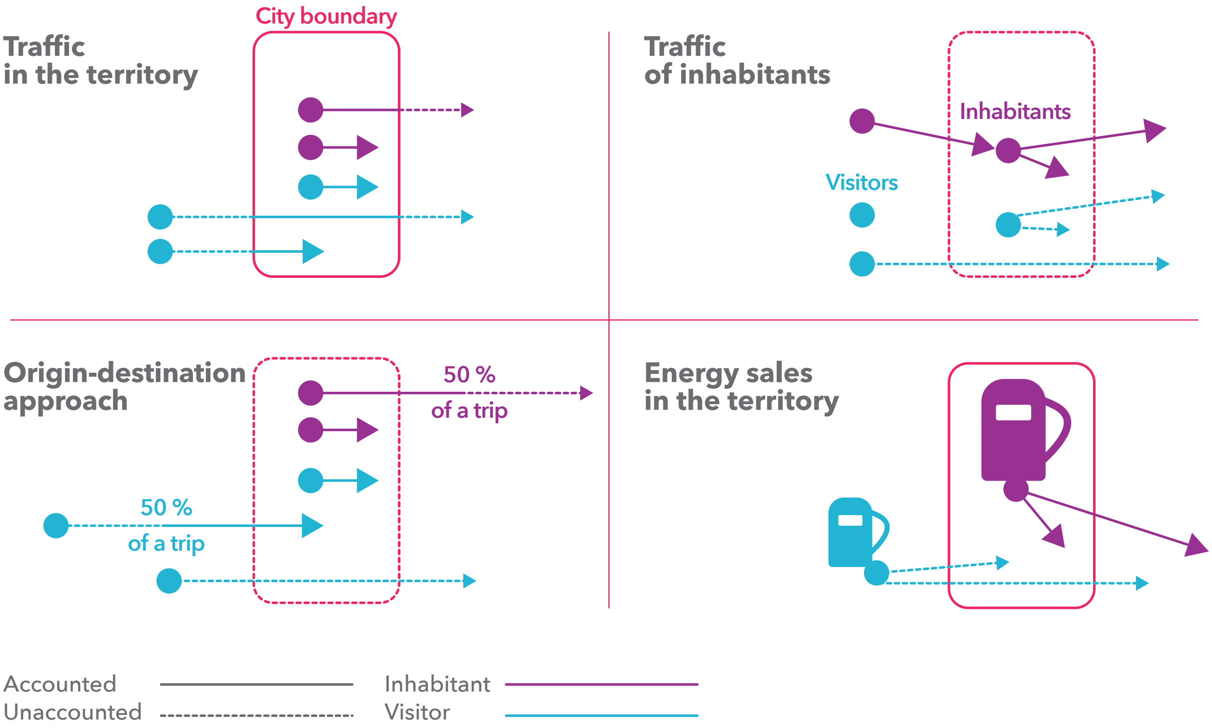


Figure no. 6: Different system boundaries for urban transport emission accounting / Figure source: IFEU Heidelberg, 2012.

3 Origin-destination (OD) approach: All traffic with an origin and/or destination within the city's territory is covered (boundary-crossing traffic: 50% of long-distance trips is counted). This approach reflects urban transport activities very well, but it requires high levels of data availability that only a few cities are able to meet. Furthermore, it still includes 50% of long-distance trips, which city policies has no influence on. Transit traffic is not covered.

4 Energy sales: Emissions are calculated using a top-down approach based on statistics on fuel sales in the city. This approach only allows for a rough estimation since a purely sales-based approach does not provide any information on how much of the purchased fuel is actually used within the city. It also does not provide data on the actual transport activities that are related to the city, or their causes – information which is necessary for transport planning. Using energy sales data alone does not adequately monitor the effects of SUMPs, but it can be used to cross-check bottom-up calculations.

Source: Dünnebeil et al., 2012

In addition to the general approach to system boundary, several other parameters have to be decided on in order to fine-tune the accounting process, namely:

- Which transport modes are covered?
- Which emissions/gases are accounted for?
- What is the timeframe and monitoring interval?

TRANSPORT MODES

Ideally, all motorised modes (passenger and freight transport) are included in the emissions inventory. This helps paint a complete picture of the transport sector's emission profile in each territory. In reality, however, data may not be readily available for all modes. A pragmatic option is to begin with those modes that are relevant to the scope of the individual SUMP, i.e. those modes directly affected by the measures included in the SUMP. In most cases, this means disregarding aviation emissions (territorial boundary emissions only include take-offs and landings) and emissions of inland shipping if they are not affected by the SUMP and only make up a small share of transport and emissions. This of course depends on each city's specific context. If a city has an airport or a port within the city territory, these emissions could account for a significant portion of transport related emissions and a deliberate decision has to be taken whether or not to include them.

In addition, it is recommended to differentiate the emission profile for transport modes that are under the influence of local administrations (transport within the city boundary or with an origin/destination within the territory, including passenger and freight transport) and those that are hardly affected by local measures (transit traffic, public long-distance transport, such as bus, rail and aviation, as well as rail-bound and inland freight transport) (IFEU, 2014). Such a differentiation enables accounting all emissions in each territory, while highlighting those that are influenced by the SUMP and analysing their emission development separately. In this way, the complete emission profile can be reported and the SUMP's achievements can be tracked.

EMISSIONS

The MobiliseYourCity approach aims to account for CO2, CH4 and N2O in CO2-equivalents (see Box 2), including direct tailpipe emissions and upstream emissions that result from the production and transportation of fuels. Accounting for upstream emissions ensures the comparability of conventional propulsion systems and electric vehicles (for which emissions only occur upstream), as well as other fuel switch options.

In addition to GHG emissions, black carbon emissions, a component of soot, which is released during diesel fuel combustion, may be monitored. Black carbon has a strong warming effect as well as disastrous impacts on local air quality and public health (see Box 3). Monitoring black carbon emissions can therefore be extremely useful for cities. Unfortunately, due to the complex interactions of black carbon in the atmosphere, its exact global warming potential is still subject to scientific uncertainties. Nonetheless, monitoring black carbon emission developments can help keep track of the order of magnitude and local air quality effects.

BOX 3: TRANSPORT RELATED EMISSIONS AND THEIR WARMING EFFECT

GHG emissions and their global warming potential

GHGs emitted by transport mainly consist of carbon dioxide (CO2), in addition to small amounts of methane (CH4) and nitrous oxide (N2O). In order to compare the warming effects of different GHGs, the global warming potential (GWP) is used. The GWP relates the amount of heat trapped in the atmosphere by a particular GHG to the amount of heat trapped by a similar mass of CO2. In this way, the sum of all GHG emissions can then be indicated as CO2 equivalents.

The global warming potentials (for a time horizon of 100 years) of carbon dioxide, methane and nitrous oxide are as follows (IPCC, 2007):

$CO_{2:}$ 1 $CH_{4:}$ 25 N_2O: 298

Black carbon (not calculated in MobiliseYourCity)

Black carbon – a component of soot – is released by burning biomass (wood stoves and biomass burning, as well as natural wild fires), coal and diesel fuels. It is an important component of particulate matter, contributing to air pollution and leading to respiratory diseases like asthma and lung cancer. The World Health Organisation estimates that outdoor air pollution led to 3.7 million premature deaths in the year 2012 alone, of which almost 90% occurred in low- and middle-income countries (WHO, 2014). A lesser known fact is that soot also has a strong warming effect on the climate. In fact, it is the second largest man-made contributor to climate change (Bond et al., 2013). Soot warms in two ways:

1. Particles in the air absorb sunlight, generating heat in the atmosphere.

2. Winds transport soot particles to the Arctic and the Himalayas, where they settle on ice and snow like a black blanket, stopping the reflection of sunlight. Instead, radiation is absorbed, accelerates the melting of the arctic ice sheet and the Himalayan glaciers, and further intensifies global warming.

In contrast to CO2, which stays in the atmosphere for centuries, black carbon only remains for several weeks. Abating black carbon therefore has a short- term effect on climate change and an immediate effect on local air quality. The main contributors to black carbon from the transport sector are diesel vehicles without particulate filters. This includes trucks, ships, rail, utility vehicles and construction machinery (Eckermann et al., 2015).

Calculating the exact effect of black carbon is a complex and scientifically contested issue. MobiliseYourCity does not require an assessment of black carbon warming effects. It may however be of interest to cities that wish to account for particulate matter out of air quality considerations. In this case, the number of PM can also give an order of magnitude indication to the development of black carbon emissions.

Upstream and downstream emissions from vehicle production are not accounted for since they are small compared to transport related emissions.

The inventory also does not account for construction emissions from major infrastructure projects, such as metros or highways. Metro construction emissions are, however, significant and should be considered in the emission reduction calculations. This is usually done in the form of an ex-ante estimation to get an idea of the total emissions, but it is not monitored during construction in an attempt to keep the data requirements low. Whether or not include construction emissions are included in emission reporting is decided on a case-by-case basis. If construction is considered in the accounting system then it also has to be included in the baseline emission calculations.

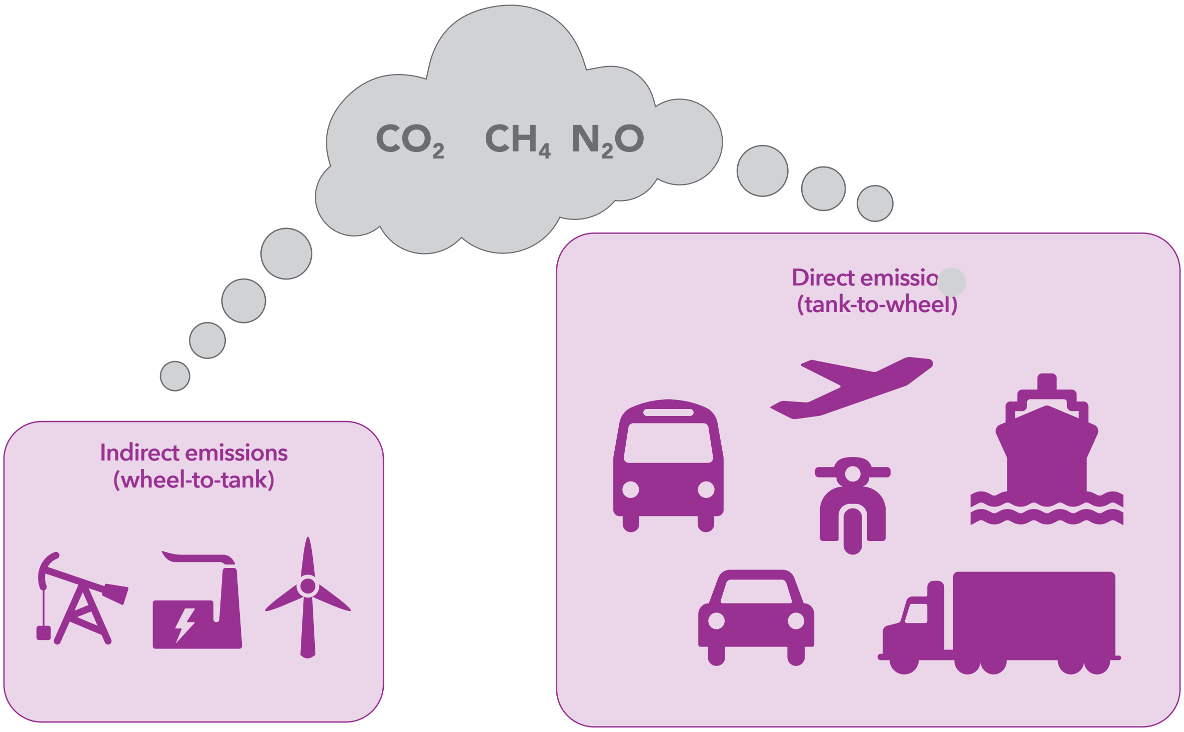


Figure no. 7: Transport modes and emissions included in the GHG monitoring (ideal case) / Source: adapted from IFEU, 2013 [3]

TIMEFRAME

MobiliseYourCity suggests a GHG monitoring interval of 1-3 years. For ex-ante emission reduction scenarios the timeframe has to be adopted to fit into the SUMP's planning cycle. Assuming that the implementation of a SUMP will take approximately 10 years, the minimum time span for the MRV system should also be ten years. In order to harmonise reporting, estimated emission reductions should therefore be reported in accumulated form for every 10-year period, and as the average annual reduction over a 10-year reporting period. However, since the full benefits will not be apparent until the SUMP measures have been implemented, annual emission reduction benefits will increase over time. This means that a longer assessment period, e.g. 20 years, will show larger effects.

Once all of the above parameters have been decided upon, the system boundary for monitoring is set. The boundary will always be a compromise between as close a representation of the territorial emission profile as possible and the extent of locally available data and resources. Finding this compromise is a key challenge for good inventories. Often, data needs to be combined from various data sources and data needs to be analysed and processed to meet the defined boundaries.

As shown above (Figure 5), the calculation of transport related emissions requires information on each transport mode included in the monitoring boundary and specific GHG emission factors (in gCO2e per km), which depend on the type of vehicle, as well as fuel consumption and fuel type, i.e. fleet composition. The data collection process for these parameters is explained in the following chapters.

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3 Icons created by Viktor Vorobyev, Matthew Hall, Ricardo Ruíz, Edward Boatman, Creative Stall, lastspark from Noun Project https://thenounproject.com/

5 Monitoring transport by mode

Transport data has to be collected and determined at city level. National averages do not enable an evaluation of SUMP progress. Typical sources of transport data are summarised in Table 2. If transport data is not yet routinely collected and available from official statistics, a number of options for low-effort data collection exist (cf. Table 2). One of the most common approaches to data collection for private road transport is traffic counts, which should be differentiated according to road type (inner-city road, urban roads and highways) (see Monitoring Greenhouse Gas Emissions of Transport Activities in Chinese Cities – A Step-by-Step Guide to Data Collection, Section 2.1.2).

In addition to assessing transport in general in each territory, transit traffic has to be estimated separately. This is important to distinguish from other types of transport since urban transport policy has – in most cases – little influence over transit traffic.

Cities with travel demand models that are frequently updated can extract transport data from the model by multiplying traffic flow data with the length of the road network. In this case, it is important to compare the geographic boundary of the travel demand model to the assessment territory since some models only cover city centres.

Once transport by mode is known, this needs to be multiplied with the correct emission factors to calculate the urban transport emission inventory. In order to choose the right emission factors, information on the composition of the vehicle fleet is required.

6 Monitoring fleet composition

The composition of a city-specific vehicle fleet strongly influences local transport emissions. The more private cars are on the road and the larger or older the vehicles are, the higher their fuel consumption is and the higher the related GHG emissions are. In other words, GHG emissions depend on the vehicle fleet and on the distribution of VKT across the fleet's vehicle mix.

Data on the vehicle fleet is usually available from vehicle registration statistics for passenger cars, taxis, trucks and motorcycles (e-bikes are mostly excluded), which includes technical specifications for the different vehicle types. Once the registered fleet is documented for the base year, e.g. 2015, only newly registered (and deregistered) vehicles have to be monitored each year.

If there are no big differences in the fleet compositions across different cities in a country, using national averages for urban fleet composition may be considered. Where the fleet is known to be quite specific, however, these local characteristics should be accounted for; e.g. prosperous metropolitan areas may have a larger number of new and larger cars than less prosperous mid-sized cities with a smaller but older fleet.

Table 1: Data sources for vehicle fleet composition in cities

Data source	Means of transportation	Type of data	System boundaries	Fleet composition	Traffic situation
Vehicle registration statistics	- Passenger cars - Taxis - Trucks - Motorcycles (usually no e-bikes)	Vehicle stock by technical characteristics	Inhabitants (= owners of registered vehicles)	Yes, but only for stock, not for VKT	No
Trip survey (households or companies)	- Passenger cars - Motorcycles - Taxi - Buses - Subway - Regional train	Per person: - Pkm* * For cars differentiated into driver, co-driver, with chauffeur	Inhabitants	Optional (depending on configuration of the survey)	No
Vehicle activity survey	- Passenger cars - Taxis - Motorcycles - Trucks	Per vehicle: - VKT or - number of trips and distances	Inhabitants (= owners of the vehicles)	Optional: Depending on configuration of the survey	No (only if survey includes floating car data)
Main inspection data	- Passenger cars - Taxis - Trucks	Per car: - VKT from odometer	Inhabitants (= owners of the vehicles)	Yes	No
Taxometer information	- Taxis	Per taxi: - VKT or - number of trips & trip distances	Territorial: cruising radius of local taxi fleet (territory might differ to geographical boundaries of the city	Optional: only if analysed taxis are representative of entire taxi fleet	No
Floating car data (GPS)	- Passenger cars - Taxis - Buses - (Trucks)	Per vehicle: - VKT for single vehicle in analysed time period Extrapolation to total VKT only if analysed vehicles and time period are representative of fleet	Inhabitants (= owners of the vehicles)	Optional: only if analysed vehicles are representative of entire fleet	Yes: Conversion to HBEFA traffic situations is only possible with linkage to GIS data on the road network
sensors	- Passenger cars - Taxis - Buses - Motorcycles - Trucks	Traffic volumes for analysed road section	Territorial: can be used as basis for calculating travel activity based on street lengths and for calibrating traffic model and estimating VKT development	No	Optional: Some road sensors provide information on vehicle speed

Table 1: Data sources for vehicle fleet composition in cities (continuation)

Data source	Means of transportation	Type of data	System boundaries	Fleet composition	Traffic situation
Video monitoring on selected road sections	- Passenger cars - Taxis - Buses - Motorcycles - Trucks	Traffic volume for analysed road section	Territorial: can be used as basis for calculating travel activity based on street lengths for territorial VKT of a city and for calibrating traffic model and updating VKT data	Optional: Licence plate survey and matching with vehicle registration statistics	No
Public transport companies	- Bus - Subway - Regional train	For the entire public transport network or for different routes: - Final energy consumption - VKT - Pkm - Transport capacity - Load factors	Territorial: public transport network might differ to geographical boundaries of the city	Optional: - Bus per engine type (and size) - Train per traction	No
Public transport network plans	- Bus - Subway - Regional train	Length of each public transport route	Territorial: public transport network might differ to geographical boundaries of the city	No	No
Public transport timetables	- Bus - Subway - Regional train	Service frequency of each public transport route (e.g. number of buses per day)	Territorial: public transport network might differ to geographical boundaries of the city	No	No
IC cards	- Bus - Subway	- Number of passenger trips - Pkm (only subway)	Territorial: public transport network might differ to geographical boundaries of the city	No	No
Car hailing apps	- Taxi	- Number of passenger trips - Pkm	Territorial: public transport network might differ to geographical boundaries of the city	No	No

7 Selection of emission factors

Specific GHG emission factors (CO_2, CH_4, N_2O in gCO_2e/km) apply according to the different transport characteristics. The accuracy of emission factors greatly affects the overall emission calculations.

At vehicle level, the specific energy consumption per kilometre travelled depends on technical parameters and operating conditions. In road transport, considerable differences in energy consumption and related GHG emission factors per kilometre are caused by:

- Different vehicle characteristics, such as engine type, engine capacity, vehicle age and, to a lesser extent, the emission concept (such as Euro 1-6). As emission standards are phased in over time, data on emission concepts can be used as a proxy indicator for vehicle age (based on fleet composition).
- Different traffic characteristics, especially speed, traffic quality and road gradients. These depend primarily on transport infrastructure and traffic volumes, but also on other conditions, such as traffic lights or weather conditions.

Emission factors range from highly disaggregated factors, e.g. specific emission factors for each passenger car differentiated by vehicle size, age and emission class (e.g. EUR 4), to averaged emission factors, e.g. only one average emission factor for all buses. If average emission factors are used, these should ideally be derived from detailed factors that are aggregated based on average fleet compositions and average driving situations.

Since the many factors that influence fuel consumption vary significantly from country to country, country-specific emission factors are required. Using international default values introduces high uncertainties into emissions calculations, which is not recommended since it does not reflect country-specific circumstances. In addition, improvements that affect emission factors, such as changes in vehicle fleets or improvements in driving conditions, cannot be reflected in emissions calculations if international defaults are used.

Several countries already have national average emission factors based on average national fleet compositions (how many vehicles of a certain size (engine capacity), age and fuel type per vehicle category), average driving conditions on different road types, and ideally also upstream emissions of fuels. If emission factors are only available for tank-to-wheel emissions, a correction factor for upstream emissions can be applied.

If official national emission factors exist, cities must decide whether it is appropriate and sufficient to work with national defaults or whether city-specific adaptations to emission factors are required. This can depend on several factors:

1. Which measures are covered by the SUMP? Can their effects be reflected in national average values or not?
2. Does the local context vary significantly to the national average, e.g. due to a wealthier population in the capital, which affects the fleet composition (e.g. higher number of larger cars)?

For instance, if the national average emission factors are based on an average fleet composition, efficiency improvements in the local municipal fleet will not show up in the city-specific emission calculations. This can also affect public transport fleets. Similarly, if larger cities are interested in traffic flow measures and their effects, local data on driving conditions, such as congestion reduction measures, will need to be collected. This is possible in cities where travel demand models and differentiated emission factors exist, e.g. the Chinese city of Shenzhen.

If no country-specific emission factors exist, international (or possibly regional) default values can be used as a fall-back option, especially for ex-ante calculations. However, MobiliseYourCity recommends striving towards the adaptation of emission factors that are country-specific in order to ensure accurate monitoring. MobiliseYourCity can provide support for this process to participating cities.

Furthermore, it is suggested that emission factors should be differentiated by fuel type within each vehicle category.

8 Step-by-step approach to GHG monitoring and reporting

The previous sections set out the MobiliseYourCity's approach to GHG monitoring and reporting. They also highlighted how these principles fit into the broader monitoring framework, including sustainable mobility and implementation indicators. A rough impact assessment should already be conducted initially to identify each SUMP's emission reduction potential. The following checklist sums up the key elements of a successful

CHECKLIST MONITORING AND REPORTING	✔
SUMP Step 1: Getting ready to start	
The needs for external support on MRV are assessed	
A budget for MRV is set	
SUMP Step 2: Diagnosis & scenarios	
Transport data availability is checked and available data collected	
Baseline scenario for transport emission development is calculated and assumptions are agreed upon among relevant stakeholders	
SUMP Step 3: Goal setting and action plan development	
Expected effects of the planned SUMP and actions are described (cause-effect relation/logical framework)	
Scope of the monitoring approach is set (assessment boundaries)	
GHG impact of the SUMP has been calculated ex-ante	
Limitations of the GHG emission quantification are described (uncertainties)	
Sustainable mobility benefits have been assessed ex-ante	

CHECKLIST MONITORING AND REPORTING (CONTINUATION)	✓
SUMP Step 4: Validation of the action plan	
If necessary, adjust the ex-ante GHG impact calculation to the validated action plan for the SUMP	
Data needs and collection methods have been identified and agreed by relevant stakeholders	
Responsibilities for MRV have been assigned	
Precise budget for MRV has been confirmed	
A monitoring plan and procedures have been developed, including quality assurance	
SUMP Step 5: Implementation and monitoring	
Data is collected, processed and quality controlled continuously	
Emission inventory is calculated every 1-3 years	
The baseline scenario is recalculated ex-post and emission reductions are assessed every 1-3 years	
Supporting information to verify the GHG impact can be provided	
Implementation monitoring report is produced annually	
Sustainable mobility report is produced every 5 years (mid-term assessment)	

Monitoring, Reporting and Verification process during the development and implementation of SUMPs.

In reality, this process must be adapted to local circumstances and decision-making processes. As a result, timing may vary from city to city.

Data collection and management, as well as emission calculations, are iterative processes that can be improved over time as data availability increases. To ensure consistency and transparency in emission reporting it is important to clearly document all data sources, definitions and assumptions. If done correctly, monitoring and reporting can greatly improve the information basis for transport planning and vice versa. Most of the data needed for emission calculations must also be collected as part of the development of a sound SUMP. At the same time, monitoring reports can be used to communicate progress, highlight the impacts of SUMP implementation and help secure on-going support from stakeholders.

Annex 1: Indicators Assessing Urban Transportation Systems (A Compilation of Factsheets) - 10.05.2016

An expanded compilation of indicator sets based on the Annex II of the report Sustainable Transport Evaluation – Developing Practical Tools for Evaluation in the Context of the CSD Process

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Title	Ecomobility SHIFT Assessment	
Responsible Body	ICLEI (Local Governments for Sustainability) Contributors: Edinburgh Napier University, Mobiel 21, Trivector, City of Burgas, City of Miskolc, Mobycon	
Target Group	Cities that want to assess and audit its EcoMobility.	
Year of Publication	2013	
Approach	The EcoMobility SHIFT Assessment and audit scheme includes a set of 20 predefined indicators. These indicators allow cities to measure and asses EcoMobility performance at the local level, and to connect such measurements with specific improvements.	
Descriptions and Lessons learnt	The manual describes the 20 indicators in detail including the definition purpose, terminology, suggested evidence, the scoring (weighting), the grounds for reducing total maximum possible score and links to further information and best practice. There are further templates and guides available on the website with detailed reports on assessing and auditing cities. The publication does not include any examples yet nor lessons learnt.	
Main Application	Transparency and Information Monitoring process towards sustainability	
Indicators	**Enablers:** • E1: Understanding User Needs • E2: Public participation in decision making • E3: Vision, strategy and leadership • E4: Personnel and resources • E5: Finance for EcoMobility • E6: Monitoring, evaluation & review **Results & Impacts:** • RI1: Modal Split • RI2: Safety conditions • RI3: Greenhouse gas emissions • RI4: Local air quality	**Transport System & Services:** • TSS1: Planning of new city areas • TSS2: Low speed/car free zones • TSS3: Information provision and systems • TSS4: Mobility Management Services • TSS5: Parking measures • TSS6: Walking conditions • TSS7: Cycling Conditions • TSS8: Public Transport coverage and speed • TSS9: Usability of Public Transport • TSS10: Low emission vehicles (LEV's)
Link	http://www.ecomobility-shift.org/en/project-downloads/category/8-shift-manual file:///C:/Users/moecke_han/Downloads/Appendix%201%20Indicator%20Descriptions%20(4).pdf	

Title	Sustainable Urban Transportation System
Responsible Body	Economic and Social Commission for Asia and the Pacific (UN-ESCAP)
Target Group	Rapidly growing cities in Asia
Year of Publication	2012
Approach	When implementing a sustainable transport system, one must consider different areas in which progress can be measured. This document gives a detailed overview of possible indicators for these areas.
Descriptions and Lessons learnt	This study identifies seven key areas when developing a sustainable urban transportation system (including several subareas). Each indicator is described comprehensively including information about "Issues and Importance", "Objective" and "Actions and Policy Considerations". The indicators should support stakeholders in Asian City to assess progress of policy and infrastructure measures in order to develop sustainable urban transport systems. The indicator set does not yet include weighted categories, which should be improved in a further study.
Main Application	Benchmarking and policy target setting Monitoring process towards sustainability
Indicators	**TRANSPORTATION PLANNING AND GOVERNANCE:** **• Transportation Planning in the Comprehensive Plan** > Adequate consideration of future strategic directions of transportation development in the comprehensive plan > Sustainable transportation development plans, policies and projects exist in the comprehensive plan **• Capacity of the Transport Authority** > Number of qualified personnel required to run the transportation system and the existing number of qualified personnel in the transportation system **• Public Participation in the Planning Process** > Recognition and practice of public participation in the planning and service delivery process > Availability of trained man power in participatory approach to planning and development > Existing institutional mechanism for public participation and consultation **• Financing for the Transportation System** > Percentage of funding needs that are met > Availability funding from the private sector > Innovative funding mechanism including low-carbon financing mechanism are used > Availability of funding support from the national government **• Affordability of the Transportation Services** > Percentage of income that people spend on transportation > Cost of travel by using public transit (cost/km) > Cost of public transit compared to cost of public transit with comparable cities (percentage of cost of the public transit of the comparable cities)

Title	Sustainable Urban Transportation System (continuation)
Indicators (continuation)	**ORGANIZATION OF URBAN SPACE AND SUBSTITUTION OF TRAVEL NEEDS BY OTHER MEANS (CONTINUATION):** **• Dense and Mixed Use Developments** > Existence of policies to promote high density mixed use land developments > Density of development (persons/hectare) > Percentage of area designated for dense and mixed use developments **• Road Hierarchy System** > Level of service of the roads > Classification of roads according to its main purpose > Roads function according to their classification category > Absence of through traffic on residential and minor roads **• Location of Schools and Other Facilities** > Average distance to a primary school and high school > Percentage of children attending schools in the neighbourhood > Percentage of children walking or using non-motorized transport to go to school > Percentage of people walking or using non-motorized transport to access daily necessities **• Sidewalks, Pedestrian Ways and Bike Lanes** > Length of walk ways > Level of service on sidewalks in major activity areas > Share of walking and other non-motorized transport > Quality and aesthetic appeal of sidewalk and walkway pavement and furniture > Share of walking and other non-motorized transport > Connectivity between major activity areas through sidewalks and pedestrian ways > Connectivity between important locations through bike lanes and bike paths > Availability of safe bike stands **• Substitution of Travel Needs by Other Means** > Proportion of work force on telecommuting and work-from-home scheme > Usage indices of e-governance and e-commerce > Number of service that are available through the internet and other means that do not require any actual travel > Usage of shopping parcel delivery services **PUBLIC TRANSIT:** **• Diverse, Integrated, Balanced and Well Coverage Public Transit Service** > Modal share of public transit (by different types of services) > Integration of public transit services > Existence of a common ticketing system > Percentage of city covered by public transit service > Percentage of population covered by public transit service **• Quality of the Public Transit** > On-time performance > Excess waiting time (proportion of passengers subject to longer than average waiting time) > On-board level of service (load factor, availability of seats, lowfloor/level platform boarding) > Cost of service > Environmental condition (clean vehicle, air condition etc.)

Title	Sustainable Urban Transportation System (continuation)
Indicators (continuation)	**PUBLIC TRANSIT (CONTINUATION):** **• Accessibility of the Public Transit** > The distance people need to walk to access the public transit > The design of the transit stop, transit system and other infrastructure and facilities related to the public transit > Quality of access infrastructure **PERSONAL VEHICLE:** **• Usage of personal vehicle** > Modal share of personal vehicle compared > Average occupancy rate personal/private vehicles > Modal share of school trips by personal vehicles > Number of trips by personal vehicle trips compared to other transport modes > Trip lengths by personal vehicle compared to other transport modes > Parking space per 1000 sq. m or per 1000 jobs in the CBD (should be minimum) > Parking price (should be higher) **SAFETY AND SECURITY:** **• Safety of the Transport System** > Accident rates (per 100,000 population, per 10,000 vehicles etc.) > Number of accidents -Fatality rate (total) > Accident rates rate by mode of transport and VRUs (Vulnerable road user groups) > Total fatality number > Economic cost of crashes as a percentage of the GDP > Security of the Transport System > Number of criminal incidents (mugging, harassment etc.) while people are using the transportation system > Number of criminal incidents on public transit services **FREIGHT TRANSPORT:** **• Urban Freight Transport Operation:** > Freight ton-km per unit of GDP > Freight ton-km per 10,000 urban people > Fuel consumption and GHG emission by freight transport > Distance over which freight is moved > Proportion of freight traffic that neither have origin or destination in the city through which they are passing **ENVIRONMENT:** **• Emissions by the Transportation Sector** > Aggregate GHG emissions and other air pollutants caused by the transportation sector compared to other sectors > Composite emission/veh-km > Percentage of vehicles using environment friendly and renewable energy > Usage of low-carbon vehicles > Energy efficiency of vehicles (km/lit)
Link	http://www.uncclearn.org/sites/default/files/inventory/unescap20_0.pdf

Title	Diagnosing Transport – Developing Key Performance Indicators to Assess Urban Transportation Systems	
Responsible Body	McGill University – School of Urban Planning	
Target Group	Cities all around the world aiming at assessing its urban transportation networks	
Year of Publication	2012	
Approach	Identification of performance indicators to assess urban transportation systems	
Descriptions and Lessons learnt	This paper assesses transportation networks in cities by using a series of performance indicators based on research and review of practices from all around the world. Thereby city / transportation plans from mainly developed countries were reviewed as developing countries could not often provide detailed performance indicator lists. Measures taken from international development agencies and nongovernmental organisation were also taken into account. A list of transportation plans, policies and research is included in the document. The indicators are weighted according to its relevance. The indicator set was then applied to 63 cities throughout the world whereat most of them were able to provide sufficient data for the assessment. In order to establish a contextual relationship, the cities were grouped by population. The results are shown in rankings grouped by population of the cities.	
Main Application	Knowledge transfer Benchmarking and policy target setting	
Indicators	**Affordability and Accessibility** • Transit coverage by population (percentage of people who live within 1 or 2 km of rapid transit) • Average length of commute (minutes) • Share of household income spent on transport (%) • Length of roads per 1,000 people (km) **Economic development** • Cost of vehicle congestion (in US$) **Safety:** • Road fatalities • Crime rates on public transport (%) **Quality of life** • Number of noise and vibration exceedances per year • Share of transport facilities with step-free access (%) •Public transport customer satisfaction (%)	**Operational Efficiency** • Public transport capacity (passenger-km) • Cost recovery from fares [fare-box recovery ratio (%)] **Environmental and Resource Conservation** • Greenhouse gas emissions from passenger travel (kg/capita) • Annual energy consumption of transport (MJ) • Biofuel and fossil fuel used per VKT or per capita (L) **Mobility** • Average speed of trip (km/h) • Transport trips by mode (% by mode) •Annual volume of container traffic (tonnes) **Infrastructure condition and performance** •Percentage of roads in a state of good repair
Link	http://tram.mcgill.ca/Research/Publications/Diagnosing%20transportation.pdf	

Title	Towards Sustainable Mobility Indicators – Application to the Lyon conurbation	
Responsible Body	ENTPE (Laboratoire d'Economie des transports)	
Target Group	Citizens of Lyon, but study should be reproduced in other urban areas	
Year of Publication	2003	
Approach	This study focusses on the greater area of Lyon. Selected indicators are applied to the area while specific results are explained in a detailed manner.	
Descriptions and Lessons learnt	While taking the environmental, economic and social dimension into account, this study verifies the feasibility and usefulness of elaborating sustainable mobility indicators. Specific indicators were selected given that they fulfilled criteria to cover issues at stake and offered strong coherence with statistical data bases (a list with information sources for each indicator is included). A survey (household trip survey 1995) containing all the indicators was applied to the Lyon population. The study explains in detail the specific results for each indicator considering the specific context of Lyon/ France.	
Main Application	Transparency and information Knowledge transfer Monitoring process towards sustainability	
Indicators	**Mobility:** • Daily number of trips • Structure of trips purposes • Daily average time budget • Modal split • Daily average distance travelled • Average speed (global and per person) **Economic:** • Annual Cost chargeable to residents of the conurbation, due to their mobility in this zone (total, per resident and per passenger-km) • Annual average expenditures for their urban mobility (per person) • Cost of employee parking • Subsidies to employees (company cars…) • Possible local taxes (total per resident and per employee • Annual expenditures for investments and operates (total and per residents)	**Social:** • Proportion of households owning 0,1 more cars • Distance travelled • Expenditures for urban mobility **Environmental:** • Annual energy consumption and CO_2 Emissions (total and per resident) • Levels of CO_2, NO_x, hydrocarbons and particles • Daily individual consumption of public space involved in travelling and parking • Space taken up by transport infrastructures • Noise intensity levels • Risk of accident
Link	https://halshs.archives-ouvertes.fr/file/index/docid/68232/filename/tpolicy_def.doc	

Title	The Propolis approach to urban sustainability – Theory and Results from Seven European Case Cities
Responsible Body	LT Consults as part of the Association for European Transport
Target Group	European Cities
Year of Publication	2004
Approach	This research project, within the Fifth Framework Programme of the European Commission, developed indicators to measure environmental, social and economic dimensions of sustainability. It aims at defining sustainable long-term urban strategies.
Descriptions and Lessons learnt	The Propolis (Planning and Research of Policies for Land Use and Transport for Increasing Urban Sustainability) approach consists of three dimensions (environmental, social and economic). It emphasized the impact from transport on land use, whereby the approach names land use transport models to be the driving engines of the system. Propolis uses three different land use transport models which simulate policy effects. Besides also GIS databases and other transport models were used to develop an indicator set to assess policy options. The indicator set was applied to seven European cities, which showed that with growing traffic, the environmental sustainability deteriorates in all seven cities.
Main Application	Benchmarking and policy target setting
Indicators	**ENVIRONMENTAL DIMENSION:** **• Global Climate Change** > GHG from transport **• Air Pollution** > Acidifying gases from transport > Volatile organic compounds from transport > Consumption of natural resources > Consumption of mineral oil products > Land coverage > Need for additional new construction **• Environmental quality** > Fragmentation of open space > Quality of open space **ECONOMIC DIMENSION:** **• Total net benefit from transport** > Investment costs > Transport user benefits > Transport operator benefits > Government benefits from transport > Transport external accident costs > Transport external emissions costs > Transport external greenhouse gases > Transport external noise costs **SOCIAL DIMENSION:** **• Health** > Exposure to particulate matter from percentage of population transport in the living environment > Exposure to nitrogen dioxide from transport percentage of population in the living environment > Exposure to traffic noise > Traffic deaths > Traffic injuries **• Equity** > Justice of distribution of economic benefits > Justice to exposure to particulates > Justice of exposure to nitrogen dioxides > Justice of exposure to noise > Segregation **• Opportunities** > Housing standard > Vitality of city centre > Vitality of surrounding region > Productivity gain from land use **• Accessibility and traffic** > Total time spent in traffic > Level of service of PT and slow modes > Accessibility to city centre > Accessibility to services > Accessibility to open space
Link	http://abstracts.aetransport.org/paper/download/id/1958

Title	Sustainable Urban Transport in Asia	
Responsible Body	The partnership for Sustainable Transport in Asia (PSUTA) as part of the Clean Air Initiative for Asian cities (CAI-Asia) with support from the Swedish International Development Agency, the Asian Development Bank and EMBARQ the World Resources Institute Centre for Transport and the Environment	
Target Group	Stakeholders in Asian cities, Case Studies in Xi'an, Hanoi and Pune	
Year of Publication	2006	
Approach	The project aimed "to help municipal decision makers to better understand the sustainability, or lack of it, of their urban transport systems, and to develop more structured and quantified approaches to policy making" (ADB 2006)	
Descriptions and Lessons learnt	Based on a framework for sustainable transport developed by PSUTA, the definition of indicators was handled in a decentralised manner: The three partner cities Xi'an, Hanoi and Pune each reported a set of indicators which were deemed relevant and for which the necessary data were available in the respective local context. The goal "was not a complete set of numbers, rather a recognition of which indicators counted the most for good policy development and a strategy to get the information required for those indicators. An important outcome was the identification of major data gaps in the tree cities. The decentralised approach of this concept is especially noteworthy, as it involved numerous local stakeholders and thus increased acceptance of the indicator set, which of course is a challenge for comparability. Another important point is the focus on governance found in the sustainability framework. It highlights the relevance of current municipal transport policy for future progress towards sustainability – an issue difficult to capture by using only static quantitative indicators.	
Main Application	Identification of challenges, Benchmarking and policy target setting	
Indicators	**• Equity /Social:** > Different exposures by region, gender, group > Different accident rates for walkers, bikers, drivers, women /men > Different delays and travel times by gender, group **• Economics:** > Health and property costs of pollution > Costs of abatement (extra costs of vehicles, fuels) > Social and direct costs of accidents > Expenditure on safety and driver training > Money value of losses of time, transport business profits	**• Governance:** > Clean air agency > Enforcement laws monitoring stations > Seat belt laws > Driver training requirements > New/existing vehicles safety standards > Emergency plans on polluted days, > HOV lanes **•Environment and Safety:** > New car emission standards / I-M for existing vehicles > Death and disease from polluted air > Excess pollution from congestion > Circuitous routing
Link	http://www.adb.org/publications/sustainable-urban-transport-asia-making-vision-reality http://pdf.wri.org/sustainable_urban_transport_asia.pdf	

Title	Methodology and Indicator Calculation Method for Sustainable Urban Mobility
Responsible Body	WBCSD Mobility (World Business Council for Sustainable Development)
Target Group	Cities
Year of Publication	2015
Approach	This report contains several sustainable mobility indicators, which allow cities to perform a standardized evaluation of its mobility systems and measure improvements when implementing new mobility practices or policies.
Descriptions and Lessons learnt	The indicators are presented as a comprehensive set spanning four dimensions (Global environment, Quality of life in the city, Economic success and Mobility system performance) of sustainable mobility. Methodologies have been developed to include all modes of transport for passengers and freight. A measureable parameter has been defined for each indicator and is described in detail with the methodology to quantify it (a spreadsheet based calculation tool is also available for interested authorities). The indicators have been calculated in Bangkok, Campinas, Chengdu, Hamburg, Lisbon and Indore (results are explained graphically).
Main Application	Transparency and Information Monitoring process towards sustainability
Indicators	• Affordability of public transport for the poorest people • Accessibility for mobility impaired groups • Air polluting emissions • Noise hindrance • Fatalities • Access to mobility services • Quality of public area • Urban Functional diversity • Commuting travel time • Economic Opportunity • Net Public Finance • Mobility space usage • Emission of GHG • Congestion and delays • Energy efficiency • Opportunity for active mobility • Intermodal integration • Comfort and pleasure • Security • There are dimensions defined, but they are overlapping (indicators are grouped in >1 dimension)
Link	http://wbcsdpublications.org/wp-content/uploads/2016/01/SMP2.0_Sustainable-Mobility-Indicators_2ndEdition.pdf

Title	Toolkits for Urban Transport Development – Comprehensive Mobility Plans (CMPs)	
Responsible Body	Institute of Urban Transport (IUT) and a team of researchers and consultants from premier institutions in India, UNEP and UNEP Risoe Centre	
Target Group	Indian Cities	
Year of Publication	2013	
Approach	The indicator set was furnished by reports on city level indicators. The report only mentions the indicators briefly as they are only a small part of the toolkit	
Descriptions and Lessons learnt	The developed indicator set is part of a toolkit for Urban Transport Development. The toolkit mainly focusses on the elaboration of Comprehensive Mobility Plans (CMPs) including information about the preparation process, definition of its scope, data collection, development of scenarios and implementation possibilities of programs. As part of the analysis of the existing urban transport environment this indicator set has been developed. Recommendations for data sources and how to measure these indicators are also given in the annex as well as the resulting benchmarks (Annex 4).	
Main Application	Identification of challenges Transparency and Information	
Indicators	**MOBILITY AND ACCESSIBILITY** **• Modal Shares** > Modal shares by trip purpose i.e. work, education, health and others > Modal shares by social groups i.e. by income, women headed household **• Travel time** > Average travel time by trip purpose i.e. work, education, health and others using different modes > Trip purpose wise average travel time disaggregated by social groups **• Trip length** > Average trip length frequency distribution > Mode wise average trip length disaggregated by social groups > Trip purpose wise average trip length disaggregated by social groups **• Affordability** > Affordability of PT and para-transit fare by social group > Cost of commuting **INFRASTRUCTURE AND LAND USE** **• Infrastructure quality** > Average speed on roads of different modes > Percentage of Household within 10 min walking distance of PT and para-transit stop > Average number of interchanges per PT trip > Accessibility of disadvantaged groups by different modes **• Land Use parameters** > Land use mix intensity > Income level heterogeneity > Kernel density of roads, junctions and PT stop	**SAFETY AND SECURITY** **• Safety** Risk exposure mode wise Risk imposed by modes Overall safety Speed limit restrictions Quality of footpath infrastructure **• Security** Percentage of road lighted Percentage of footpath lighted Percentage of people feeling safe to walk/ cycle and use PT in city by gender **ENVIRONMENTAL IMPACTS** **• Emissions** GHG emissions Lifecycle cost of different modes **• Depletion of land resource** Per capita consumption of land for transport activity Land consumed for different transport activities **• Health hazards** Percentage of population exposed to air pollution Percentage of population exposed to noise levels > 50 dB **ECONOMIC (RESPONSE INDICATORS)** **• Investment** Trend in investments for development of infrastructure for various modes **• Cost borne by operators** Tax burden mode wise Fuel prices at pumps by fuel type Other charges levied as applicable at city level disaggregated by modes **• Fare policy** Percentage of subsidies granted Percentage of population owning passes
Link	http://unep.org/pdf/CMP%20Report.pdf	

Title	Urban Transport Benchmarking Initiative
Responsible Body	European Commission, Directorate General for Energy and Transport
Target Group	European Cities
Year of Publication	2006
Approach	The key goal of this EU-funded project was to "compare the transport systems of the participating cities in order to identify and promote interesting practices in urban transport. Numerous stakeholders in participating cities were involved, and a total of 44 cities provided information on the selected common indicators during the course of the project.
Descriptions and Lessons learnt	The results of the exercise are presented in the form of a ranking for each individual quantitative indicator, comparing cities with similar characteristics. The working groups established gathered more qualitative and in-depth information on specific topics such as cycling or public transport organisation and policy. Their goal was not "creating a set of 'winners' and 'losers' (…), because it may dishearten those perceived to have 'bad practices' whereas these groups of participants probably have the most to gain from this type of project. Best practices therefore were loosely defined as interesting practices in the various urban transport systems. Although the term "Benchmarking" might still be slightly misleading for this project as there were no defined benchmarks for which to strive, it certainly provides a good example of using a common indicator scheme to derive relevant policy implications and to learn from each other. The approach to avoid a "blame and shame" of low performers is especially noteworthy, as any evaluation scheme on a global level would have to deal with similar challenges.
Main Application	Identification of challenges, Knowledge Transfer, Benchmarking and policy target setting
Indicators	• Size of regional administrative area • Size of urban administrative are • Number of residents of the regional administrative area • Number of residents of the urban adminstrative area • Description of key geographical features influencing transport • One-way length of urban transport infrastructure in the administrative area (road/train/metro/tram) • One-way length of flexible urban transport routes in the administrative area (bus/ trolleybus/ferry) • One-way length of bus lanes and segregated right of way for trams • One-way length of cycle network. If possible data to be segregated according to cycle lanes, on & off road tracks and routes • Number of cars and motorcycles registered in the administrative area submitted separately • Number of individual vehicles (by mode) operating in the administrative area • % of public transport vehicles which are wheelchair accessible by mode • Average speed of cars/motorcycles in peak hour • Average speed of buses/trains/metro vehicles in peal hours • Most frequent service intervals of buses/ trains/metro/ vehicles / trams in peak hour T • otal number of daily one-way journeys by mode in the administrative area on a weekday • Total number of daily one-way journeys by mode in the administrative area on a Saturday • Total number of passengers carried by all public transport modes (segregated by mode) • Total distance of passenger kilometres travelled by all public transport modes (segregated by mode) • Total farebox revenue from ticket sales for all public transport odes (segregated by mode) in 2003 • The cost in euro of a single 1km and 5 km and 10 km public transport trips to the city centre (by mode) • Average cost to user of car use • Capital expenditure on public transport, by mode, averaged over the last 5 years

Title	Urban Transport Benchmarking Initiative (continuation)	
Indicators (continuation)	• Cleanliness of vehicles in the public transport fleet • Additional pollution reduction technologies for vehicles in the public transport fleet • Average fuel consumption of vehicles in the public transport fleet • Age of the vehicles in the public transport fleet • % of public transport stops / stations which are wheelchair accessible	• Capital expenditure on roads, averaged over the last 5 years • GDP per head of population • The number of urban administrative area residents in employment and the number of positions held in the city • Number of injuries on the road network, per annum • Number of deaths on the road network, per annum
Link	http://www.transportbenchmarks.eu/ http://transportbenchmarks.eu/pdf/final-reports/UTB3-A0-FINAL-REPORT.pdf	

Title	Quality Targets and Indicators for Sustainable Mobility – User Guide
Responsible Body	German Federal Environmental Agency (Umweltbundesamt – UBA)
Target Group	Municipal stakeholders in four German cities (Erfurt, Görlitz, Lörrach, Herdecke)
Year of Publication	2005
Approach	The aim of this project embedded in the local Agenda 21 was to formulate goals for sustainable mobility and to establish a set of indicators which may be used to measure progress towards such defined targets. The procedures were applied to three medium-sized German cities as case studies.
Descriptions and Lessons learnt	Even though the concept is embedded in the specific context of German urban transport planning, there are interesting results with relevance for an international evaluation scheme. The most important one refers to the fourth dimension of sustainability proposed in this document: Participatory transport in planning and policymaking. As part of the Local Agenda 21, the development of sustainability goals and according indicators was conducted city-specific, involving not only urban planning and transport specialists, but also citizens engaged in Agenda 21 initiatives, This process contributed to successful outcomes of the projects, such as particular measures taken in cities to reach defined sustainability goals, The experiences of this project may be used as background information, e.g. when designing indicators (or even audits) for the participatory dimension of sustainability
Main Application	Benchmarking and policy target setting Monitoring process towards sustainability
Indicators	**Major indicators:** • Share of environmentally friendly transport modes in total trips (%of total) • Share of main streets with adequate facilities for pedestrians (% of total) • Share of pedestrian streets / zones with traffic calming (% of total network) • Share of main streets with adequate bikeways or 30 km/h-speed restriction (%of total) • Share of inhabitants living within a 300m radius of a bus stop 500m for light rail/S-Bahn • Share of main streets with 30 km/h speed restriction (%of total) • Share of population exposed to more than 65 dB(A) during daytime and more than 55 dB (A) during the night (%of total) • Share of population affected by a critical concentration of PM10 (%of total) • Persons killed or severely injured in road accidents in the city area, per 10,000 inhabitants
Link	https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/3793.pdf

Title	The Urban Audit – Towards the Benchmarking of Quality of life in 58 European Cities
Responsible Body	European Commission and cities
Target Group	Municipal stakeholders and the public
Year of Publication	2000
Approach	The overall goal of the extensive set of indicators was to measure the quality of life in European cities
Descriptions and Lessons learnt	Transportation plays a minor role, with only half a dozen of the about 100 single indicators related to issues such as the modal split and GHG emissions of the transport sector. Data are available for several years. The latest data set has been collected in 2004. The related website allows user to select any of the numerous indicators and compare them across the city sample. Results can also be presented in the form of rankings. Despite the project title, there is no true audit or benchmarking, as no target values or policy goals are provides. Nevertheless, the web-based possibility for every user to compile such specific data and rankings of interest may be of interest for dissemination and presentation of an international evaluation scheme to a wider audience
Main Application	Transparency and Information Knowledge transfer
Indicators	• Travel patterns (length, mode purpose of trips) • Road accidents (death of serious injury per 1,000 of the population)
Link	http://ec.europa.eu/regional_policy/archive/urban2/urban/audit/ftp/volume1.pdf (volume I) http://ec.europa.eu/regional_policy/archive/urban2/urban/audit/ftp/vol3.pdf (Volume III)

Title	Observatorio de movilidad urbana (OMU)
Responsible Body	CAF Development Bank
Target Group	Latin American Cities
Year of Publication	2009
Approach	The OMU gathers data on urban transport characteristics for 15 Latin American Cities. 11 different categories are included, ranging from basic socioeconomic background data to detailed information about modal splits and vehicle fleets as well as emissions and costs
Descriptions and Lessons learnt	The associated website offers excellent spreadsheet tables for every data category, which enables users to do their own data analysis. The additional report provides comprehensive information on the state of urban transportation in the 15 cities, and includes some basic ranking and benchmarking efforts (e.g. for costs of public transportation). However, there are neither underlying definitions of sustainability nor any policy goals to which the data are connected. While it may not be considered a true sustainability evaluation scheme, OMU certainly constitutes a noteworthy effort to compile relevant data on characteristics and negative effects of urban transportation.
Main Application	Identification of challenges Transparency and information

Title	Observatorio de movilidad urbana (OMU) (continuation)
Indicators	• The following 11 categories are included, each with about 2-20 individual indicators: • Socioeconomic characteristics • Transport system asset value • Costs and tariffs • Road safety • Emissions • Energy consumption and costs • Public transportation • General mobility characteristics • Vehicle fleets • Infrastructure
Link	http://omu.caf.com/media/2537/caf_omu_jun2010.pdf only in Spanish

Annex 2: Examples of Implementation and Sustainable Mobility Indicators

Indicators to track implementation of single measures		
Topic	**Infrastructure or services offered**	**Use of the new infrastructure or service**
Public transport	• PT improvements: length of bus lanes, number of bus priority intersections; • PT offer (quantity): vehicles x km • PT offer (quality): average commercial speed	• PT usage: number of annual trips, number of boardings/alightings at main stops
Intermodality	• P & R parking offer	• Number of combined TER/PT subscribers • Number of P & R subscribers
Cyclists	• Route improvements: length of routes for cycling • Parking improvements: number of bicycle parking stands in public space, including secure stands	• Bicycle flow counts on certain routes • Counts of bicycles parked on certain stands
Walking	• Route improvements: size of pedestrian areas • Length of pavements of width <1.40 m • Occasional improvements: number of dangerous crossings redeveloped	• Pedestrian counts on some routes
Powered two-wheelers	• Number of parking spaces in public car parks	• PTW flow counts on certain routes
Private vehicular traffic	• Road prioritisation scheme • Speed calming scheme	• Flow counts on certain routes • Average speed
Parking facilities	• Parking offer on roads by type (free, free limited-time, paid) and in car parks	• Paid hours/space/day on road • Road occupancy rate • Use of car parks, including subscribers • Number of parking fines
Sharing the road network	• Length of roads converted into traffic calming areas • Surface of former road space converted into green areas, parks, pedestrian places	• Pedestrian and bicycle counts in these areas • Number of street events (festival, market, exhibition…) using the street space
Mobility management and new services	• Car-sharing offer • Car-pooling offers • Initiative for the development of company mobility plans	• Number of car-sharing subscribers, number of uses/day per car • Number of subscribers to carpool portals • Number of company mobility plan
Transportation of goods	• Number of delivery areas	• Number of parking fines

Source: Certu (2012)

Sustainable Mobility Indicators	
Transport modal share	• Mode split between different transport modes
Environmental Protection	• Number of days or hours where permitted pollution thresholds are exceeded (particulate matter, nitrogen oxides, ozone) • Average measured noise level • Population exposed to different noise levels • Surface area of parks in the city •Number of trees planted in the parks and streets
Road safety	• Number of accidents and fatalities, serious injuries and slight injuries recorded by the police during the year, distinguishing pedestrians, cyclists, motorists, users of PTWs and others
Transport Accessibility (all types)	• Network share accessible to persons with reduced mobility • Number of pedestrian crossings equipped for persons with reduced mobility
Integration of transport and urban planning	• Number of micro-SUMP initiatives/sector plans • Number of housing developments, jobs and amenities near existing PT networks

Source: adapted from Certu (2012)

Another set of 19 sustainable mobility indicators has been developed by the World Business Council on Sustainable Development and has already been tested in four cities in emerging economies:

Set of 19 indicators for the sustainability of urban mobility	Short names of indicators	Dimensions	
Affordability of public transport for the poorest people	Affordability	S	Q
Accessibility	Accessibility for impaired	S	Q
Air polluting emissions	Air pollution	Q	
Noise hindrance	Noise hindrance	Q	
Fatalities	Fatalities	Q	
Access ti mobility services	Access	Q	
Quality of public area	Public area	Q	
Urban functionel diversity	Finctional diversity	Q	E
Communting travel time	Travel time	Q	E
Economic opportunity	Economic opportunity	Q	E
Net public finance	Public finance	E	
Mobility space usage	Space usage	G	E
Emissions of greenhouse gases (GHG)	GHG	G	
Congestion and delays	Congestion	G	S
Energy effeciency	Energy effeciency	G	S
Opportunity for active mobility	Active mobility	G	S
Intermodal integration	Intermodal integration	S	
Comfort and pleasure	Comfort and pleasure	S	
Security	Security	S	

Table 1: Overview of the 19 Sustainable Urban Mobility Indicators indicating the dimensions of the sustainability of the mobility system. Source: Oran Consulting for WBCSD SMP 2.0, 2014.

G	Global environment
Q	Quality of life
E	Economic success
S	Mobility system performance

For more information on these indicators and how to assess them please see:
http://wbcsdpublications.org/project/smp2-0-sustainable-mobility-indicators-2nd-edition/

9 References

- Bond, T. C., Doherty, S.J., Fahey, D.w., Forster, P.M., Berntsen, T., DeAngelo, B.J., Flanner, M.G., Ghan, S., Kärcher, B., Koch, D., Kinne, S., Kondo, Y., Quinn, P.K., Sarofim, M.C., Schultz, M.G., Venkataraman, C., Zhang, H., Zhang, S., Bellouin, N., Guttikunda, S.K., Hopke, P.K., Jacobson, M.Z., Kaiser, J.W., Klimont, Z., Lohmann, U., Schwarz, J.P., Shindell, D., Storelvmo, T., Warren, S.G., Zender, C.S. (2013) ***Bounding the role of black carbon in the climate system: A scientific assessment, in Journal of Geophysical Research Atmospheres***, 118, 5380–5552, doi:10.1002/jgrd.50171.

- Bongardt, D., Eichhorst, U., Dünnebeil, F., and Reinhard, C. (2015) ***Monitoring Greenhouse Gas Emissions of Transport Activities in Chinese Cities: A Step-by-step Guide to Data Collection.*** Eschborn: GIZ. Available online: http://sustainabletransport.org/?wpdmdl=3797 (accessed 06.04.2017).

- Certu (ed.) (2012) ***L'évaluation des PDU: des convergences d'approches pour une réalité complexe (Assessing SUMPS: Converging approaches for a complex reality). In Mobilité et transports – Pratiques locales***, 02. Lyon: Certu.

- Dünnebeil, F., Knörr, W., Heidt, C., Heuer, C. and Lambrecht, U. (2012) ***Balancing Transport Greenhouse Gas Emissions in Cities – A Review of Practices in Germany.*** Beijing: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and Beijing Transportation Research Centre. Available online: http://sustainabletransport.org/?wpdmdl=2974 (accessed 06.04.2017).

- Eckermann, A., Henkel, A., Lah, O., Eichhorst, U., Bongardt, D., and Wuertenberger, L. with input from Sutter, D. and Chua, H. (2015) ***Navigating Transport NAMAs – A practical handbook on Nationally Appropriate Mitigation Actions (NAMAs) in the transport sector***, 2nd revised edition. Eschborn: GIZ.

- IFEU (ed.) (2014) ***Empfehlungen zur Methodik der kommunalen Treibhausgasbilanzierung für den Energie- und Verkehrssektor in Deutschland (Recommendations on the methodology for GHG-accounting in the energy and transport sector in local municipalities in Germany)***. Heidelberg: IFEU. Available online: https://www.ifeu.de/energie/pdf/Bilanzierungsmethodik_IFEU_April_2014.pdf (accessed 06.04.2017).

- WHO – World Health Organisation (2014) Ambient (outdoor) air quality and health. ***Fact sheet N°313***. Available online: http://www.who.int/mediacentre/factsheets/fs313/en/ (accessed 15.04.2017).

- WRI - World Resources Institute, Iclei – Local Governments for Sustainability, C40 Cities Climate Leadership Group (eds.) (2014) ***Greenhouse Gas Protocol. Global Protocol for Community-Scale Greenhouse Gas Emission Inventories: An Accounting and Reporting Standard for Cities***. WRI. Available online: http://ghgprotocol.org/files/ghgp/GHGP_GPC.pdf (accessed 06.04.2017).

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