SuSMo

# Sustainable Shared Mobility

## Transition guidance tools on Impact Evaluation

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TU Delft

eit Climate-KIC

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# Executive summary

Shared sustainable mobility has the potential to support the decarbonisation of the transport system. As part of the SuSMo project guidance and training materials are developed that will support change agents in making the shift towards shared sustainable mobility. Research identified the following areas for further work:

- Behavioural change
- Private sector engagement
- Policy, regulation and procurement
- Evaluation of the impact

This report reflects the work of TU Delft on mapping the impacts of shared mobility as well as developing a tool to provide cities with an estimation of the order of magnitude expected for pollution reduction after implementing shared mobility systems.

Even though diverse impact evaluation methods exist, there is a critical gap in the evaluation of shared mobility, which is the lack of a comprehensive, multi-perspective, evaluation framework that can be applied to assess the full range of impacts that urban shared mobility entails. Future research in the field of shared mobility should focus on exploring efficient ways to use these evaluation methods to design frameworks that utilize the strengths of each one while minimizing the downfalls.

A literature review has provided a categorization of **the impacts of shared mobility** as follows:

- Built environment
- Society
- Traffic conditions
- Economy
- Environment
- Travel behaviour

In addition, this report briefly outlines the methodology for the **development of a tool for evaluating the impacts of shared mobility in cities.** It also discusses the case where this tool could be a valuable instrument in the decision-making process.

This tool aims at providing city authorities and decision-makers with a simple, user-friendly, and flexible way to explore different future scenarios and the associated impacts that shared mobility can bring to their city, by trying out different combinations of shared modes and how these combinations influence the $CO_2$ footprint of their city.

# Introduction

The SuSMo (Sustainable Shared Mobility) Project aims to catalyse systemic change by instigating behaviour change, enabling connections and collaborations, and removing barriers through policy change. SuSMo brings together leading European municipalities with experts in the transport sector to provide decision-makers with tools and knowledge to maximise the benefits and mitigate the negative impacts of shared mobility modes. Funded by EIT Climate KIC, SuSMo was launched in 2019 and has worked with city representatives and private sector shared mobility providers to establish the key needs and priorities for the effective deployment of sustainable shared mobility. Research has identified the following areas for further work:

- Behavioural change
- Private sector engagement
- Policy, regulation and procurement
- Evaluation of the impact

This report will describe the outcome of TU Delft's work on the development of a tool for evaluation of impacts of shared mobility. The material in this report should be used as guidance material to successfully evaluate the impacts shared mobility service have on cities compared to the current use of privately owned cars.

## Theory of Change

In collaboration with the SuSMo team, MOTION (project to develop evaluation methodology at a project level) has identified the transformative outcomes, processes that need to be activated to promote transformational change, with regards to impact evaluation, this resulted in figure 1 on the next page.

These transformative outcomes reflect and review the activities, outputs, and inputs of an ongoing project within the context of Theory of Change. To increase the transformative potential and allow for structural learning, it is necessary to examine and review the underlying convictions, theories and dominant models that apply. Reassessing the criteria against which an innovation is evaluated is an additional challenge towards achieving systemic change.

The application of the proposed transition tool will provide decision makers with a better understanding of how cities can facilitate systemic change to achieve quick and optimal integration of low carbon urban shared mobility into their existing public transport system.

Regarding evaluation of shared mobility impacts, the SuSMo project is working with cities to help them understand the potential impacts following the introduction of new shared modes and whether these modes fit the needs of the city and citizens and not the other way around.

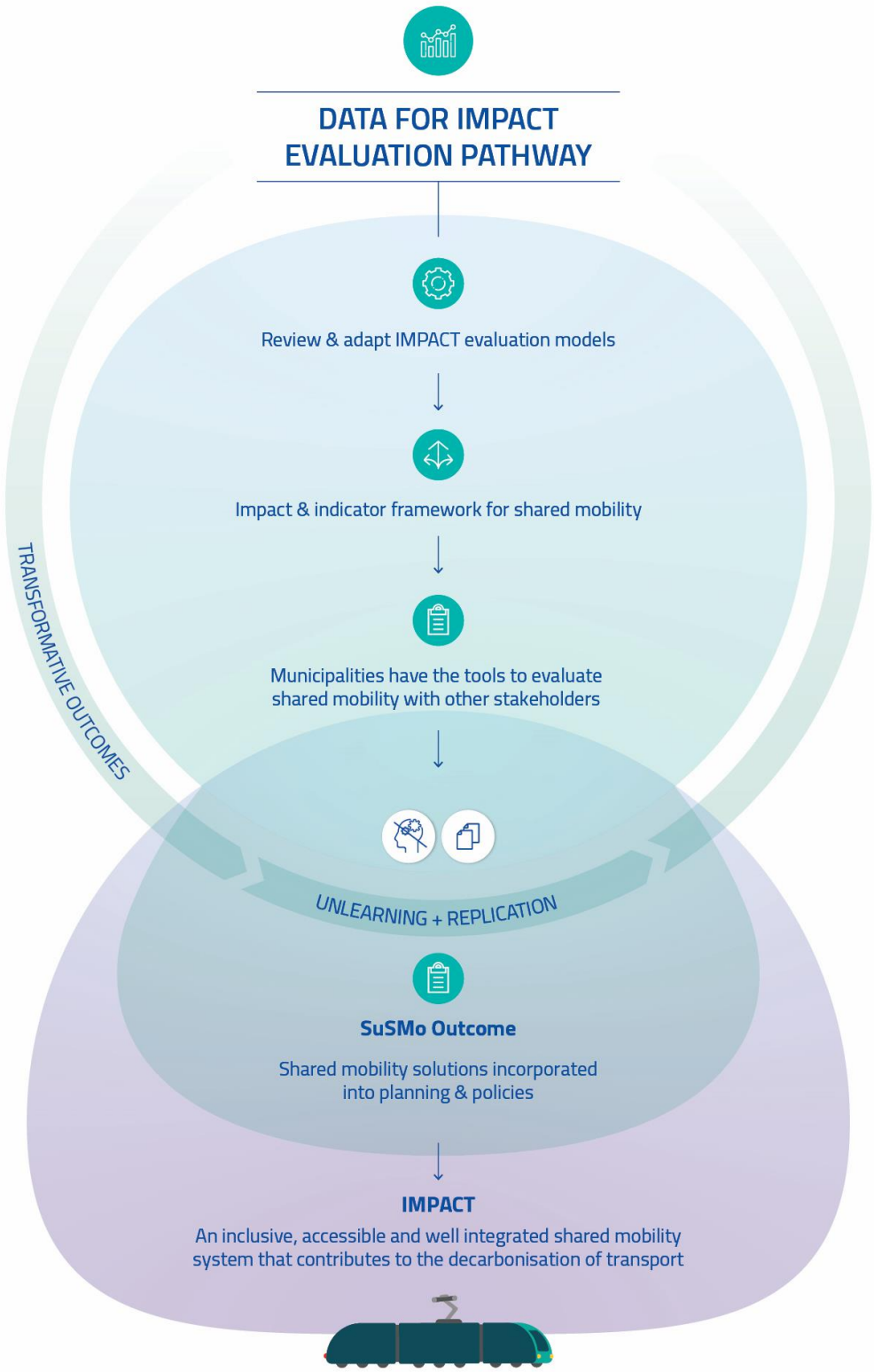



*Figure 1: Theory of Change – Data for Impact Evaluation*

# What are the impacts of shared mobility?

Nowadays shared mobility is all around, but often the wide range of impacts that it can have on a city are not fully understood by the citizens and the city authorities. Evaluating these impacts is of critical importance for modern cities, in their endeavour to create a sustainable, people-oriented urban transport system. In order to better understand the different types of impacts and how they can be evaluated, TU Delft conducted a thorough literature review of the different types of methods that can be used for this evaluation and suggested a classification of them.

As a result of literature review, the key categories of shared mobility impacts are:

**Built environment, Society, Traffic conditions, Economy, Environment, and Travel behaviour**

The diagram of figure 2 illustrates the main categories of evaluation methods, classified based on the time frame in which they can be used, in line with the distinction described above.

Even though diverse impact evaluation methods exist, there is a critical gap in the evaluation of shared mobility, which is the lack of a comprehensive, multi-perspective, evaluation framework that can be applied to assess the full range of impacts that urban shared mobility entails. Future research in the field of shared mobility should focus on exploring efficient ways to use these evaluation methods to design frameworks that utilize the strengths of each one while minimizing the downfalls.

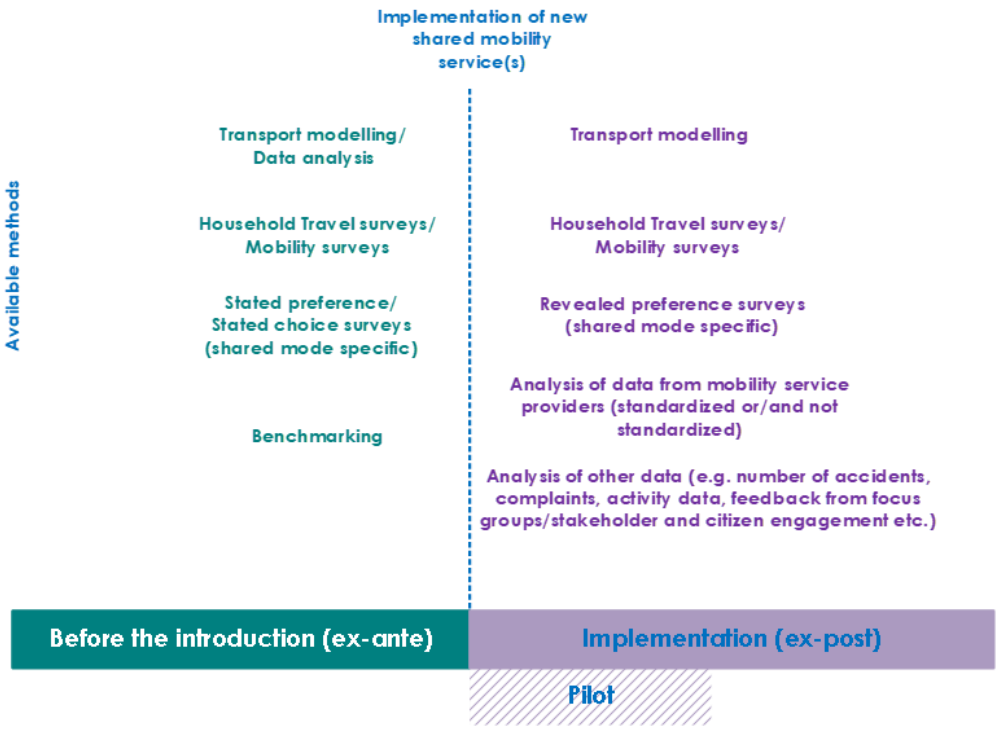



*Figure 2: Overview of available methods for evaluating shared mobility*

# Calculating the $CO_2$ reductions attributed to shared mobility

## Methodology

The starting point for the development of the tool is understanding that different impacts of shared mobility are not standalone, but are very much interrelated e.g., the impact on the environment is a direct consequence of the changes observed on the travel behaviour of the citizens, which is reflected among others on modal shift and vehicle kilometres travelled. When citizens change the way they used to travel as a result of the introduction of a new shared mode, this alteration of travel behaviour results in changes in the transport – related $CO_2$ emissions.

The calculations for the tool are based on three types of urban shared mobility: **car sharing, bike sharing and e-scooter sharing**. The electrification of (part of) the shared cars fleet is also considered.

The approach used for the calculations for the three modes is identical: the baseline data to be input in the tool is the current modal split in the cities, in order to estimate what types of transport modes are substituted with shared mobility and therefore what reductions of GHG could be achieved. For the $CO_2$ calculations, the tool uses data from studies in European cities.

The tool uses the following data as a baseline for the calculations:

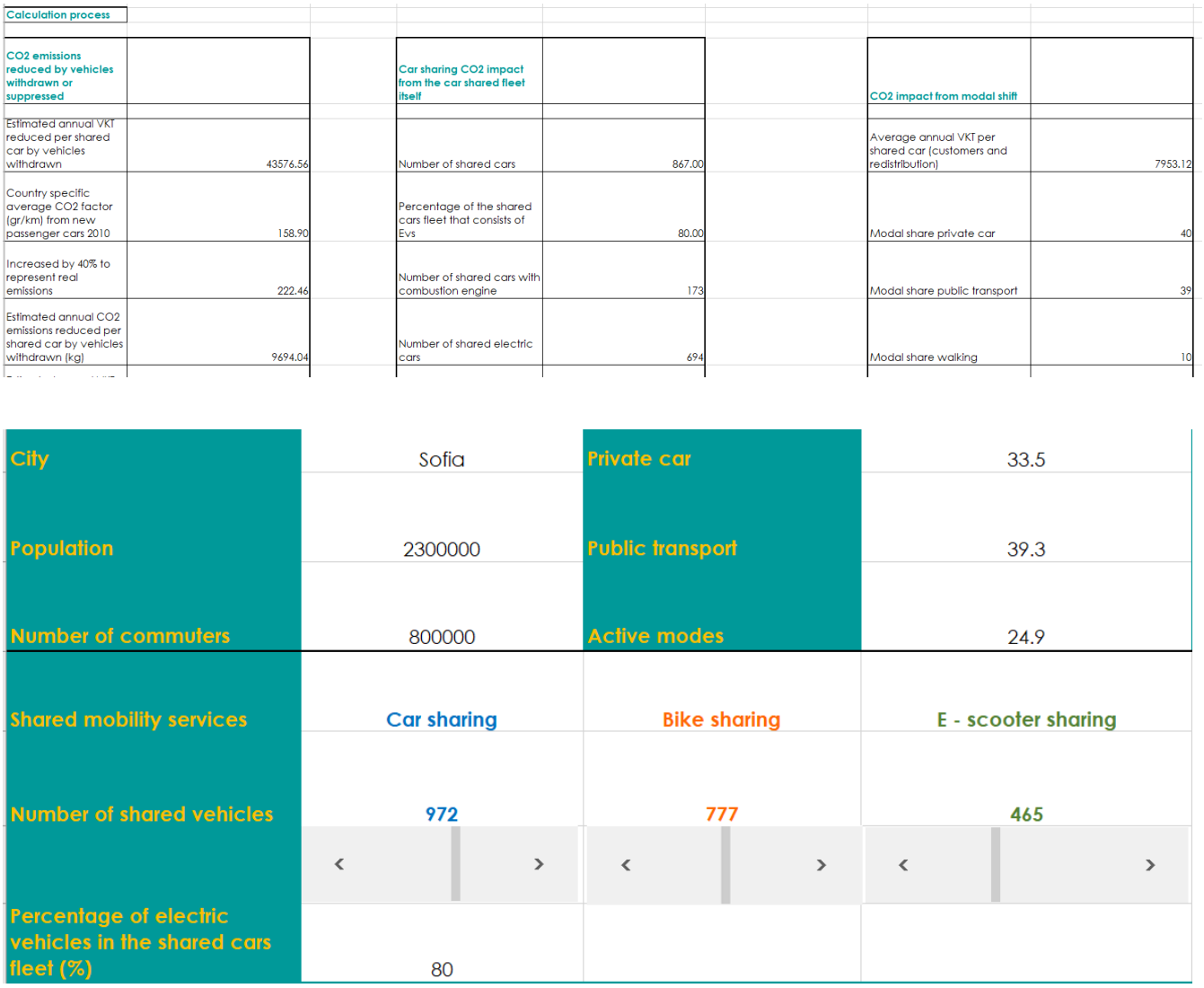
- Country (e.g., France)
- City (e.g., Paris)
- Population (# of inhabitants)
- Current modal split (private car, public transport, active modes in %)
- Average distance traveled by mode (in km)
- Data for shared mobility services (number of vehicles per mode (shared cars, e-bikes, e-scooters))

The assumption is that current modal split will be shifted to shared mobility modes in the same percentage of distribution i.e., one mode is replaced by the same usage of shared mobility. This allows to calculate the potential $CO_2$ reduction for when shared mobility services are present in a city. Additionally, the average number of trips per shared mobility mode per day is included in the calculation to back up usage rates with empirical data from studies.

## Output

The output of the tool is the potential $CO_2$ emission reduction per mode in kilograms. Taking in account the stated number of shared mobility vehicles and a total amount for all shared mobility modes. Basically, the tool represents a simple, user-friendly, and flexible way to explore different future scenarios and the associated impacts that shared mobility can bring to a city. These scenarios can be utilized by cities in the decision-making process with the following application:

- Evaluation of existing savings realized through shared mobility on a daily basis
- How shared mobility can contribute to the achievement of city's $CO_2$ targets
- What the impact of newly introduced service could be on the $CO_2$ emissions of a city



Calculation process

| CO2 emissions reduced by vehicles withdrawn or suppressed | | Car sharing CO2 impact from the car shared fleet itself | | CO2 impact from modal shift | |
|---|---|---|---|---|---|
| Estimated annual VKT reduced per shared car by vehicles withdrawn | 43576.56 | Number of shared cars | 867.00 | Average annual VKT per shared car (customers and redistribution) | 7953.12 |
| Country specific average CO2 factor (gr/km) from new passenger cars 2010 | 158.90 | Percentage of the shared cars fleet that consists of Evs | 80.00 | Modal share private car | 40 |
| Increased by 40% to represent real emissions | 222.46 | Number of shared cars with combustion engine | 173 | Modal share public transport | 39 |
| Estimated annual CO2 emissions reduced per shared car by vehicles withdrawn (kg) | 9694.04 | Number of shared electric cars | 694 | Modal share walking | 10 |

| | | | |
|---|---|---|---|
| City | Sofia | Private car | 33.5 |
| Population | 2300000 | Public transport | 39.3 |
| Number of commuters | 800000 | Active modes | 24.9 |
| Shared mobility services | Car sharing | Bike sharing | E - scooter sharing |
| Number of shared vehicles | 972 | 777 | 465 |
| Percentage of electric vehicles in the shared cars fleet (%) | 80 | | |

*Figures 3,4: Calculation examples using the tool*

# Lessons learned

The scope of this work done in the context of the SuSMo poject is to look at the evaluation process of the impacts of shared mobility from a city perspective, in the direction of assisting decision-makers in the challenging process of selecting the most suitable method or combination of methods to apply to assess the impacts of shared mobility. We classified the main categories of options that can be used to evaluate the impact of shared mobility in a clear format to be helpful to city authorities and decision-makers; the people who often face the difficult decisions regarding the implementation of shared mobility programs.

The tool developed afterwards and presented herein aims at providing city authorities and decision-makers with a simple, user-friendly, and flexible way to explore different future scenarios and the associated impacts that shared mobility can bring to their city, by trying out different combinations of shared modes and how these combinations influence the $CO_2$ footprint of their city.

The urgent need for a tool that can be tailored-made to each city but also easily adaptable to a case-by-case basis emerged from our desk literature review research but also from the contact with the SuSMo partners cities. Being aware of certain limitations of the tool, we believe that it can act as an important first step towards the development of a comprehensive, multi-perspective evaluation framework that can be applied to assess the full range of impacts that urban shared mobility entails in cities in Europe.

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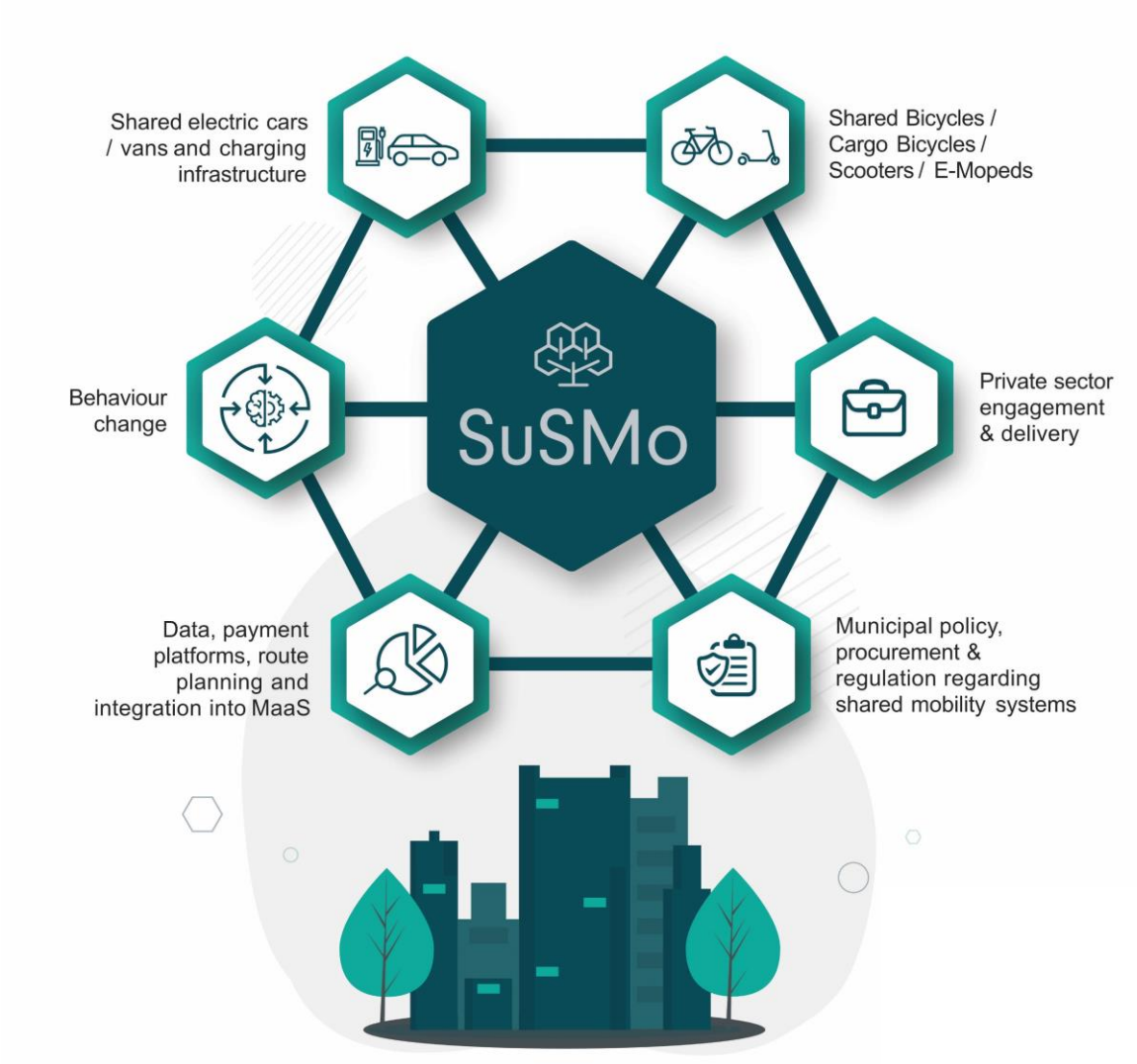
# Impact evaluation of shared mobility

**Being able to calculate the potential reductions of $CO_2$ emissions with the use of shared mobility is the first step for cities in understanding in metrics how novel transport modes impact the urban landscape. Planning can now be backed up with calculations and exploration of different scenarios prior to decision making.**





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