The European City Calculator

CliMobCity2050
Final Dissemination Event
19, 20 & 21 June 2023
Leipzig

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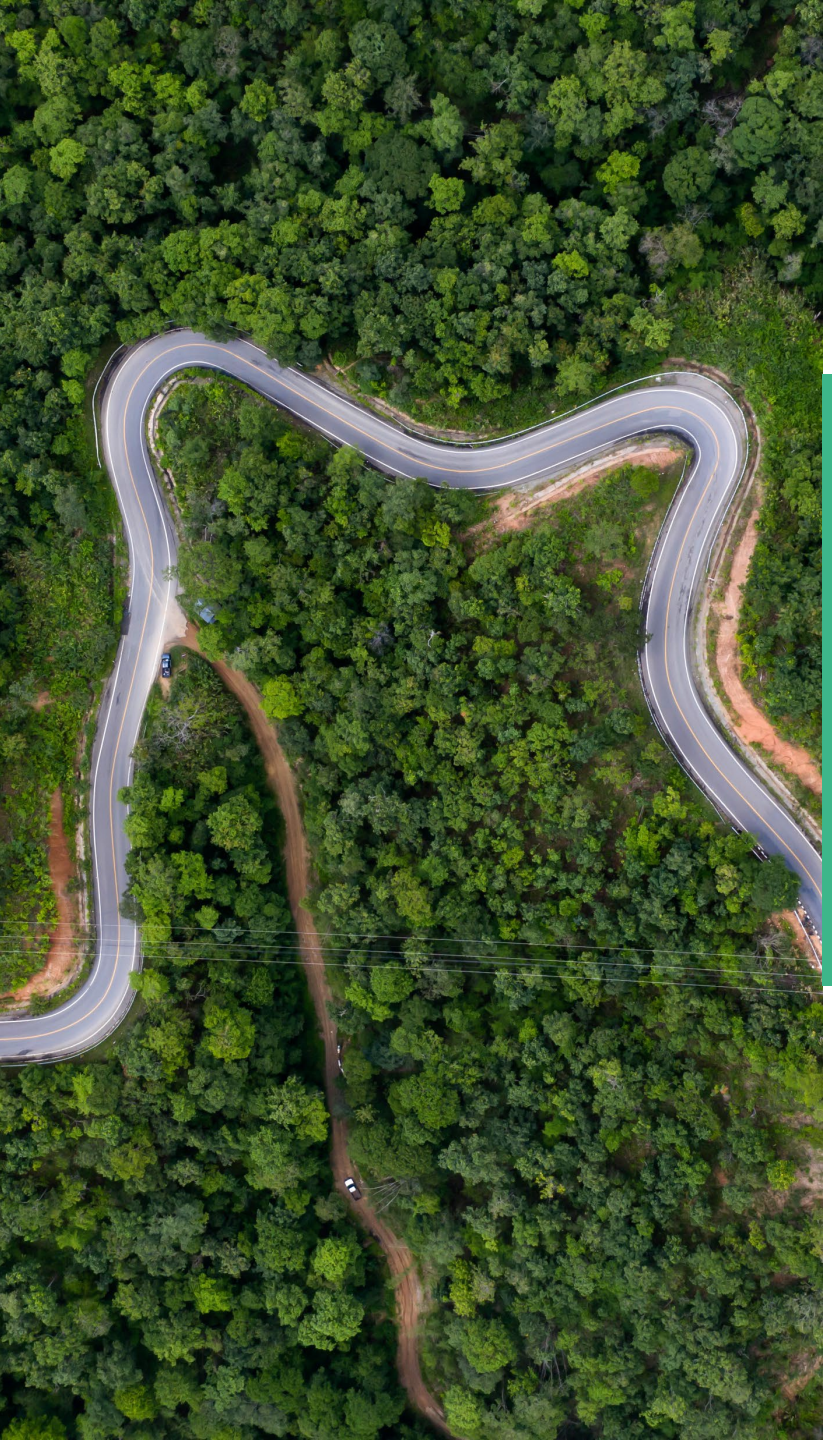
Potsdam Institute for Climate Impact Research (PIK)

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 101022965



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Model-view vs city-view

Implementing measures in the energy model
Introducing measures in the energy model
List of measures and quantification logic
Different options for measure implementation

Webtool
General overview
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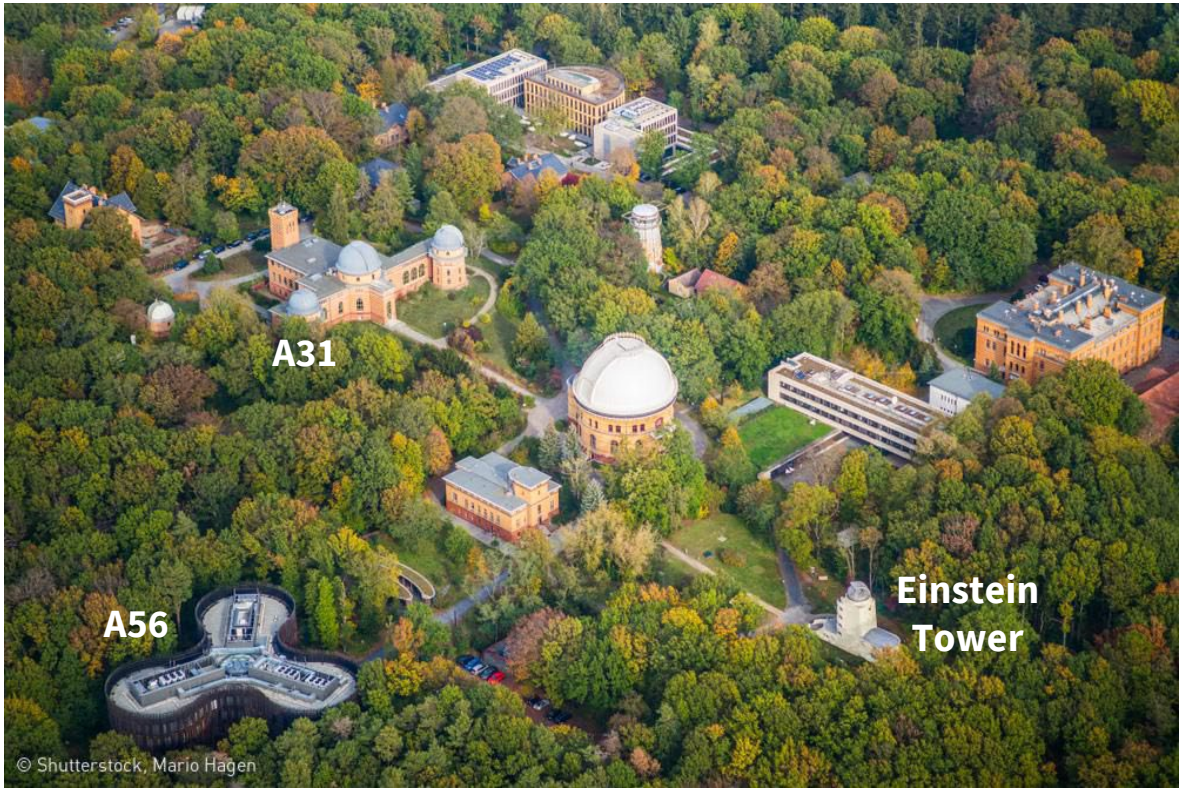
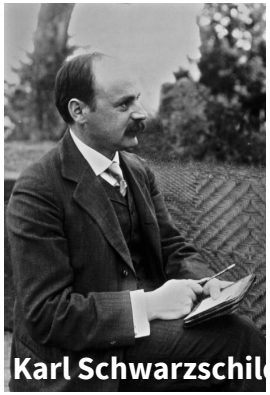
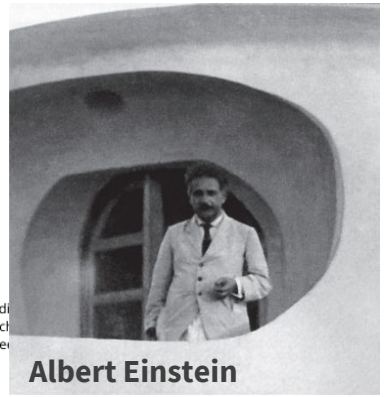
1. Introduction

Potsdam Institute for Climate Impact research (PIK)

- Founded in 1992, located at the *Wissenschaftspark Albert Einstein*
  - **Currently ~400 staff (261 scientists)**
- Advancing scientific frontier on **inter-disciplinary climate impact** research for global sustainability.
- Contributing **knowledge and solutions** for a safe and just climate future.







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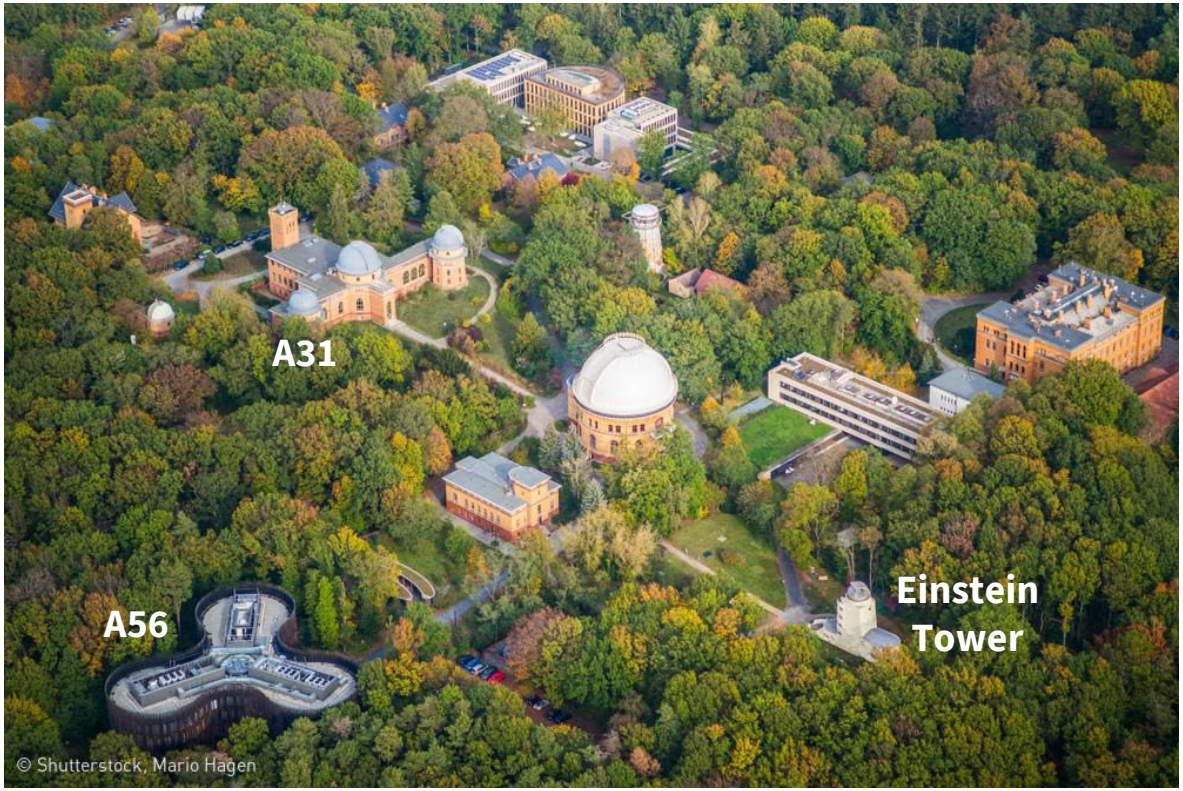
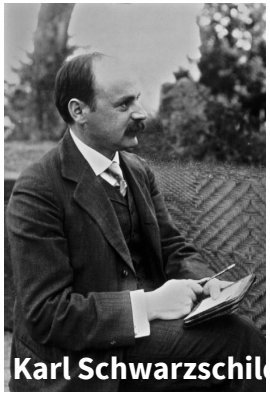
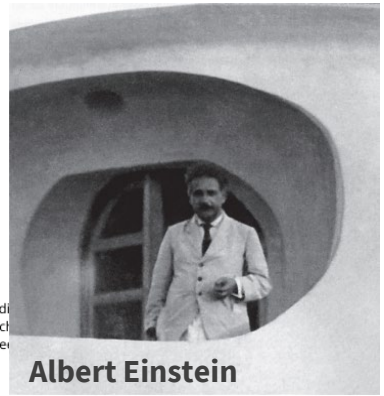
Potsdam Institute for Climate Impact research (PIK)



Climate and resilence





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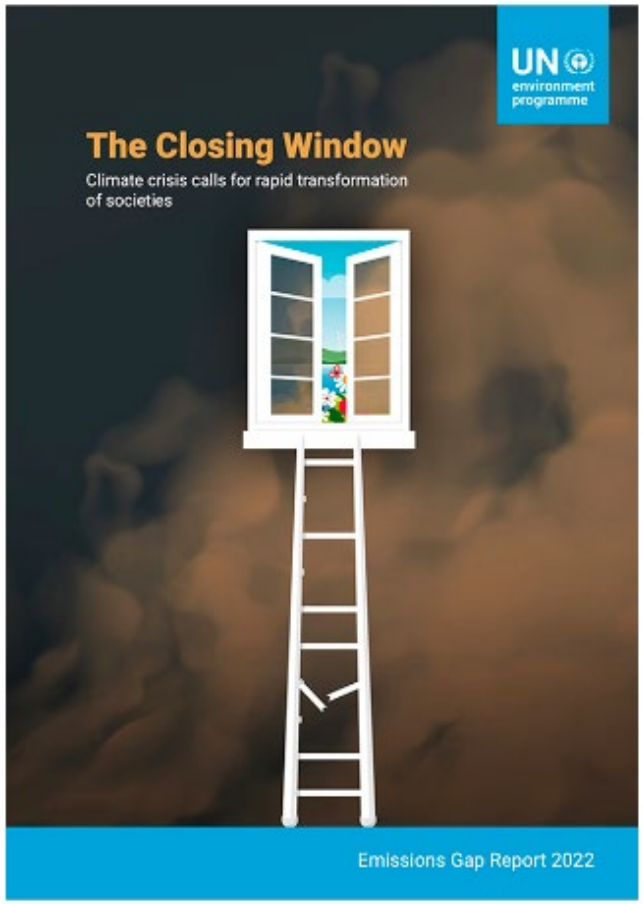
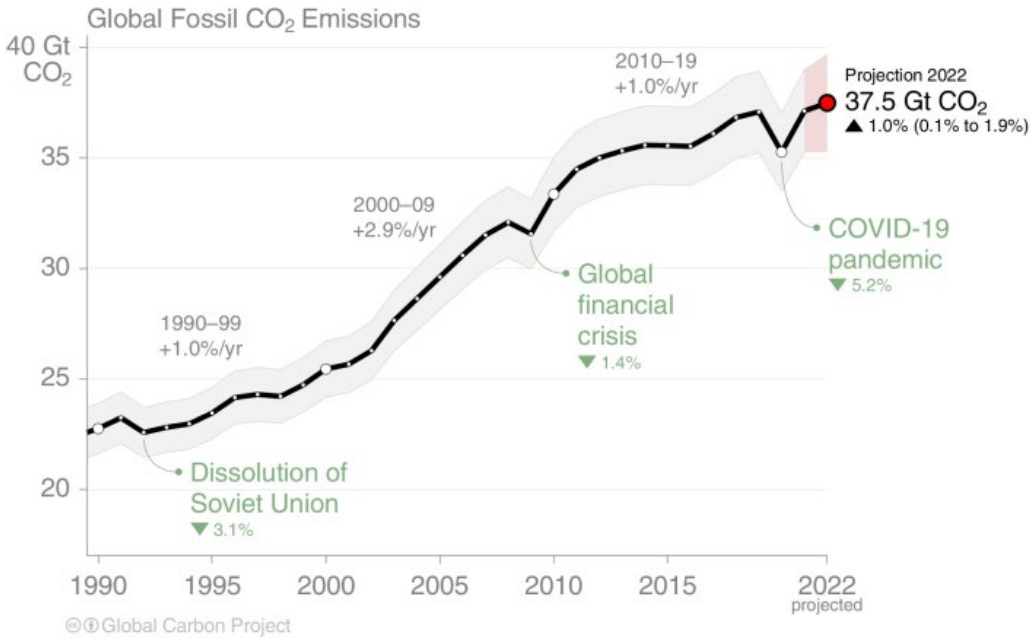
Global mitigation goes slow…

"*Despite a call for strengthened **Nationally Determined Contributions** (NDCs) for 2030, **progress since COP26** in Glasgow has been **woefully inadequate***".





+1% emissions growth in 2022.

- **India +6.0%**
- **USA +1.5%**
- **EU -0.8%**
- **China -0.9%**

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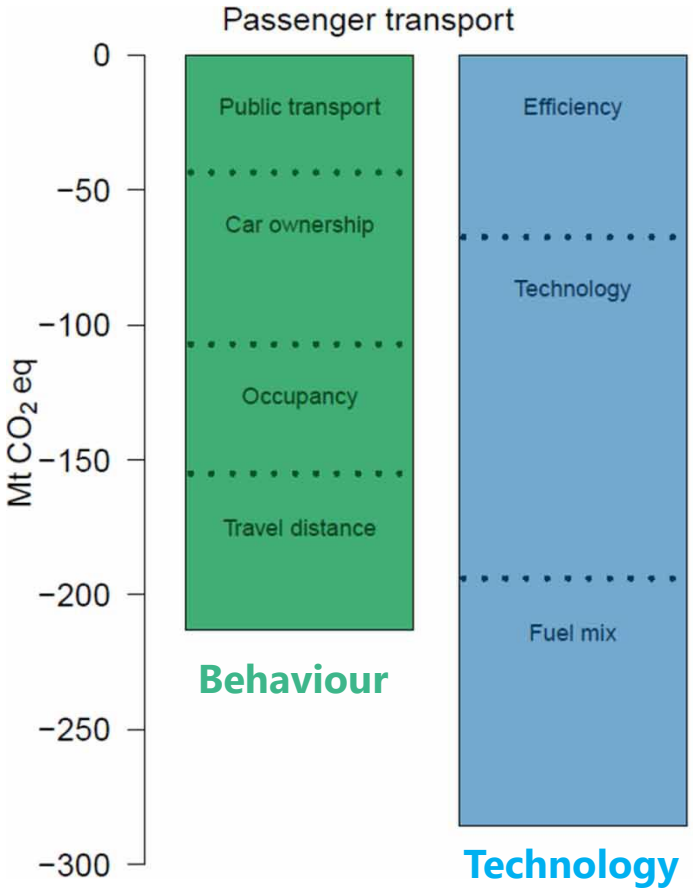
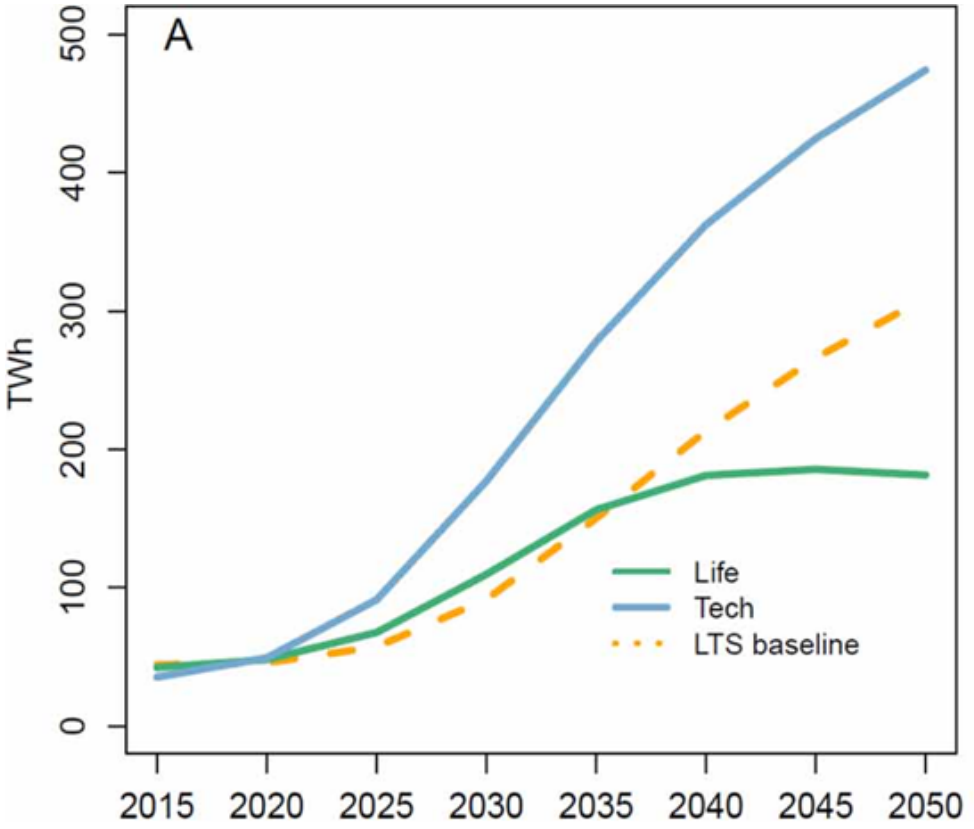
Insights from EU/national energy modelling...

GHG savings from EU's passenger transport (2050 vs 2015)



Electricity demand from EU's transport sector



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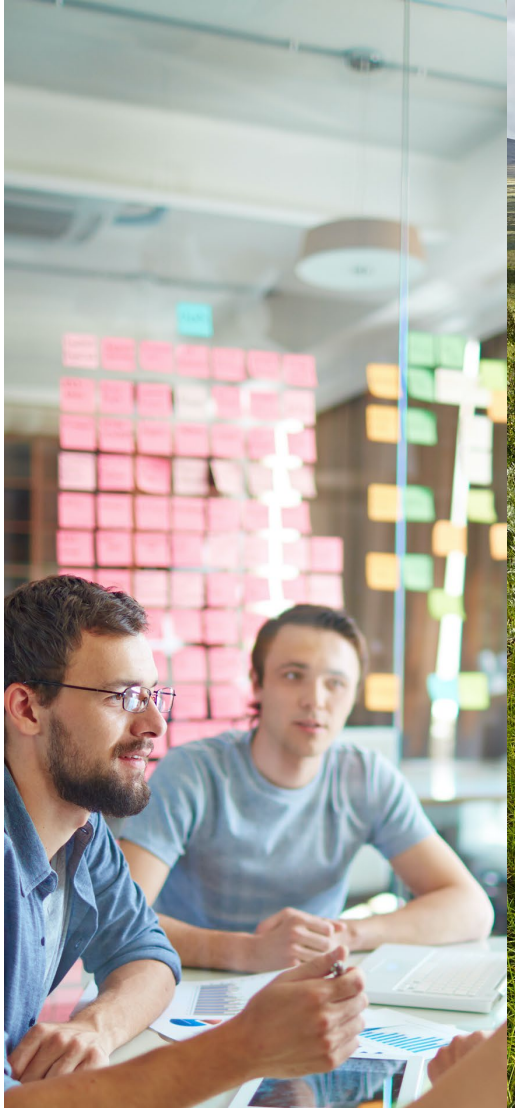
EUCityCalculator supports cities creating their climate strategy

Bring integrated energy-modelling capacities to small and medium-sized cities.

Allow cities to independently test the CO2 reductions associated with specific measures.

Facilitate the elaboration of Sustainable Energy and Climate Action Plans of cities (SECAPs).

Track city-progress to Net-Zer other National targets.



User oriented

Easy-to-use interface with step-by-step guidance

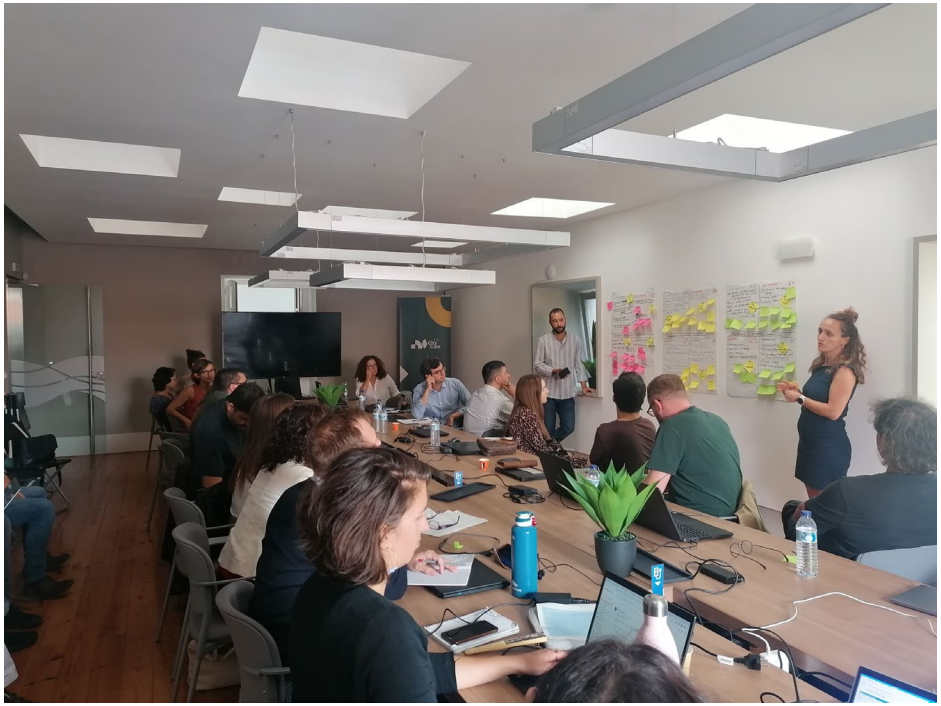
Robust

Energetic model approach more than 10 years

EUCityCalc is beeing developed in close interaction with pilot cities

9 Pilot cities

Setúbal 2022



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EUCityCalc is beeing developed in close interaction with pilot cities

11 partners

ENERGYCITIES

CLIMACT

Carbon Market Watch

COMUNE DI MANTOVA

DIJON métropole

ENA

ŽĎÁR NAD SÁZAVOU

SEMMO

Regional Energy Agency North

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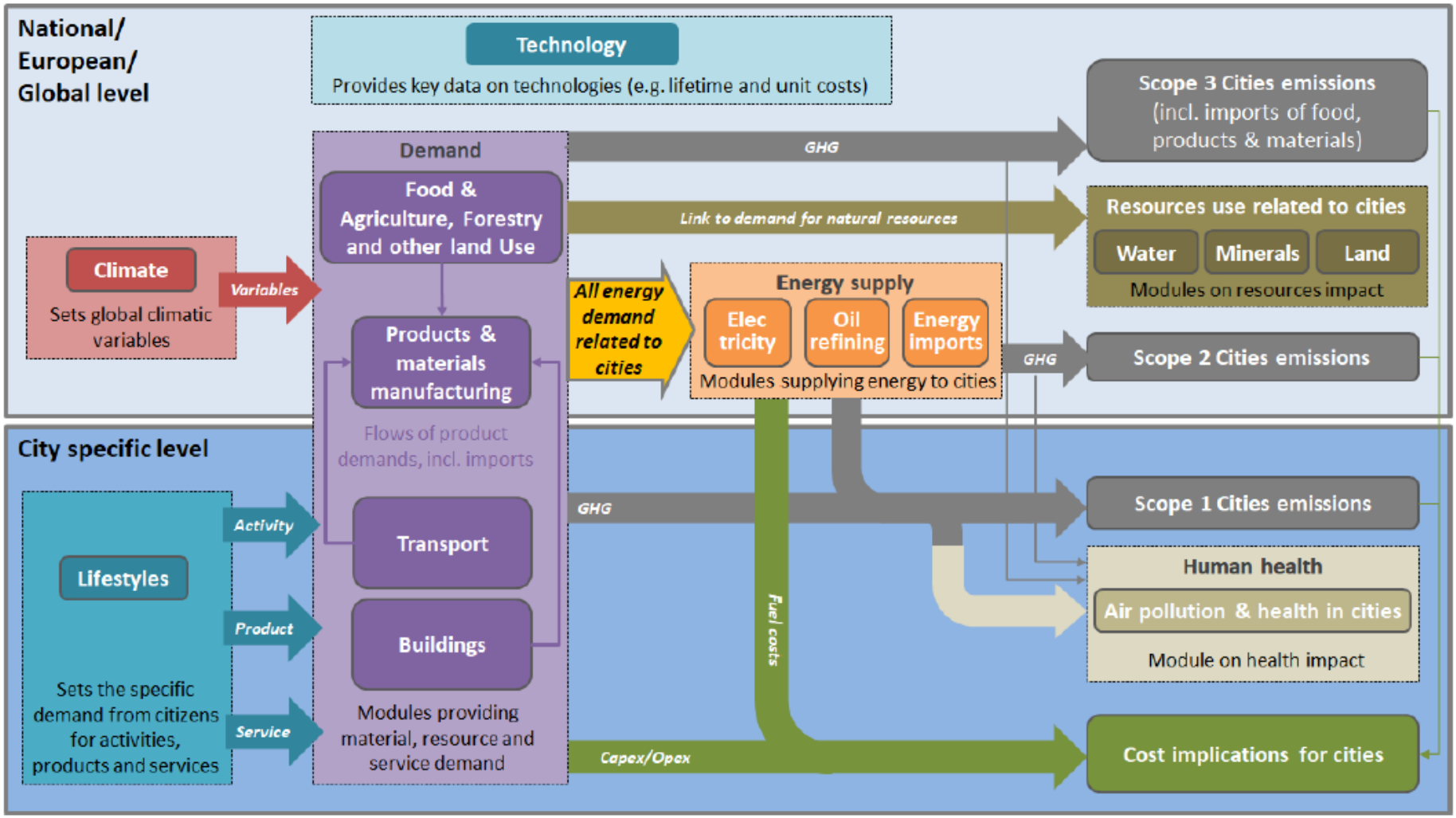
2. Model archietecture

EUCityCalculator model: interactions between sectors & scales.



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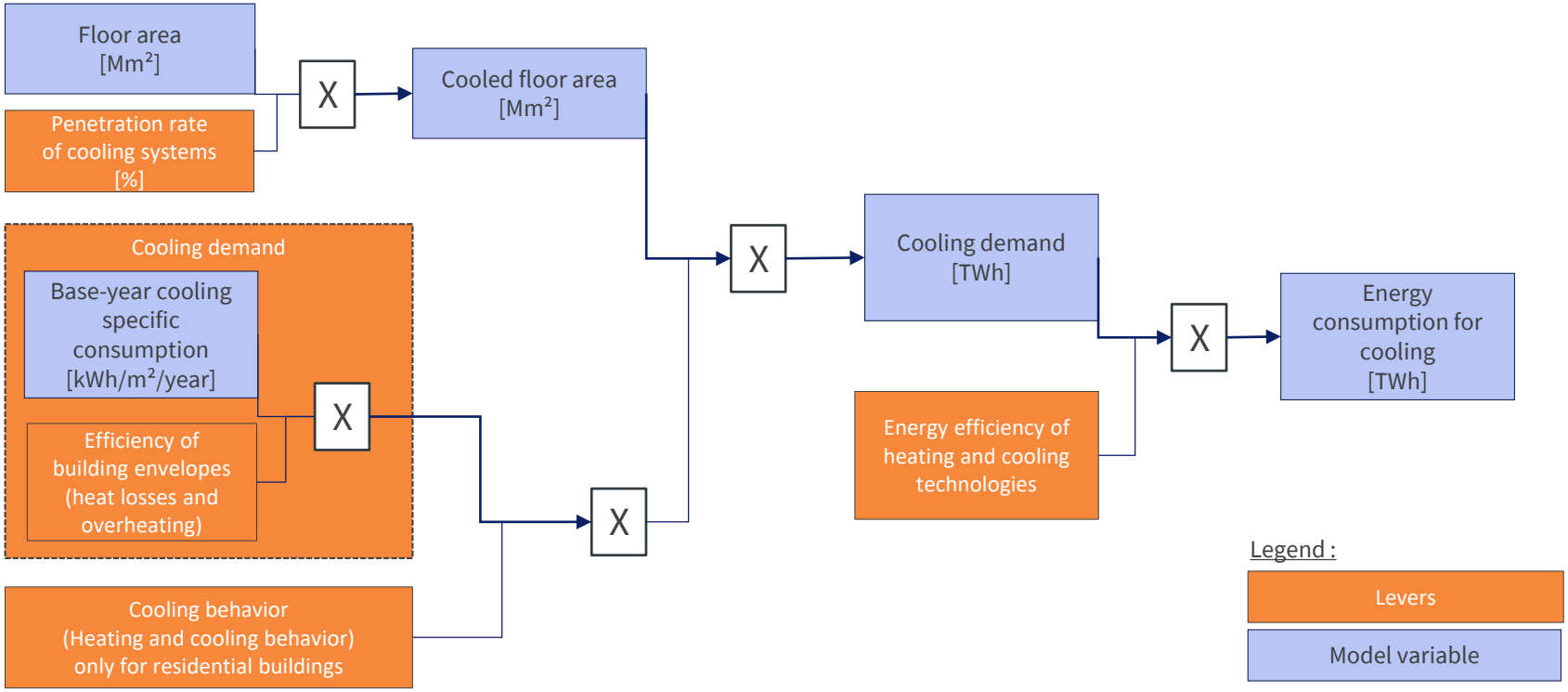
Example of calculation tree for energy consumption on residential buildings – related to cooling demand



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Example of calculation tree for energy consumption on residential buildings – related to cooling demand

Floor area [Mm²]

Penetration rate of cooling systems [%]

X

Cooled floor area [Mm²]

X

Cooling demand [TWh]

X

Energy consumption for cooling [TWh]

envelope

X

Smart-meters

heat-pumps

Legend :

Levers

Model variable

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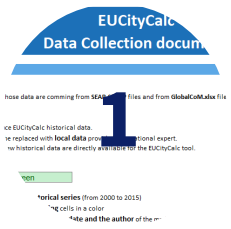
Data crawling

Our heritage, a hierarchy of data

Local data
(specific and accurate but difficult to get and only specific years)

Global data
(proportional or copy)

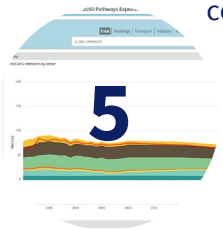


City Experts
internal data

SECAP data
internal data

GCoM
consolidated file
external data

Regional
databases
external data



Pathways Explorer
for national data
external data

EUCityCalc
database

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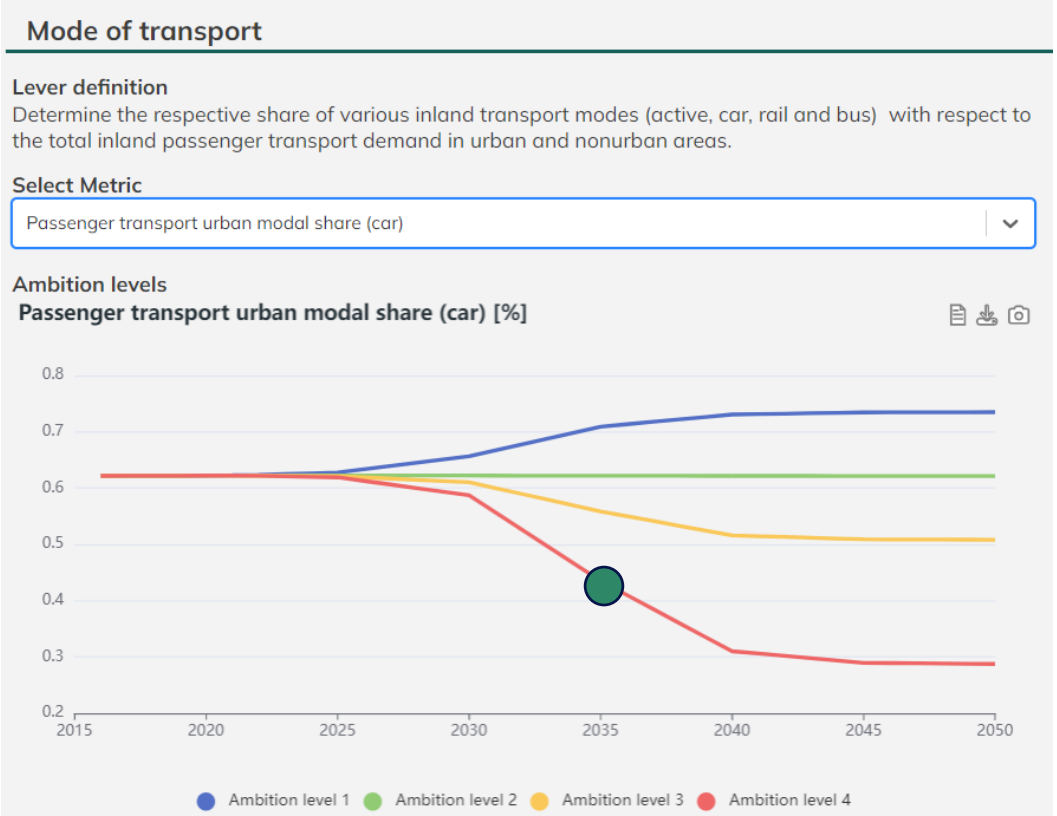
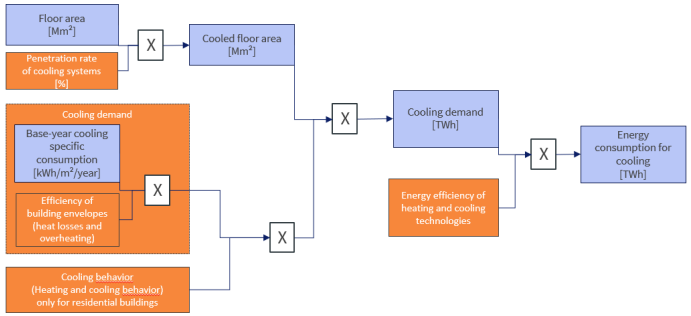
3. Implementing measures in the energy model

Introducing city measures in the energy model



- Simulation model that converts changes in a lever into savings of energy and emissions



Changes in energy and GHG in the transport sectors (and others…)

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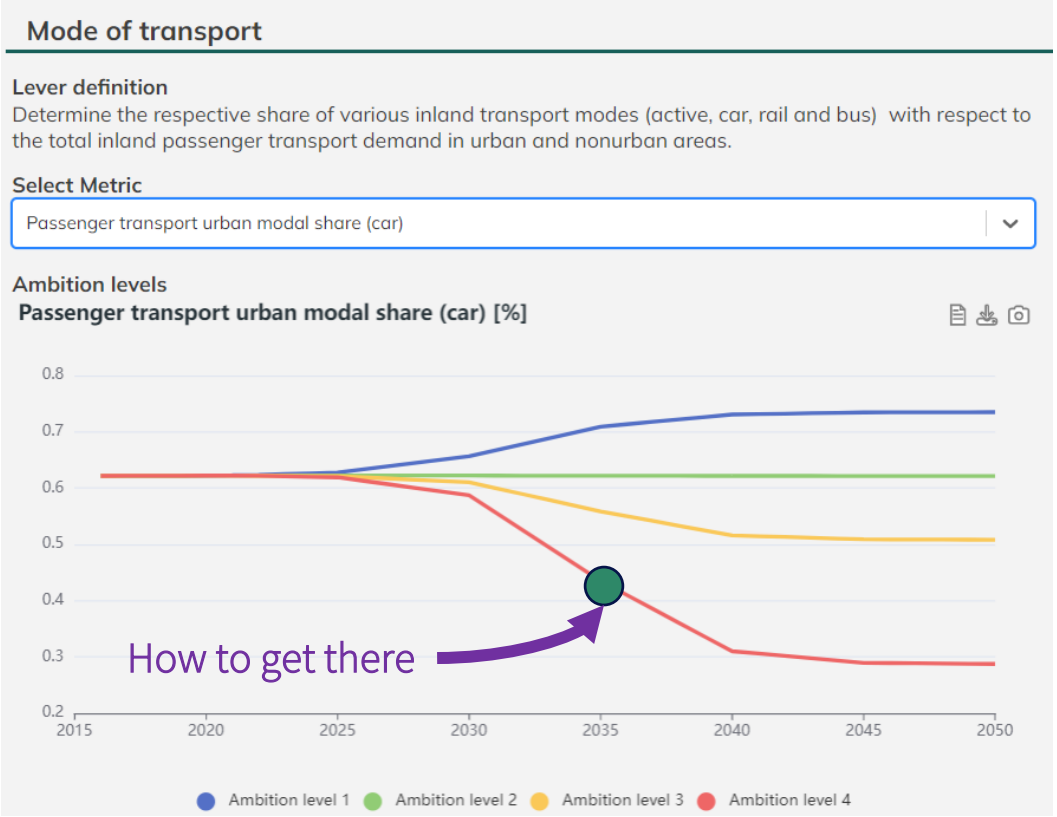
Introducing city measures in the energy model



- Simulation model that converts changes in a lever into savings of energy and emissions
- It is not a policy model, that is, it does not inform what policies/measures may help you to achieve the goal.

Changes in energy and GHG in the transport sectors (and others…)

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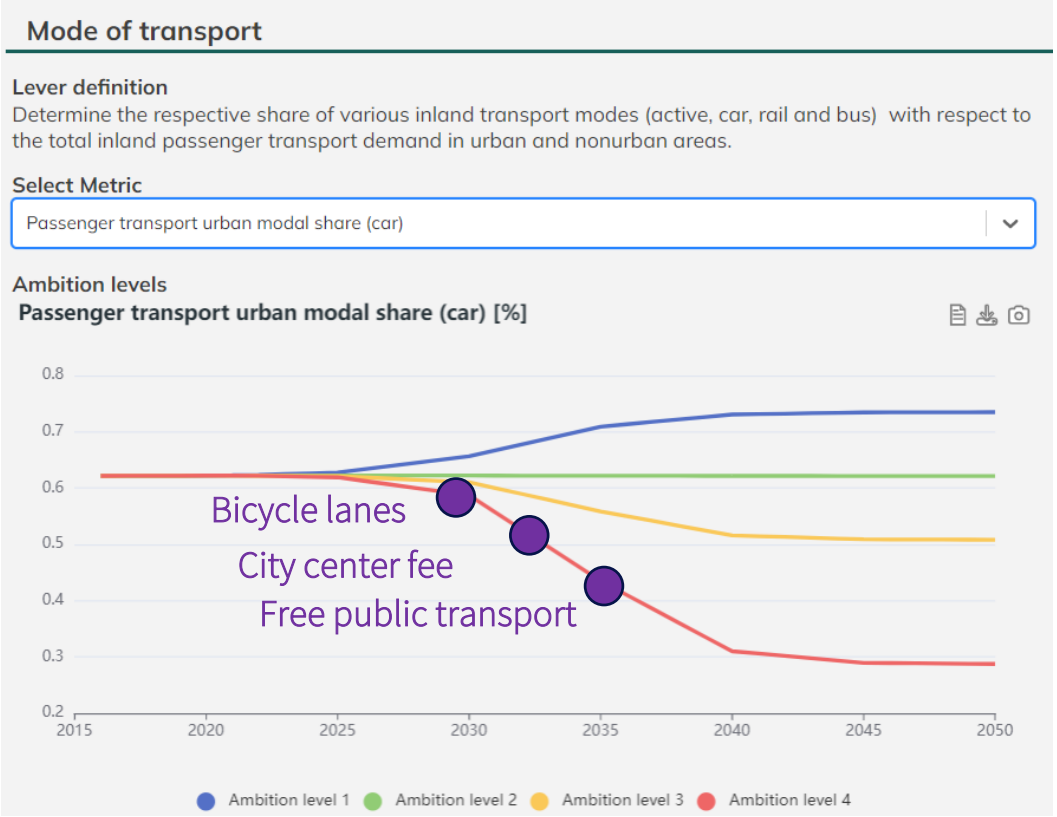
Introducing city measures in the energy model



- Simulation model that converts changes in a lever into savings of energy and emissions
- It is not a policy model, that is, it does not inform what policies/measures may help you to achieve the goal.
- Translating the effect of concrete measures into changes in levers.
  - As far as possible based on real-world examples.
  - Not always possible for all measures.

Changes in energy and GHG in the transport sectors (and others…)

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Introducing city measures in the energy model

Matrix to convert measures into changes in levers

Measures

Levers

Measure	City/panning specificities	Time	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15
Free public transport	70% of public transport is provided by buses	2	0	0	0	0	0	-6	4	2	0	0	0	0	0	4	0
Low emission zones	Ban on ICE with standards lower that EURO4	3	5	54	1	3	-1	-17	4	12	5	5	21	-4	0	4	0
Congestion charges (City-center fee)	NA	4	0	0	0	0	0	0	0	0	0	0	0	-10	0	0	0
Cycle lanes	NA	14.5	0	0	0	0	0	0	0	0	0	136	0	0	74	0	0
Cycling systems	4000 hab/km2	7.7	0	0	0	0	0	-5	-11	0	-6	18	0	0	0	0	0
Charging stations	500 charges/million habitants	0.8	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0
Mobility services (Maas) - ridesharing	Ride sharing	5	0	0	0	0	0	2	-5	0	-5	-5	0	0	0	0	8
Compact city	Increasing city density by 50%	20	0	0	0	0	0	-14	0	0	0	0	0	-15	0	7	0
Establishing new eco-districts	10 % of building stock constructed as Ecodistrict	0	0	0	0	0	0	5	5	0	3	0	0	0	0	0	0

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Introducing city measures in the energy model

Matrix to convert measures into changes in levers

passenger transport urban modal share (LDV)
passenger transport urban modal share (bus)
passenger transport urban modal share (rail)
passenger transport occupancy (bus)

Levers

Measures

Measure	City/panning specificities	Time	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15
Free public transport	70% of public transport is provided by buses	2	0	0	0	0	0	-6	4	2	0	0	0	0	0	4	0
Low emission zones	Ban on ICE with standards lower that EURO4	3	5	54	1	3	-1	-17	4	12	5	5	21	-4	0	4	0
Congestion charges (City-center fee)	NA	4	0	0	0	0	0	0	0	0	0	0	0	-10	0	0	0
Cycle lanes	NA	14.5	0	0	0	0	0	0	0	0	0	136	0	0	74	0	0
Cycling systems	4000 hab/km2	7.7	0	0	0	0	0	-5	-11	0	-6	18	0	0	0	0	0
Charging stations	500 charges/million habitants	0.8	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0
Mobility services (Maas) - ridesharing	Ride sharing	5	0	0	0	0	0	2	-5	0	-5	-5	0	0	0	0	8
Compact city	Increasing city density by 50%	20	0	0	0	0	0	-14	0	0	0	0	0	-15	0	7	0
Establishing new eco-districts	10 % of building stock constructed as Ecodistrict	0	0	0	0	0	0	5	5	0	3	0	0	0	0	0	0

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23 measures have already been quantified (1/2)

	Measure	Description	Sector	Type
1	Free public transport	Provision of free public transport	Transport	Regulatory
2	Low emission zones	Implement a Low Emission Zone (LEZ) in the city center	Transport	Regulatory
3	City-center fee	Implement a city-center entry fee	Transport	Regulatory
4	Cycle lanes	Enlarge network of bicycle lanes by constructing or marking new bicycle lanes	Transport	Infrastructural
5	Bike-sharing/use	Increase number of bicycle hire stations and promote the use of bicycle	Transport	Infrastructural
6	Low emission vehicles	Increase the number of low emission vehicles operated by, or on behalf of, the municipality	Transport	Technology
7	Charging stations and free parking for EVs	Increase the number of charging stations for electric vehicles	Transport	Infrastructural
8	Compact urban planning	Increase the urban density of services	Transport	Infrastructural
9	Eco-districts	Establishing new eco-districts or convert existing districts to eco ones	Buildings	Infrastructural
10	Renovation of residential buildings	Improve the energy standards of residential buildings via renovation	Buildings	Infrastructural
11	Renovation of public buildings	Improve the energy standards of public buildings via renovation	Buildings	Infrastructural
12	Strengthening building codes	Strengthening of energy building codes for new constructions	Buildings	Regulatory
13	Supporting solar collectors in residential buildings	Introduction of heat pumps and solar collectors	Buildings	Infrastructural
14	Installing solar collectors in public buildings	Introduction of heat pumps and solar collectors	Buildings	Infrastructural
15	Heatpumps in residential buildings	Introduction of heatpumps	Buildings	Infrastructural

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23 measures have already been quantified (2/2)

	Measure	Description	Sector	Type
15	Heatpumps in public buildings	Introduction of heatpumps	Buildings	Infrastructural
17	Expand district heating	Increase the number of buildings connected to district heating network	Buildings	Infrastructural
18	Introduce smart meters	Introduce smart metres in residential and non-residential buildings	Buildings	Regulatory
19	Reduce natural gas use in centralized heat production	Reduce natural gas in centralized heat production	Energy	Infrastructural
20	Reduce coal use in centralized heat production	Reduce coal in centralized heat production	Energy	Infrastructural
21	Increase share of renewable energy	Increase share of renewable energy	Energy	Infrastructural
22	Waste prevention and separation	Encouraging waste prevention and separation	Consumption	Information
23	Urban farming/gartening	Establishing urban agriculture/gartening initiatives	Consumption	Infrastructural

23 measures
3 options of implementation

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For each measure the project specifies assumptions, model logic and (when available) the unit costs.

Measure: Bike sharing and use

Assumptions and sources

The effect of the introduction of different bike-sharing systems on modal shift was evaluated by **Ma et al, (2020)** for the Netherlands, a country where the adoption of such systems enjoys a long tradition and empirical data is available. For the Netherlands, it was noted that the introduction of bike-sharing schemes has lead on average to a replacement of bus/tram/train transport by bicycles in the order of 11.5%. Other significant changes have been quantified for the replacement of walking by bicycles in the order of 6.4% **Ma et al, (2020)**. Similar shifts were also noted across different socio-economic and cultural contexts. **Fishman et al, (2014)** reports that bike-sharing programs translated into mode substitution primarily via an average decrease of 40% in the number of users of public transportation (...)

Modeling logic

Compiling the values of % car shift to bicycle for 10 cities reported in the literature (see section Assumptions and sources) and population density in hab/km2, and empirical exponential function was constructed to estimate the potential car-to-bicycle shift for any city with population density between 100 and 6000 hab/km2. We make use of such function to set a corresponding decrease of passenger transport via private car in the energy model do to the introduction of a bike sharing scheme. Reflecting the rationale in section Assumptions and sources, the introduction of bike-sharing systems leads to a penalty in the usage of public transportation (...)

Estimated costs

The real costs of implementing and operating the bicycles are taken from the case of Paris. Paris pays around 4000 euros a year for each bicycle in its Vélib' service reported in **Héran (2015)**.

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Different measure implementation options are provided

Free public transport

Implementation options

Choose between the available options below. By default the most ambitious one is selected.

[Everyone] [Senior and young] [Senior]

Renovation of public buildings

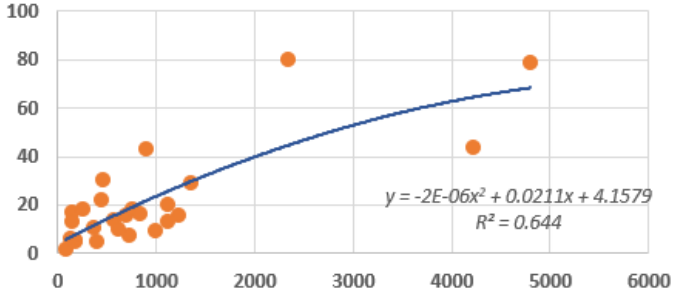
Implementation options

Choose between the available options below. By default the most ambitious one is selected.

[25% of public building stock] [50% of public building stock] [80% of public building stock]

Charging stations for EVs

Public chargers per million hab *vs* % of EV in new car sales for EU cities (for the year 2021)



Implementation options

Choose between the available options below. By default the most ambitious one is selected.

[100 chargers/100000 habitants] [250 chargers/100000 habitants] [500 chargers/100000 habitants]

- Cities were interested in having more choice on how measures are implemented.
- For each measure three options of implementation are (usually) available.
  - Quantitative
    - *Population affected by the measure*
    - *Building stock affected by the measure*
    - *Based on empirical relations*
  - Qualitative
    - *Selecting particular technologies*

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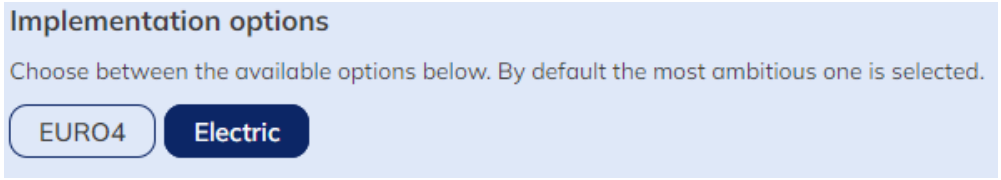
Different measure implementation options are provided

Low/zero emissions zones



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    - *Selecting particular technologies*

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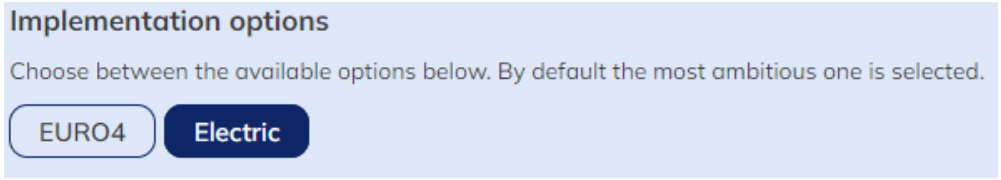
Different measure implementation options are provided



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    - *Based on empirical relations*
  - Qualitative
    - *Selecting particular technologies*

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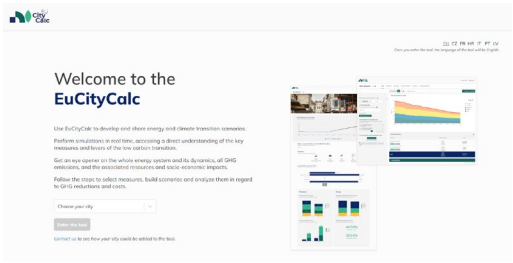
4. Webtool

WEBTOOL: structure



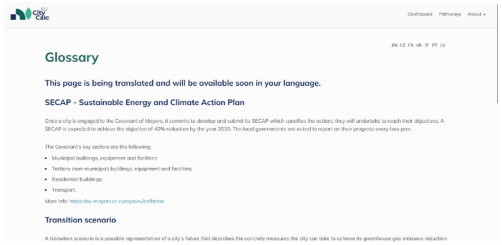
Welcome page

Introduction and basics about the webtool and project

Content of webtool

- Dashboard page
- Pathways page

Build, compare and visualize impacts of scenarios



About

- User guide
- Glossary
- References

How to use the webtool and methodology details

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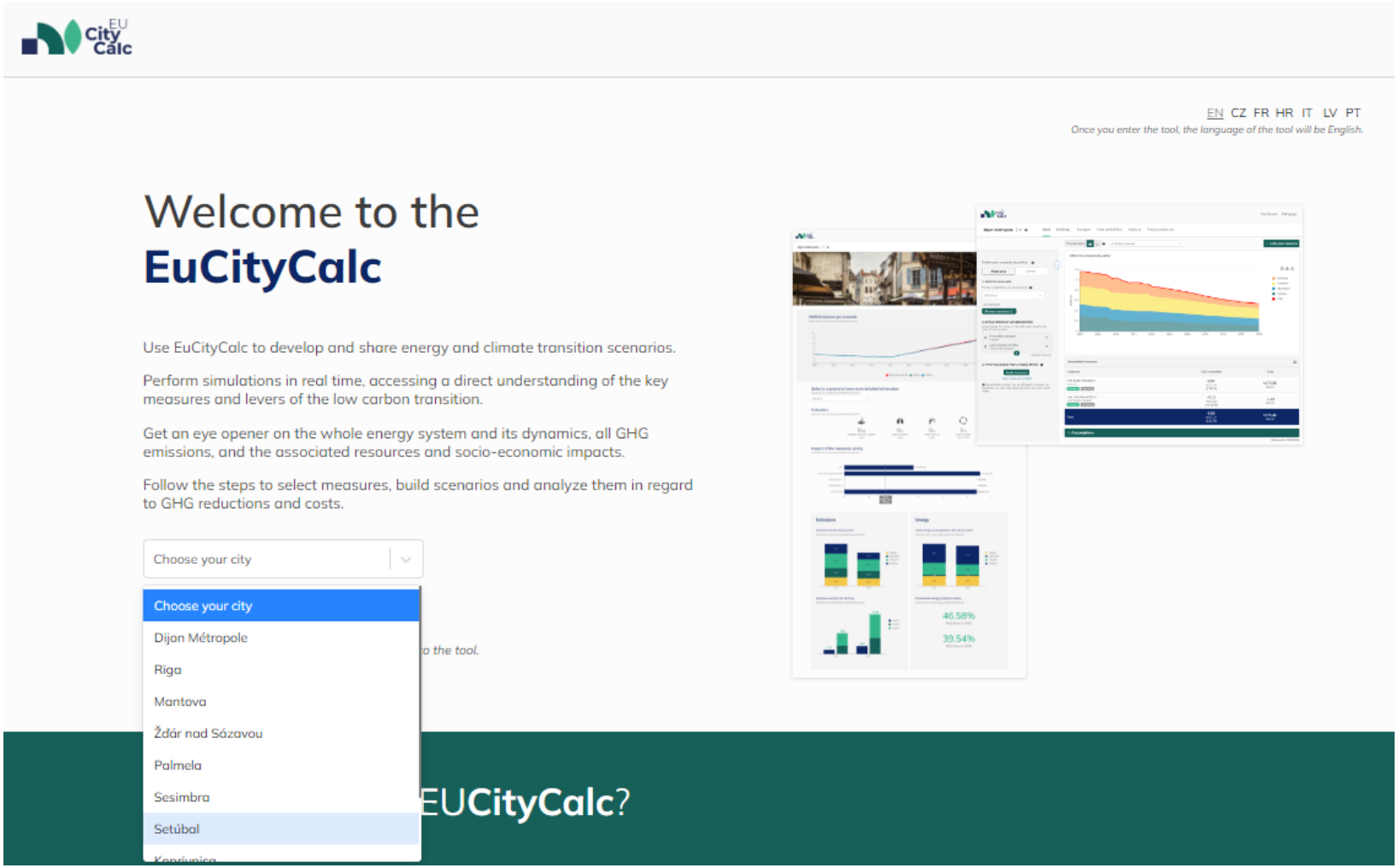
WEBTOOL: Main functionalities



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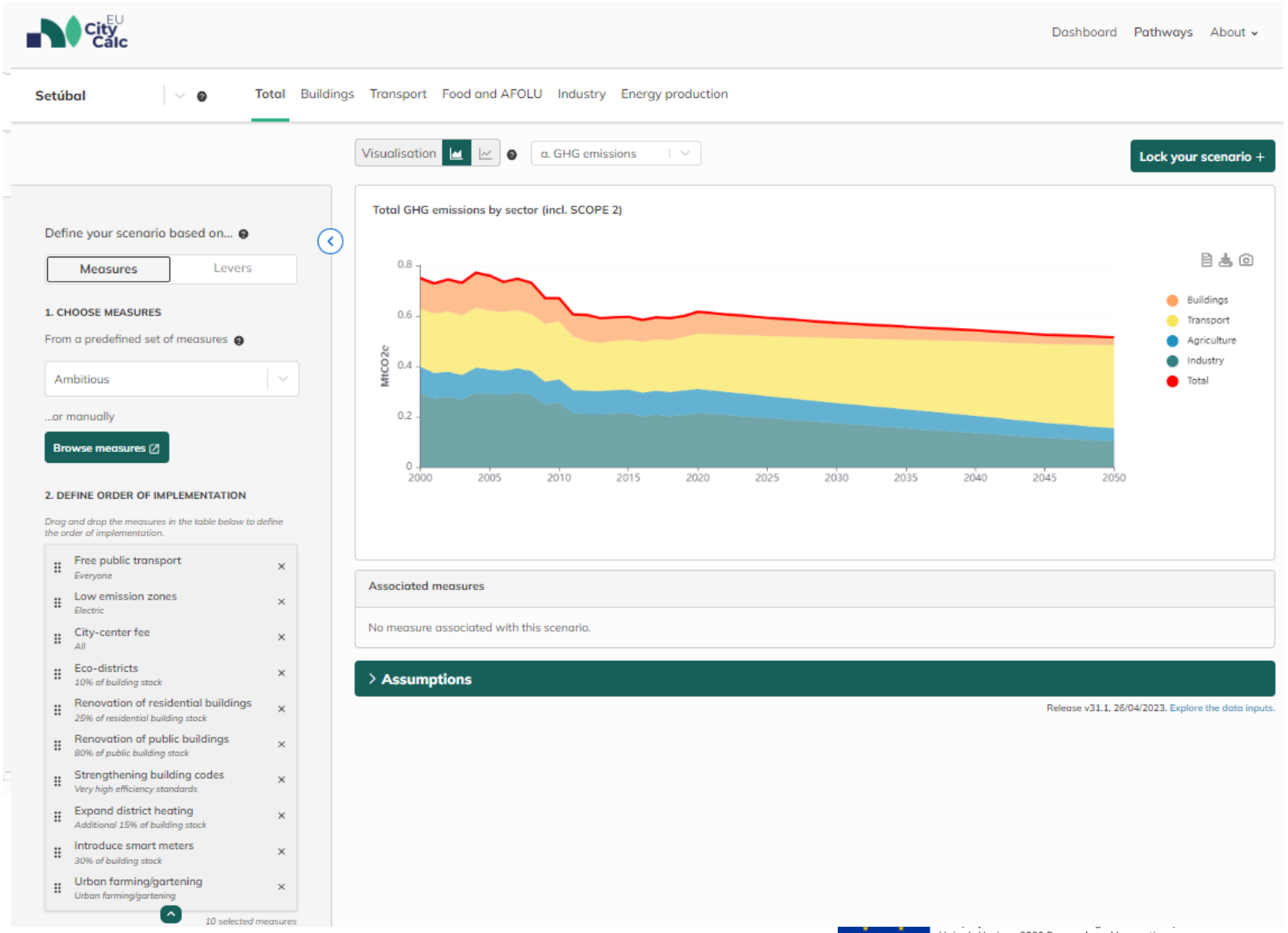
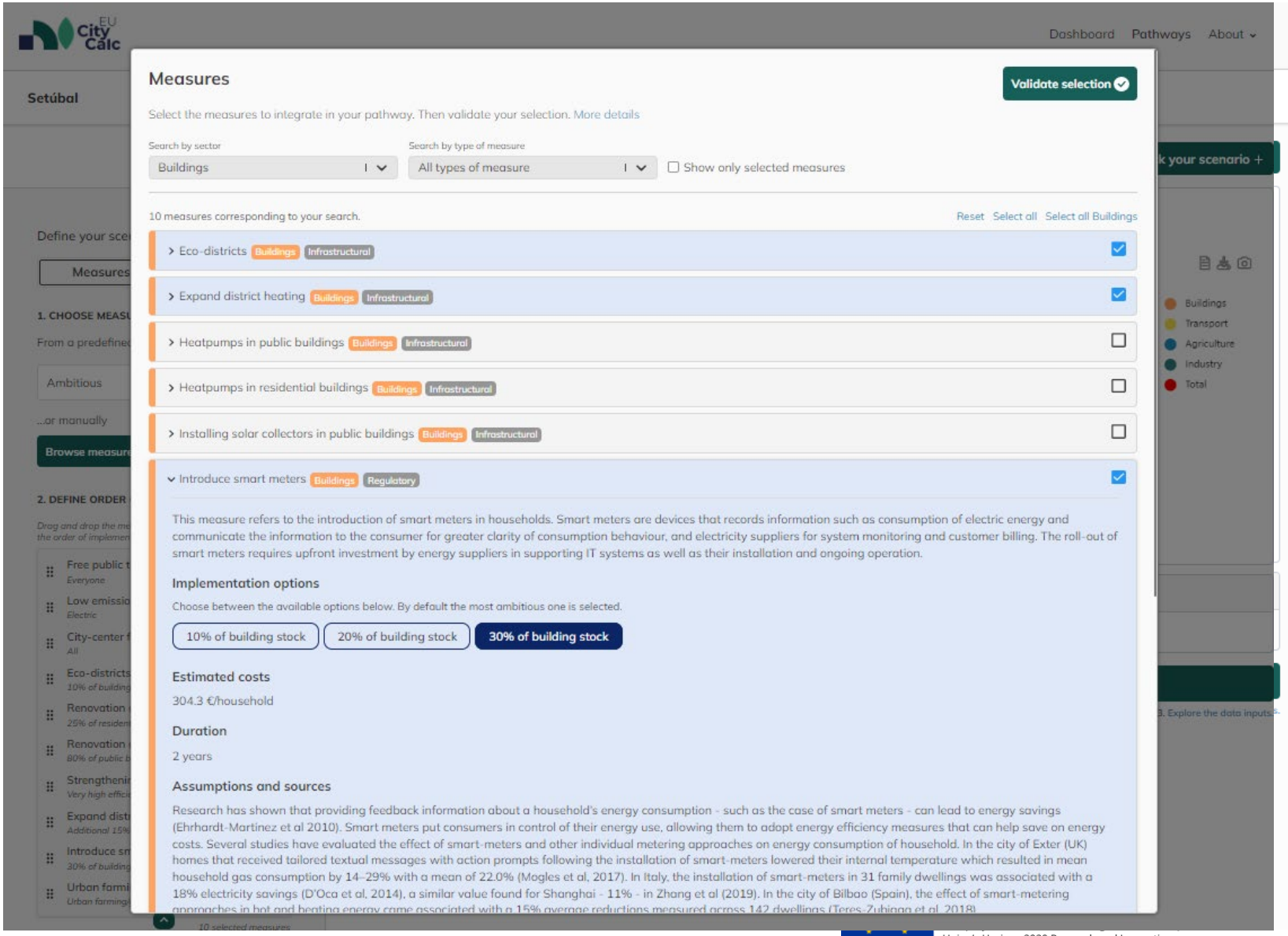


Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 101022965

WEBTOOL: Main functionalities



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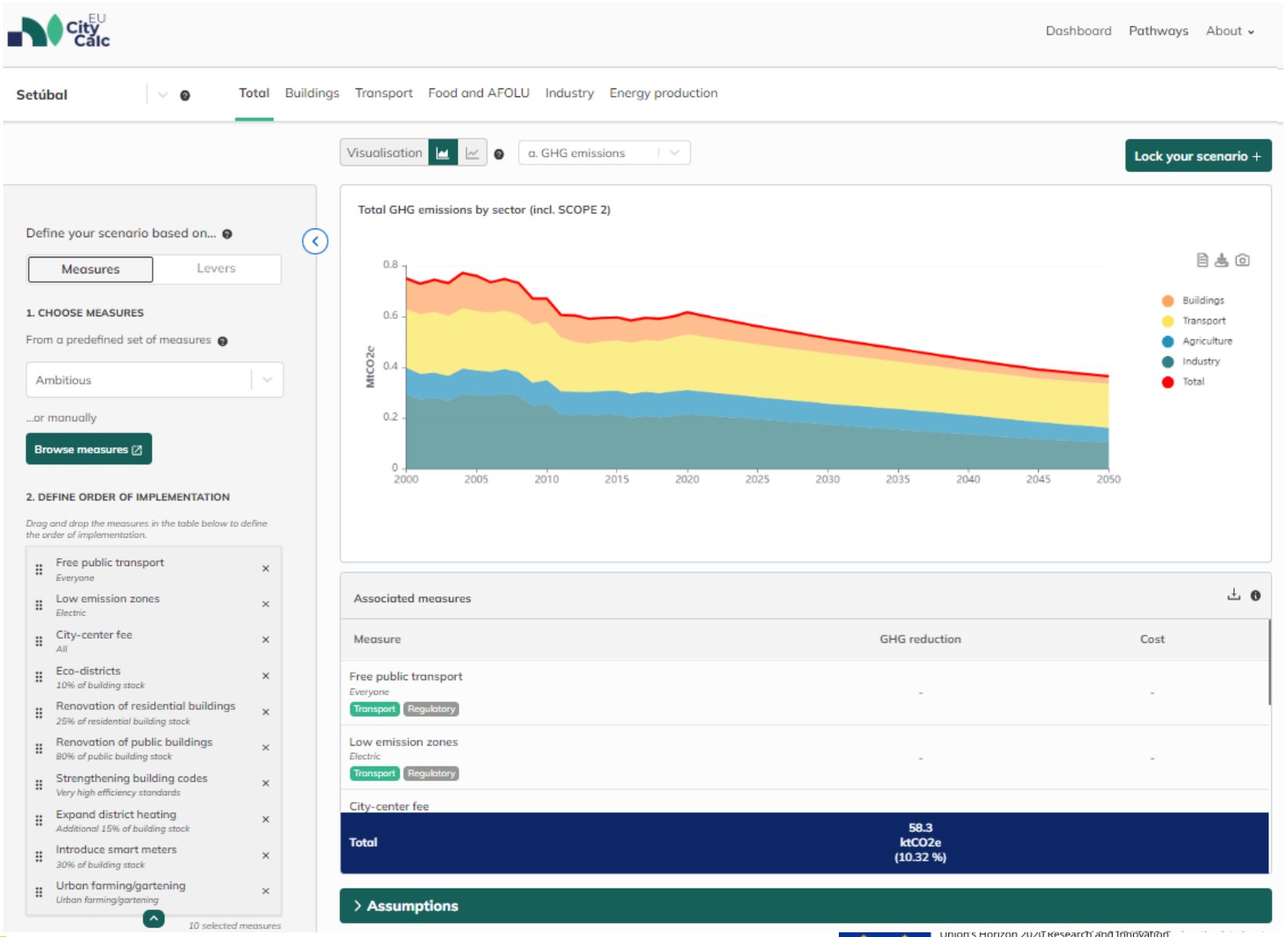

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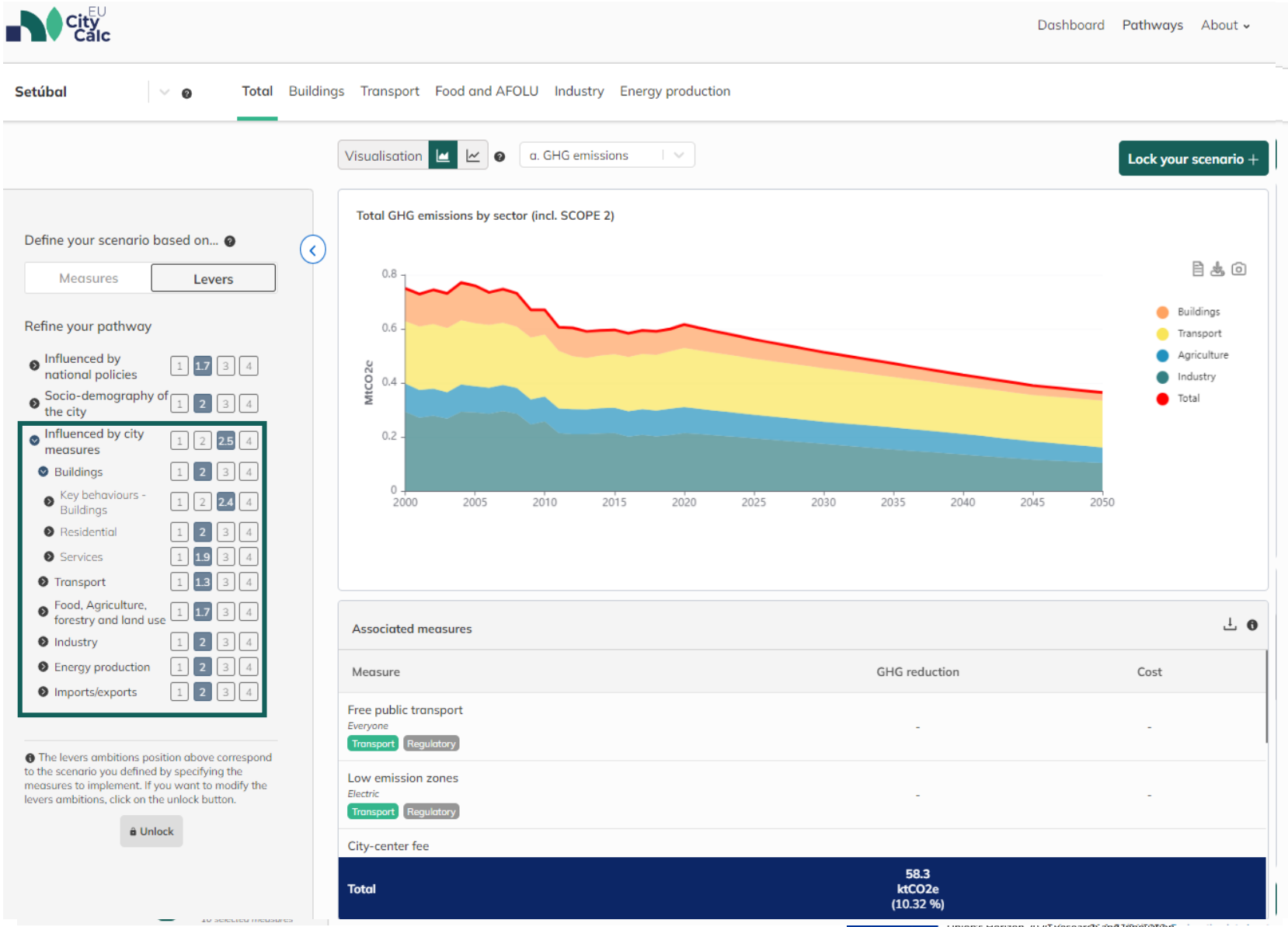

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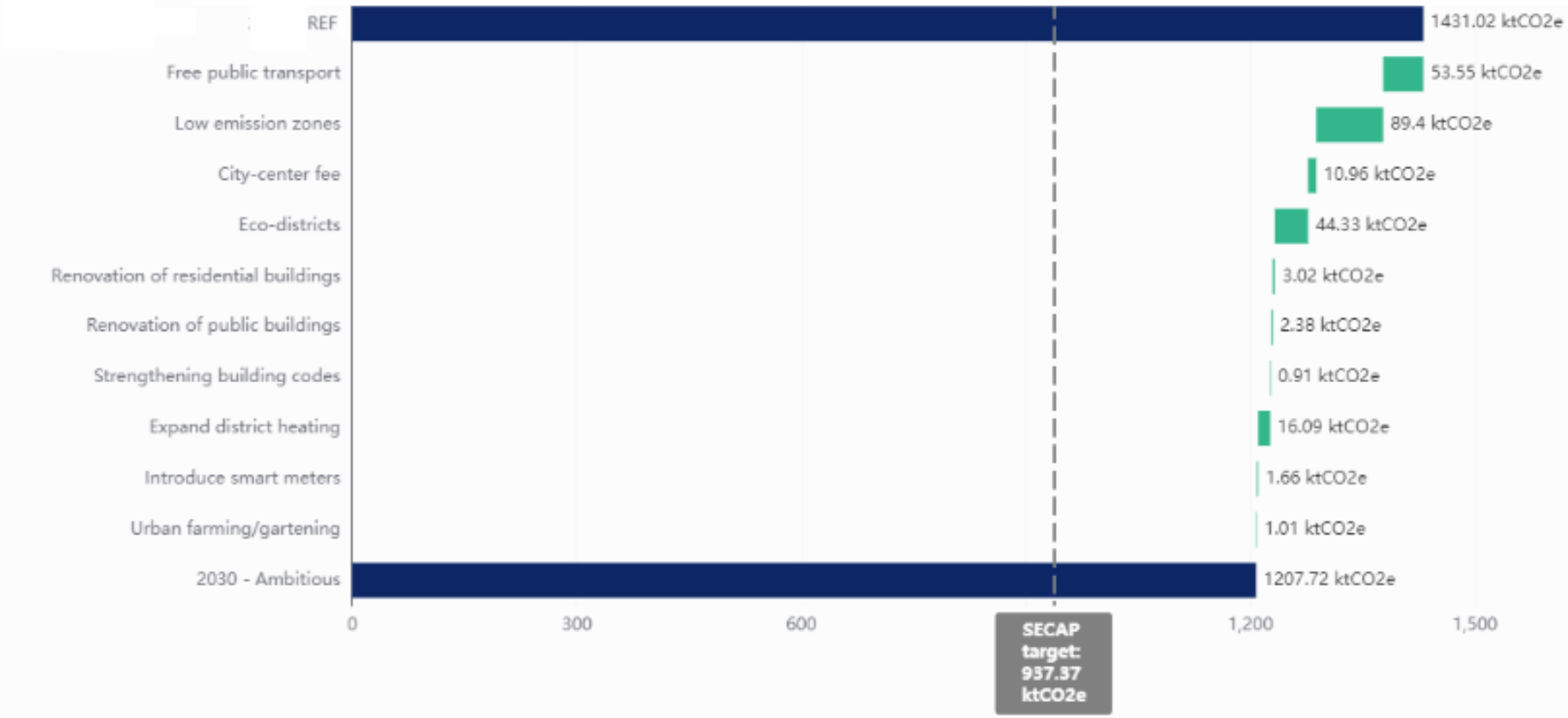
WEBTOOL: Summary visuals

Impact of the measures (GHG) by 2030

Data below are currently being completed and improved.



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What I learned from today & some reflections…

- **Many technology & infrastructure based options, but paltry understanding how people respond to incentives to change travel patterns.**
  - "*we assume that info campaigns lead to attractiveness of shifting from car to other modes*", "*assume we migrate part of the population into the city core*".
  - Behavioral scientist should also participate in these projects to open perspectives.
    - "Citizen-informed" sensitivity rather than exploratory.

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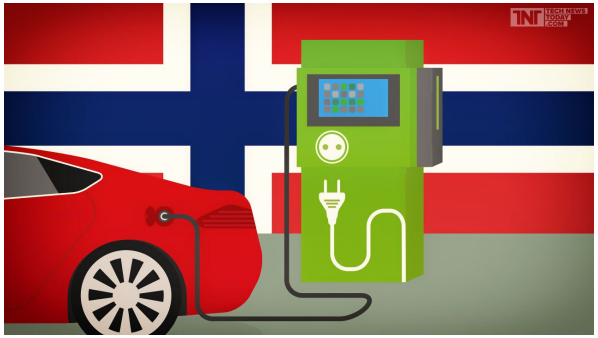
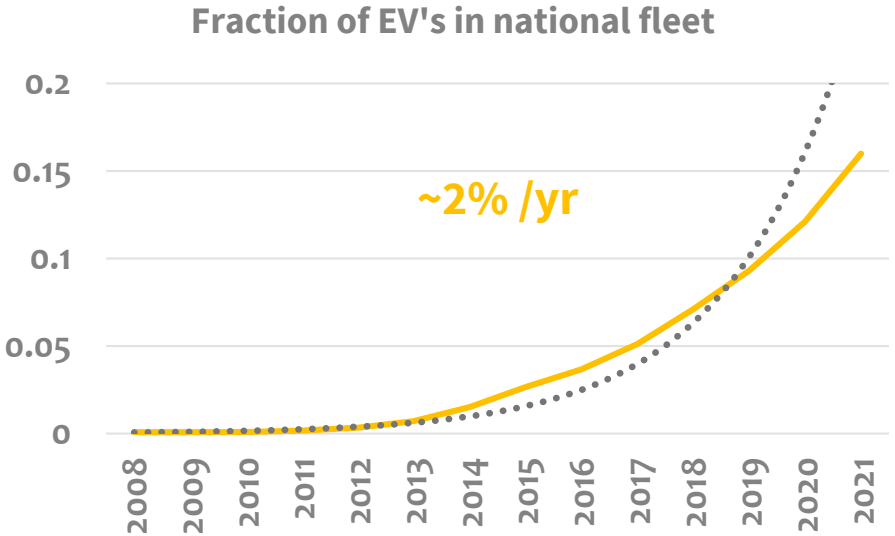
In isolation, technology can only so as much...

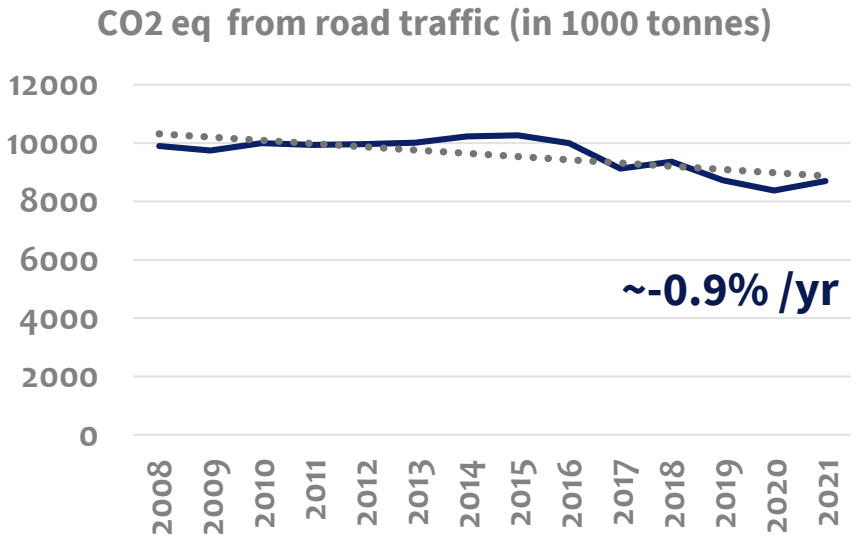


Statistisk sentralbyrå
Statistics Norway

~0.8% /yr increase of distance travelled with private car...

behaviour
infrastructure
jobs
planning
public transport
...





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- **How granular can the city/administration be in regards to sectioning measures by particular target groups? "Does one measure fit all"?**
  - No explicit differentiation of wealthy vs poor/vulnerable citizens in measures.
  - From social studies we know that much of the carbon footprint of citizens get "locked in" when a family is raised (where one lives, buying a house, etc…).
  - Restrictions or/vs incentives – both IF fair.

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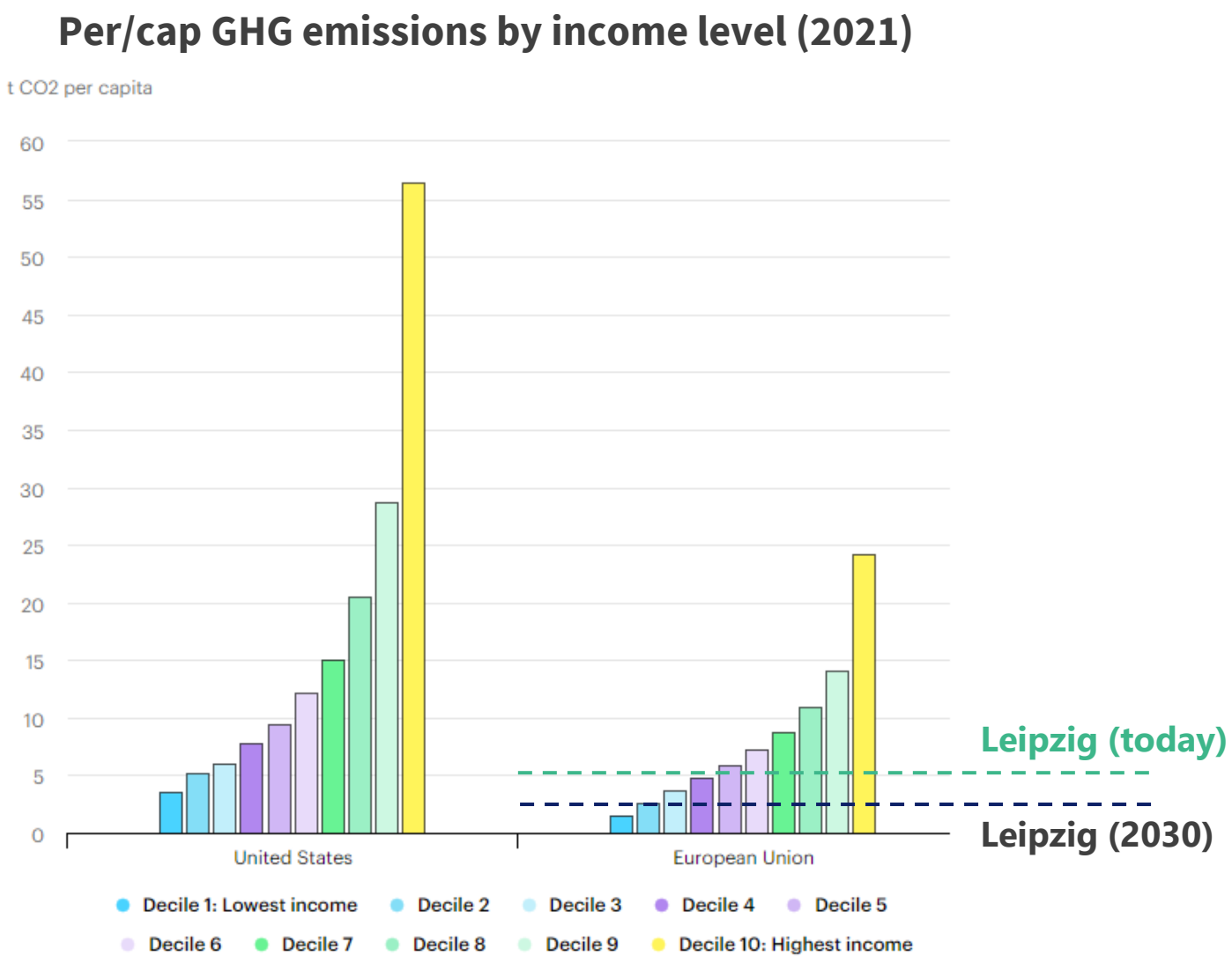
IEA report: The world's top 1% of emitters produce over 1000 times more CO2 than the bottom 1%.



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- **What reductions of emissions in the city are controlled by "external factors" at national level?**
  - Funding, fuel tax, electricity grid, building codes, etc...
- **Financing of projects on bringing different sectoral visions together, not in a technical way but as a concrete visions for the city.**
  - Go beyond the CO2-measure-improvements a "new better way of living".
  - You will live longer and save CO2.
- **Communication of results beyond the project/technical-minded persons seems challenging.**
  - Cross comparison of cities in a single figure, clear guide on what is and what is not in the scenarios.

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THANK YOU

For more information contact:

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