Apostolos Ziakopoulos, Maria Oikonomou, George Yannis - NTUA

LEVITATE Policy Support Tool

Event: Final Conference
Location: Brussels and Online
Date: 25/05/2022

LEVITATE has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824361.

LEVITATE PST

- The LEVITATE PST is an **open access, web-based system** that provides access to results obtained by LEVITATE methodologies.
- The LEVITATE PST is the go-to, one-stop-shop for **decision support** on CCAM-related interventions. It is expected to be used by city authorities, transport planners and engineers, transport researchers and interested citizens and NGOs.
- Its detailed design takes into account the specific **needs of the key stakeholders** and provides access to related bibliography, project results, documentation of tools and methods, excerpts from CCAM guidelines, as well as a PST with forecasting, backcasting and CBA capabilities.

LEVITATE PST Components

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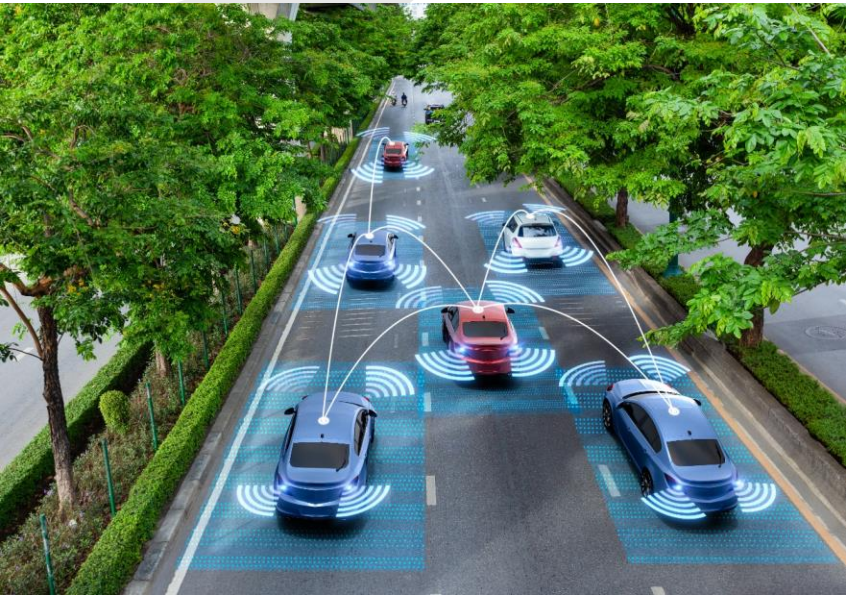
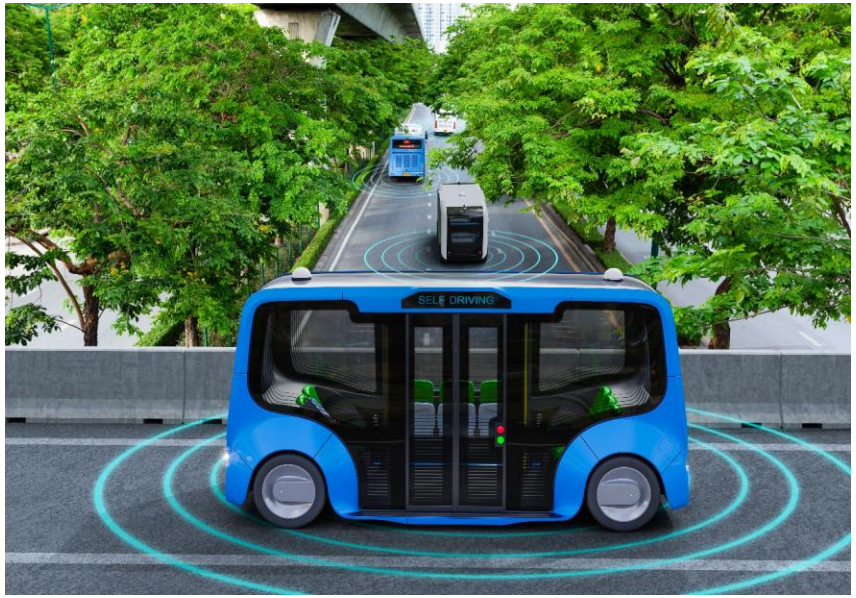
Use Cases

Three automation use cases are considered:

Passenger cars



Urban transport



Freight transport

as well as specific sub use-cases are investigated for each domain.

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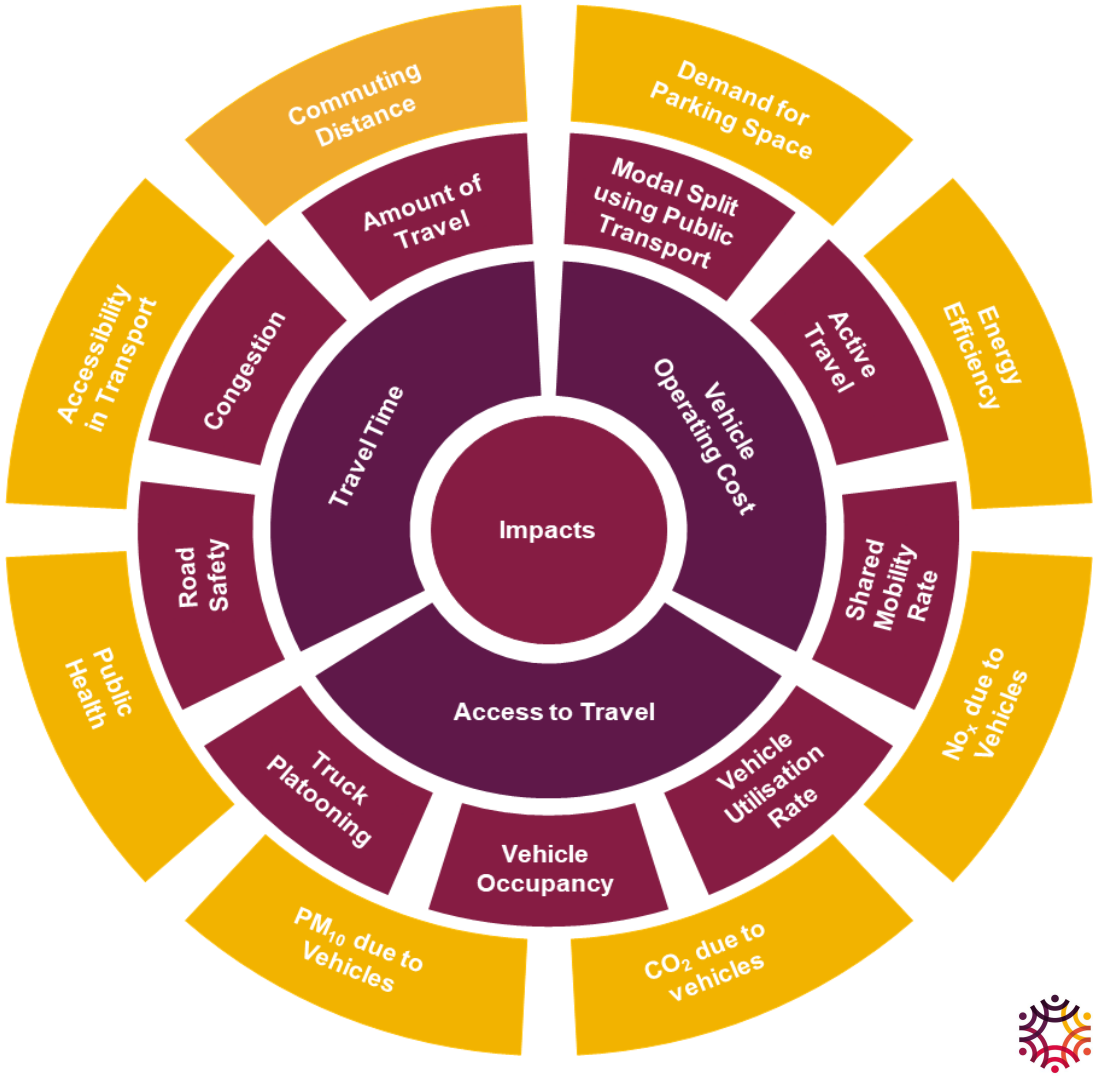
Dimensions of CCAM impacts

Twenty-three distinct impacts are examined, classified into three distinct categories:

- **Direct impacts (inner circle)**
- **Systemic impacts (middle circle)**
- **Wider impacts (outer circle)**

... as well as three road safety impacts: unmotorized VRU crash rates, motorized road crashes and total road safety effect.



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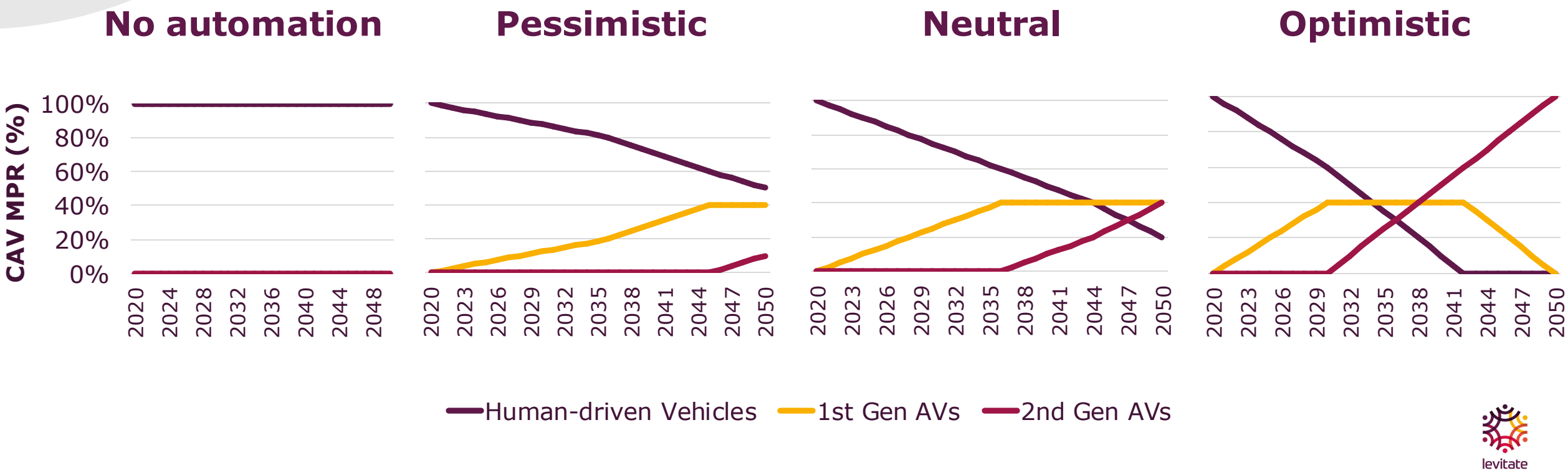
Base scenarios

Four predefined base scenarios are also established, concerning the temporal distribution of the market penetration rates (MPRs) of CAVs throughout the study period (from 2020 to 2050) and are the following:



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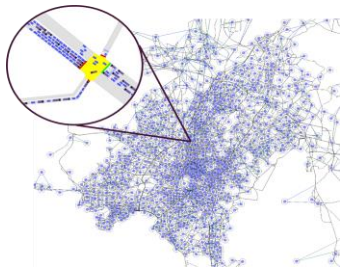
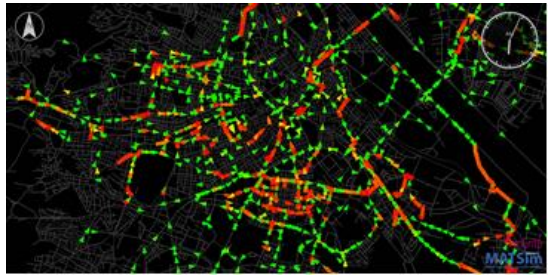
Impact assessment methodologies

Five different methods are used in order to provide and forecast the examined impacts, which are:

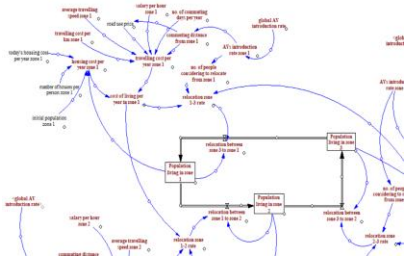
- **Microscopic simulation**



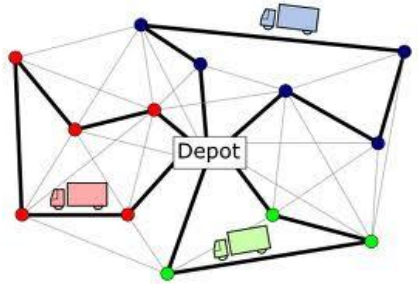
- **Mesoscopic simulation**



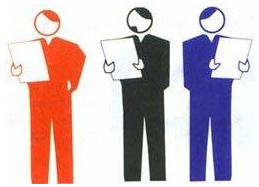
- **System dynamics**



- **Operations research**



- **Delphi method**



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Design of the Levitate Policy Support Tool

Overview of the LEVITATE PST

FORECASTING

The forecasting module provides quantified and/or monetized output on the expected impacts of automation and CCAM related policies, featuring customizability of parameter quantities.

BACKCASTING

The backcasting module enables users to identify the sequences of CCAM measures that are expected to result in their desired policy objectives and monetize their implementation.

KNOWLEDGE

The knowledge module contains the repository and recommendations of the LEVITATE project, including documentation of the project toolbox, results of the various methods, relevant literature from CCAM guidelines.

Forecasting

- The main purpose of the forecasting sub-system is to provide **quantitative estimates** to users about the future impacts of policy interventions.

- In the forecasting sub-system, the user is able to select a **policy intervention**, define the required **CCAM factors** and the module provides quantified and/or monetized output on the expected impacts.

- In the sub-system, the capability of an **intervention combination** is also made based on a methodological basis drawn from the Crash Modification Factor (CMF) approach highlighted in the Highway Safety Manual and the respective CMF clearinghouse repository of the US Federal Highway Administration.

Policy intervention combination

The following methods used for creation of Impact Modification Factors (IMFs) and their combinations in pairs drawing from the US FHWA HSM philosophy for CMFs

- **Additive method**: $IMF_c = 1-[(1-IMF_1) + (1-IMF_2)]$
- **Multiplicative method**: $IMF_c = IMF_1 * IMF_2$
- **Dominant effect method**: $IMF_c = min(IMF_1, IMF_2)$
- **Dominant common residuals method**: $IMF_c = (IMF_1 * IMF_2)^{min(IMF1, IMF2)}$
- **Amplificatory method (not existing in FWHA)**: $IMF_c = [IMF_1 * IMF_2]^2$

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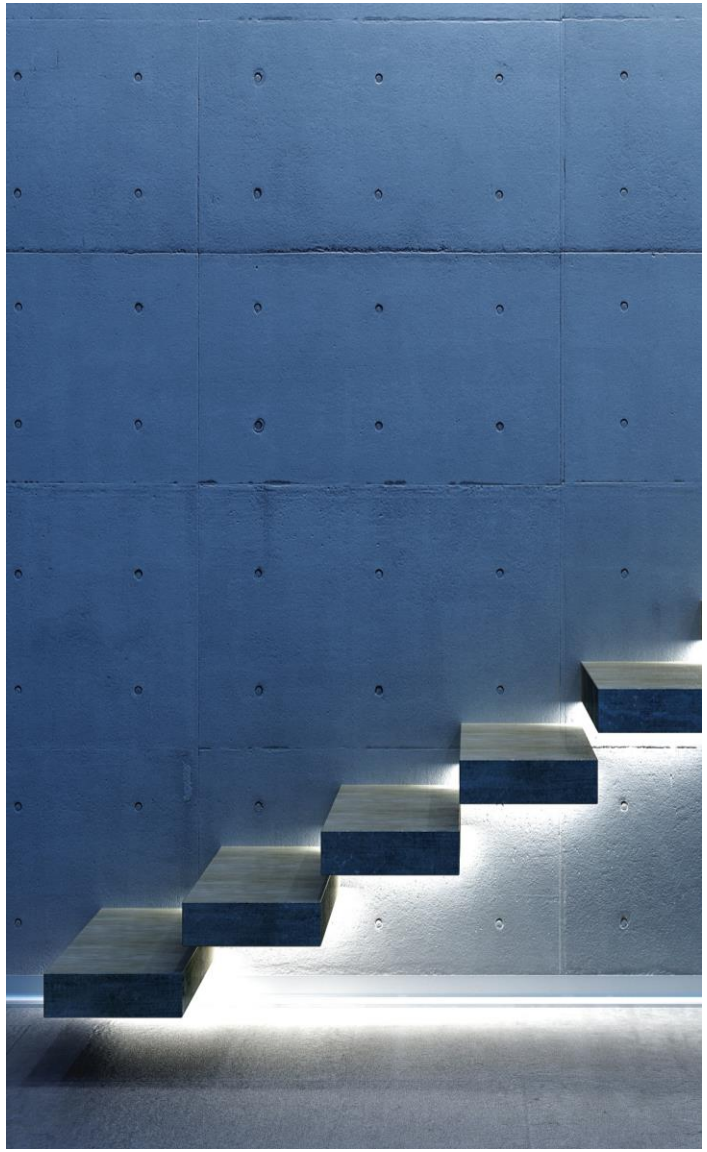
Steps of the forecasting analysis

1. Select one or two **policy interventions**
2. Select the CCAM **deployment scenario**
3. Define the **policy intensity and policy effectiveness** through the years 2020-2050
4. Adjust the **initial PST values** of the parameters and impacts
5. Provide input in terms of **temporal implementation of the measure**(s) for the system to take into account by adjusting the response curves of the impacts
6. Receive the **results**, in form of table with analytical results and curves presenting both results for the baseline scenario (no intervention) and for the selected policy intervention(s)

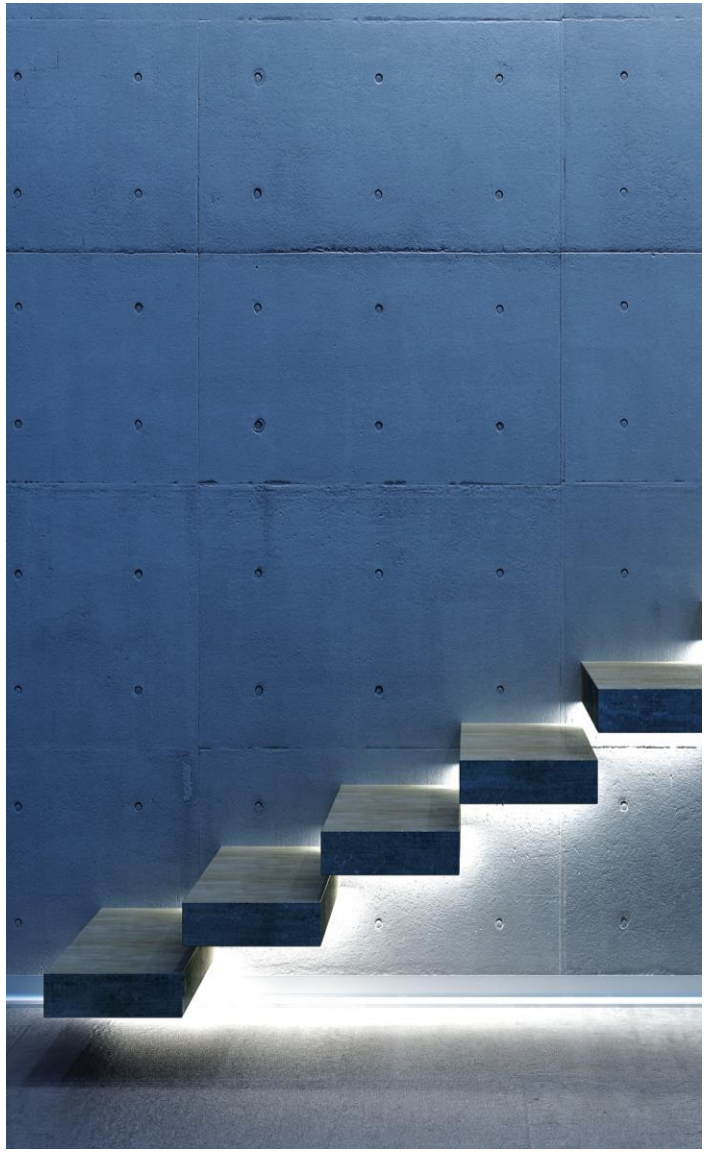


Backcasting

- The main purpose of the backasting sub-system is to provide a conclusion from a defined vision (set of policy goals) to **the most promising policy interventions**, given that all these relationships and impacts have been quantitatively assessed.
- A primary goal of the backasting sub-system is to **estimate the impacts of CCAM** for various impact dimensions.
- Coming from the opposite direction, a **strategic "vision"** of a city/region can also be broken down into quantified targets belonging to various dimensions in the backasting sub-system.

Steps of the backcasting analysis

1. Selection of **target year** between 2020-2050
2. Selection of CCAM **deployment scenario**
3. Definition of the **desired policy vision** described in terms of desired values in 1 (minimum) to 5 (maximum) impacts as well as the desired values for each of the selected impacts
4. Adjust the **initial PST values** of the parameters and impacts
5. Receive the **results**, in form of table where all policy interventions are presented with the characterization “true” or “false”, based on the potential to reach the desired policy vision



Knowledge

- The PST Knowledge module aims to provide a **searchable static repository** through fully detailed and flexible concise reports.
- The **concise reports** aim to inform the user in the most essential and summarizing way, offering the necessary information.
- The reports differ in the **documentation categories** that essentially are the contents of the module.

Documentation categories

Project-level documentation

Use case bibliography documentation

SUC-level documentation

Method-level documentation

Impact-level documentation

Case study documentation

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Hands-on trial of the LEVITATE PST

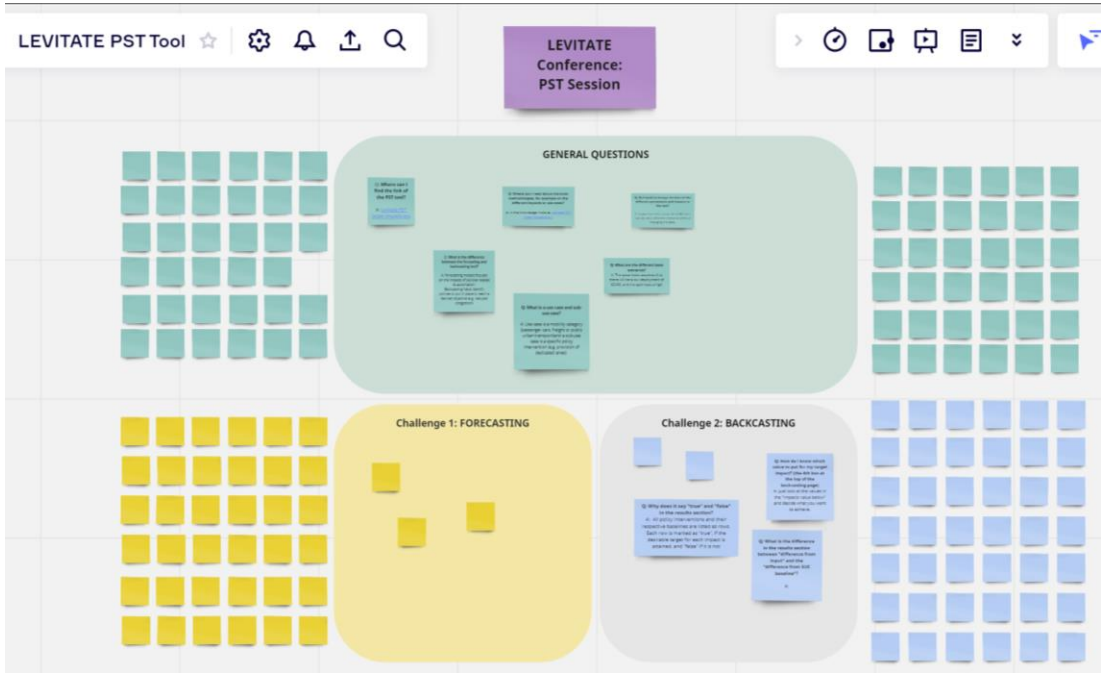
The online PST can be found in the following link
https://www.ccam-impacts.eu/

In-person

- Groups of 2-3 people, try having 1 person from the LEVITATE Consortium
- Use 1 computer
- Ask questions to NTUA Staff

Online

- Individually
- Use Miro for questions
- Link to the tool in the chat



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Challenge 1: Forecasting

You are a technical advisor in a European capital city. Your mayor is interested in learning about the impacts of Cooperative, Connected and Automated Mobility (CCAM) and potential public policies.

The mayor asks you to research the **impacts of dedicated lanes** for Connected and Automated **passenger cars** on **travel time**. She wants to put this policy into place in **2025**, but only for **motorways**. The city is expected to have a **high deployment (optimistic)** of Connected, Cooperative Automated Mobility.

You need to find out by **which year:**

- dedicated lanes have reduced travel time by 3 minutes on motorways
- the concentration of CO2 pollutants as grams per vehicle kilometre be reduced by over 50%

Don't forget to add your city's data in the parameters and impacts section (page 2).

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Challenge 2: Backcasting

Congratulations on finding the results for the mayor's request forecasting challenge! She now has more questions about CCAM policies.

She wants to know which policies need to be put in place by **2030** to ensure Cooperative, Connected and Automated Mobility will help **decrease congestion**. She now wants you to look at a scenario where there is a **low penetration rate of CCAM (pessimistic scenario)**. The goal is to reduce congestion from the initially provided value of 197 delay seconds per vehicle kilometre to **170**.

The mayor has two questions for you:

Will **automated ride-sharing** help reach the desirable vision (reduce congestion by 2030)? What about **removing or replacing on-street parking**?

Don't forget to add your city's data in the parameters and impacts section (page 2).

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Data from your city

For any missing data, leave the pre-filled data on the PST website.

PARAMETERS

GDP per capita (EUR)	Annual GDP per capita change (%)	Inflation (%)
25 000	0.020	2
City Population (million)	Fuel Cost (EUR)	Electricity Cost (EUR/kWh)
5	2	20

IMPACTS

The average duration of a 5km trip inside the city centre is 30 min (travel time) and the concentration of CO2 pollutants is 2 000 grams per vehicle kilometre (CO2 due to vehicles).

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Closing Session

LEVITATE has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824361.

Pete Thomas,
Loughborough University

What next for LEVITATE?

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What has Levitate achieved?

- **Forecasts** of impacts of CCAM services and technologies
  - 3 use cases
  - 12 CCAM interventions (sub-use cases)
  - 32 different implementation modalities
  - 23 impact dimensions
  - 3000 impact assessments
  - 5000 hours computing time
- Results
  - Incorporated in PST
  - Shared with stakeholder community
  - Academic publications

no.	Impact	Description / measurement	Unit of Measurement
	Direct impacts		
1	Travel time	*Average duration of a 5Km trip inside the city centre*	*min*
2	Vehicle operating cost	*Direct outlays for operating a vehicle per kilometre of travel*	*€/Km*
3	Freight transport cost	*Direct outlays for transporting a tonne of goods per kilometre of travel*	*€/tonne.Km*
4	Access to travel	*The opportunity of taking a trip whenever and wherever wanted (10 points Likert scale)*	-
	Systemic impacts		
5	Amount of travel	*Person kilometres of travel per year in an area*	*person-km*
6	Congestion	*Average delays to traffic (seconds per vehicle-kilometer) as a result of high traffic volume*	*s/veh-km*
7	Modal split of travel using public transport	*% of trip distance made using public transportation*	*%*
8	Modal split of travel using active travel	*% of trip distance made using active transportation (walking, cycling)*	*%*
9	Shared mobility rate	*% of trips made sharing a vehicle with others*	*%*
10	Vehicle utilisation rate	*% of time a vehicle is in motion (not parked)*	*%*
11	Vehicle occupancy	*average % of seats in use (pass. cars feature 5 seats)*	*%*
	Wider impacts		
12	Parking space	*Required parking space in the city centre per person*	*m2/person*
14	Energy efficiency	*Average rate (over the vehicle fleet) at which propulsion energy is converted to movement*	*%*
15	NO_X due to vehicles	*Concentration of NO_x pollutants as grams per vehicle-kilometer (due to road transport only)*	*g/veh-km*
16	CO_2 due to vehicles	*Concentration of CO_2 pollutantsas grams per vehicle-kilometer (due to road transport only)*	*g/veh-km*
17	PM_{10} due to vehicles	*Concentration of PM_{10} pollutantsas grams per vehicle-kilometer (due to road transport only)*	*g/veh-km*
18	Public health	*Subjective rating of public health state, related to transport (10 points Likert scale)*	-
19	Accessibility in transport	*To which degree are transport services used by socially disadvantaged and vulnerable groups, including people with disabilities (10 points Likert scale)*	-
20	Commuting distances	*Average length of trips to and from work (added together)*	*Km*
21	Unmotorized VRU injury	*Injury crashes with unmotorized VRUs per vehicle-kilometer driven*	*injury-crashes/million veh-km*
22	Road safety motorized	*Number of crashes per vehicle-kilometer driven*	*crashes/ million veh-km*
23	Road safety total effect	*Road safety effects when accounting for VRU and modal split*	*crashes/ million veh-km*

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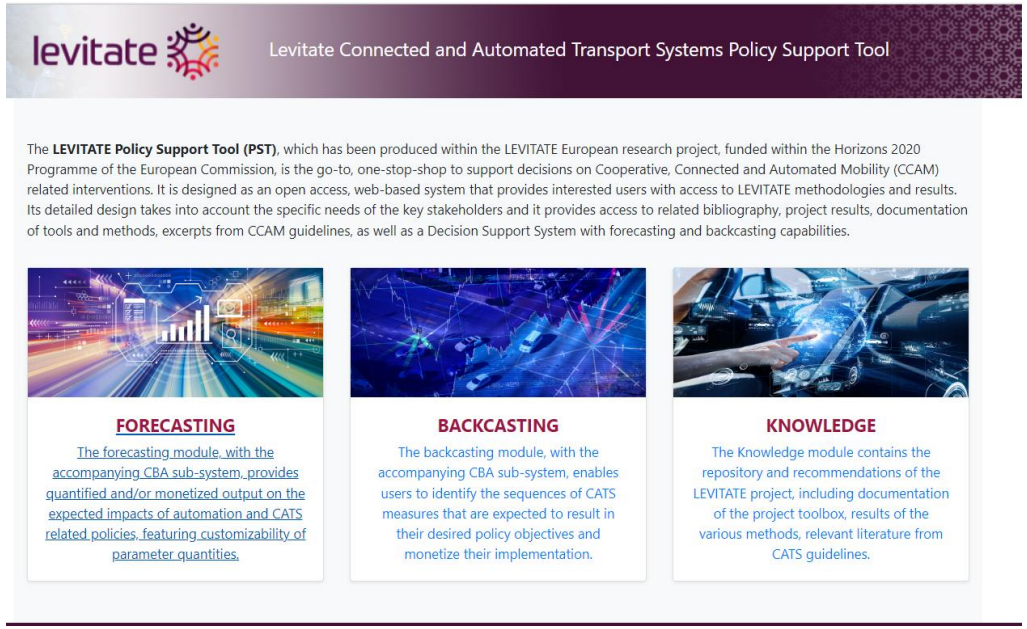
What has Levitate achieved?

- **Policy support tool** to enable specialists to explore the impact of CCAM services on their own city
- No other tool exists
- Provides access to forecasting, backcasting and cost effectiveness tools
- Access to all Levitate results and procedures



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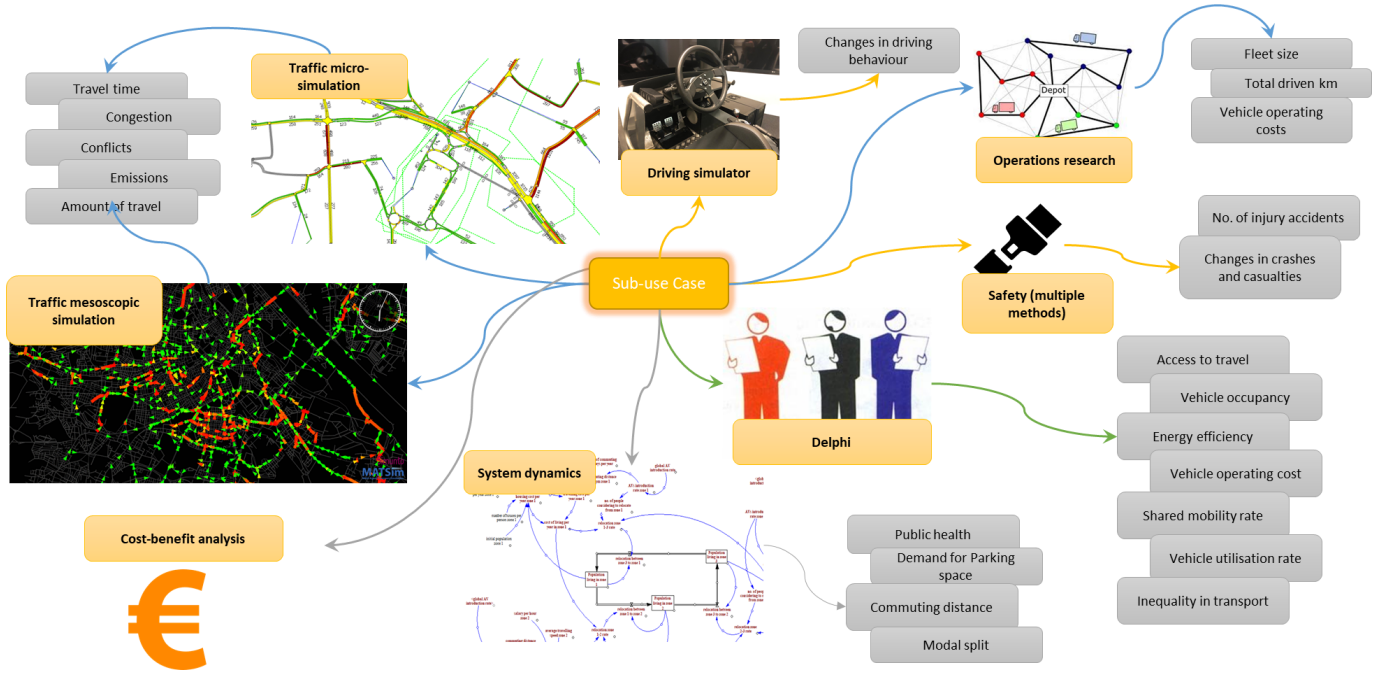
What has Levitate achieved?

- **Toolbox of methods**
  - Microsimulation
  - Mesosimulation
  - Cost-benefit analysis
  - Operations Research
  - System Dynamics
  - Delphi
  - Safety estimation
  - CAV models
  - Transferability



Dissemination actions

Consultation

- Driven by the needs of the cities
- Identifying and framing the CCAM services for analysis

Dissemination

- Webinars, newsletters, direct presentations
- Taking the results directly to users
- Academic publications for validation

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What’s new?

Main results

- The impact forecasts from Levitate are highly effective in helping cities and other stakeholder groups prepare for the introduction of CCAM services
- CCAM technologies and services are expected to provide many societal benefits once the systems are highly advanced, when traffic infrastructure is equally developed for CAVs and human road users are fully adapted to a CAV environment
- Until then we expect a mixture of positive and negative impacts on traffic, safety and wider societal measures
- Cities can prepare policies to mitigate negative impacts and harness the technologies to help achieve their policy goals.

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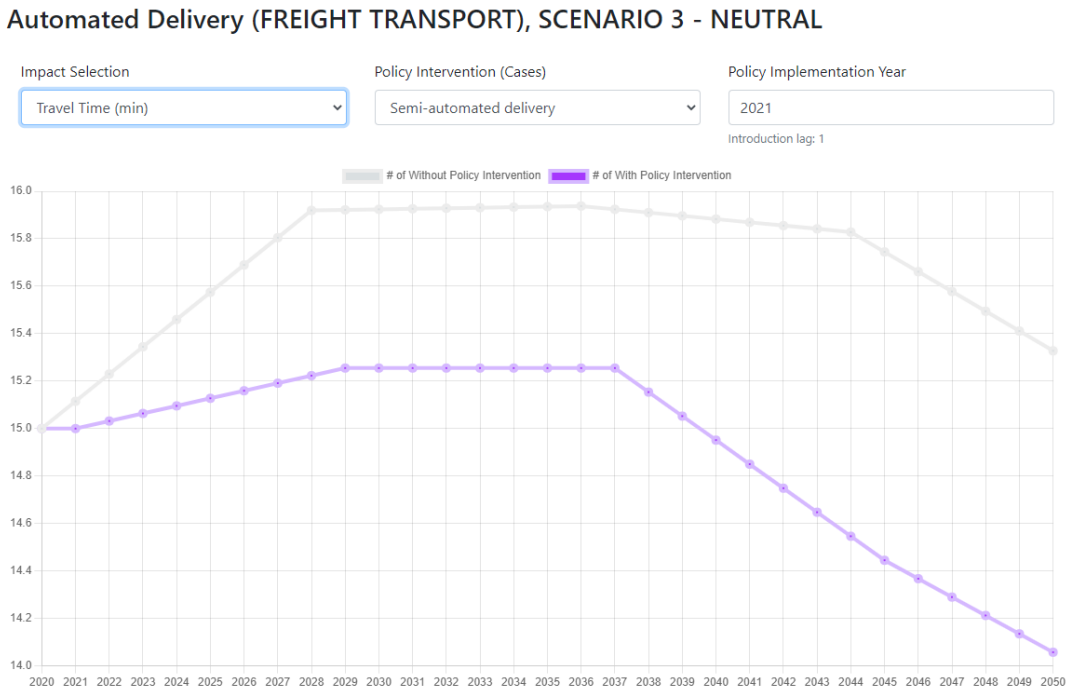
The LEVITATE Policy Support Tool

- A new tool for cities
  - Can’t control introduction of automation
  - Can influence introduction of many CCAM services
- What will the uncontrolled impacts be on cities?
- How can CCAM services help achieve city policy goals?
- What measures should be introduced to mitigate adverse impacts and to use CCAM services to achieve policy goals?



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How can cities use the PST?

- "What if" analyses – exploring possible mobility futures
  - eg how will an automated shuttle passenger service affect local traffic?

- Identifying scenarios where new interventions are required
  - eg early automated vehicles will increase travel times and congestion – how to mitigate?

- Understanding the relationships between impact types
  - eg increased use of advanced automated vehicles will improve congestion but decrease active travel – what are the trade offs?

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Accessing the results

- PST is a technical tool, freely accessible on the web
- Results are customisable to changing scenarios
  - GDP
  - Fuel costs
  - Population size
  - Accident types
- Results are transferable
  - Trends are consistent between cities studied
  - A CCAM service in one city is implemented similar to another city

How can the Levitate team help?

- Cities can achieve a lot using the PST directly
- but
  - What if a city is very different from those studied?
  - What if a new CCAM service will be implemented?
  - What if there is a new CCAM service that has not been considered?
- The LEVITATE team can use the new tools and methodologies with other cities and other CCAM services or scenarios.
  - Contact individual team members or levitate@lboro.ac.uk

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Closing remarks

- Levitate will end on 31 May 2022
- PST and project website will remain available for up to 10 years

- Thank you for joining us today

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For more information:
www.levitate-project.eu

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