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LEVITATE

Development of a Policy Support Tool to assess Societal Level Impacts of Connected and Automated Vehicles

Event: Annual Polis Conference 2020
Location: Virtual Event
Date: 30 November - 3 December 2020

levitate

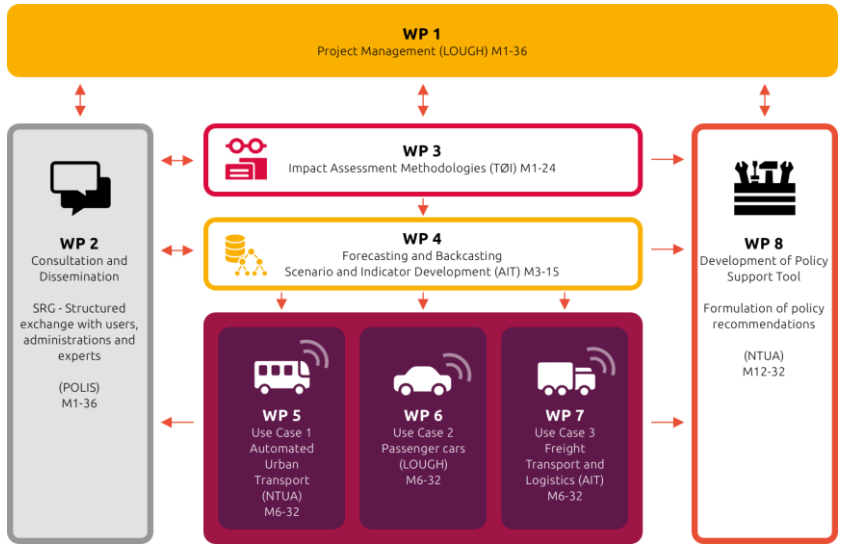
LEVITATE has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824361.

National Technical University of Athens

The Levitate Project

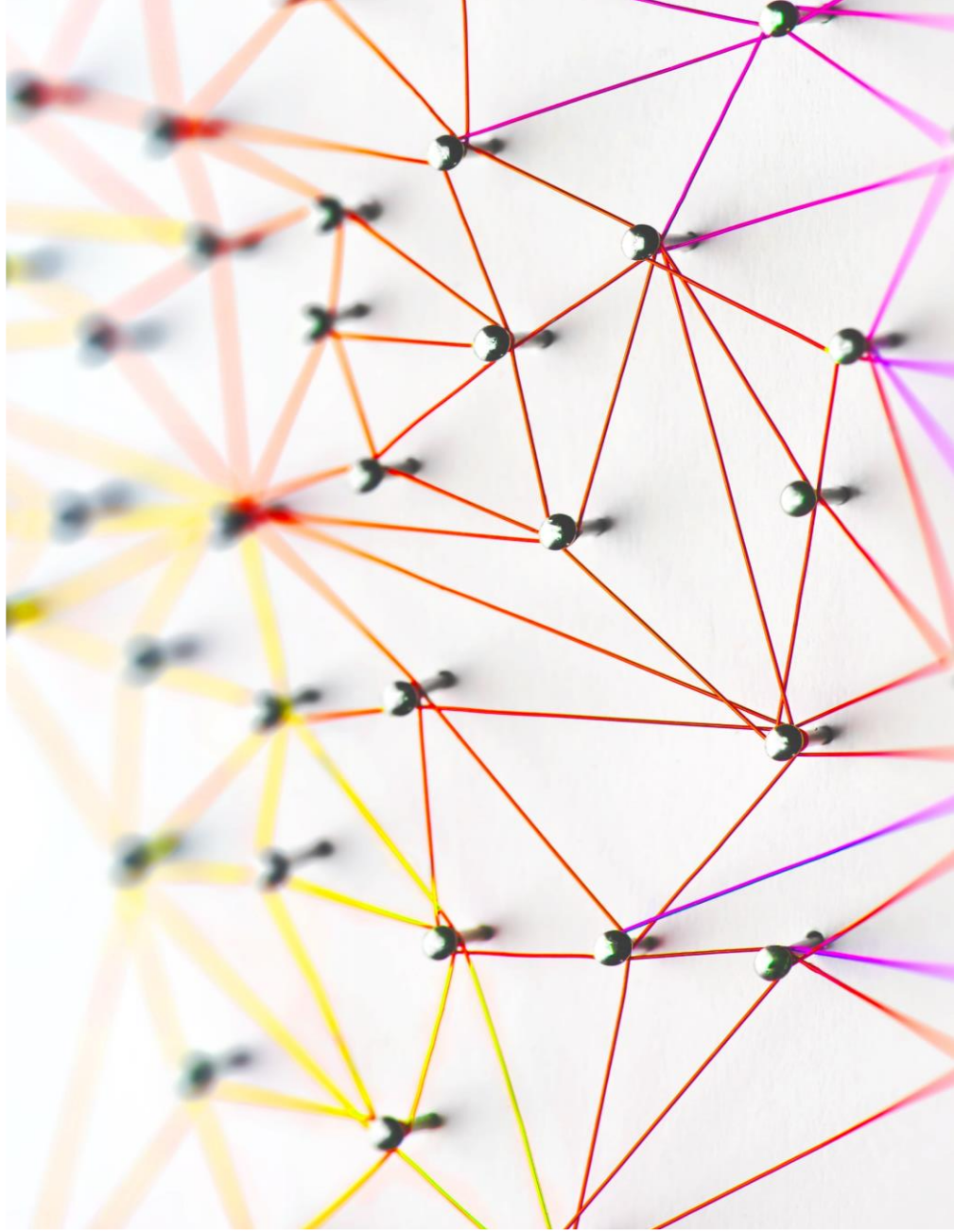
LEVITATE focuses on the development of a new impact assessment framework, in order to enable policymakers to manage the **introduction of connected and automated transport systems**, maximise the benefits and utilise the technologies to achieve societal objectives

- **Project partners:**
  LOUGH (UK), AIT (AT), AIMSUN (ES), NTUA (EL), POLIS (BE), SWOV (NL), TOI (NO), TfGM (UK), City of Vienna (AT), QUT (AU), TJU (CN), UMTRI (US)
- **Duration of the project:**
  36 months (December 2018 – December 2021)
- **Framework Program:**
  Horizon 2020 - The EU Union Framework Programme for Research and Innovation – Mobility for Growth



Aims

- To consolidate the outputs of WPs 4-7 into an **overall framework** for the assessment of impacts, benefits and costs of CATS, for different automation and penetration levels and on different time horizons;
- To **analyze user needs** for a decision support tool aiming to assist in the analysis of urban policy scenarios and targets;
- To develop and implement a **toolkit** and a **decision support** tool, allowing the testing of various policy scenarios on the basis of the needs of relevant stakeholders, incorporating both **forecasting** and **backcasting** approach;
- To provide **policy recommendations**.



PST Structure

- **Static**
- **Searchable**
- **Components:**
  - Bibliography
  - Results
  - Tools
  - Guidelines and policy recommendations

Policy Support Tool (PST) - release 5 [June 2020]

Knowledge Module

Bibliography

Levitate results

- use case results
- predefined impact assessment scenarios

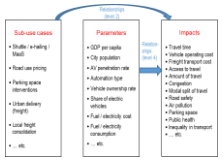
Tools Documentation

Guidelines

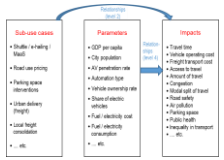
Estimator Module

Forecasting sub-system

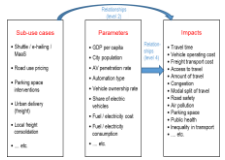
Sub-use case 1



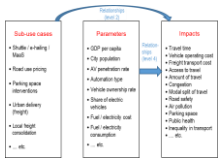
Sub-use case 2



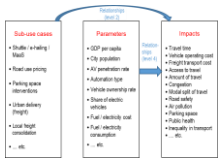
Sub-use case 3



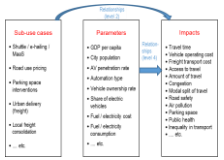
Sub-use case 4



Sub-use case 5



Sub-use case .....



Backcasting sub-system

Employment of forecasting in an iterative process ("goal seek"), testing alternative policy interventions until the desired impact - policy goal is obtained
TO BE DEFINED

- **Dynamic**
- **Interactive**
- **Javascript Design**
- **Sub-systems:**
  - Forecasting
  - Backcasting
  - CBA module
  - Case studies

PST Knowledge Module: Overview [1/2]

PST Knowledge Module Contents – based on the NTUA conceptual framework:

1. **Bibliography:** Relevant literature concerning impact assessments of CATS
   - Systematic literature review across the project and one per use case
   - The documentation of each sub-use case
   - Short synopsis summarizing each use-case/sub use-case
2. **Project results:** Case studies, impact assessments

   For each case study:
   - Information regarding the scenarios and baseline conditions
   - Assumptions and limitations relevant to each case study to be explained in detail there-in as well
   - Showcasing of case study results

PST Knowledge Module: Overview [2/2]

3. Documentation of tools: Toolbox of Levitate methods

For each methodology (Microsimulation, Delphi, System Dynamics):

- Information regarding the methodological background, much of which is existing on presentations
- Assumptions and limitations relevant to each methodology to be explained in detail as well

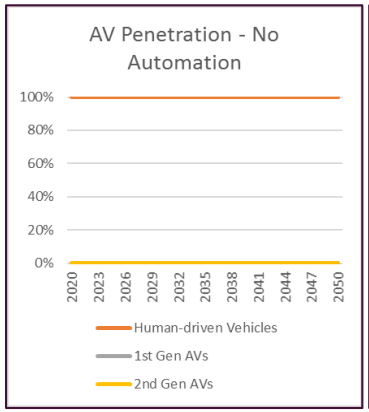
4. Guideline excerpts: Guidelines and policy recommendations regarding CATS

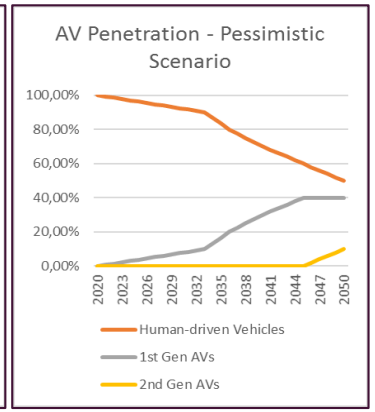
- Explanations and tutorials on the use of the PST Estimator modules
- Overall recommendations to cities from project results
- Additional recommendations from literature or other inputs if necessary

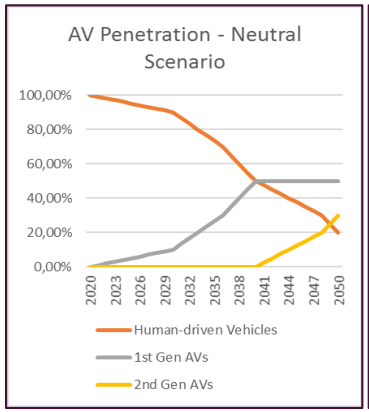
The PST Knowledge Module will be **static & searchable**

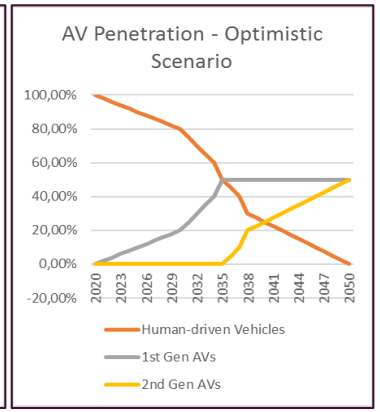
PST Forecasting Estimator

- **Step 1:** Selection of use case and sub-use case:
- **Step 2:** Definition of initial values
- **Step 3:** Definition of base scenario:
- **Step 4:** Details of sub use-case implementation
- **Step 5:** Estimation of forecasted impact indicator values for reference scenario (without SUC)
- **Step 6:** Estimation of forecasted impact indicator values for intervention scenario (with SUC)
- **Step 7:** SUC impact estimation – presentation of results









PST Forecasting Demo [input]

Step 1: Selection of use case — **PASSENGER CARS**

WP6 parking behaviour SUC

Step 2: Definition of initial values

PARAMETERS

no.	Description	Unit of Measurement	Default Initial Value (changeable by user)
1	GDP per capita	€	15,000
2	Annual GDP per capita change	%	1.50%
3	Inflation	%	1.00%
4	City Population	million persons	3.000
5	Annual City Population change	%	0.50%
6	Urban shuttle fleet size	no. of vehicles	~~300~~
7	Freight vehicles fleet size	no. of vehicles	~~100~~
8	Average load per freight vehicle	tones	~~3~~
9	Average annual freight transport demand	million tones	~~1.5~~
10	Human-driven Vehicles	%	100%
11	1st Gen - Cautious AVs	%	0%
12	2nd Gen - Aggressive AVs	%	0%
13	Fuel cost	€ / lt	1.50
14	Electricity cost	€ / KWh	0.10
15	Fuel consumption	lt / 100Km	8.00
16	Electricity consumption	KWh / 100Km	13.00

no.	Impact	Description / measurement	Unit of Measurement	Initial Value
Direct impacts				
1	Travel time	*Average duration of a 5Km trip inside the city centre*	*min*	*15.0*
2	Vehicle operating cost	*Direct outlays for operating a vehicle per kilometre of travel*	*€/Km*	~~0.25~~
3	Freight transport cost	*Direct outlays for transporting a tonne of goods per kilometre of travel*	*€/tonne.Km*	~~0.25~~
4	Access to travel	*The opportunity of taking a trip whenever and wherever wanted (10 points Likert scale)*	-	~~5~~
Systemic impacts				
5	Amount of travel	*Person kilometres of travel per year in an area*	*person-km*	*19165.40*
6	Congestion	*Average delays to traffic (seconds per vehicle-kilometer) as a result of high traffic volume*	*s/veh-km*	*197*
7	Modal split of travel using public transport	*% of trip distance made using public transportation*	*%*	~~0.4~~
8	Modal split of travel using active travel	*% of trip distance made using active transportation (walking, cycling)*	*%*	~~0.03~~
9	Shared mobility rate	*% of trips made sharing a vehicle with others*	*%*	~~0.04~~
10	Vehicle utilisation rate	*% of time a vehicle is in motion (not parked)*	*%*	~~0.08~~
11	Vehicle occupancy	*average % of seats in use (pass. cars feature 5 seats)*	*%*	*25%*
Wider impacts				
12	Parking space	*Required parking space in the city centre per person*	*m2/person*	~~0.9~~
13	Road safety	*Number of traffic conflicts per vehicle-kilometer driven (temp. until crash relation is defined).*	*Conflicts/veh-km*	*1.23*
14	Energy efficiency	*Average rate (over the vehicle fleet) at which propulsion energy is converted to movement*	*%*	~~0.25~~
15	NO_X due to vehicles	*Concentration of NO_x pollutants as grams per vehicle-kilometer (due to road transport only)*	*g/veh-km*	*1.80*
16	CO_2 due to vehicles	*Concentration of CO_2 pollutantsas grams per vehicle-kilometer (due to road transport only)*	*g/veh-km*	*2500.00*
17	PM_{10} due to vehicles	*Concentration of PM_{10} pollutantsas grams per vehicle-kilometer (due to road transport only)*	*g/veh-km*	*0.20*
18	Public health	*Subjective rating of public health state, related to transport (10 points Likert scale)*	-	~~5~~
19	Inequality in transport	*To which degree are transport services used by socially disadvantaged and vulnerable groups, including people with disabilities (10 points Likert scale)*	-	~~5~~
20	Commuting distances	*Average length of trips to and from work (added together)*	*Km*	~~20~~

Step 3: Definition of base scenario — **SCENARIO 2 - PESSIMISTIC**

Step 4a: Selection of sub-use case — **Parking toll - balanced behaviour**

Step 4b: Selection of policy implementation year — **2027**

Incorporates relationships estimated through microsimulation methodology

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PST Forecasting Demo [output]

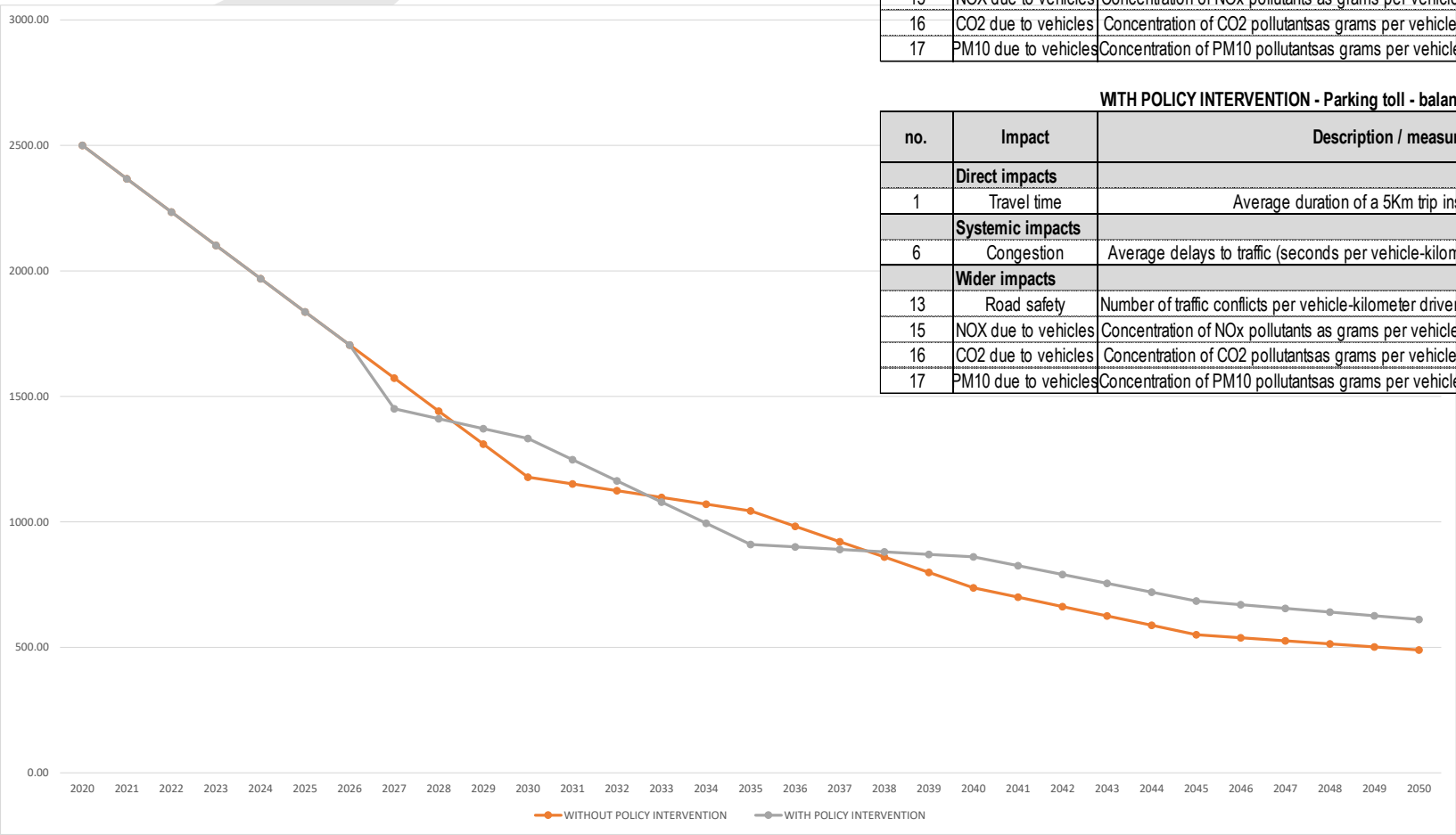
Provides impact estimations for six impacts

WITHOUT POLICY INTERVENTION

no.	Impact	Description / measurement	Unit of Measurement	2020	2021	2022	2023	2024	2025
	Direct impacts								
1	Travel time	Average duration of a 5Km trip inside the city centre	min	15	-0.23%	-0.46%	-0.70%	-0.93%	-1.16%
	Systemic impacts								
6	Congestion	Average delays to traffic (seconds per vehicle-kilometer) as a result of high traffic volume	s/veh-km	197.37	-0.21%	-0.42%	-0.64%	-0.85%	-1.06%
	Wider impacts								
13	Road safety	Number of traffic conflicts per vehicle-kilometer driven (temp. until crash relation is defined).	Conflicts/veh-km	1.23	3.22%	6.45%	9.67%	12.89%	16.11%
15	NOX due to vehicles	Concentration of NOx pollutants as grams per vehicle-kilometer (due to road transport only)	g/veh-km	1.80	-6.24%	-12.49%	-18.73%	-24.97%	-31.21%
16	CO2 due to vehicles	Concentration of CO2 pollutantsas grams per vehicle-kilometer (due to road transport only)	g/veh-km	2500.00	-5.31%	-10.62%	-15.93%	-21.23%	-26.54%
17	PM10 due to vehicles	Concentration of PM10 pollutantsas grams per vehicle-kilometer (due to road transport only)	g/veh-km	0.20	-2.21%	-4.41%	-6.62%	-8.83%	-11.03%

WITH POLICY INTERVENTION - Parking toll - balanced behaviour

no.	Impact	Description / measurement	Unit of Measurement	2020	2021	2022	2023	2024	2025
	Direct impacts								
1	Travel time	Average duration of a 5Km trip inside the city centre	min	15	0.89%	1.79%	2.68%	3.57%	4.47%
	Systemic impacts								
6	Congestion	Average delays to traffic (seconds per vehicle-kilometer) as a result of high traffic volume	s/veh-km	197.37	0.81%	1.63%	2.44%	3.26%	4.07%
	Wider impacts								
13	Road safety	Number of traffic conflicts per vehicle-kilometer driven (temp. until crash relation is defined).	Conflicts/veh-km	1.23	-9.43%	-18.85%	-28.28%	-37.71%	-47.14%
15	NOX due to vehicles	Concentration of NOx pollutants as grams per vehicle-kilometer (due to road transport only)	g/veh-km	1.80	-9.18%	-18.37%	-27.55%	-36.73%	-45.91%
16	CO2 due to vehicles	Concentration of CO2 pollutantsas grams per vehicle-kilometer (due to road transport only)	g/veh-km	2500.00	-7.76%	-15.53%	-23.29%	-31.06%	-38.82%
17	PM10 due to vehicles	Concentration of PM10 pollutantsas grams per vehicle-kilometer (due to road transport only)	g/veh-km	0.20	-2.72%	-5.43%	-8.15%	-10.87%	-13.59%



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PST Backasting Estimator

Functionality: The backcasting process is envisioned to be the inverse of forecasting

Specifically:

1. With what measures can one reach impact goal X in year Y?
2. What year would they need to be taken?
3. What happens when two measures are combined?

Current approach: The creation of Impact Modification Factors (IMFs) and their **combinations** in pairs drawing from the HSM philosophy for CMFs

Current Achievements

- Contribution in the **definition** of CATS sub-use cases, parameters and impacts, considering both user needs and practical project limitations.
- **Standardization** of WPs 5-7 impact estimation outcomes and of assumptions at project level.
- Continuous development and updates of **PST framework**, as the project results gradually mature.
- Development of **1st Demo Forecasting Excel** with guessed relationships.
- Development of **2nd Demo Forecasting Excel** with actual estimated relationships, for one SUC and six impacts.

Future Plans

- Finalization of the PST **backcasting estimator**
- Development and integration of the PST **CBA estimator**
- Development of the online PST structure and preparing a highly ergonomic, eye-catching **user interface**
- **Test**, **validate** & improve all PST estimators
- Integrate information and project results into the static **knowledge module** of the PST
- Develop **policy recommendations**

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