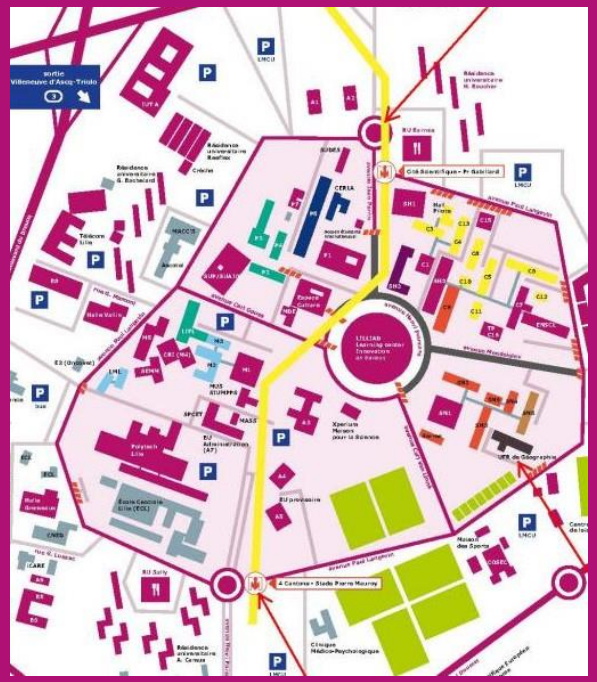
https://cumin.univ-lille.fr/



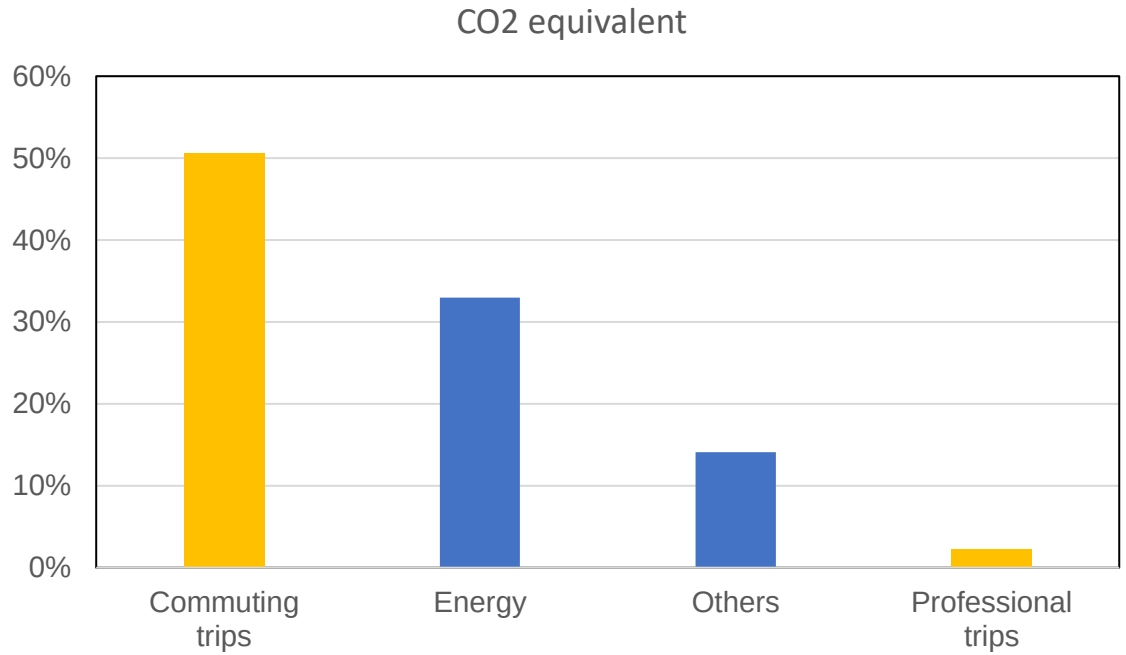
Campus of University with Mobility based on Innovation and carbon Neutrality

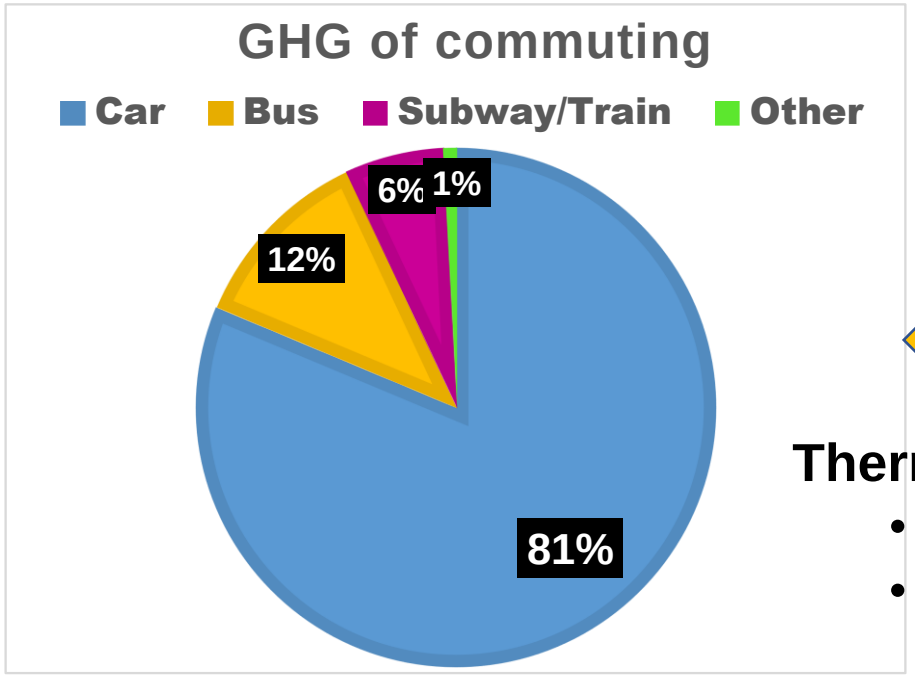
Pr. A. Bouscayrol
(ST, L2EP)

Pr. E. Castex
(SHS, TVES)

University carbon footprint

In 2020
74 000 students
7 000 staff members
Green House Gases (GHG) 52 000 tons CO2eq





Thermal cars

- only 24% of km
- but 81% of GHG

e-mobility transition?

Thermal vehicles = 41% of the GHG of the University

How to motivate commuters with thermal vehicle to switch to low-carbon alternative?

[ADEME 2022]

	TV 1 person	TV 2 persons	EV 1 person	EV 2 persons	bus GNV*	subway	bike
kgCO2eq / km	0,22	0,11	0,1	0,05	0,12	0,03	0
GHG saving	reference	50%	55%	**77%**	45%	**86%**	**100%**

* Natural Gaz Vehicle

5 000 Thermal Vehicles (TV)

Which distribution?

Which incentives?

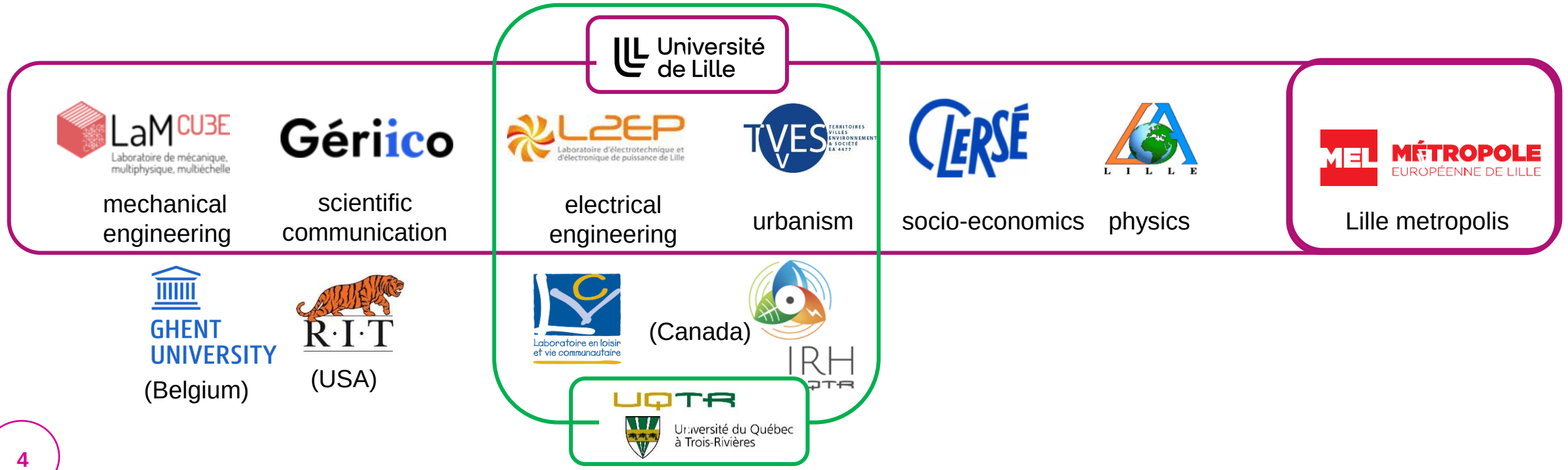
Which constraints? Which cost? Which technologies?

Interdisciplinairy Programme

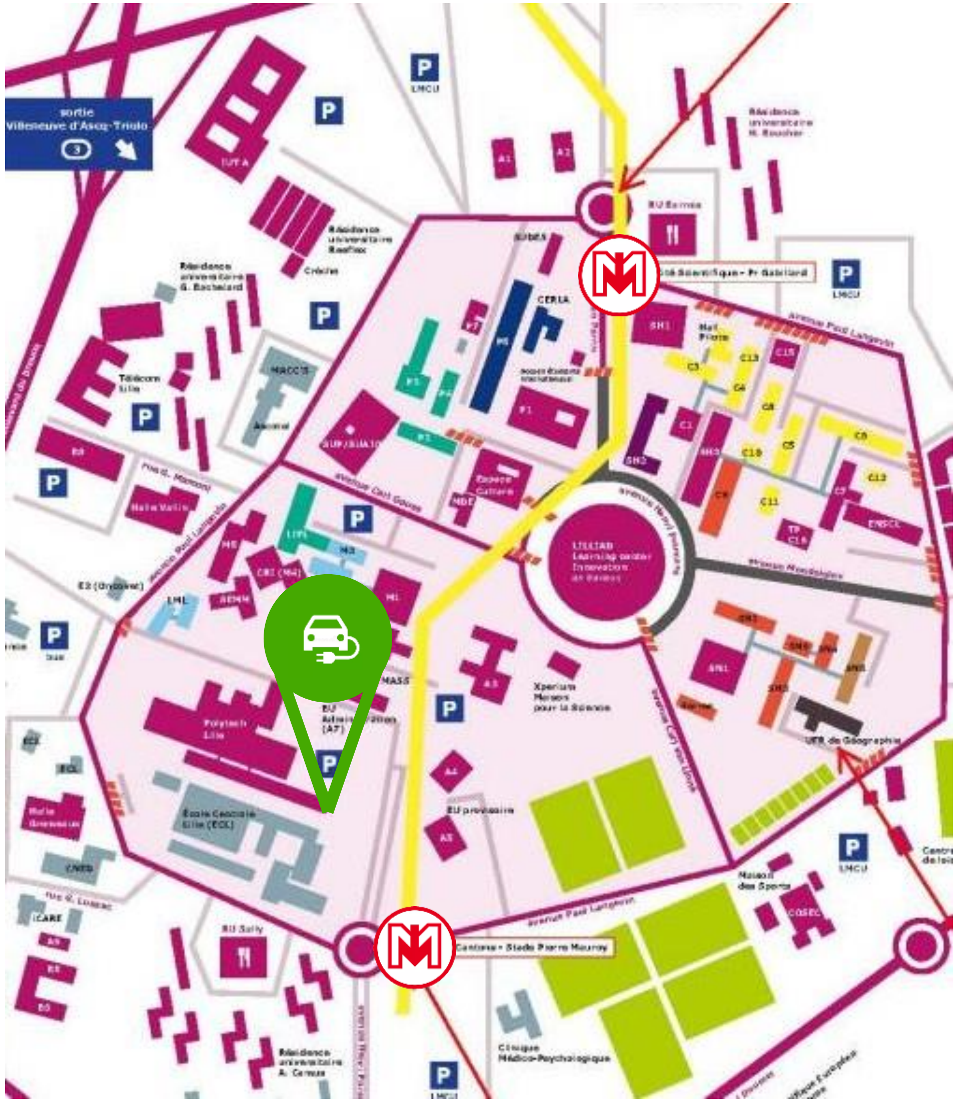
Objective: flexible méthods and tools for e-mobility transition

Mean: demonstrator campus(Living Lab)

Outputs : innovaties technical solution…. To sustainable urban mobility plab



Campus “Cité scientifique” as demonstrator (Living Lab)



20 000 students

2 000 staff

80 buildings / 110 ha

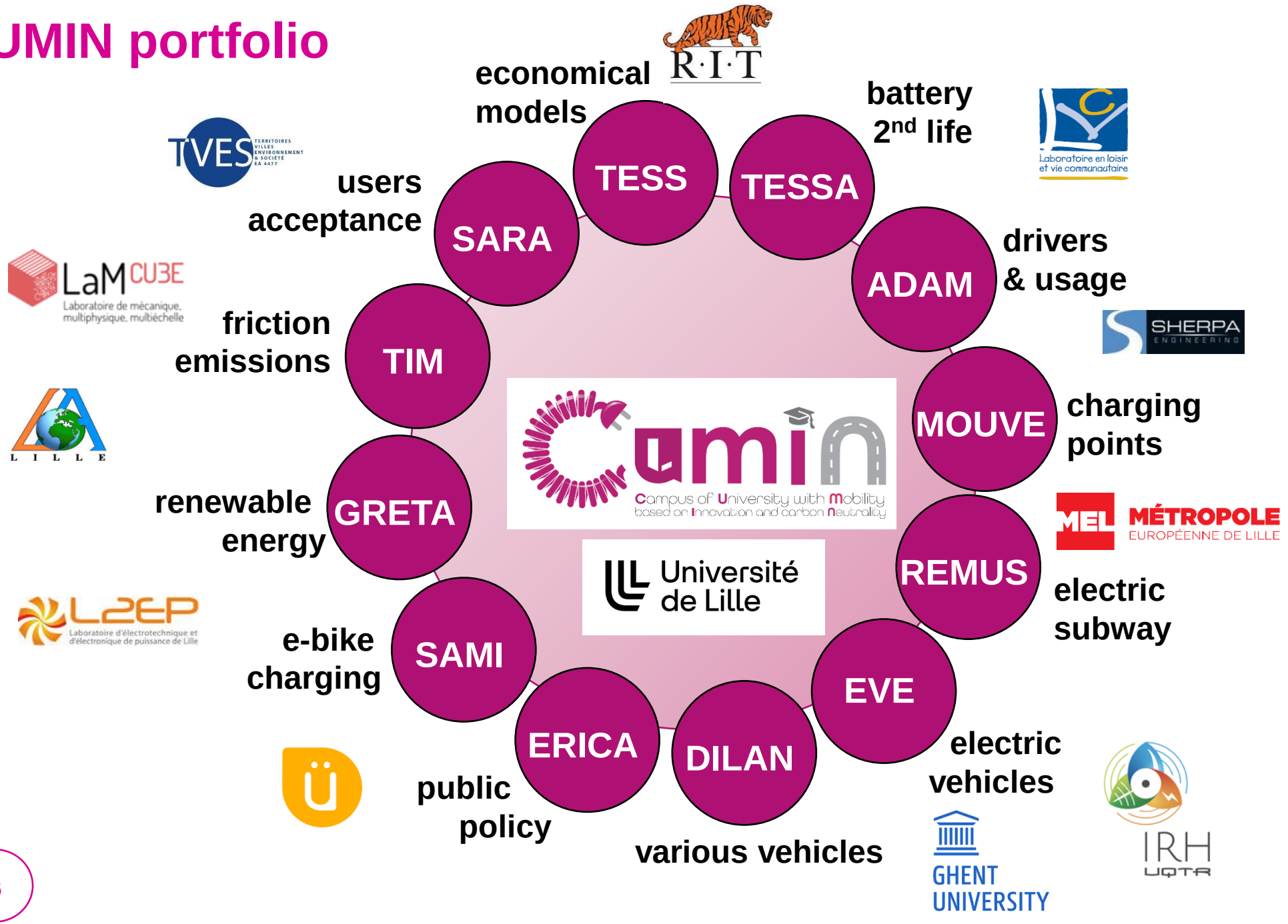
1 hub de bus

2 subway stations

5 000 thermal vehicles

Every day!!

CUMIN portfolio



Funding

I-SITE Université Lille Nord-Europe
Université de Lille
MESHS Lille Nord de France
MEL Métropole Européenne de Lille
Région Hauts-de-France
l'Europe s'engage en Hauts-de-France avec le FEDER
Liberté • Égalité • Fraternité République Française
bpifrance
Agence Nationale de la Recherche ANR
Investir l'avenir
Union Européenne

Supports

MEGEVH French network on HEVs
COMASUS Continuum de l'énergie
Panda
ce2i convertisseur d'énergie Intégré Intelligent
ELSAT2020

Scientific outcomes

A unique interdisiplinary approach

from theory to experimenation

from experimentation to theory

Flexible methods and tools

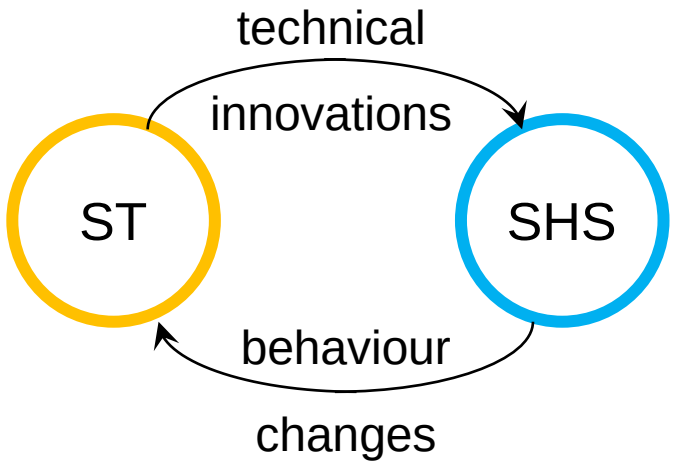
with different spatial

and temporal layers

Accurate and reliable results

with validation and

good understanding



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Accurate energy consumption for comparison of climate change impact of thermal and electric vehicles

A. Desreveaux [a,*], A. Bouscayrol [a], R. Trigui [b], E. Hittinger [c], E. Castex [d], G.M. Sirbu [e]

[a] Univ. Lille, Arts et Metiers Institute of Technology, Centrale Lille, Junia, ULR 2697-L2EP, F-59000, Lille, France
[b] Univ Eiffel, Univ Lyon, ENTPE, LICIT-ECO7, F-69675, Lyon, France
[c] Rochester Institute of Technology, Rochester, NY, 14623, USA
[d] Univ. Lille, Univ. Littoral Côte d'Opale, ULR 4477 – TVES – Territoires Villes Environnement & Société, F-59000, Lille, France
[e] Renault Technologie Roumanie SRL, 062204, Bucharest, Romania

ARTICLE INFO

Handling Editor: X. Ou

Keywords:
Electric vehicle
Conventional vehicle
Life cycle assessment
Global warming potential
Vehicle simulation

ABSTRACT

Performing a climate impact assessment of vehicles is essential for comparing different powertrain options during an entire vehicle life. Life Cycle Assessment (LCA) is used to estimate these effects over a vehicle's lifecycle, including manufacturing, usage, and end-of-life phases. LCA comprises several indicators, such as the Global Warming Potential (GWP). Generally, LCA or GWP studies use manufacturer-reported standard cycle data to estimate the energy consumption of vehicles. In this article, we develop diesel, gasoline, and electric vehicle simulation tools using the Energetic Macroscopic Representation formalism to evaluate that practice. These simulations are validated with actual, measured driving cycles. The simulations are then used to compare the calculated GWP from real, measured driving cycles relative to standard driving cycles used as industry benchmarks. The results show that standard driving cycles consistently underestimate the benefit of switching from fossil fueled vehicles to electric vehicles. Finally, a sensitivity analysis of the battery life duration is included in this work. It shows that the replacement or second life of batteries is also a key parameter in the GWP advantages of electric vehicles.

Societal outcomes

Université de Lille

Contribution of CUMIN:

- Ecologic Transition Plan of University of Lille (2023-2033)
- 3 committees on « Sustainable Development Goals » among 7
- Transition week(18-22 March) workshops & vehicle tests

Un exemple pour :

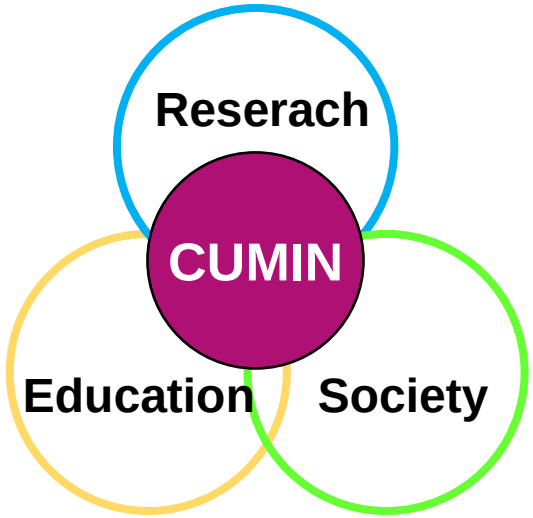
- Lille European Metropolis
- Other international campuses
- etc.

MEL MÉTROPOLE EUROPÉENNE DE LILLE

Campus Living Lab

Methods & tools ?

Education outcomes



eV platform visits
(Univ, IUT, Polytech'Lille, Centrale Lille, ENSAM)

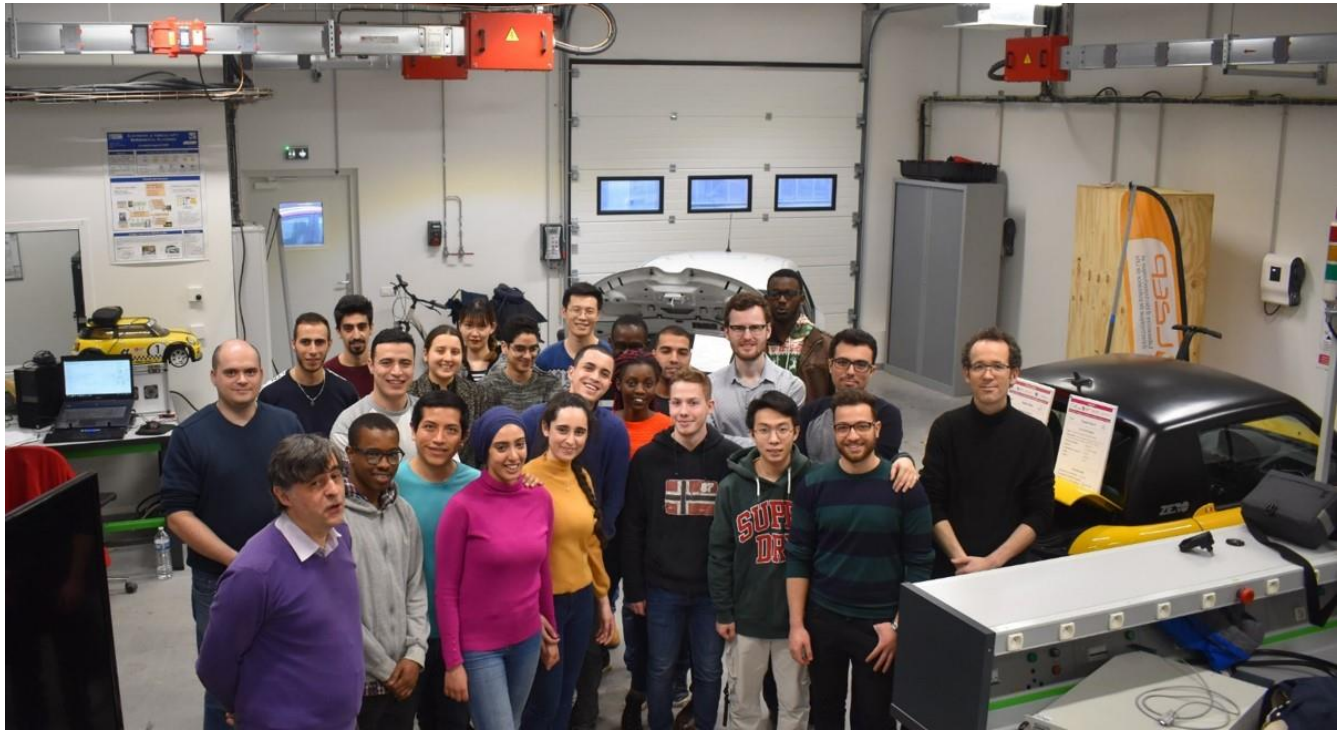
Various projects
(Bachelor, Master, ST & SHS)

Lesctures & seminars
(Master ST & SHS)

A transversal doctoral unit
« Green Mobility » (ST & SHS)

Co-supervised PhD theses

- **6 defended**
- **4 on-going**



https://cumin.univ-lille.fr/

CUMIN-SARA

(Social Acceptance of electric vehicles in Restricted Areas)

L. Junker, E. Castex,

A. Bouscayrol, C. Audouit

About SARA…..

Social

Acceptability

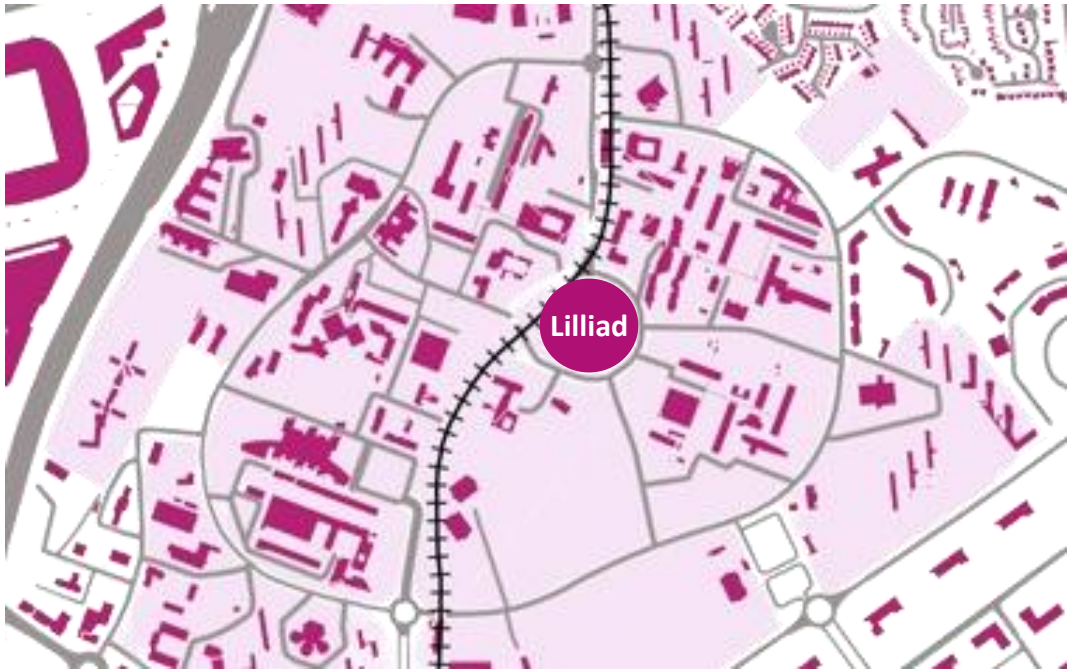
of electric vehicles in

Restricted

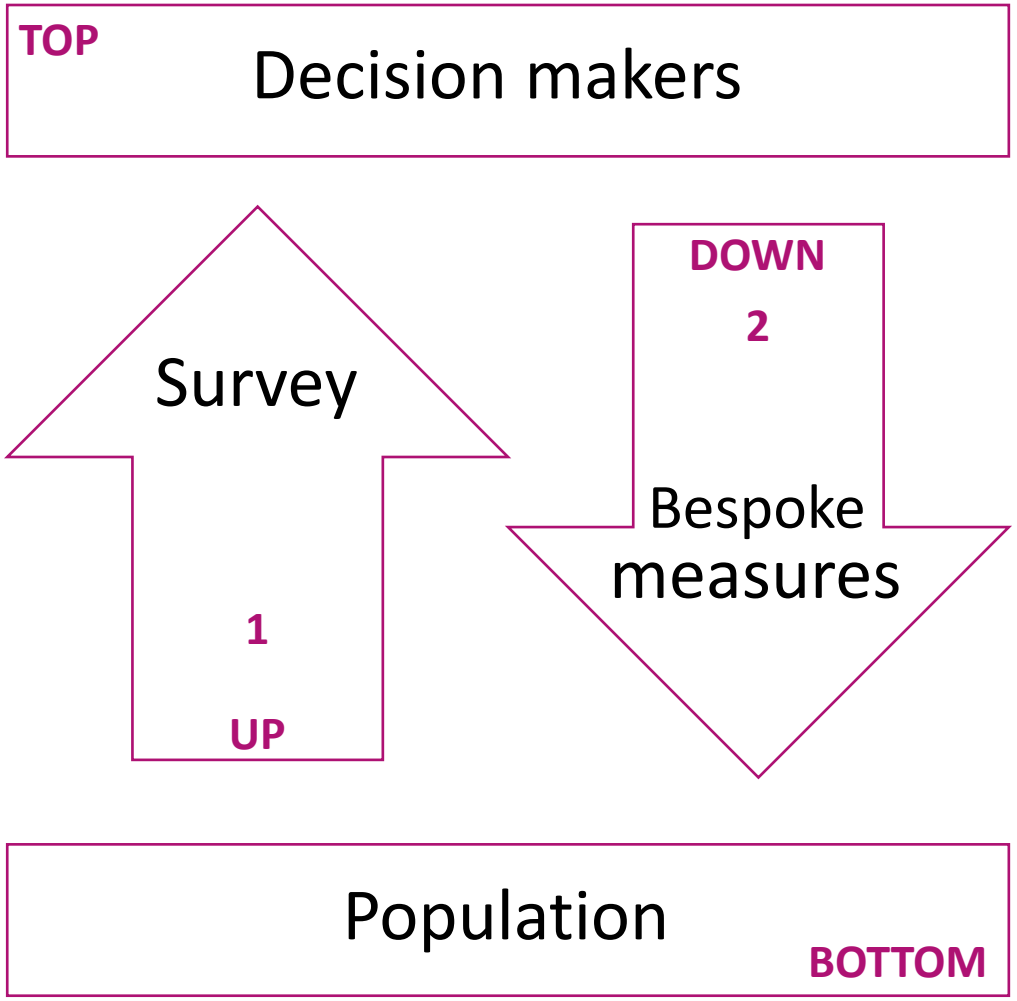
Areas

DEF: *Social acceptability refers to the **level of approval a project or decision gets from a population**. It is based on the collective belief that the proposed option is preferable to alternatives, including the status quo. This concept includes **legislative, economic, environmental, and social dimensions**, reflecting the **community's consensus** on the merits of the undertaking.*

In our case, the campus :



Defining : Integrating top-down & bottom-up approaches into energy transition



Assessing the social acceptability of e-mobility as part of the energy transition

Collect feedback from the people concerned

Made-to-measure actions

More sustainable changes in mobility behaviours

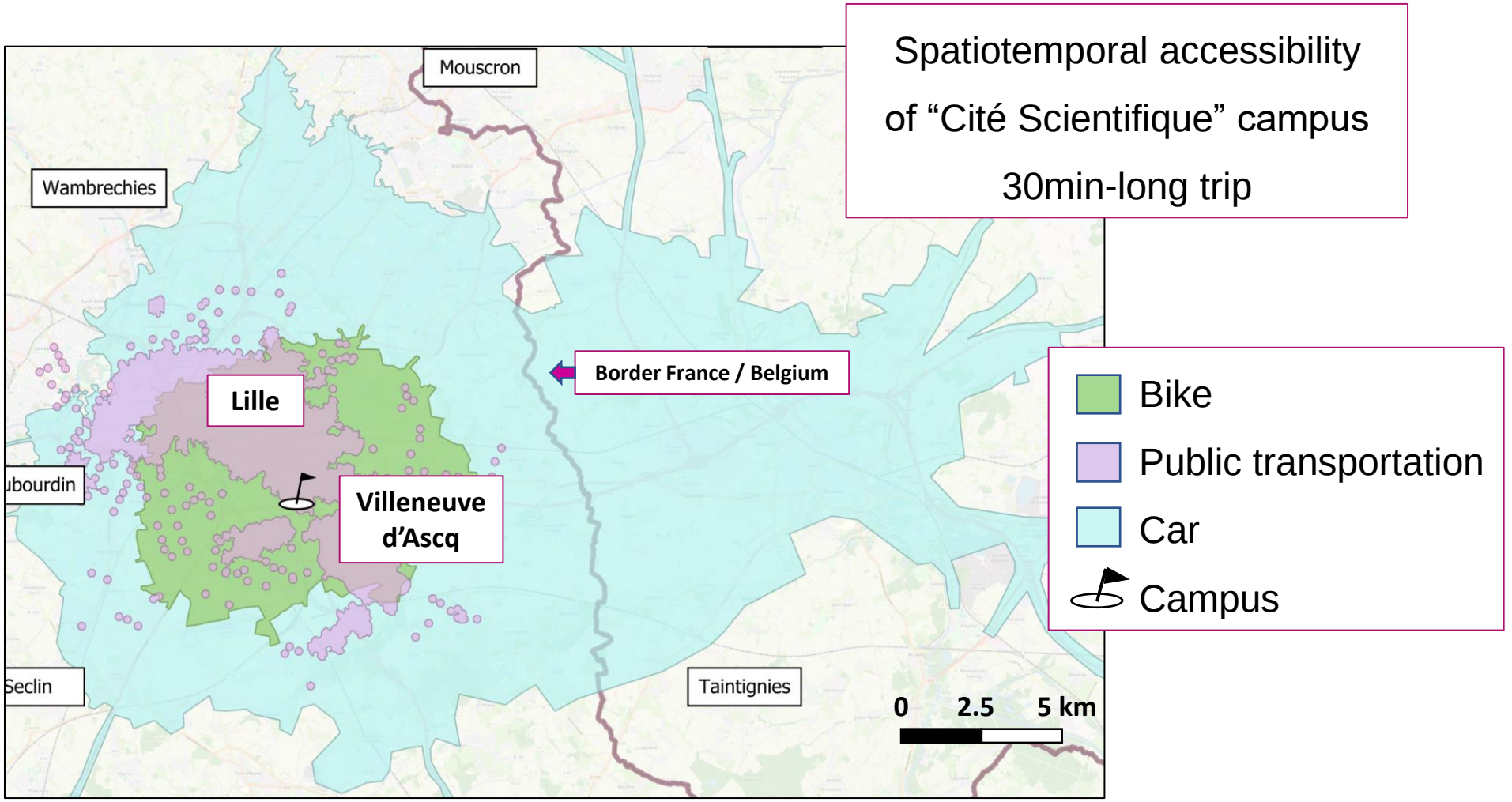
Objectives

Identify levers for action to decarbonize commuting trips

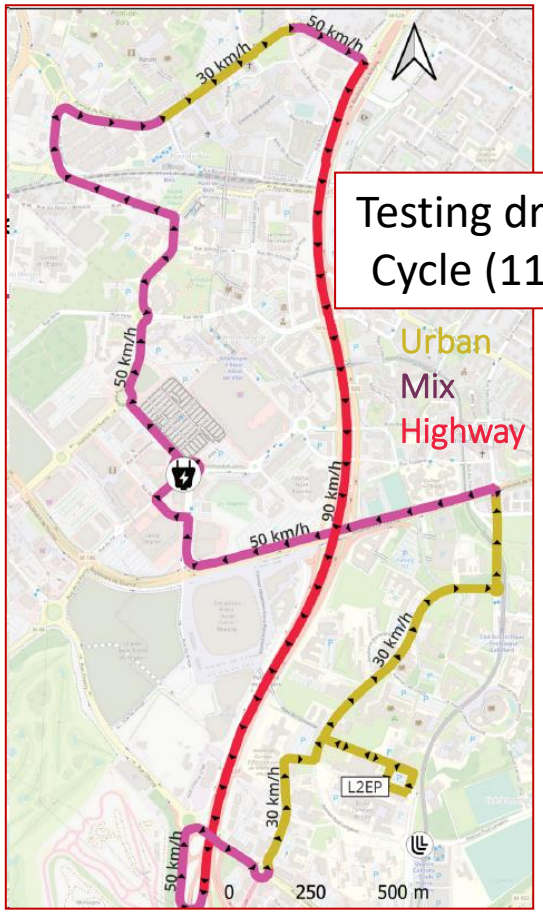
Collecting information on the mobility habits of campus users

Identify obstacles and think about planning solutions that encourage the use of sustainable mobility

Isochore maps of various transport types



CUMIN-SARA – Driving tests of an EV



Testing driving Cycle (11 km)

Urban
Mix
Highway

ST Engineer:

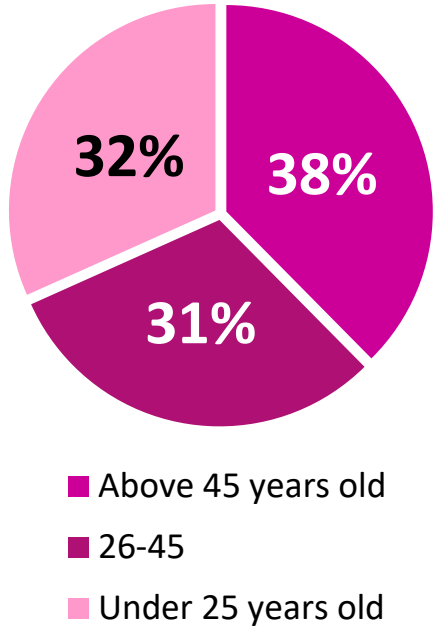
1. Instrumentation of the EV
2. Charging
3. Collection of recorded data

SHS Engineer:

1. Survey on EV perception
2. Driving tests
3. Survey on EV perception and commuting habits

CUMIN-SARA – First results (SHS)

72 drivers
same vehicle
same trip
same period



Socio-behavioural aspects

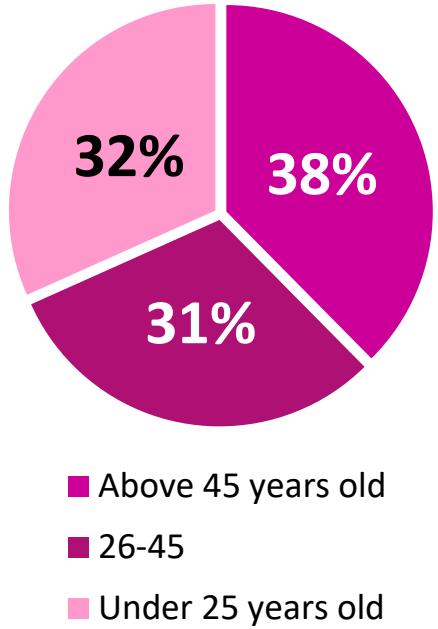
- 49% unaware of campus charging stations
- 82% in favor of adopting an EV

  but 47% cannot buy HEV
- 51% with cost as their first issue

⇨ Connexion with CUMIN-TESS
(Technical Economical Study of Sustainable campuses)

CUMIN-SARA – First results (ST)

72 drivers
same vehicle
same trip
same period



Technical aspects

- Variation in terms of energy consumption of 21%
- Impact of traffic ?
- Impact of driver ?

⇨ Connexion with CUMIN-DILAN (Driver-In-the-Loop of transport Application for New e-mobility)

If you'd like to contribute to our research and try out an electric vehicle, you can reach out to me at: lucie.juncker@univ-lille.fr

(A valid driving license is mandatory)

https://cumin.univ-lille.fr/

CUMIN-TESS

(Technical Economical Studies of Sustainable campuses)

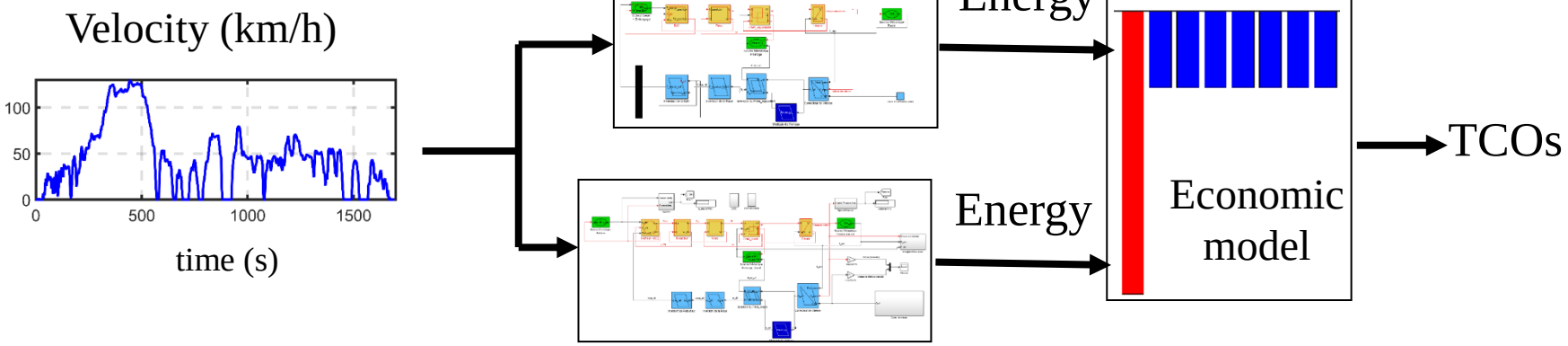
E. Hittinger, A. Desreveaux,

A. Bouscayrol, E. Castex,

Comparison of Total Cost of Ownerships (TCO)

Diesel Car
(Renault Clio)

Electric car
(Renault Zoe)



Fair comparison of TCO of EV and TV using:

- Real vehicles of the same segment
- Real driving cycles
- accurate technical and economic models

[Desreveaux 2020]

Digital Model & validation

GA#824256

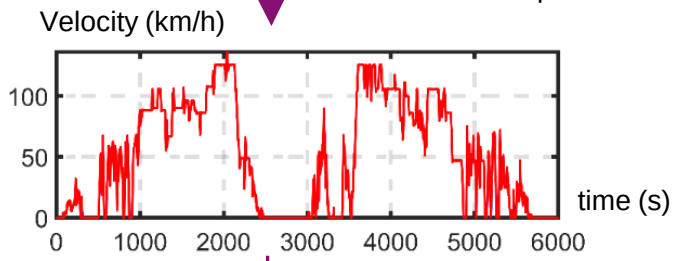
different real driving cycles
from RTR track

GROUPE RENAULT

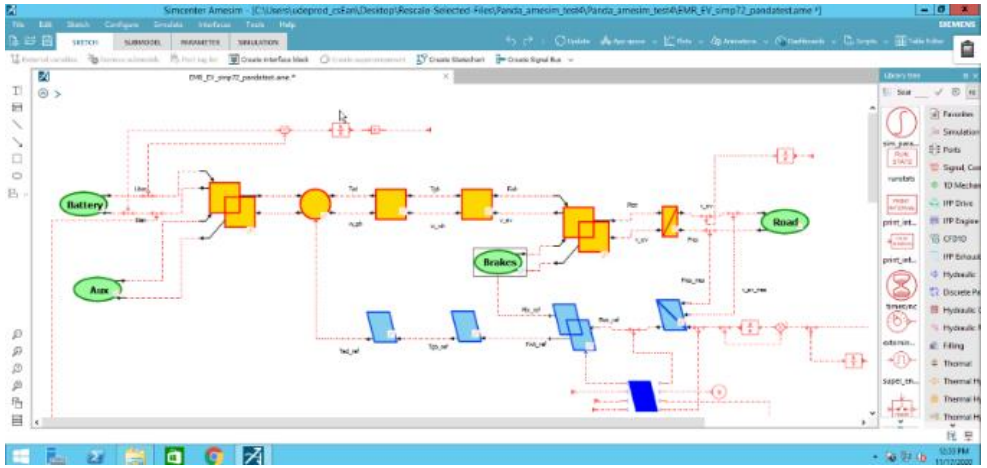
measurements

Extra-urban real driving cycle

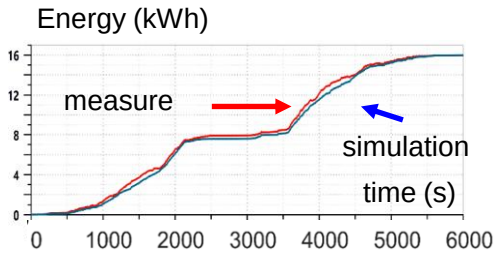
input

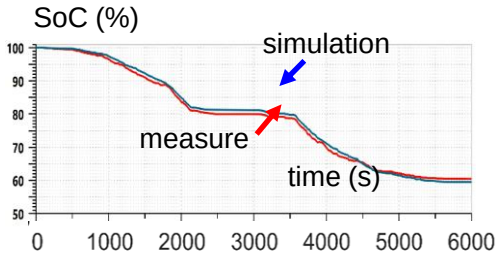


Digital model



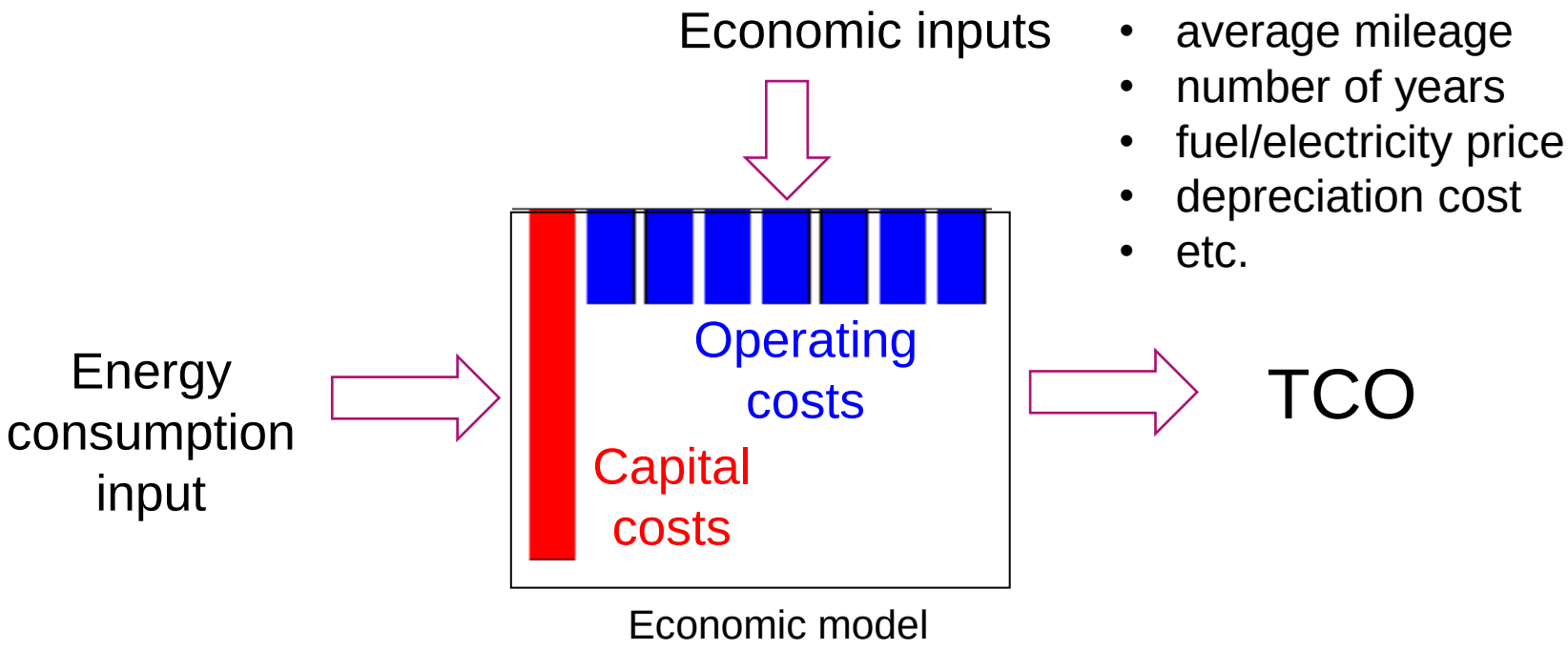
results





Error on energy < 2% for different driving cycles

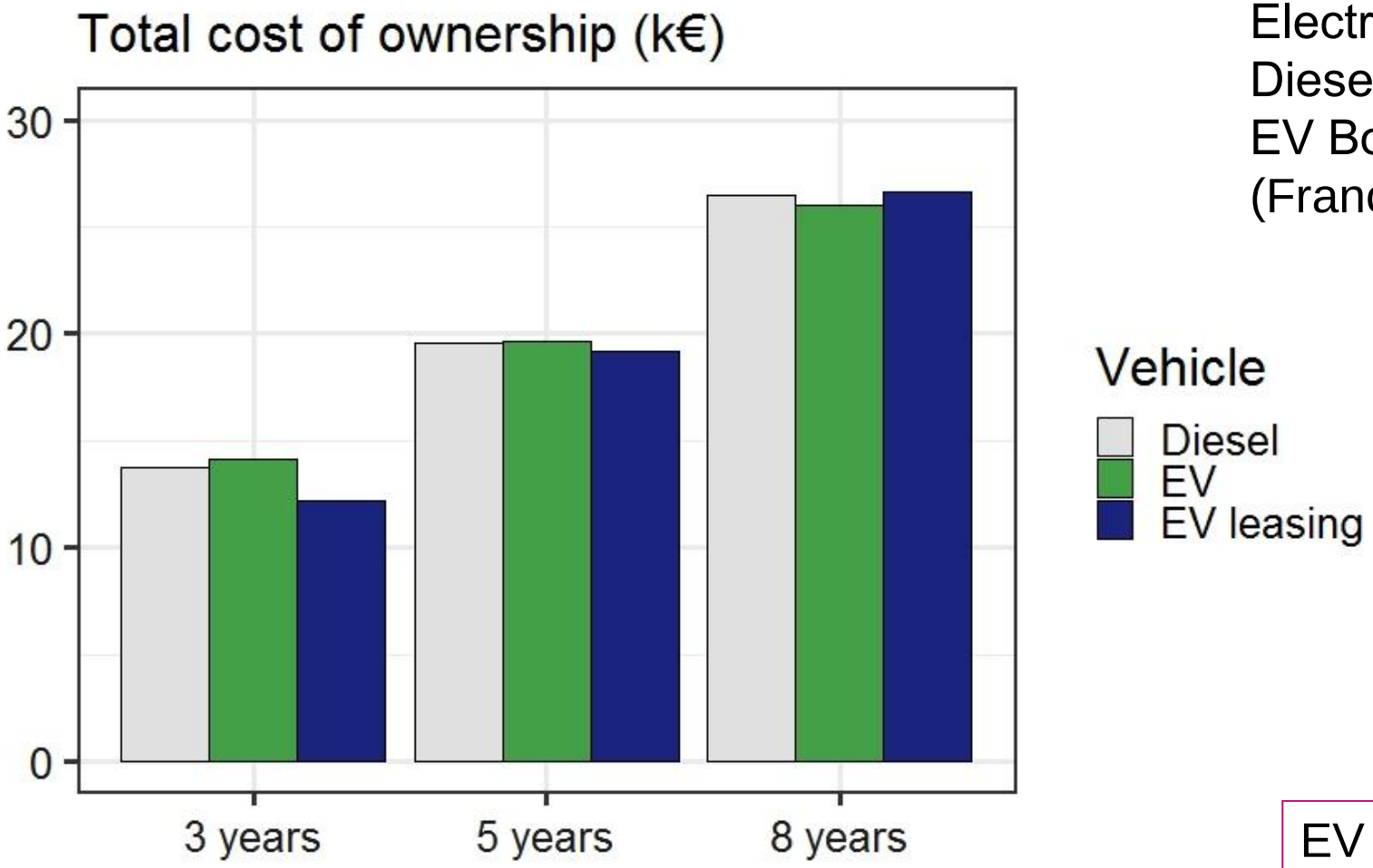
Economic model



$$Operating\ costs = Energy + Maintenance + insurance\ \text{costs}$$

$$TCO = Capital\ Cost - Salvage\ Value + \sum_{i=0}^{n} \frac{Operating\ cost}{(1+\sigma)^i}$$

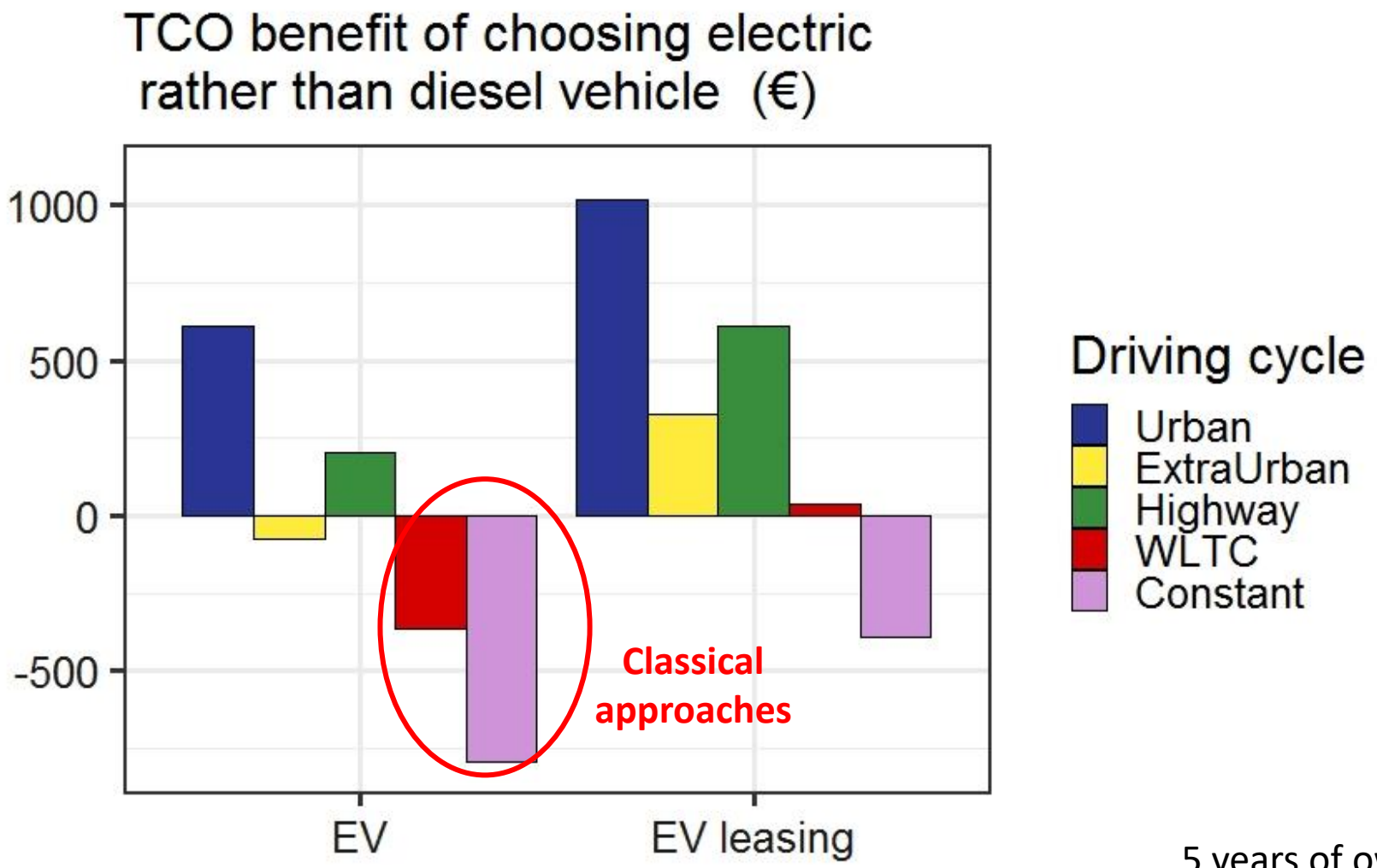
TCO for an Extra-Urban Cycle



Annual mileage: 9,500 km
Electricity price: 0.13 €/kWh
Diesel fuel price: 1.44 €/l
EV Bonus: 8,000 €
(France 2019)

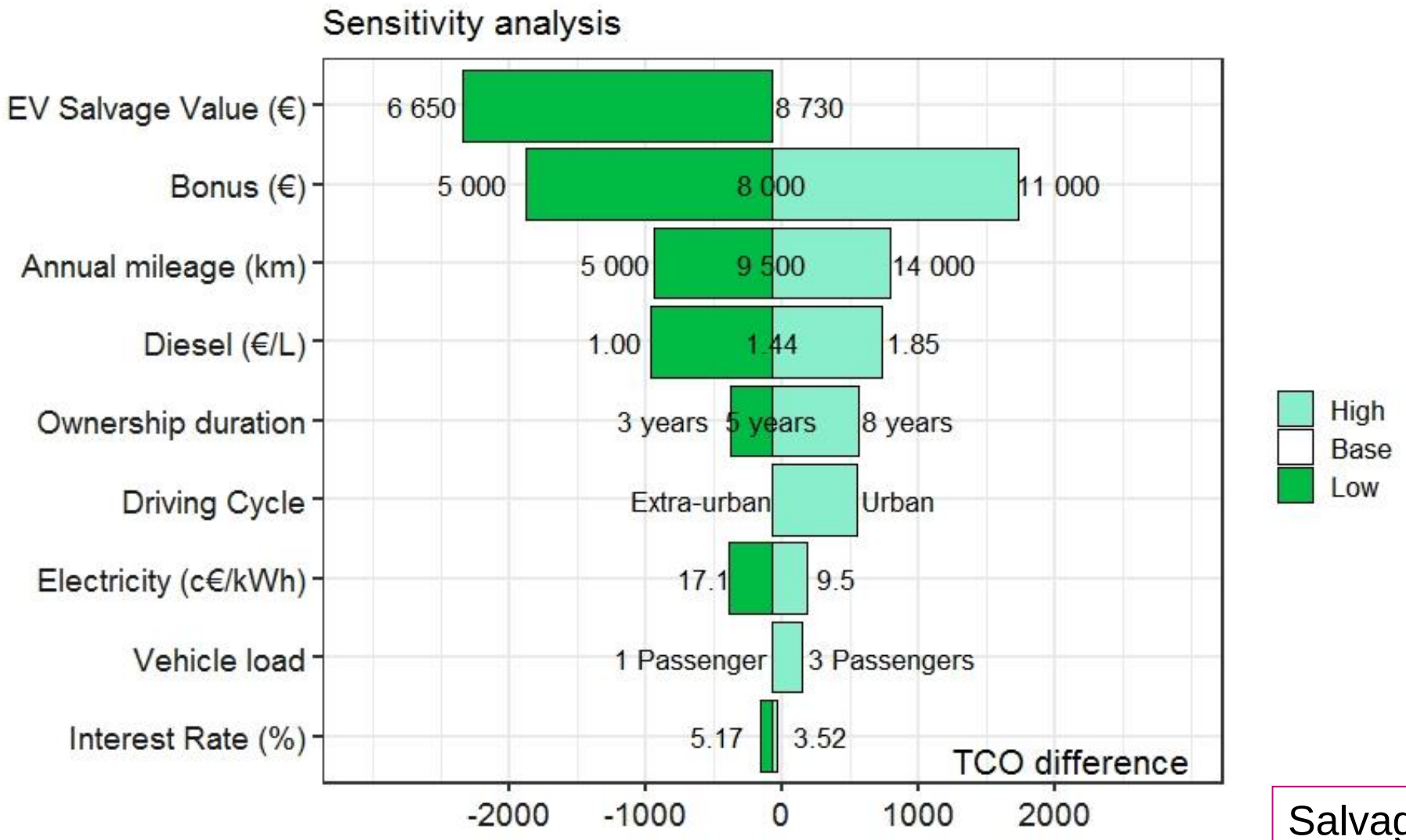
EV with battery is more interesting with a high life duration

Interest of interdisciplinary approach



5 years of ownership

Sensitivity Analysis



Salvage value and EV bonus have the most impact

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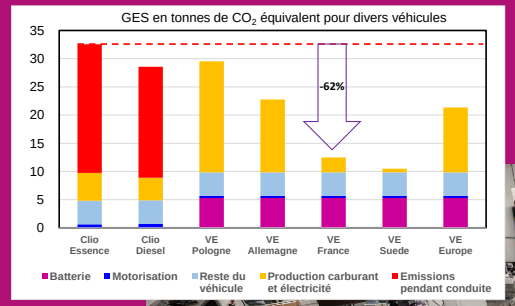

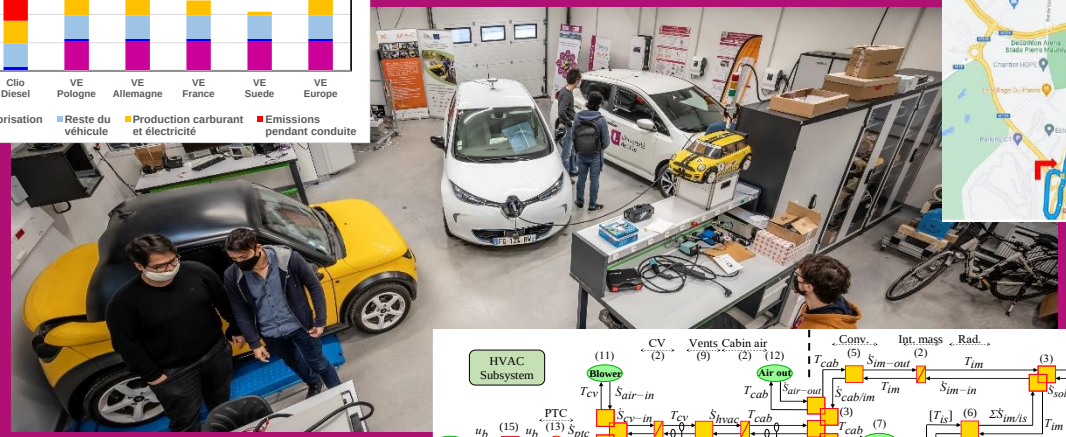

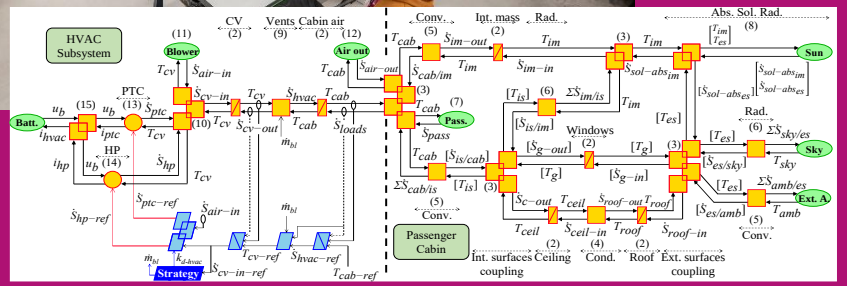

Our university as an exciting living lab towards eco-cities !