CUMIN – TESS / TESSA

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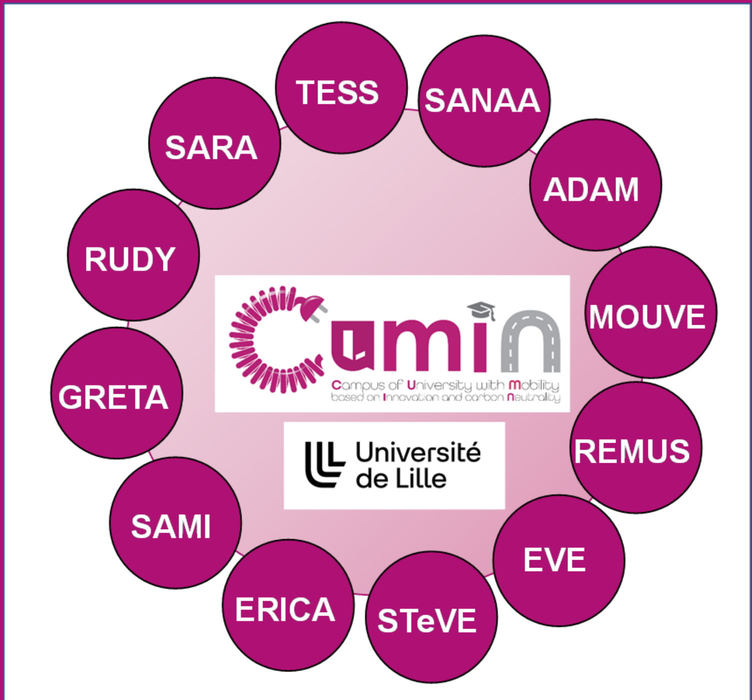

TESS and TESSA

Techno-economic studies for a transition to a e-mobility campus

E. HITTINGER (RIT), R. GERMAN (L2EP), E. CASTEX (TVES), A. BOUSCAYROL (L2EP)

coupling technical and economical models

University

User

Sustainable Urban Mobility Plan (coupling to MOUVE)

First roadmap of campus electrification

?

More detailed roadmap?
Extension to RIT campus?

Battery 2nd life (TESSA)

- Optimal usage
- When to replace
- Availability

- Awareness
- Preferences

(coupling to ERICA)

French case (5 years):
e-car TCO > diesel car TCO

?

extension to US case?
extension to other vehicles?

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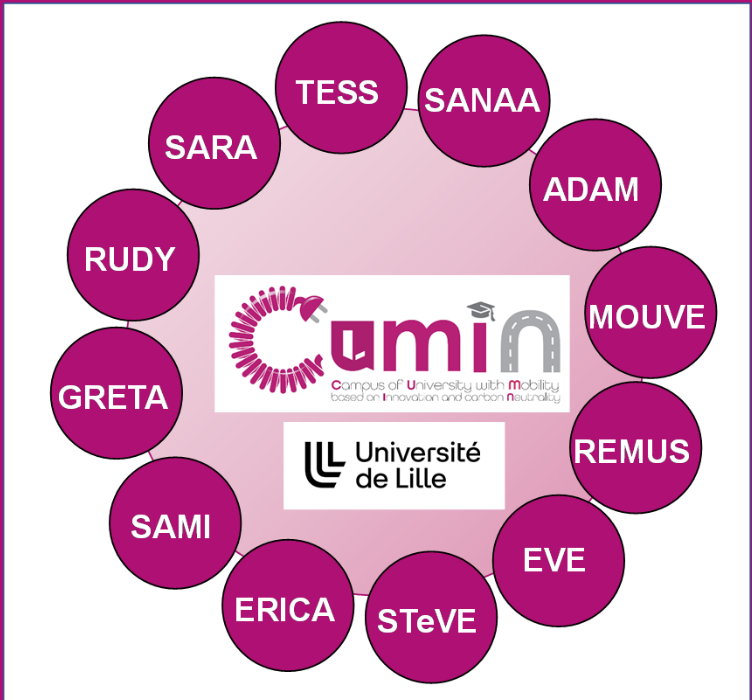


CUMIN – TESS

Technical Economical Study of Sustainable campuses (TESS)

E. HITTINGER (RIT),
E. CASTEX (TVES),
A. BOUSCAYROL (L2EP)

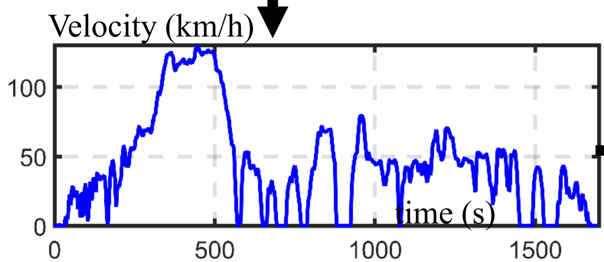
TESS brings together different streams of research

- Technology research at L2EP on EVs, solar PV, batteries
- Social science research at TVES on transport needs and behaviors
- Techno-economic and financial modeling approaches to understand alternatives

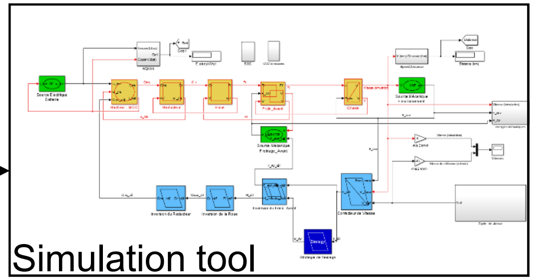
Question 1: What are the economics of replacing ULille commuter cars with EVs?

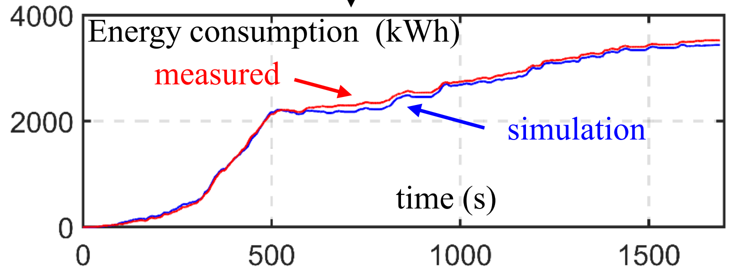
Trip Campus – Baisieux 21 km

Measured data



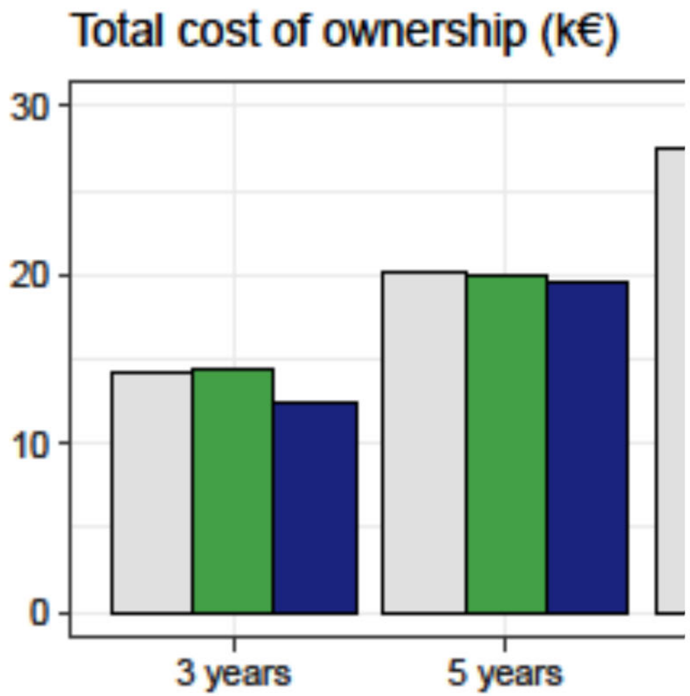
Accuracy ≥ 97%

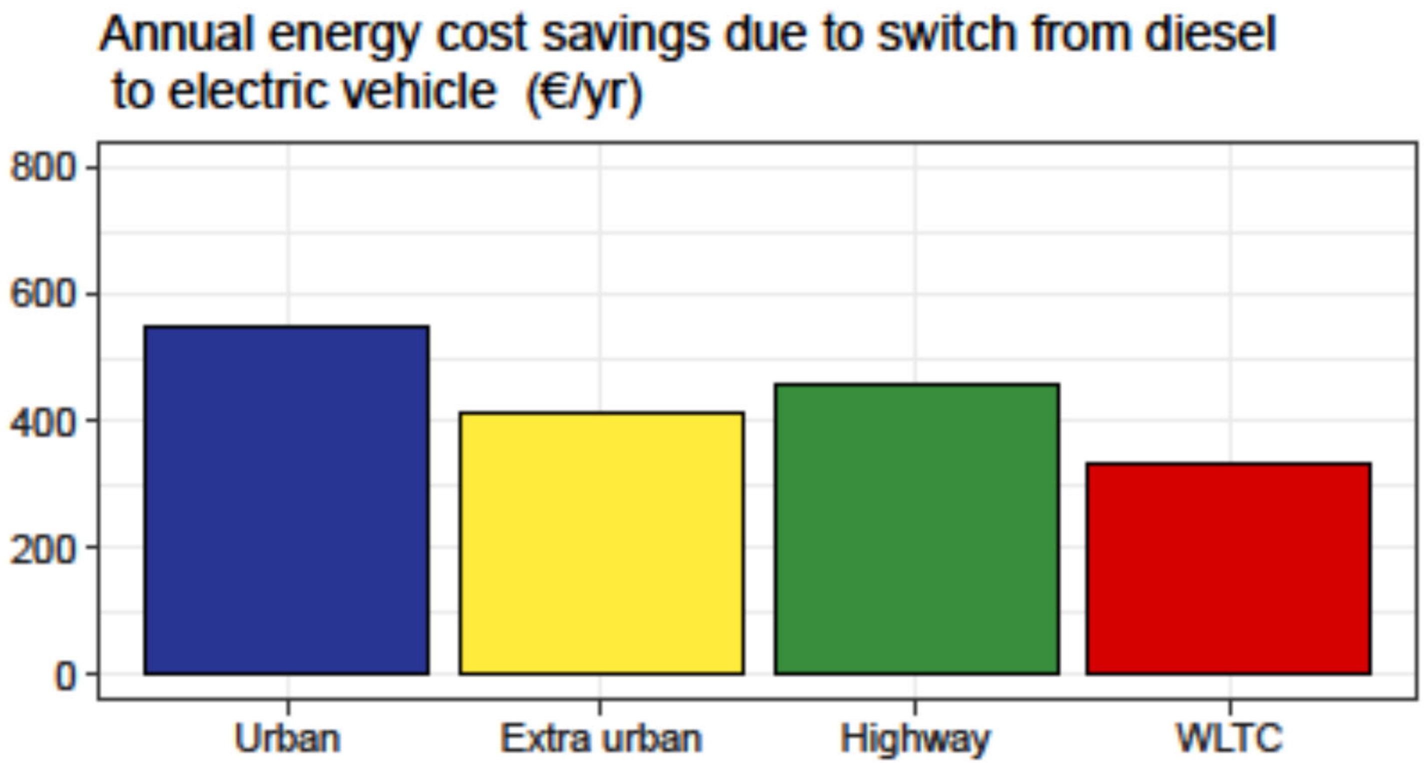




A similar workflow (model, validation) is completed for the diesel car (accuracy > 95%)

Question 1: What are the economics of replacing ULille commuter cars with EVs?





Desreveaux, Anatole, et al. "Techno-Economic Comparison of Total Cost of Ownership of Electric and Diesel Vehicles." *IEEE Access* 8 (2020): 195752-195762.

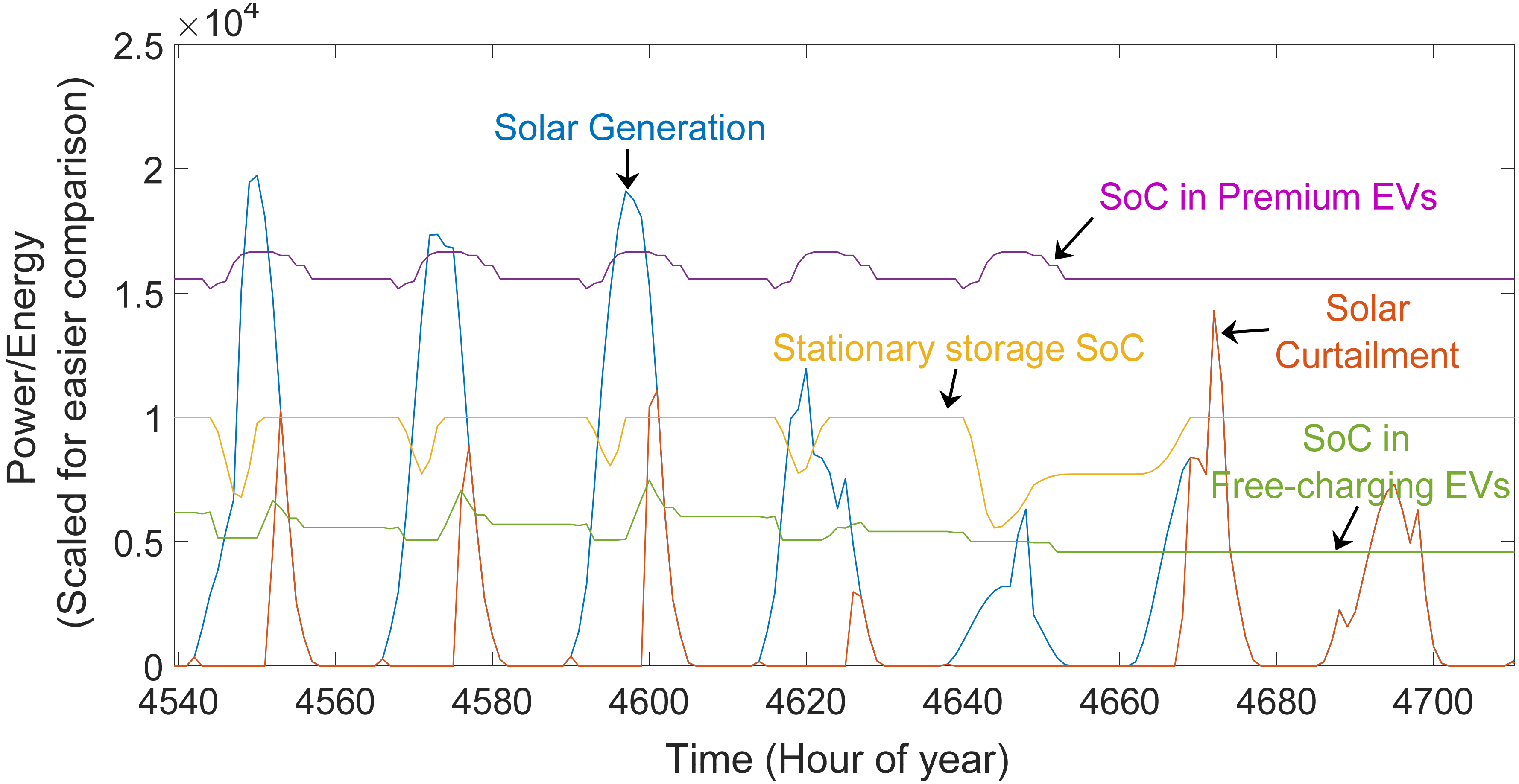
Question 2: What infrastructure (charging stations, solar PV, and storage) should the university build in response to a growing EV demand?

What infrastructure should be built and **when should we build it**, given things like economy of scale and falling costs of new technology?

Is it better to buy clean electricity from grid suppliers or generate it locally?

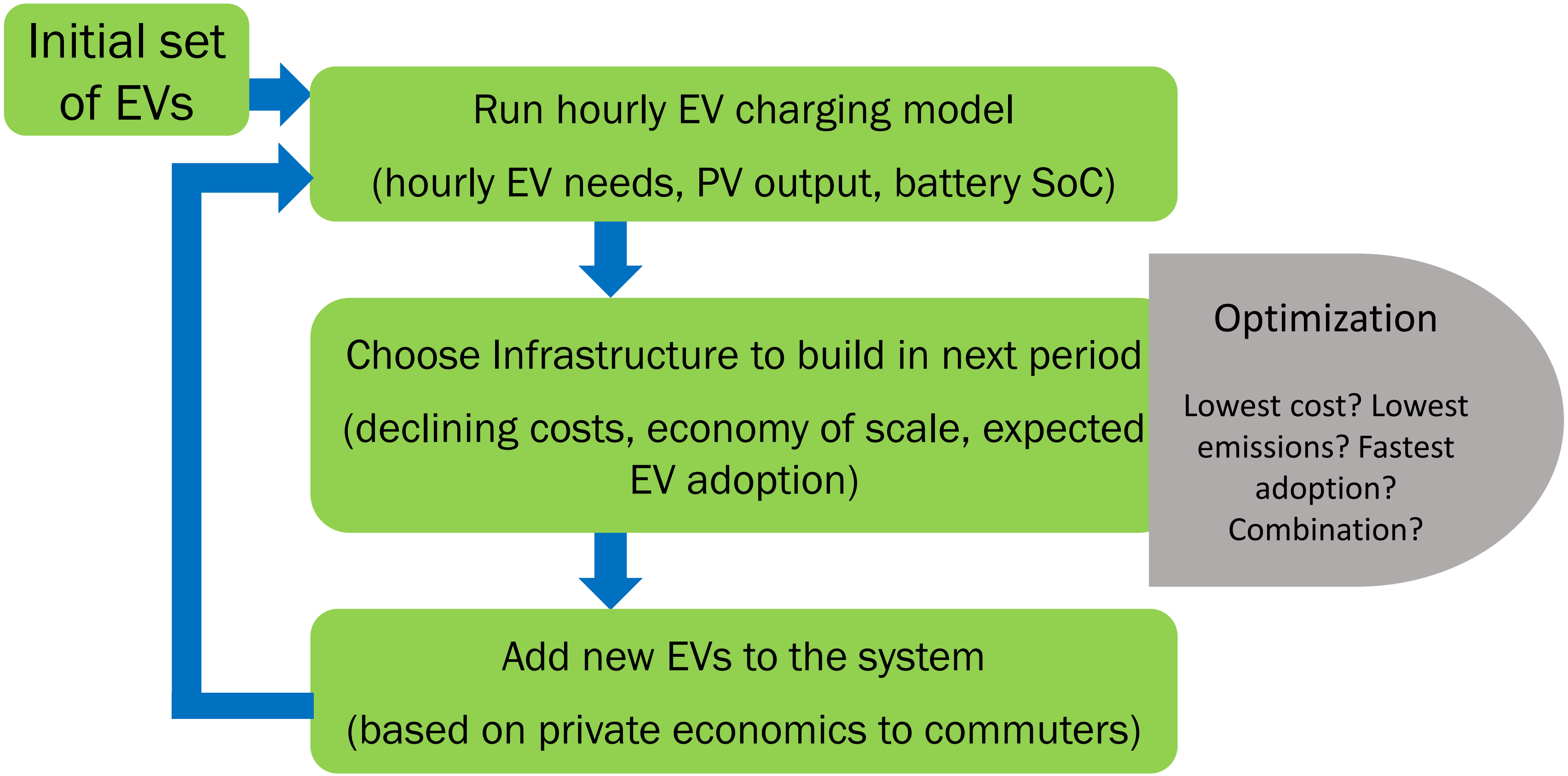
What business model for charging will attract commuters while raising some income?

The central part of the model uses an hourly "dispatch model" to route power between energy sources and EVs

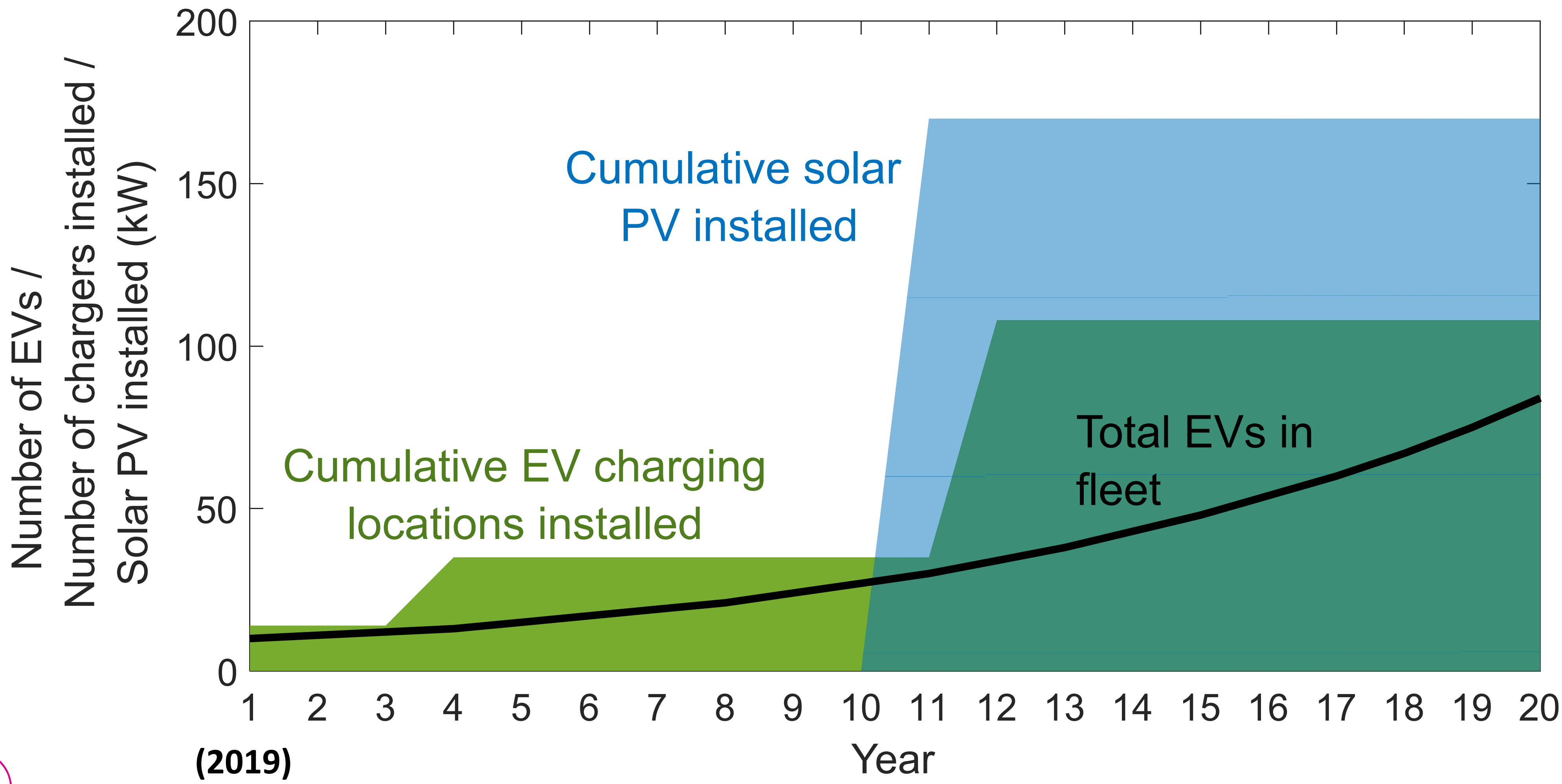


The model is flexible and could also include different types of customers, more variety in vehicle types or work patterns, or other energy sources.

The analysis of driver economics and the analysis of charging needs can be combined for further insights:



In a scenario with continual growth in EVs, the optimal strategy is to build chargers and solar PV every ~10 yrs



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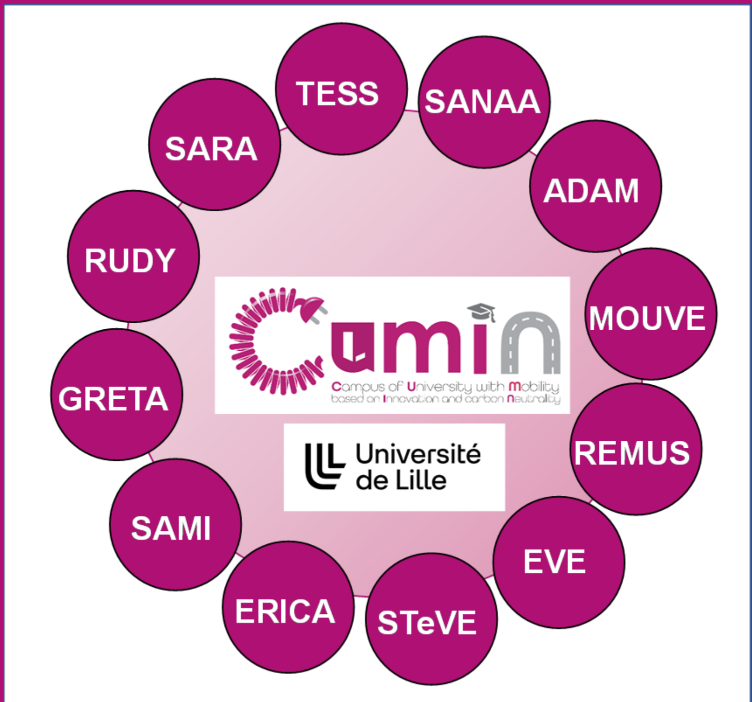


CUMIN – TESSA

Techno-Economical Study of Second life batteries for Affordable e-mobility campus (TESSA)

E. HITTINGER (RIT),
R. GERMAN (L2EP),
E. CASTEX (TVES),
A. BOUSCAYROL (L2EP)

TVES
L2EP Laboratoire d'électrotechnique et d'électronique de puissance de Lille
R·I·T
Université de Lille
FRANCE 2030

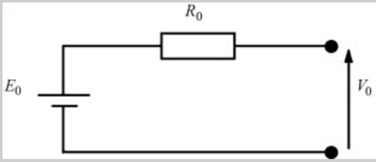
TESSA will extend the ideas of TESS to questions about secondary use of EV batteries

TESSA is funded through the University of Lille WILL International Chair program (awarded March 2023)

4 year collaborative project connecting technical modeling, economic analysis, and EV driver behavior/needs to understand opportunities for second life EV batteries.

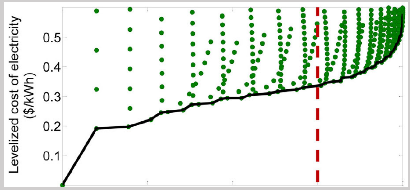
1. How should second-life EV batteries be operated to balance their economic and environmental benefits?

Technical Models



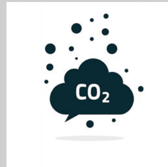
Battery performance = f(operation)
Battery lifetime = f(operation)

Economic Models



Economic value = f(operation, performance, lifetime)

Environmental Assessment



Grid emissions effects = f(operation, performance)
Embodied emissions = f(lifetime)

Integrated Framework

Economic value = f(operation)

Net emissions effect = f(operation)

How should second life batteries be operated?

What are the tradeoffs between economic and environmental benefits?

2. If electric vehicle batteries have a useful second life, when should drivers replace them?

Traditional Approach

EV battery replacement defined by pre-defined cutoff (80% of original capacity)

Discarded

Second life uses discarded batteries for economic or environmental benefits

TESSA Approach

EV battery replacement defined by EV owner needs & behavior

Value of second life affects EV battery replacement

Second life uses discarded batteries for economic or environmental benefits

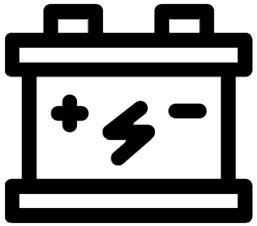
How does this change in perspective affect the decision to replace EV batteries?

3. What is the overall potential for supply of second life EV batteries in France, EU, US, and the world?

Second life batteries are not “manufactured”

EV battery production = f(EV sales, battery size)

Time (~10 yrs)

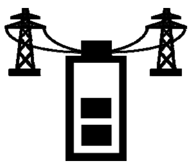


Second life batteries = f(EV sales, battery size, battery lifetime)

Second life battery lifetime is limited

How well will the supply(t) of second life batteries match the demand(t) for grid energy storage?

Decarbonization requires increasing amounts of energy storage



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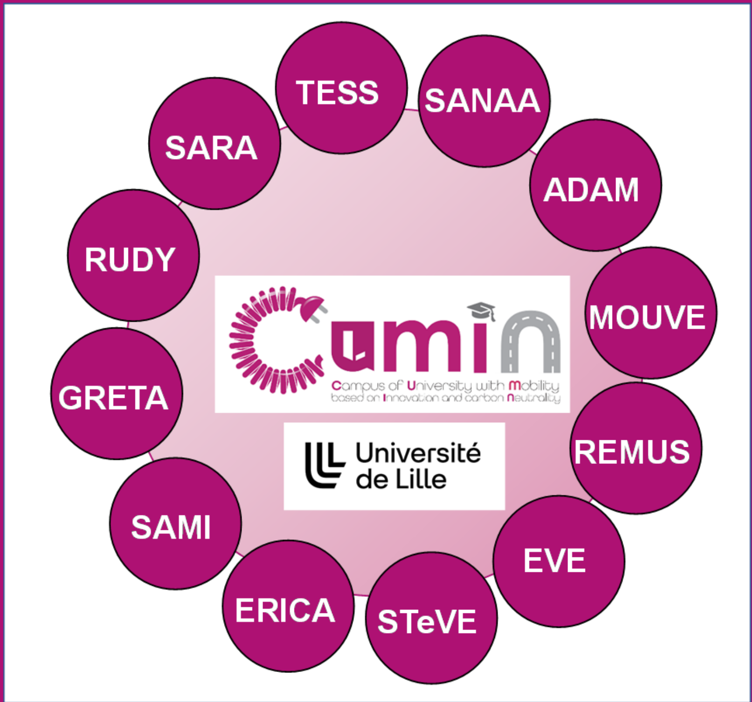

CUMIN programme

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