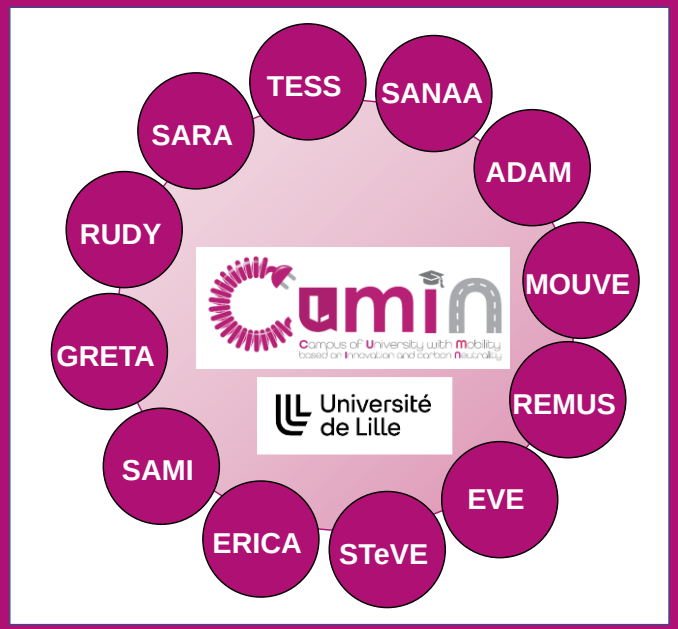
CUMIN - TESS

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



Nissan Leaf – total cost of ownership

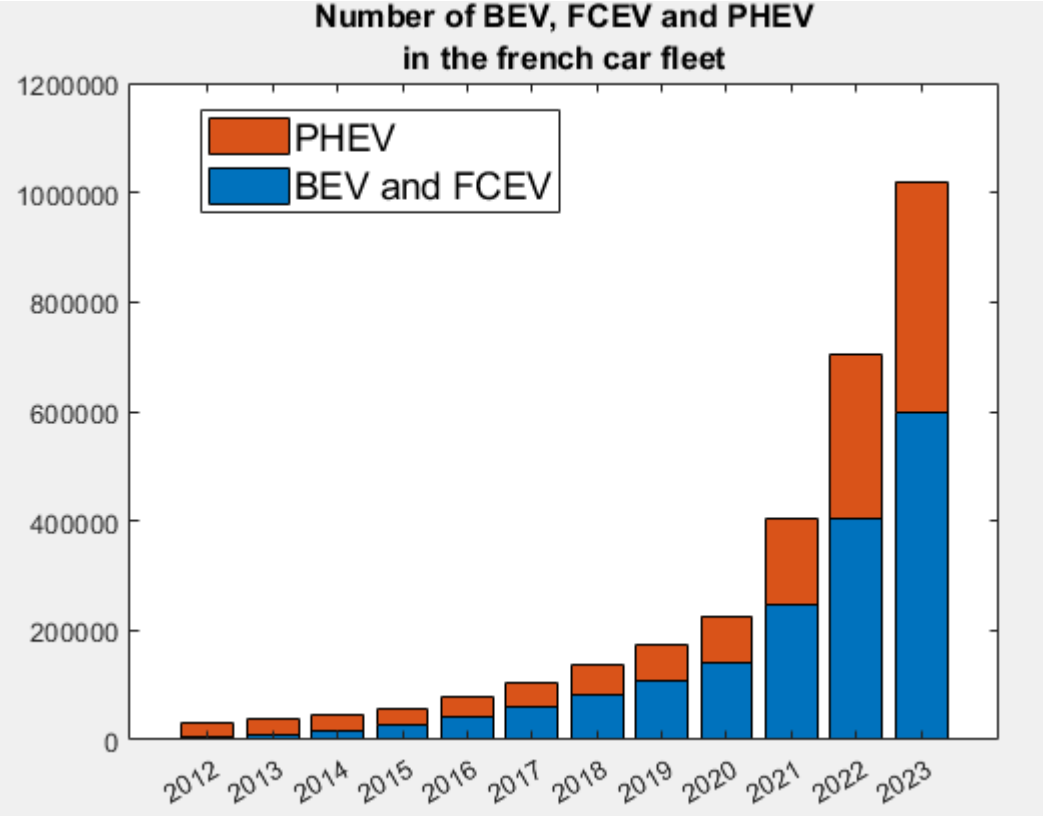
LEHUT JÉHU Margaux
BOUSCAYROL Alain
HITTINGER Eric

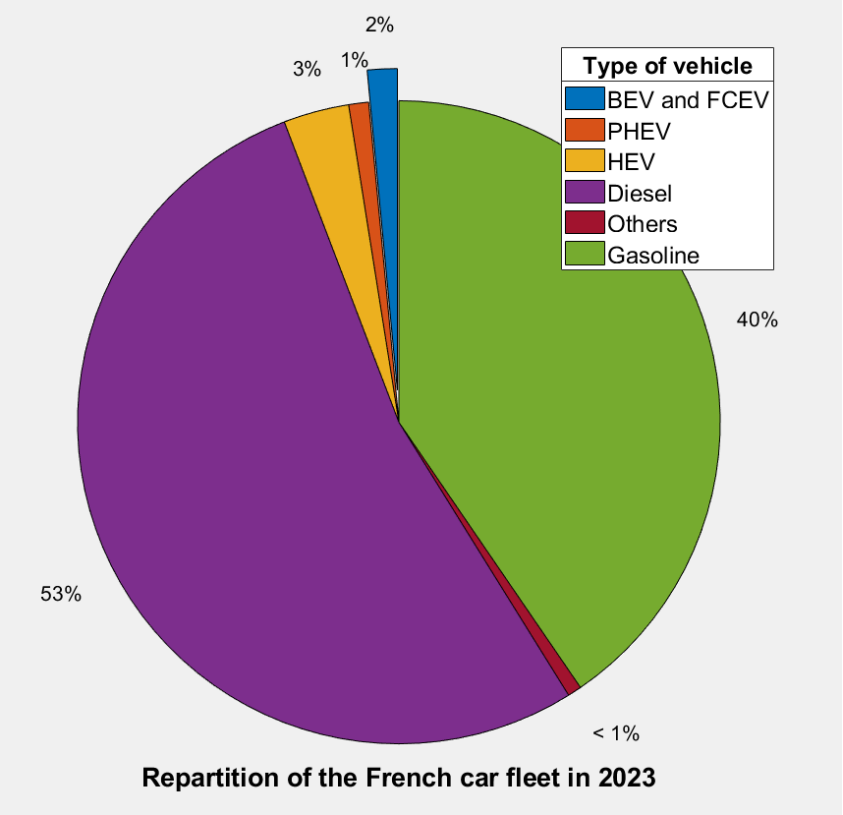
13/02/2025

Outline

1. Economic value of cars
2. Technical tools needed
3. Analysis and future possibilities

Is an electric car economically viable?





In 2035, only BEV and FCEV will be available for new cars in France

TESS objective: develop flexible technical-economic models, prevision works (TCO of Renault ZOE, economic model of charging stations, etc)

Presented project: Total cost of ownership of the Nissan leaf

Vehicle chosen: the Nissan Leaf

The Nissan Leaf of the L2EP

Source : documentation given by the L2EP

Country	Number of electric cars sold
Europe	320 000
Japan	230 000
China	230 000
North America	210 000

Data by Nissan about the number of electric cars sold from 2010 to 2023 (rounded numbers)

- A real vehicle is available in the L2EP laboratory
- This vehicle is sold around the world, it may be used for different driving patterns
- Compact vehicle – segment classically used in France

TCO: total cost of ownership

$$TCO = CAPEX - SV + \underbrace{\sum_{i=0}^{n} \frac{AC}{(1+\sigma)^i}}_{\text{OPEX}}$$

CAPEX: Capital expenditures

OPEX: Operational expenditures

SV: Salvage Value

AC: Annual costs: Energy consumption, Maintenance and Insurance

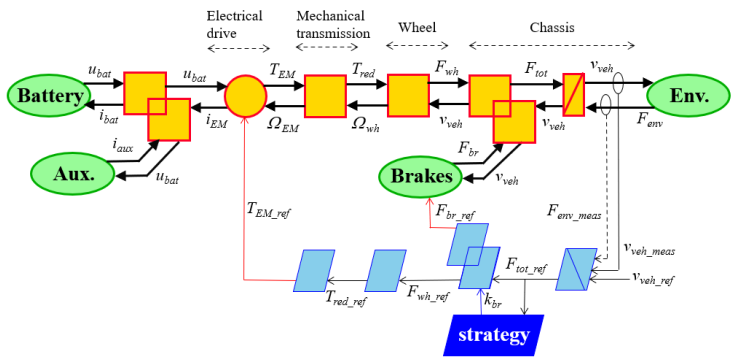
σ: discount rate

n: years of ownership

Methodology of TCO estimation

Total cost of ownership

Estimation of the energy consumption

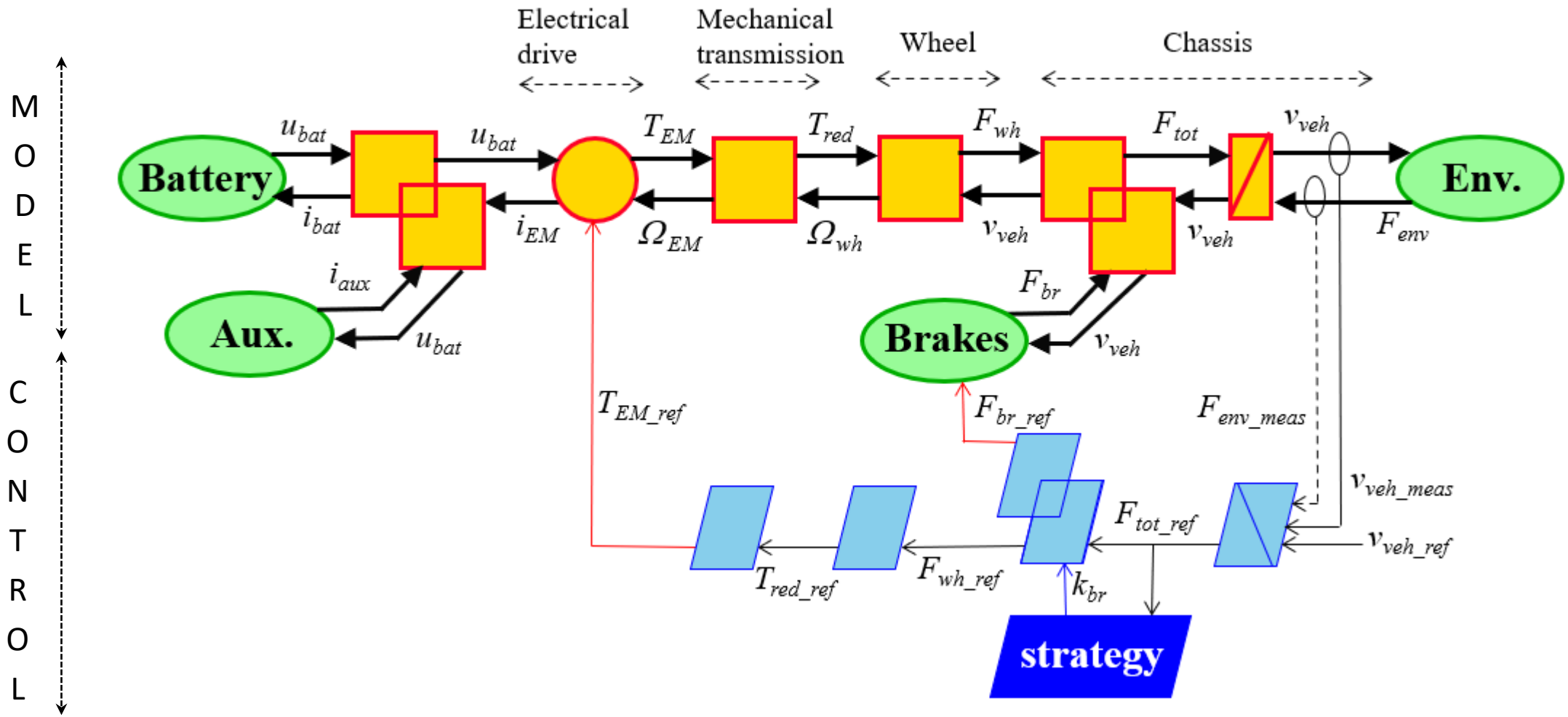


Economic values chosen for 2023

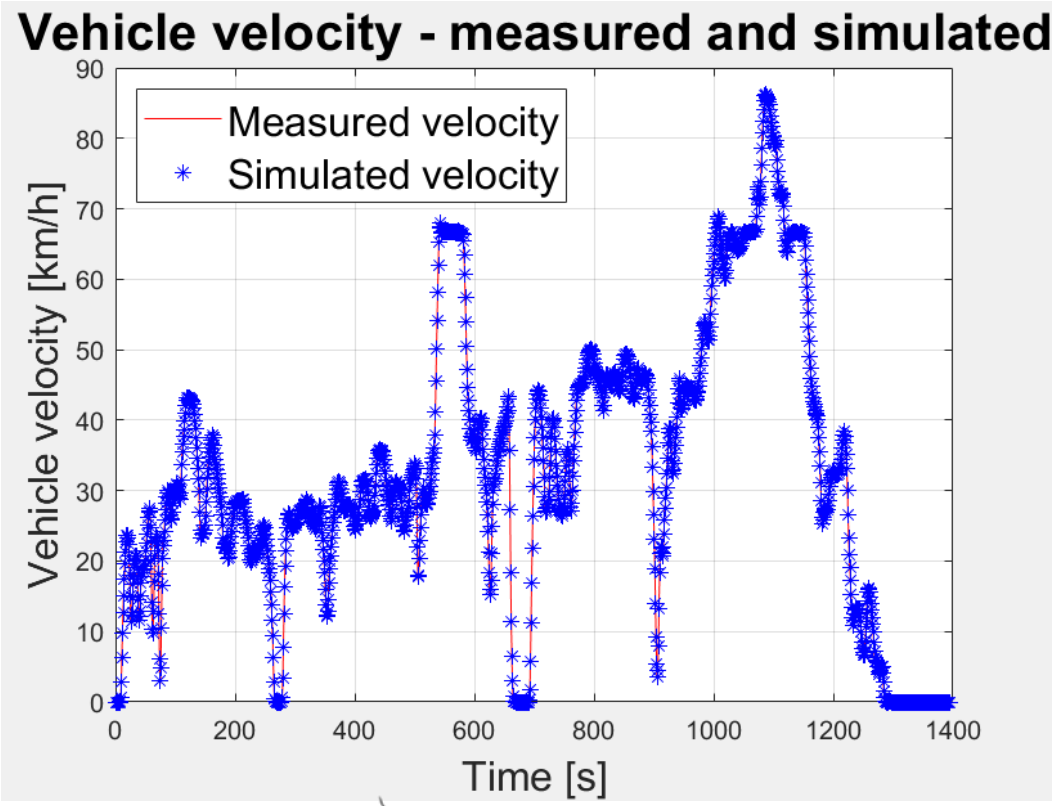
Inflation adjustement

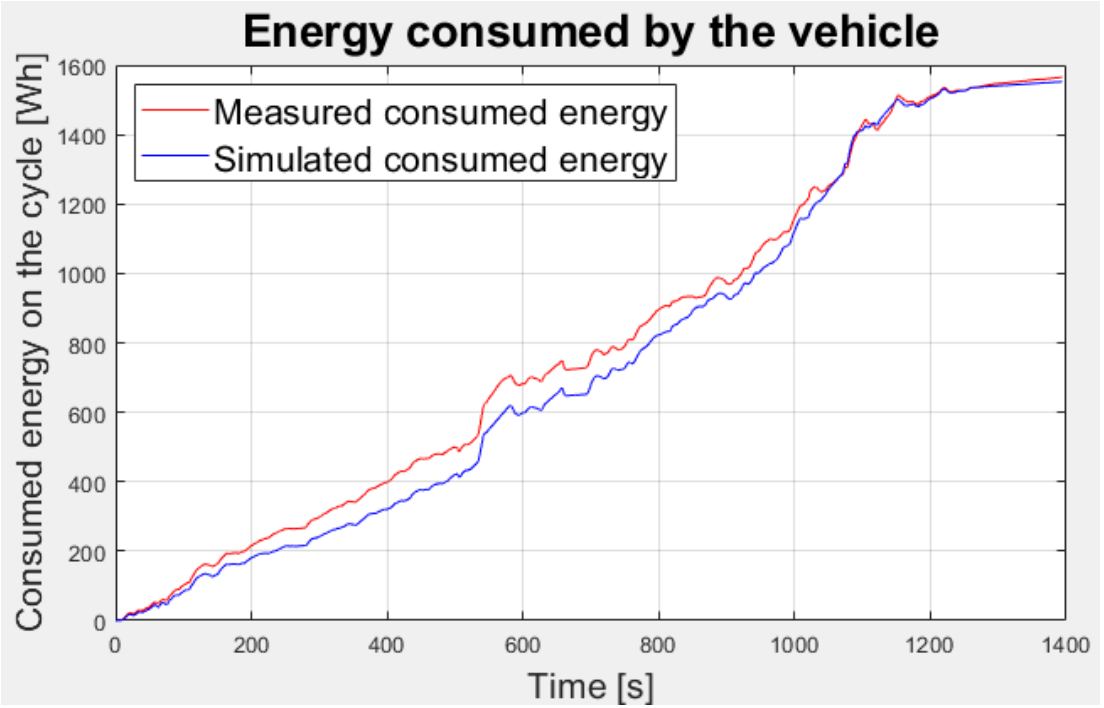
Model of the Nissan Leaf

using the EMR (Energetic Macroscopic Representation) formalism



Validation of the model of the Nissan Leaf on a real cycle





Error at the end of the cycle: <1%

Average error on the cycle: 10%

Inflation adjustment

Example: Car insurance in New York

Value found for 2024: $1016

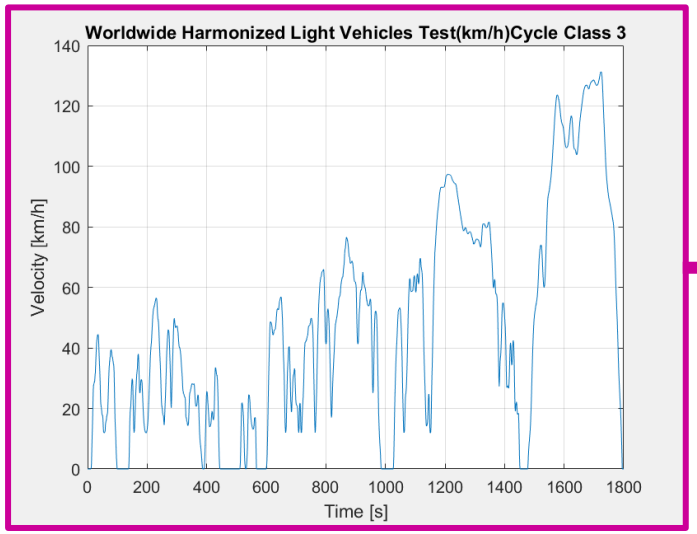
$$Price_{2023} = Price_{2024} \frac{CPI_{2024}}{CPI_{2023}}$$

Value inflation-adjusted for 2023: $879

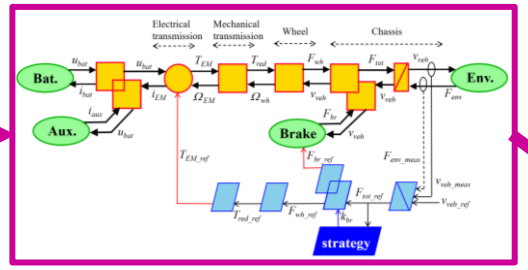
In 2023, $1 =0.92€

Value inflation-adjusted for 2023-€: 808€

Sensitivity Analysis – Different parameters



Driving cycle: WLTC 3



Consumption model

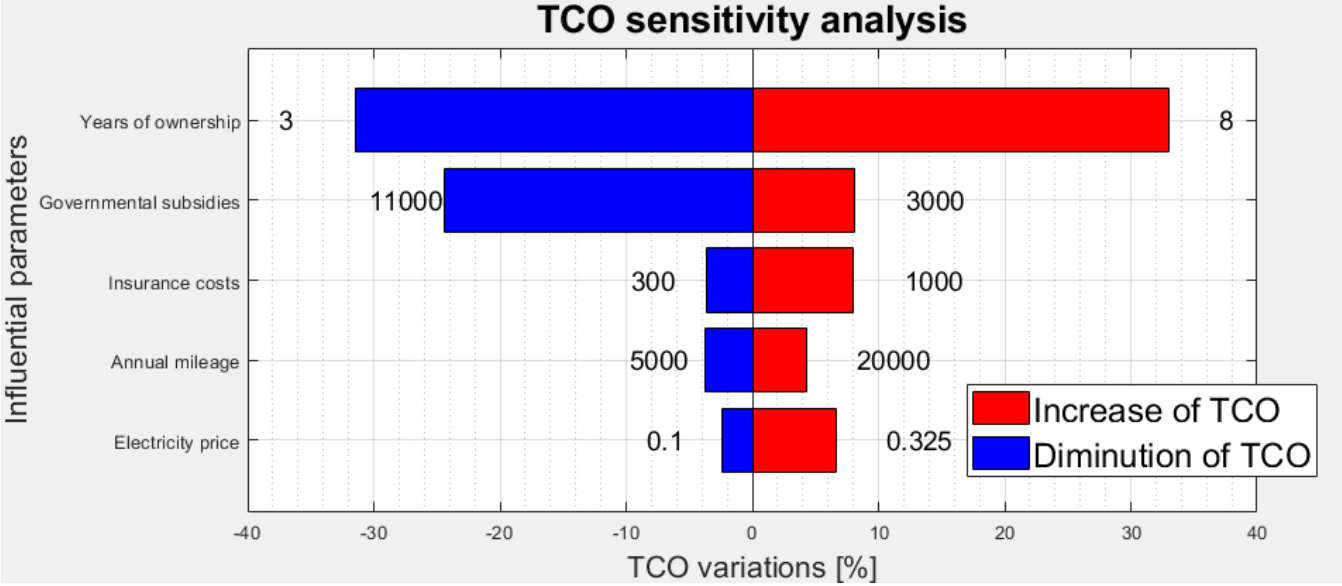
Influential parameters:

	2023
Average cost of electricity [€/kWh]	0.180
Cost of insurance [€/year]	534
Ownership duration [year]	5
Mileage [km/year]	11 960
Governmental subsidies [€]	5 000

TCO calculation

$$TCO = CC - SV + \sum_{i=0}^{n} \frac{AC}{(1+\sigma)^i}$$

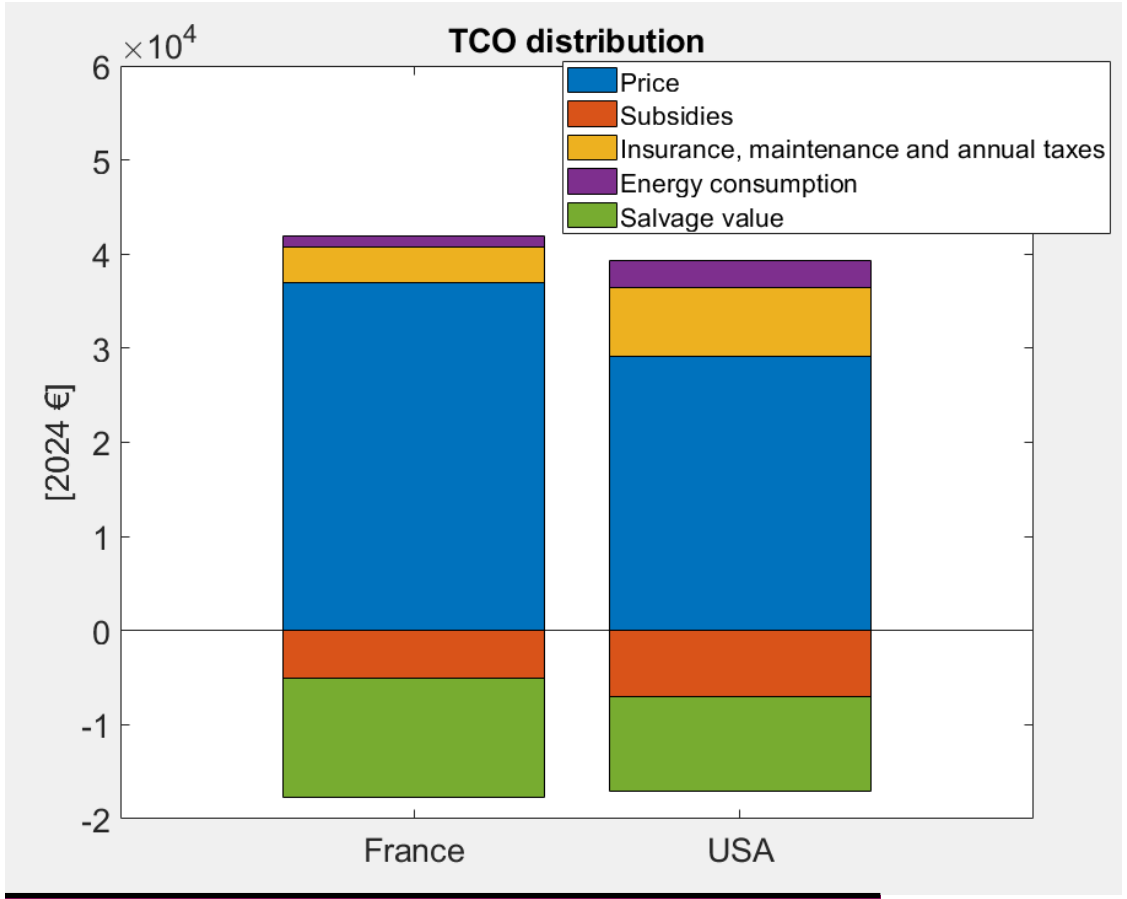
Different exploitations of the results



Sensitivity analysis for the French case

Starting values	2023
Average cost of electricity [€/kWh]	0.180
Cost of insurance [€/year]	534
Ownership duration [year]	**5**
Mileage [km/year]	11 960
Governmental subsidies [€]	5 000

TCO distribution for France and USA for 5 years



Country	France	USA
TCO [2023-€]	24 211	22 332

Conclusion

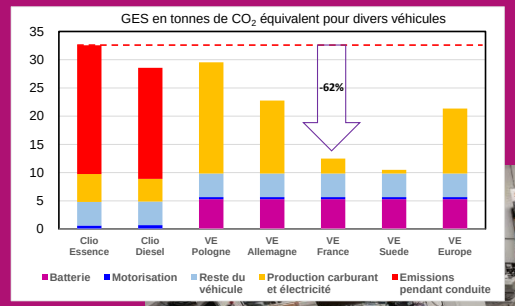
TCO of Nissan Leaf

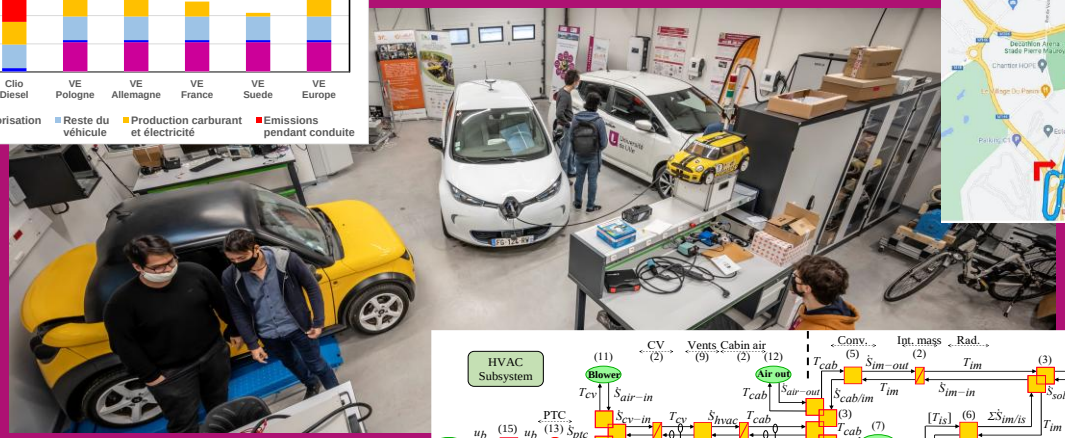
- simulation of a consumption model
- estimation of TCO for a driving cycle

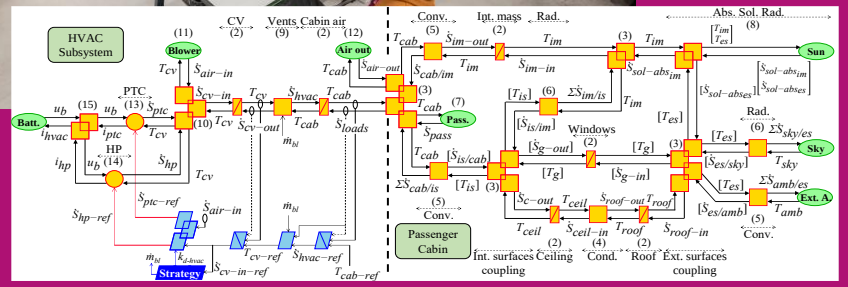
Perspectives

- more accurate simulation model (CUMIN-EVE)
- better estimation of the maintenance and insurance costs
- other expenses to consider
  - impact of different driving cycles (CUMIN-SARA)
  - comparison with other countries

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



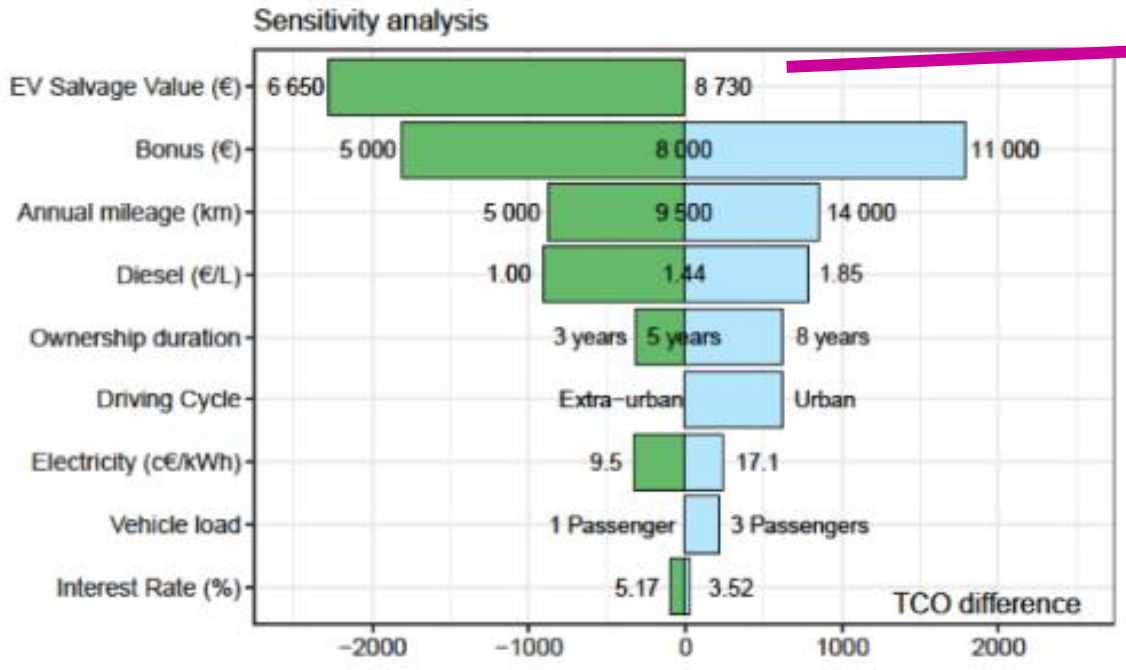




Our university as an exciting living lab towards eco-cities through an innovative transdisciplinary framework !

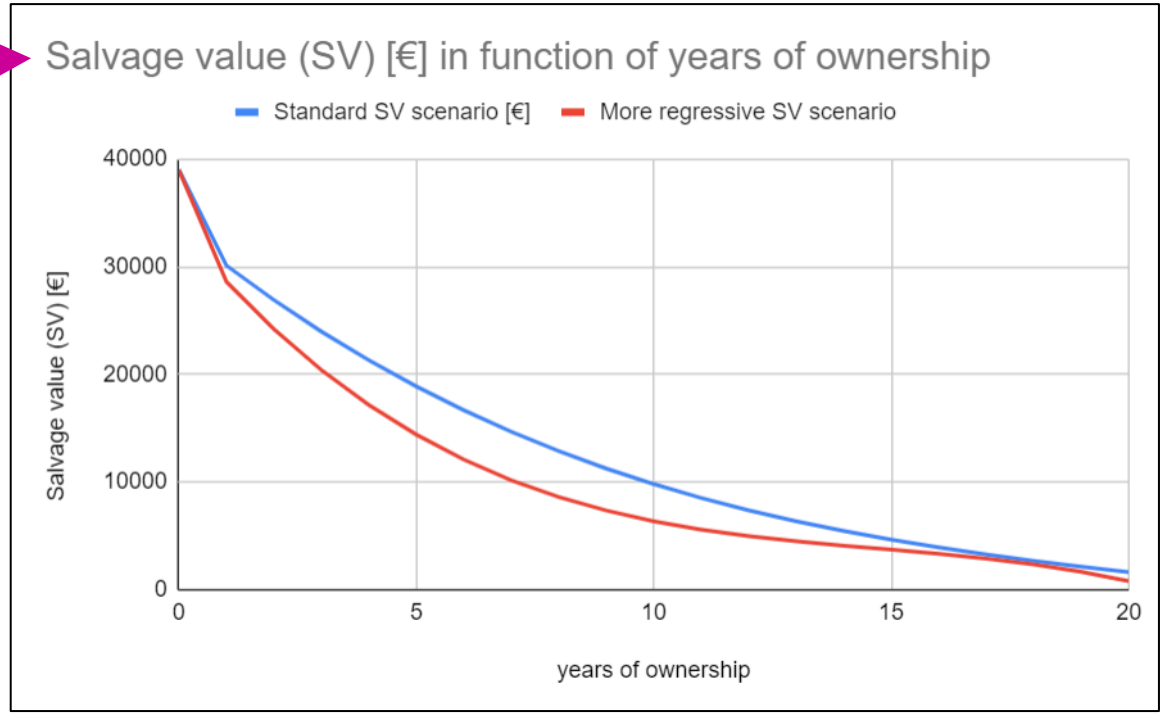
Annex

Sensitivity Analysis – Different parameters



Sensitivity analysis for the **Renault Zoé and Clio in 2018**

from « Techno-Economic Comparison of Total Cost of Ownership of Electric and Diesel Vehicles » by A. Desreveaux and Al



Salvage value for the **Nissan Leaf** with an initial cost of 39 000€ in 2023