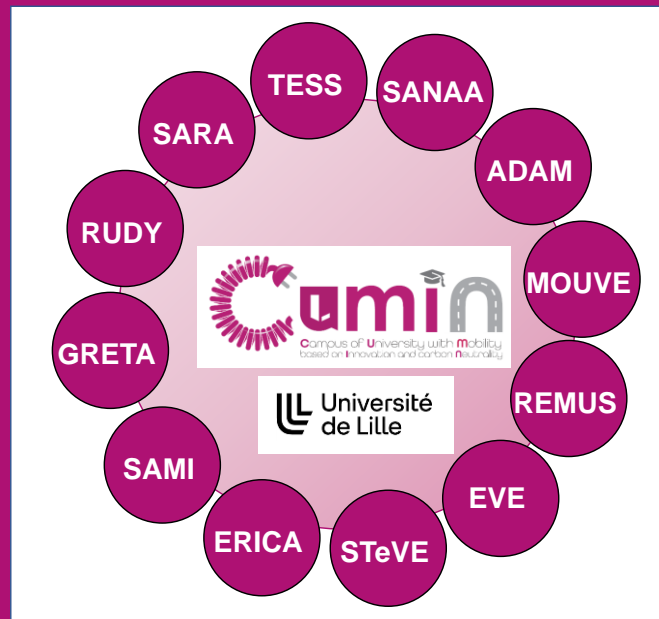




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CUMIN - TESS

Nissan Leaf – total cost of ownership

LEHUT Margaux

Master VIE project

Supervisor: BOUSCAYROL Alain

14/02/2024

Outline



Economic value of cars

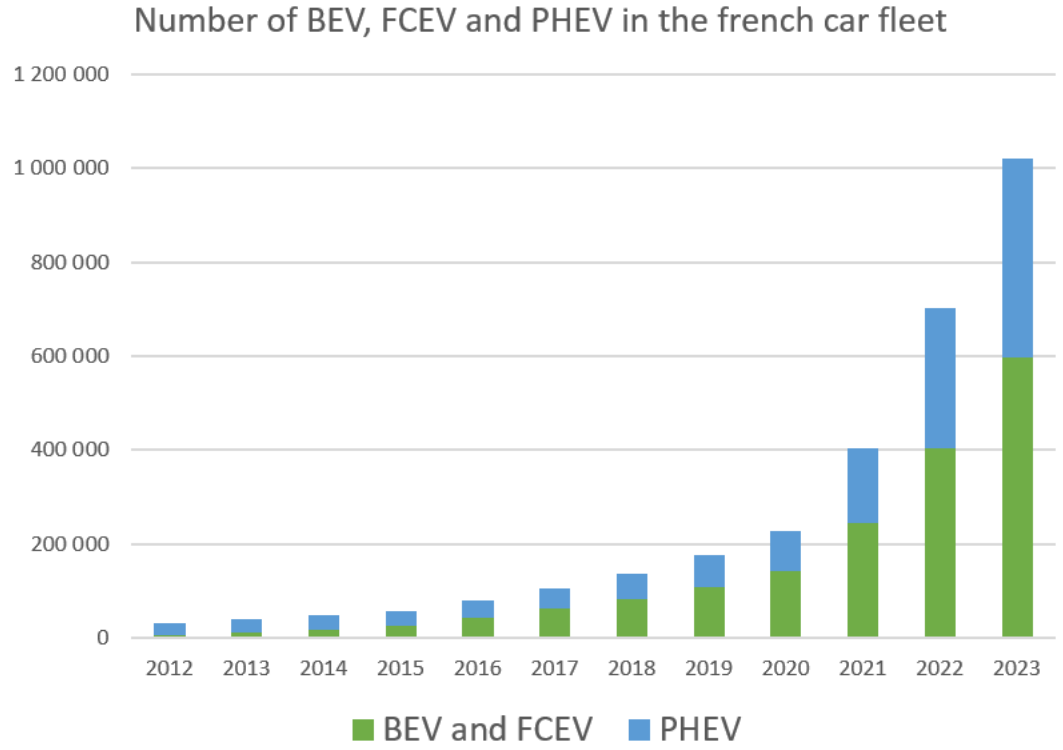


Technical tools needed

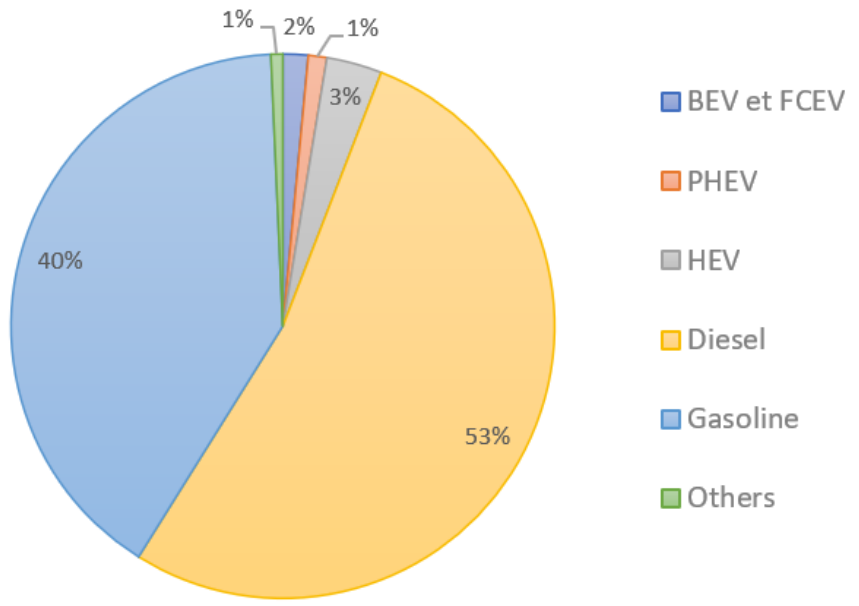


Analysis and future possibilities

Does an electric car is economically viable?



Repartition of the french car fleet in 2023



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)

Master project: Total cost of ownership of the Nissan leaf

Vehicle choosen: 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

TCO: total cost of ownership

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

CC: Initial spendings

SV: Salvage Value

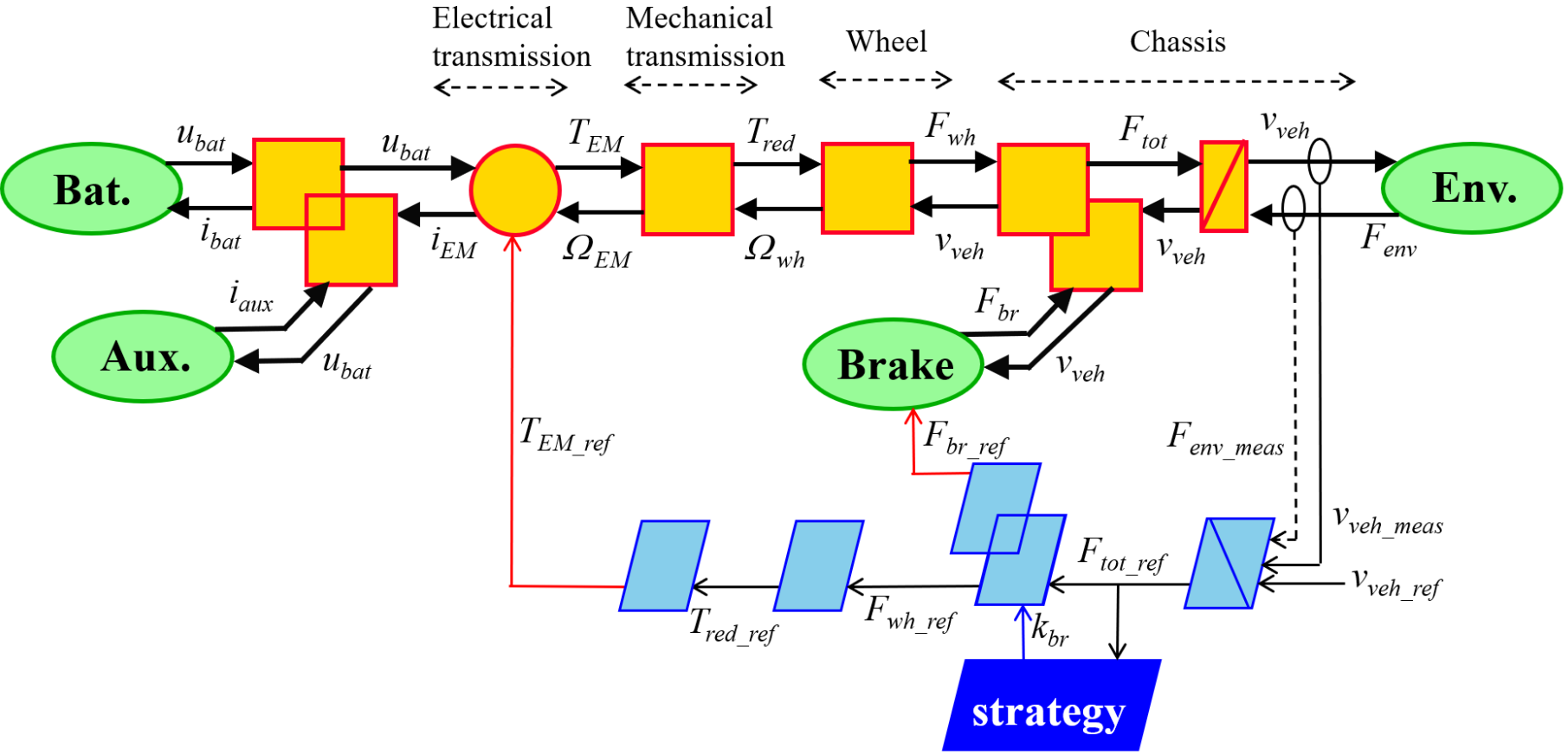
AC: Annual costs: Energy consumption, Maintenance and Insurance

σ : depreciation rate

n : years of ownership

Energy consumption  Model of consumption of the vehicle

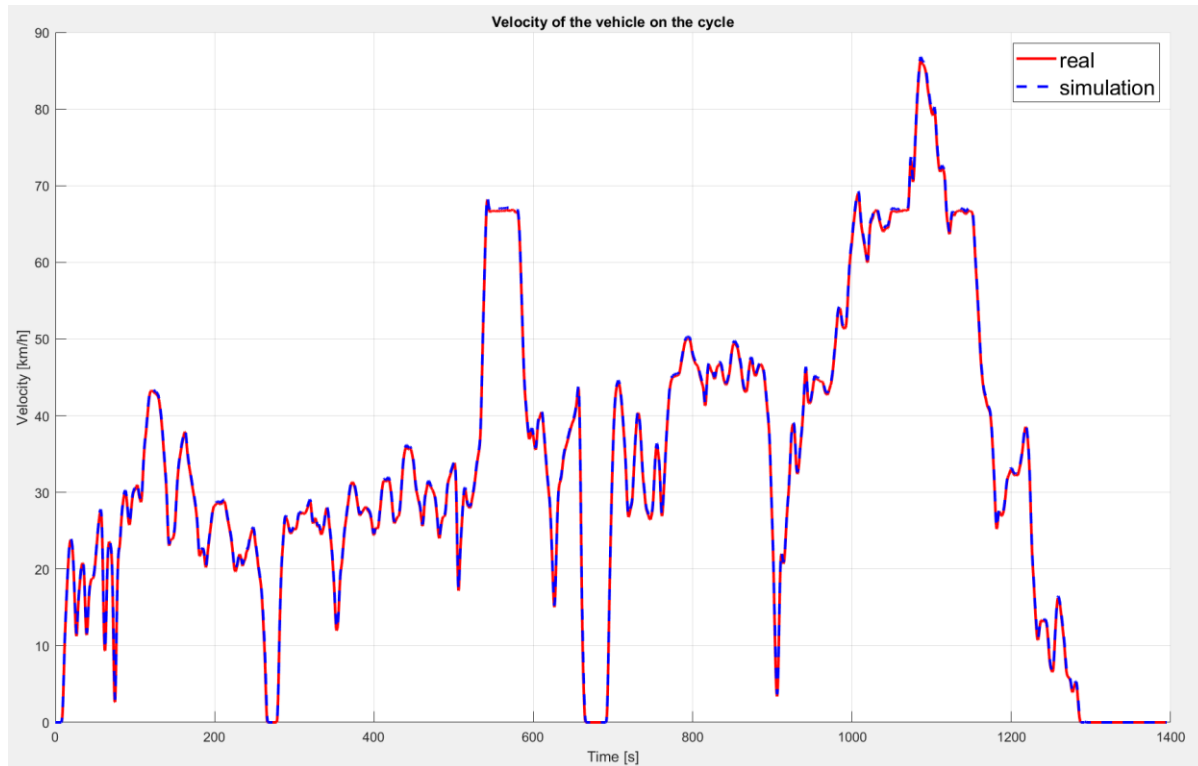
Model of the Nissan Leaf



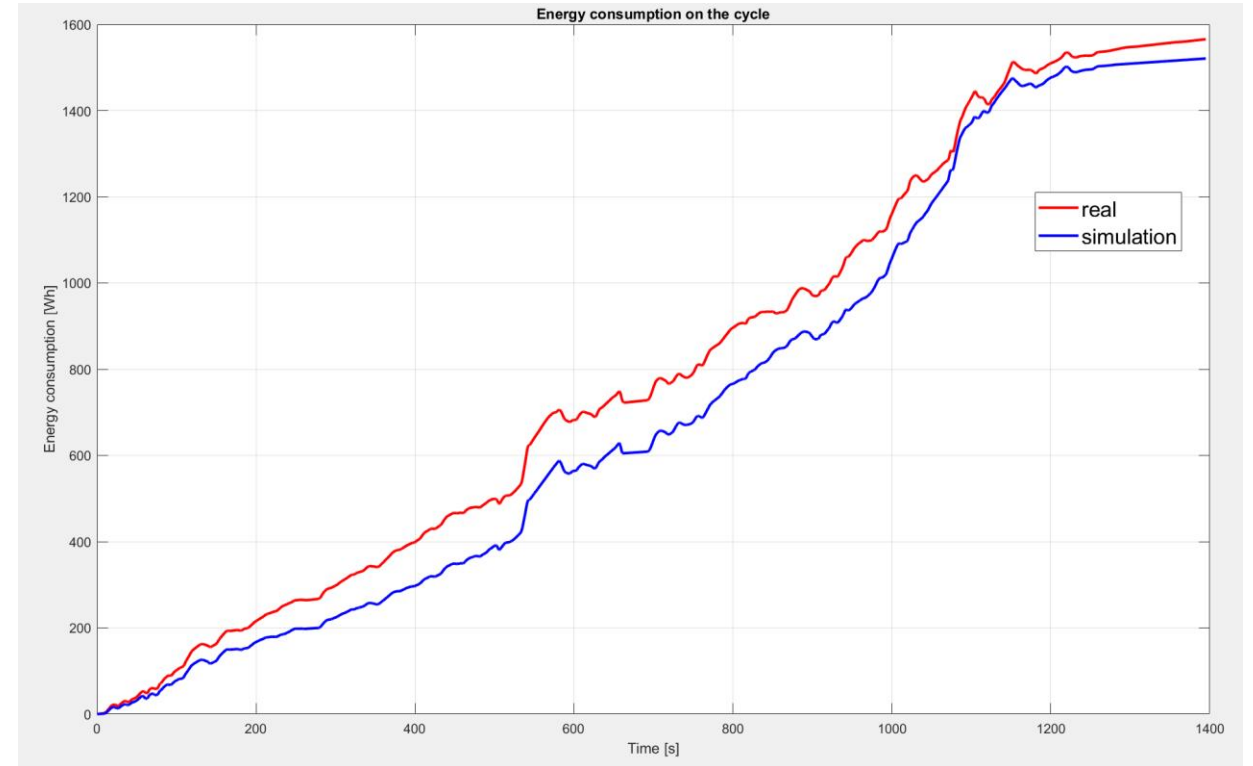
- Use of the EMR formalism
- Several simplifications made: simplification of the electrical transmission and the auxiliaries

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

Velocity of the vehicle

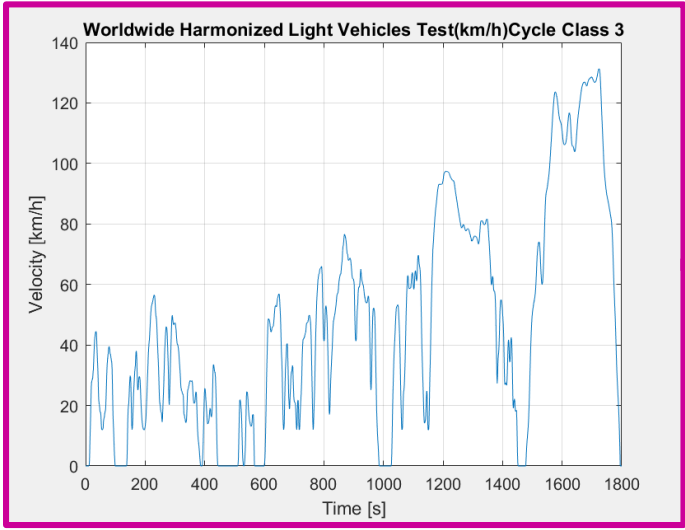


Energy consumption on the cycle

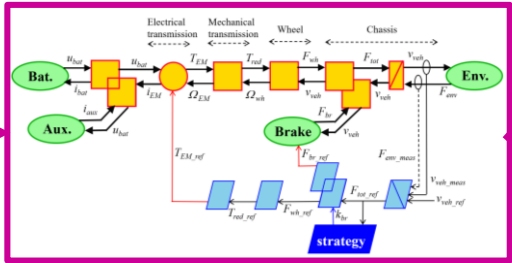


Error at the end of the cycle: 2 % → the model may be used

Sensitivity Analysis – Different parameters



Driving cycle : WLTC 3



Consumption model

TCO calculation

Influential parameters:

	2018
Cost of electricity [€/kWh] (off-peak hour)	0.132
Ownership duration [years]	5
Mileage [km/year]	9 500
Insurance and maintenance [€/year]	900

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

Results

	Renault Zoé - 2018	Nissan Leaf - 2018
Consumption on the WLTC [kWh/100km]	14,16	16,6
Energy cost [€/year]	204	239

	Renault Zoé - 2018	Nissan Leaf - 2018
CC: Initial spending	32 000	39 000
SV : Salvage value	11 818	14 403
AC : Annual costs (per year)	1 104	1 139
Total cost of ownership [€]	15 883	20 415

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

Conclusion

TCO of Nissan Leaf

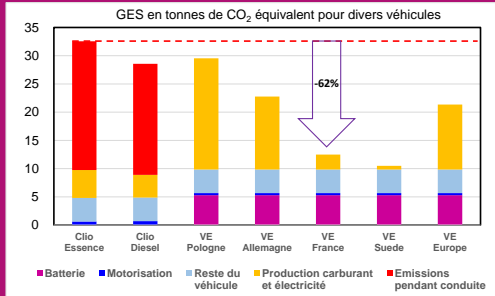
- simulation of a consumption model
- estimation of TCO for a driving cycle
- first results

Perspectives

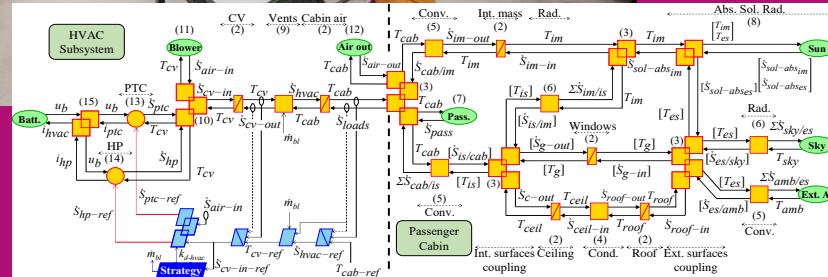
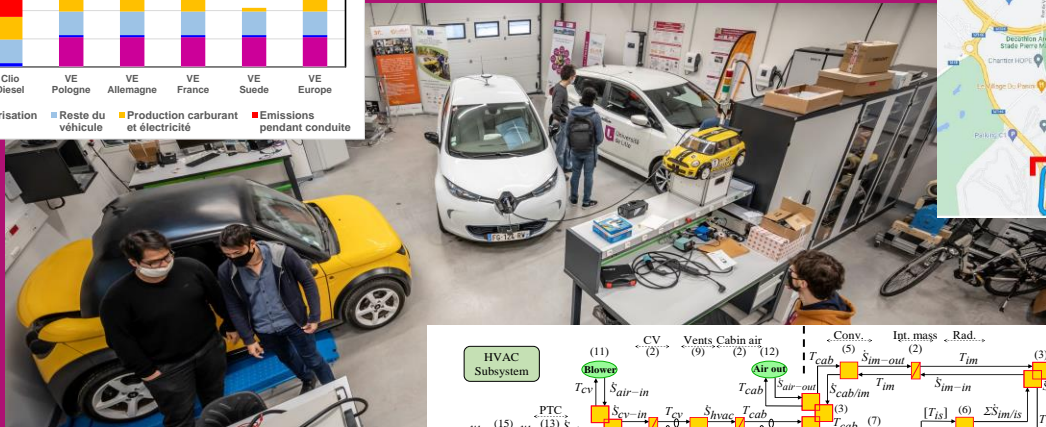
- more accurate simulation model (CUMIN-EVE)
- other expenses to consider
 - impact of different driving cycles (CUMIN-SARA)
 - comparison with USA (Argonne National Lab) and other countries



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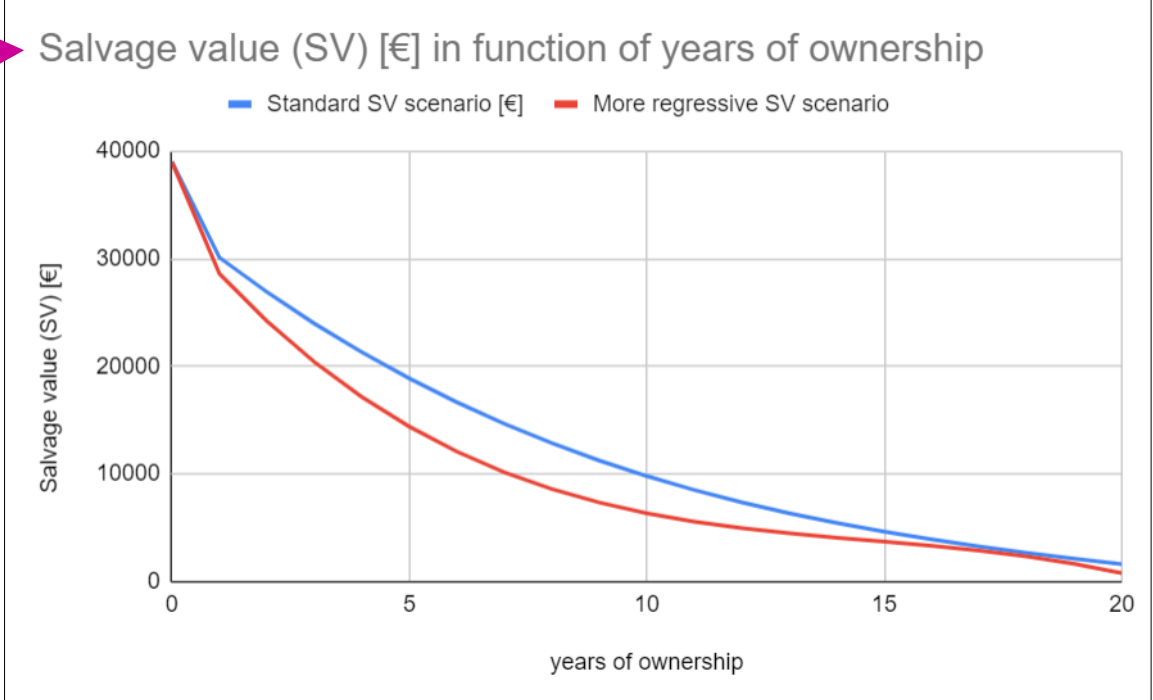
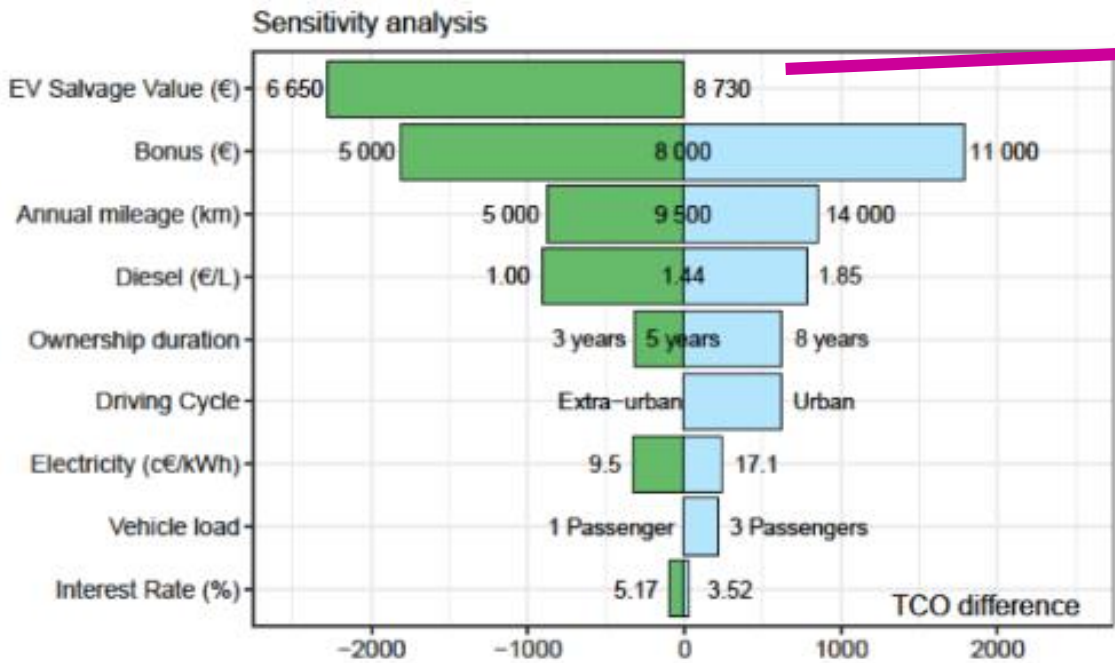


Our university as an exciting living lab towards eco-cities through an innovative transdisciplinary framework !



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 AI

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