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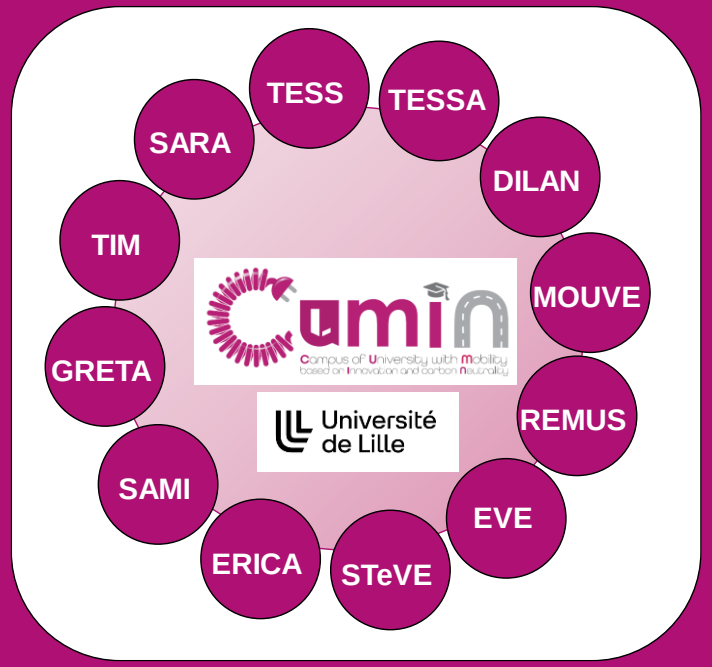

CUMIN – TESSA & MOUVE

Study of the Impact of User Charging Habits on EV Battery Aging

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MEGEVH French network on HEVs

Université de Lille

Outline

1. Context and objective of the thesis
2. Vehicle and battery model
3. Impact of user charging habits on EV Batterie aging
4. Conclusion

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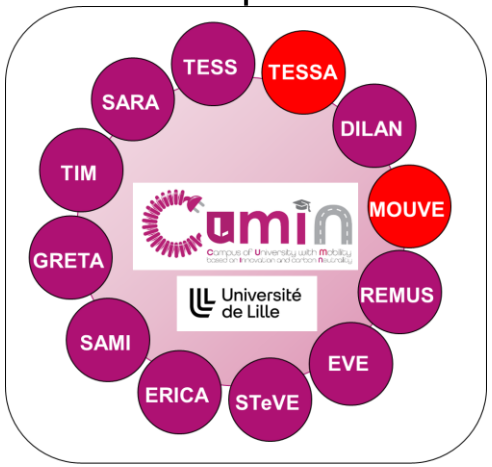
1. Context and objective of the thesis

Positioning of the Thesis

CUMIN: Campus of **U**niversity with **M**obility based on **I**nnovation and carbon **N**eutral



TESSA: Techno-**E**conomical **S**tudy of **S**econd life batteries for **A**ffordable e-mobility campus → Battery aging

MOUVE: MObility and **U**se of electric **VE**hicles based on dedicated charging infrastructure → User charging habits

Collaborating laboratories:

TVES Territoires Villes Environnement & Société EA 4477 — CUMIN Campus of University with Mobility — L2EP Laboratoire d'électrotechnique et d'électronique de puissance de Lille — MEGEVH French network on HEVs — Ampère

Human and social sciences

Modeling and control of electrical systems

Characterization of energy storage component

Electric vehicle charging

Thèse de A. Ndiaye

Thesis Objective

Objective: Study the impact of electric vehicle user's charging habits on battery aging.

Battery characterization

Model of Vehicle
Model of charging station

User's scenarios

Charging guideline

Studied vehicles:

Nissan Leaf 2019

Renault Zoe 2018

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2. Vehicle and battery model

Nissan Leaf modelling

❑ Traction model

❖ CUMIN program

Nissan Leaf 2018

Battery Modules (x24)

8 modules acquired for characterization

Instrumented to acquire data (SoC, battery current, ...) → Traction model

❑ Chargers

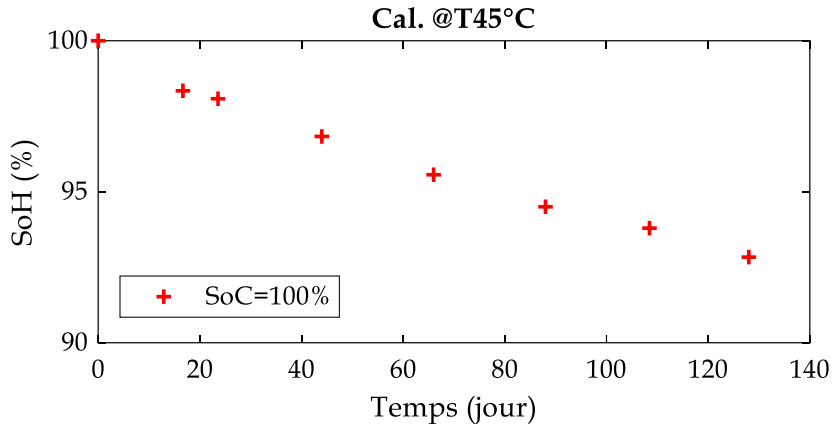
EV-box Charger

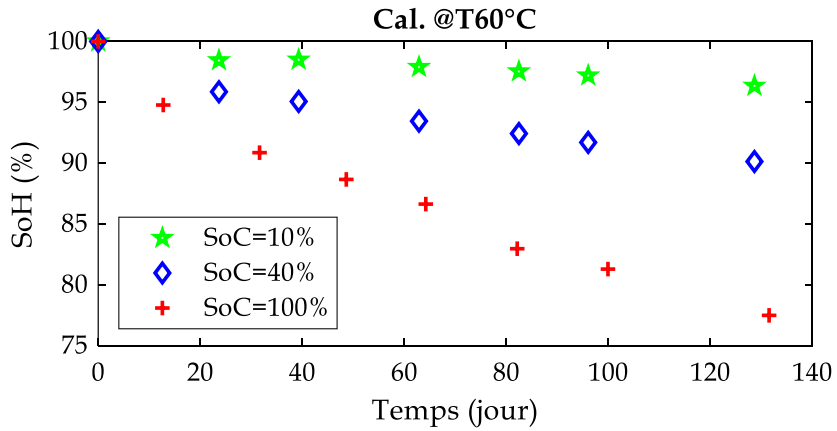
→ Recording charges

→ Modeling the charger

❑ Battery ageing

High SoC/high T accelerate ageing





→ Battery aging model

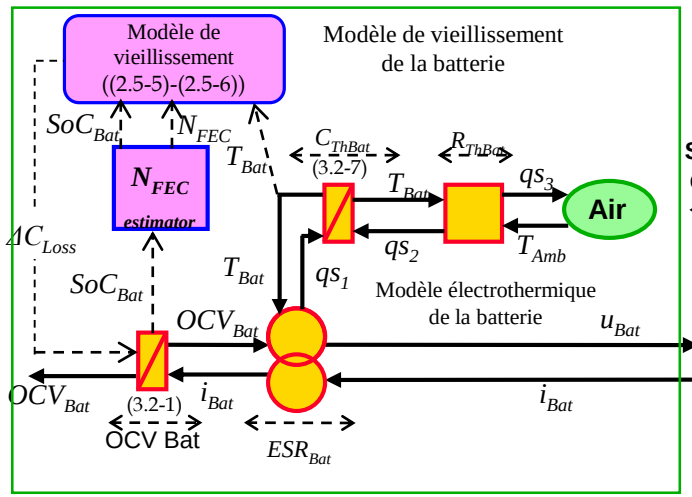
Def: SoC: State of Charge
SoH: State of Health

Model organization of the vehicle

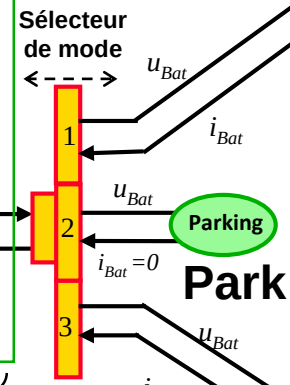
Using the Energetic Macroscopic Representation formalism

4 subsystems to model: battery, traction, charger, parking

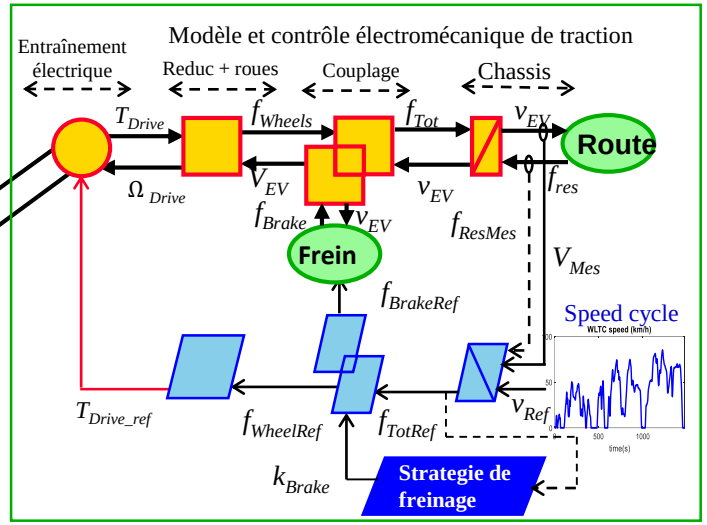
Envison AESC
(Nissan Leaf)



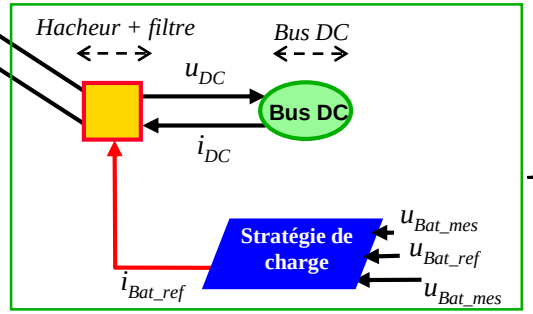
Battery



Traction



Nissan Leaf
2018



Charger EV-box

Charger

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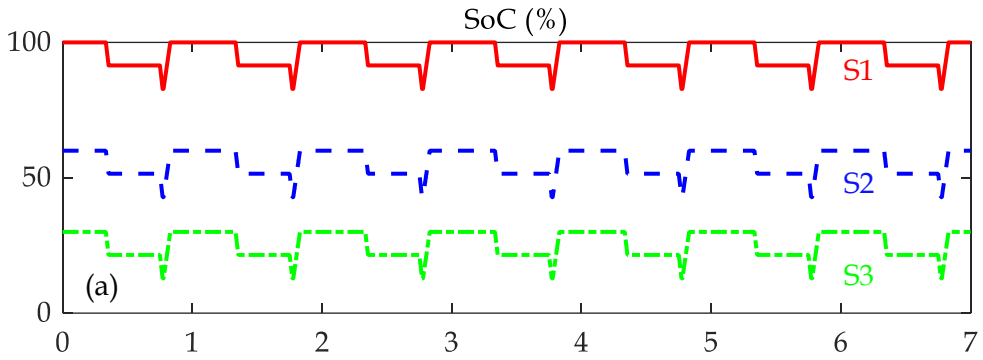
3. Impact of user charging habits on EV Batterie aging

Study of the impact of charging habits

Charging scenarios

Speed cycle: WLTC

S1, S2, S3 ➡ **Daily charge**



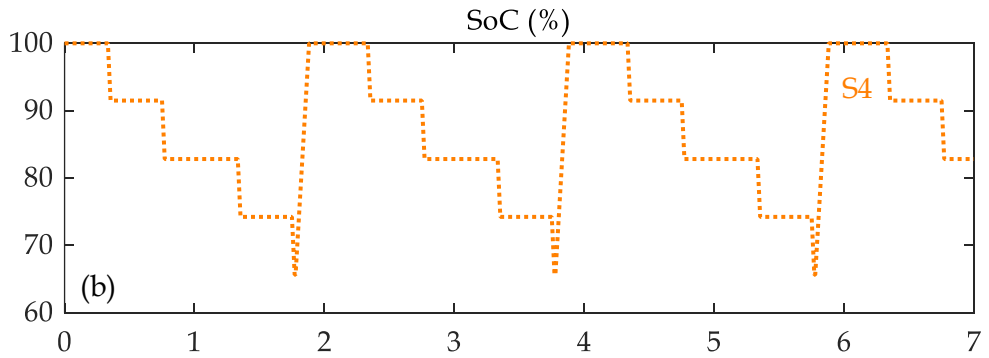
Initial SoC

S1 : 100 %

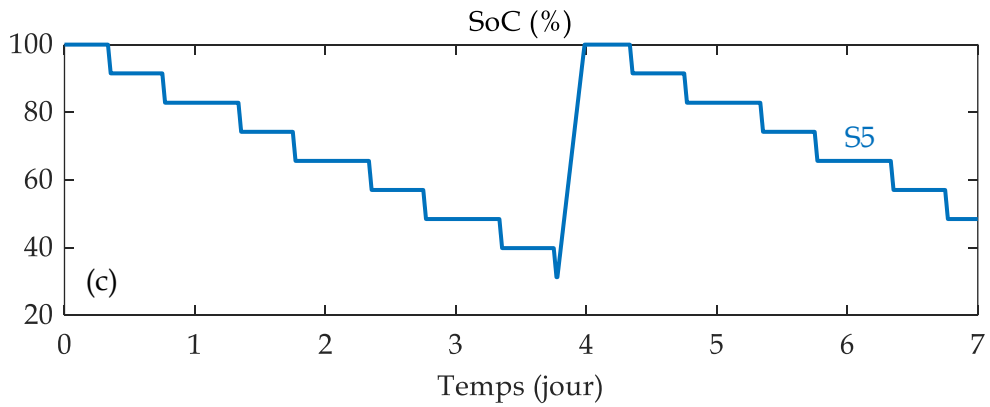
S2 : 60 %

S3 : 40 %

S4 ➡ **Charge every 2 days**

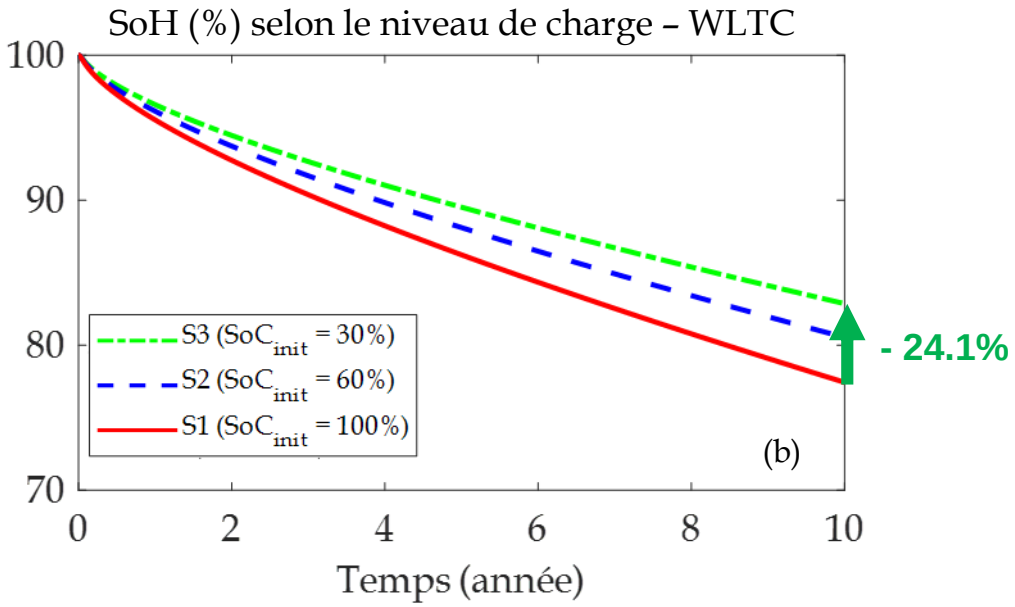


S5 ➡ **Charge every 4 days**



Study of the impact of charging habits

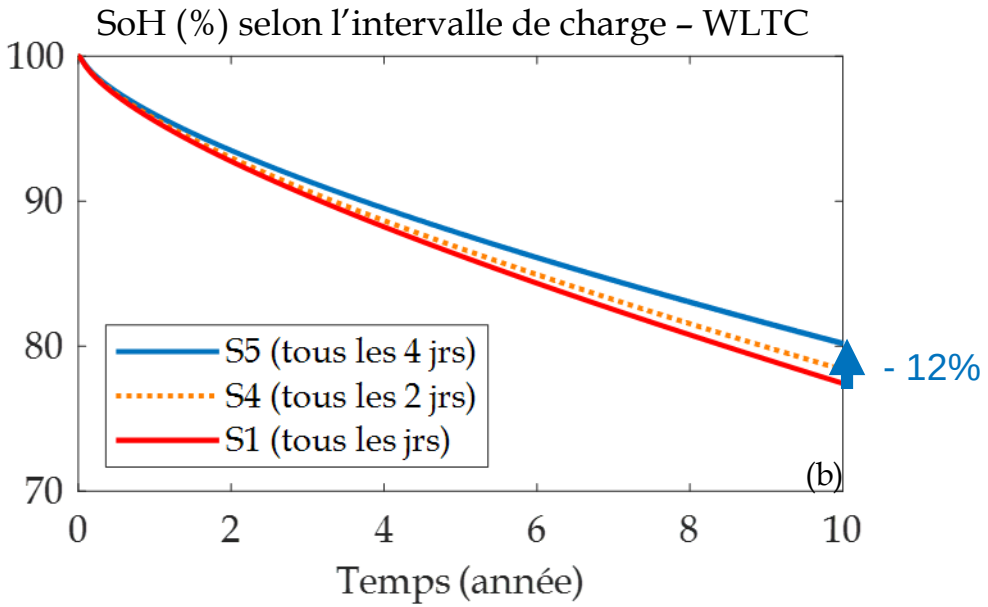
Daily charging scenarios over 10 years



Up to – 24.1% degradation

➡ Lower SoC helps to extend the battery's lifespan

Scenarios with various charging intervals over 10 years



Up to - 12% degradation

➡ Spacing out recharges helps reduce battery aging

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4. Conclusion

Conclusion

✓ **Modeling:**

1. Vehicle and battery model and EMR
2. Experimental characterization of AESC cells
3. Aging tests results

✓ **Practical recommendation:** Adapt charging habits to reduce battery degradation

1. Reduce the average State of Charge (SoC)

   ➡ **Do not fully charge for long rest time (e.g. vacation)**

2. Space out recharges

   ➡ **Do not charge every day**

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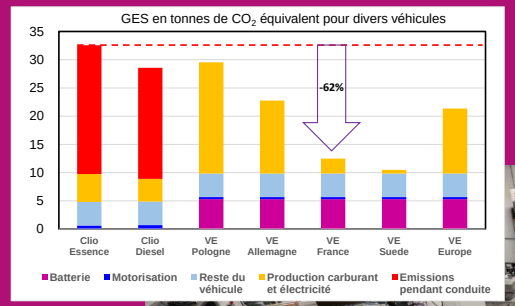

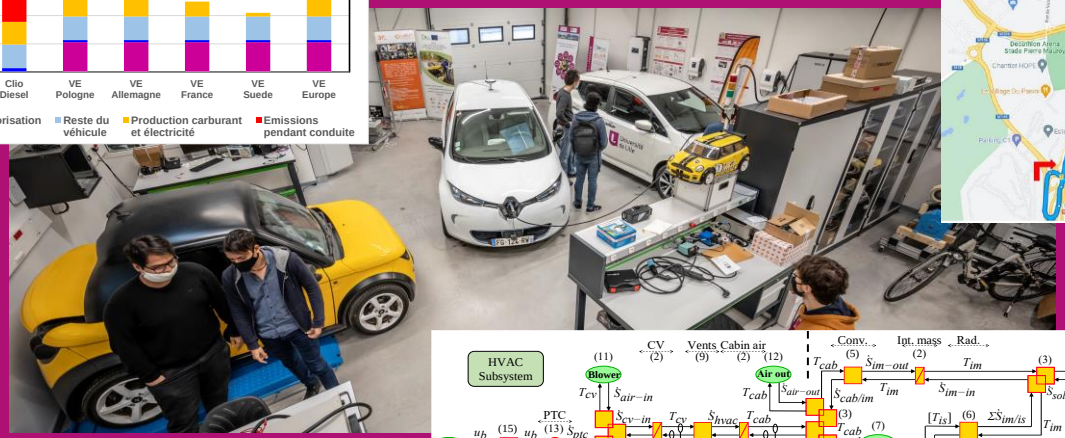

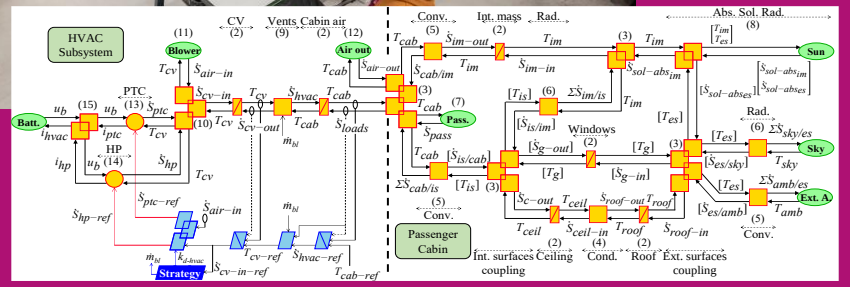

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