CUMIN - TESSA

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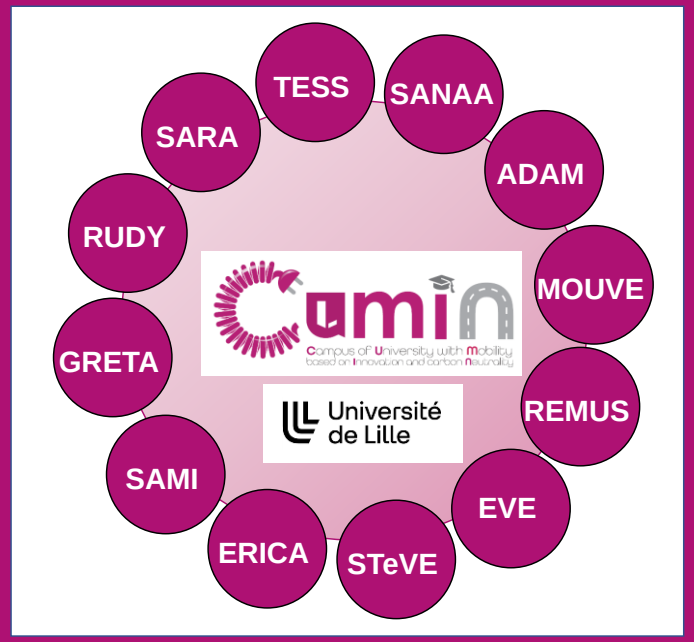

Impact of the user charging practice on the battery aging in an electric vehicle

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TVES

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Outline

1. Context and objective
2. Vehicle modeling
3. Simulation and results
4. Conclusion

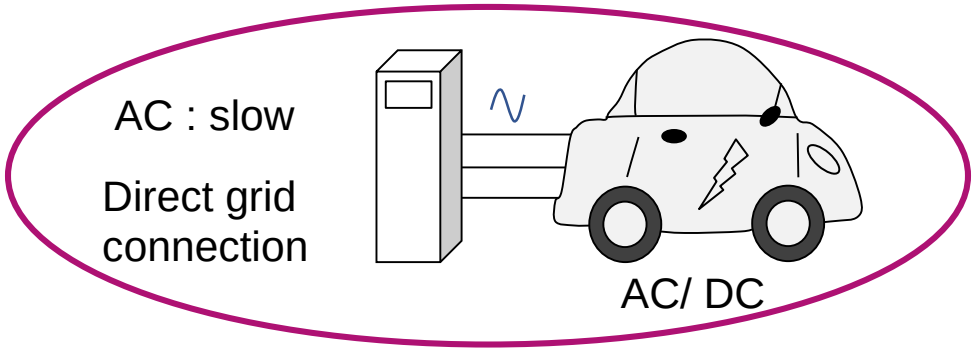
Important definitions

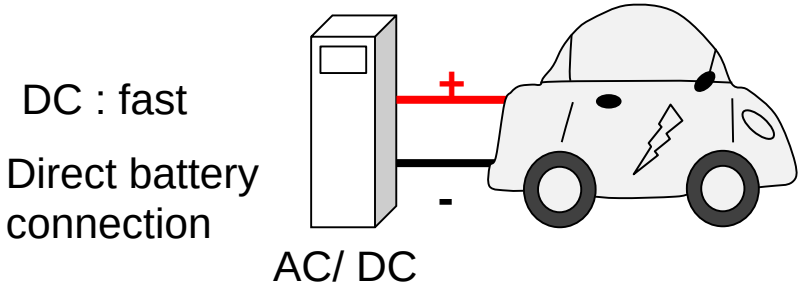
- Cell : Battery elementary component

- State of charge SoC (%) SoC = 100% ➡ Battery fully charged

- State of health SoH (%) SoH =80% ➡ Battery can be changed

- Different charging modes





Studied EV

Renault Zoe 2018, 41 kWh : segment B EV

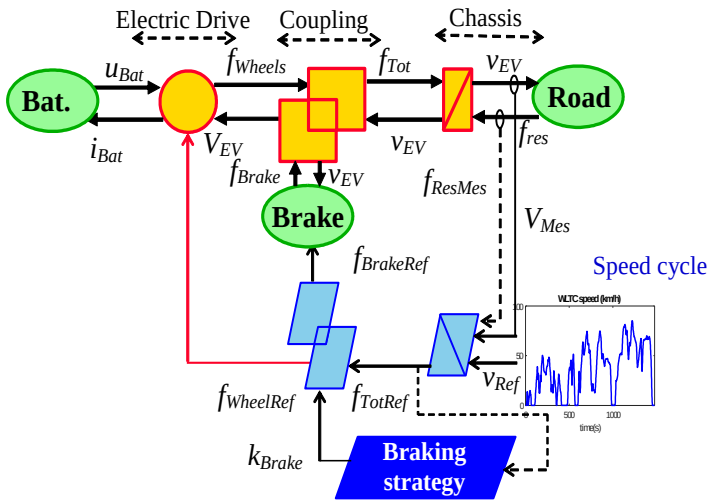
Mass : 1468 kg

SCx : 0.75 m²

Charge
AC : 7kW
DC: 22 kW

Machine Power: 110 kW

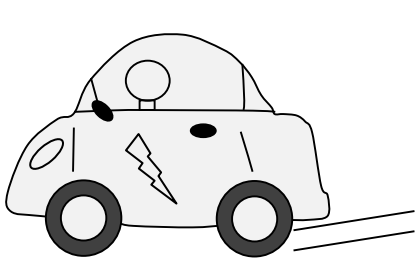
Validated traction model organized by EMR [Desreveaux 2019]



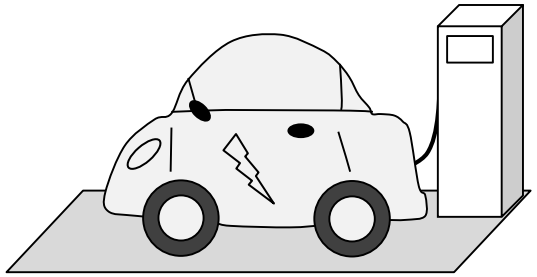
Objective of the work

Objective: study the impact of charging on battery ageing [Ndiaye 2024]

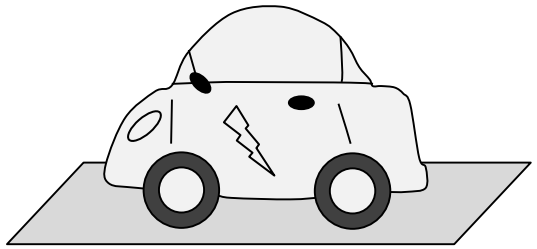
Different EV modes to consider



Driving



Charging



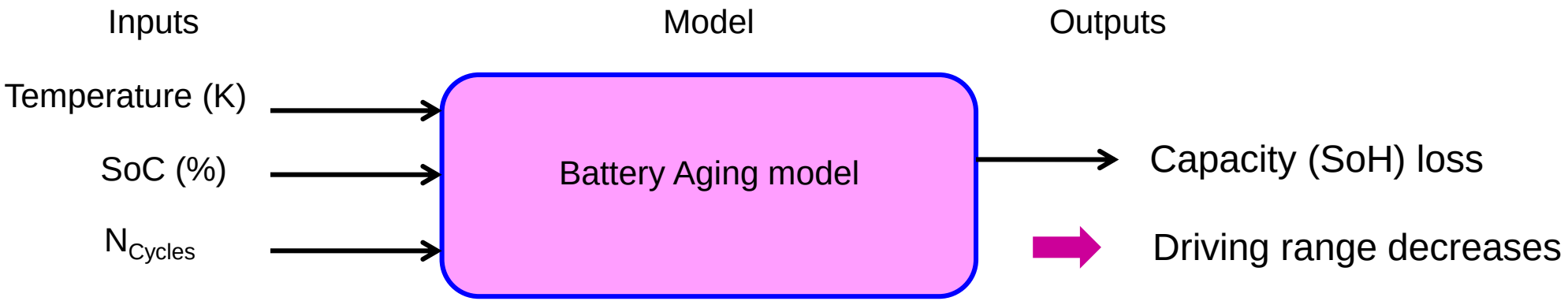
Parking

EVE ⟷ MOUVE → TESSA

➡ Every mode has a different impact on battery ageing

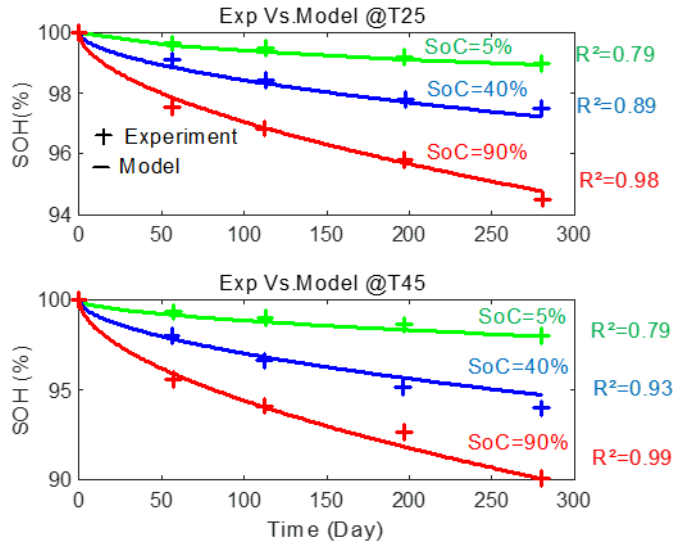
Battery ageing model

SoC and Temperature in any modes ➡ Inputs for ageing [Redondo 2020]



Zoe cells Ageing tests

[LG 2018]

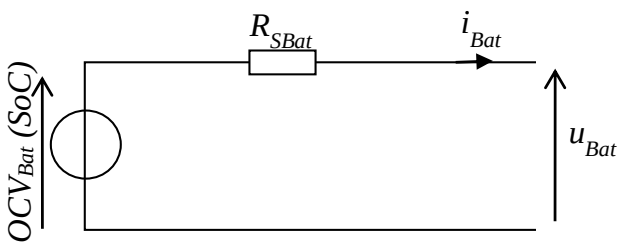


➡ Parameters identification

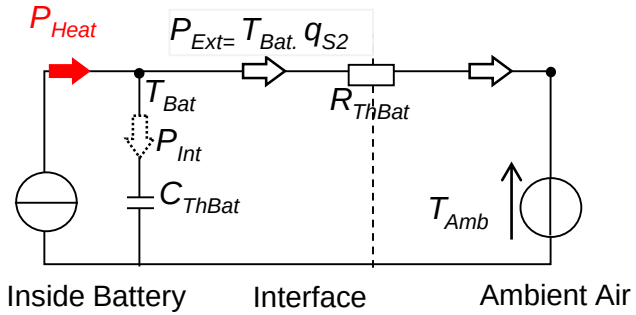
Electro-thermal model of a battery [German 2020]

Goal: estimate SoC_{Bat} , u_{Bat} and T_{Bat}

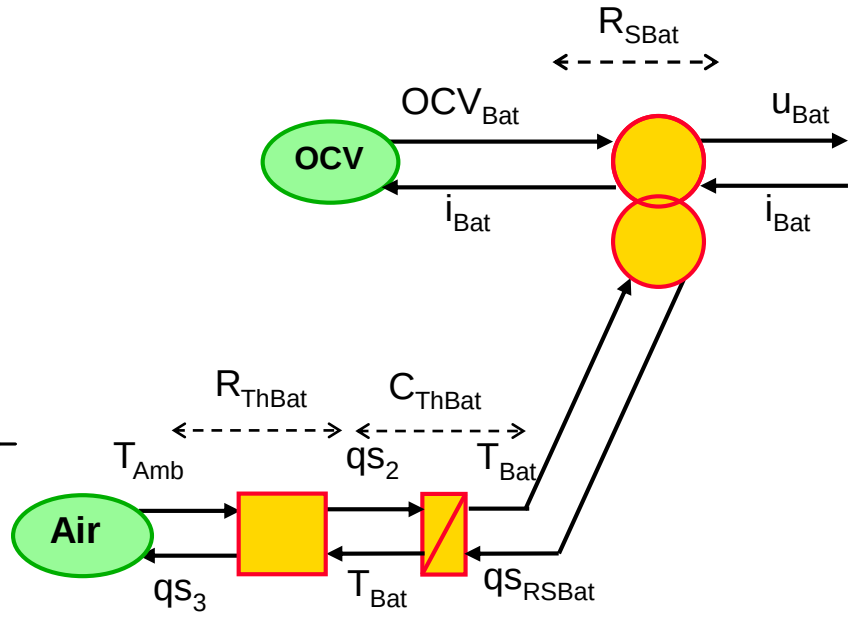
Electrical part of the battery



Thermal part of the battery



$$P_{Heat} = R_{sBat} i_{Bat}^2$$

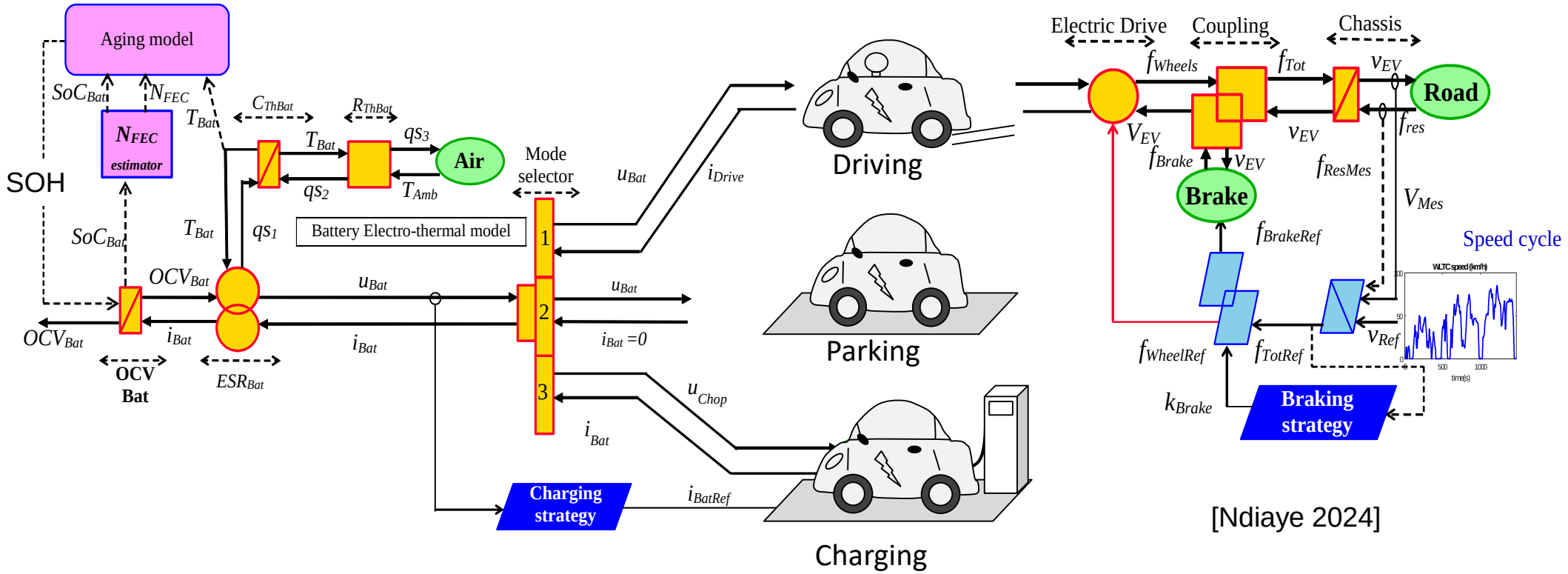


R_{SBat} is in the thermal part and the electrical part

➡ Can be used in interaction with the ageing model

Multi-domain inter-connection

Battery ET model ⟷ Battery aging model ⟷ EV mode models

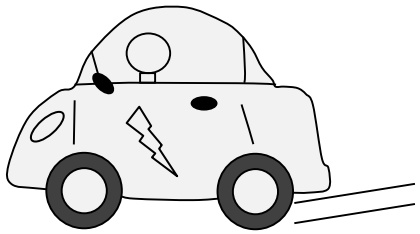


[Ndiaye 2024]

The user practice can linked with the battery degradation (scenarios)

Scenario definition

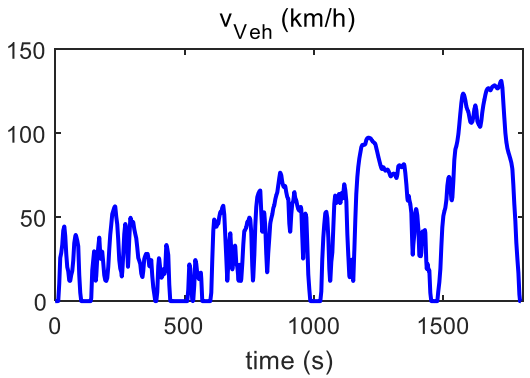
T_{Amb} = 20 °C

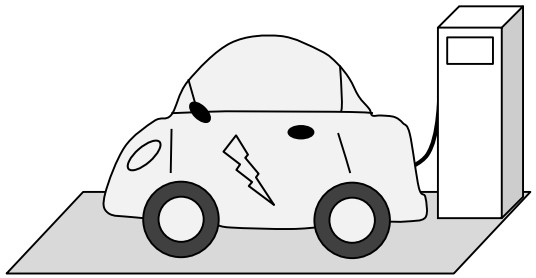


Driving

2 WLTC / Day

46 km (60 min) / Day

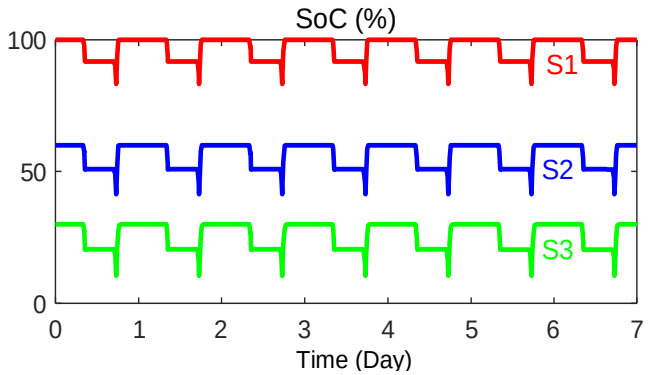




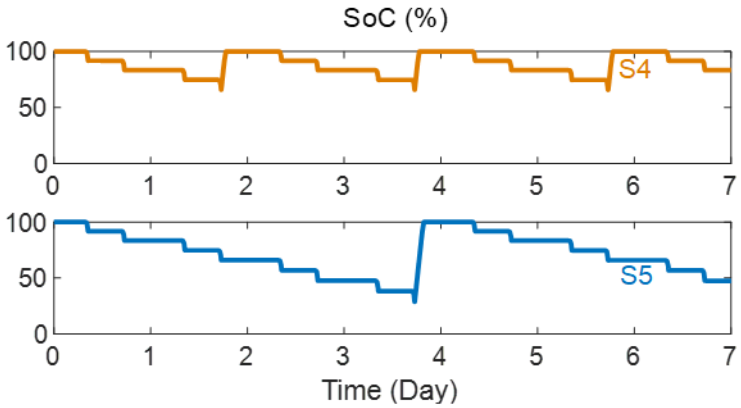
Charging

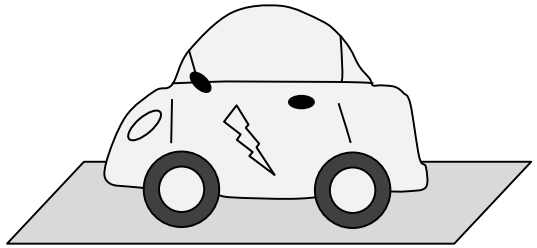
(AC: 7 kW)

Every Day at various SoC



With various interval (2 days or 4 days)



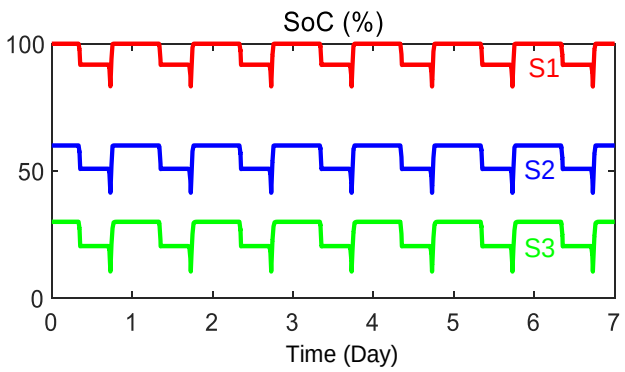


Parking

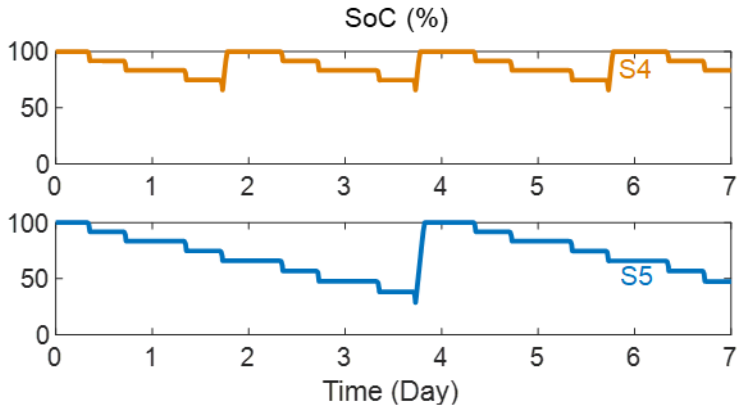
Rest of the time

Results [Ndiaye 2024]

Charging everyday

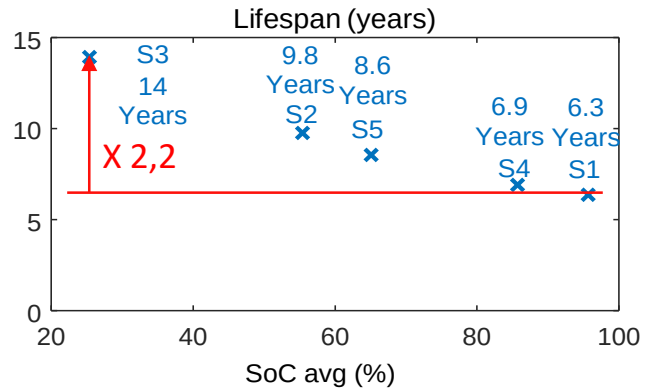


Charging with various time interval



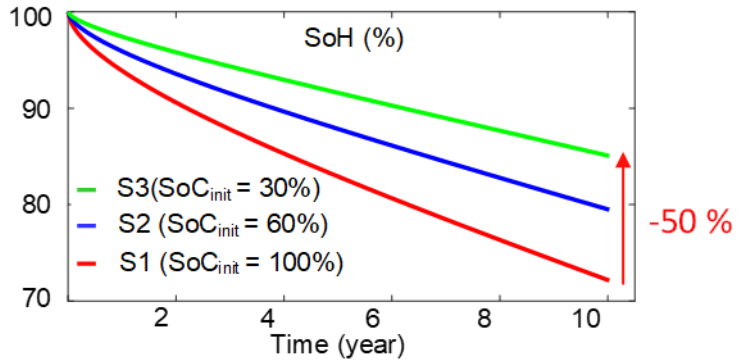
Lifespan Vs avg SOC

Lifespan: 80% SoH



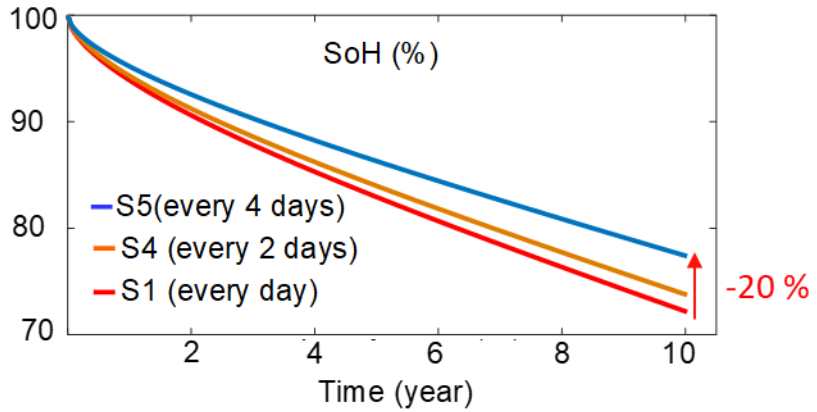
Average SoC is the most impacting parameter for lifespan

SoC interval (low, mid range, high)



50 % degradation can be spared at low SoC

Everyday to every 4 days



20 % degradation can be spared by charging less often

Conclusion

- **Impact of charging strategies on an EV battery ageing:**
  - simulation with all modes organized using EMR formalism
  - experimental validation of the simulation
  - charging every day: reduction of the battery lifetime by 20%
  - long parking (e.g. airport): better to have low SoC for reducing battery ageing

- **Perspectives:**
  - Impact of fast charging vs. slow charging?
  - Impact of charging at low ambient temperature?
  - Extension to other batteries, vehicles, driving cycles?

Expertise of each partner is crucial

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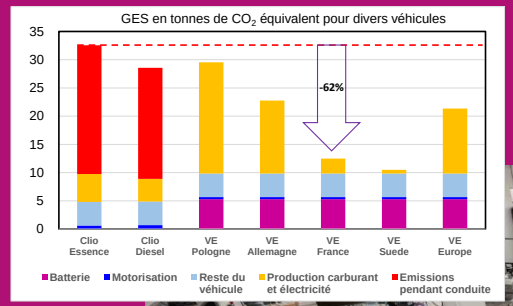

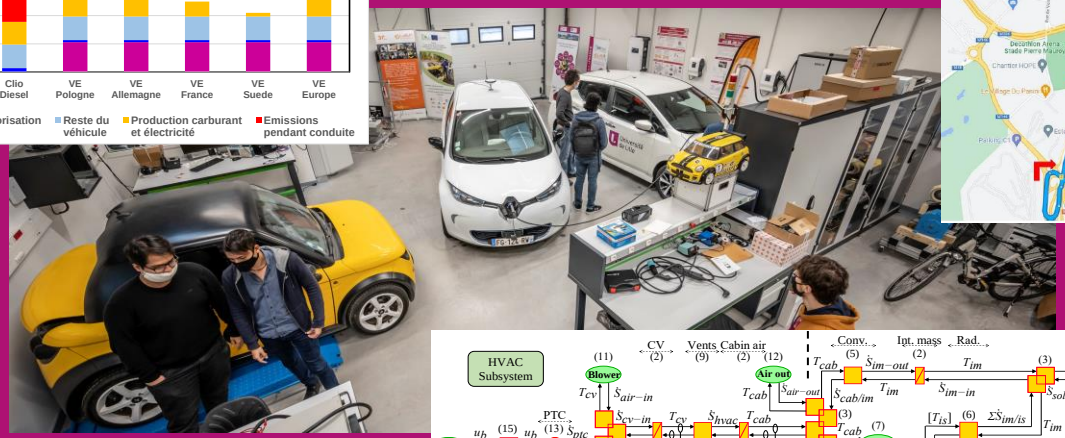

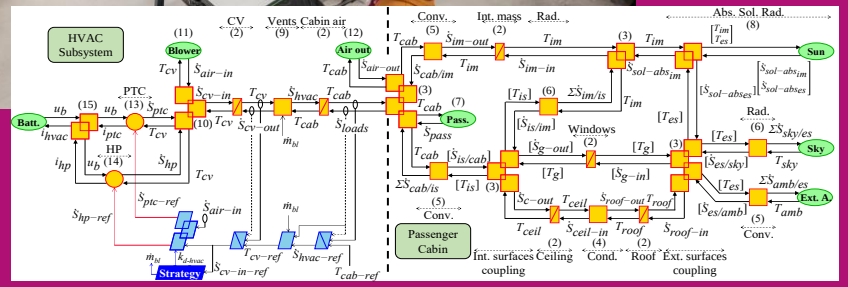

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