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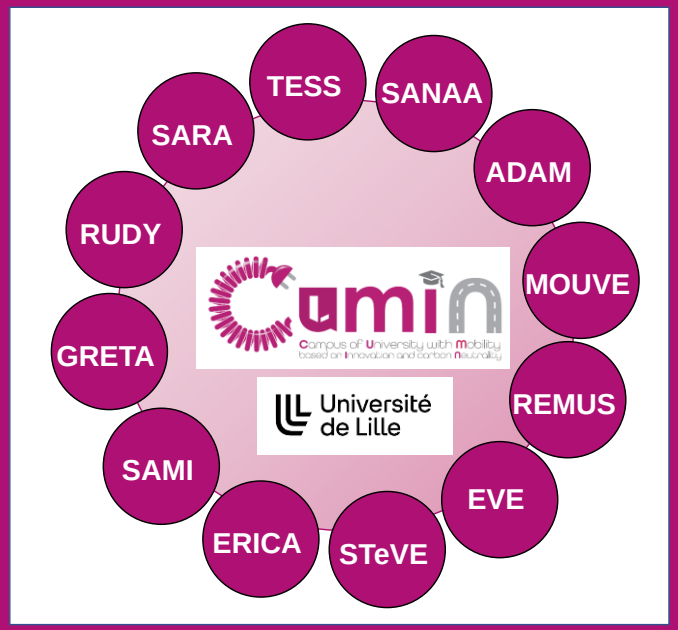

Comparison of different batteries for an EV

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SHERPA engineering

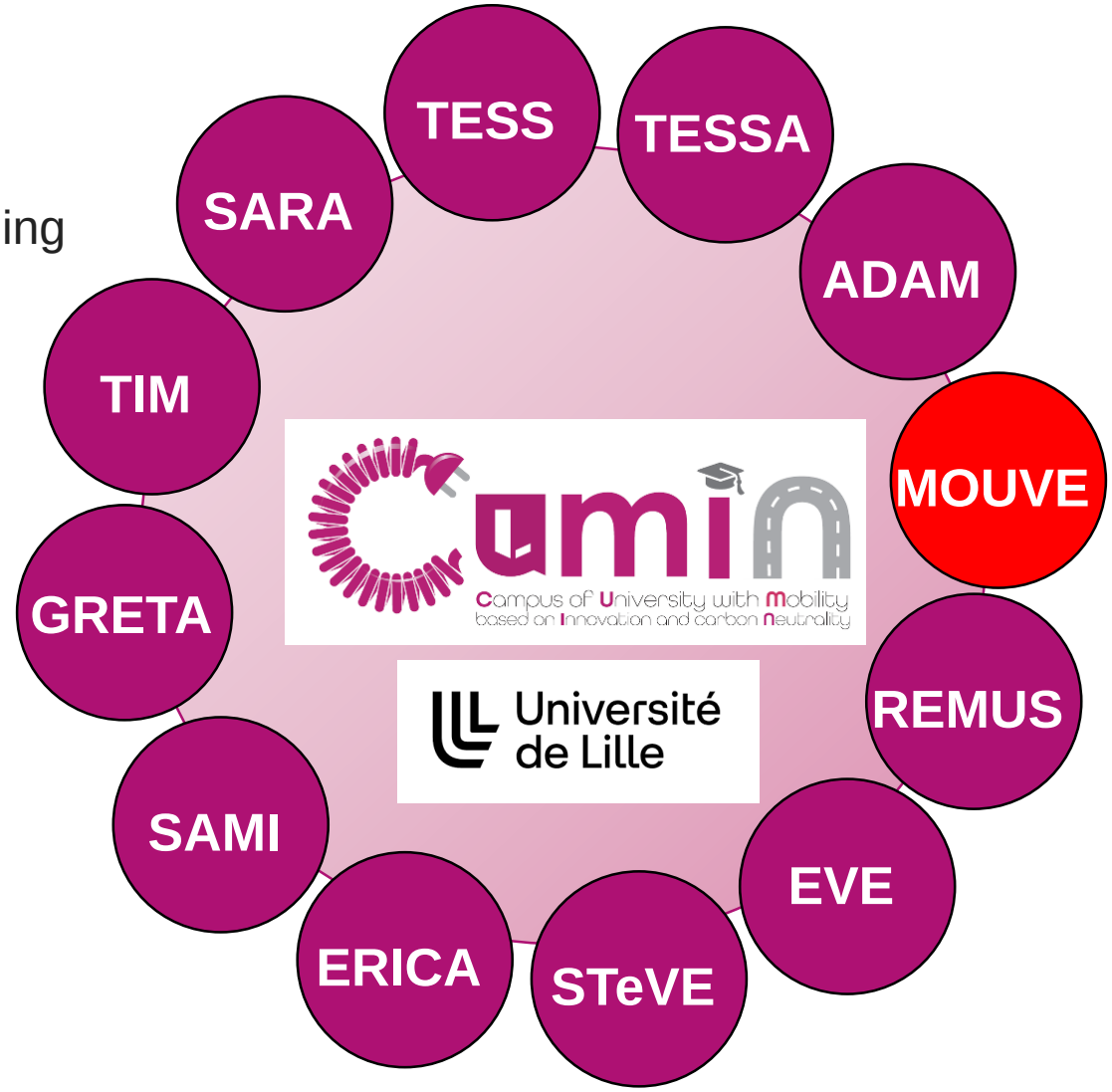
Outline

1. Context and objective
2. Accurate models & simulation
3. Experimental comparison
4. Conclusion

Context

MObility and Use of electric VEhicles based on dedicated charging infrastructure

- Intersectoral PhD on fast charging station



Reference vehicle: Nissan Leaf
Reference charging station: evbox Troniq 50

Objective of this presentation

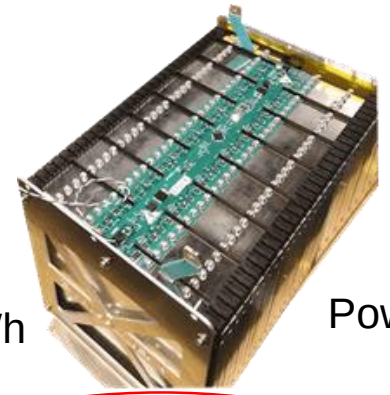
Initial battery of Nissan Leaf
(High energy battery)

Energy = 40kWh

Power = 110kW

Weight = 303 kg

New battery
(High power battery)



Energy=40kWh

Power = 525kW

Weight = 406 kg

+103 kg

- High equivalent series resistance
  - ➢ High losses
  - ➢ Overheating problems

- Low equivalent series resistance
  - ➢ Low losses
  - ➢ No cooling system needed

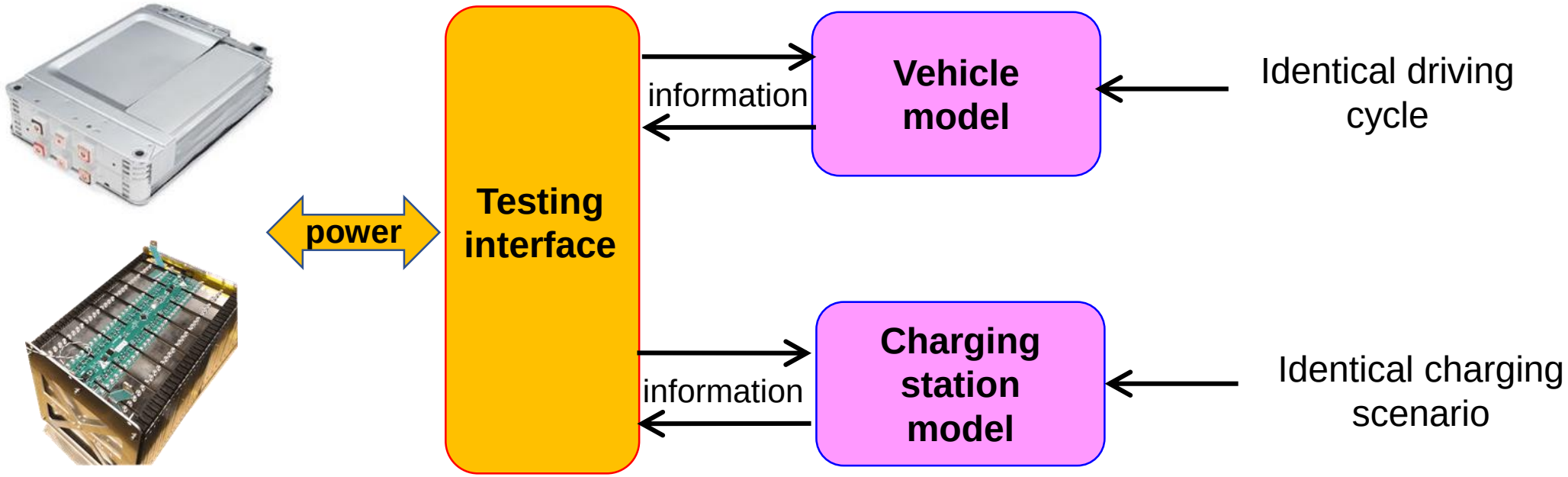
➡ Objective: study the impact of the two batteries on the Nissan Leaf

Method for a fair comparison

Limitations:

- no possibility to integrate the new battery in the real vehicle (safety, etc.)
- no possibility to reproduce exactly the same driving condition (traffic, etc.)
- The battery is a complex system to model (assumptions, errors, etc.)

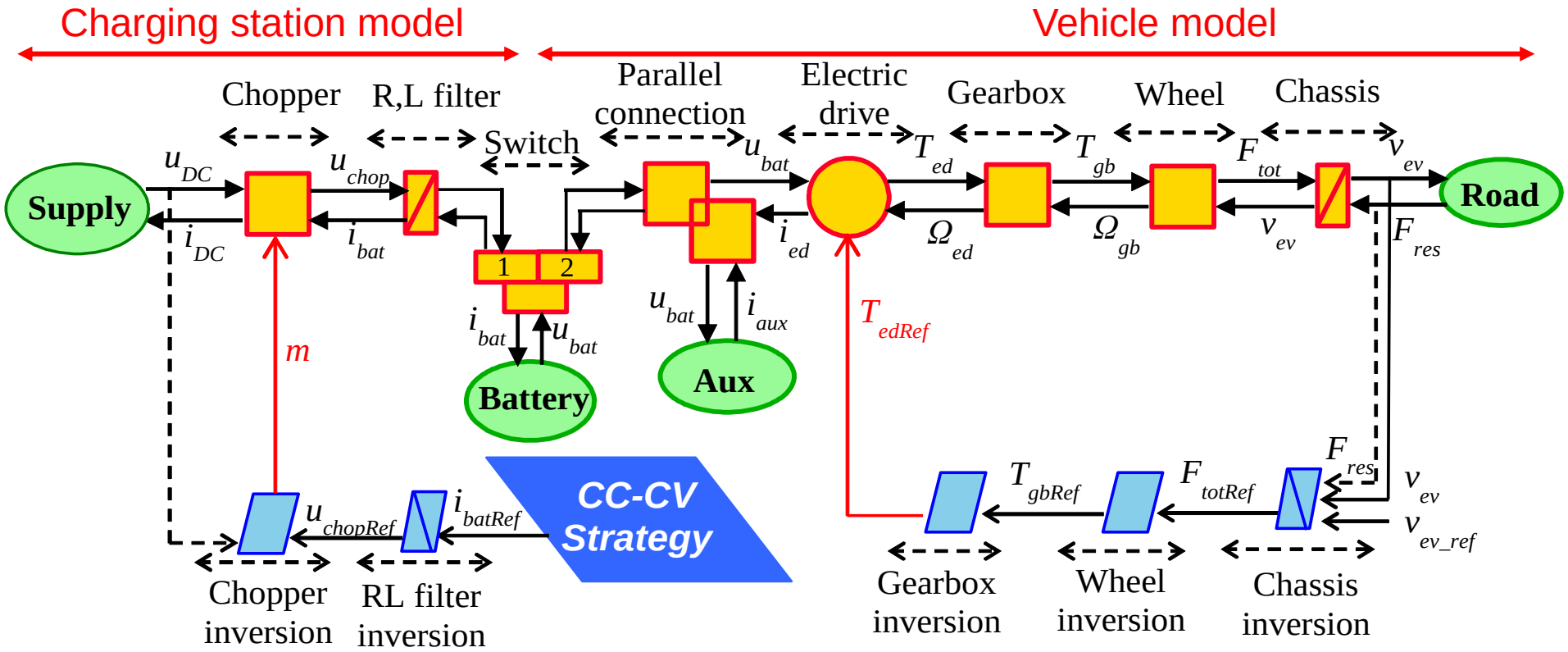
➡ Experimental tests using HIL (Hardware-In-the-Loop) method



Efficient organization + accurate models + transparent testing interface

Organization of the model and validation

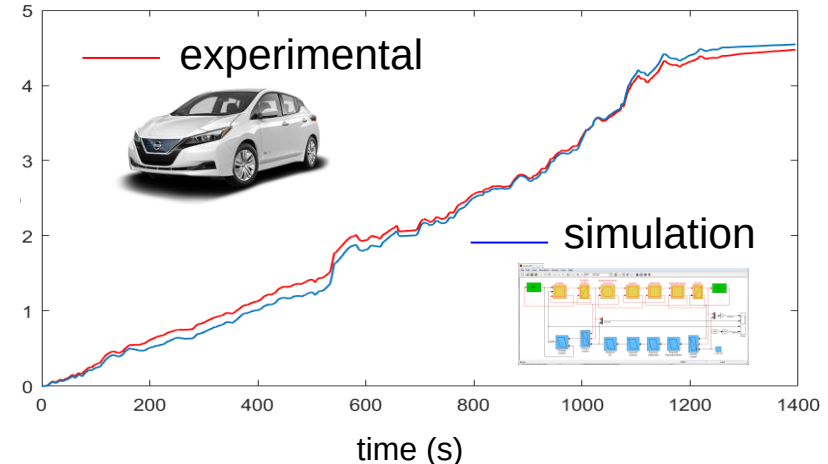
Energetic Macroscopic Representation: graphical formalism for organisation of complex models



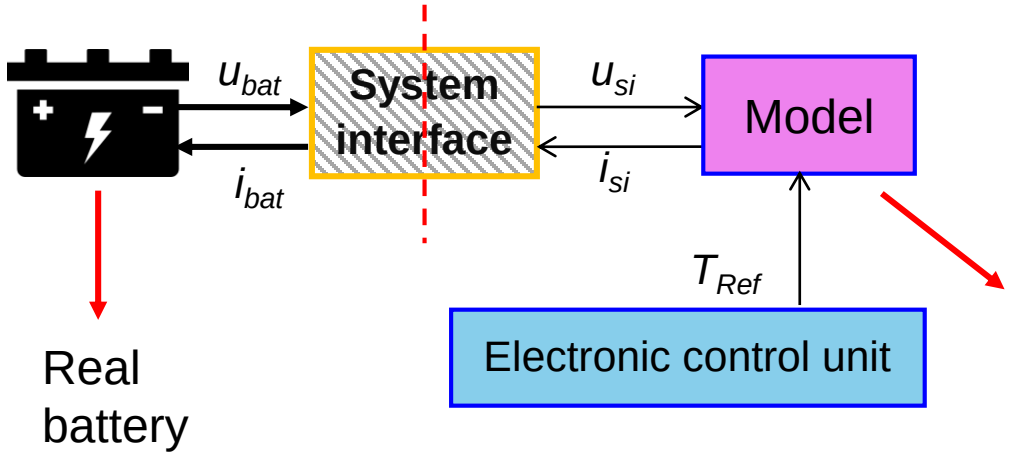
Simulation using Matlab-Simulink©:

- validation by comparison with results on the real car
- 2% of error in energy consumption

Cumulative Charge (A.h)



Hardware-in-the-Loop power testing

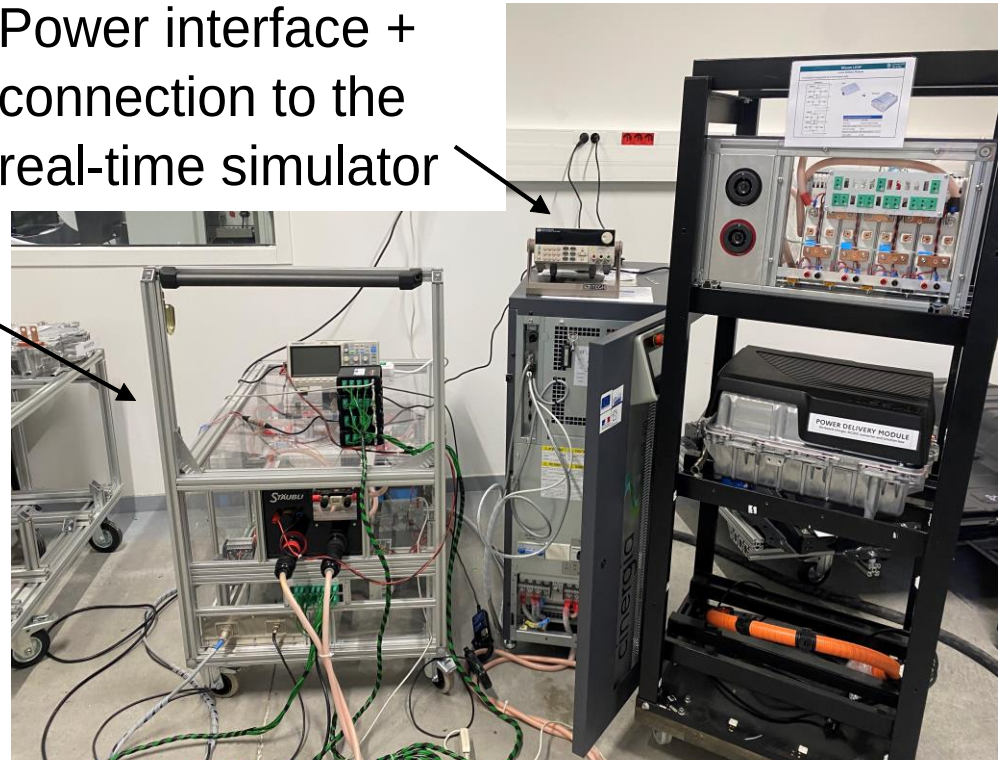


- Advantages:

- More outputs can be measured (temperature)
- No more assumptions

Power interface + connection to the real-time simulator

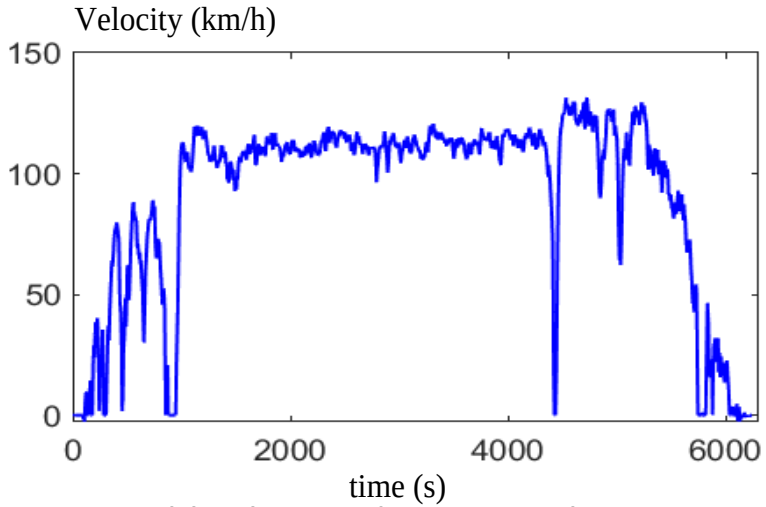
New battery modules



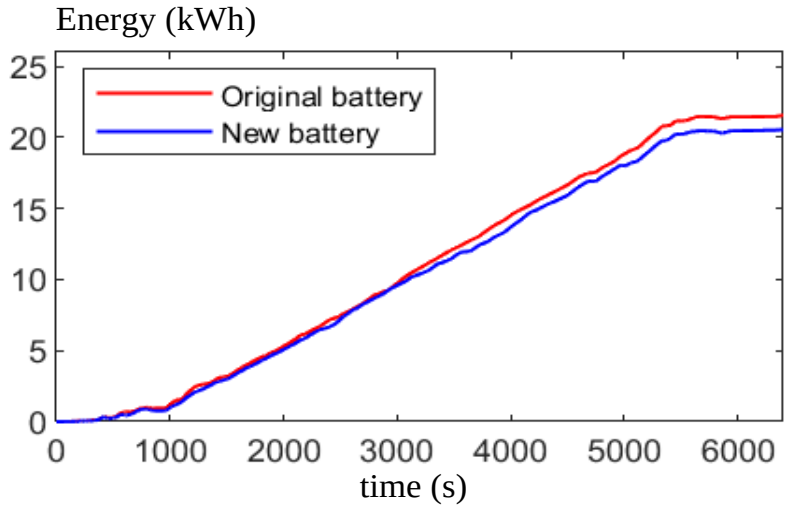
Initial battery modules

Experimental results

- Mode 1: traction mode

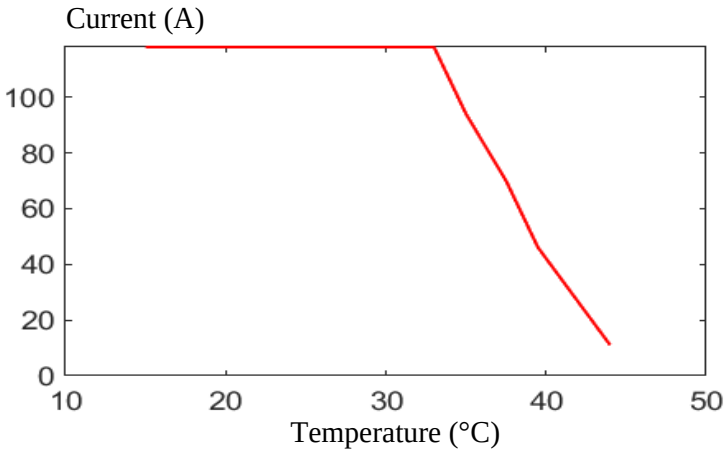


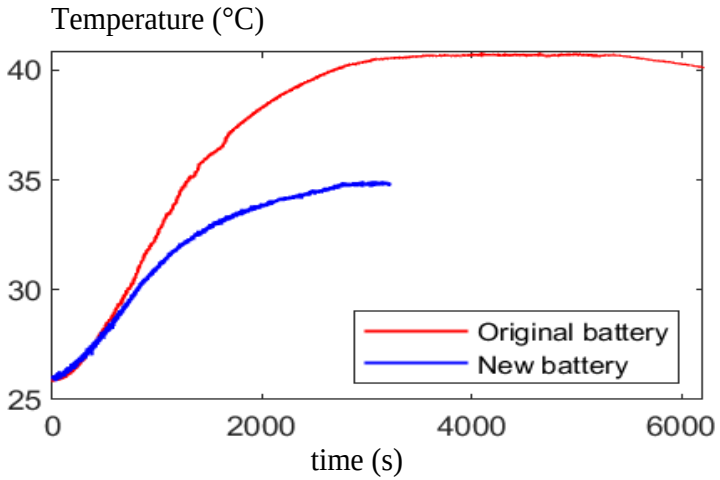
Real highway driving cycle

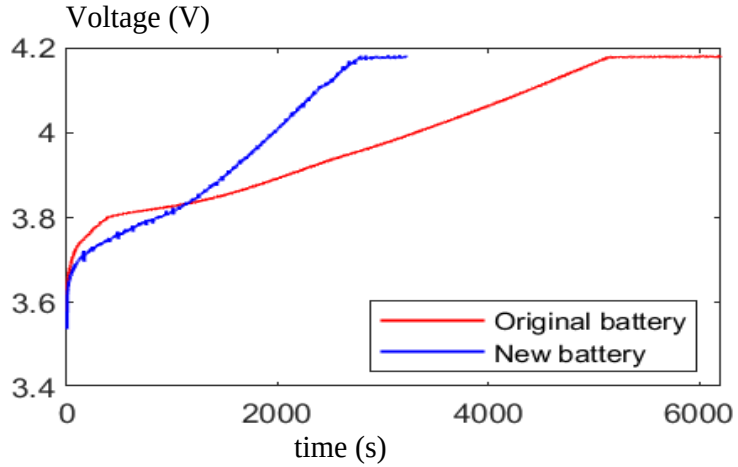


4% lower consumption

- Mode 2: charging mode



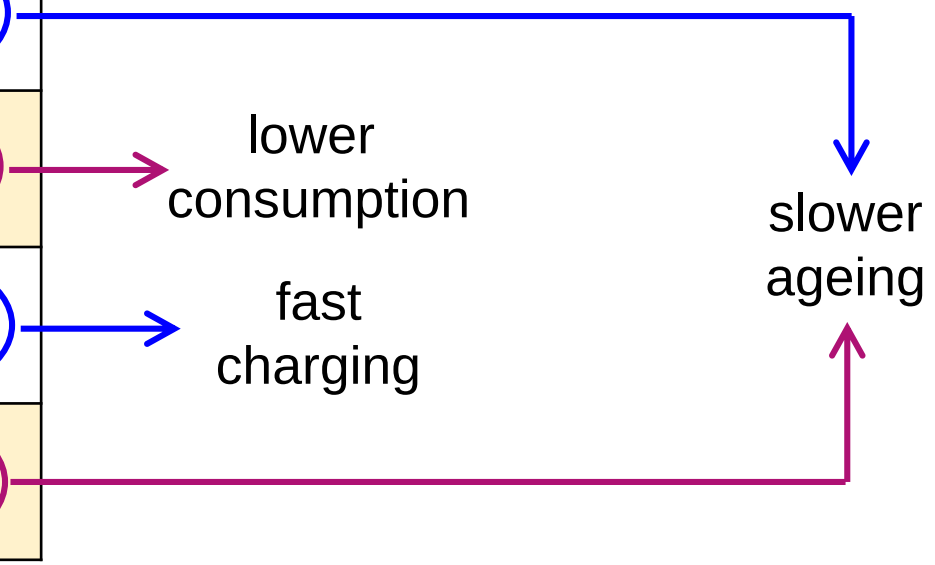




The current is limited by the temperature ➔ new battery charges faster

Batteries comparison

	Initial battery	New battery	difference
Real highway driving cycle (160 km)			
Temperature in traction (°C)	6.4	2.9	-54%
Consumption (Wh/km)	137.9	131.7	-4.4%
Charging time (min)	103	53	-48,5%
Temperature in charging (°C)	14,1	8,7	-38,3%



Conclusion

Testing of a new battery for Nissan leaf

- Experimental test using HIL method
  - EMR formalism for the global organisation
  - Simulation models validated by experimental tests
  - Dedicated testing interface

- Limitation and interest of the new battery
  - Bigger weight and space
  + Slight lower energy consumption
  + Fast charging time reduced by 40%
  + Potential reduction of battery ageing

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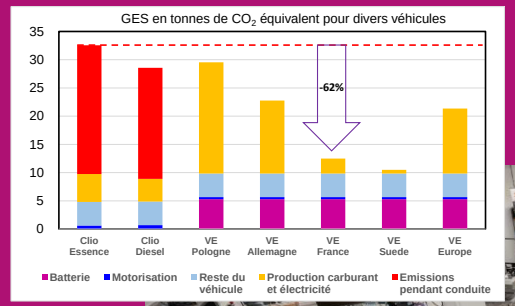

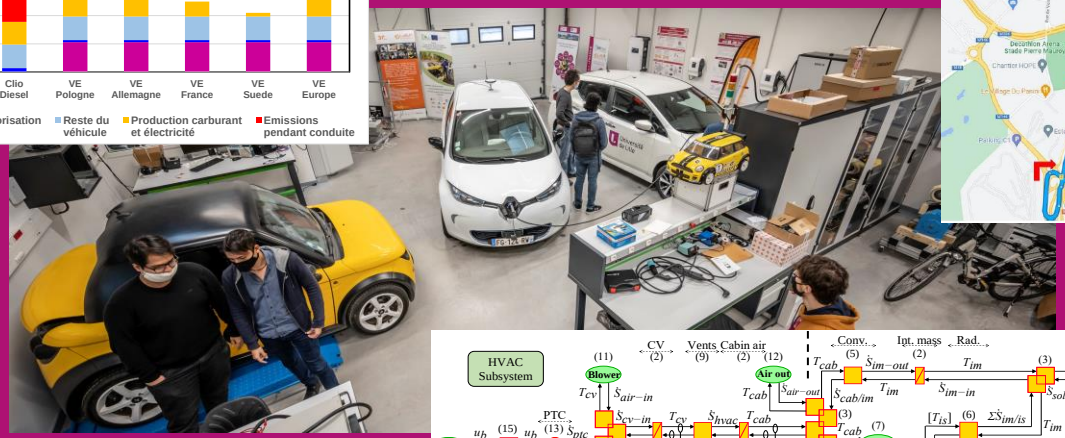

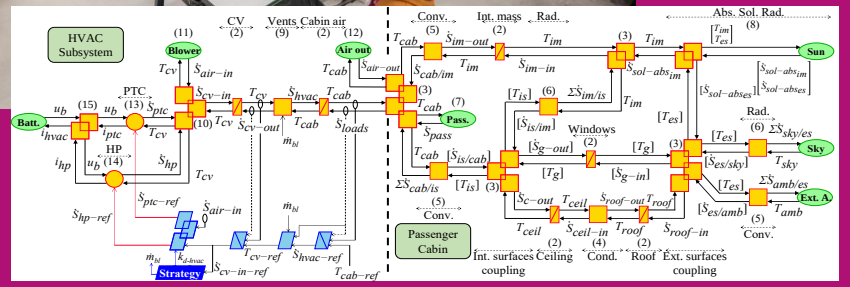

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