CUMIN eCAMPUS

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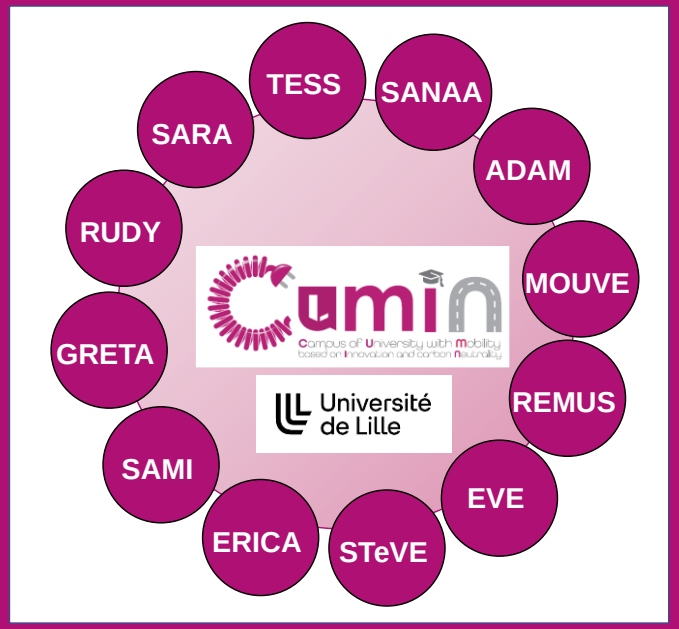

Nissan Leaf charging

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Outline

1. Context and introduction
2. Nissan Leaf & chargers
3. Experiments & results
4. Conclusion

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Context and introduction

Context of eCAMPUS: EV charging

General limitations of EV

Limited driving range

Long charging time

Battery ageing

Specific limitations of EV

Low / high temperatures

Insufficient driving range

Longer charging time

Faster battery ageing

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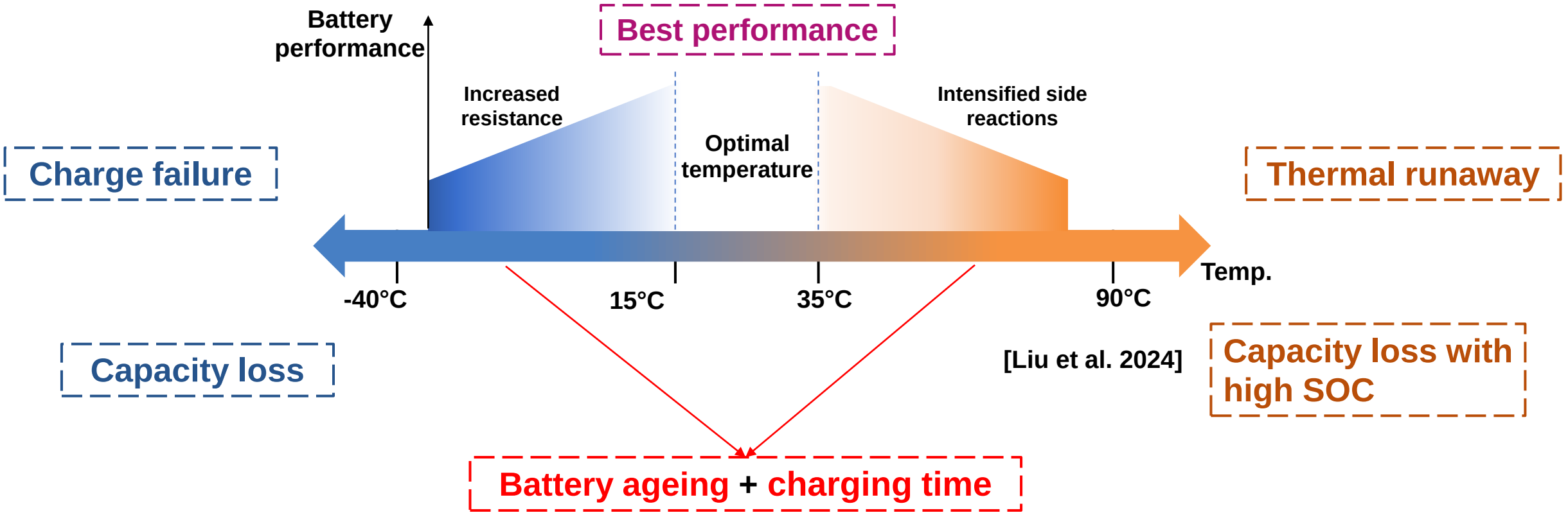
Context of eCAMPUS: EV battery performance

Impact of various temperatures on battery charging



Objective: Quantify the impact of ambient temperature on charging time of the Nissan Leaf.

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Nissan Leaf & charger

Nissan Leaf- reference vehicle

Nissan Leaf ZE1 Acenta is used for experiments

Model: ***Leaf ZE1 Acenta MY2019***

Nissan Leaf
high voltage Battery

40 kWh battery

Capacity **112 Ah**

One of the most popular EVs worldwide.

A strong market presence

[Vrtana et al. 2019]

Affordable EV available in the market

[Benavides et al. 2024]

Available chargers for Nissan Leaf

Two types of chargers used for charging Nissan Leaf

Fast charging

63kW
(125A, 500V)

Charge connector types

CHAdeMO

1.5 h

Slow charging

4.8kW
(20A, 240 V)

7.5kW
(32 A, 400 V)

Charge connector type

Type 2 AC

7.5 h

Time to charge a 40 kWh Nissan Leaf

[Official Nissan global website n.d]

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Experiments

Fast charging experiment methodology

Procedure followed in conducting the fast charging experiments

always same charging station

EV driven until SoC below 30%

Park EV
inside / outside the platform

to influence the initial battery temperature.

Drive EV
to the
charging station

Fast charging
(SoC 100%)

CHAdeMO
63 kW

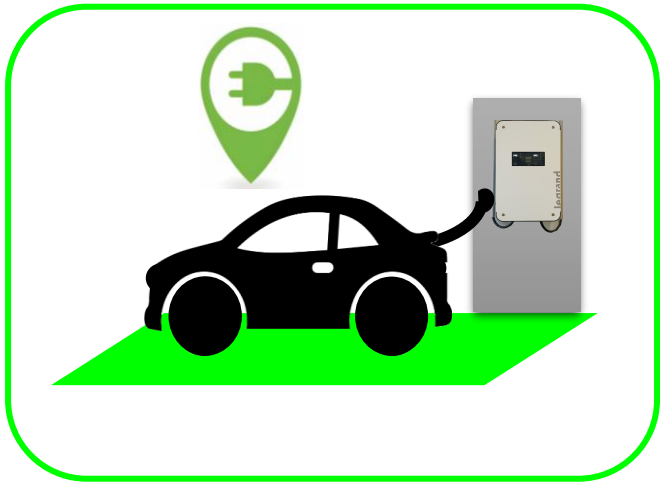
Data acquisition

This process is followed for all charging experiments

Classification of experiments

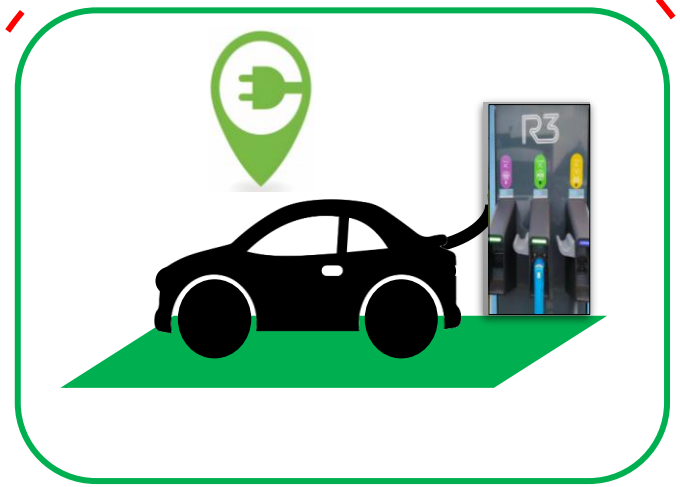
Experiments conducted at various ambient temperatures

Slow charging



cold to mild
initial battery temperature

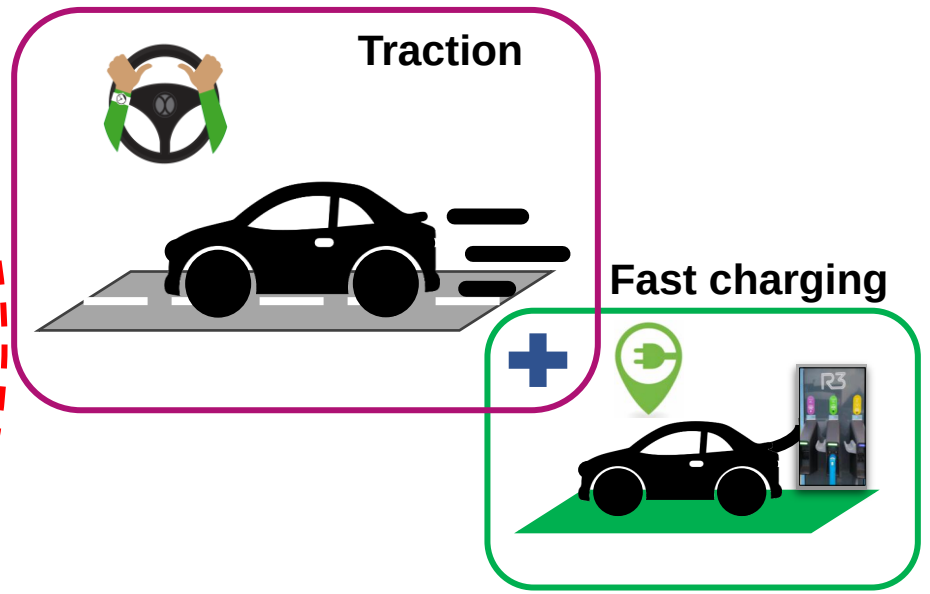
Fast charging



Park outside **Park inside**

cold to mild
initial battery temperature

Post traction charging



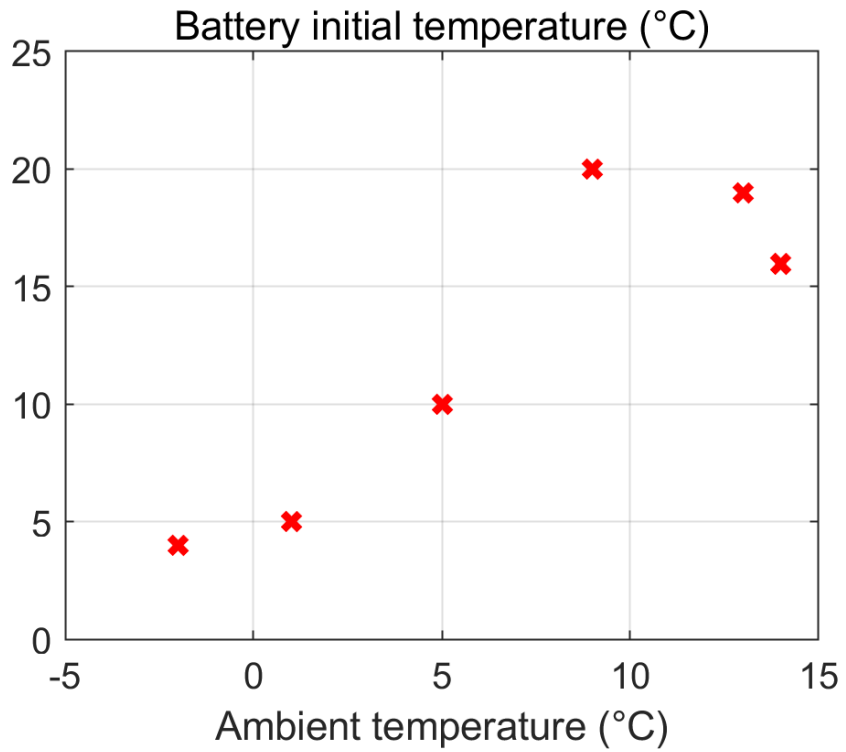
hot
initial battery temperature

Explored different possibilities for conducting the experiments

Results of research

Results obtained from fast charging experiments

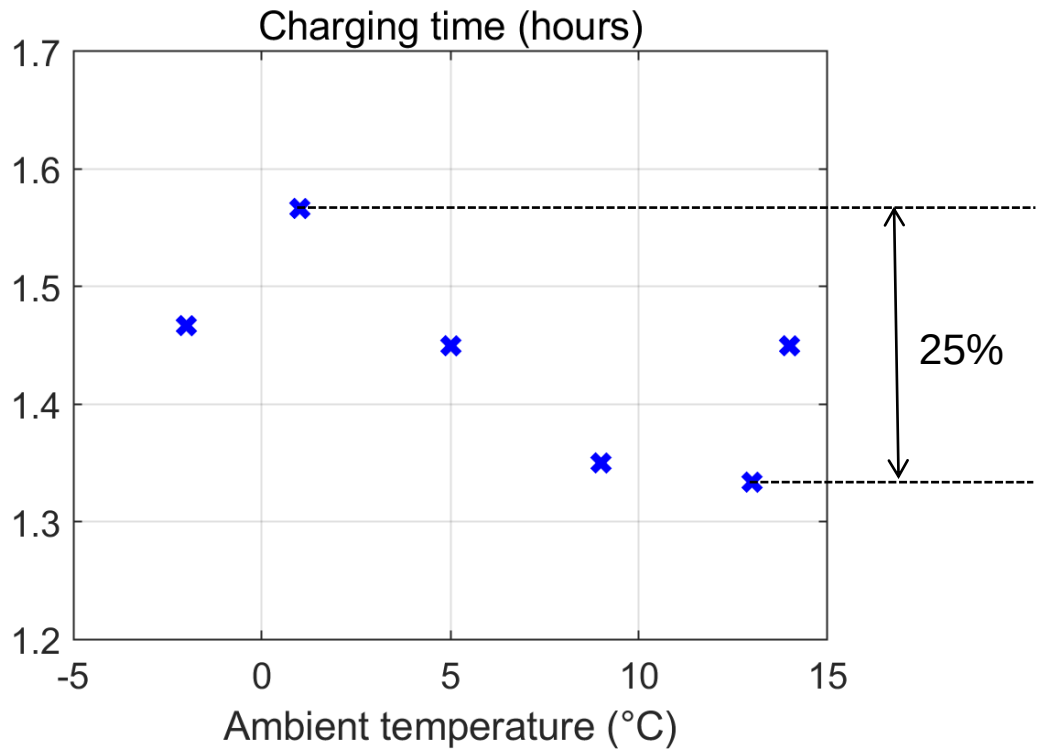
Experiments



6 fast charging sessions

ambient temperatures (-2 to 14°C)

Results



Charging time is longer at low temperatures

Impact up to 25%

Conclusion

- Temperature plays a key role in the Nissan Leaf's charging process
- Low temperatures can increase charging time (by 25%)
- Experiments show insights into the charging strategies for different temperatures

Perspective

- Development of models to replicate the results obtained by these experiments
- Study the impact of more extreme temperatures on charging

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Thank you for your attention

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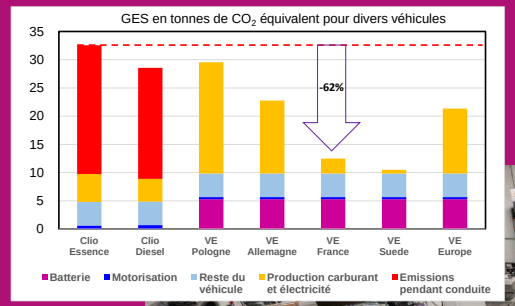

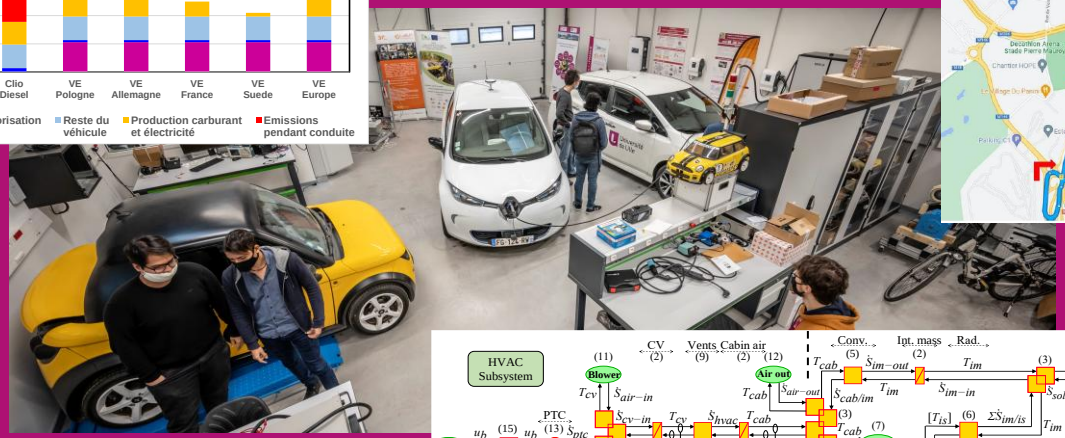

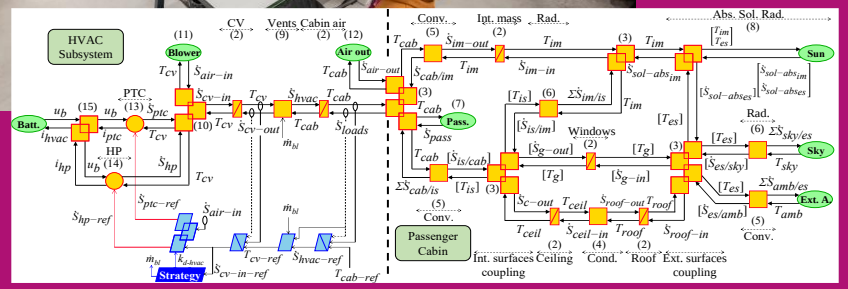

Our university as an exciting living lab towards eco-cities through an innovative transdisciplinary framework !

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Appendix

Positioning of this research globally

within university research

Charging

Optimized charging for EVs (0 to 37°C)
Li et al. 2020

Optimal preheating charging at low temp.
Cao et al. 2023

Battery thermal behaviour

Thermal behaviour of NMC battery
Lyu et al. 2020

Li-Ion Battery Low-Temp. Effects
Vidal et al. 2019

EV charging and battery ageing
Ndiaye et al. 2024

EV consumption in extreme conditions
Ramsey et al. 2022

Battery behaviour at sub-zero temp.
Jaguemont et al. 2016

Modelling and control

Validation and social science

Charging Nissan Leaf in various ambient temp.
Revankar