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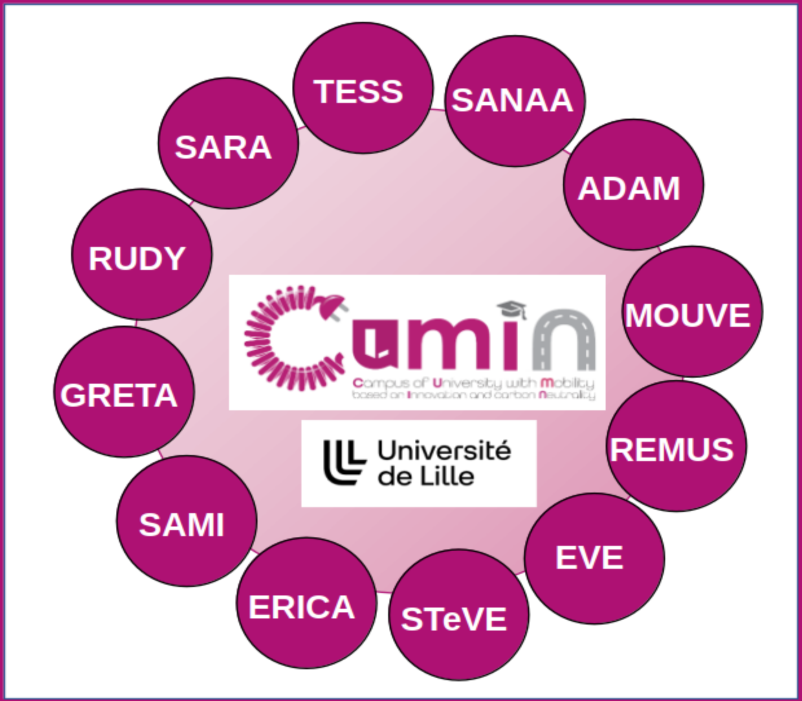
CUMIN – MOUVE

Université de Lille



Study of the stationary bidirectional charger for electric vehicles

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Outline

1. Context and objective
2. Literature review
3. Our case study

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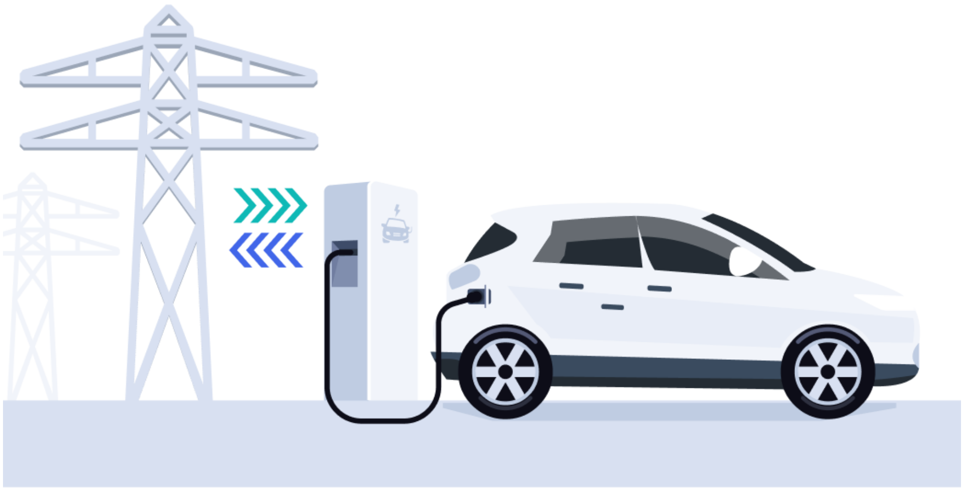
Context and objective

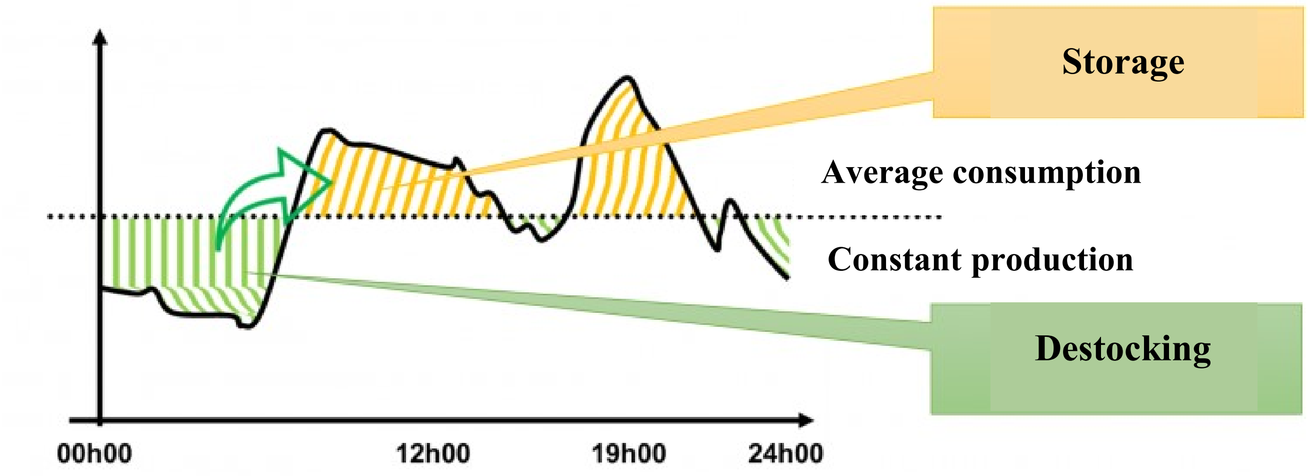
Context and objectives

G2V



V2G

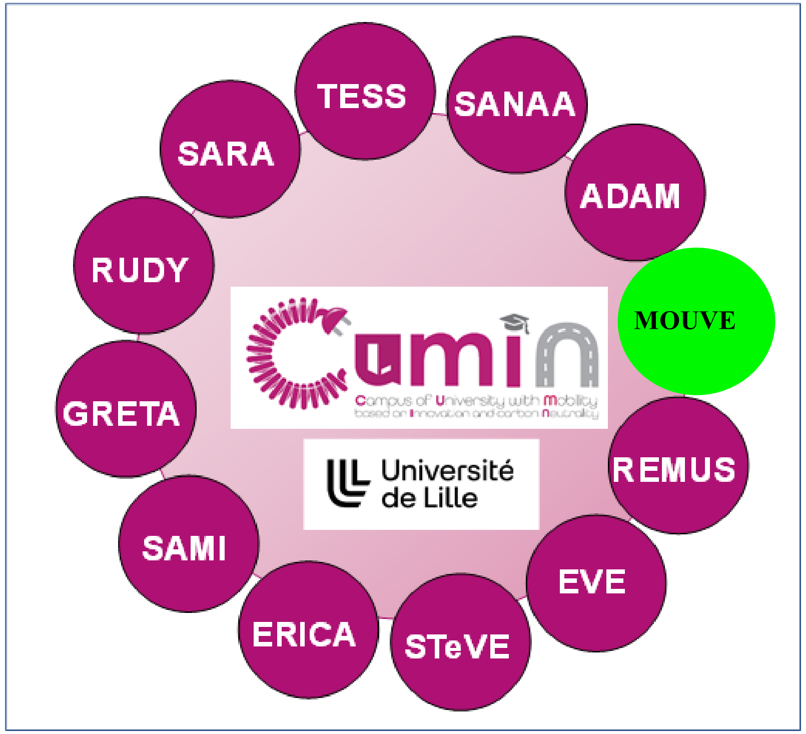
Consumption



source: https://energieplus-lesite.be/techniques/reseau-electrique5/stockage-energie/stockage-delectricite/

Context and objectives

Positioning in the CUMIN programme
Campus of University with Mobility based on Innovation and carbon Neutral



MOUVE : MObility and Use of electric VEhicles based on dedicated charging infrastructure

Objective of this project is to model and simulate a stationary bidirectional power charger

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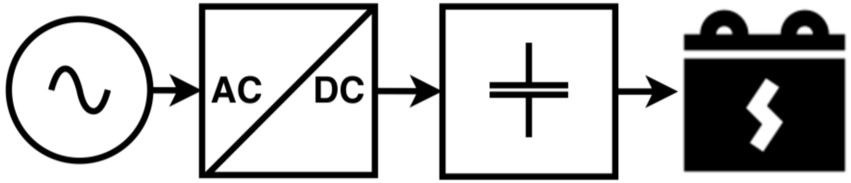
Literature review

Stationary charger topology

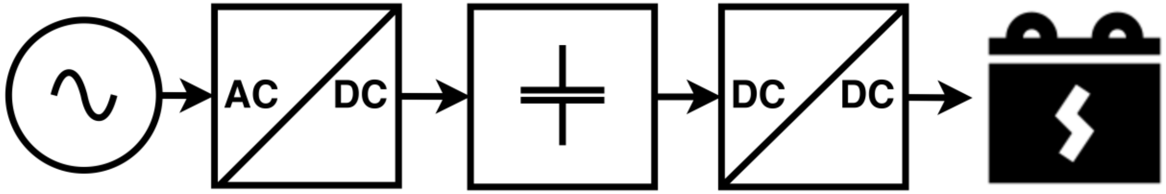
Single stage bidirectional charger



- ✅ High yield
- ✅ Fewer components
- ✅ Cheaper cost

- 👎 Limited voltage

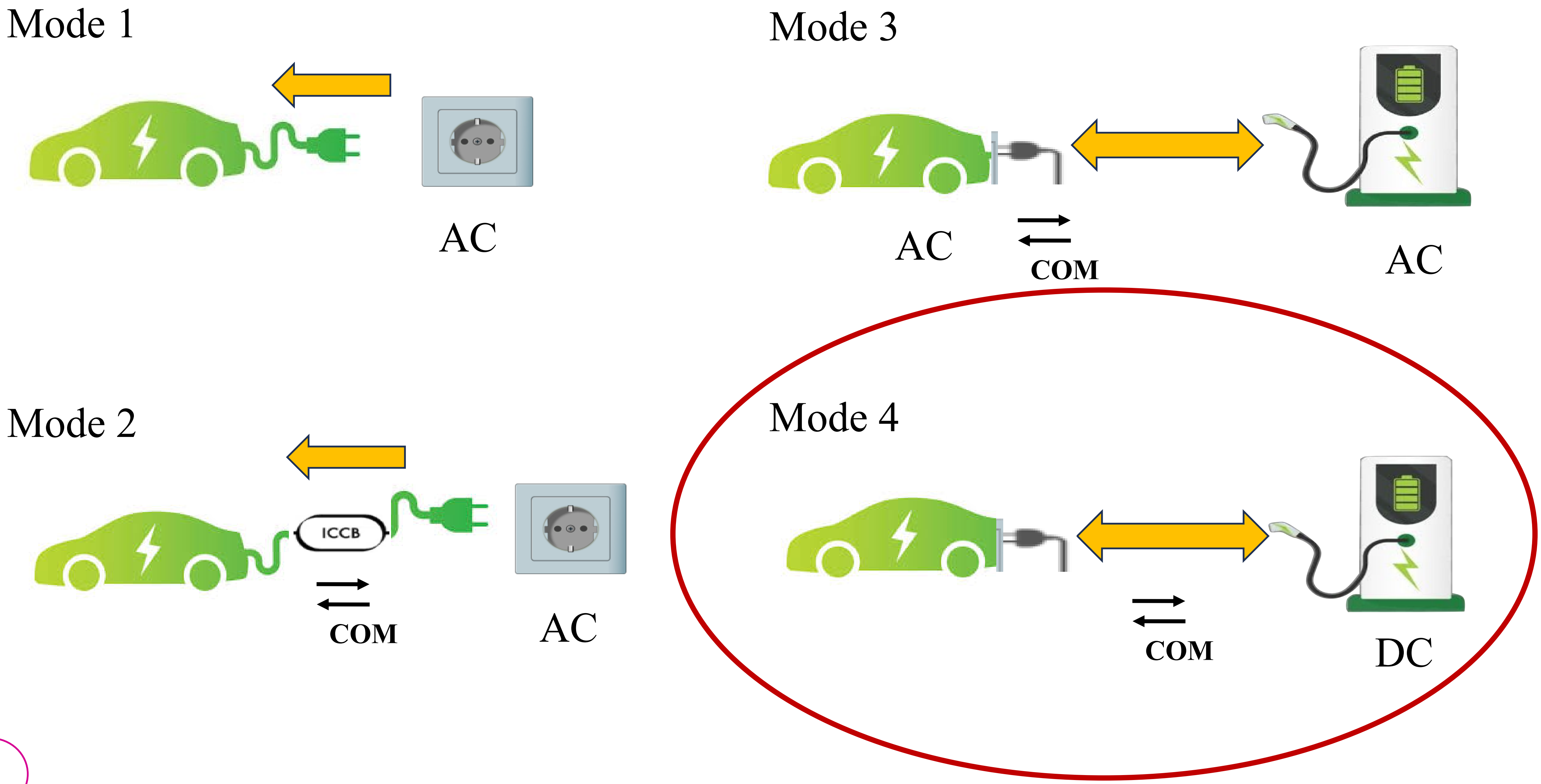
Two stage bidirectional charger



- ✅ More flexibility
- ✅ Better voltage management batteries.

- 👎 Higher cost
- 👎 More bulky

The different charging modes



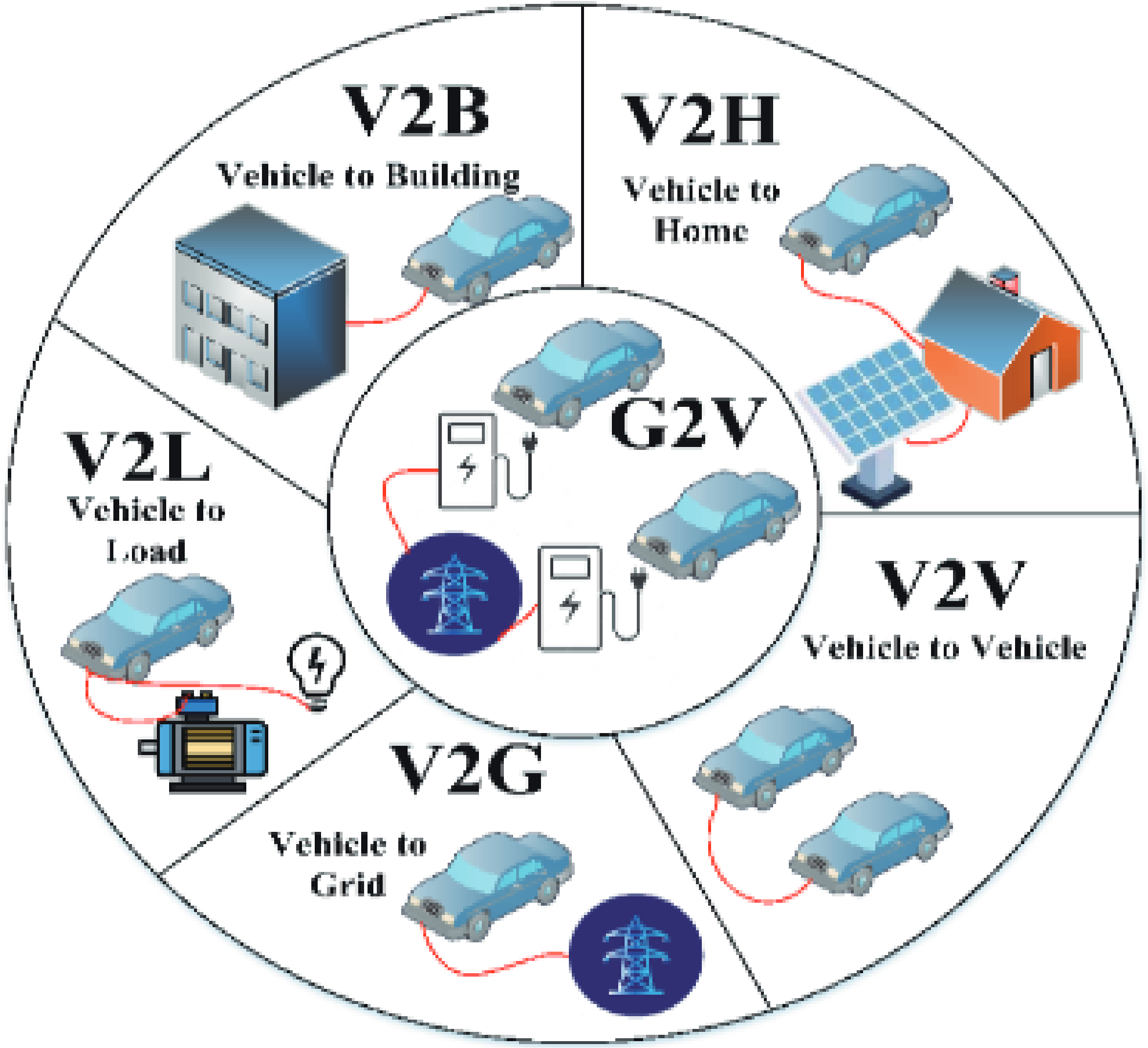
Types of bidirectional chargers

👍 Advantages of bidirectional chargers:

- Grid stabilization ⚡
- Cost savings 💰
- Renewable energy support 🌱
- Peak demand reduction 🔌

👎 Disadvantages of V2G:

- Battery degradation 🔋
- Infrastructure cost 💲
- Energy losses ⚠️
- Limited vehicle compatibility 🚗



file:///home/etudiant/T%C3%A9l%C3%A9chargements/Critical_Review_of_Vehicle-to-Everything_V2X_Topologies_Communication_Power_Flow_Characteristics_Challeng.pdf

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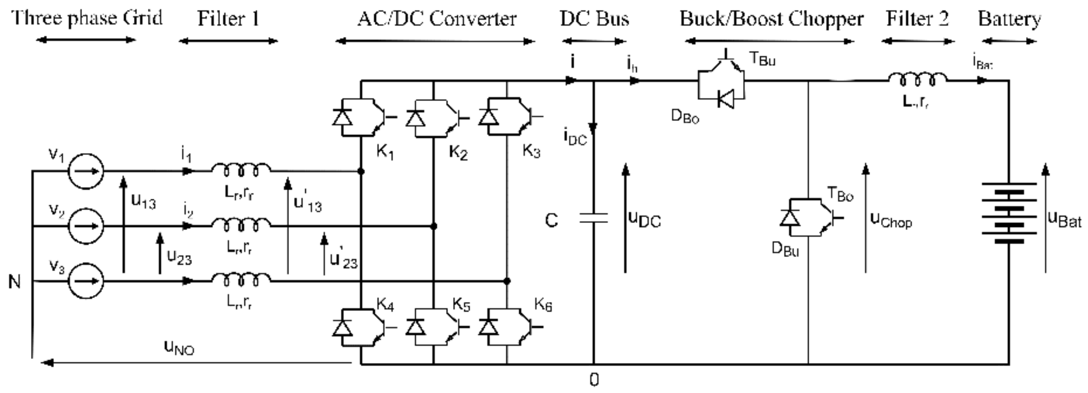
Our case study

Stationary bidirectional charger

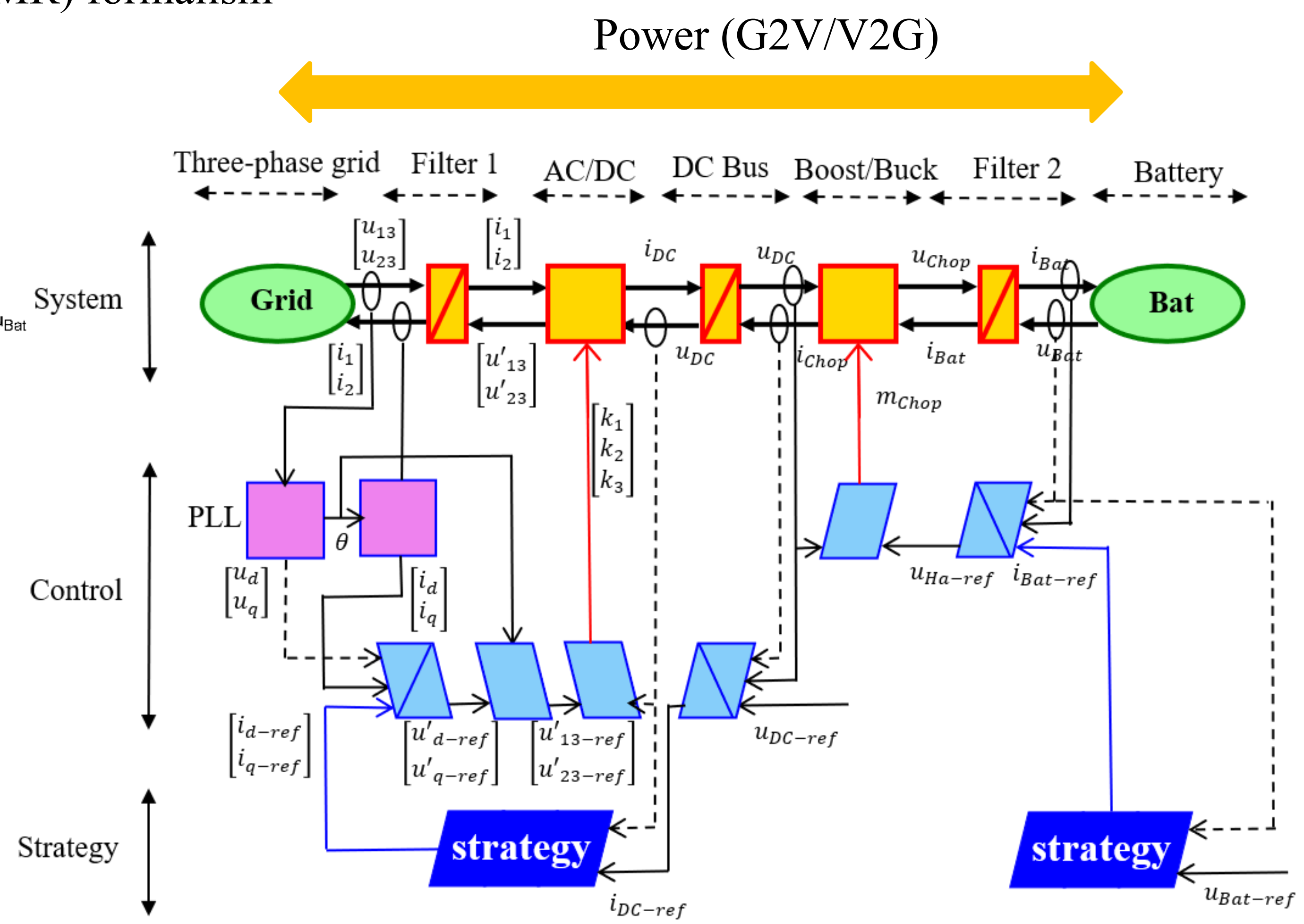
L2EP Laboratoire d'électrotechnique et d'électronique de puissance de Lille
TVES
LaMcube Laboratoire de mécanique, multiphysique, multiéchelle
CLERSÉ
Gériico
MEL MÉTROPOLE EUROPÉENNE DE LILLE

Model organization

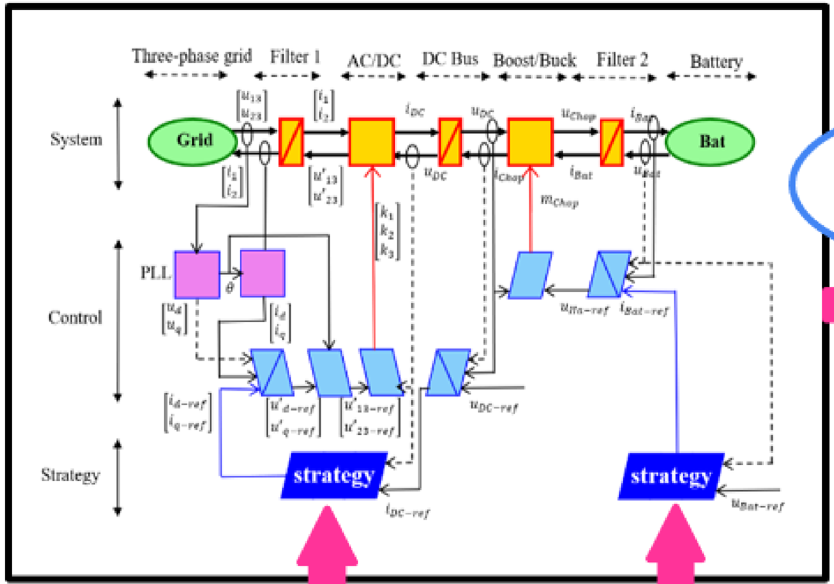
Using the Energetic Macroscopic Representation (EMR) formalism



Assumption: ideal converters

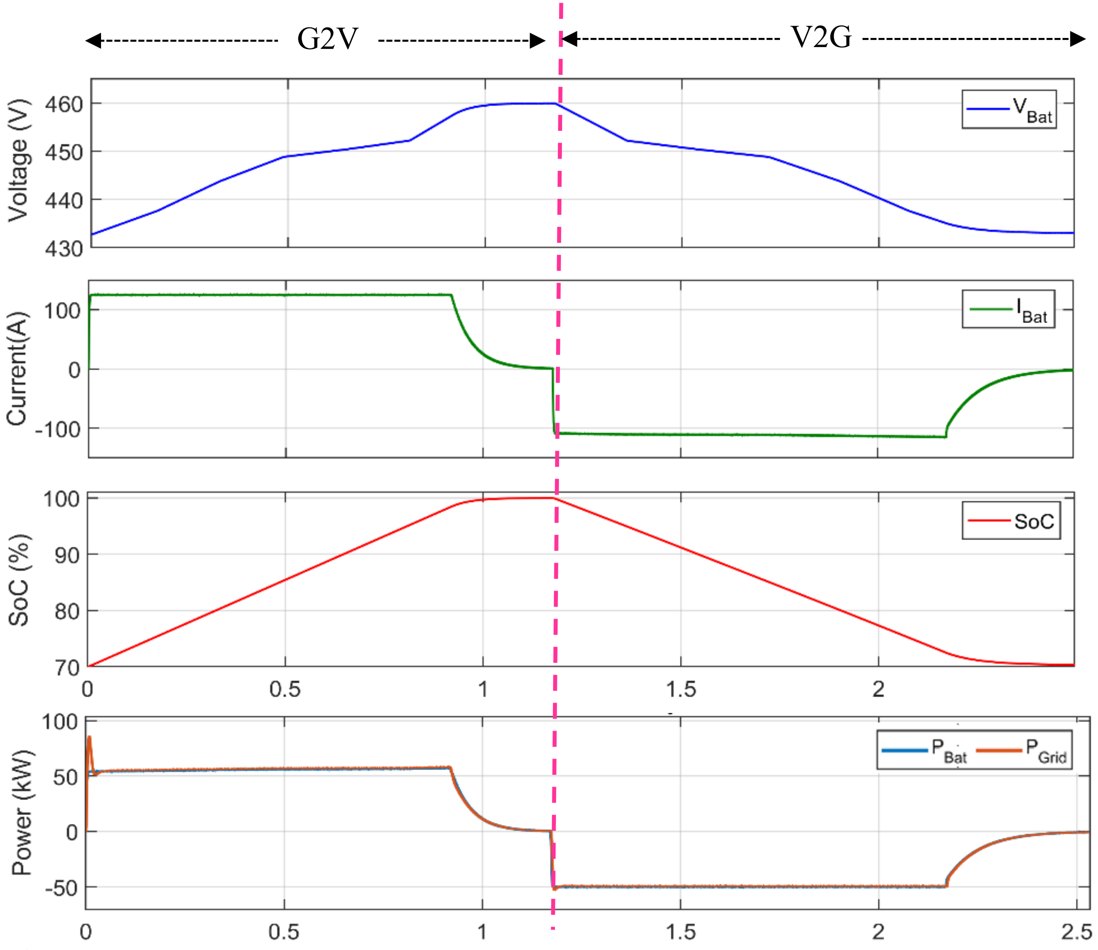


Simulation results



Active Power and Reactive Power

Current, voltage and State of Charge (SoC) of the battery



Battery power and Grid Power

G2V: charging at Constant Current of 125 A + Constant Voltage

V2G: discharging at Constant Power of 50 kW + Constant Voltage

$\eta_{G2V} = 98,5\ \%$

$\eta_{V2G} = 98,6\ \%$

Conclusion and perspectives

Conclusion

- A stationary two-stage bidirectional power charger is modeled and simulated.
- Reactive power is controlled.
- PWM (Pulse Width Modulation) methods help reduce harmonic distortion, minimize distorsion and lower power losses in the three-phase grid.
- The Constant Current-Constant Voltage (CC-CV) strategy is employed for battery charging.
- The Constant Power-Constant Voltage (CP-CV) strategy is used for battery discharging.

Perspectives: Future work should focus on:

- Studying the loss in a converter component
- Effect temperature during the battery charging and discharging.

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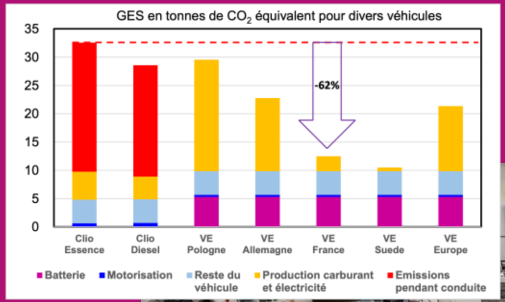
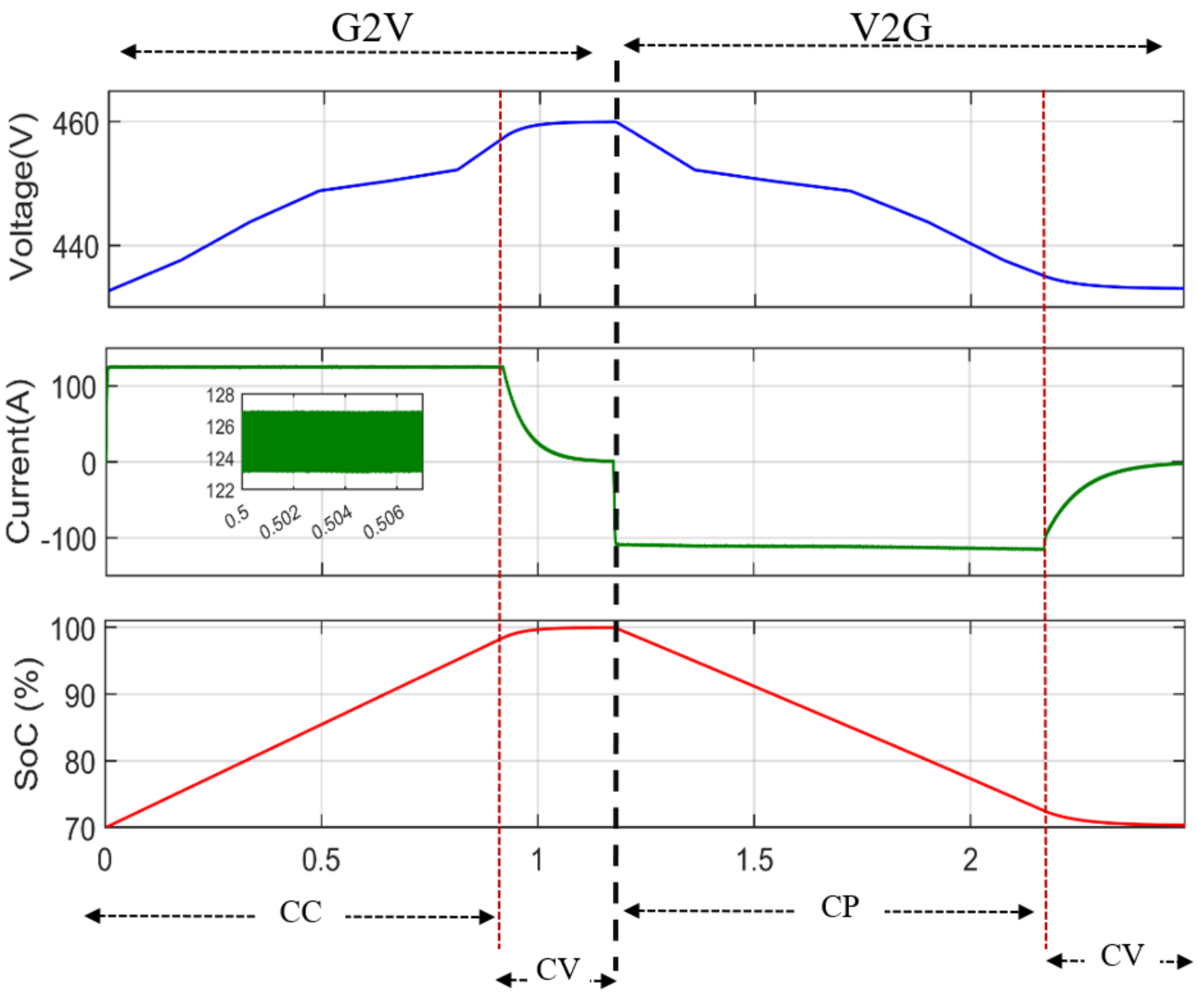


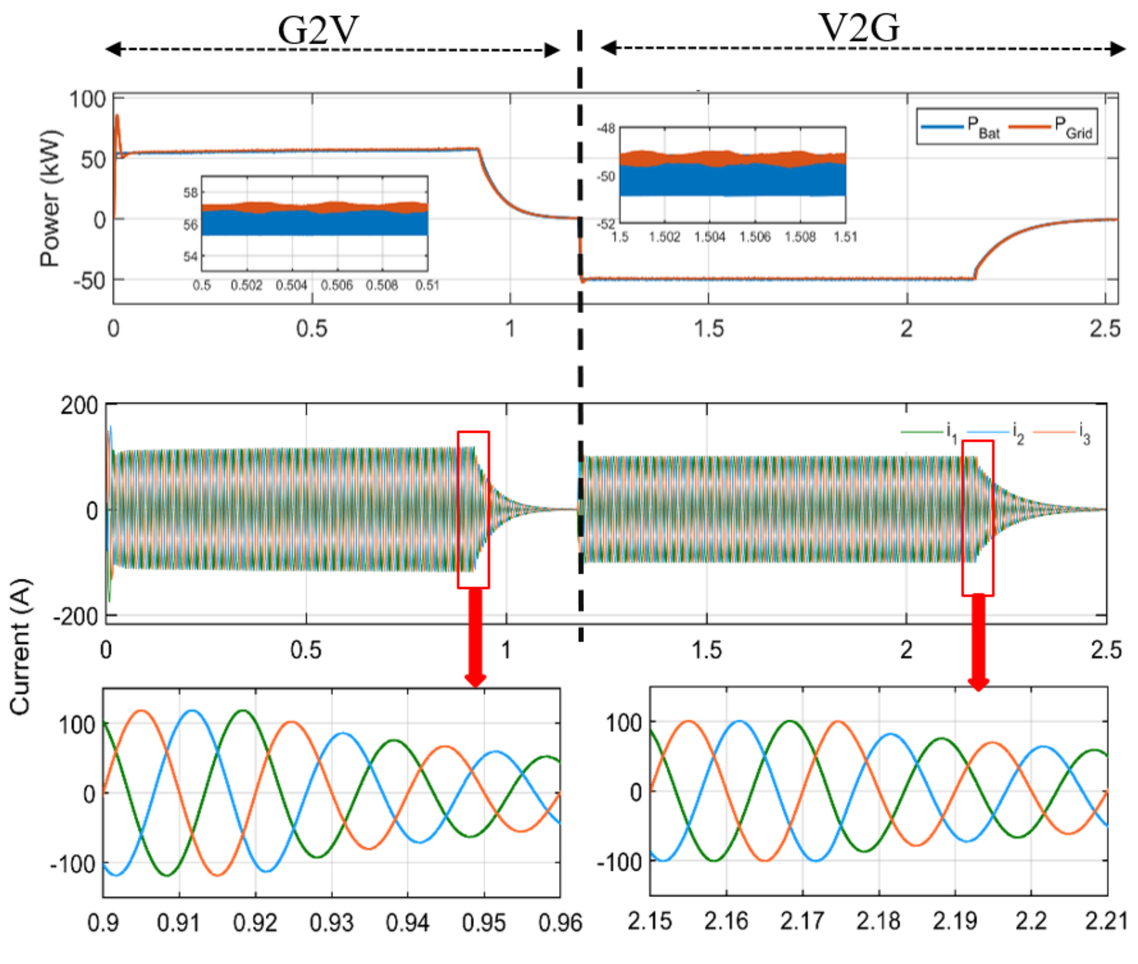
Our university as
an exciting living lab
towards eco-cities
through an innovative
transdisciplinary
framework !

Annex

Current, voltage and State of Charge (SoC) of the battery



Battery power and Grid Power



Charging/ discharging grid current

CC-CV: Constant Current - Constant Voltage

CP-CV: Constant Power - Constant Voltage