CUMIN - MOUVE

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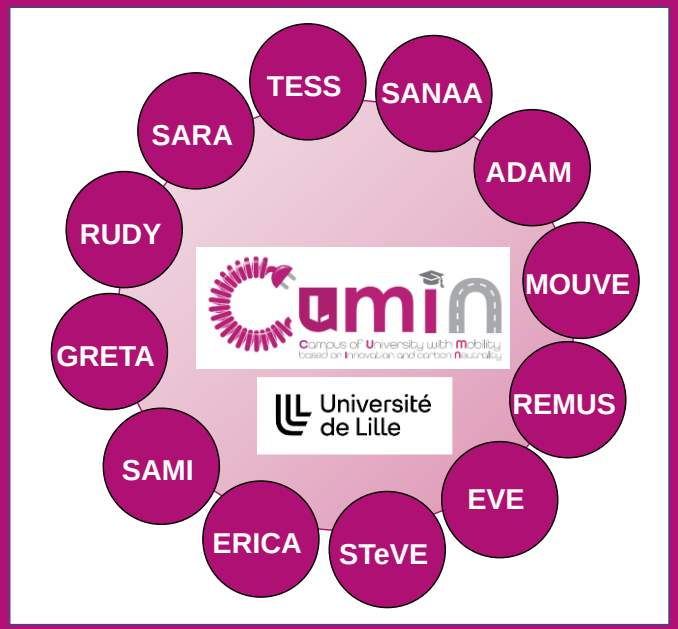

Fast charging strategies

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Outline

1. Studied system
2. Multi-level modeling
3. Fast charging strategies
4. Conclusion

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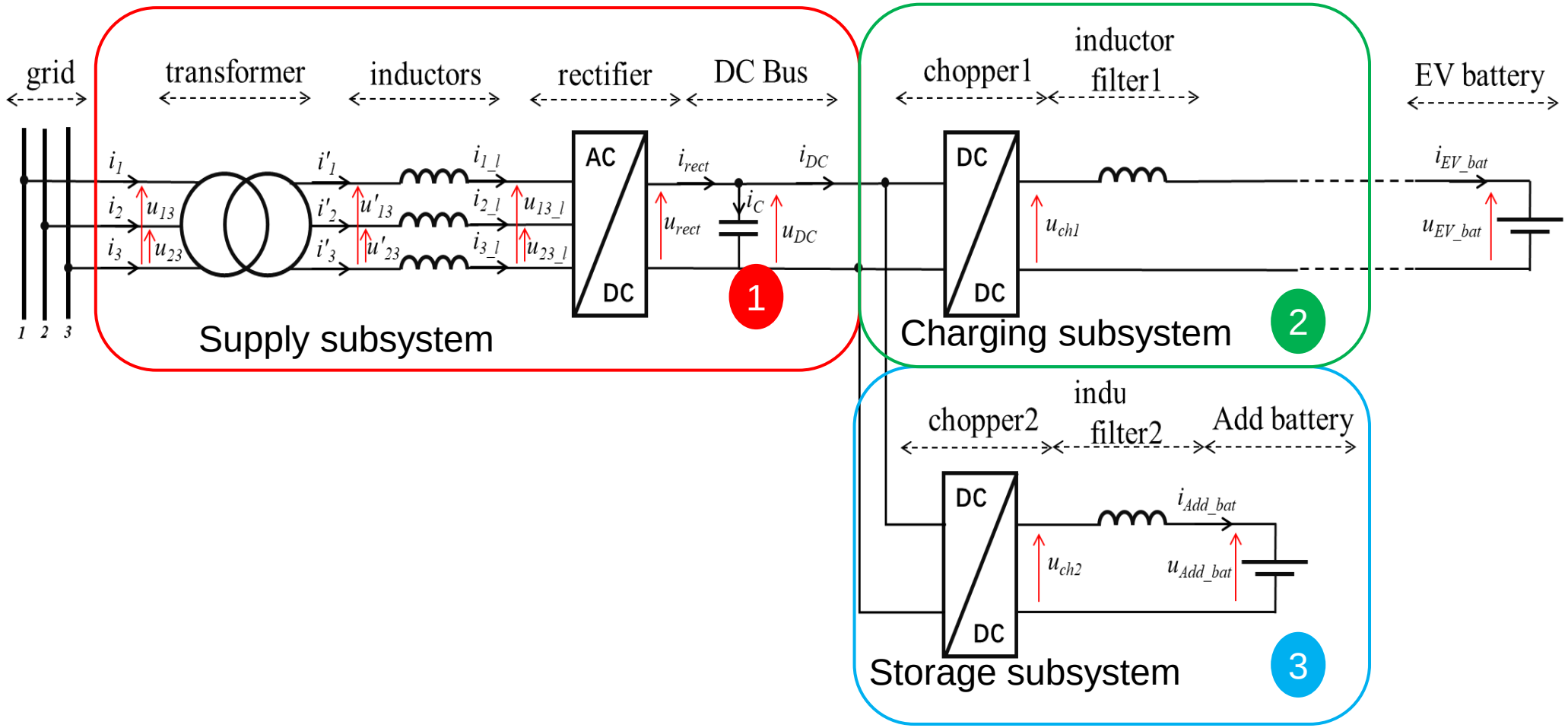
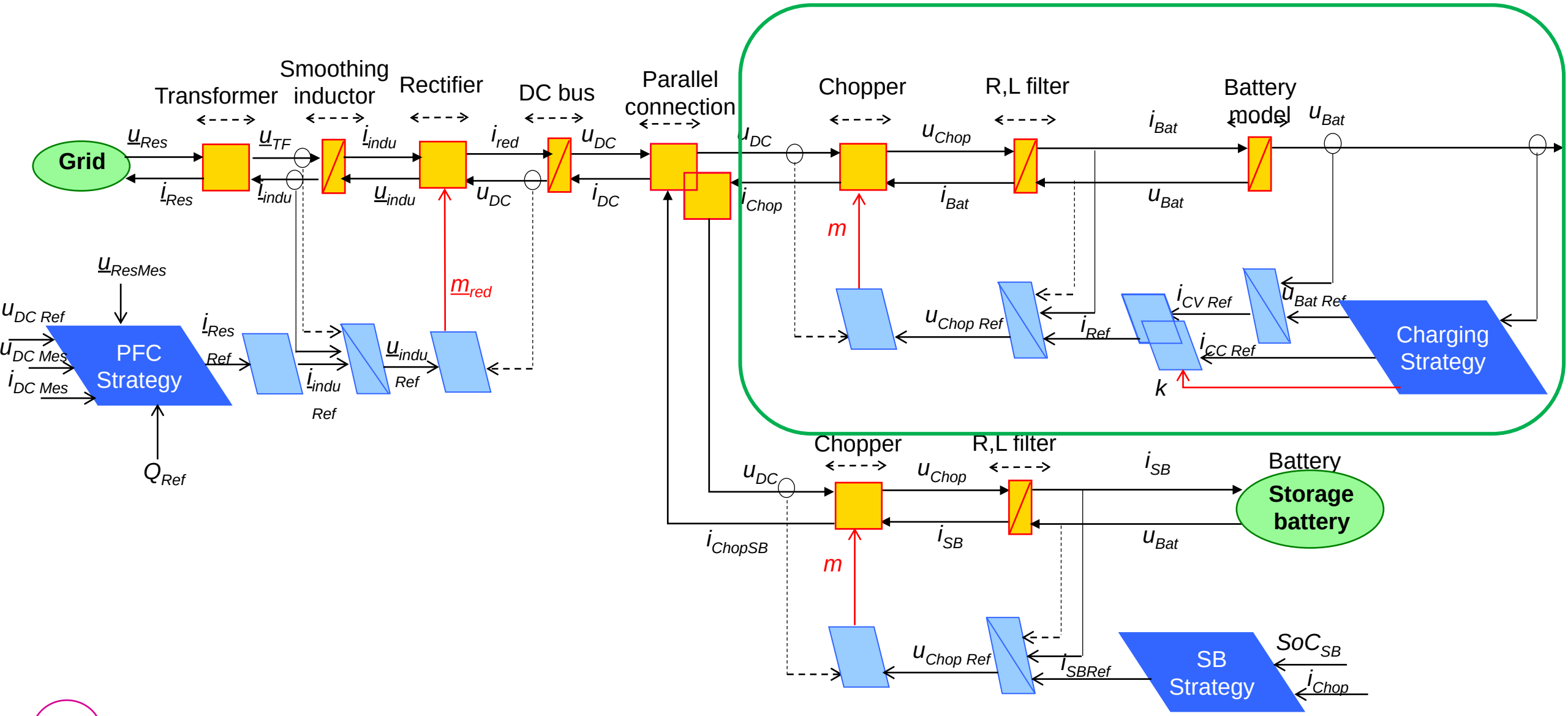
Studied system

Structural scheme



Energetic macroscopic representation



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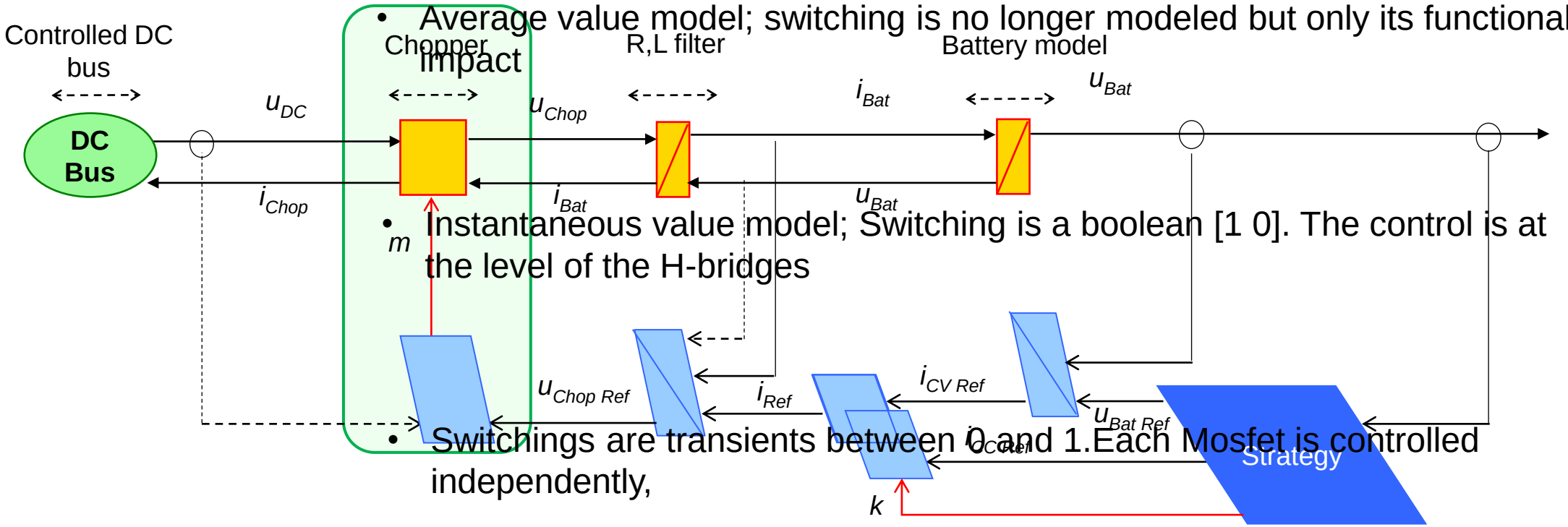
Multi-level modeling

Modeling tool

EMR can be used for multilevel modeling



- Average value model; switching is no longer modeled but only its functional impact
- Instantaneous value model; Switching is a boolean [1 0]. The control is at the level of the H-bridges
- Switchings are transients between 0 and 1.Each Mosfet is controlled independently,

Modeling tool

EMR can be used for multilevel modeling

- 1st model, simplified electrical model

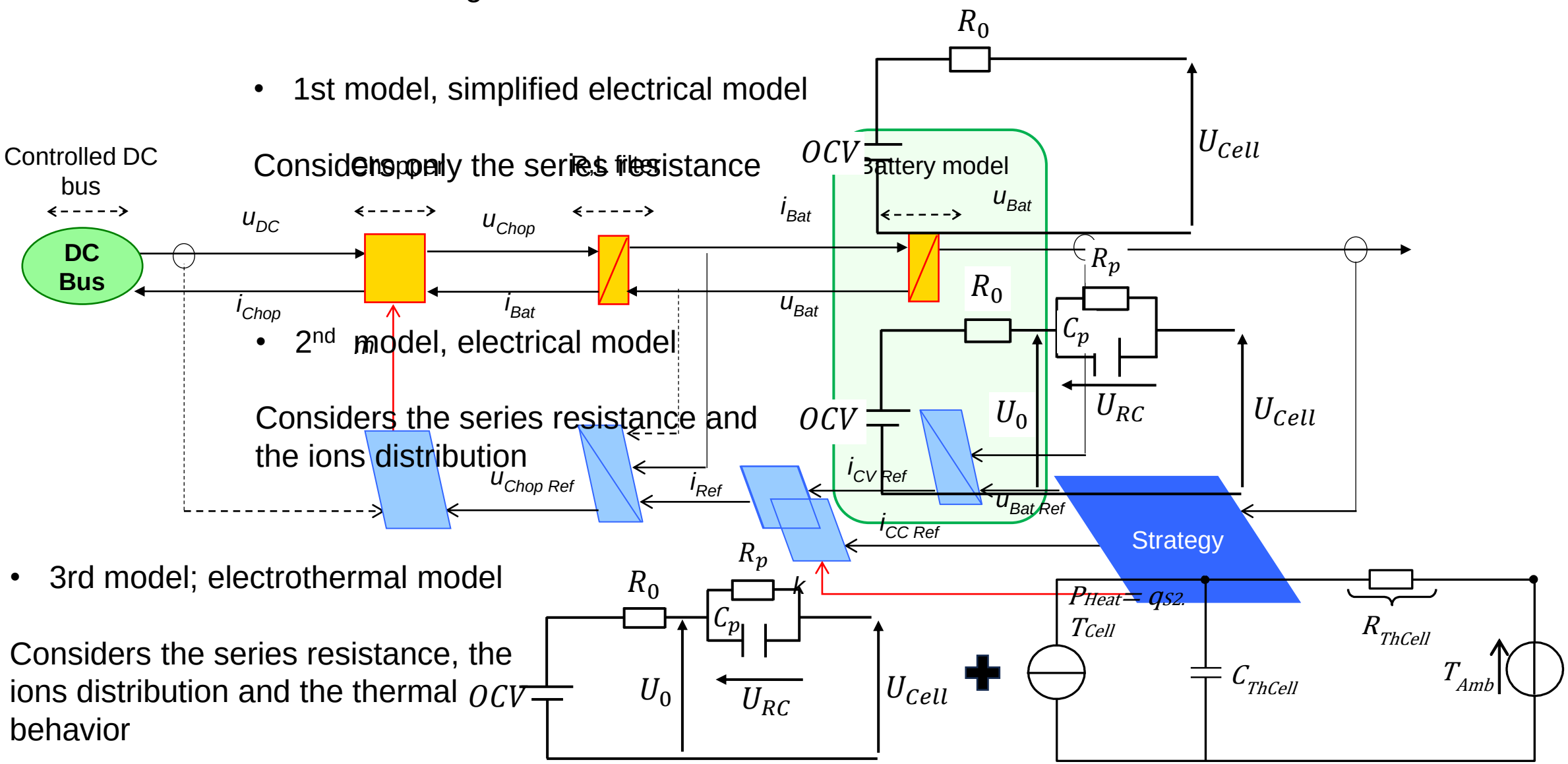
Considers only the series resistance

- 2nd model, electrical model

Considers the series resistance and the ions distribution

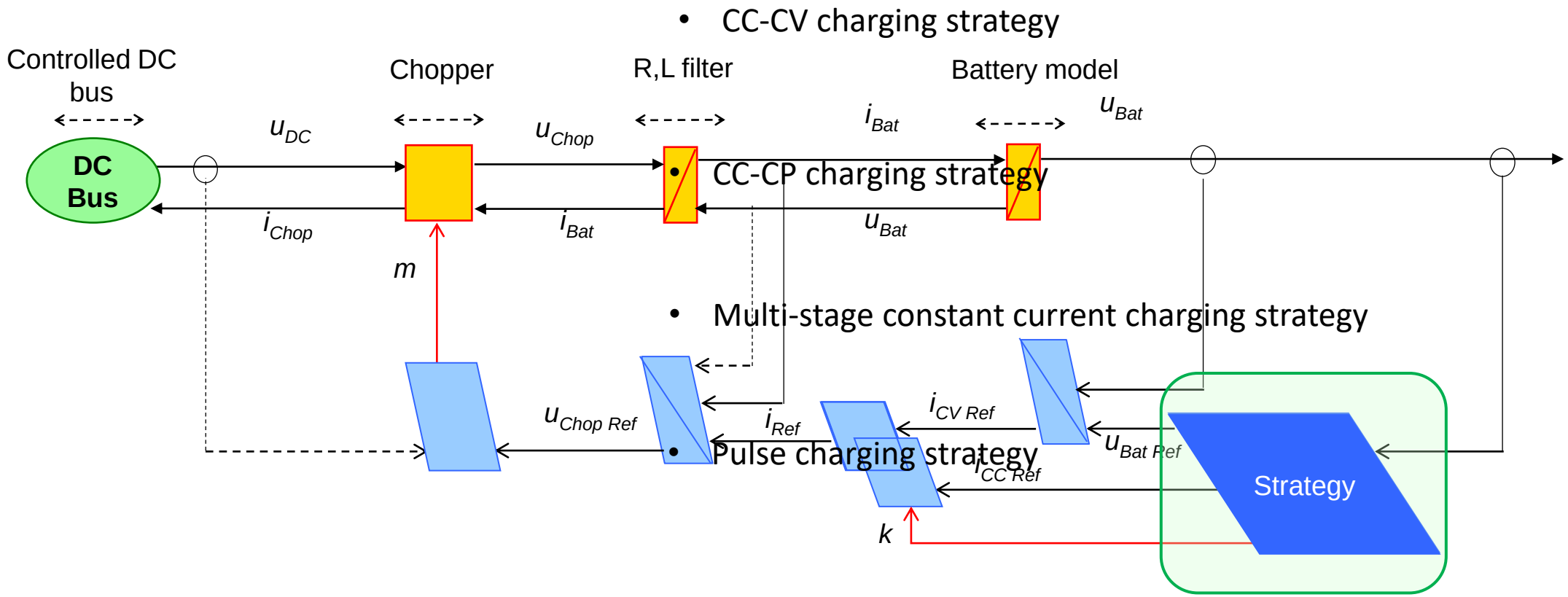
- 3rd model; electrothermal model

Considers the series resistance, the ions distribution and the thermal behavior



Modeling tool

EMR can be used for multilevel modeling



- CC-CV charging strategy
- CC-CP charging strategy
- Multi-stage constant current charging strategy
- Pulse charging strategy

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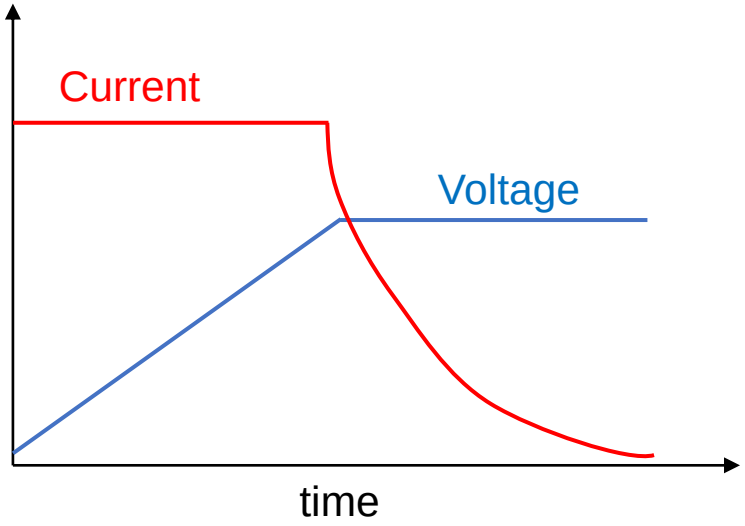
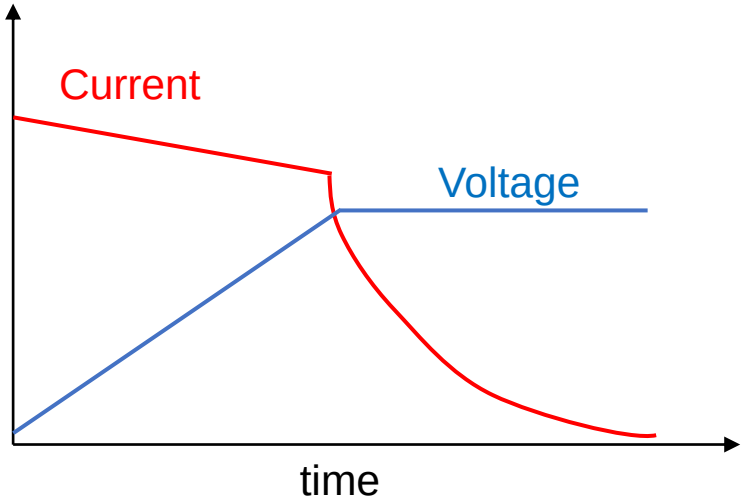
Fast charging strategies

Fast charging strategies



Constant current – constant voltage



Constant power – constant voltage

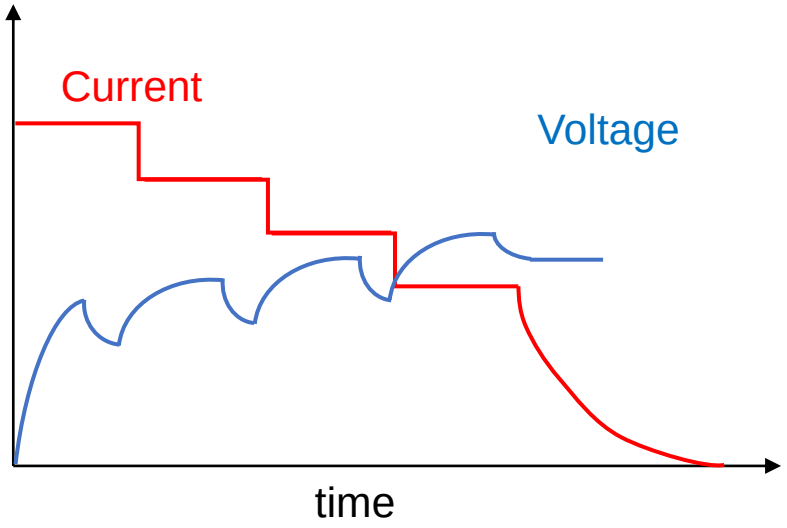
+ Simple to control
+ Widely adopted
+ Balance between speed and battery life

- Heat generation
- Need optimisation

+ Faster charging
+ Optimised grid use
+ Efficiency in high power applications

- High heat generation
- Complex control system
- Potential battery degradation

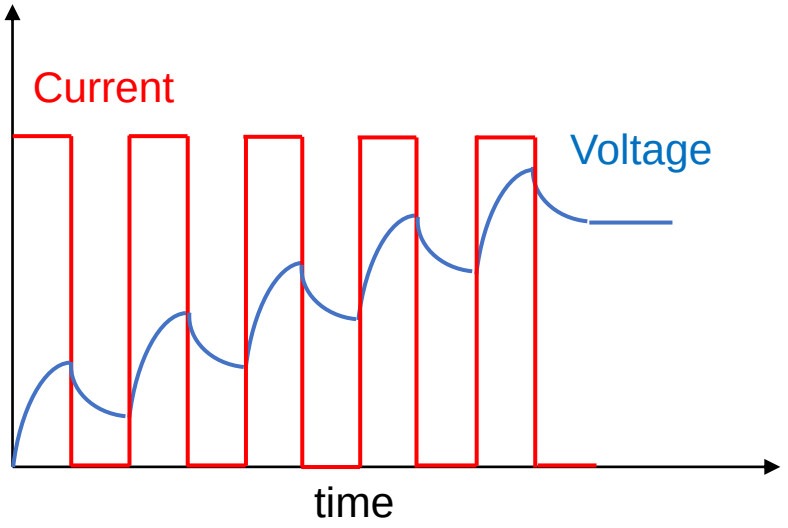
Fast charging strategies



Multi-stage constant current

+ Improved efficiency
+ Reduced heat generation
+ Extended battery life

- Complex control system
- Longer charging time



Pulse charging

+ Minimized lithium plating
+ Reduced heat generation
+ Extended battery life

- Complex control system
- Efficiency concerns

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Conclusion

Conclusion and perspectives

Conclusion

- Each study needs a different model
- Multi-level models are organised using EMR
- Charging and storage subsystems are modeled

Perspectives

- Analyze the different charging strategies for several EVs
  - Nissan Leaf, thesis (S. Revankar)
  - Jaguar I Pace, masters project (B. Catrice, G. Houedanou, B. Makosso Pambou)
- Suggest an optimized strategy by considering
  - Battery ageing, thesis (A. Ndiaye)
  - Vehicle preconditioning (D. Ramsey)

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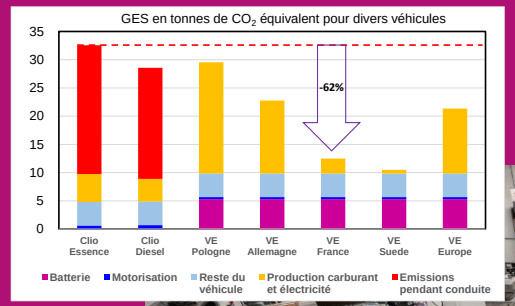

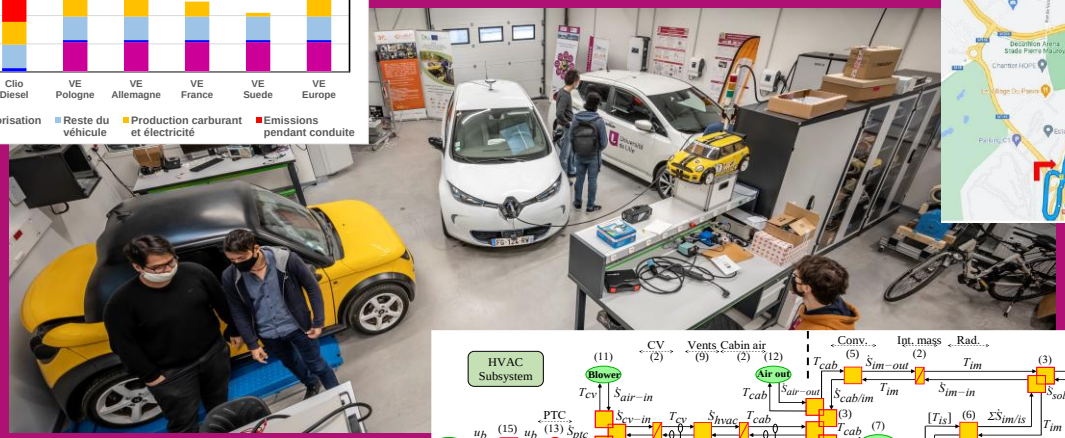

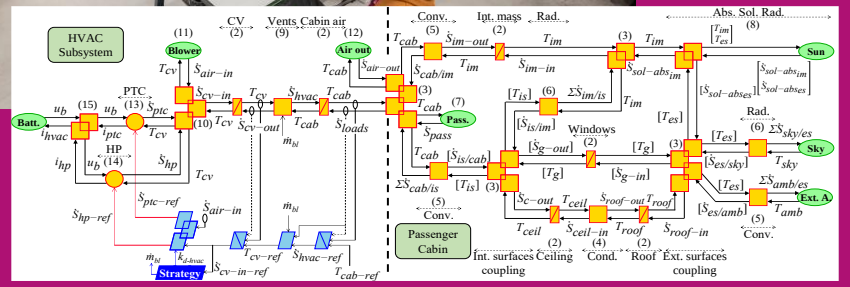

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