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# Assessment of Public Off-Grid Solar Charging System for E-Bikes

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# Outline



**Public Off-Grid charging system overview**



**Data set & Backward model**



**Result of simulations for specific scenario**



**Discussions and perspectives**



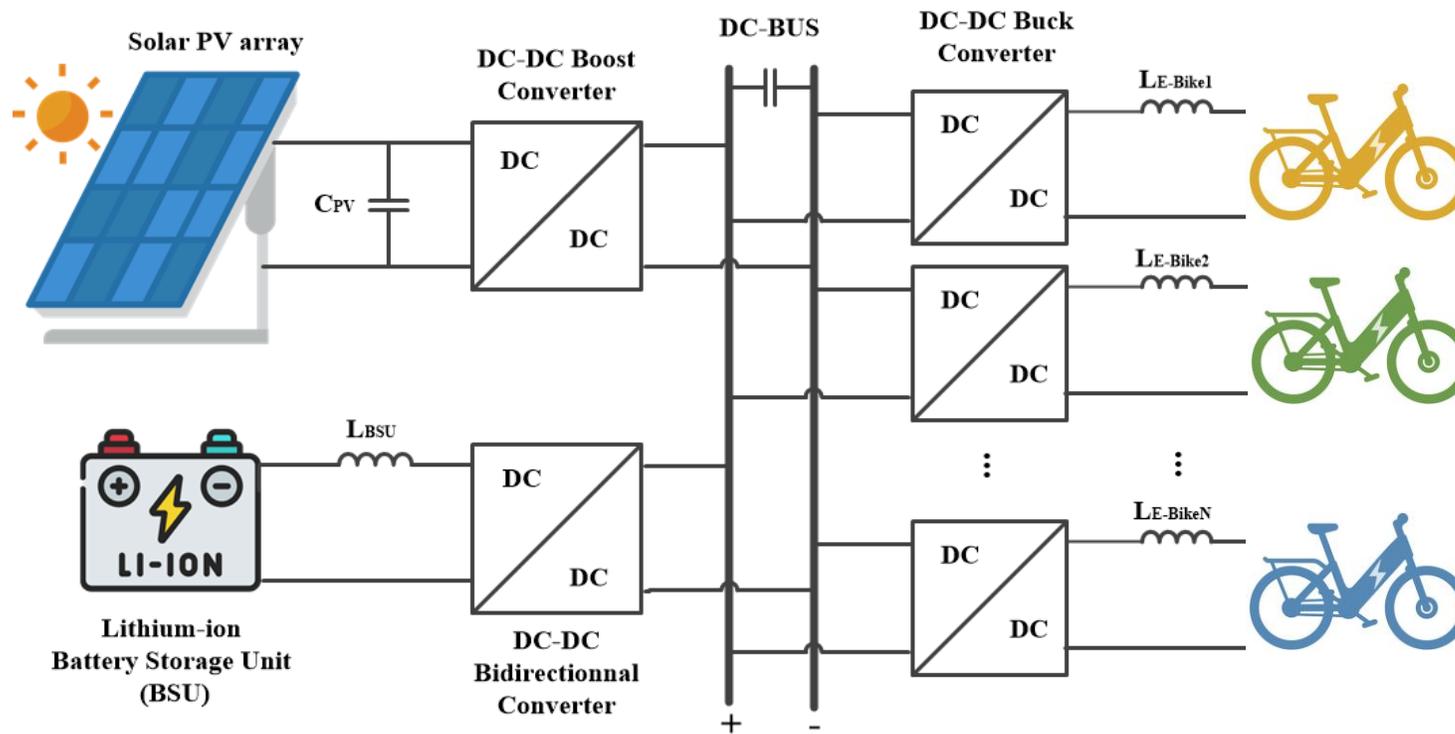
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# Public Off-Grid Charging System Overview

# Public Off-Grid charging system specifications

## System overview and specifications



Pv panel parameters	Specifications
Type	Monocrystalline PERC
Efficiency	22%
Rated power $P_{max}$ (W)	410
Panel area (m <sup>2</sup> )	1.9
Operating voltage (V)	40
Current at MPP (A)	10.2

Battery storage parameters	Specifications
Type	Lithium Iron Phosphate
Nominal voltage (V)	48
Nominal capacity (Ah)	100
Current of discharge (A)	100
Operational Temperature (°C)	-10/ 50
Wight (Kg)	60

E-bikes battery parameters	Specifications
Standard	NF EN 15194/ EPAC
Battery type	Li-ion NMC
Battery capacity (Ah)	14
Nominal power (W)	252
Nominal voltage (V)	36
Charging time (h)	2
Autonomy (km)	40

# Identified scientific challenge

## 1) Problem statement after studies

- **Solar energy (weather variability, variable yield)**
- Temperature (overheating or under-performance)
- Stationary battery (ageing, thermal management, cycling)
- **System autonomy (storage management vs user demand)**
- **Variable recharging demand over time**

## 2) Objectives

- **Study the viability and feasibility of setting up public off-grid charging stations**



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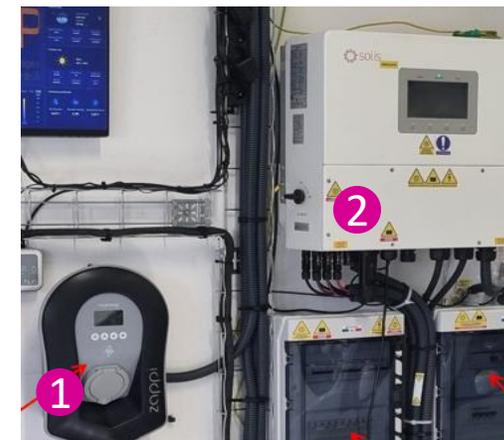
## Data set & Backward model

# Off-Grid charging system specifications

## How to build a consequent data base ?



Exemple of system  
with API interface on eV  
platform



1 - Charging station (myenergi)  
2 - Solis Inveter (solis cloud)

Very easy and quick to build a strong database



Weather server API (Open-meteo)



Ebike server API (velib – Paris)

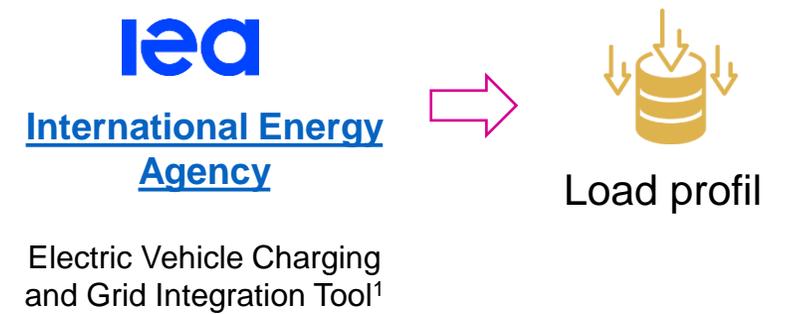
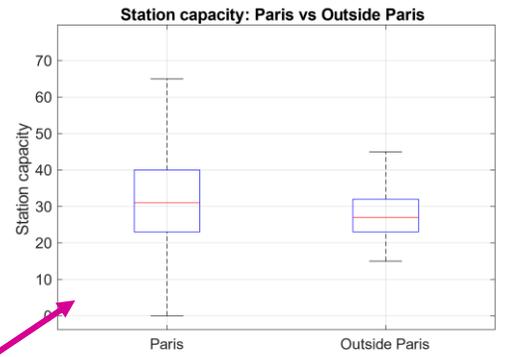
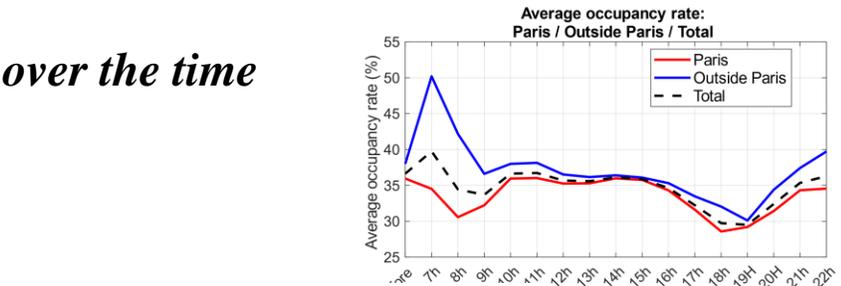
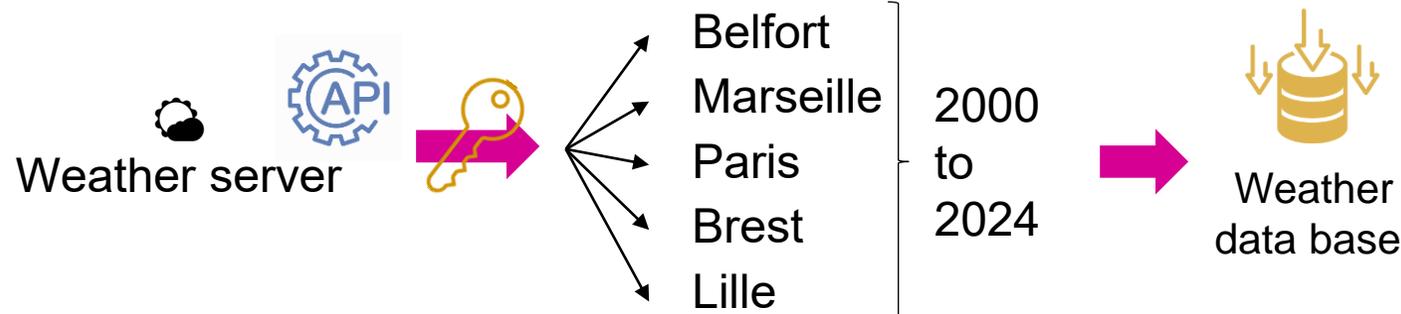
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# Data set build

2 sensible points: *Global Horizon Irradiation (GHI)* and *Charging demande profil over the time*

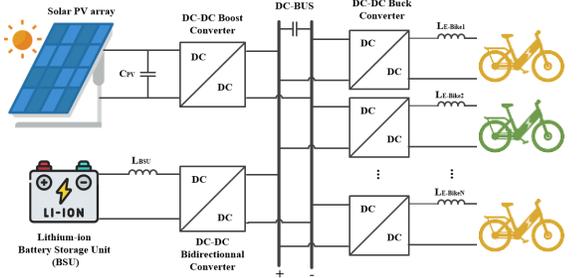
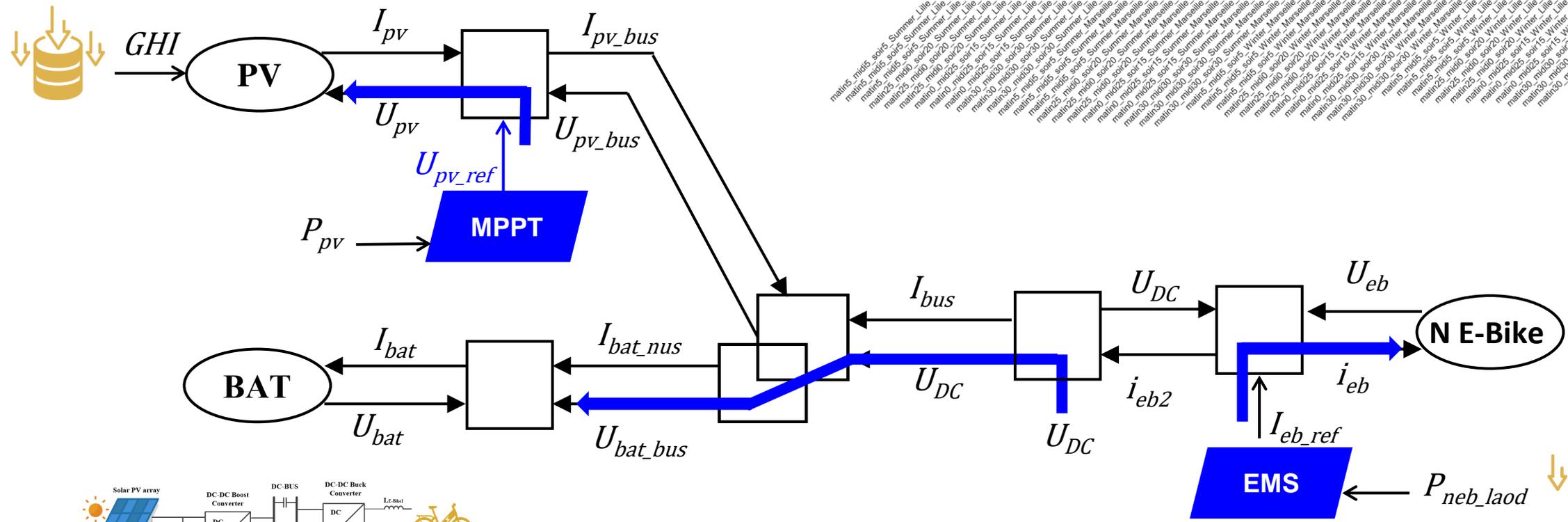
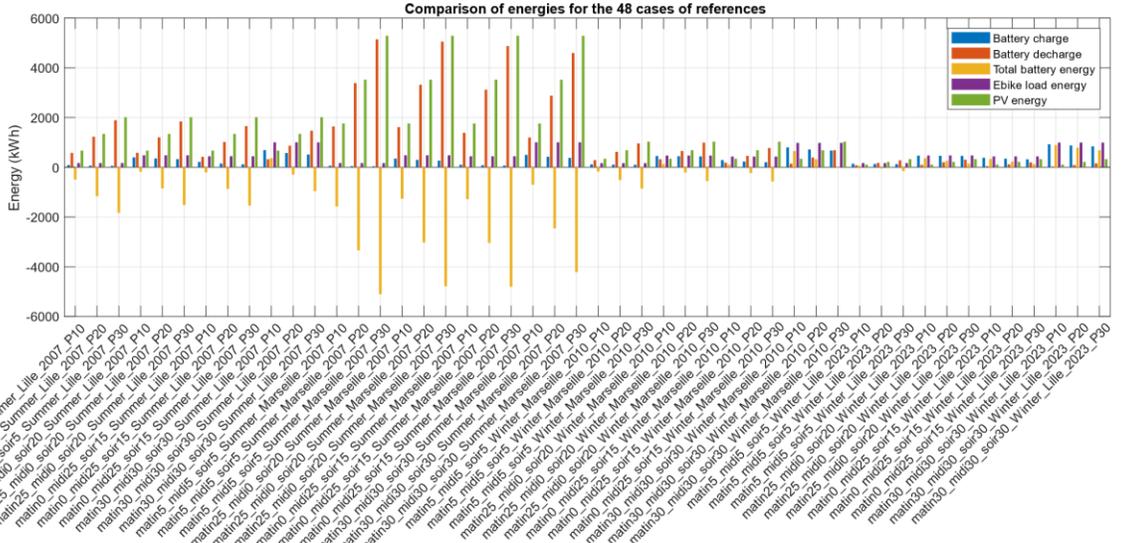


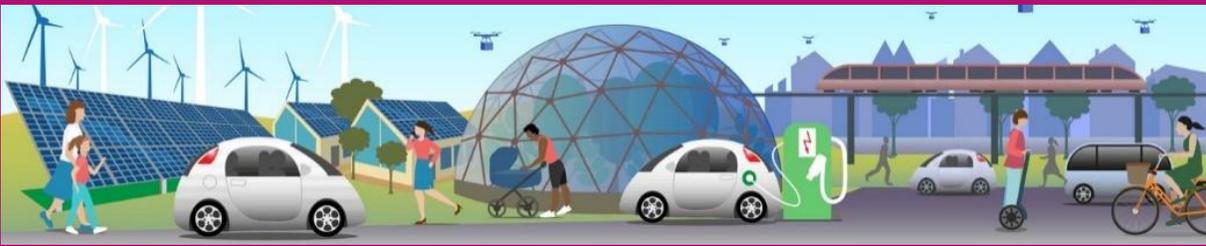
15 552 000 combinaisons → Global data base

<sup>1</sup>GEF-7 Global Program to Support Countries in the Shift to Electric Mobility

# Backward approach

Simple model for rapid simulations with a high number of combinations over a long period





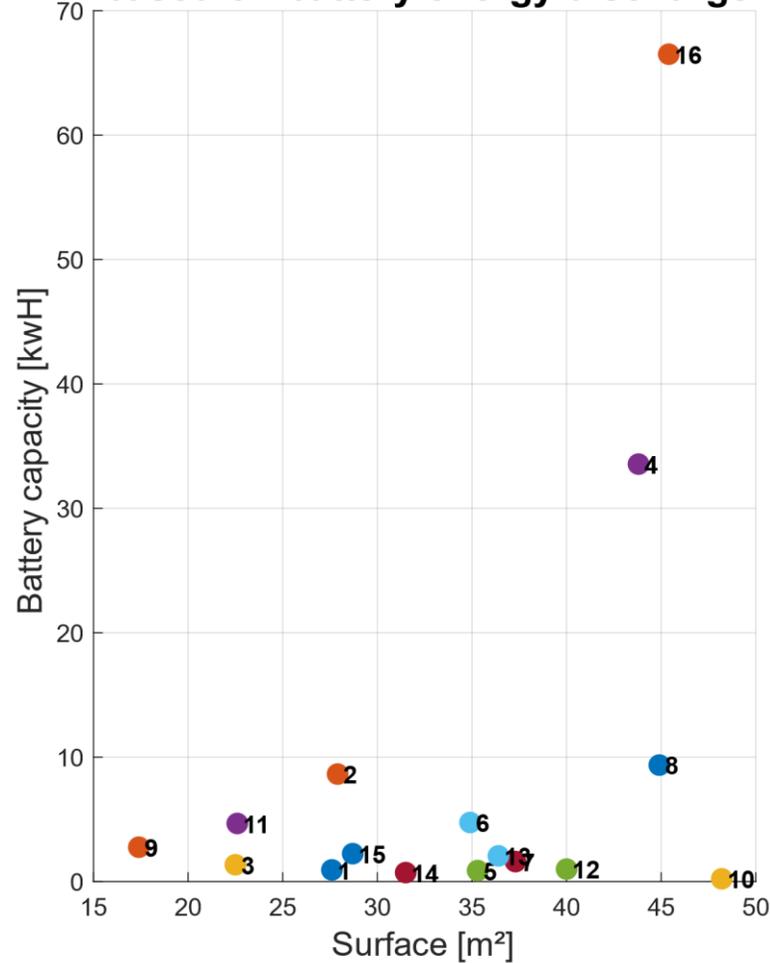
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# Result of simulations for specific scenario

# Global results : Based on optimization

Optimization of the surface area based on battery energy discharge



- 1: Lille Summer 2007 Load scenario 1
- 2: Lille Summer 2007 Load scenario 2
- 3: Lille Summer 2007 Load scenario 3
- 4: Lille Summer 2007 Load scenario 4
- 5: Marseille Summer 2007 Load scenario 1
- 6: Marseille Summer 2007 Load scenario 2
- 7: Marseille Summer 2007 Load scenario 3
- 8: Marseille Summer 2007 Load scenario 4
- 9: Marseille Winter 2010 Load scenario 1
- 10: Marseille Winter 2010 Load scenario 2
- 11: Marseille Winter 2010 Load scenario 3
- 12: Marseille Winter 2010 Load scenario 4
- 13: Lille Winter 2023 Load scenario 1
- 14: Lille Winter 2023 Load scenario 2
- 15: Lille Winter 2023 Load scenario 3
- 16: Lille Winter 2023 Load scenario 4



**No trends for the solution about sizing process.**

**System depend have strong dependence at :**

- **Solar Irradiance**
- **Load profile over the time**
- **Battery capacity to assume charge**
- **Same oversizing PV or Battery is not soconciacious**



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# Global results : Based on specific cases

Based line scenario;

S1; M5\_A5\_E5 : Low demand

S2; M25\_A0\_E20 : Medium demand

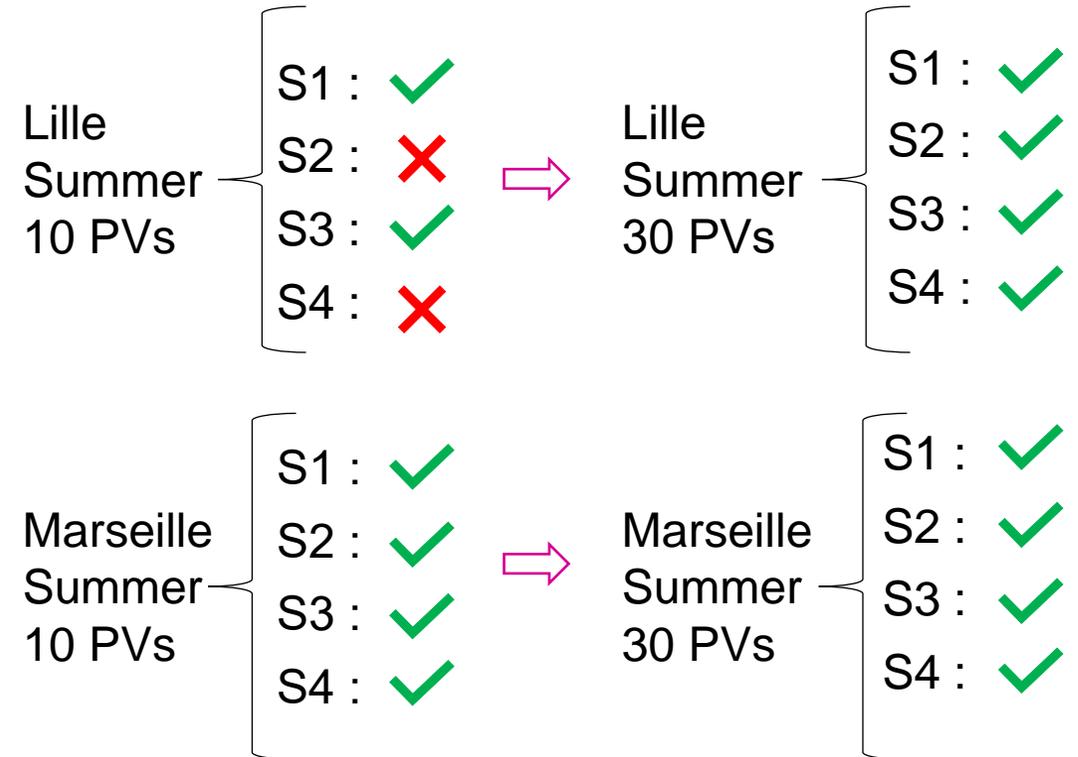
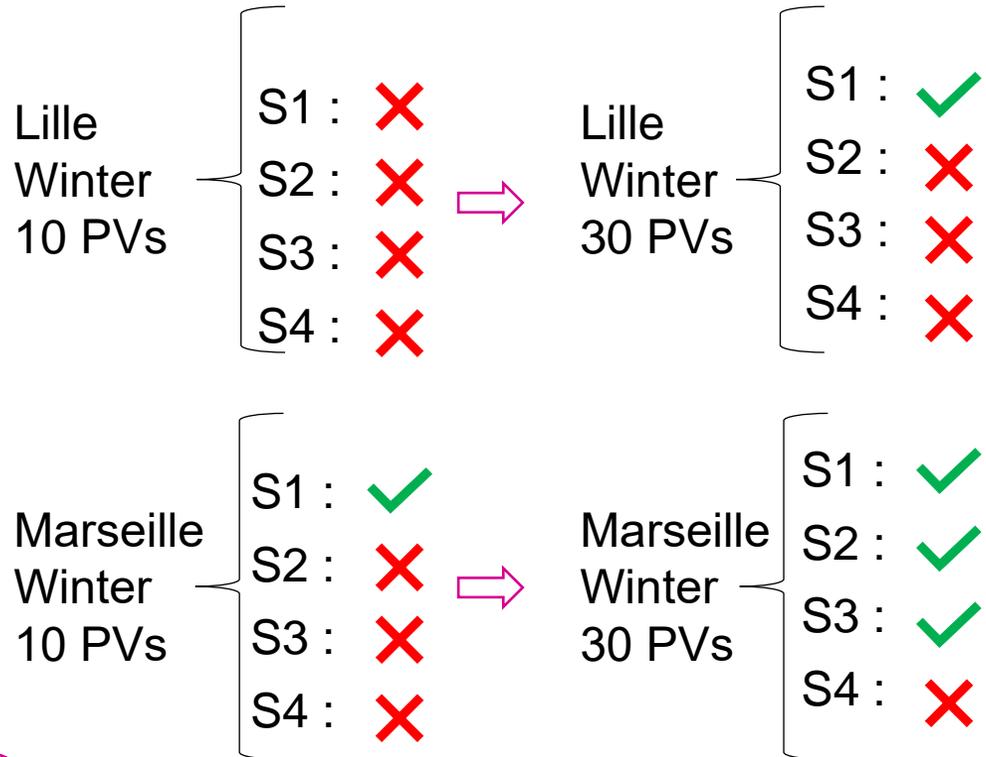
S3; M0\_A25\_E15 : Medium demand

S4; M30\_A30\_E30 : High demand



Evaluation criteria:

- Energy balance (production vs. load)
- Battery performance (ability to operate autonomously)





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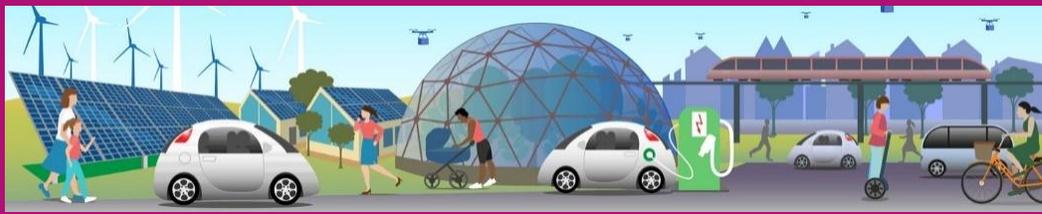
# Discussions and perspectives

# Conclusion

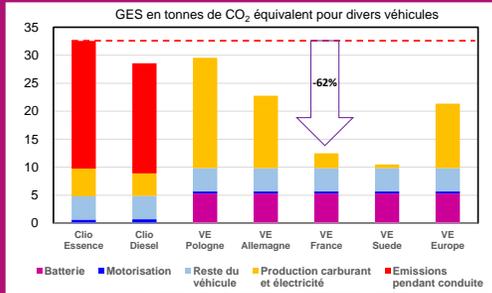
- Off-grid station has major limitations due to reduced sunlight and seasonal variability
- Energy production is too unstable to consistently meet demand in case of public station
- In sunnier locations like Marseille, these systems can be more effective
- Require large panel surfaces in winter and may lead to energy overproduction in summer
- Adding a flexible third energy source or improved battery storage could improve reliability
- Future research should focus on hybrid systems and advanced energy storage solutions

# Perspective

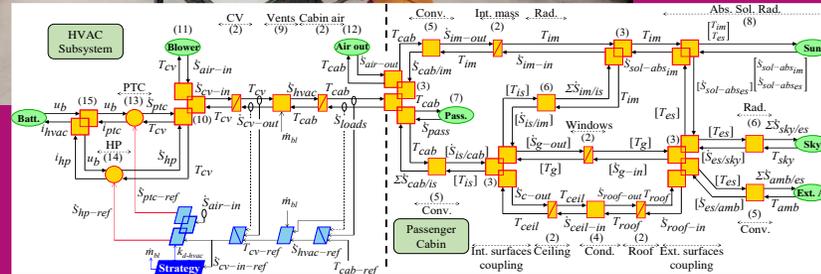
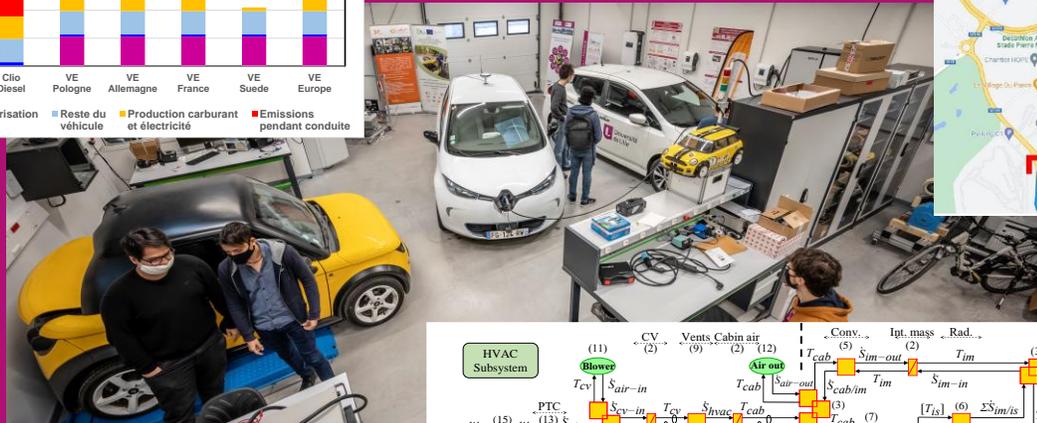
- ACV studies of off grid station
- Define clear rules about viability of this kind on installation



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# - Off-Grid charging system: Structural scheme of Ebikes charging system-

## Structural scheme of the PV charging station

