POLITECNICO MILANO 1863

DIPARTIMENTO DI ENERGIA

MG² MultiGood MicroGrid Lab

MOST CENTRO NAZIONALE PER LA MOBILITÀ SOSTENIBILE

MG2Lab Experimental Campaign

From 13/10/2023 to 19/10/2023

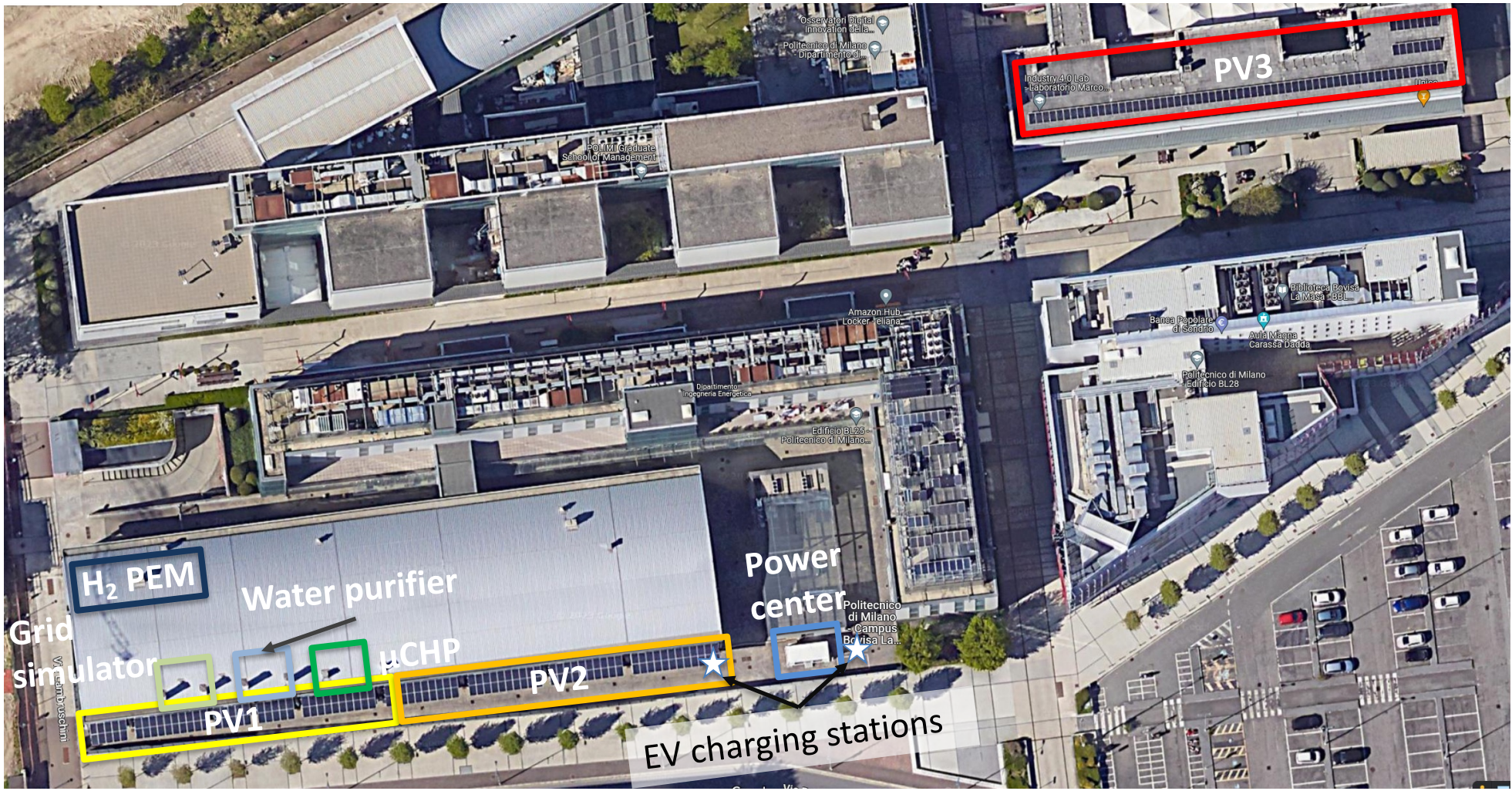
Centro Nazionale Mobilità Sostenibile
Spoke 13 – TASK 2.4

Department of Energy
Via Lambruschini, 4A
20156 Milano

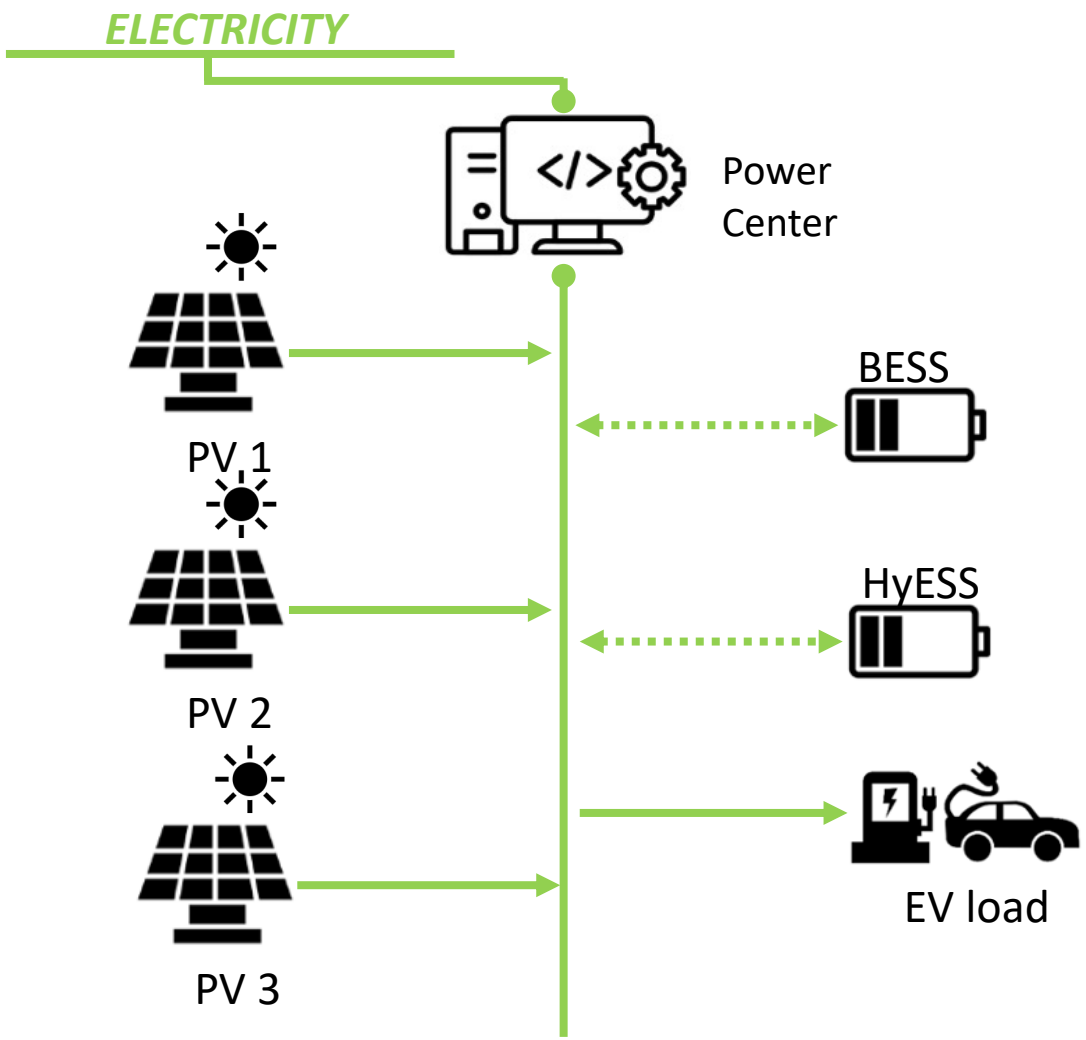
MG2lab – Multigood microgrid experimental facility

Configuration

- Electric power generation capacity: 100 kW
- Thermal power generation capacity: 45 kW
- Potable water production: 1 m^3/h
- PEM electrolyzer 6 Nm^3/h
- Electric storage: 150 kWh
- Hydrogen storage: 30 kWh
- Thermal storage: 50 kWh
- Electric Vehicles (EV): 2
- Electric Bikes: 10



Case study microgrid configuration



Power System (PV + BESS) connected to the National Electricity Grid through a single connection point

Microgrid components

PV fields

- ❑ PV1: 27kW$_{nom}$
- ❑ PV2: 26kW$_{nom}$
- ❑ PV3: 25kW$_{nom}$

Batteries

- ❑ BESS : 70kW$_{peak}$, size 70kWh
- ❑ HyESS: 70kW$_{peak}$, size 70kWh

EV load

- ❑ Data from JPL database

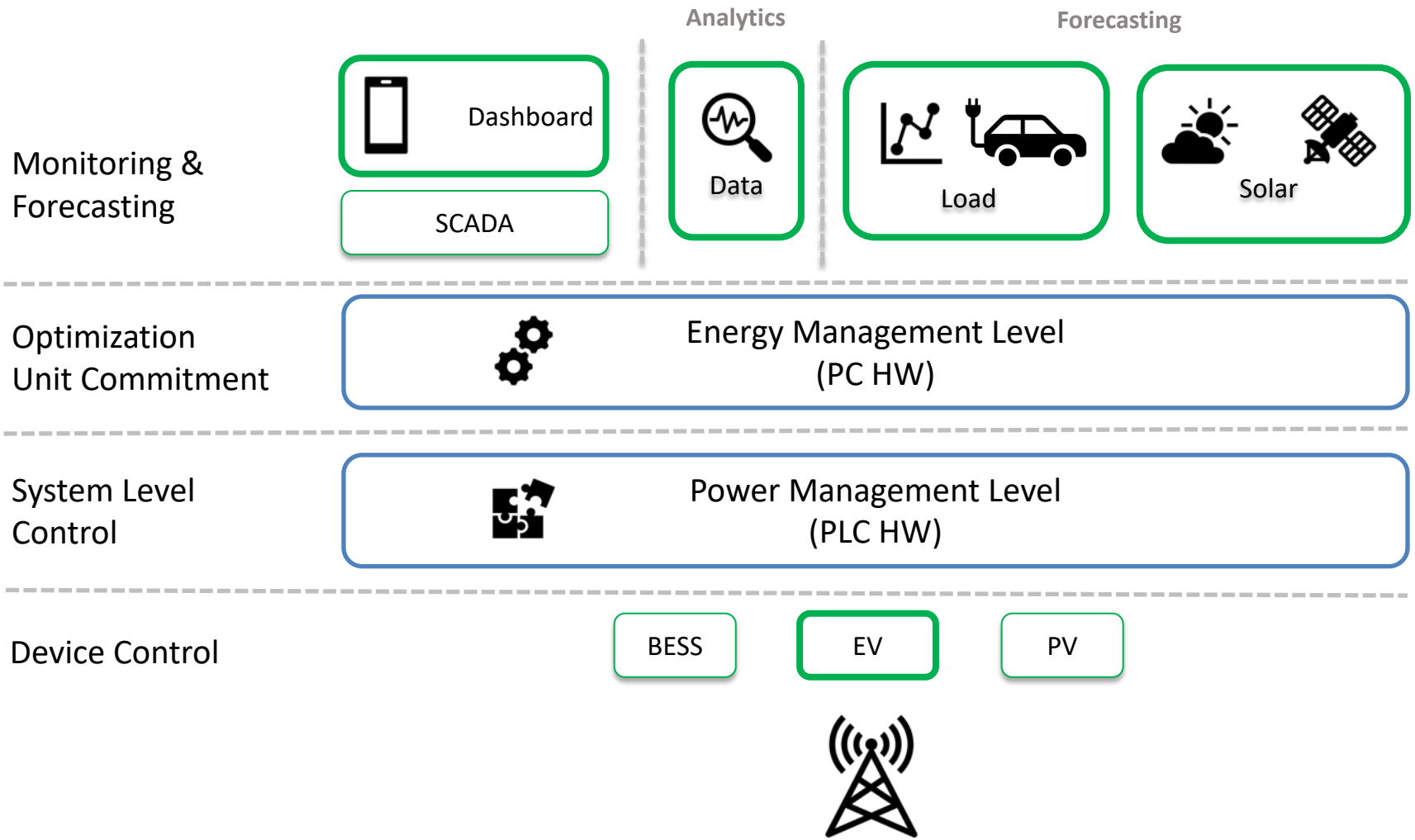
Grid

- ❑ Maximum purchase electricity 40kW

	Module	Technique	Version	Reference
FORECASTER	PV Forecaster	PHANN	v1.0	[1]
	EV Forecaster	LSTM+ persistence	v2.1 v1.0	[2]
OPTIMIZER	1° Layer	Deterministic MILP	v1.0	[3]
	2° Layer	Heuristic Control	v1.2	[4]

[1] *"Robust 24 Hours ahead Forecast in a Microgrid: A Real Case Study"* https://www.mdpi.com/2079-9292/8/12/1434
[2] *"User Behavior Clustering Based Method for EV Charging Forecast"* https://ieeexplore.ieee.org/document/10014991
[3] *"Assessing the impact of a two-layer predictive dispatch algorithm on design and operation of off-grid hybrid microgrids"* https://www.sciencedirect.com/science/article/pii/S0960148119307207?via%3Dihub
[4] *"Numerical and experimental testing of predictive EMS algorithms for PV-BESS residential microgrid"* https://ieeexplore.ieee.org/document/8810548

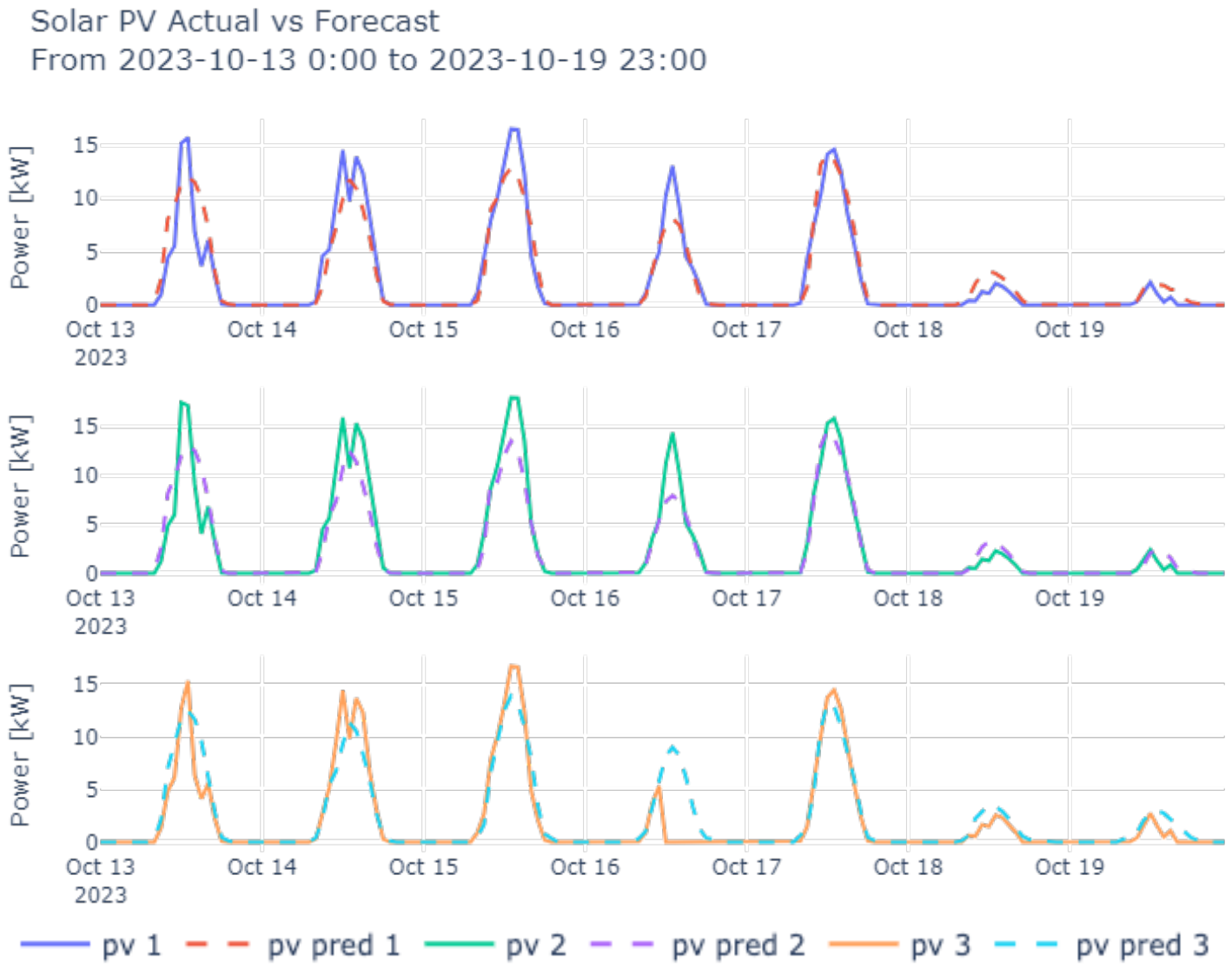
Optimizer focus



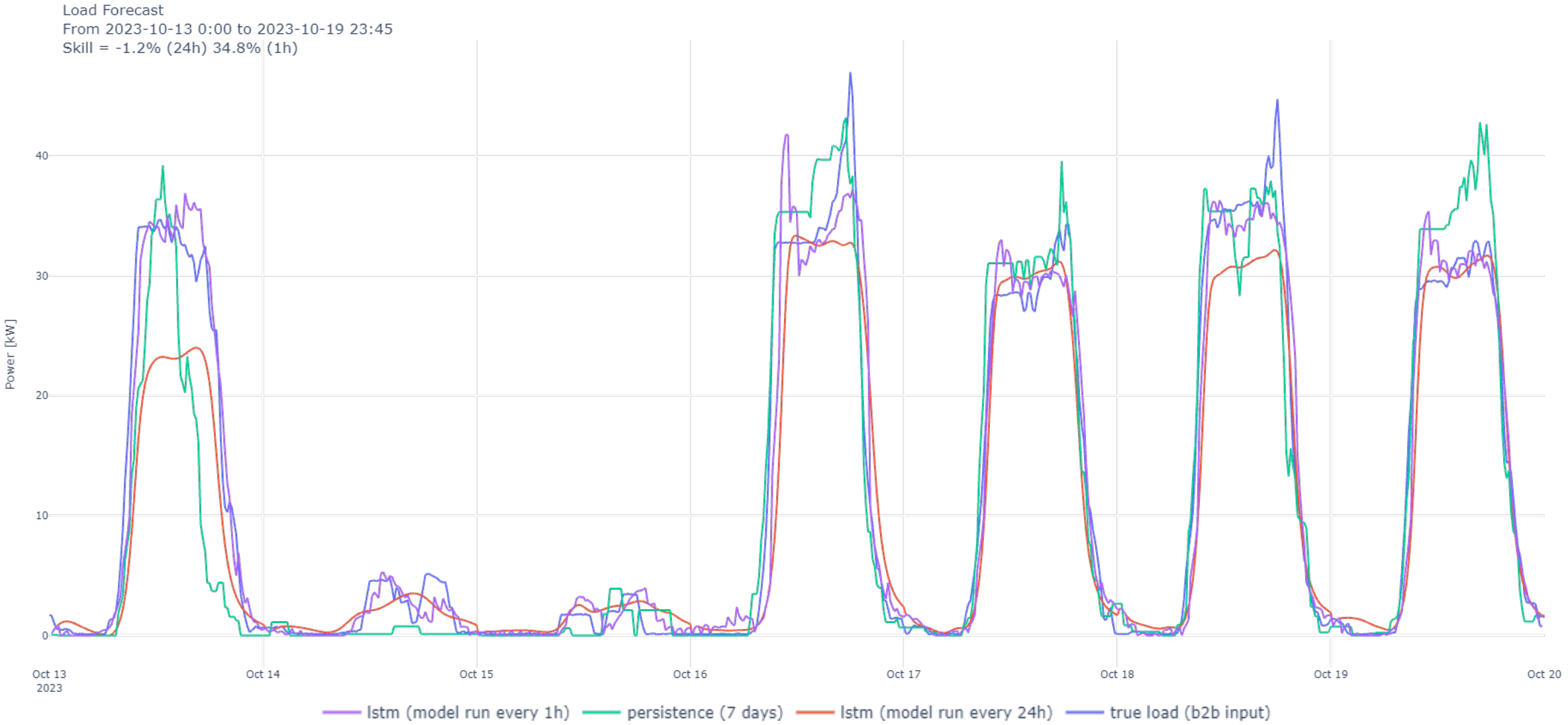
Case Study – Data Features

Data	Components	Reference
PV Data	PV1, PV2, PV3	MG2Lab Measurements
EV Data	B2B	JPL Dataset
Simulation Outcomes	/	Result's folder

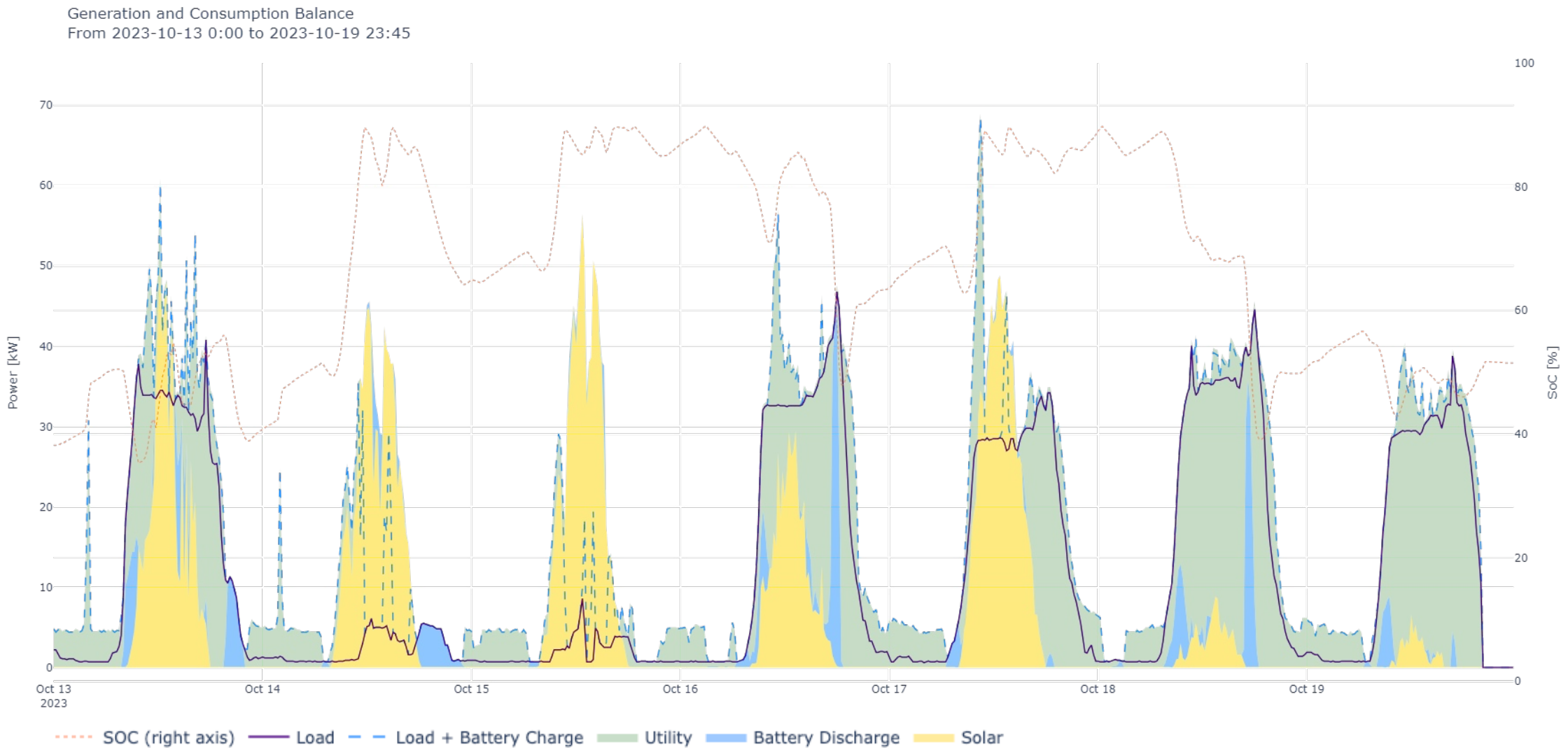
Simulation Outcomes – PV forecasting performance



Simulation Outcomes – EV forecasting performance



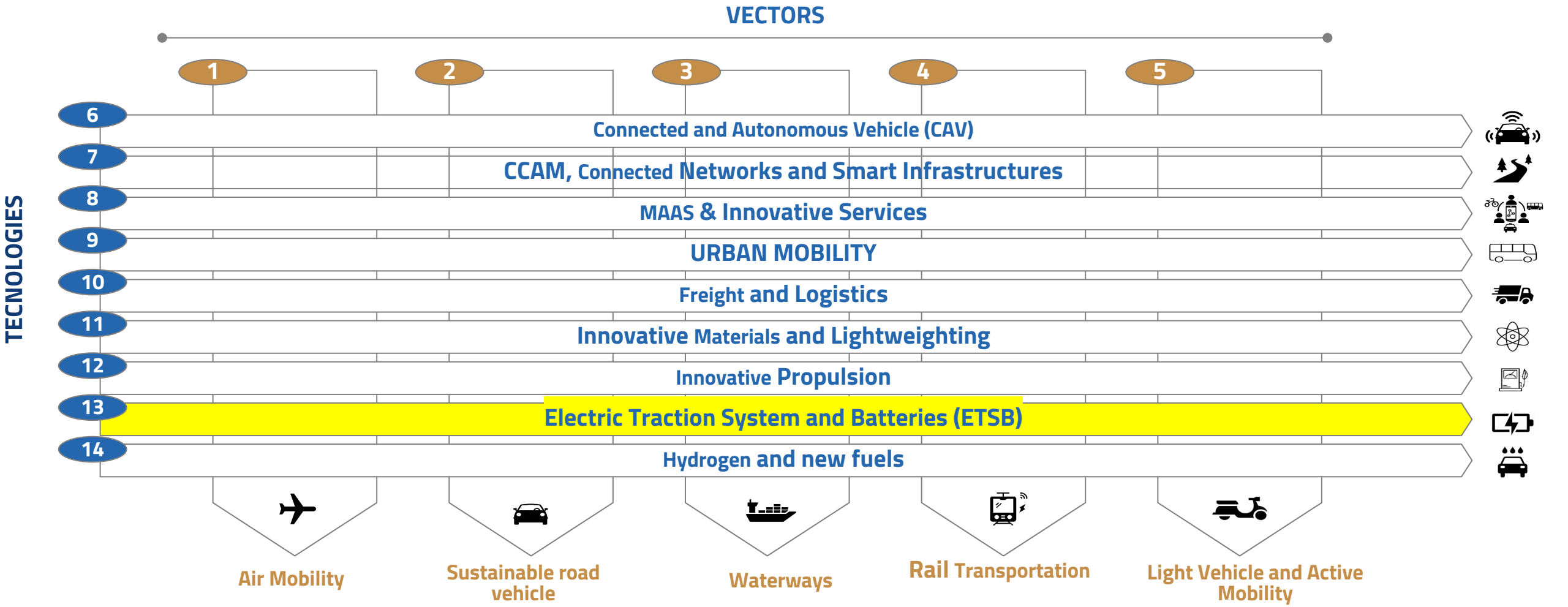
Simulation Outcomes – EMS Optimization Results – Scheduling example



Highlights

- The experimental campaign has been performed **without** any malfunctioning
- **PV Forecaster's** performances are good and quite consistent over the entire week of experiments
- Three **EV Forecaster based** on the LSTM+ tested: a persistence model (with seasonality = 7days), an LSTM+ model ran every 24 hours, an LSTM+ model ran every hour
- The LSTM+ model ran every hour shows the best performance in predicting the peaks and the changes in the load in both workdays and during the weekends. During this week also persistence models show acceptable performances only during workdays, when the load profile is more predictable
- The EMS rightly exploits PV and EV forecasts to anticipates the change in the load and minimizes the overall operational costs

www.MG2lab.polimi.it



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PNRR Total fund: around 200 MEuros

25 Universities and Research Centers

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SPECIAL AKNOWLEDGEMENT

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