

BD4OPEM H2020: A step forward towards grids digital twins

Mònica Aragüés Peñalba

ORGANIZED BY:



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Accurate digitalised model of the physical (real) grid that adapts itself to actual state and operating conditions (real time).

Potential of digital twin technology in power systems

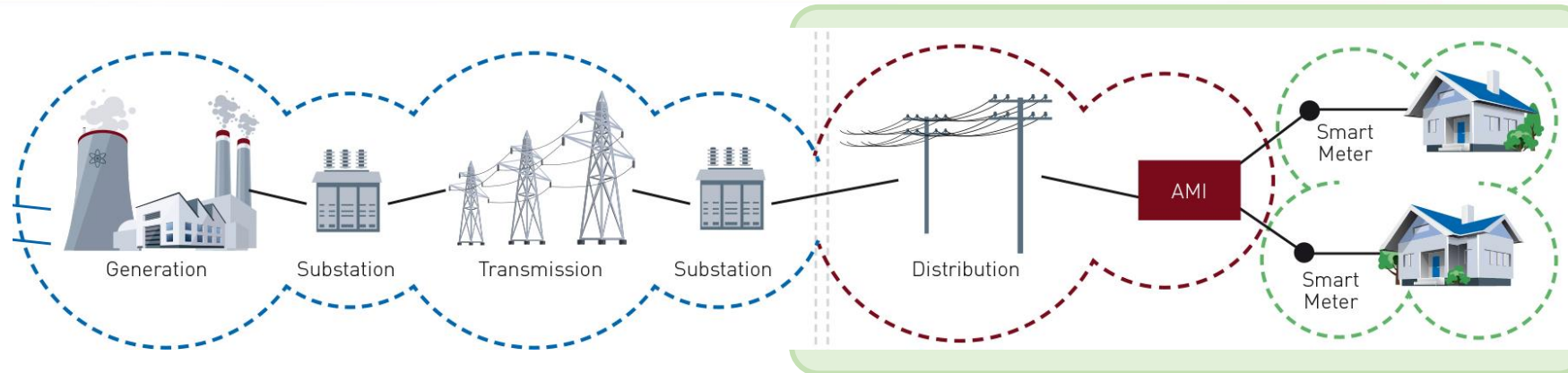
- System state observability, efficiency improvement, asset management enhancement
- Able to replicate a system and predict its future

As grids become more decentralized operating near their operational limits, this potential becomes even more significant

Challenges

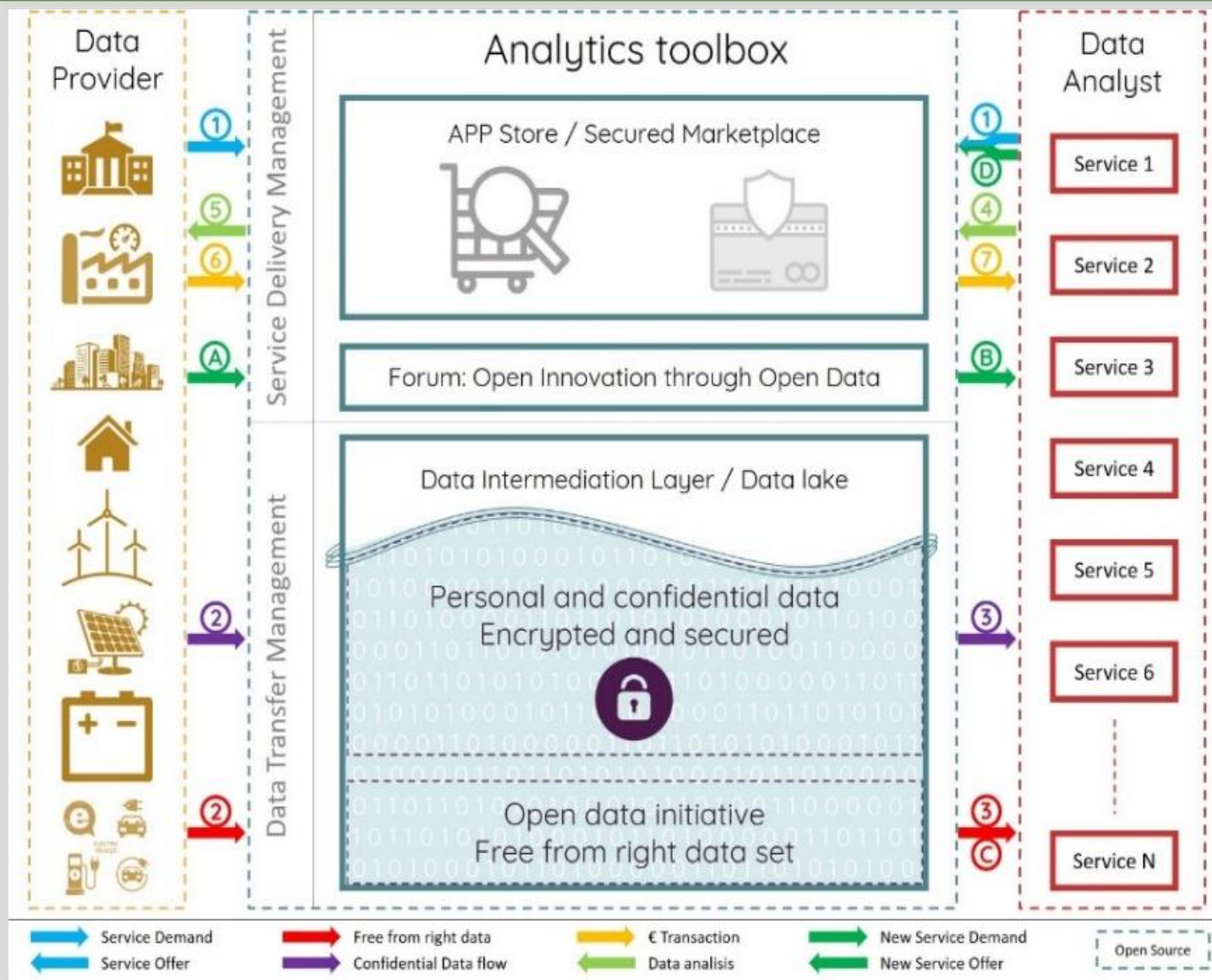
modeling, data management, storage, computational requirements, and scalability

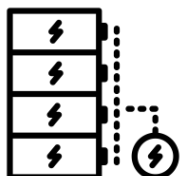
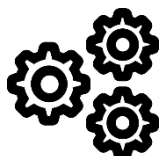
The smart meter is at the heart of the transformation of the electricity grid into a **smart grid**.



micro vs MEGA: trends influencing the development of the power system. Source: ISGAN

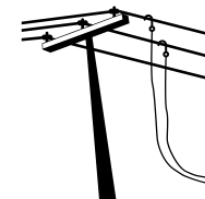
- Smart meters go beyond traditional meters
 - provide detailed information on consumption (≤ 1 h basis) and enable billing at different tariffs
 - permit simultaneous management of purchase and sale contracts
 - more knowledge about the grid status (improves its performance and the quality of service)
- Information provided near real time
- Data collected is empowering the use of digital technologies: data-driven enabled services
- **Digital twins would enable the on-line execution of these services**





Category	Service in BD4OPEM
Operation and Maintenance	S1.1 Topology
	S1.2 Observability
	S1.3 Predictive maintenance in electrical power systems
	S2.1 Measurement errors detection
	S3.1 Grid disturbance simulations
	S3.2 Impact study PV, EV & new loads
Fraud Detection	S4.1 Inconsistences in energy balance and power-voltage
	S4.2 Fraud patterns detection
Flexibility and Demand Response	S5.1 Flexibility Forecast
	S5.2 Flexibility aggregated services for BRPs
	S5.3 Flexibility aggregated services for DSOs
	S5.4 EV to Grid
Smart houses, buildings and industries	S6.1 Energy management at household or at community level
	S6.2 Demand estimation
Trading	S7.1 P2P trading
Planning	S8.1 Asset and investment planning
	S8.2 Asset estimation optimization for microgrids
Monitoring	S9.1 Grid KPIs

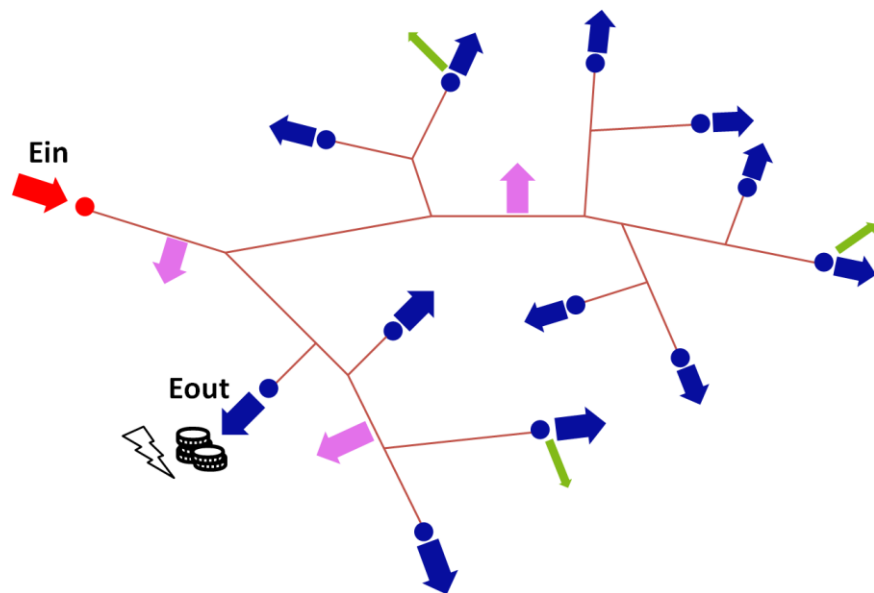
grid digital twin



Errors detection



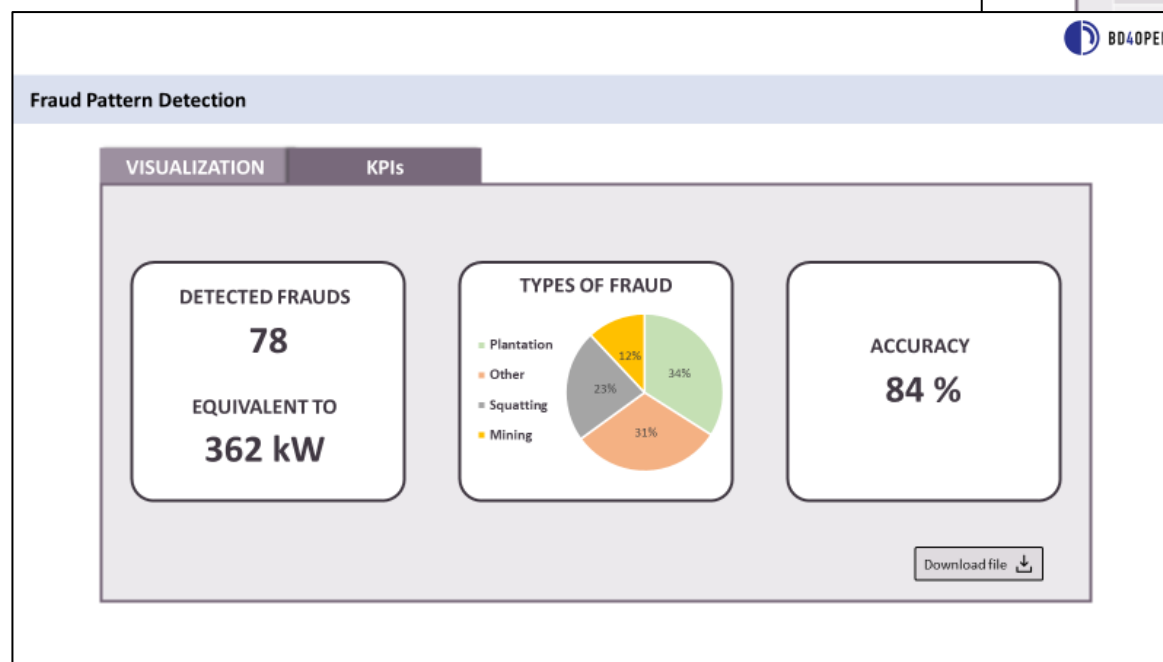
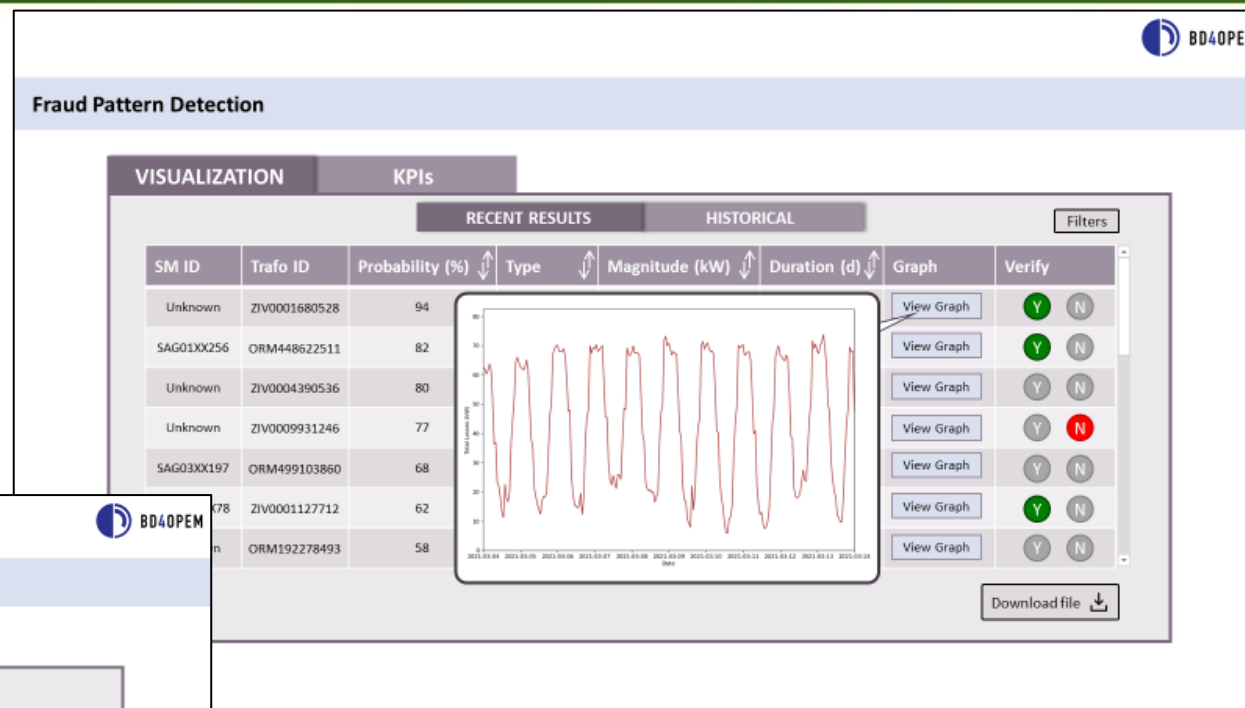
- Meter measuring energy entering the grid
- Meters measuring energy consumed



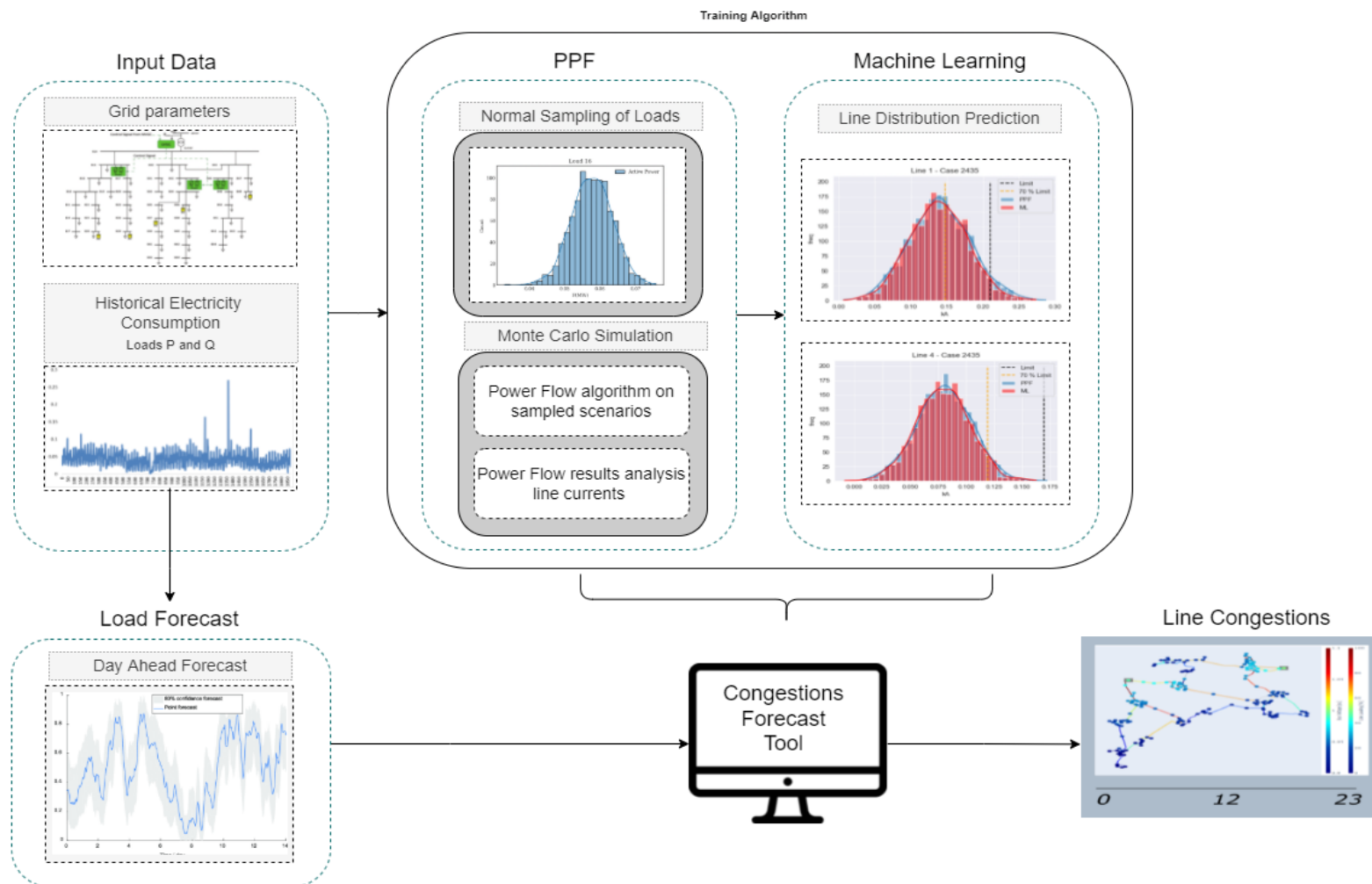
NTL (Non-technical losses): Network equipment issues, network information issues and energy data processing issues

Fraud patterns detection

provides information on detected frauds to optimize field inspections



congestion scenarios for the day-ahead operation planning. The output of this service contains information such as location and time of a possible congestion in the grid.



day ahead forecasting for inflexible and flexible electrical assets (PV generation, building consumption, EVs, HVAC...)

FORECASTING Dashboard

Predictions

KPIs

Start date

End date

Frequency

2021/05/09

2021/05/21

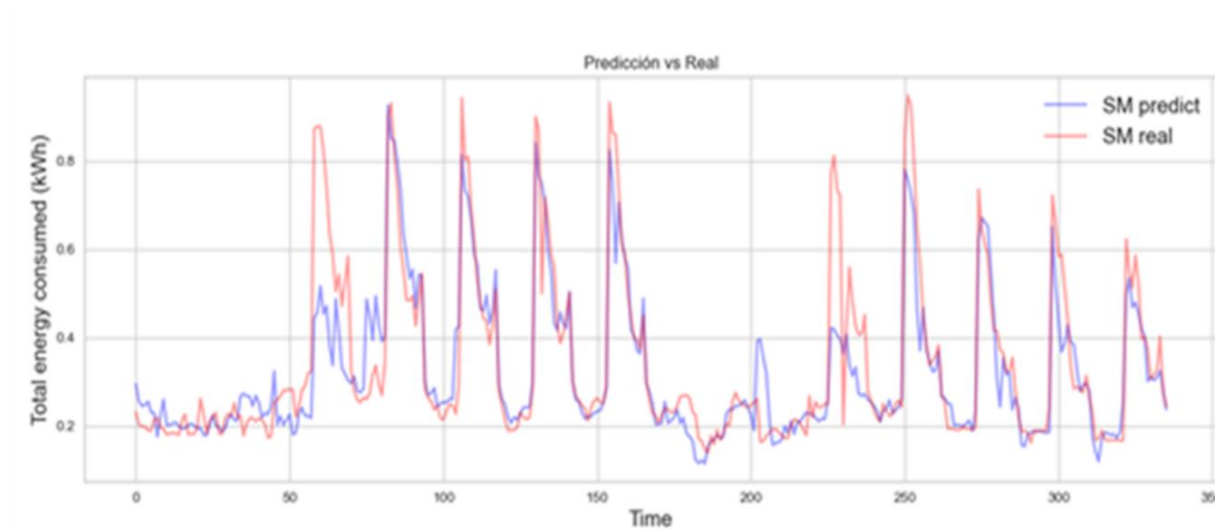
hourly

☒ hourly

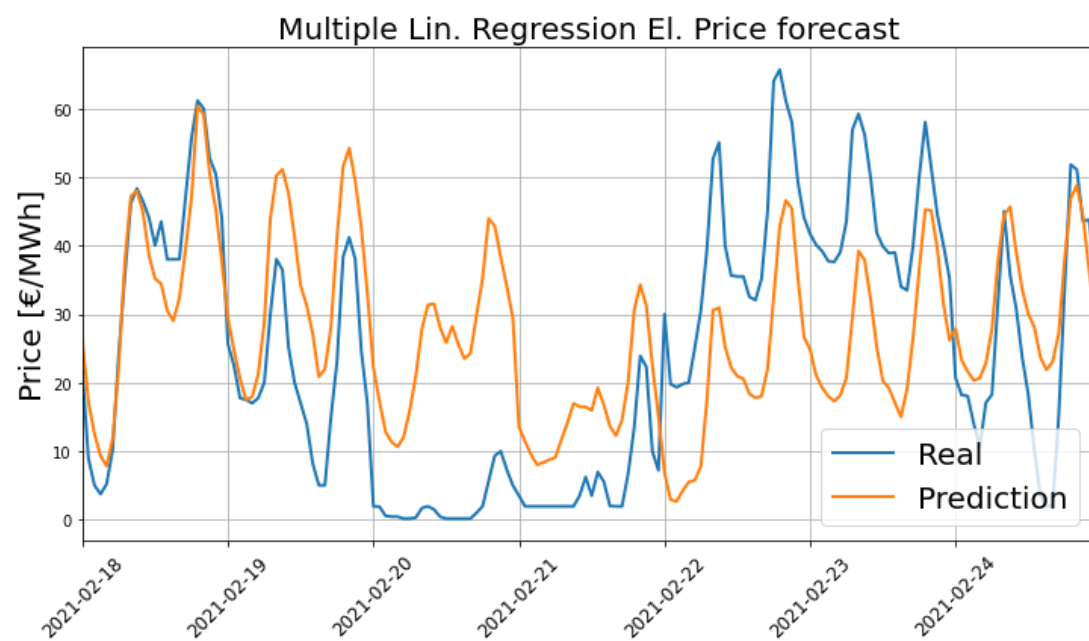
☐ daily

☐ weekly

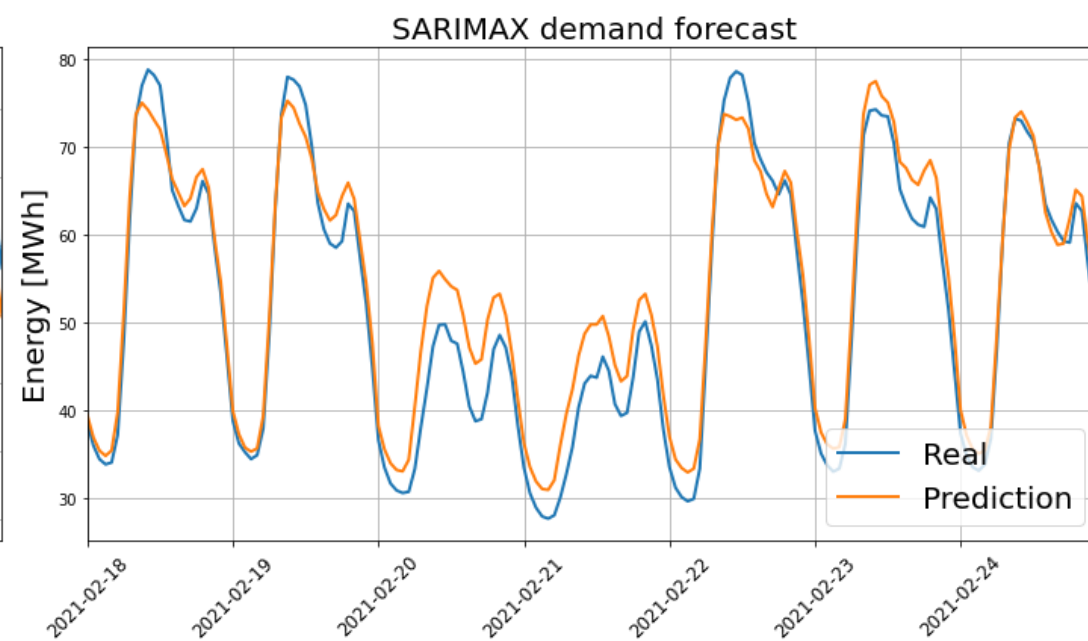
Building consumption



From 18/02/2021 to 24/02/2021

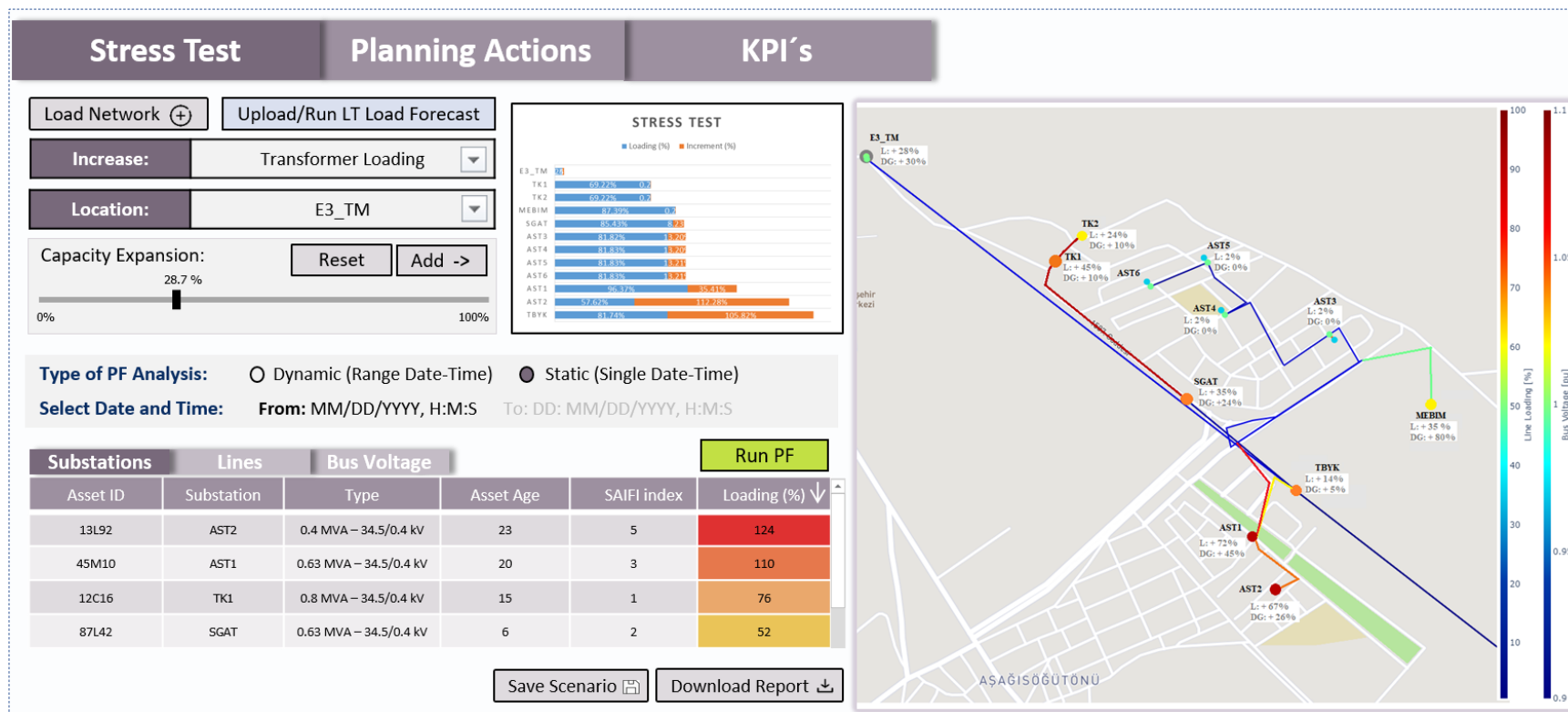


MAE	RMSE	R^2
2.24	14.19	0.33



MAE	RMSE	R^2
2.22	3.57	0.95

optimal planning actions for long term scenarios, aiming to minimize the asset investment costs for DSOs using traditional and flexible planning strategies.

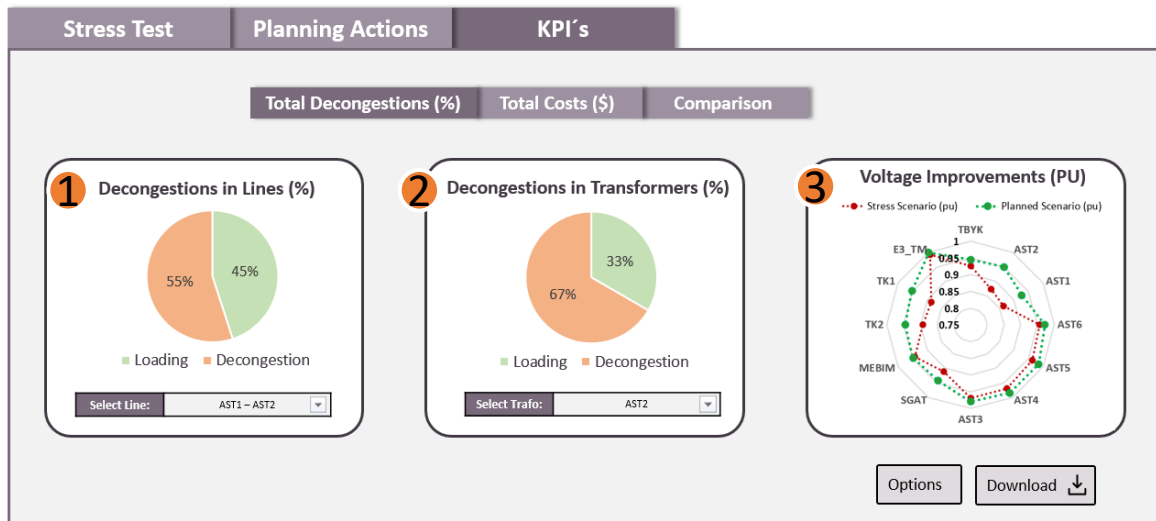


Power Flows:

- Python (PandaPower)
- QGIS (Coordinate)

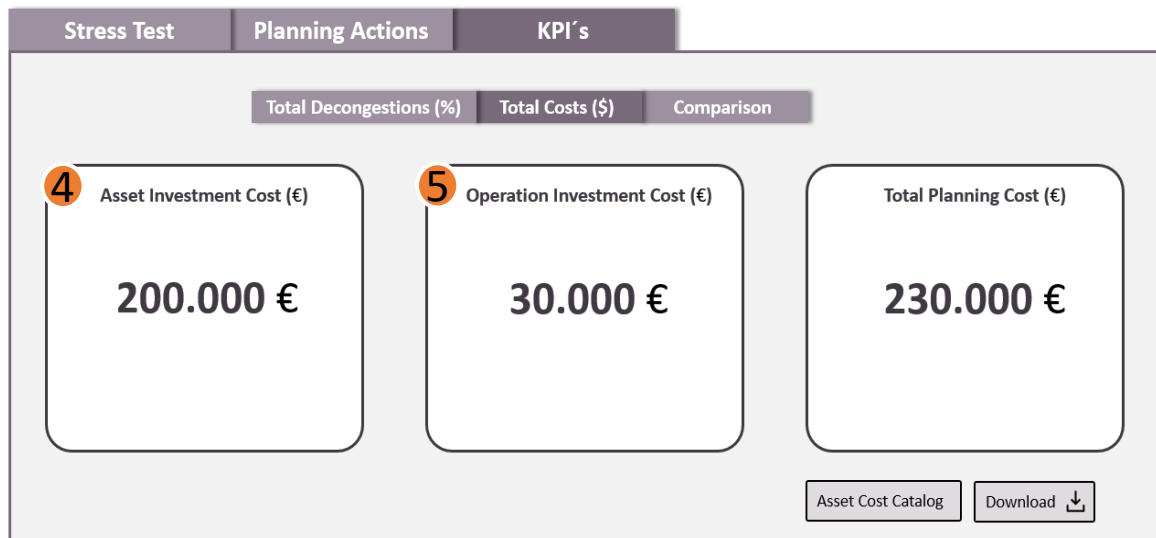
Outputs:

- Line Congestions
- Transformer Congestions



Optimal Planning Actions

1. Traditional Planning (Asset Replacement)
2. Flexible Planning Solutions (optimal battery –capacity, power, location-)
3. Hybrid Solutions



KPIs

1. Line Decongestion %
2. Transformer Decongestion %
3. Bus Voltage Improvements (pu)
4. Asset Investment Costs
5. Operation Investment Costs



ESTEBANELL
SPAIN



ELEKTRO CELJE
SLOVENIA



OEDAS
TURKEY



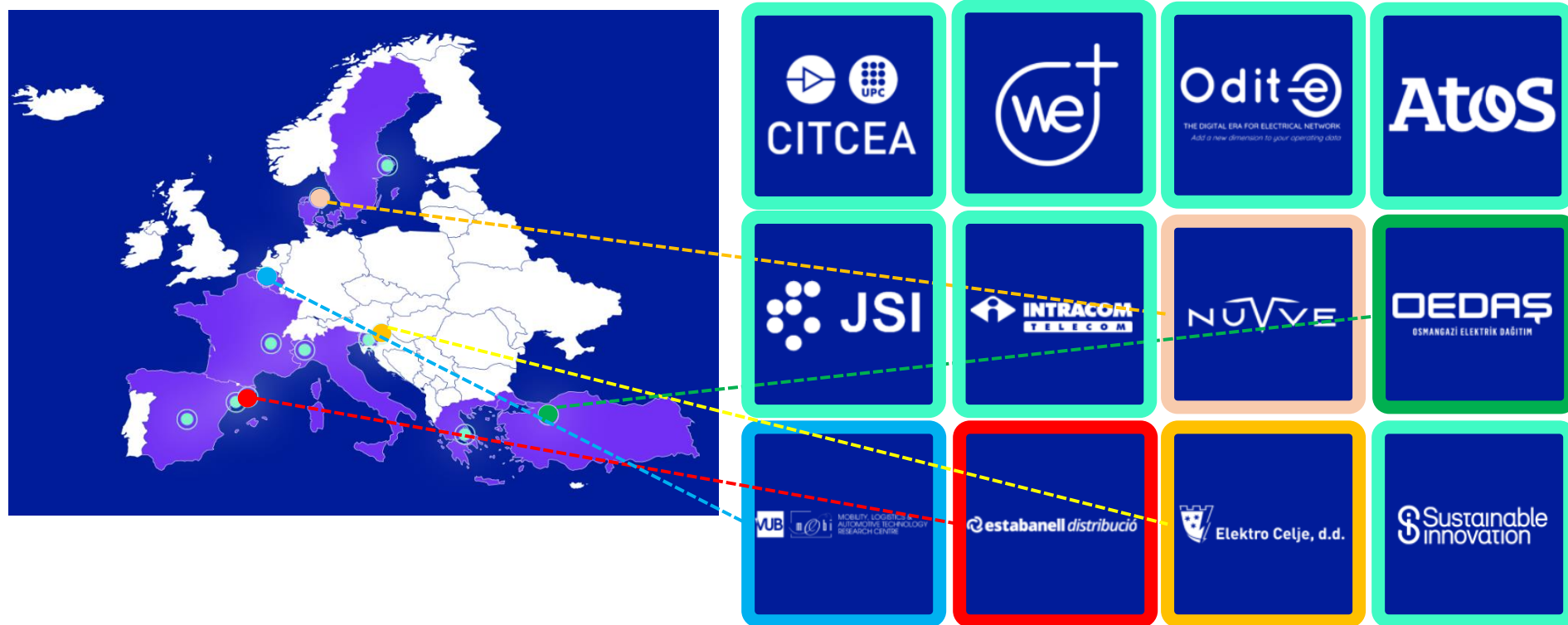
VRIJE UNIVERSITEIT
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DENMARK

BD4OPEM consortium

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BIG DATA FOR INNOVATIVE OPEN ENERGY SOLUTIONS



Mònica Aragüés Peñalba
monica.aragues@upc.edu



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