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CHIST-ERA Projects Seminar 2022

Topic Call 2019 CES

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29th March 2022

ULB



UCD
ENERGY
INSTITUTE



Programme co-funded by the
EUROPEAN UNION



Introduction: Projects of the Topic

Supporting Energy Communities- Operational Research and Energy Analytics (SEC-OREA)

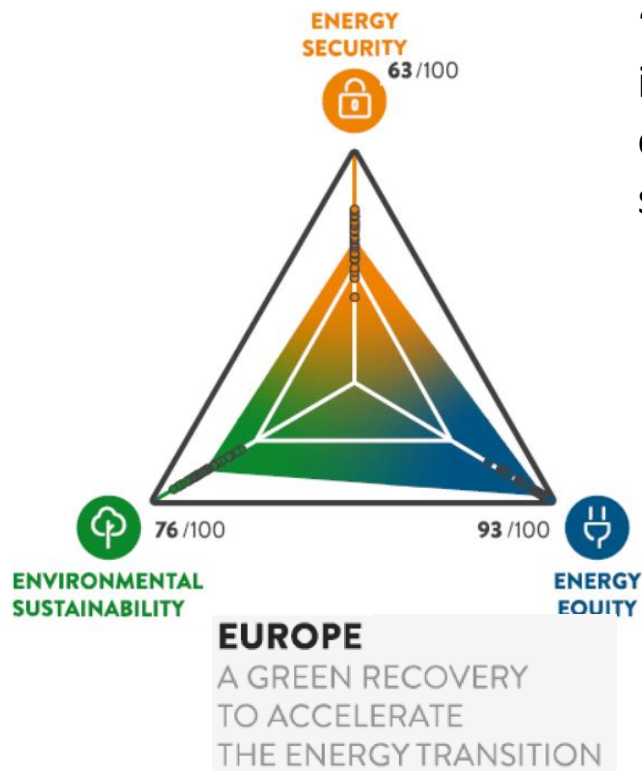
SEC-OREA aims to enable local energy communities (LECs) to participate in the decarbonisation of the energy sector by developing advanced efficient algorithms and analytics technologies.

Focusing on Future Emerging Technology

- ❖ **Developing computationally efficient algorithms for fair solutions to the multilateral community energy economic dispatch problem;**
- ❖ **High quality weather forecasts integrated with load demand and renewable energy source forecasts.**

Major Achievements and Outputs

Understanding the Energy Trilemma: The World Energy Trilemma Index is a rating of national energy system performance across three dimensions: Energy Security, Energy Equity and Energy System Environmental Sustainability.



New rules for EU Electricity Market, May 2019:

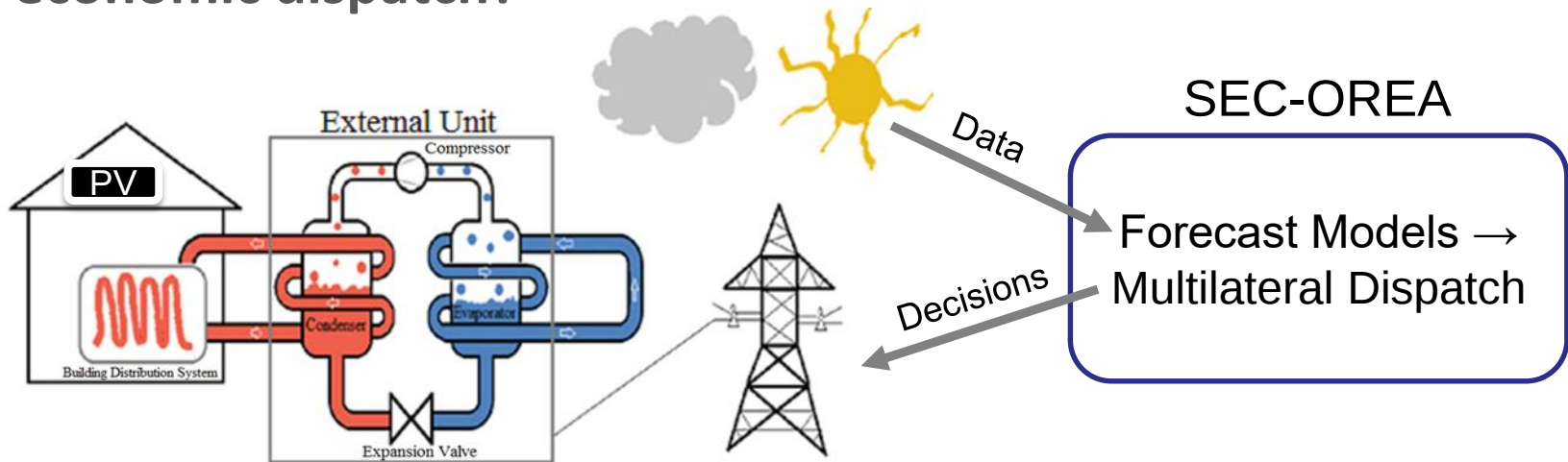
“Consumers will be able to participate actively, individually or through communities, in all markets, either by generating electricity and then consuming, sharing or selling it, or by providing storage services.”

Project commenced 26th April 2021:

- Collaboration Agreements finalised;
- Data Management Plan – with Institutional and Stakeholder support;
- Recruitment completed;
- Kickoff workshop with stakeholders in Nov 2021;
- First deliverables and publications in preparation.

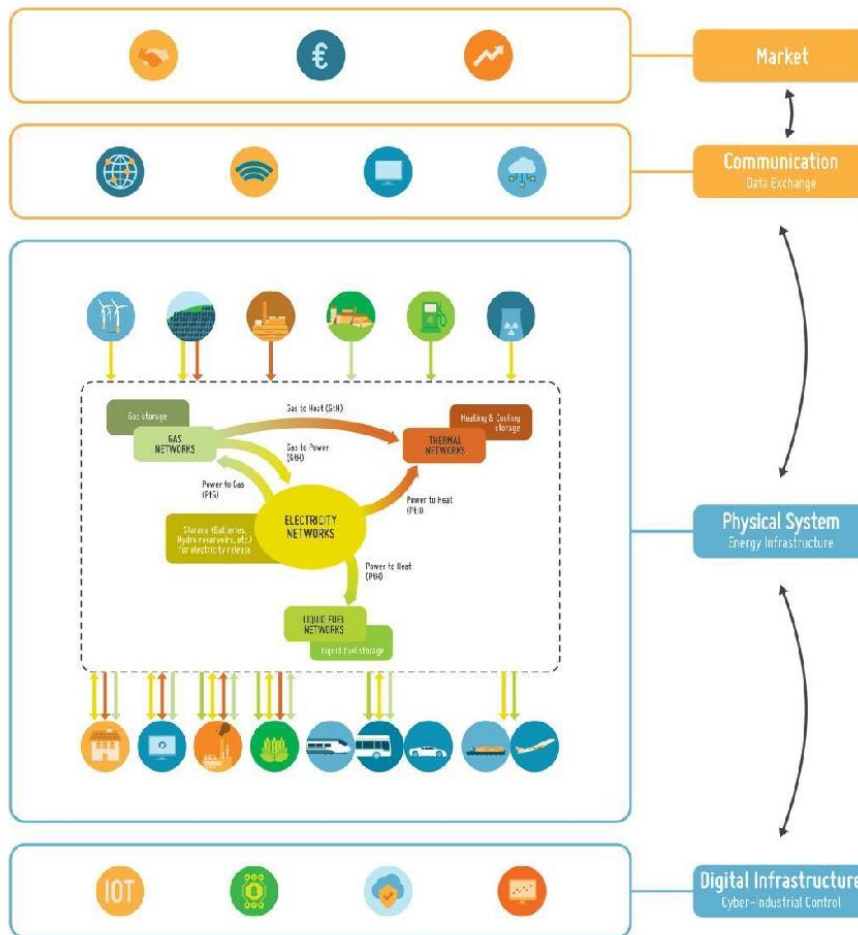
Upcoming Challenges and Needs

The Future and Emerging smart grid needs to be a decarbonised, decentralised, democratised and digitalised system. Given estimated renewable energy generation and estimated demand of the LEC members on an LV network and their resource sharing preferences, what is the optimal multilateral economic dispatch?

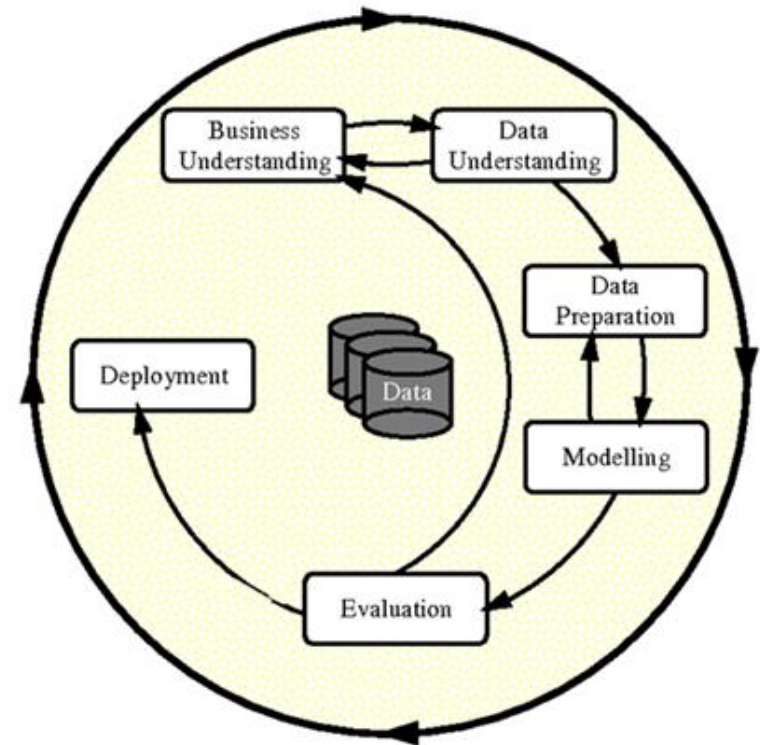


Possible Roadmap

Architectures, Digitalisation and Data Frameworks

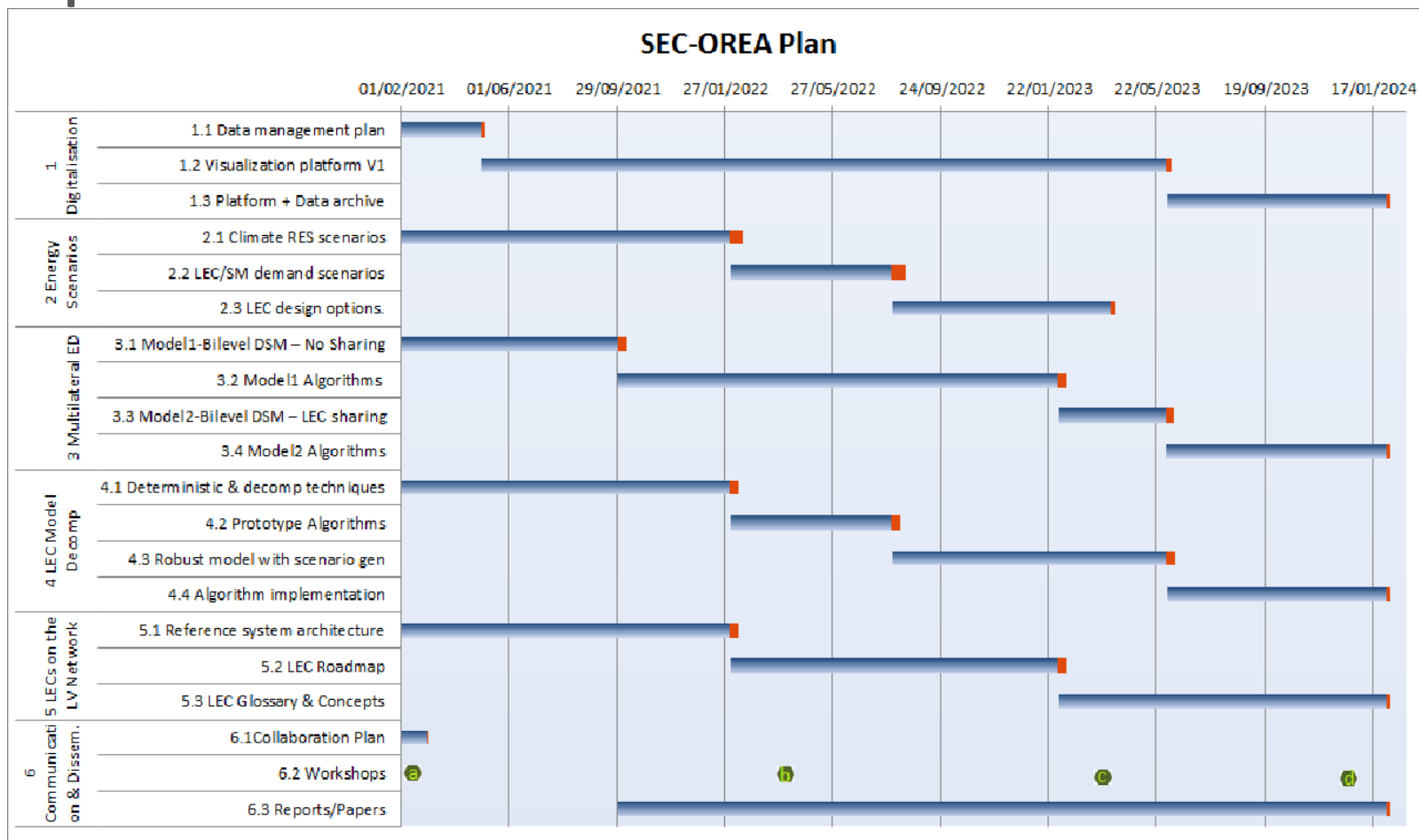


ETIPSNET Architecture



CRISP DM Framework

Connecting us with the CHIST-ERA community: here's what we plan to do:



Opportunities to address UN Sustainable Development Goals

❖ **Sustainable Development Goal 5**

- ✓ Achieve gender equality and empower all women and girls
- articulate the Gender Dimension in and of the Energy Transition;

❖ **Sustainable Development Goal 7**

- ✓ Ensure access to affordable, reliable, sustainable and modern energy for all – “fair” multilateral economic dispatch algorithms

❖ **Sustainable Development Goal 13**

- ✓ Take urgent action to combat climate change and its impacts – integration of renewable energy



1. **Data Management Plan in anticipation of Open data;**

1. Receiving Open Data: Climate model data from the ESGF9 and the Copernicus Climate Change Service (C3S) Climate Data Store;
2. Sending: Renewable energy supply scenarios and potentially anonymized metered electricity demand.

2. **Institutional and Community support for Open Access publications**

1. Journal and conference papers and technical reports of mathematical and statistical models and algorithms with reproducible science in mind;
2. ArXiv for preprints and institutional repositories;
3. Github or Gitlab for code.



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Technology Transfer

- ❖ Institutional support for any IP developed
- ❖ Strong stakeholder participants



Acknowledgements:

INRIA funded by ANR;

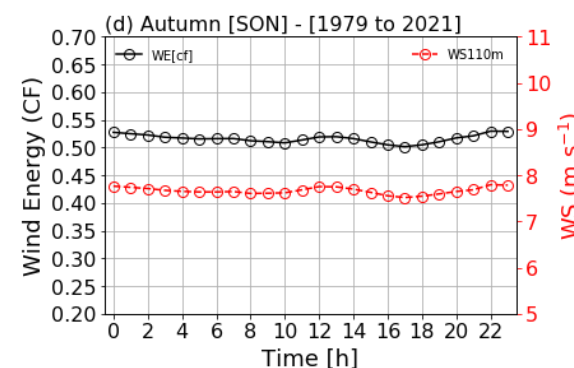
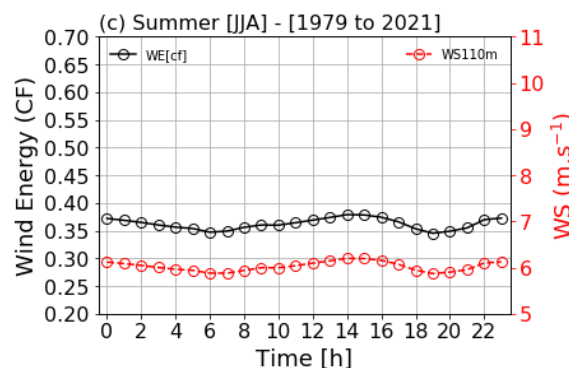
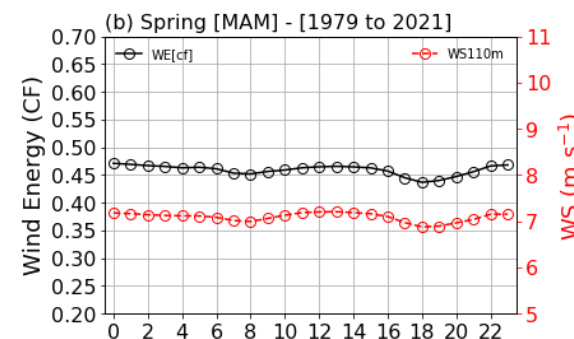
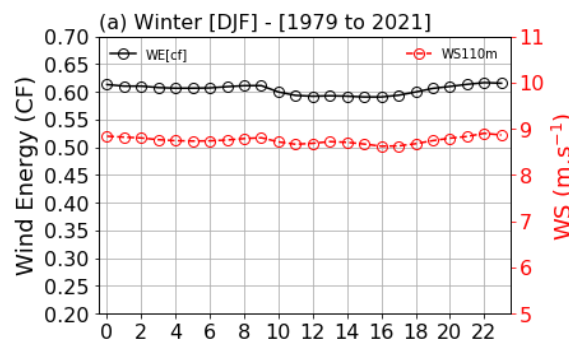
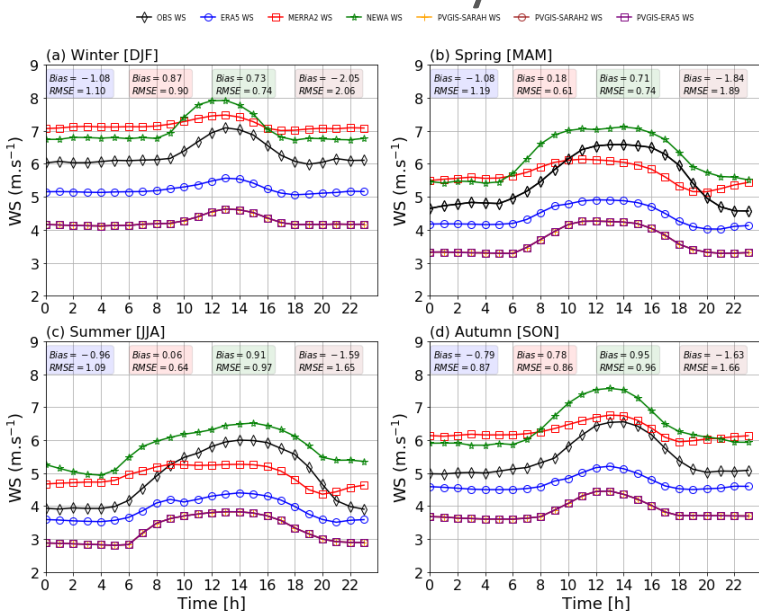
IPE funded by VIAA;

UCD funded by IRC;

ULB funded by F.R.S.-FNRS.

Questions ?

ERA-5 Reanalysis selected as the best wind speed data source





Updates from INRIA: mathematical optimisation models

- ❖ **Description of the agent- based model (utility functions, decision variables, constraints)**
- ❖ **Formulation of the grid-usage pricing problem as a reverse Stackelberg game**
- ❖ **Characterization of the solution controllability, i.e., the**
- ❖ **Submission of an abstract to EURO conference**
A Reverse Stackelberg Game Model for Grid-Usage Pricing, J. P. Sepulveda, L. Brotcorne, H. Le Cadre, *abstract accepted for EURO 2022.*

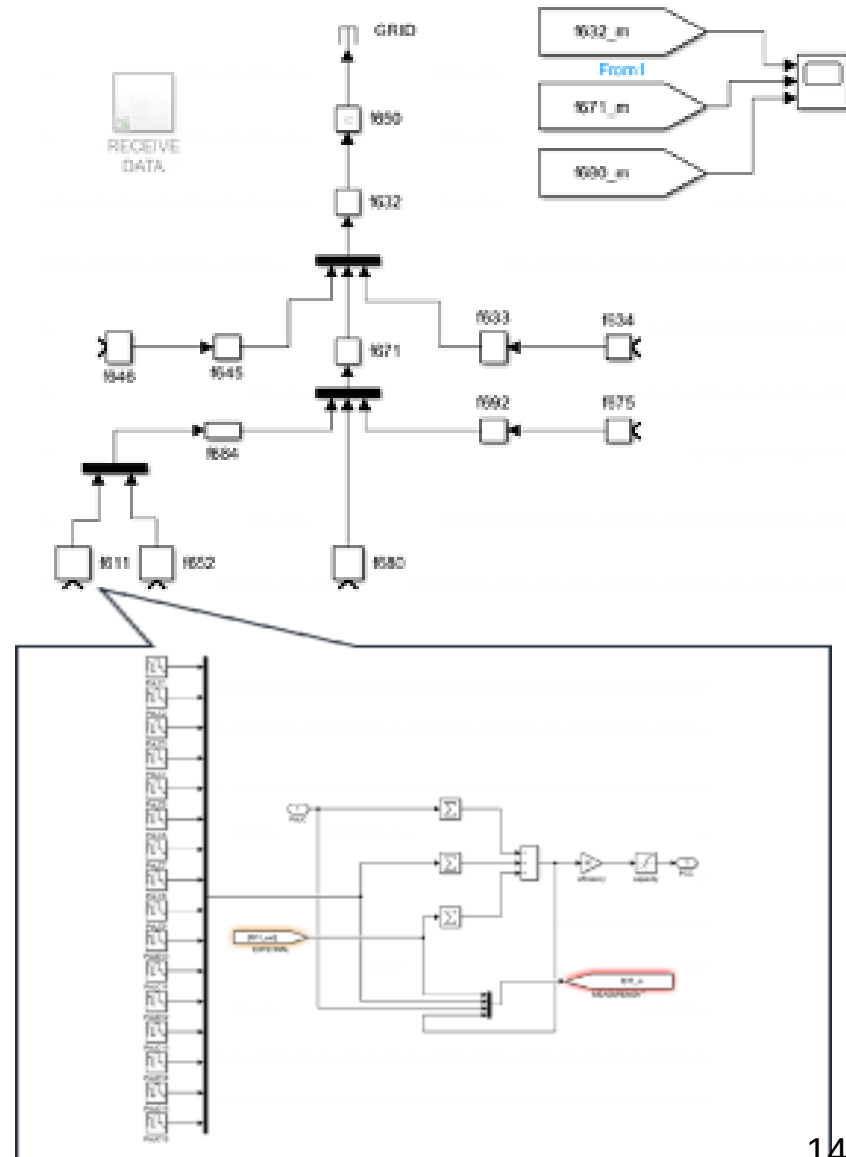


Updates from ULB: Unit Commitment optimisation models

- ❖ **MILP reformulation of the Unit Commitment model to meet an Energy Communities schema**
- ❖ **Evaluation of scenarios considering interaction between communities and power storage conditions**
- ❖ **Submission of an abstract to EURO conference**
Unit Commitment model for Local Energy Communities, C. Aguayo, B. Fortz,
abstract accepted for EURO 2022.

MatLAB model

- 1. Baseline model finalised.**
- 2. Main features:**
 - 3 different possibilities to include load profiles (other objects, matlab workspace, external source)
 - Accounting of prosumer capacity (identification of generation curtailment and overload conditions)
 - Possibility to account for prosumer internal losses
 - Model communicates as TCP/IP Client
- 3. UCD campus model – our reference system.**
 - Alternative to use LVNS Network 12 (needs to be decided)
- 4. Next activities:**
 - Model communication protocol realisation and description.
 - Reference system modelling.

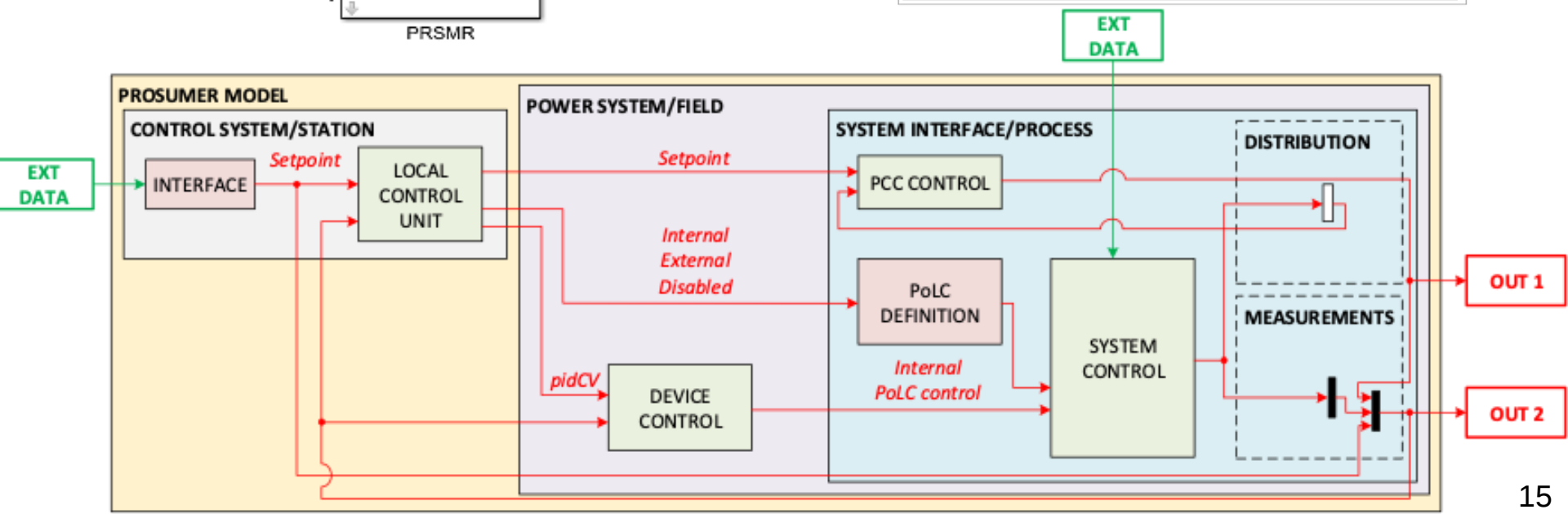
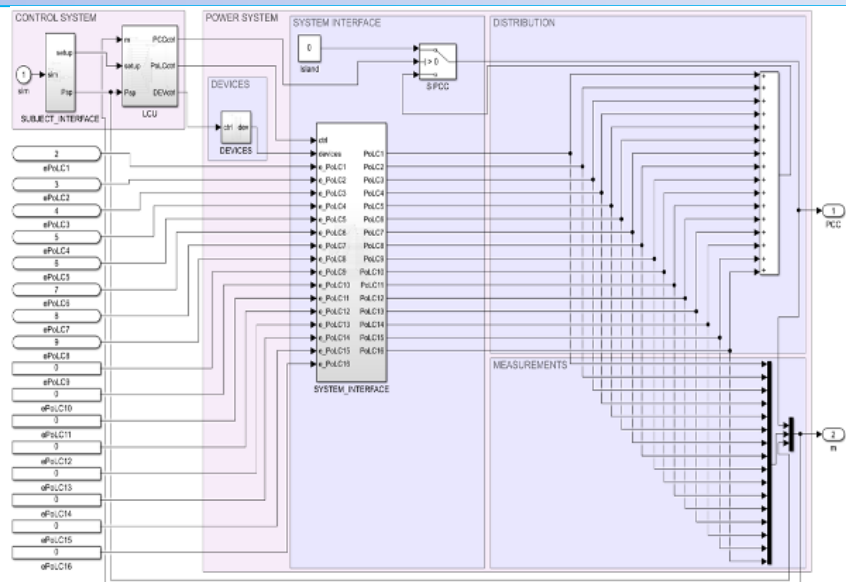
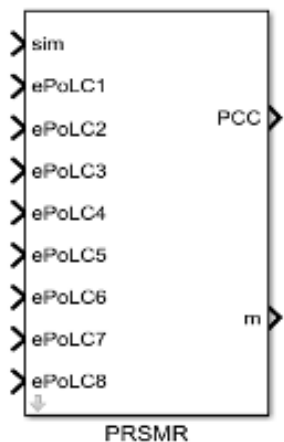




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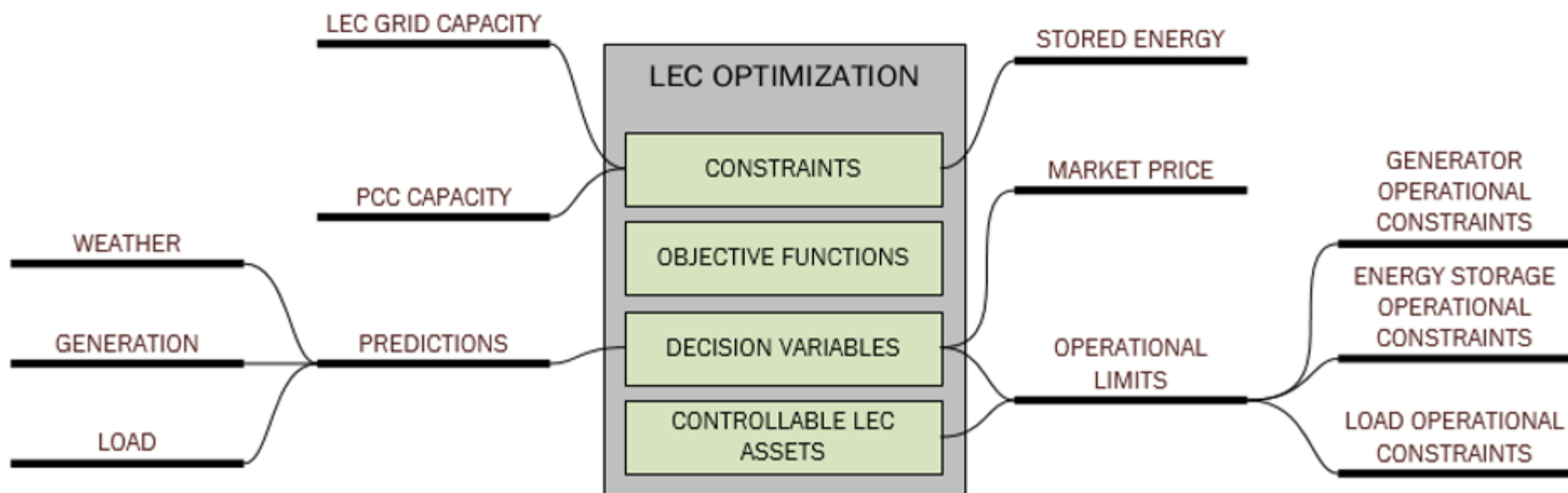
Updates from IPE: Local Energy Communities on the LV Network

Prosumer model





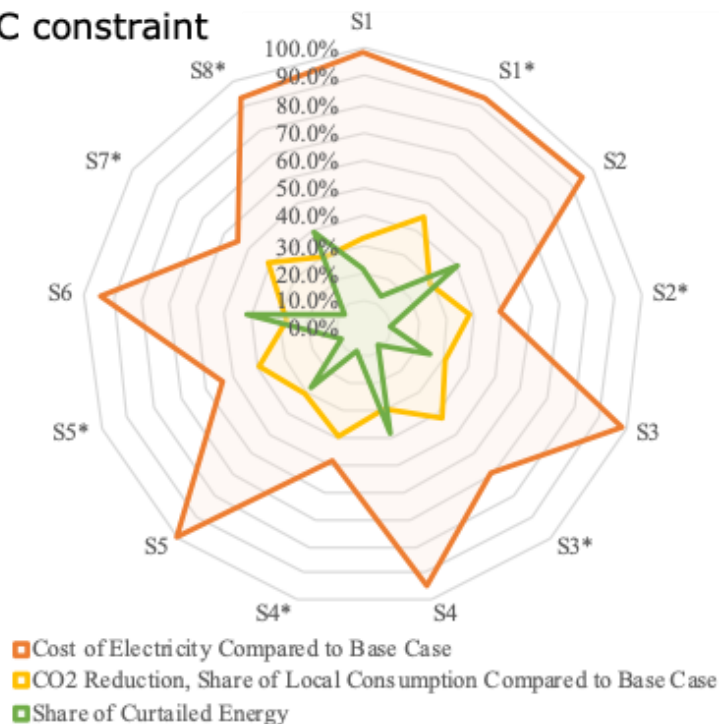
Objective function



Optimization framework

1. Optimize the energy sources and their location (considering the internal capacity restrictions) to maximize the meeting of demand profile
2. Maximize self-consumption through different measures (DSR, energy storage, P2P trading, etc)

PCC constraint



Increased self-consumption

