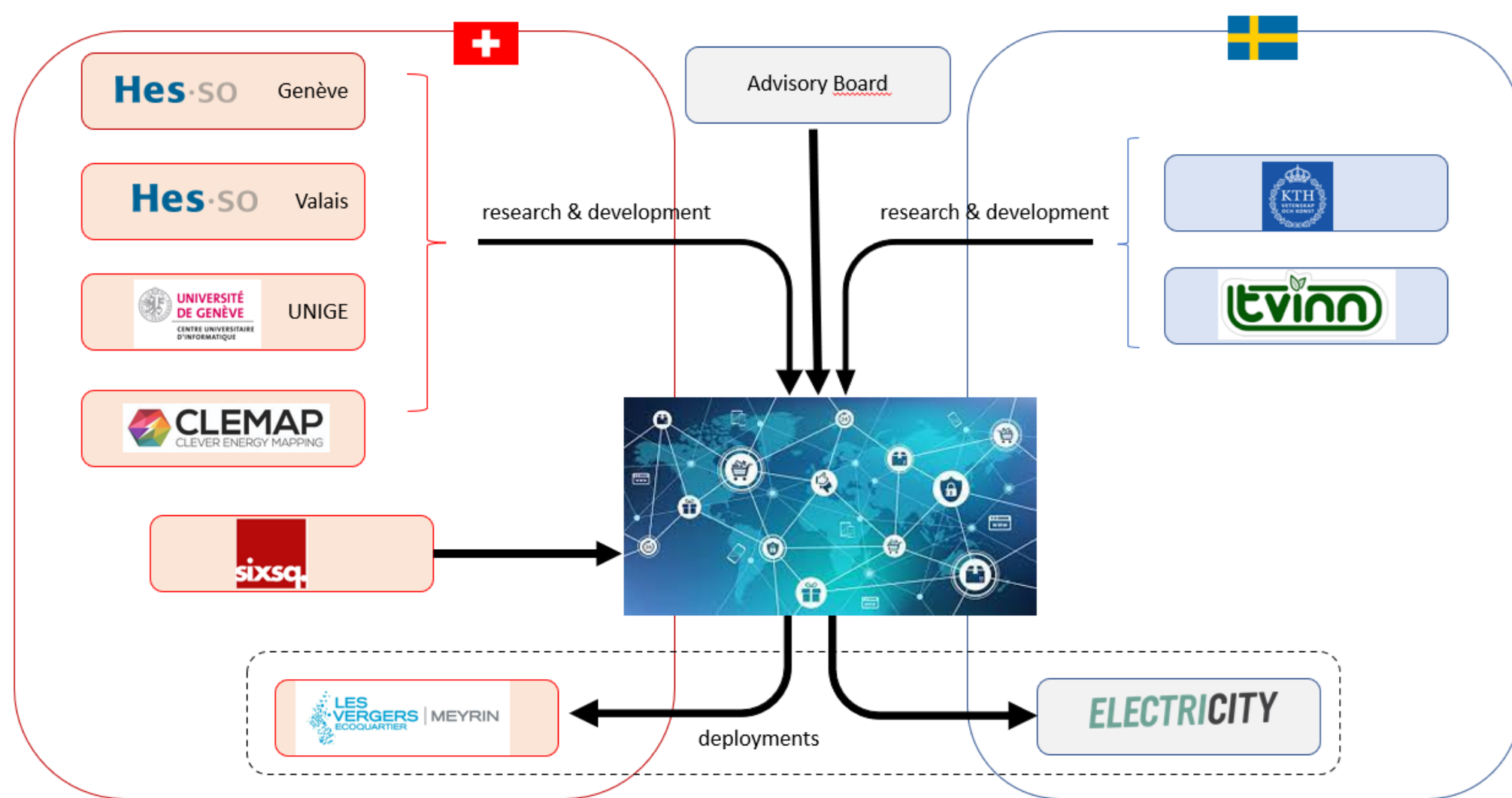
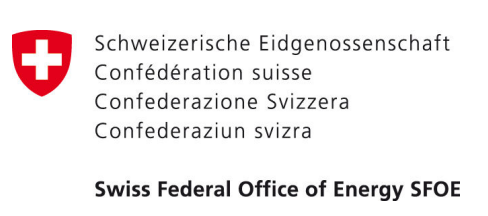


Lasagne – implementation of smartgrid in the form of a coordination system of digital twins

Team

Lasagne project (2022-2025)



UNIGE Team:

Prof. **Giovanna Di Marzo Serugendo** is full professor at Geneva School of Social Sciences, and the Computer Science Center of the University of Geneva, Switzerland.



Philippe Glass is research assistant at UNIGE. He has a MSC in AI (Université Claude Bernard, Lyon, France) and in computer science (ENSEEIH, Toulouse, France).

Research experience in AI (UNIGE) :

- Design of a smartgrid model (Internship)

Experience in software engineering :

Medical, robotic, air transport, training, insurance, press, market finance, luxury, energy



Motivation

Problem

Smart meters, which we call Grid Edge Devices (GED), do not yet manage energy exchanges in a collaborative and decentralized way. Issues to consider:

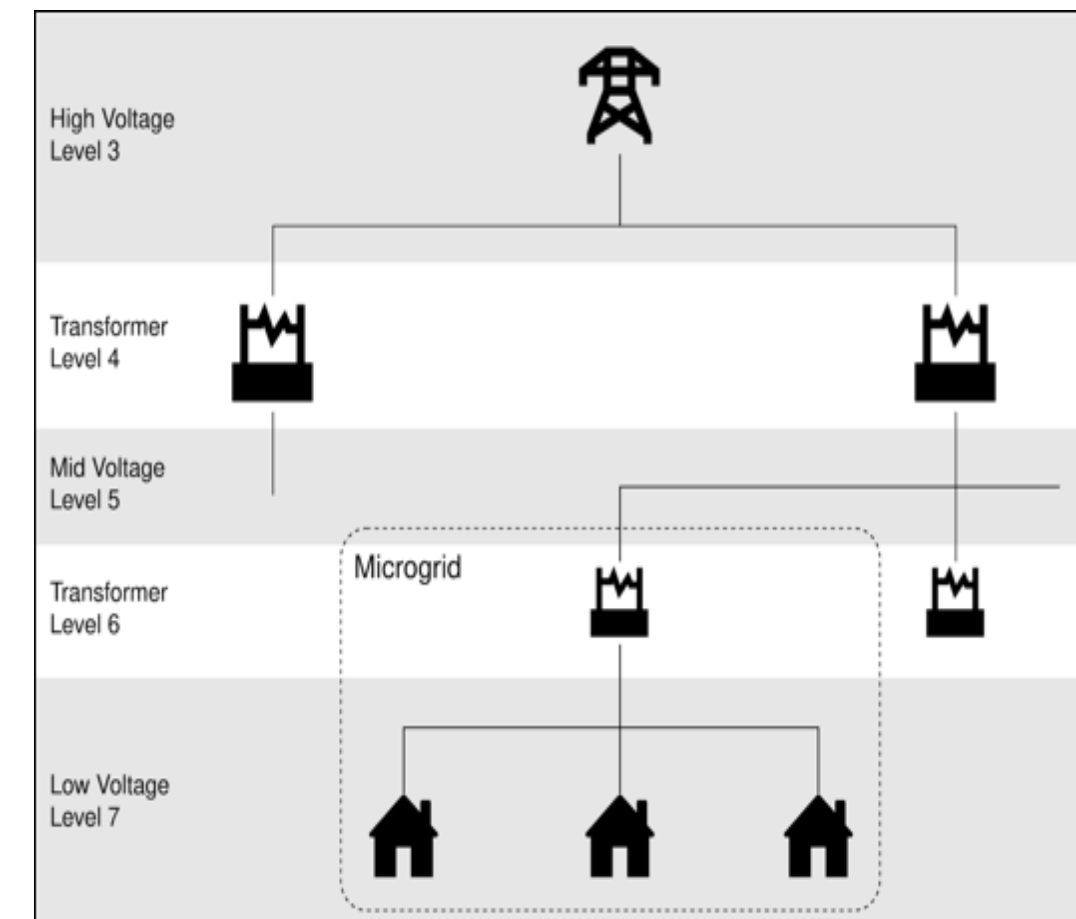
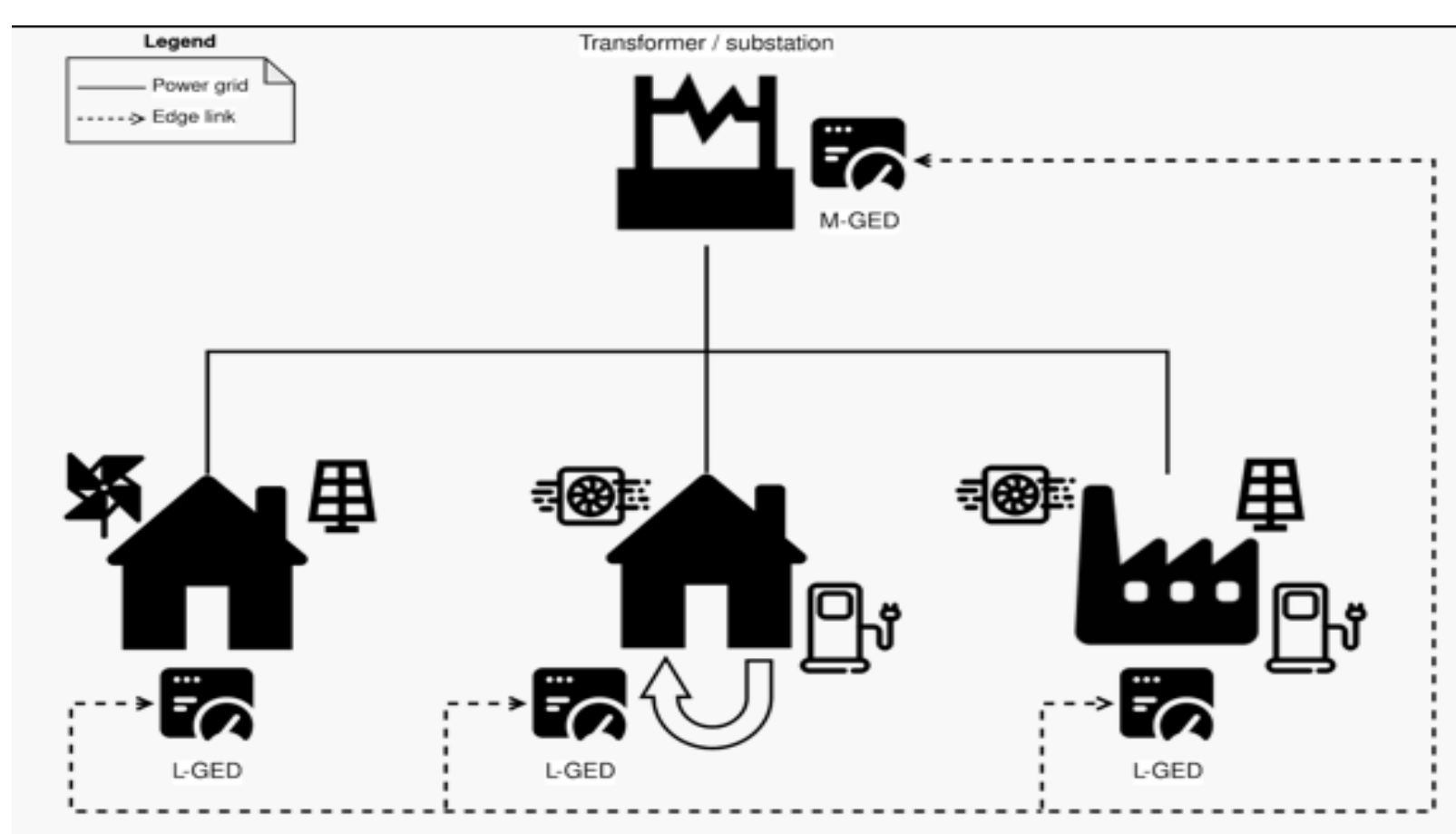
- At a local level, consumption and production devices cannot negotiate and exchange energy independently.
- It is difficult to manage renewable energy whose production is particularly fluctuating.

Examples

- Solar panels producers cannot negotiate and provide energy directly to consumers.
- Smart meters cannot collaborate to avoid peaks of consumption and production.

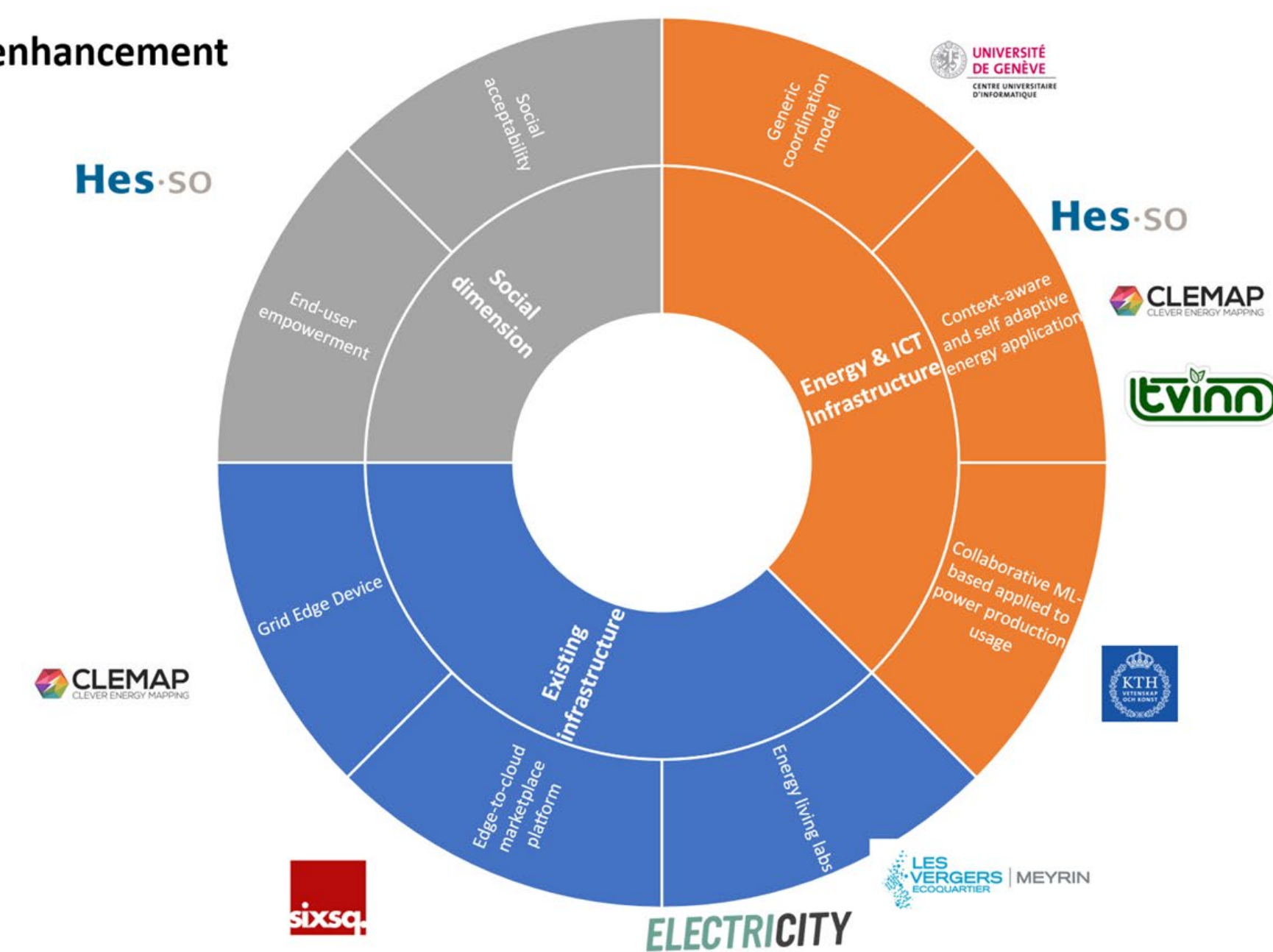
Solution: self-organization and self-adaptation

- Develop GEDs enhanced with novel AI algorithms and collaborative distributed models which are the foundation to build context-aware and self-adaptive “energy” applications, such as rate negotiation, power transactions, grid stability.
- Consider social and business perspectives to facilitate the acceptance of new tools for energy transition.



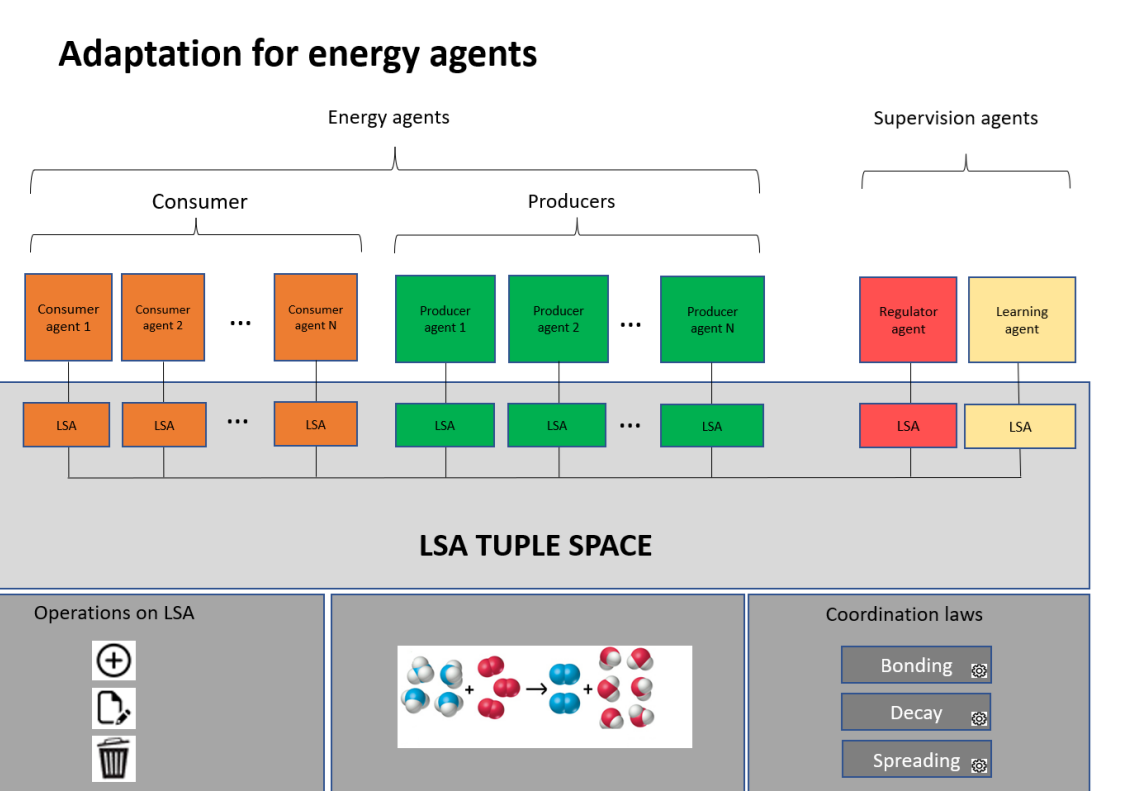
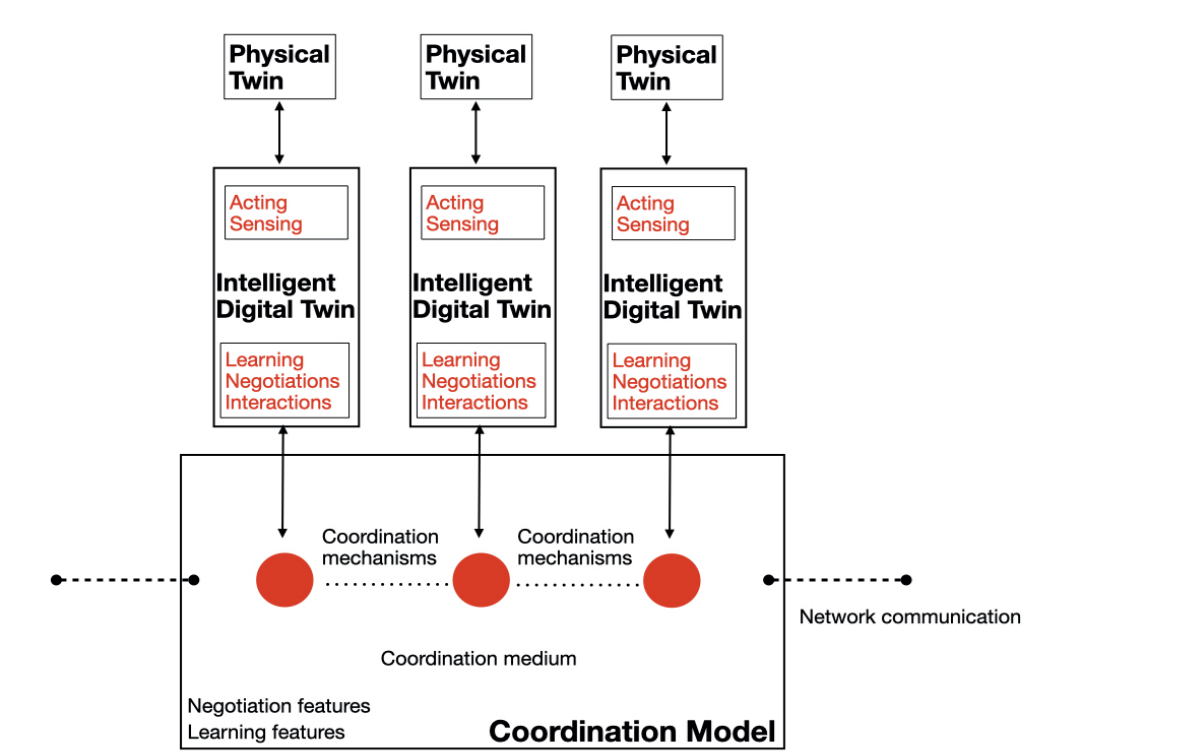
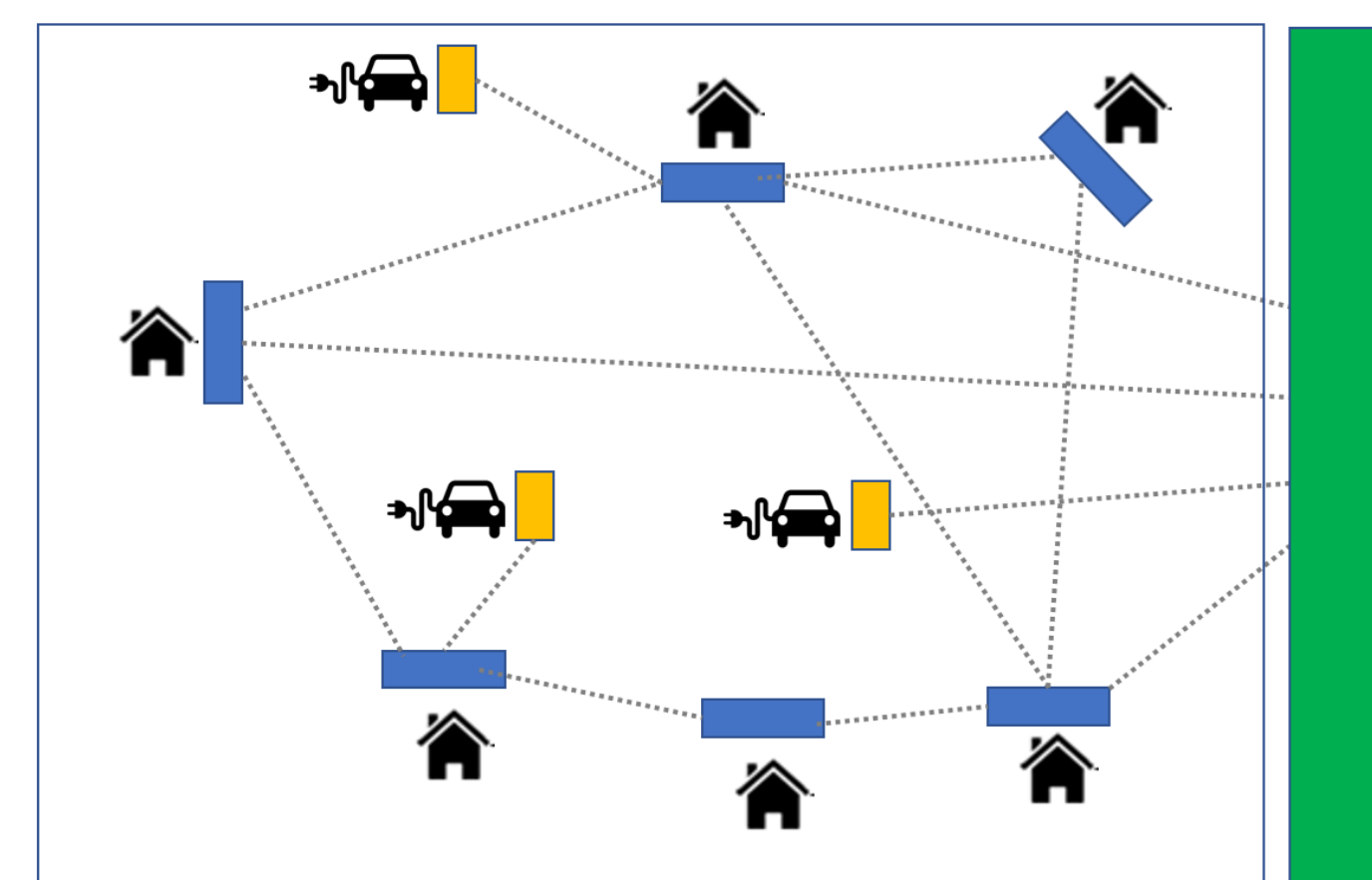
Method

Main axes of enhancement



Coordination model and intelligent digital twins (UNIGE)

- Develop methods, agents (twins), algorithms for **coordinating GEDs activities**.
- Implement a digital framework** for collaborative learning among GEDs networks.
- Use a **collaborative ML approach** among the different data sources and computational units.



Using of coordination model :

- Act as a coordination media
- Provide Digital twins (GED)
- Enable exchanges of information in a decentralized manner
- Reinforce context-aware/self-adaptive applications

Roadmap

Identification of areas of improvement:

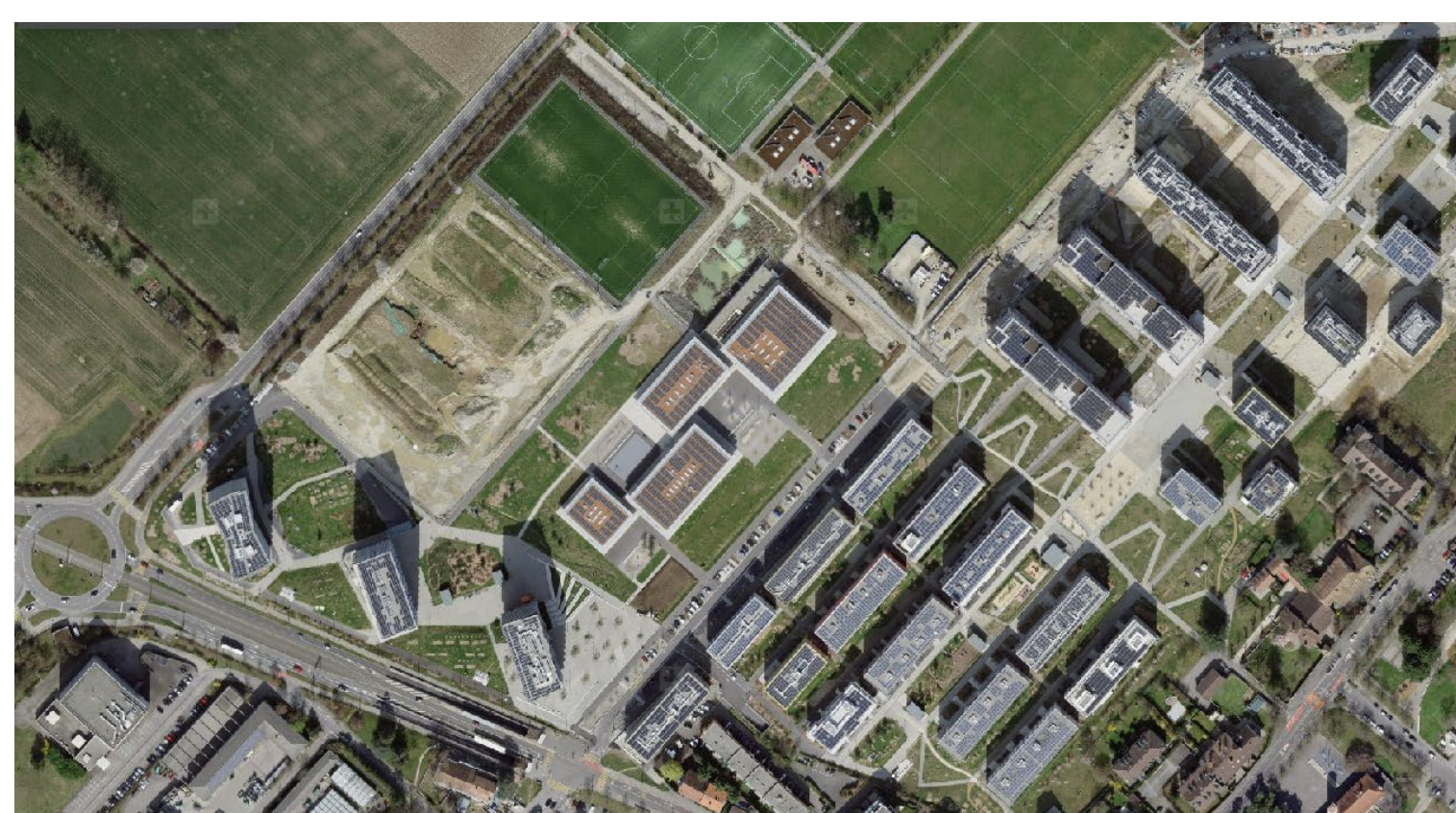
The existing coordination model that has been implemented at UNIGE

- Has not yet been tested with real data.
- Cannot support frequent changes in production/consumption.
- Contains a prediction model (based on Markov chains) with few parameters, little training data and has not been trained in real-life situations.
- Cannot manage pricing, negotiation, prosumer entities, different voltage levels.

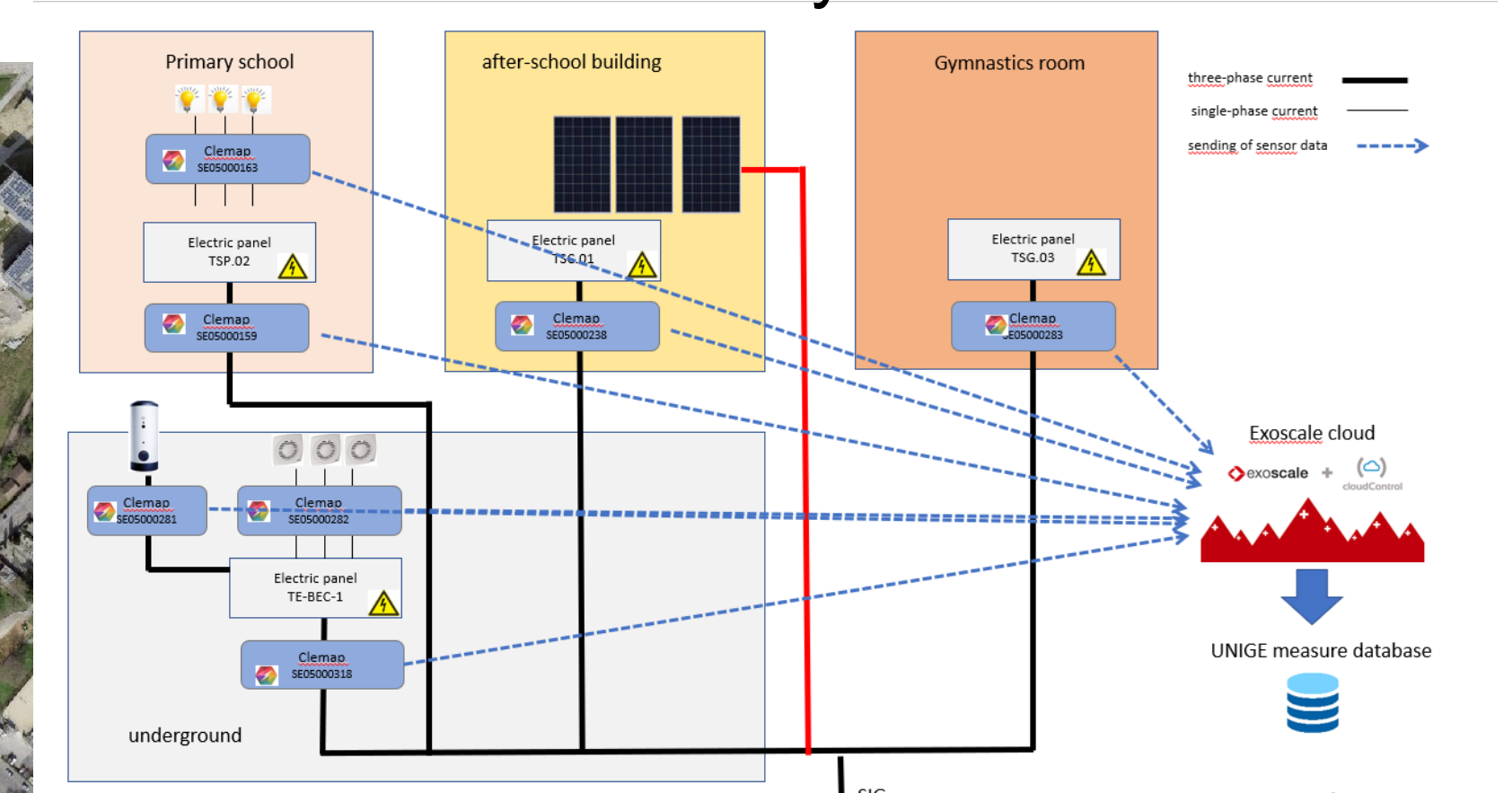
Solution:

- Use CLEMAP Data on Les Vergers (eco-district with actual prosumers) to feed current Coordination platform.
- Enhance and run existing algorithms with current platform (negotiation / control / predictions).
- Evaluate Markov chain predictions and compare the results with other ML methods.
- Strengthen the existing prediction model (more parameters, use of auto-adaptation).

Meyrin eco-district :



Architecture of the Meyrin network :



Publications

- P. Glass and G. Di Marzo Serugendo, **Plateforme de coordination et collaboration pour échanger l'énergie, réguler et prédire la production/consumption dans le cadre d'un réseau électrique intelligent**, University of Geneva, Geneva, Switzerland, Tech. Rep., 2021. <https://archive-ouverte.unige.ch/unige:155369>