Energy-Aware hybrid production SYstem RESCHEDuling

Dr. Maroua Nouiri

Associate professor

Director of ITI master's studies

Laboratoire LS2N UMR CNRS 6004

Nantes University
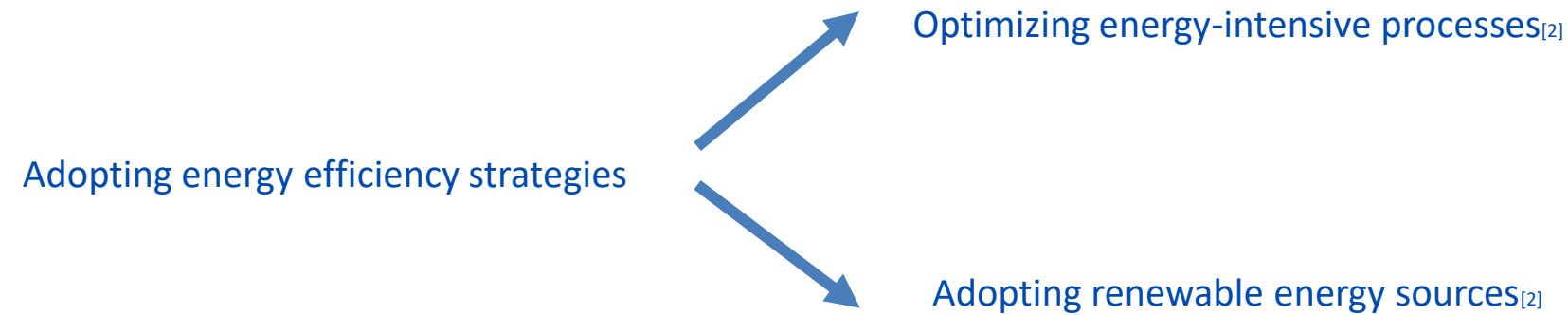
Plan

Project JCJC

Project identity sheet

- EasyRESCHED   **ANR-23-CE10-0009**
- Energy-Aware hybrid production System RESCHEDuling
- **Project Cordinator**: Maroua NOUIRI
- **Project Members**:
  - ✓ Olivier CARDIN (6p.months)
  - ✓ Christophe PLOT (3p.months)
- PartnersProject: NO
- Start date: 1/11/2023
- Project duration 48 months
- Funding from ANR : €234605
- Total cost: €234605

Introduction

Intensive Energy Industry

- 34% of global energy use in 2002

- 37% of global energy use in 2022 [1]

- Continued rising production in energy-intensive industry

Adopting energy efficiency strategies

Optimizing energy-intensive processes[2]

Adopting renewable energy sources[2]

➡️ minimizing emissions and wastes and reducing energy consumption are among the **major objectives** to be reached thanks to the better monitoring, higher data availability and more accurate and timely decision making brought by digital technologies.

Introduction
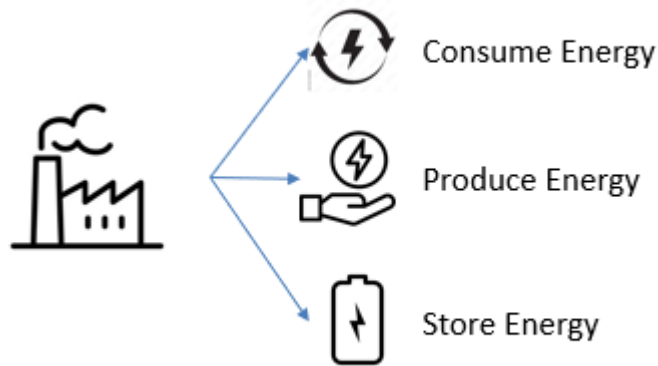
- This situation tends to amplify in the future.

- The global energy system is undergoing transformations with the advent of renewable energies.

➡️ **Microgrids** represent a valuable asset of the energy transition, by representing the shift from centralized power towards more **localized and distributed solutions.**
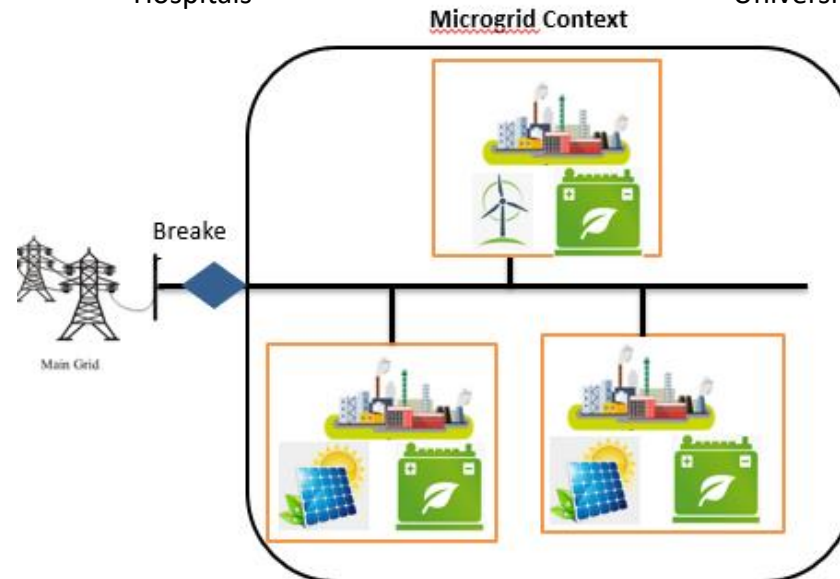
Microgrid

- A microgrid is a small-scale electrical energy network characterized by distributed generation, such as photovoltaic solar panels, wind turbines, heat and power generators and other components of control units, manageable loads and storage units. Aybar-Mejía, M.; 2021
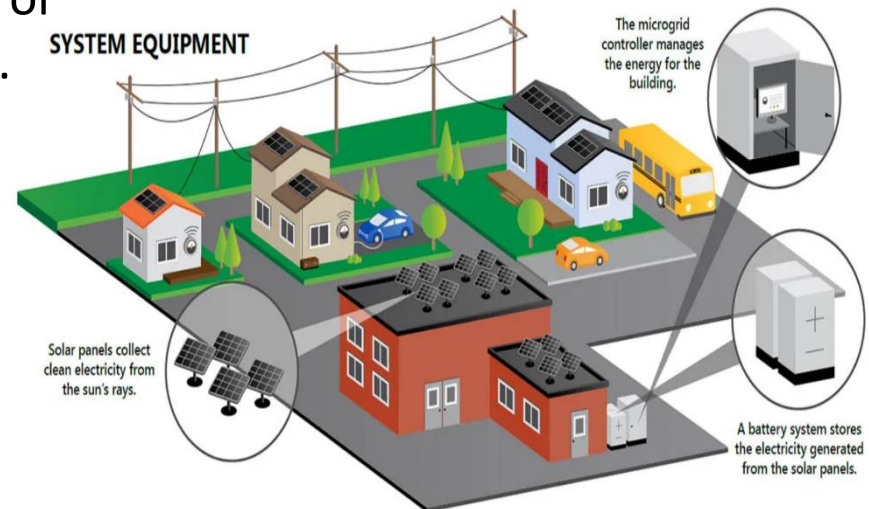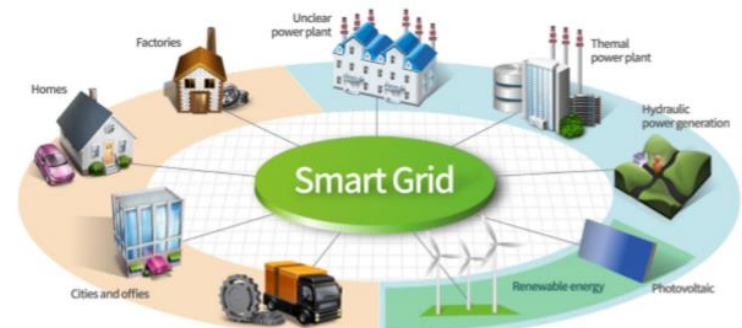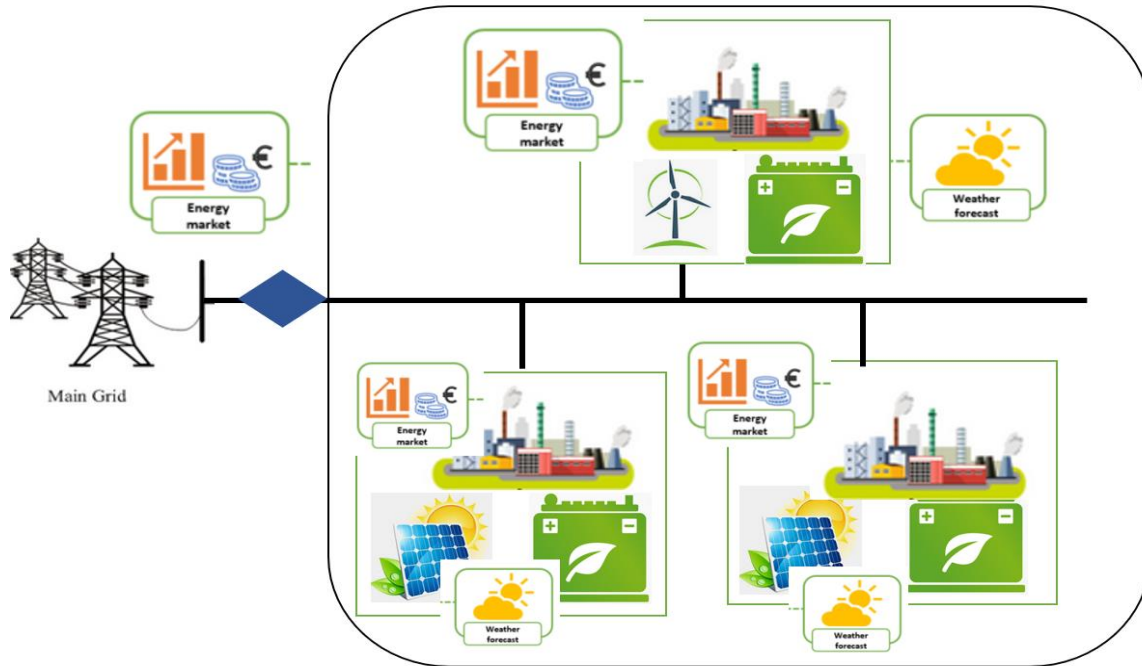

- Microgrids operate at low voltage levels, typically below 35 kV

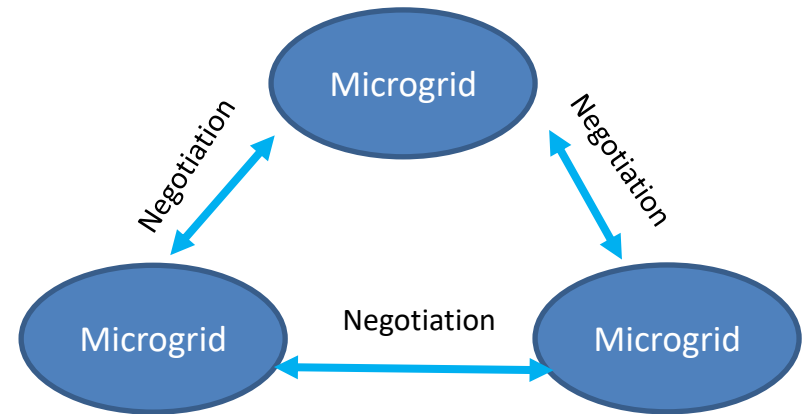- Microgids can work in an island mode where they disconnect from the main grid and continues to meet the local demand

EasyResched

Microgrids

Industries

Hospitals

Universities
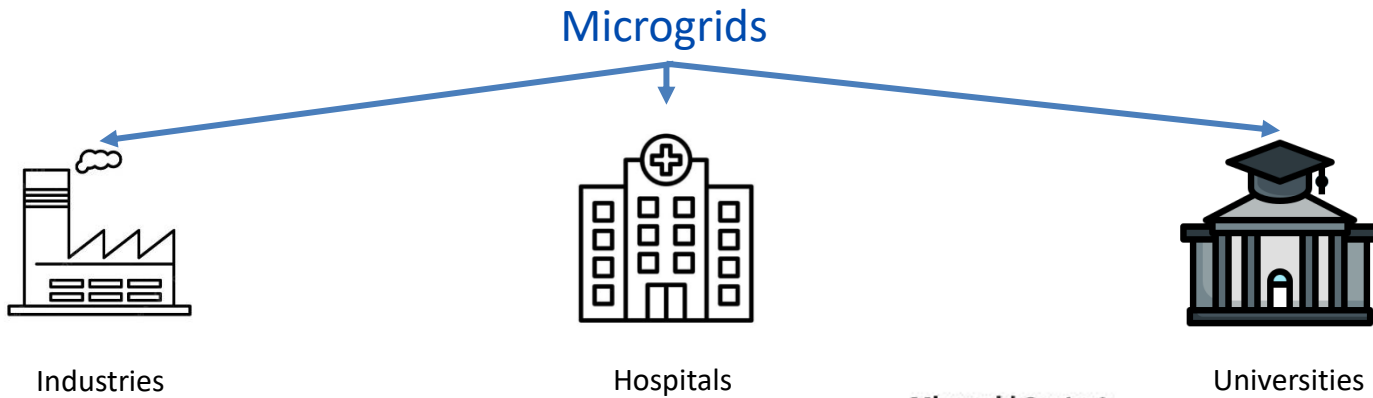
EasyResched:
we consider that factories
are connected to a microgrid.

Microgrid Context

Breake

Main Grid

EasyResched

Energy Market in Microgrid Context

Main Grid

Local Energy
Market

EasyResched

Production ←——— ? ———→ Energy

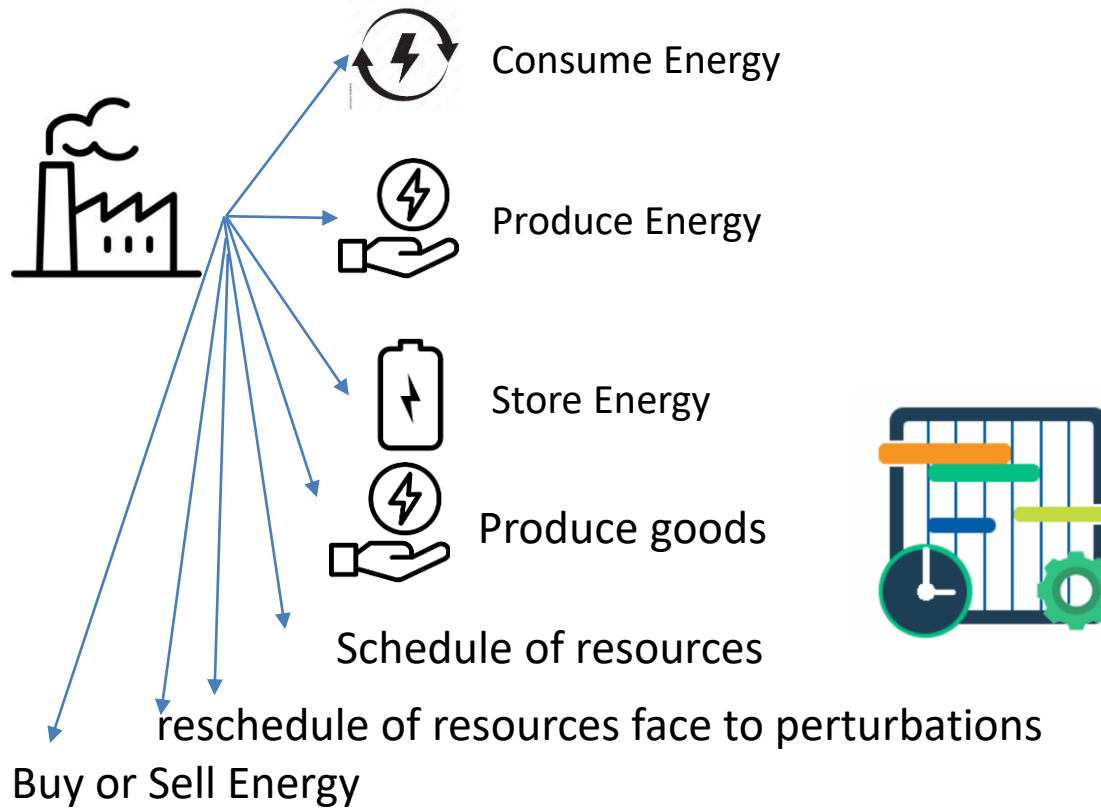Resource

consumable resource | renewable resource

energy | machine | operators
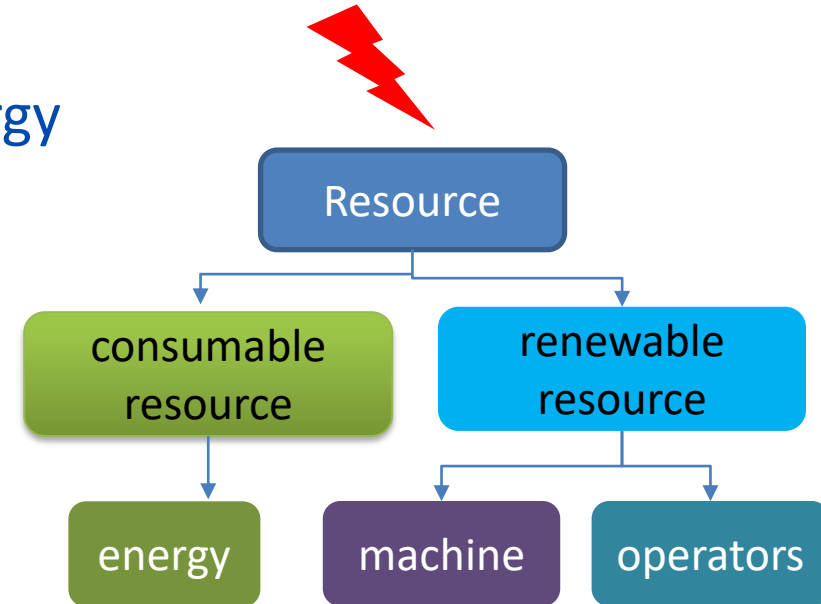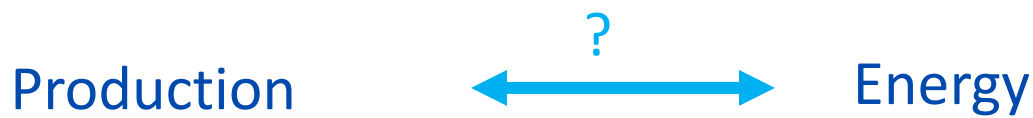
- Energy is a raw material

- Variation of energy load, energy price, etc.

- Classical perturbation on machines, new job arrivals, etc.

- Energy efficient scheduling for the manufacturers to reduce the energy cost

- **Reactive Energy efficient rescheduling solutions**

Consume Energy

Produce Energy

Store Energy

Produce goods

Schedule of resources

reschedule of resources face to perturbations

Buy or Sell Energy

- When do we have to buy or sell the energy to the neighbors (other microgris) or to main grid ?
- How can we collaborate or negotiate to get adaptative decisions face to external and internal perturbations ?
- How can we implement the energy efficiency scheduling and rescheduling methods to adapt to the energy and production disturbances in local energy market?

- **Hypothesis 1:**

 a local energy consumption, i.e. consumed close to the production location,
will be in the future years more sustainable than buying the energy
on the global energy system (denoted Main Grid on Figure 1)
the transport of energy has a relatively low yield, essentially due to necessary
 voltage transformations, and uncertainties on the price and availability of plants
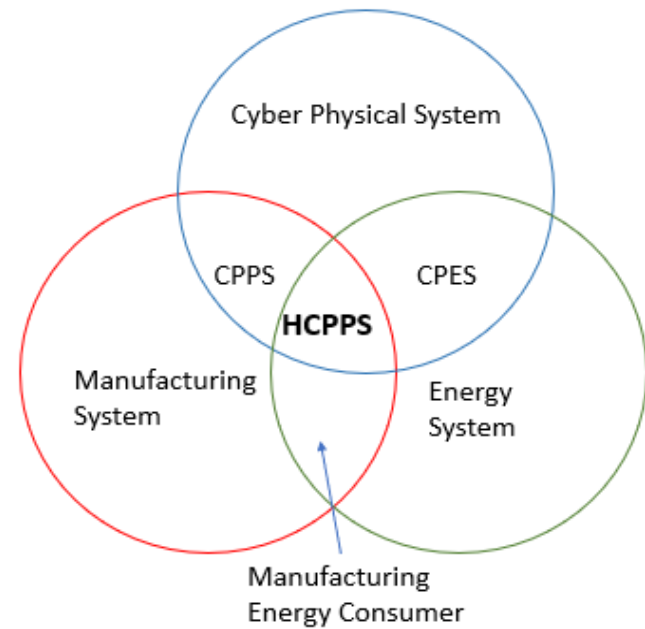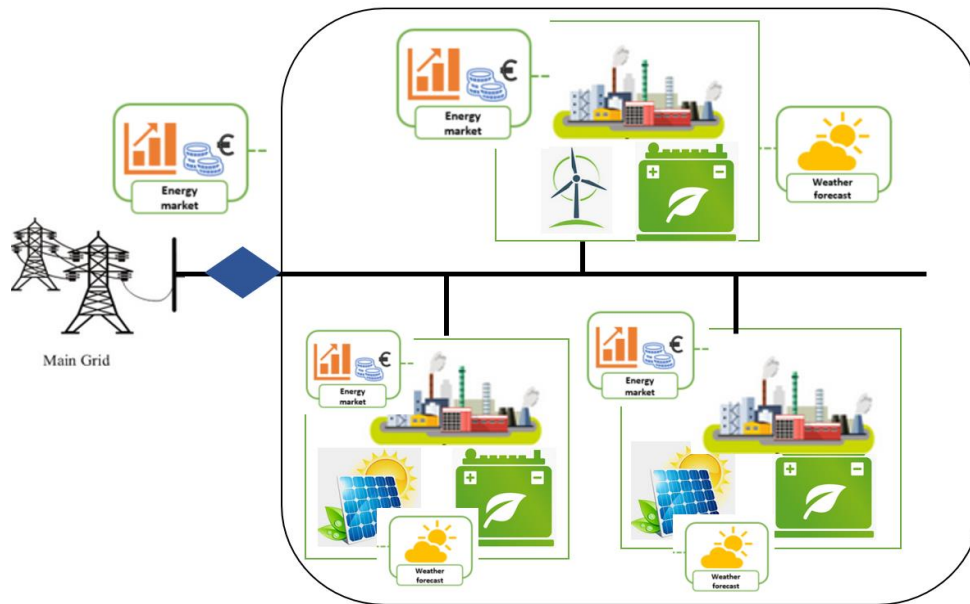 fuel

- **Hypothesis 2:**

the short-term energy production forecasts will be correctly executed.
the resilience of the microgrid in case of difference between the actual
and expected energy productions is considered out of scope of the project.
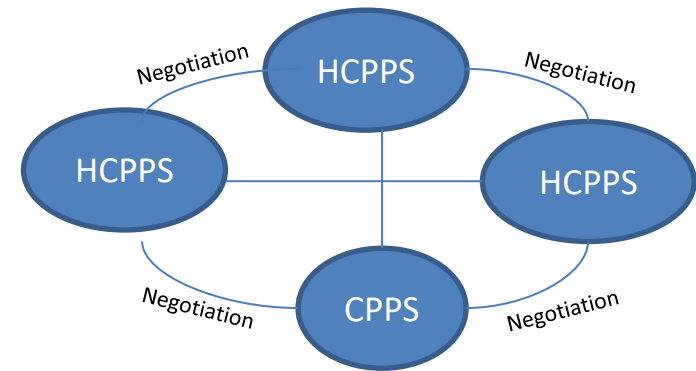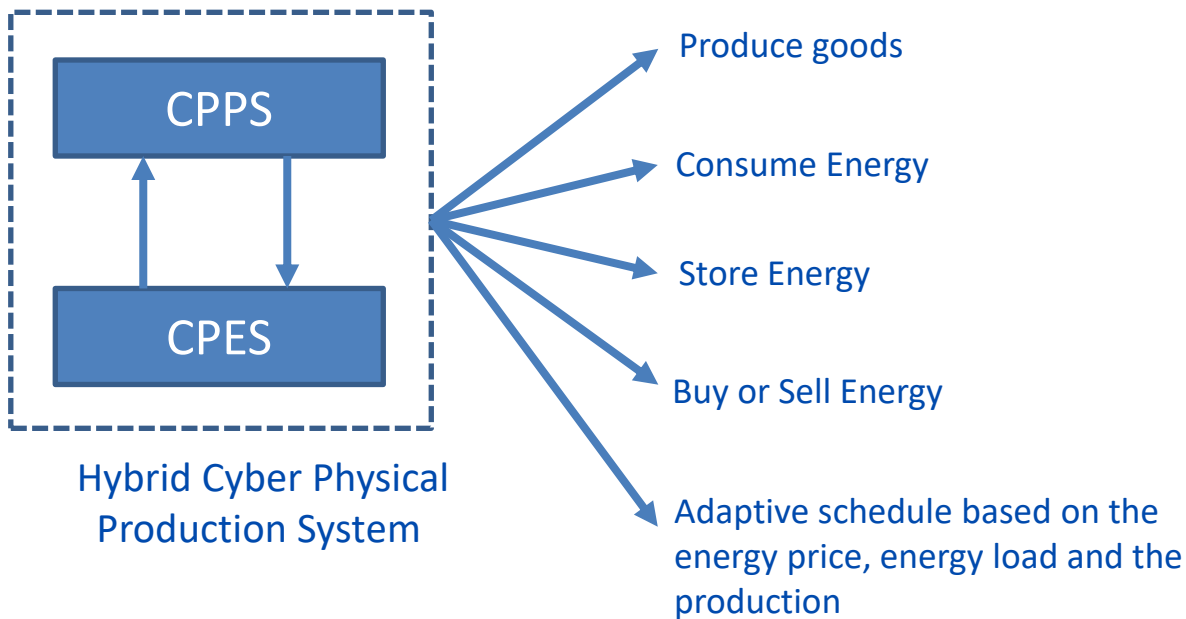the communication technology is not addressed in this project.

- **Hypothesis 3:**

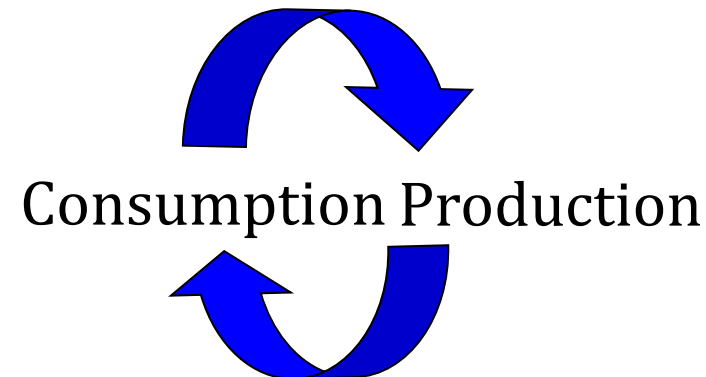**Energy Market in Microgrid Context**

- In context of Industrie 4.0, they are represented through, specific hybrid cyber-physical production systems **HCPPS.**
- **HCPPS** as a CPPS who produce goods, energy and has its own energy storage facilities. The locally produced energy can either cover its own energy demand, be stored or be sold to another HCPPS.

Energy-efficient decentralized architecture of Hybrid Cyber Physical Production System?

CPPS

CPES

Hybrid Cyber Physical Production System

Produce goods

Consume Energy

Store Energy

Buy or Sell Energy

Adaptive schedule based on the energy price, energy load and the production

Negotiation   HCPPS   Negotiation

HCPPS   HCPPS

Negotiation   CPPS   Negotiation

Local Energy Market

Consumption Production

- *RQ1: In the digitalized context of factories and microgrid, how can we design the cyber part of HCPPS, integrating collaboration and negotiation behaviors?*

- **RQ2: How can collaborative multi-objective rescheduling techniques provide energy-efficient reactive solutions in the HCPPS cyber layer?**
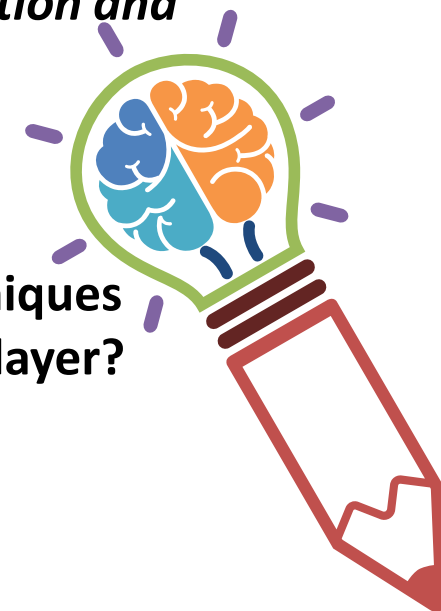
The originality of the decision tool provided by EasyRESCHED is to couple the negotiation of sale or purchase of energy on the local market to a possible reschedule of the manufacturing production of each company, depending on the energy prices, availability of energy, etc

Project decomposition into work packages
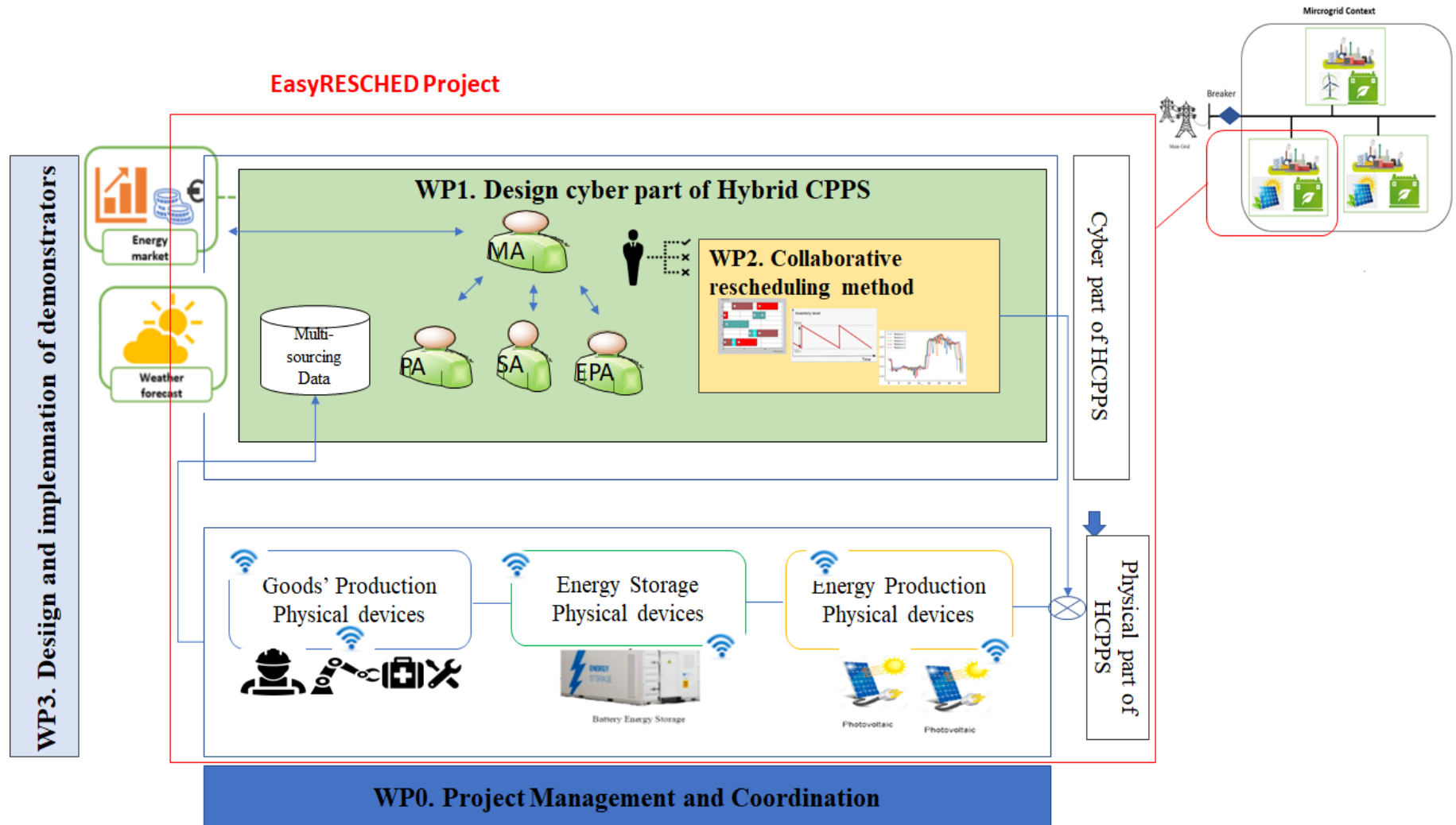
Thank you for your attention

Dr. Maroua Nouiri

https://sohoma2024.sciencesconf.org/
Maroua.nouiri@univ-nantes.fr

Google scholar