



**CENTRO STUDI  
DI ECONOMIA E TECNICA DELL'ENERGIA  
“GIORGIO LEVI CASES”**

## **LE RICERCHE DEL LEVI CASES**

# **Smart Power Energy Hub for the European Green Deal**

The seed for Energy Community spread

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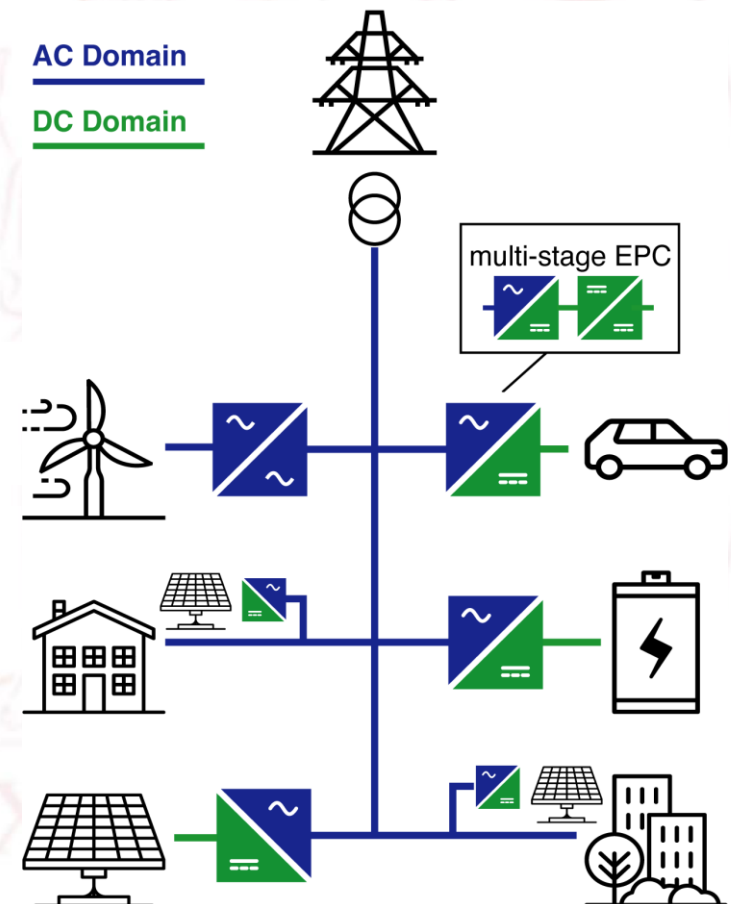
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## Considered Scenario

- The EU Energy Roadmap 2050 aims at thorough decarbonization across all the economic sectors, promoting **energy efficiency**, improving **synergies between energy infrastructures**, and adapting the energy markets to a **more complex, integrated energy system**
- The low-voltage (LV) distribution grids are permeated by an ever-increasing number of renewable sources and energy storage systems
- LV grids are a fertile environment for the adoption of integrated energy infrastructure by means of electronic power converters (EPCs)
  - Smart Power Electronic Hub (SPEH) concept

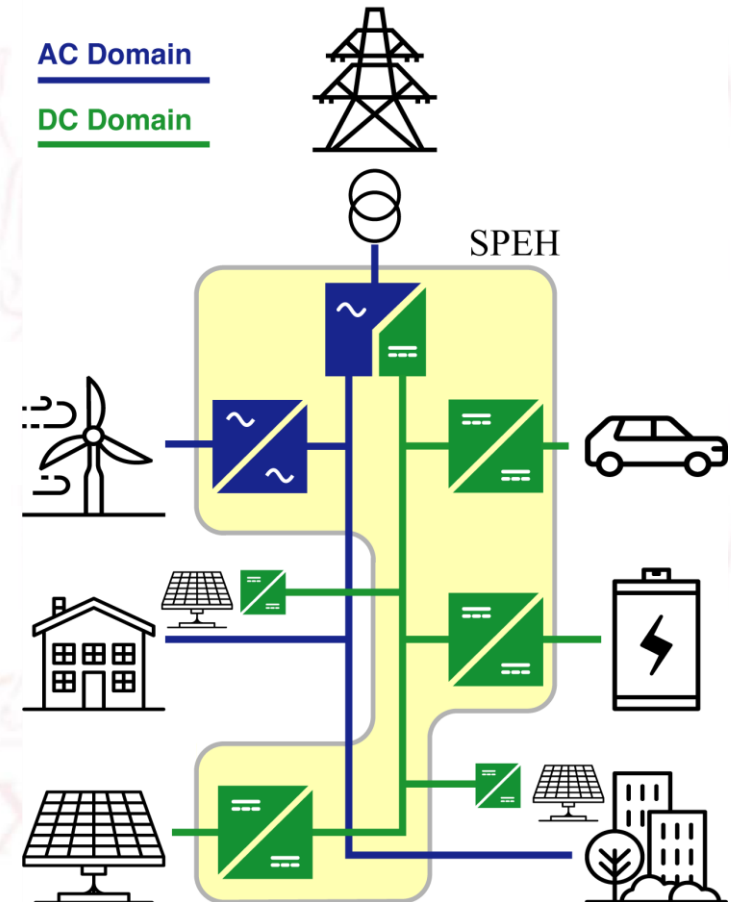
## Traditional Grid Structure

- The energy is dispatched through the local AC distribution grid
- Each energy resource/storage needs its own EPC to be interfaced with the LVAC grid
- AC-DC EPCs may suffer from lower efficiency due to multi-stage implementation and unsuitable voltage conversion ratio
- No centralized or local control of energy/power flows is present



## Smart Power Electronic Hub (SPEH)

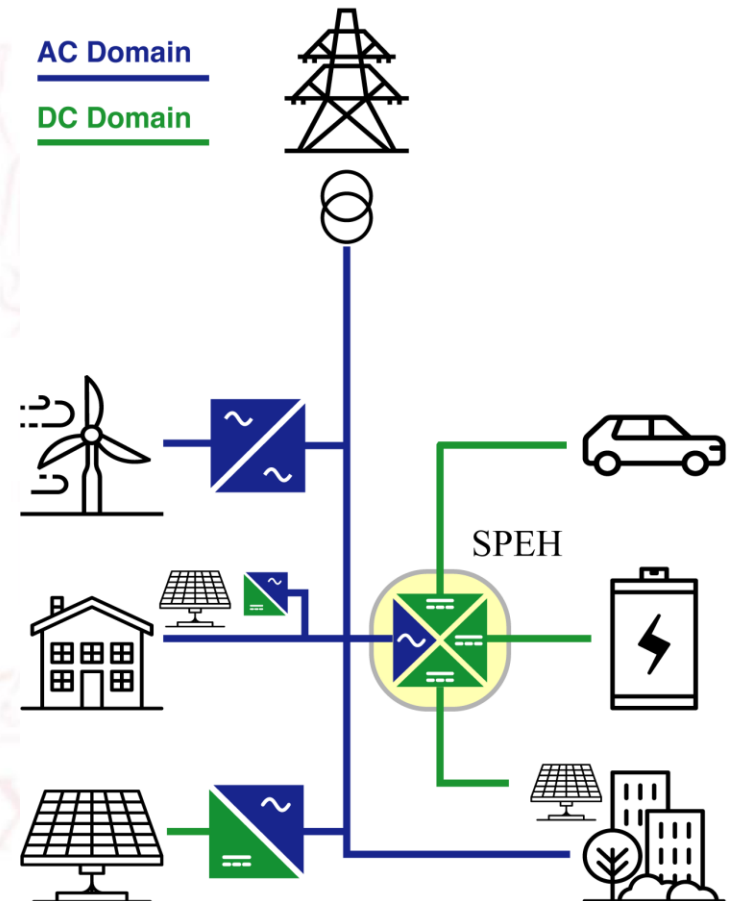
- Electronics Power Converters (EPCs) are a ubiquitous technology in contemporary LV grids that interface the energy resources with the grid.
- SPEH aims to reorganize the present EPCs in a coordinated infrastructure acting as an **energy/power hub** between sources, storages, load, and grid at different domains (i.e., AC and DC)





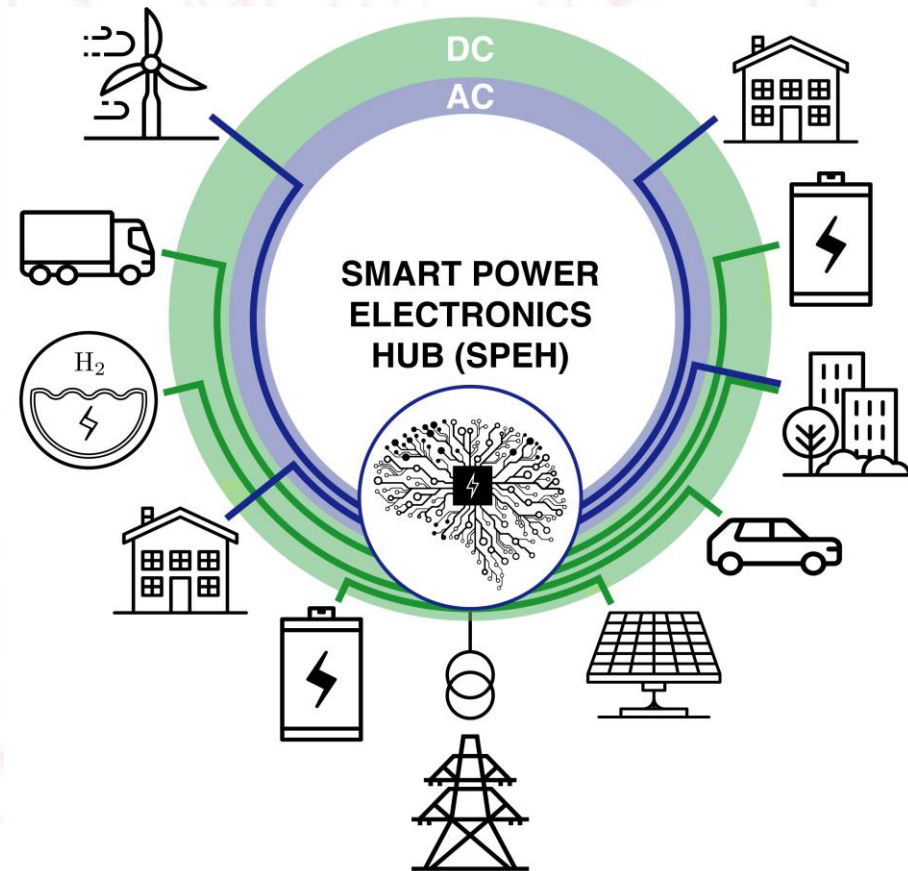
## Smart Power Electronic Hub (SPEH)

- SPEH is a polymorphic structure
- SPEH can be implemented as an aggregation of EPCs sharing one or more DC and/or AC buses at different voltages, or as a single multi-port converter
- The structure and its control will be selected based on the mission profiles of the considered loads and renewables



## Energy Communities (ECs)

- The energy communities (ECs) may play a key role in the clean energy transition by attracting private investments for new renewable energy projects and providing an opportunity for energy infrastructure enhancements from the lower level of the energy-dispatching chain
- SPEH represents an essential technical node for the Energy Community expansion



## Project Objectives

### 1. Define the architecture of the SPEH

The SPEH architecture will be defined through performance metrics, including **efficiency and reliability**. Particular attention will be devoted to the **mission profiles of the energy resources** as driving parameters for the SPEH optimization.

### 2. Focus on optimal performances of SPEH architecture

The SPEH will take advantage of state-of-art control techniques, for example, using algorithms based on **artificial intelligence (AI)**

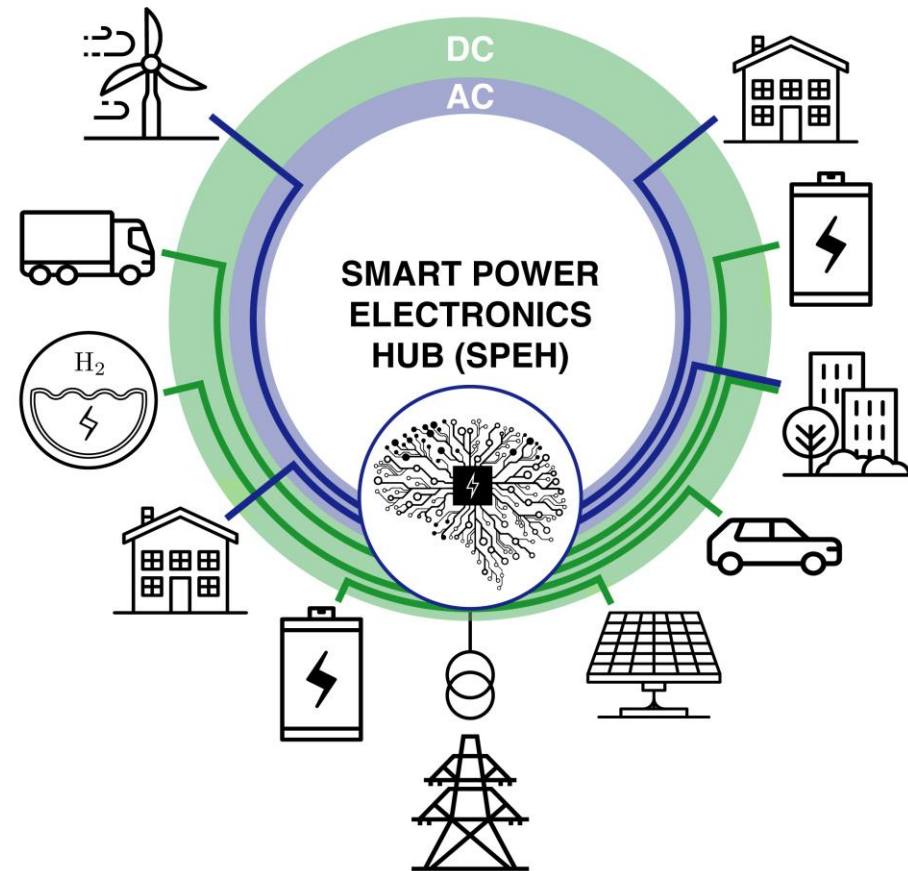
### 3. Evaluation of the performance of the derived SPEH solution

**Rapid-prototyping system combined with controller hardware-in-the-loop (HIL)** solutions will ease the integration from other research teams



## Summarizing...

- **Smart** : SPEH will be equipped with state-of-art control techniques ensuring the optimal performance of the overall system
- **Power Electronic** : the SPEH will be achieved by exploiting a capillary usage of EPCs in the LV grid
- **Hub** : the SPEH will be responsible for the energy/power management of the interested Energy Community



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**Thanks for Your Interest**

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