Enlit Europe

ENERGY COMMUNITIES AND POSITIVE ENERGY DISTRICTS

20 November 2025 – Bilbao

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2030 NEUTRALPATH

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AGENDA

1. OPENING
2. PROJECTS
3. ROUNDTABLE DISCUSSION
4. CONCLUSION

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Dr. Christos Korkas
Center for Research and Technology Hellas

Optimized Energy Management for PEDS

Funded by
The European Union

What is a PED – What needs to be optimized

What is?

- A district that produces **more renewable energy** that it consumes over a year.
- Based on **local generation**, **smart buildings**, **energy storage**, and **energy sharing**.

Core Idea

- Smart coordination of buildings and energy assets leads to **net-positive performance**.
- Optimization happens in real time, adapting to weather, demand, and grid conditions.

Key Components

- Solar PV, storage, EV charging, demand response, district heating/cooling.
- Plus digital platforms that enable monitoring, forecasting, and intelligent control

Goals of Energy Management

- Coordinate district energy assets in real time to achieve net-positive performance

Why Optimization is Needed

- Variability of renewables
- Heterogeneous buildings and systems

Key Challenges

Technical Challenges

- Heterogeneous buildings and systems with different controls.
- Difficulty predicting and managing **variable renewable generation.**
- Limited interoperability between devices and platforms

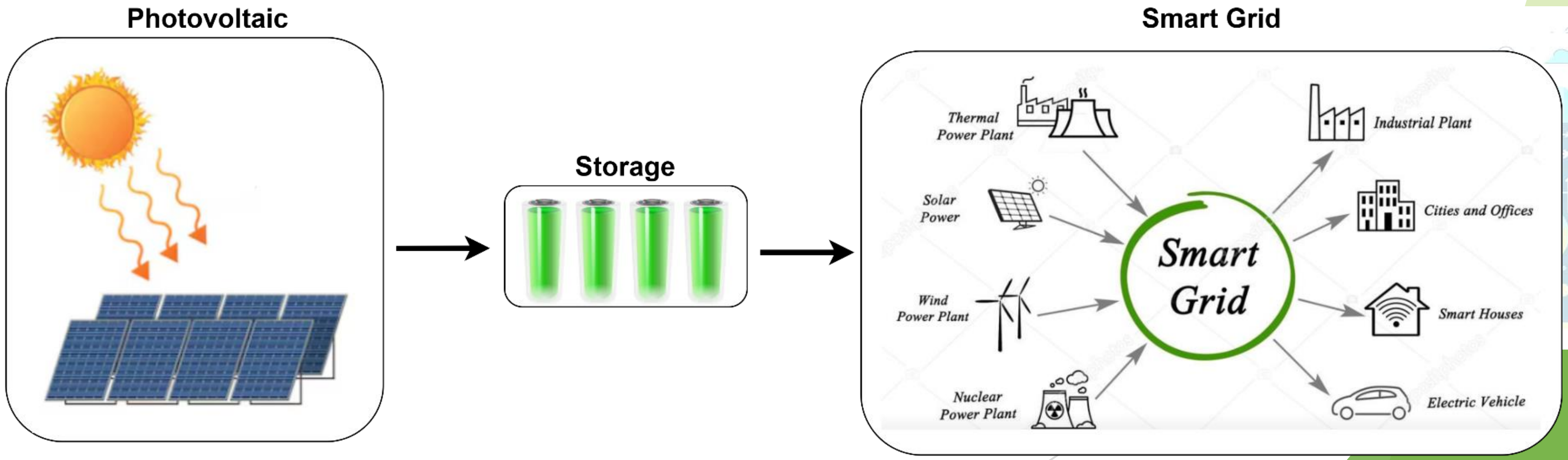
Operational Challenges

- Balancing energy efficiency, comfort, and cost
- Real-time coordination of multiple energy assets
- Uncertainty in demand, weather and occupant behavior

Regulatory and Market Challenges

- Complexity of local energy markets.
- Lack of standardized frameworks for PED governance.

<u>Without solving theses issues, PEDs cannot reliably become net-positive</u>



Current State of the Art

AI-Driven Building Control

- ML, RL & MPC algorithms optimize HVAC, lighting, and storage
- Digital twins simulate scenarios and improve decision-making

Local Energy Markets & Interoperability

- Peer-to-peer energy exchanges (blockchain-based)
- Standardized APIs for devices and data integration.
- Normalization layers for cross-building orchestration

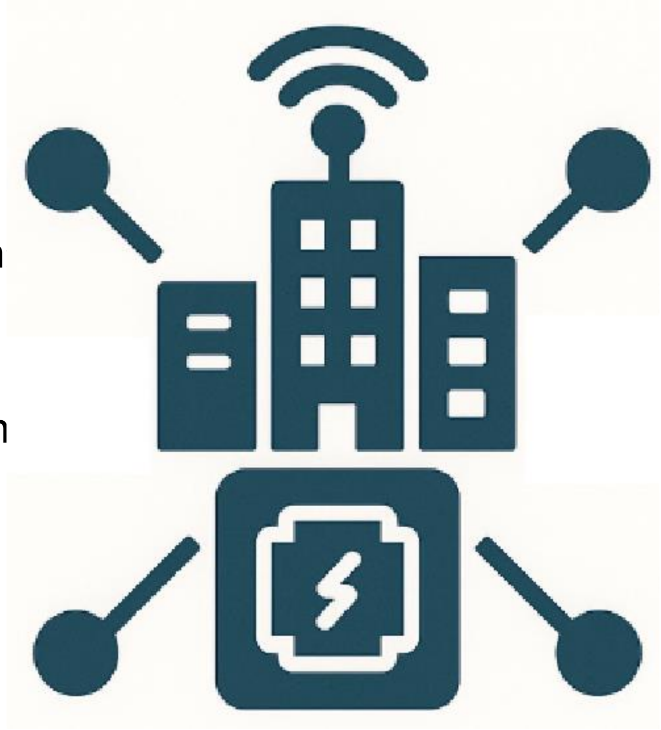
Advanced Energy Management Systems

- Integration of PV, battery storage, EV charging
- Predictive analytics for consumption and generation
- Real-time monitoring dashboards for operators

Limitations of Current Approaches

- Most solutions remain building-level
- District-level coordination is still emerging

Future Trends



Autonomous District Control

- Self-learning control system operating at district scale
- Real-time adaptation with minimal human intervention

Scalable PED Orchestration

- Integration of multiple PEDs into **PED clusters**
- Shared forecasting, load balancing, and flexibility trading

LLM-Based User Interaction

- Intelligent assistants supporting occupants and operators
- Personalized comfort recommendations and energy insights

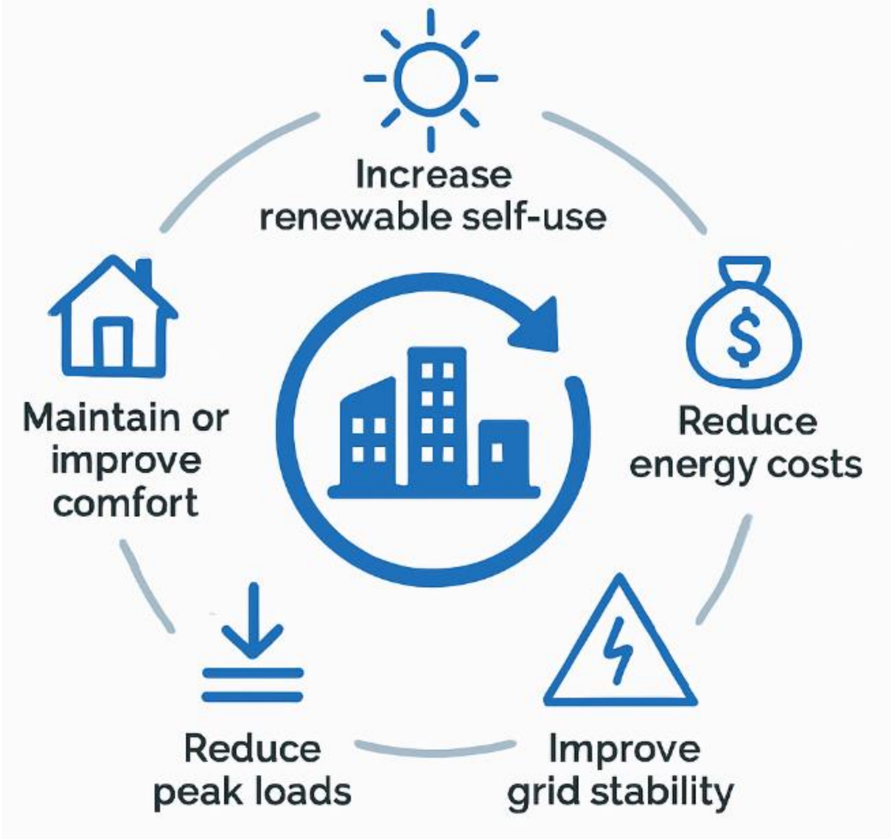
Sector Coupling & EV Integration

- Vehicle-to-grid and vehicle-to-building flexibility
- Integration with heating, cooling, and transportation systems.

<u>**These trends will enable fully optimized, self-managed positive energy districts**</u>

Expected Impact of Optimized PED Energy Management

1. Increase renewable self-use (20-40%)
2. Reduce district energy costs (10-25%)
3. Improve grid stability
4. Reduce peak loads
5. Maintain or improve comfort



THANK YOU FOR YOUR ATTENTION

Climate-neutral PEDs and replicability

Rubén García Pajares, CARTIF Technology Centre

Funded by
The European Union

NEUTRALPATH project
ENLIT Europe 2025
Thursday, 20 November 2025

Objectives of the project





NEUTRALPATH aims at demonstrating that PCEDs designed under participative and human-centre principles are cost-effective and feasible solutions to contribute significantly to the cities' transformation towards climate-neutrality, allowing to speed up the process to achieve significant emissions reduction in 2030.

NEUTALPATH consortium

25 PARTNERS

60 Months 2023-2027

7 Countries

Overall methodology

CN-Labs

- Mission and vision
- Innovative governance
- Roadmap

PCED design, implementation and evaluation

- PCED Zaragoza
- PCED Dresden

Maximisation of project impacts

- CDE strategy

Long-term city transformation

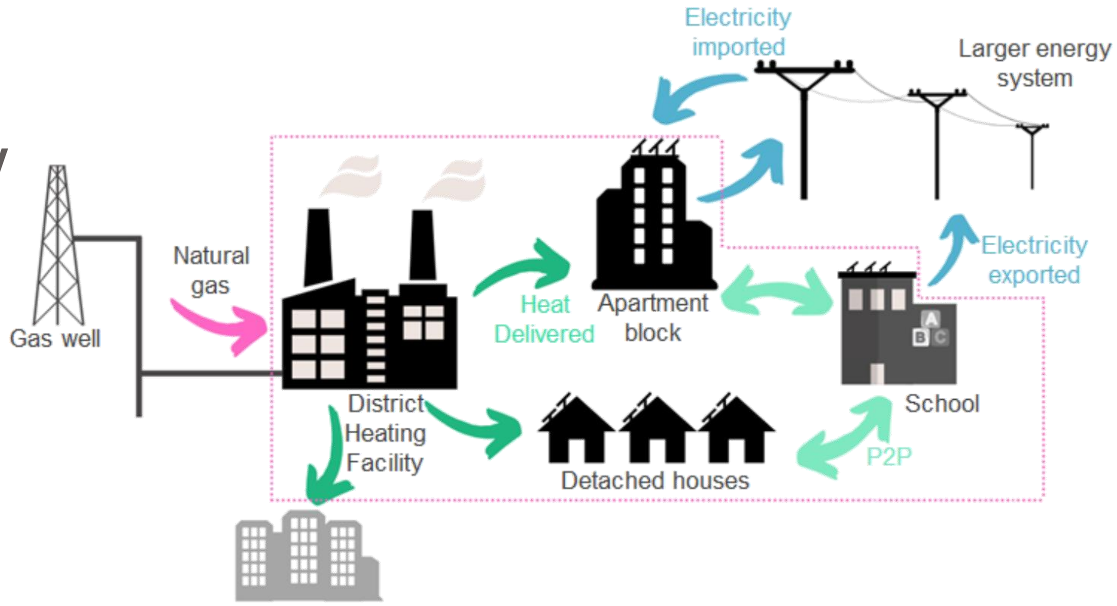
- Upscaling (5 PCEDs)
- Replication

Rubén García Pajares - rubgar@cartif.es - CARTIF Technology Centre

Positive and Clean Energy Districts (PCED)

PCED is a district that implementing Clean Energy Solutions produces more energy than consumes.

This Energy Surplus can be shared with other districts helping the Climate Neutrality of our Cities



High performance BUILDINGS

RES systems ON-SITE

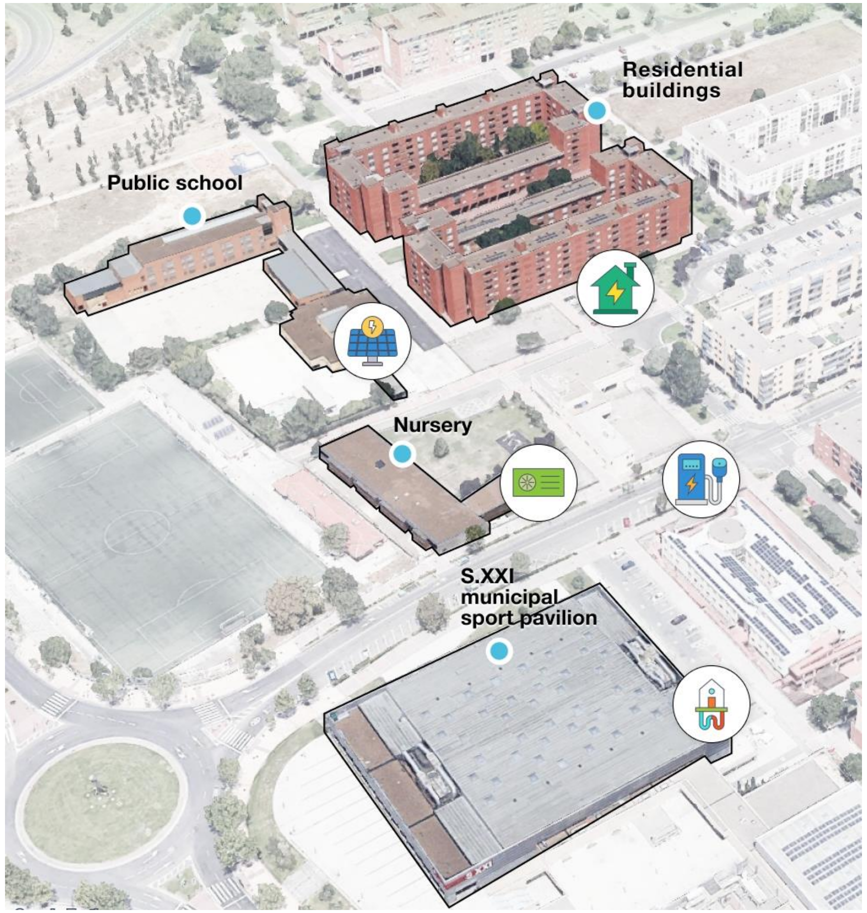
energy STORAGE

Energy flexibility & sharing

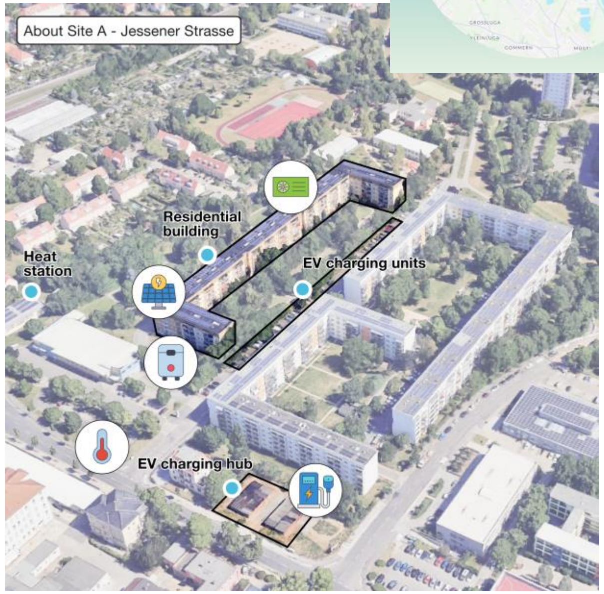
SMART control & Energy OPTIMIZATION

PCED implementation in Lighthouse Cities

- ZARAGOZA



- DRESDEN



FROM DEMONSTRATION TO LONG-TERM CITY TRANSFORMATION
accelerating climate-neutrality

Outline how the PCED concept can be integrated in the long-term strategies of the cities:

- Full design process of 3 PCEDs in the fellow cities
- Design of 2 additional PCEDs in the lighthouse cities

- Selection of the districts, design of the solutions, and definition of financial schemes.
- Identification of recommendations on new regulations, policies and for the development of the CCC.

Ghent

- 'Muide-Meulestede' and 'Mariakerke' are implementing projects.
- Potential PCED in Muide-Meulestede.

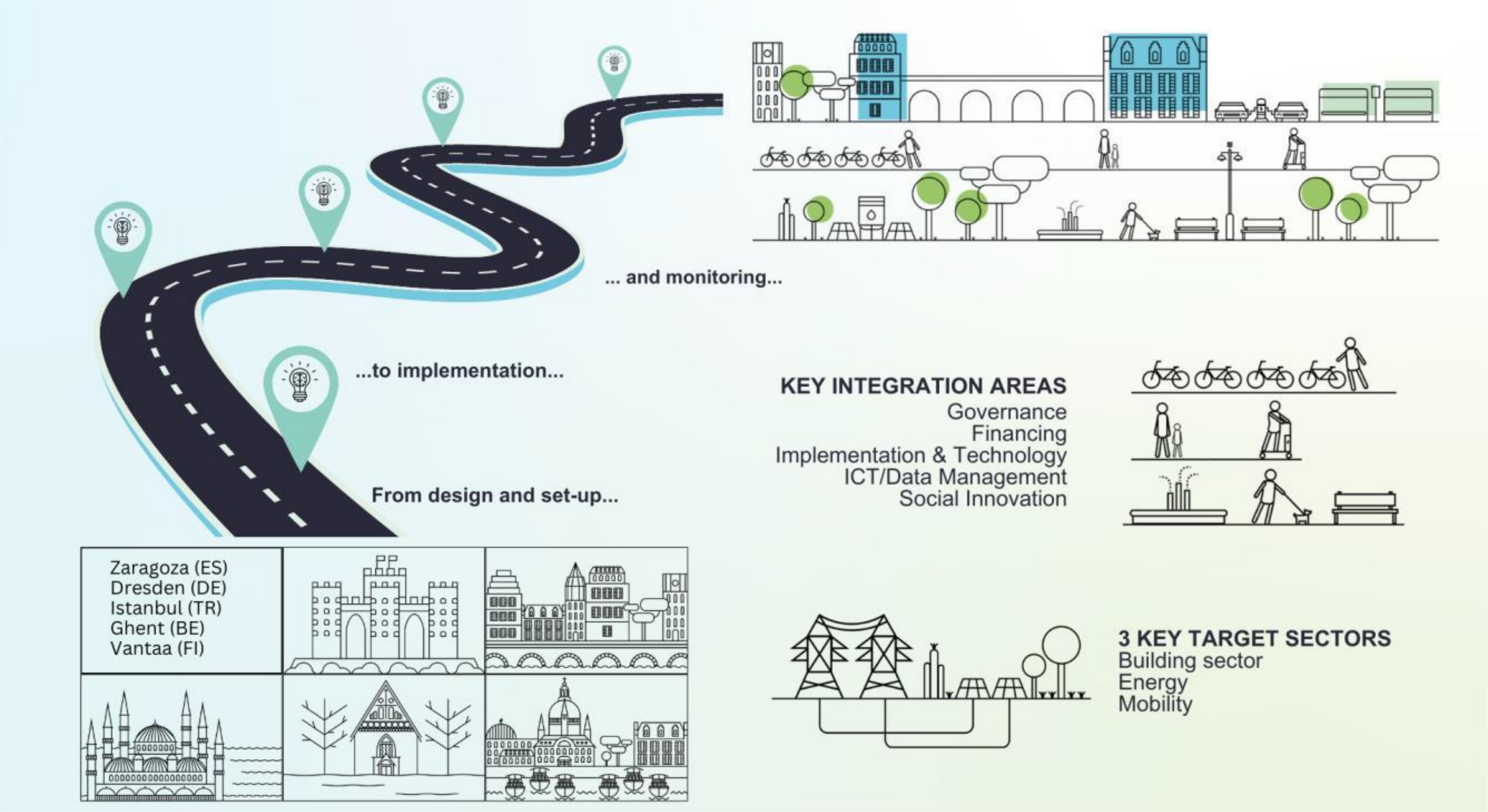
Istanbul

- One of the Mission Cities.
- Potential PCED in Ghazane.

Vantaa

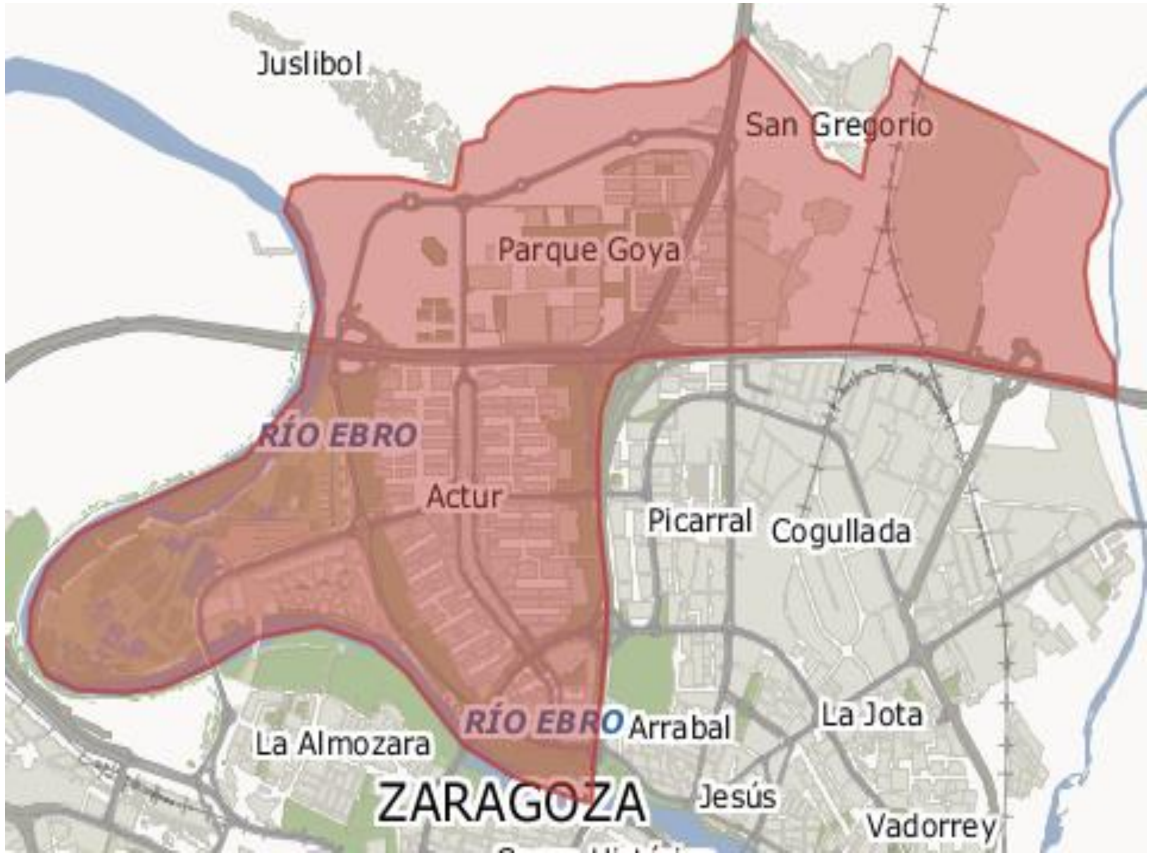
- Potential PCED in Aviapolis, which is one of the fastest growing areas.

…a journey toward the set-up of PCED



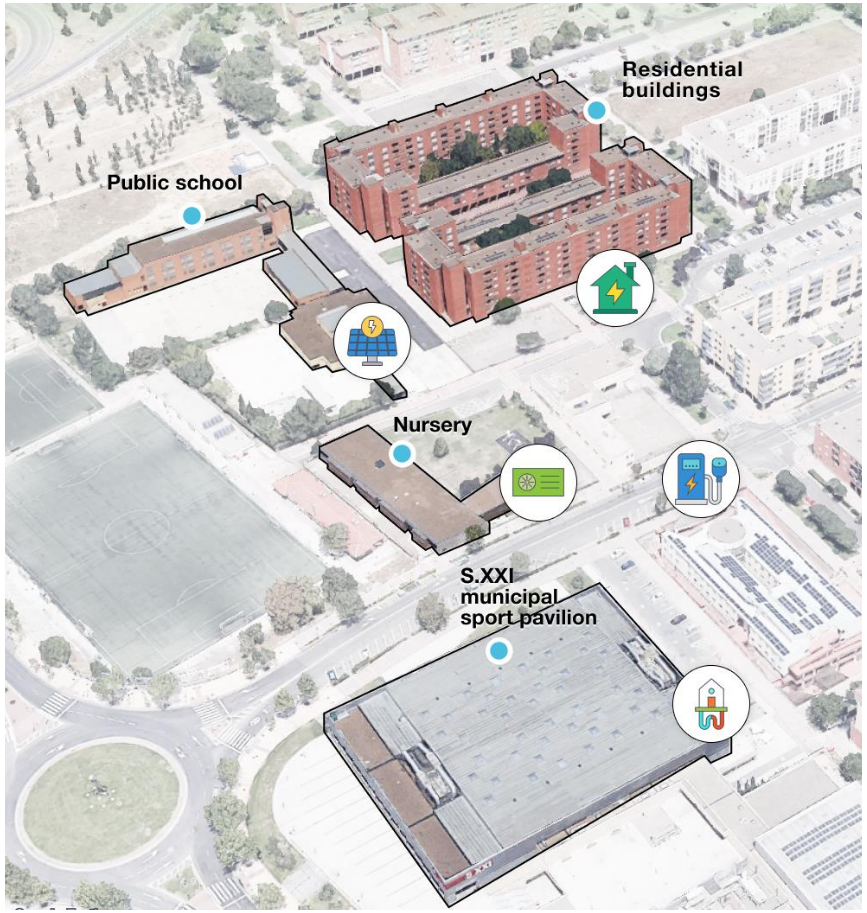
PED for Climate Neutrality: Zaragoza's demo case

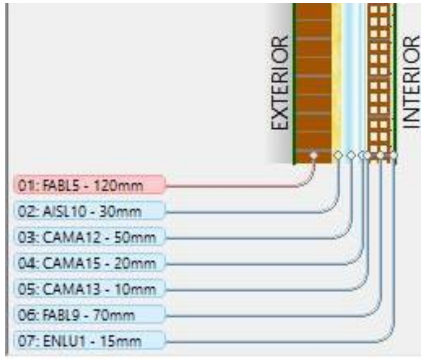
- ZARAGOZA demo PCED



Building Retrofitting for high efficiency

- Façade insulation with blowing granules of recycled polyurethane foam from recycled refrigerators





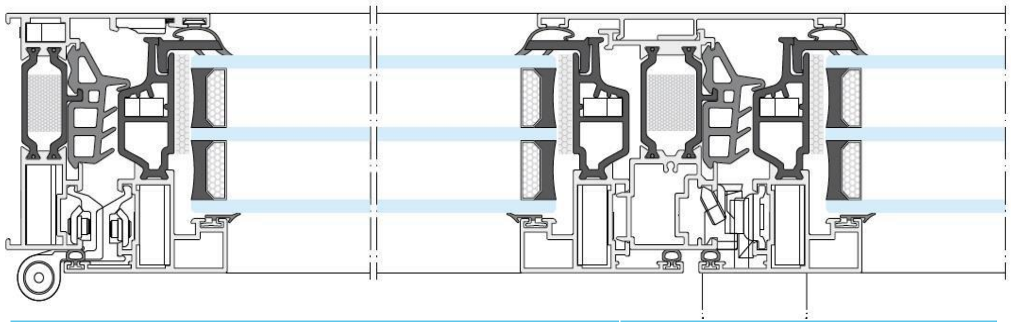
A2	Baseline	Refurbished	Improvement [%]
Thermal transmittance of façades U [W/m²k]	0,585	0,319	56%

The existing façade is composed of 1/2-foot masonry of exposed brick on the outside with interior cement plaster, thermal insulation of sprayed polyurethane foam, 7 cm air chamber and double hollow brick partition of 7 cm, trimmed and plastered inside the houses.

Rehabilitation of all the facades of the residential buildings to improve the insulation of the existing chambers by blowing granules of recycled polyurethane foam from recycled refrigerators. This insulation is suitable for high-capacity thermal insulation.

Building Retrofitting for high efficiency

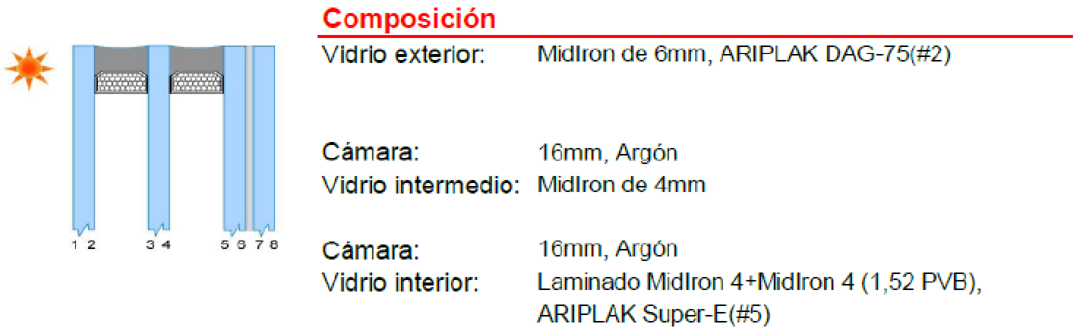
- Improvement of window carpentry



A3	Baseline	Refurbished	Improvement [%]
Thermal transmittance of windows U [W/m²k]	2,8	0,88	318 %

- Original windows are hinged, some with a fixed part, made of wood and double glass, with interior wooden shutters
- Improvement through a hidden profile window with great glazing capacity.

- DAG75 for window glass

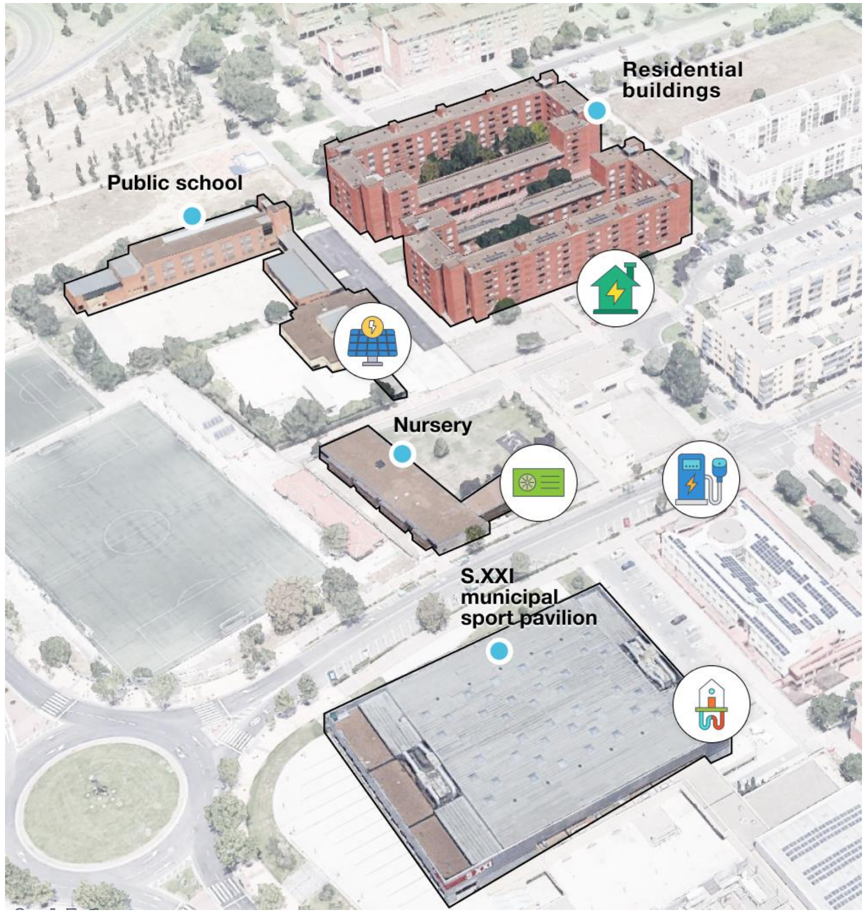


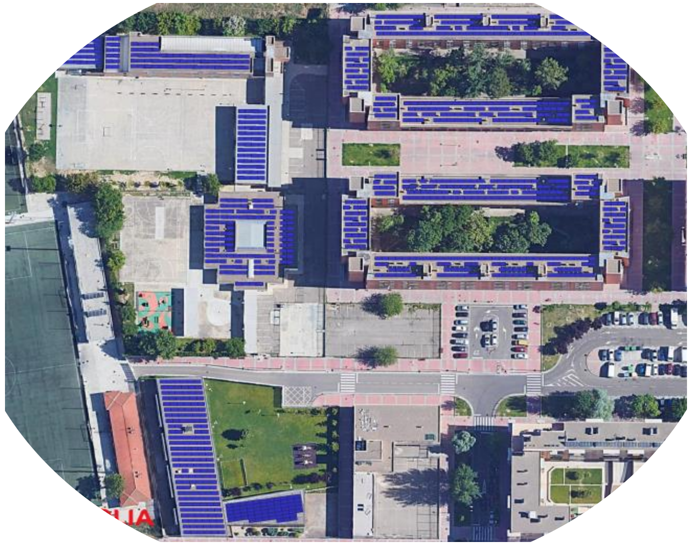
A3	Baseline	Refurbished	Improvement [%]
Thermal transmittance of glass U [W/m²k]	3,3	0,6	550 %

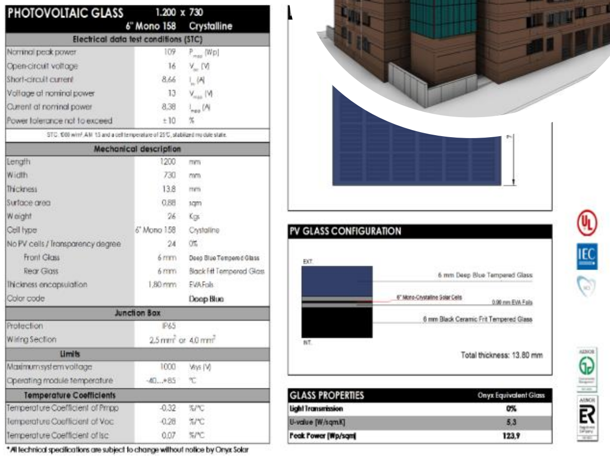
- A high-performance coating with higher visible transmission, ideal for residential applications has been developed
- The new windowpane will also include "warm edge" technology, using special glass spacers to achieve a low linear thermal bridge between the glass and the window frame.

Energy solution for our PCED

- Geothermal ring + Water to water heat pumps for **heating electrification**







PHOTOVOLTAIC GLASS	1.200 x 730	
	6" Mono 158	Crystalline
Electrical data test conditions (STC)		
Nominal peak power	109	P_{mpp} (Wp)
Open-circuit voltage	16	V_{oc} (V)
Short-circuit current	8.66	I_{sc} (A)
Voltage at nominal power	13	V_{mpp} (V)
Current at nominal power	8.38	I_{mpp} (A)
Power tolerance not to exceed	± 10	%
STC: 1000 w/m², AM 1.5 and a cell temperature of 25°C, stabilized module state.		
Mechanical description		
Length	1200	mm
Width	730	mm
Thickness	13.8	mm
Surface area	0.88	sqm
Weight	26	Kgs
Cell type	6" Mono 158	Crystalline
No PV cells / Transparency degree	24	0%
Front Glass	6 mm	Deep Blue Tempered Glass
Rear Glass	6 mm	Black Frit Tempered Glass
Thickness encapsulation	1,80 mm	EVA Foils
Color code		Deep Blue
Junction Box		
Protection	IP65	
Wiring Section	2.5 mm² or	4.0 mm²
Limits		
Maximum system voltage	1000	Vsys (V)
Operating module temperature	-40...+85	°C
Temperature Coefficients		
Temperature Coefficient of Pmpp	-0.32	%/°C
Temperature Coefficient of Voc	-0.28	%/°C
Temperature Coefficient of Isc	0.07	%/°C

*All technical specifications are subject to change without notice by Onyx Solar

PV GLASS CONFIGURATION

EXT.
6 mm Deep Blue Tempered Glass
6" Mono-Crystalline Solar Cells
0.90 mm EVA Foils
6 mm Black Ceramic Frit Tempered Glass
INT.
Total thickness: 13.80 mm

GLASS PROPERTIES	Onyx Equivalent Glass
Light Transmission	0%
U-value [W/sqm.K]	5,3
Peak Power [Wp/sqm]	123,9

low temperature (LowEx) geothermal ring that circulates water from a nearby existing well to provide a stable source of heat (15ºC approx.) for six water-to-water heat pumps that will be installed in the buildings that are part of the district.

Thank you!

2030
NEUTRALPATH

FEDErated “system of systems” approach for flexible and interoperable energy COMmunities

FEDECOM Project introduction

GORKA NAVERAN LANZ
(GIROA-VEOLIA)

ENLIT Bilbao
November 2025

Funded by
the European Union

FEDECOM

Project introduction - partners

TYPE OF PARTNERS:

- Research centres
- University
- Software developers
- End user
- Energy operator
- DSO
- ……

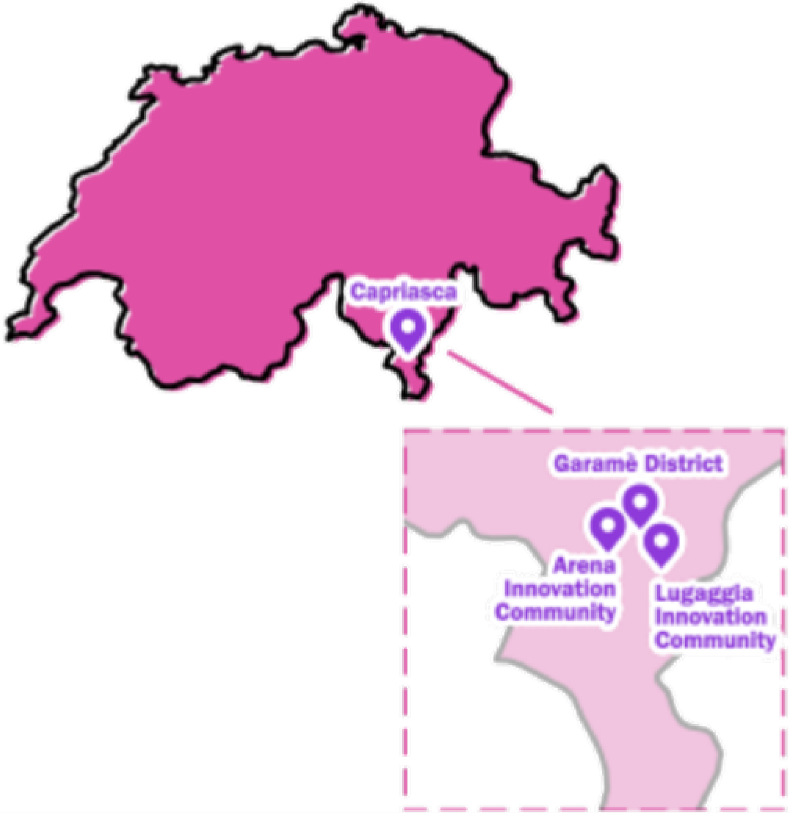
FEDECOM

Project introduction - pilots

PILOTS

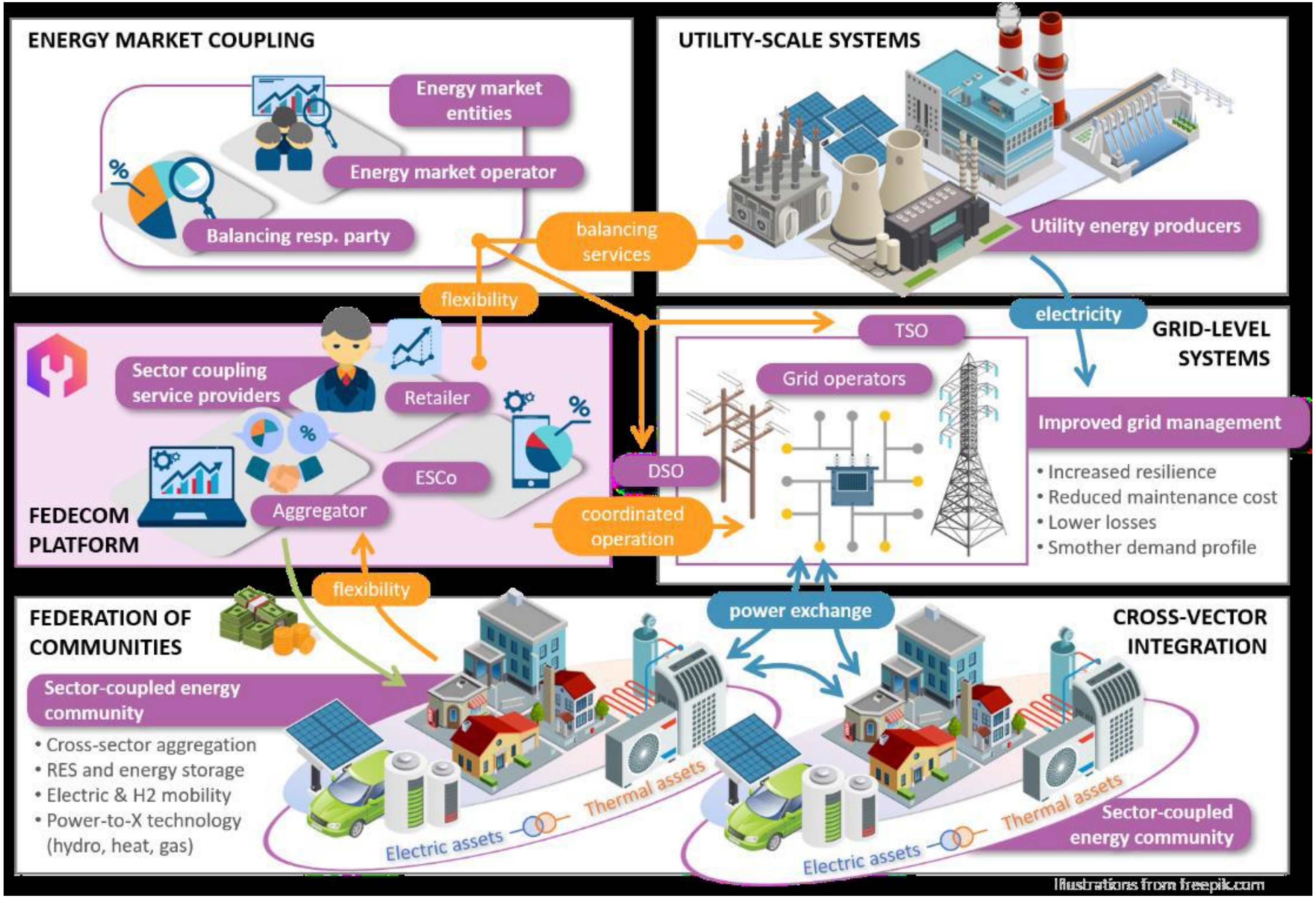
Virtual Green H2 Federation
Spain

Residential Hydropower Federation
Swiss



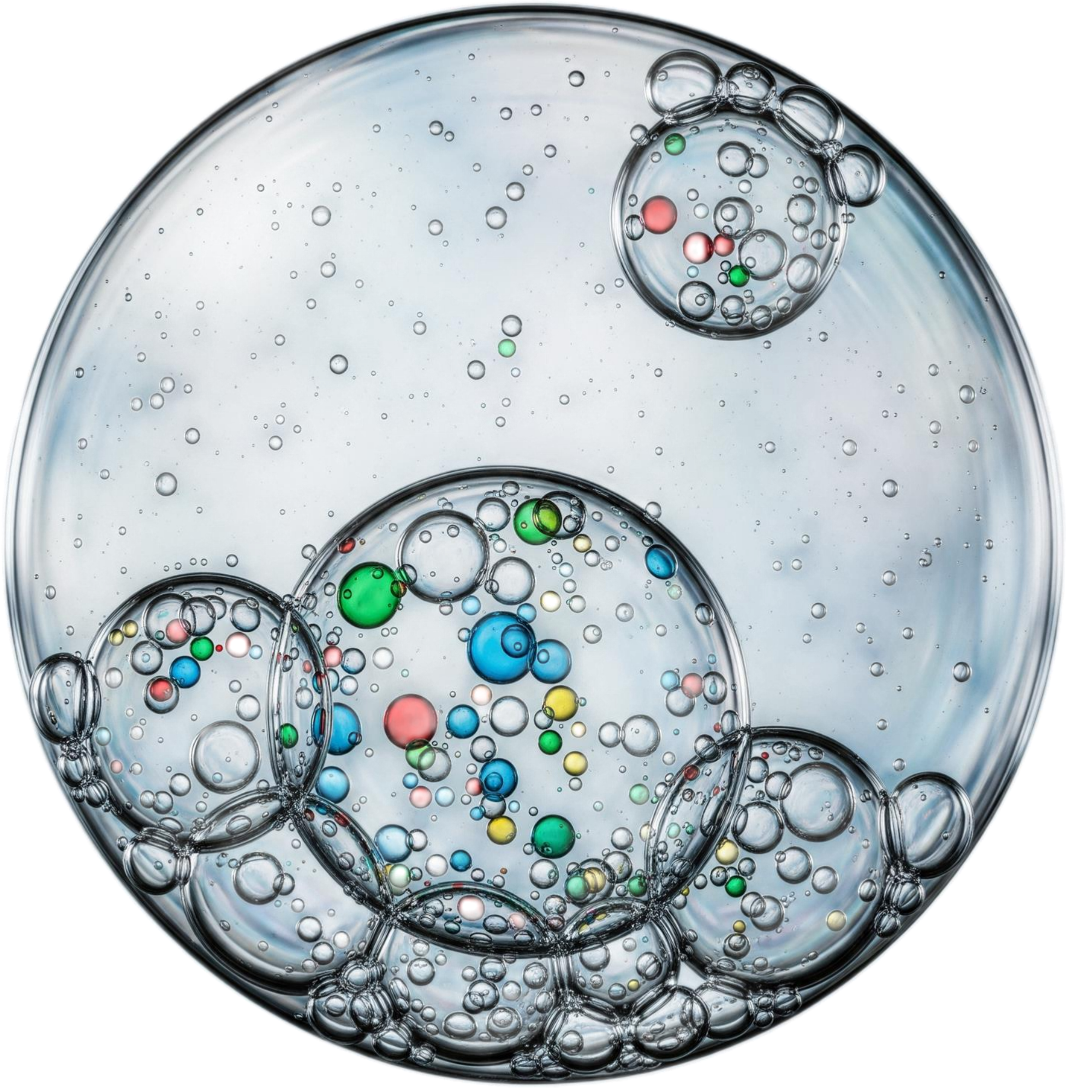
Cross-country e-Mobility Federation
Benelux / Netherlands

Project introduction - platform



FEDErated "system of systems" approach for flexible and interoperable energy COMmunities

A new energy market "more open and democratic"



How can we achieve this new electricity market?

P2P

Power to X

Cross vector

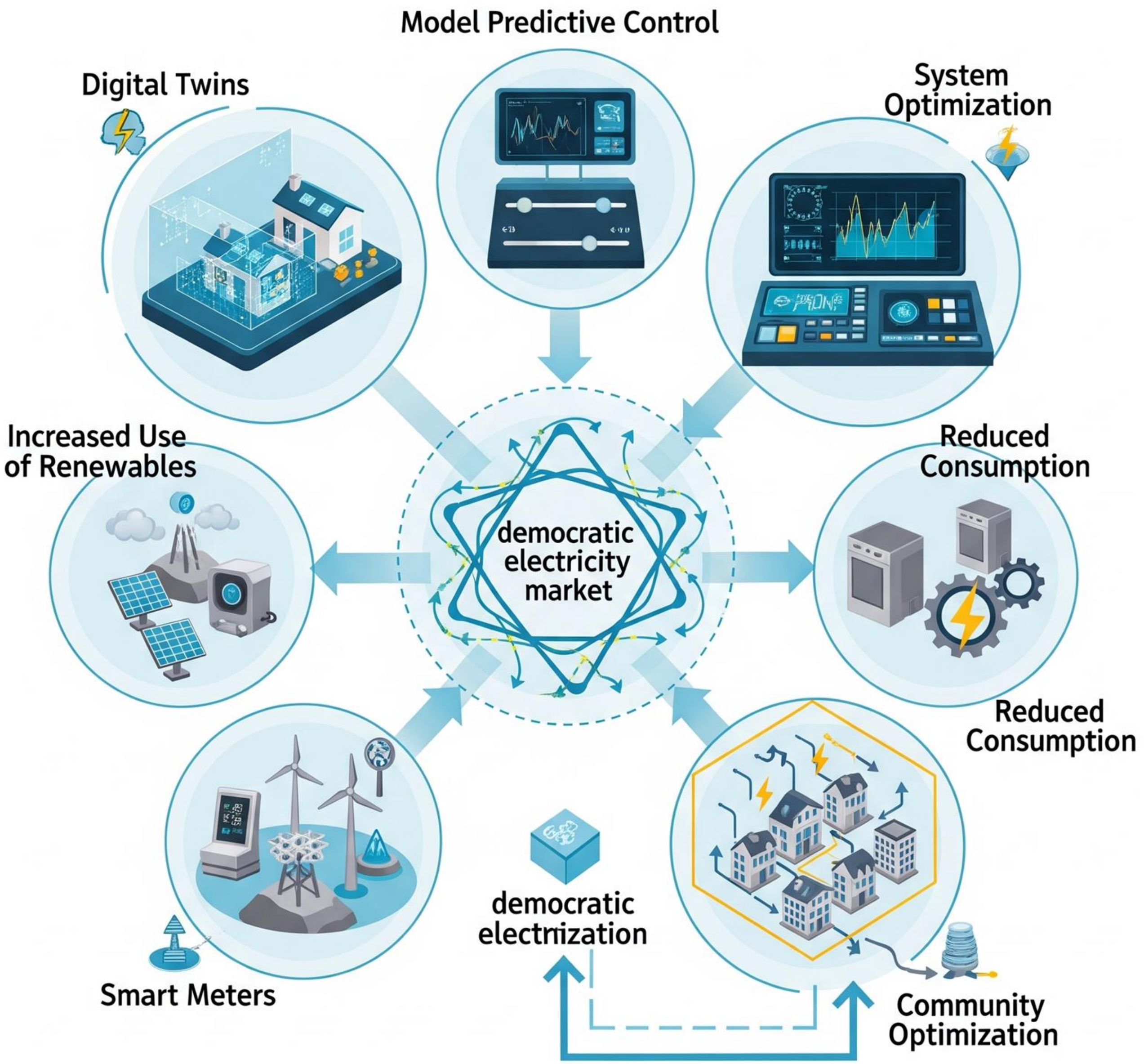
Model predictive controls

Digital twins

System optimization

RES/DER

....



What does Power To X and Cross Vector mean?

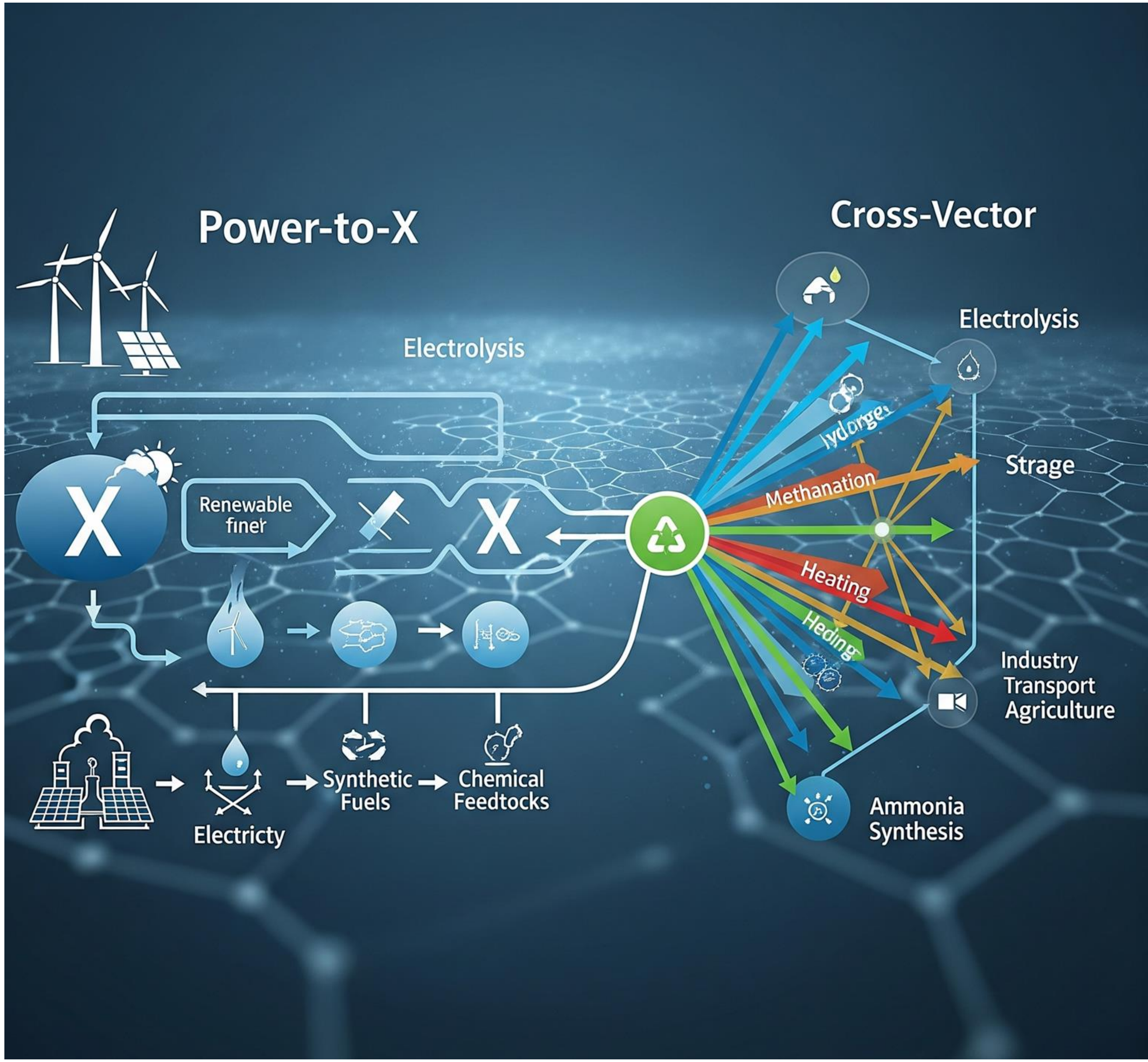
Use of RES as primary energy

Implement MPC

Using Forecast Services

Aggregate DER

....



Why use MPC?

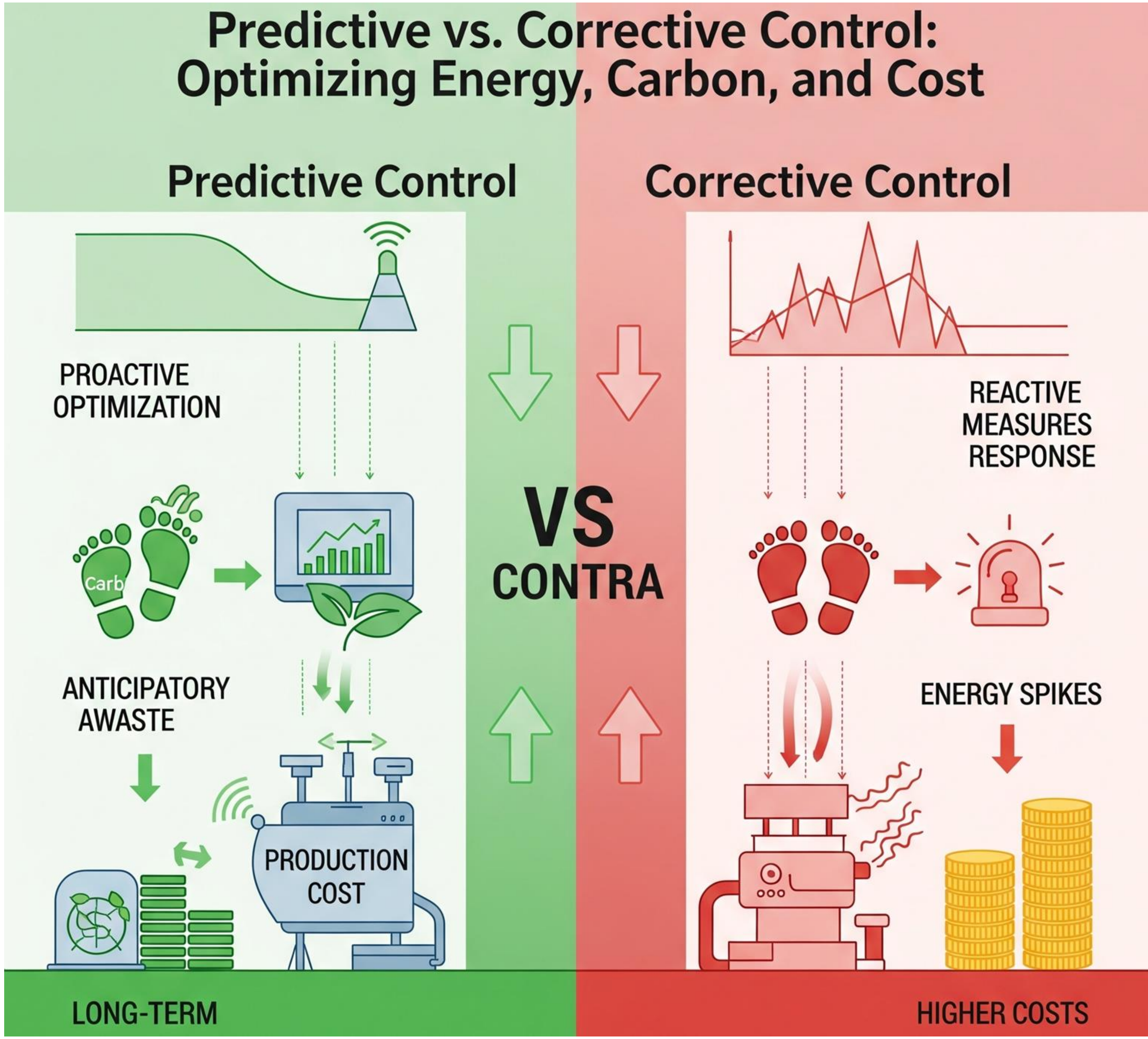
Increase of RES as primary energy

Optimized operation

Increaser assets lifetime

Reduce OPEX

….



Expected Impact

Social:

- Over 20% final energy savings
- Increased local RES hosting contributing to EU 2030 target of 40% share
- Contribute to EU 2030 target for GHG emission reduction of at least 55%
- High consumer satisfaction and solution acceptance

Economic:

- 20 - 50% energy cost savings for the final consumers
- Innovative and integral business models for service providers and grid stakeholders, unlocking services across the energy value chain
- Up to 30% saving in total grid CAPEX and OPEX by cross-energy vector coupling and DR services, together with improved system stability and reduce grid maintenance
- Increased consumer engagement and joint investments in DR and renewable energy solutions

Scientific & technological:

- Over 30% of total load available for grid balancing and ancillary services, unlocking demand side flexibility of energy communities
- Cross-platform and smart grid interoperability, facilitating replication of concepts across stakeholders and sectors.

Thank you

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Co-funded by the European Union

Grant Agreement number 101075660

INTERPED

InterPED: The Role of Citizens as Key Enablers of Positive Energy Districts

ENLIT, Bilbao, 20th November 2025

Lorena Sánchez Relaño, R2M Spain

Co-funded by the European Union

The Project – Quick Facts

Project Coordinator:

Raymond Sterling - Lorena Sánchez Relaño

R2M Solution Spain SL

Project number: 101138047

Project name: INTERoperable cloud-based solution for cross-vector planning and management of Positive Energy Districts

Project acronym: InterPED

Start: 01/01/2024

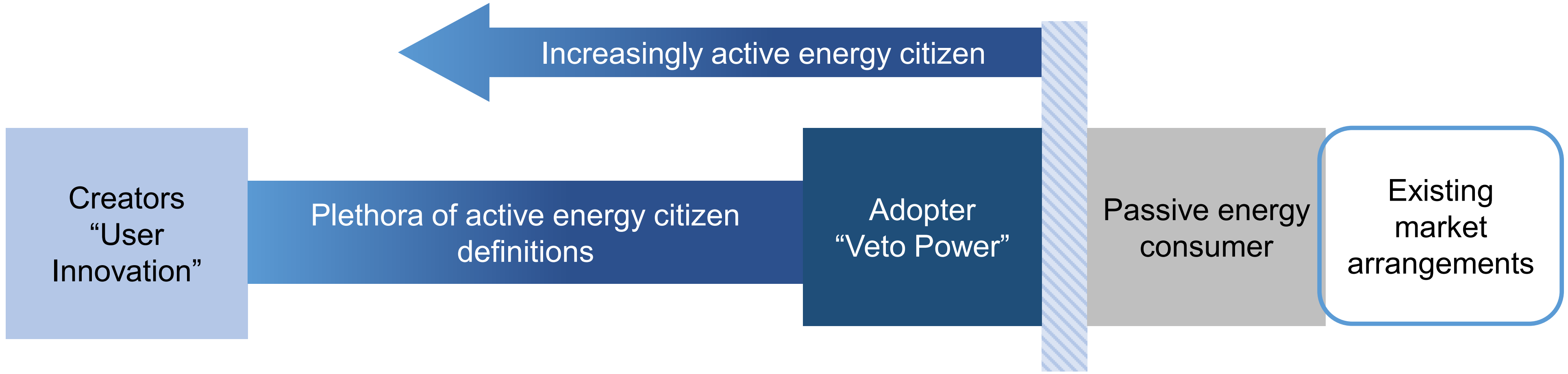
Duration: 36 months

Costs: €6,978,353

Funding: €4.884.847

InterPED challenge: from “Passive Consumers” to “Active Energy Citizens”

- **Context:** The energy transition requires a change from centralised to decentralised systems - Positive Energy Districts (PEDs).
- **Problem:** Technology alone creates infrastructure, but not a community. Top-down, technocratic solutions often fail to engage end-users.
- **Solution:** Active participation improves problem diagnosis, ensures legitimacy, and empowers citizens to modify consumption behaviour - Demand Response (DR).



Methodology: Participatory design with citizens

1. Topic Identification Phase

- Engage in discussions with community leaders to identify key topics relevant to the community.

2. Material Development Phase

- Develop Participatory Literacy Material (e.g. picture cards- interactive tools) that will be used in literacy session to engage participants.

3. Participatory literacy session

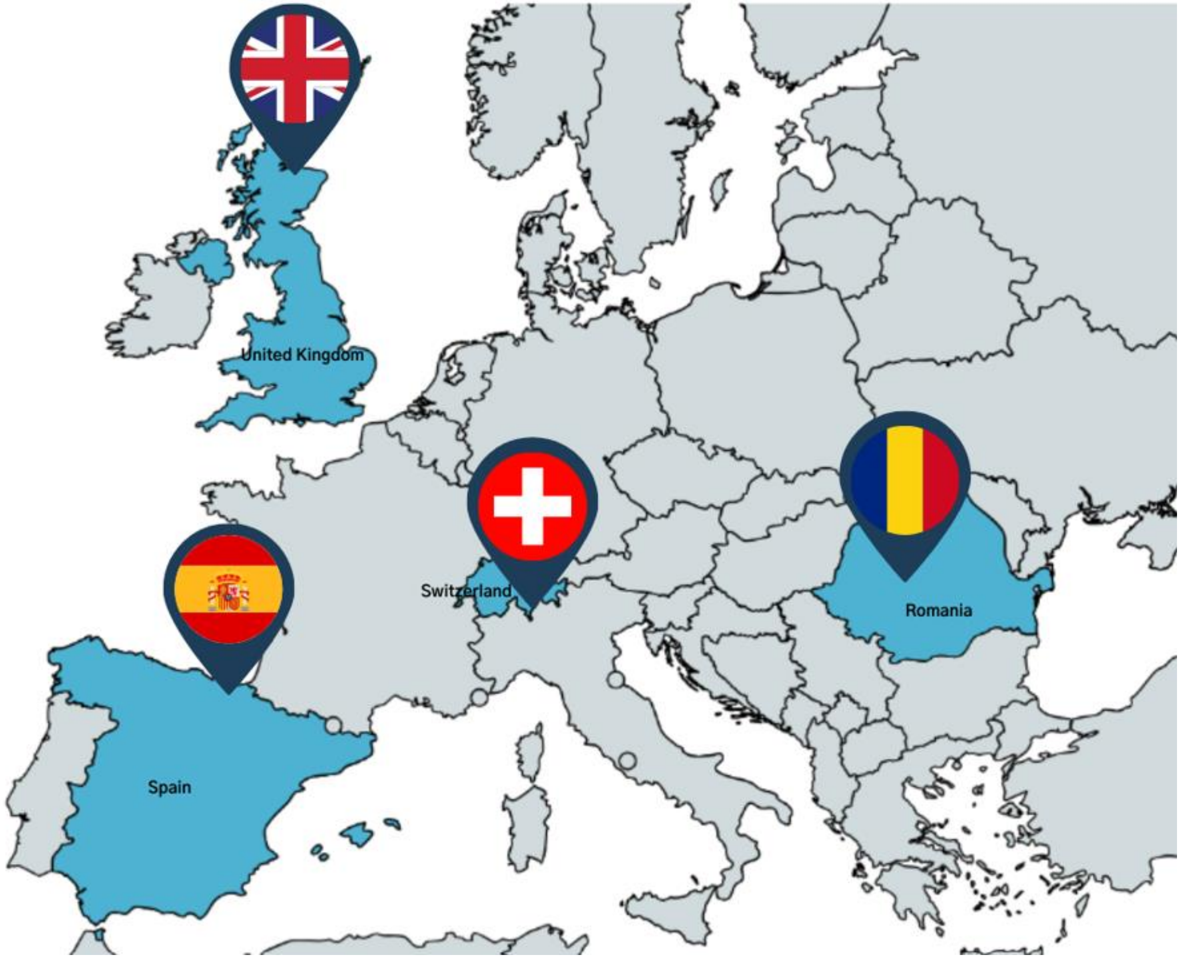
- Conduct sessions to enhance participants' energy literacy

4. Analysis and Refinement Phase

- Analyse participant's feedback and create co-dictionary for energy community

Strategy adaptation: Solutions tailored to each pilot

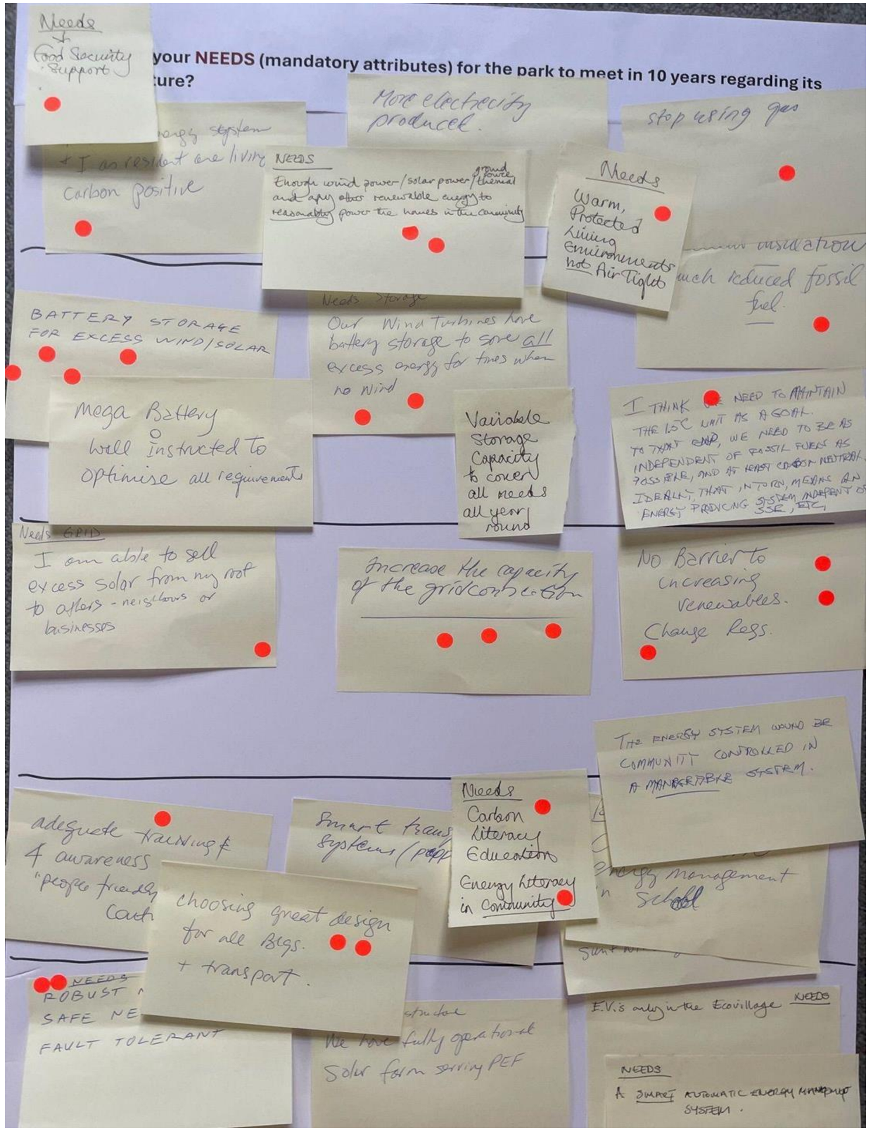
1. **Lugaritz-Matia Community (ES):** Healthcare buildings (vulnerable users) -> Post-Occupancy Evaluation Survey (Comfort focus).
2. **Findhorn (UK):** Residential ecovillage with high cohesion -> Deep participation & Co-creation workshops.
3. **Arena Innovation Community (CZ):** Residential, commercial sectors and tertiary sector buildings -> Educational workshops & Simulation tools.
4. **Alba Iulia Municipality (RO):** Tertiary and public sector buildings -> Visioning workshops & Legal framework advocacy.

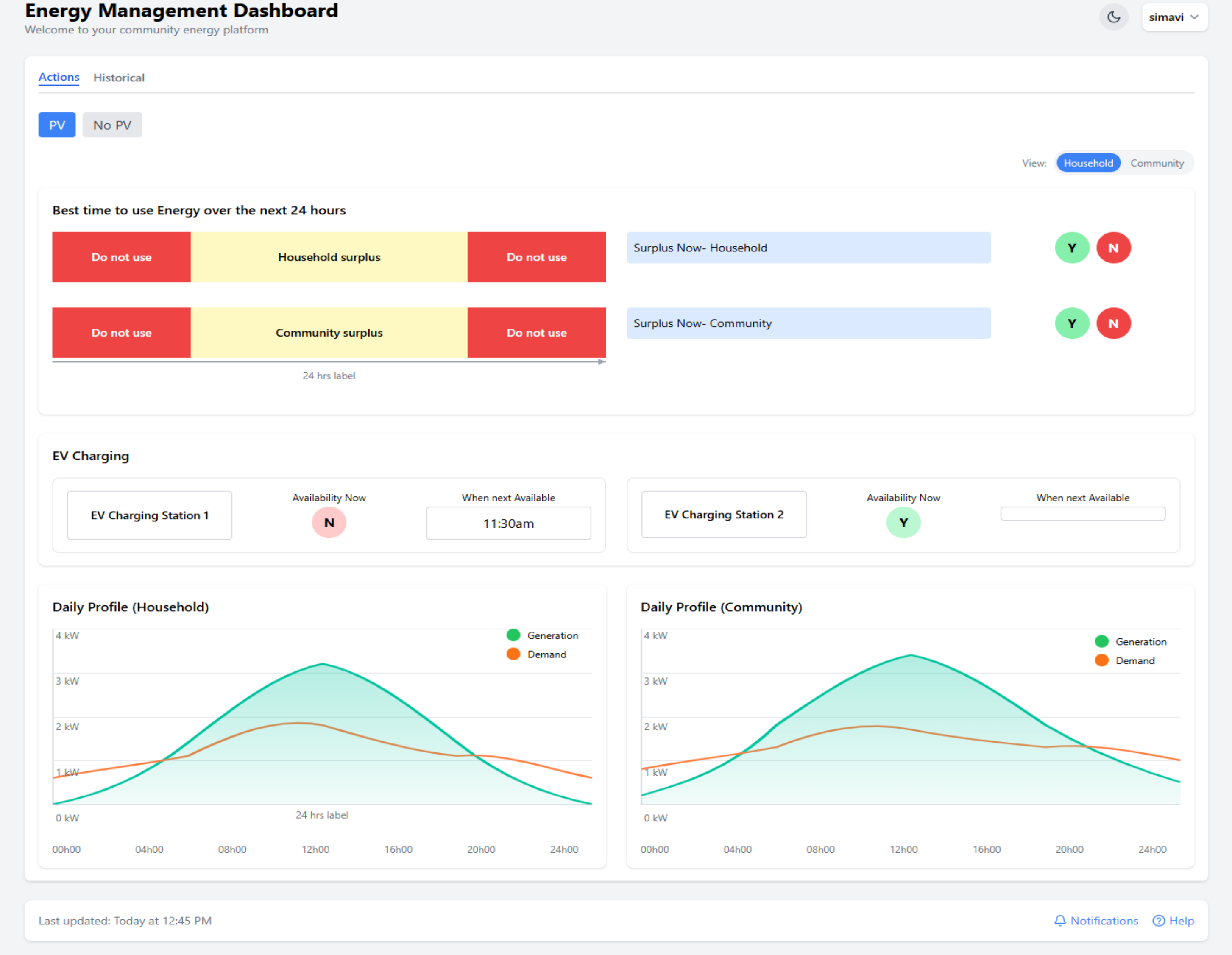


Case Study 1: Findhorn Ecovillage and the Energy Management Dashboard

- Citizens initially requested complex Peer-to-Peer (P2P) trading features for the InterPED platform.
- **Workshops** revealed confusion about immediate actions -> **Scope simplified** to reflect only current feasible options.
- **Result:** A user-centered interface co-designed to support decision-making.
  - Real-time Status: Visibility of EV charging station availability.
  - Energy Profiles: Visualisation of generation vs. consumption and surplus energy.
  - Forecasting: Indicators for the best time to use energy.

Case Study 1: Findhorn Ecovillage and the Energy Management Dashboard



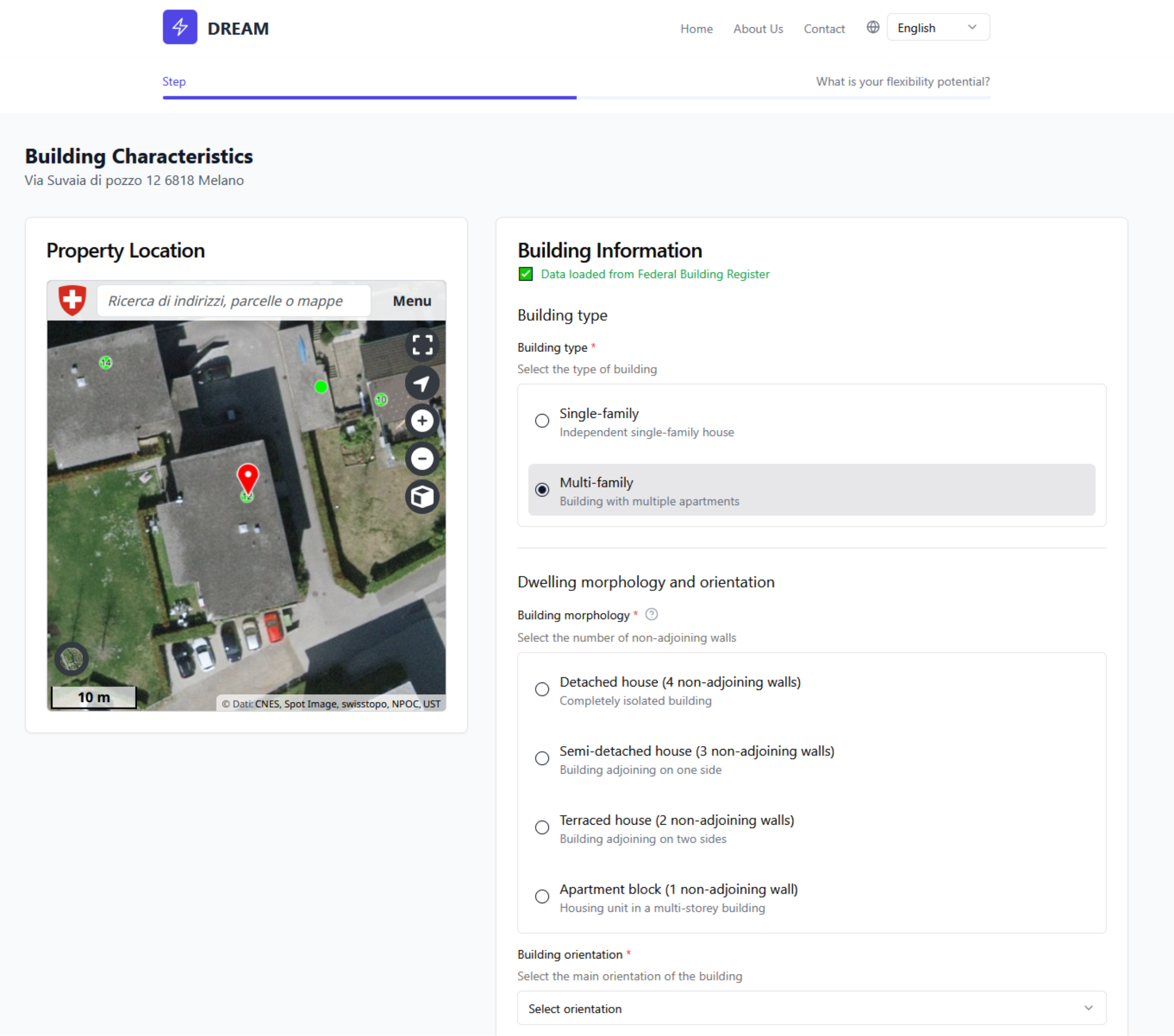


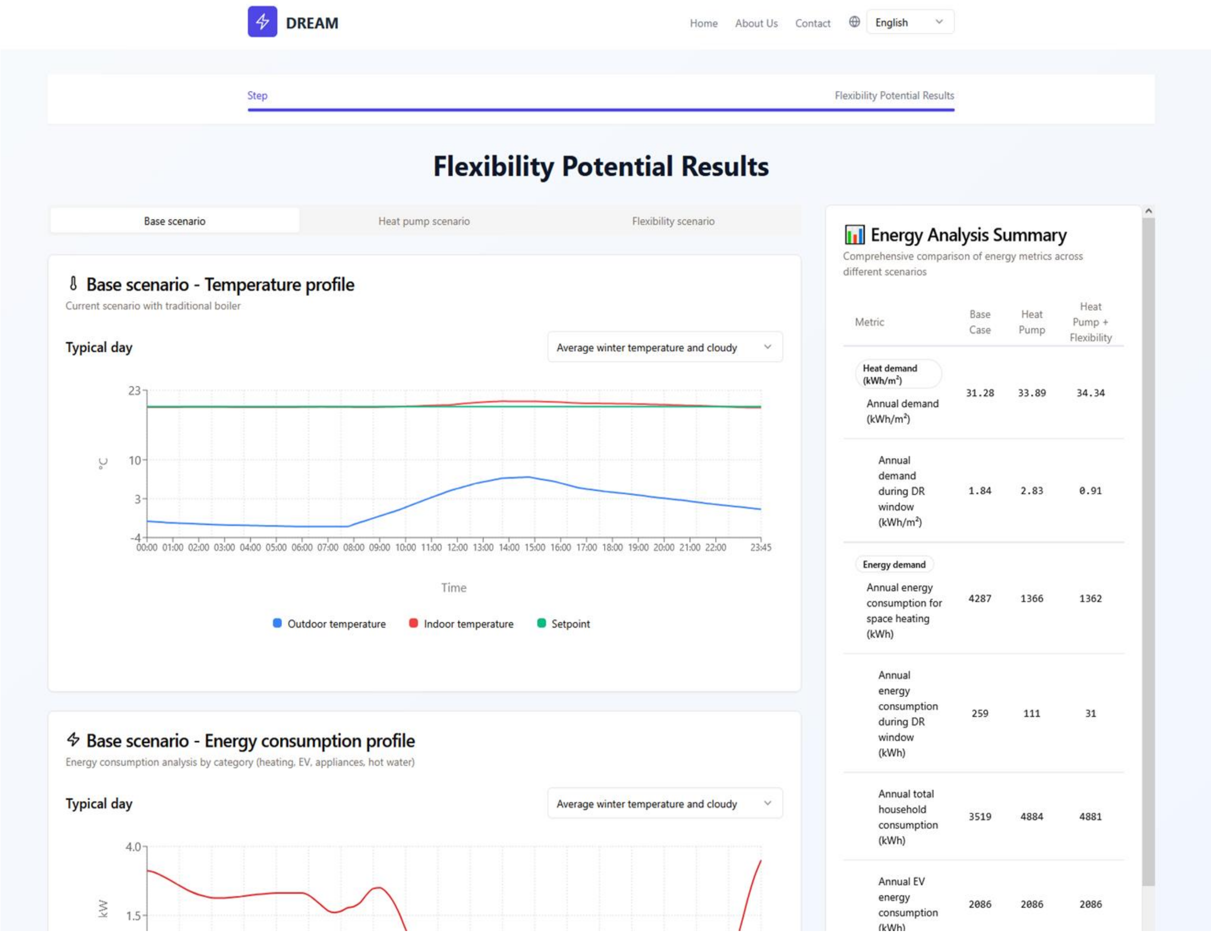
Case Study 2: Arena Innovation Community and the DREAM tool

- **Low citizen awareness** detected regarding concepts like Flexibility and Demand Response (DR).
- **Users cannot co-design DR strategies if they don't understand the trade-offs** -> Users simulating "what-if" scenarios in workshops to see the impact of behavioural change before implementation.
- **Result:** Development of an interactive Demand Response Energy Awareness Model (DREAM) tool for households (web-based simulator):
    - Input: building characteristics and flexibility strategies.
    - Output: visual impact on costs, CO_2 emissions, and thermal comfort.

Identification	
Pilot	*Arena Innovation Community*
Use Case	*Flexibility simulation tool*
Story Title	*Economic and Environmental Impact of Adjusting Heating Setpoint*
Story ID	*P3_UserStory1*
Priority	*M*
User Story	
As a (*Actor identification*)	*Domestic user utilizing the flexibility simulation tool to assess the impact of adjusting my heating setpoint temperature*
When (Optional)	*Reviewing the simulation outputs*
I want to	*See the estimated economic and environmental savings compared to not adjusting my thermostat*
In order to	*Understand how profitable it is to lower the setpoint temperature during peak hours and determine its impact on my energy consumption and electricity bill.*
Acceptance	
Acceptance Criteria	*The tool should provide a clear estimation of personal economic savings (e.g., in CHF) and environmental savings (e.g., CO_2 reduction or similar metrics).* *The outputs should reflect the impact of specific flexibility actions on energy consumption (e.g., peak shaving) and costs.*

Case Study 2: Arena Innovation Community and the DREAM tool





Conclusions and lessons learnt

- ✓ Education and awareness must always precede technology deployment. What users do not understand cannot be automated.
- ✓ The lack of a legal framework for energy communities (like in the Alba Iulia pilot) shifts the focus from technology to regulation and bureaucracy.
- ✓ Participatory processes are essential to build lasting trust and a long-term engagement.
- ✓ Citizens are the main actuators of the PED. Their acceptance defines the success of its implementation.

Thank you!

Co-funded by the European Union

Scaling by design.

Governance, Business Models, and the Digital Tools Behind Them

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