SUSTAINABLE PLACES 2025

8-10 October 2025

Milano

COLLECTiEF

TOPIC

WORKSHOP

Smartness for energy flexibility and climate resilience

Smart Readiness Indicator for energy flexibility and climate resilience in action: Insights and lessons from the COLLECTiEF project across Europe

Collective Intelligence for Energy Flexibility

An EU H2020 Project for Enhancing Energy Efficiency and Flexibility in Existing Buildings

Mohammadreza Aghaei– Project Coordinator, NTNU

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 101033683.
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COLLECTiEF

Collective Intelligence for Energy Flexibility

- **15 partners**
  from 6 European countries

- **4 Years**
  June 2021-May 2025

- **4 urban pilots**
  to test our energy management system

COLLECTiEF Consortium

- Norwegian University of Science and Technology NTNU (Norway)
- Lund University (Sweden)
- The Cyprus Institute (Cyprus)
- Energy@Work (Italy)
- R2M Solution SRL (Italy)
- EM Systemer AS (Norway)
- NODA Intelligent Systems AB (Sweden)
- Geonardo Environmental Technologies Ltd. (Hungary)
- Scientific and Technical Center for Building (France)
- CETMA - Technologies Design and Materials European Research Centre (Italy)
- LSI Lastem (Italy)
- Ålesund Municipality (Norway)
- Teicos UE SRL (Italy)
- Virtual Manufacturing AB (Sweden)
- Politecnico di Milano (Italy)

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COLLECTiEF Team

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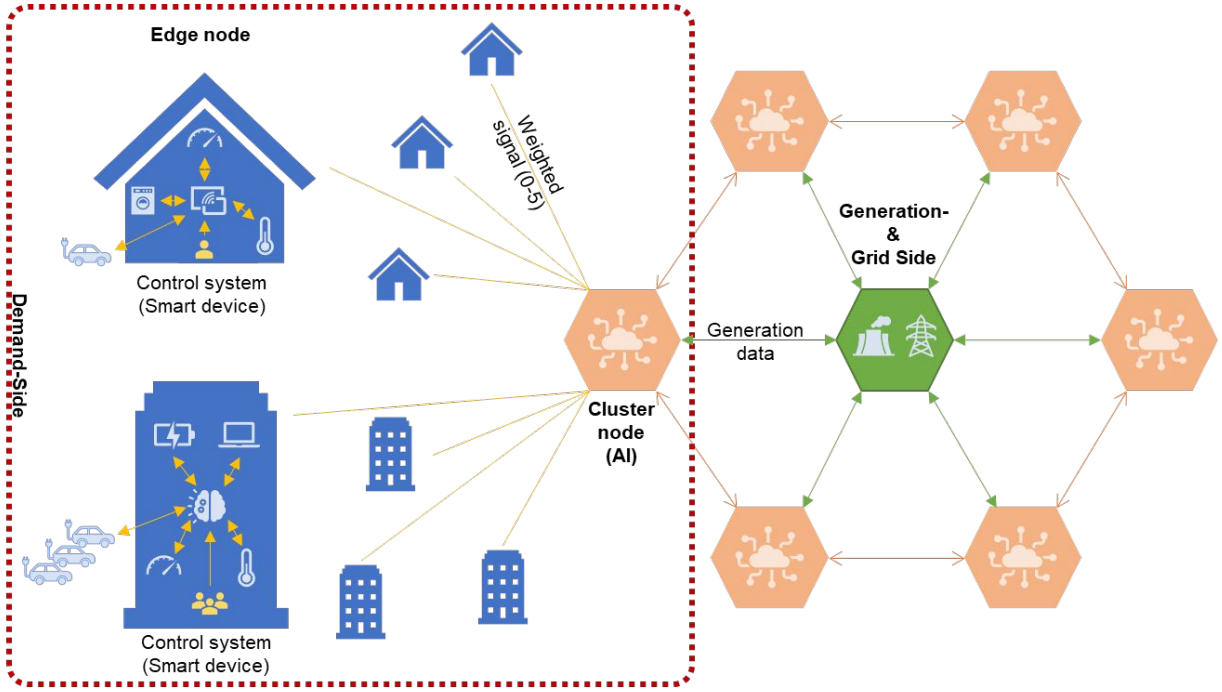
COLLECTiEF

Our Objectives

- We create **a CI-based energy flexible network** that ensures **low-cost installation** and **maximum data security**.
- We use **cost-effective components** to make our system **compatible** across Europe.
- We **test our system in 14 buildings** across the EU to prove its efficiency and adaptability to different climate zones
- We achieve more accurate and **non-invasive environmental monitoring** through sensors **focusing on user needs**
- We design a **smart, user-centric and user-friendly platform** to improve building management and **maximize energy saving**.



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COLLECTiEF
How?

The solution

We use **Collective Intelligence** to smart up existing buildings and their legacy equipment and improve their **energy performance** and **climate resilience**.

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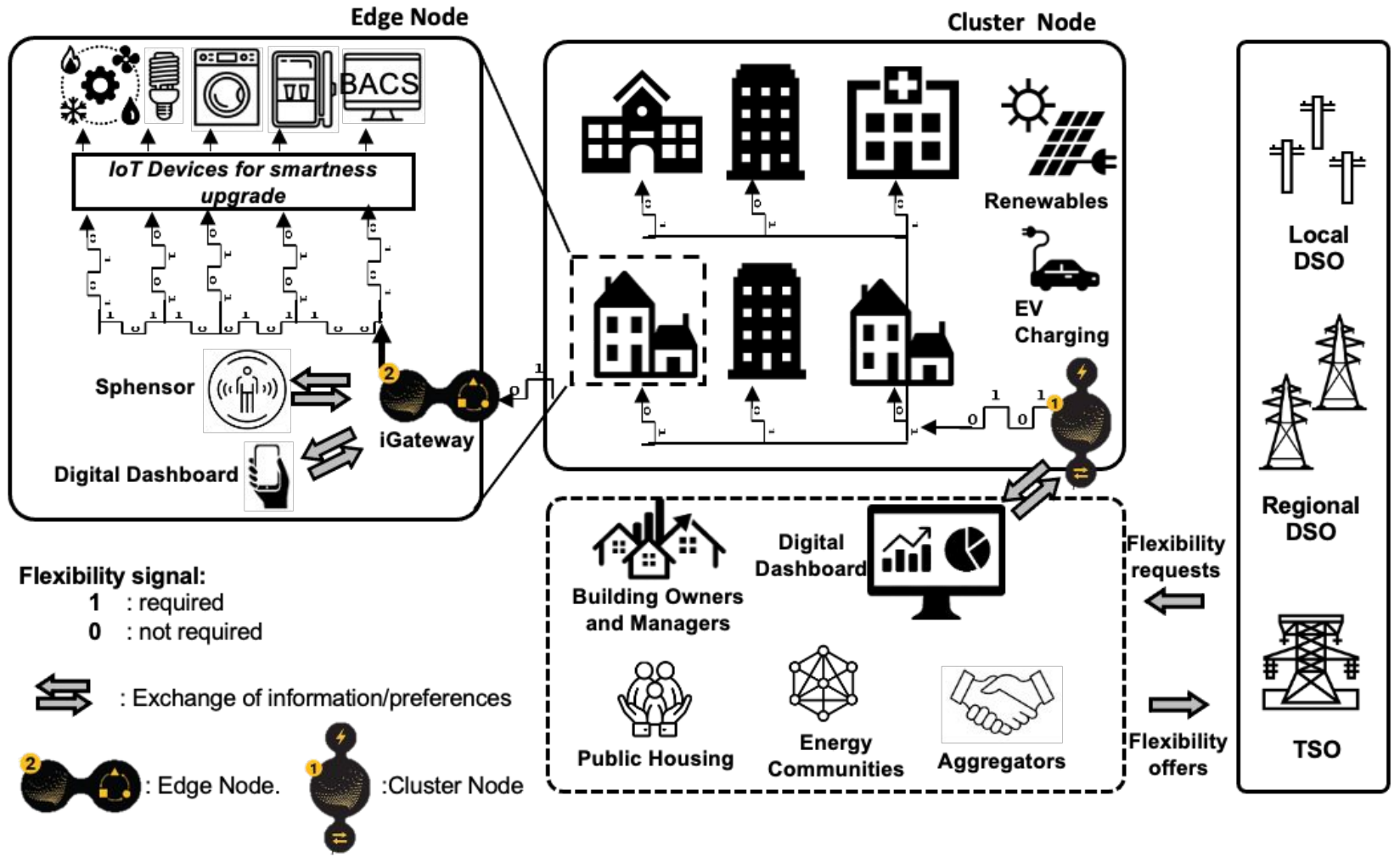
COLLECTiEF How?

Edge & Cluster Nodes



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COLLECTiEF
How?

How it works!

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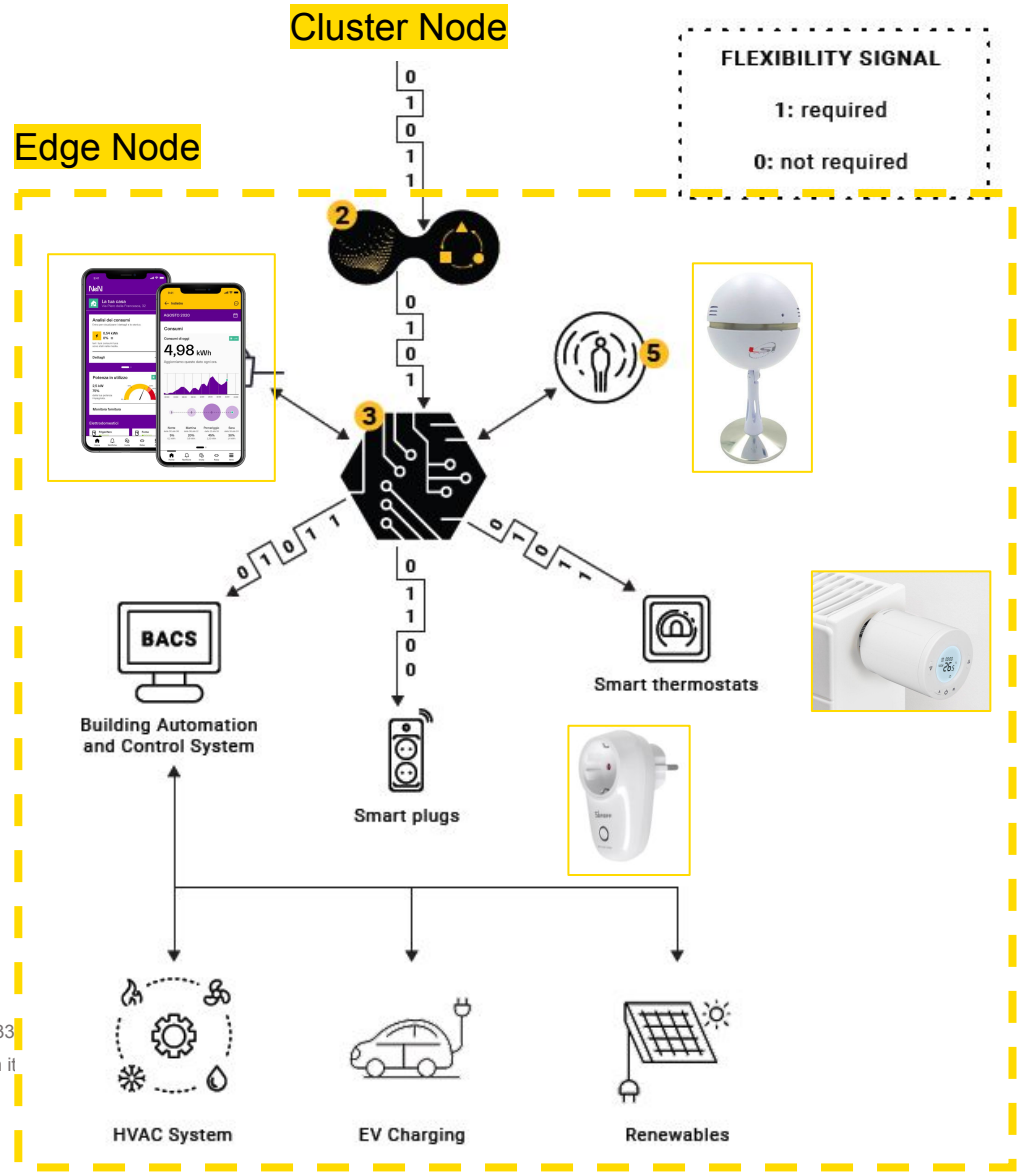
COLLECTiEF: Digital Technologies

1. **Supplier Node (CI-DSM, Noda Heat Network)**
2. **End-User Node (CI-DSM, NODA Building)**
3. **Interoperability platform (iGateway)**
4. **Building IoT operating system (Virtual)**
5. **Occupant-centric sensing unit (SphenSor)**



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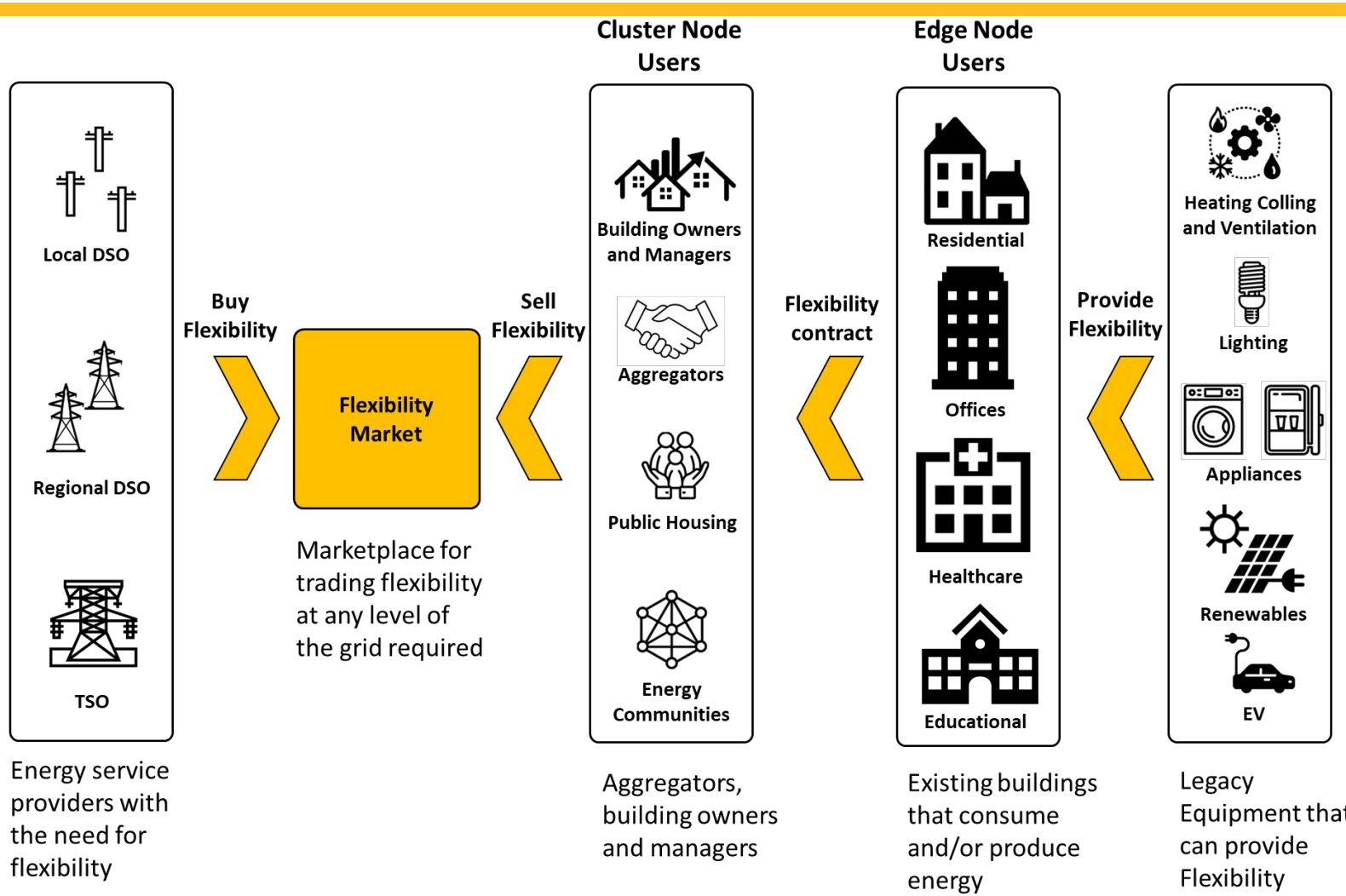
COLLECTiEF
How?

Business Model



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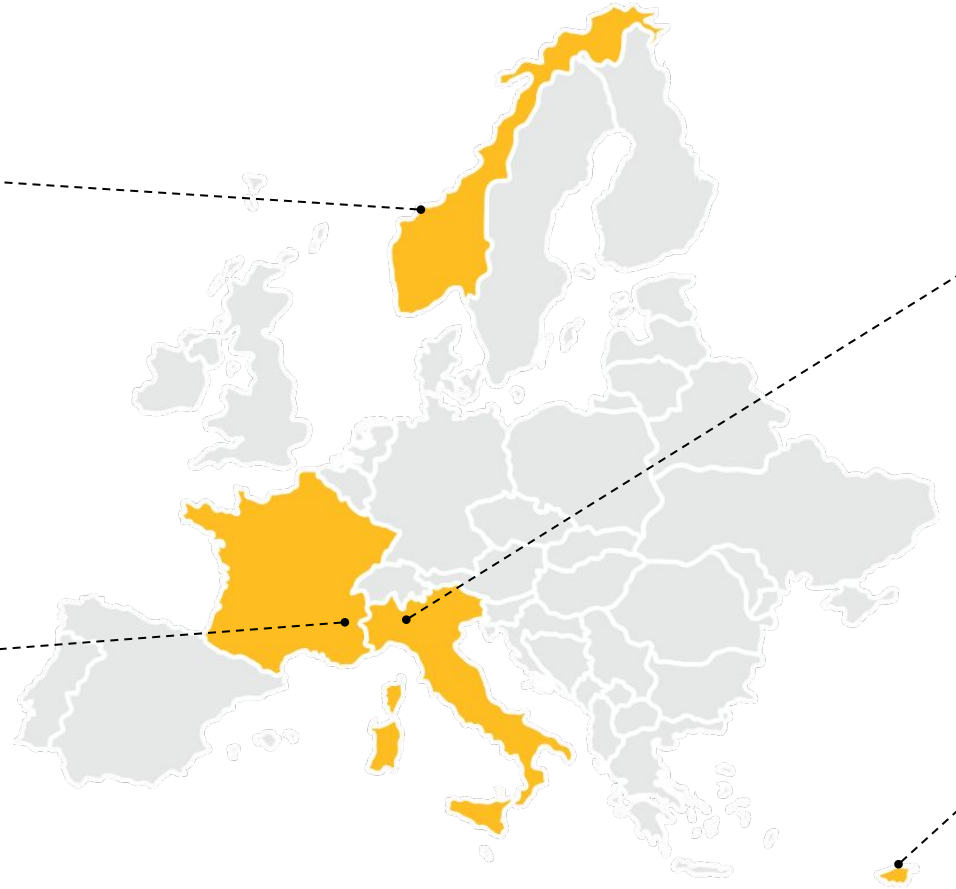
Our Pilots

Ålesund



Milano

Grenoble

Nicosia

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Pilot Buildings

EDUCATIONAL BUILDINGS



HEALTH CARE CENTERS


SPORTS ARENA

MEDICAL CENTER

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COLLECTiEF

Pilot Buildings

HIGHER EDUCATION (30%) WITH OFFICES (40%), LABORATORIES (30%), RESTAURANT (10%)

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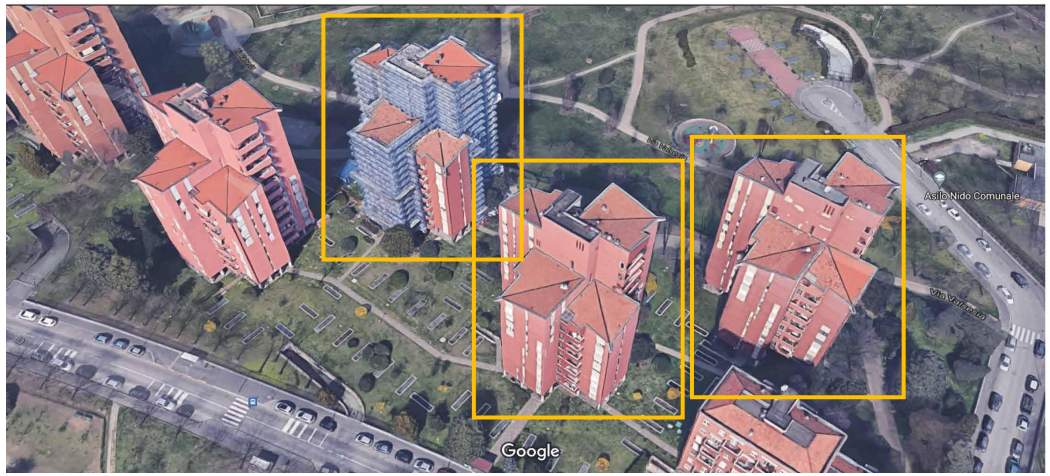
COLLECTiEF

Pilot Buildings

RESIDENTIAL BUILDINGS



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Pilot Buildings

OFFICE BUILDING

LABORATORY BUILDING WITH OFFICES

EDUCATIONAL BUILDING

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COLLECTiEF

The Benefits

Upgrade the smartness level of existing buildings:

16%

On average reduce the primary energy use

0.2-3 €/m²

annual energy cost savings

15%

Increase user satisfaction

24%

Increase the demand flexibility

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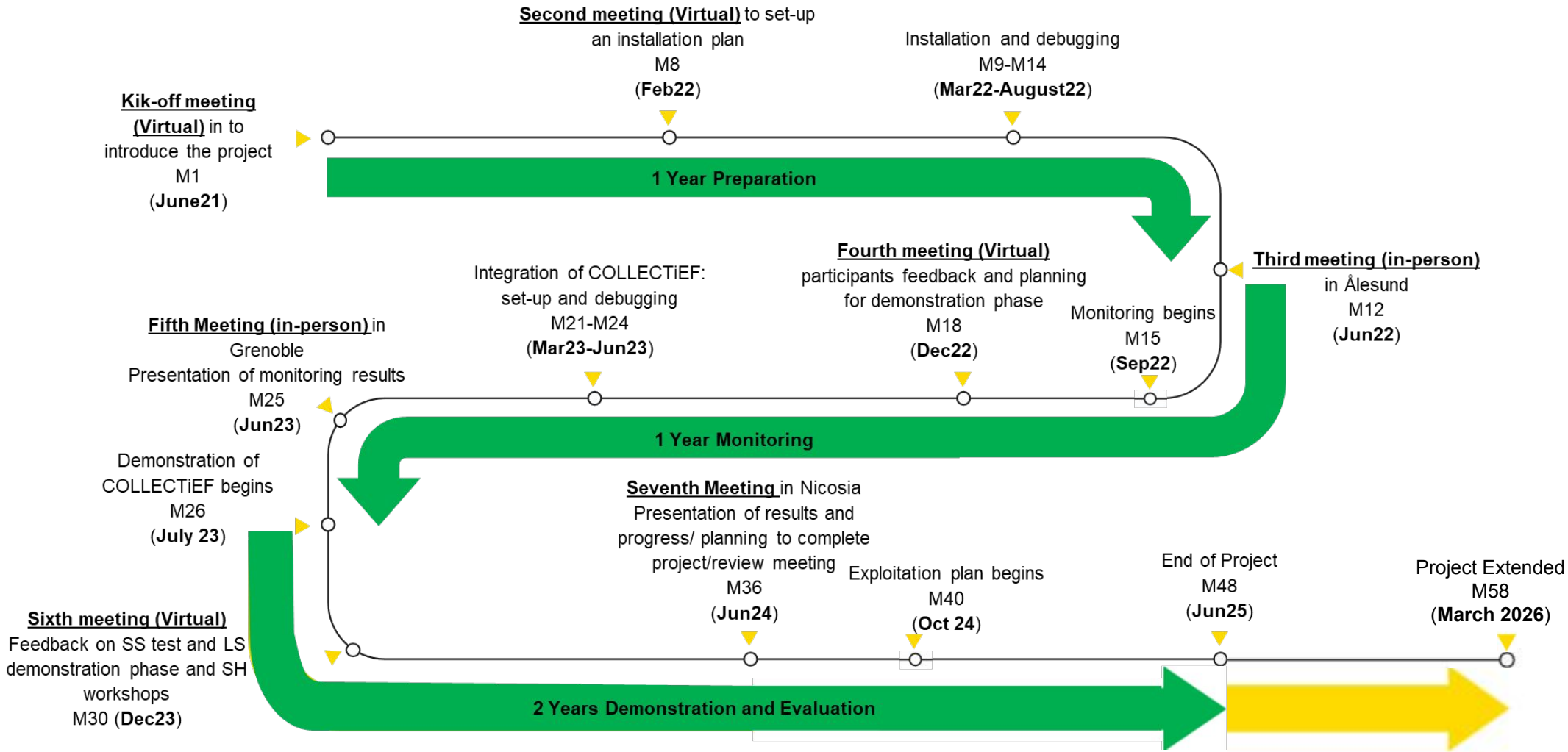
Timeline



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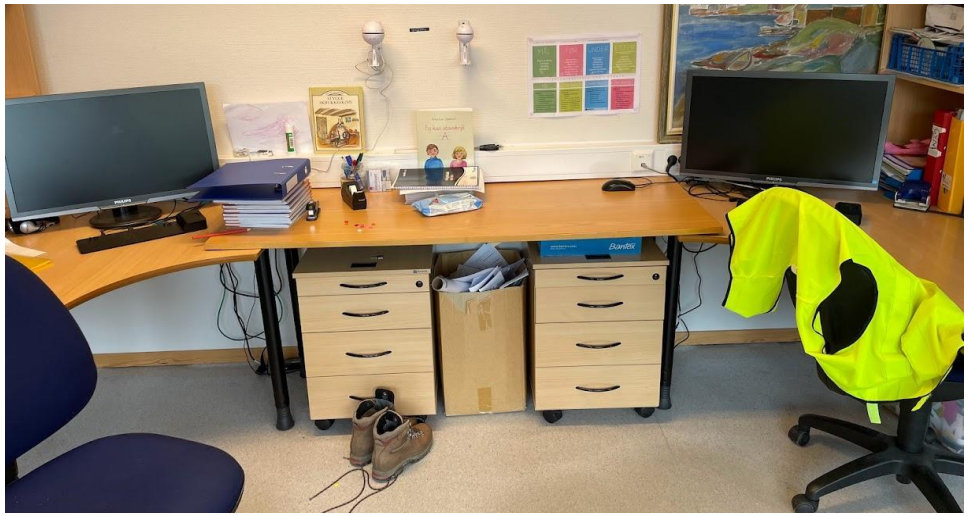
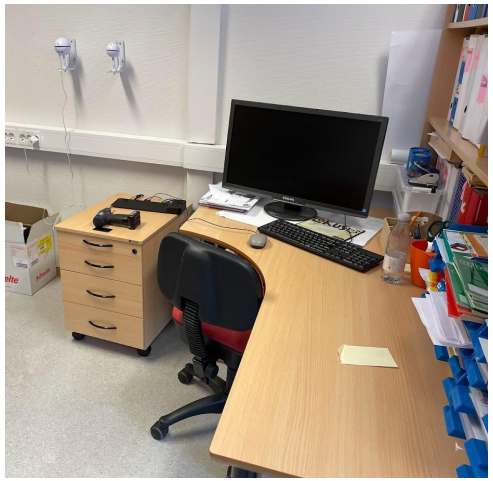
Deployment of Monitoring System





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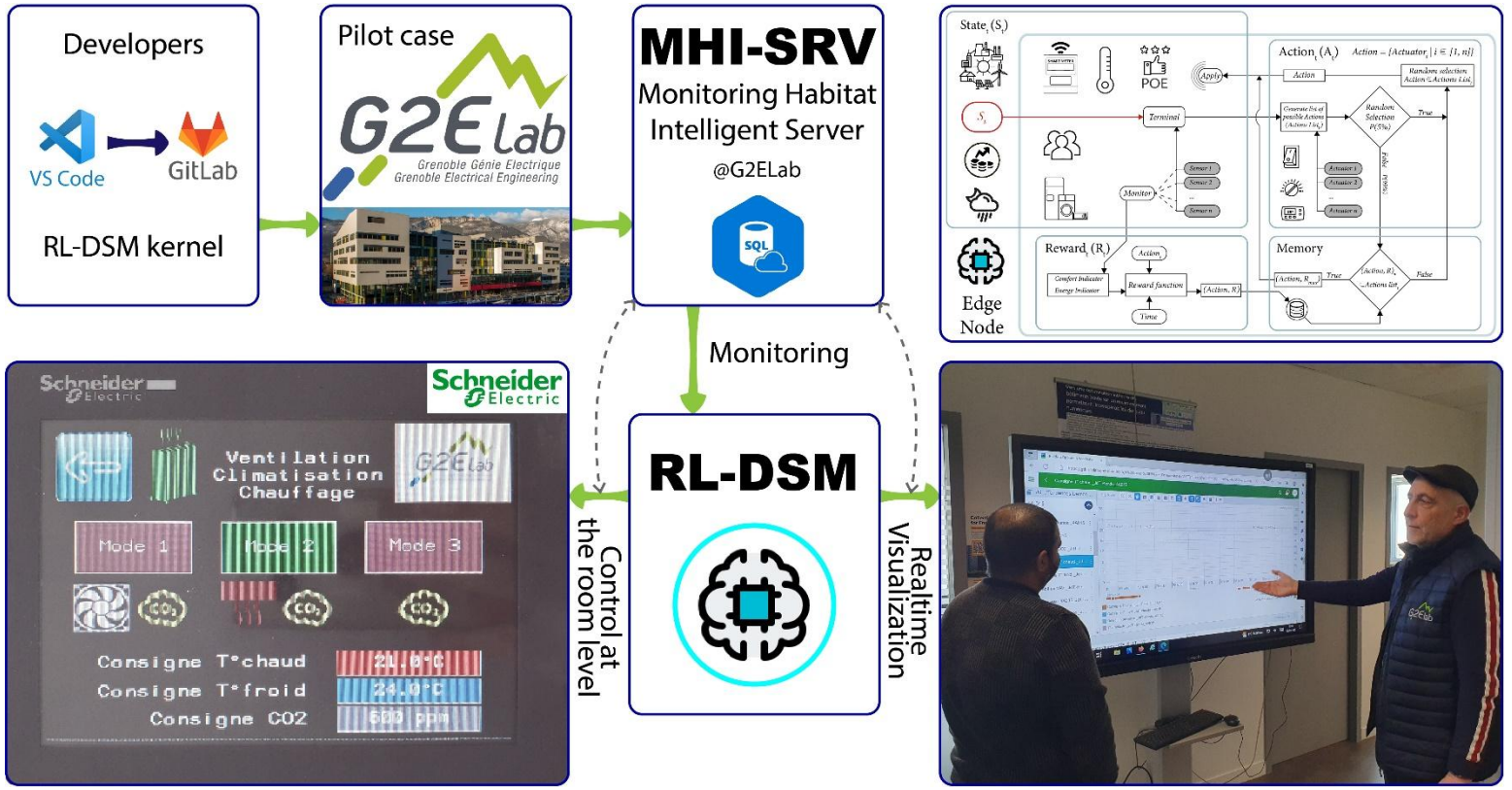
Small-Scale Demonstration



Workflow of the small-scale test in G2ELab. bottom-left: BMS panel in the rooms, top-right: flowchart of the developed algorithm, bottom-right: real-time visualization platform to demonstrate the performance of the code.

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Large-Scale Demonstration

Implementation timeframe with monthly overview of solutions deployment

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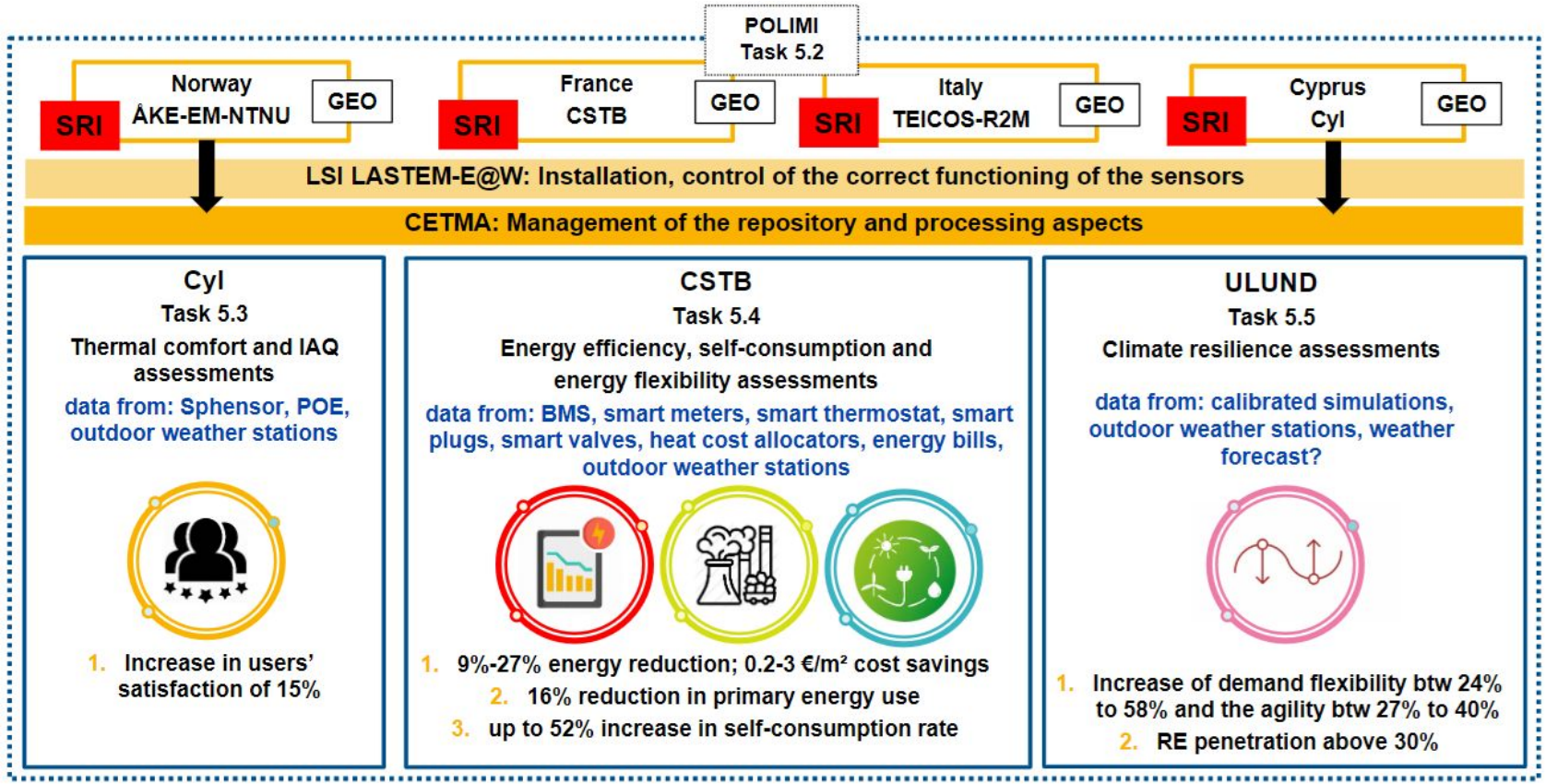
Data analysis and impact assessment



Overview of the impact assessment

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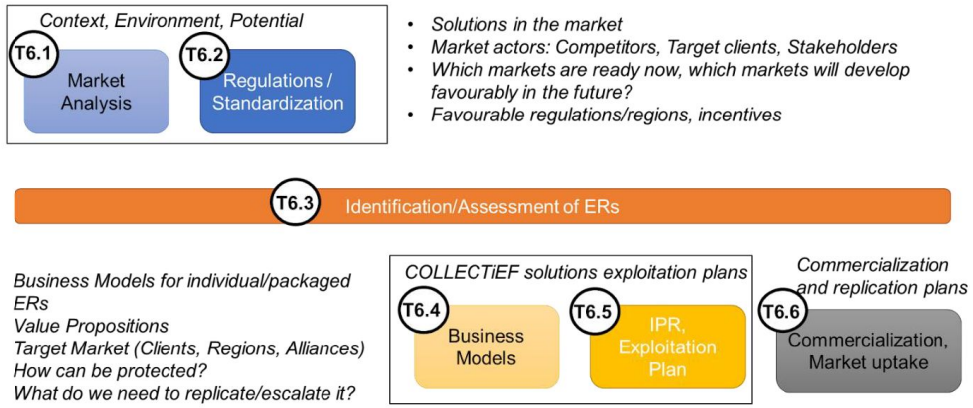
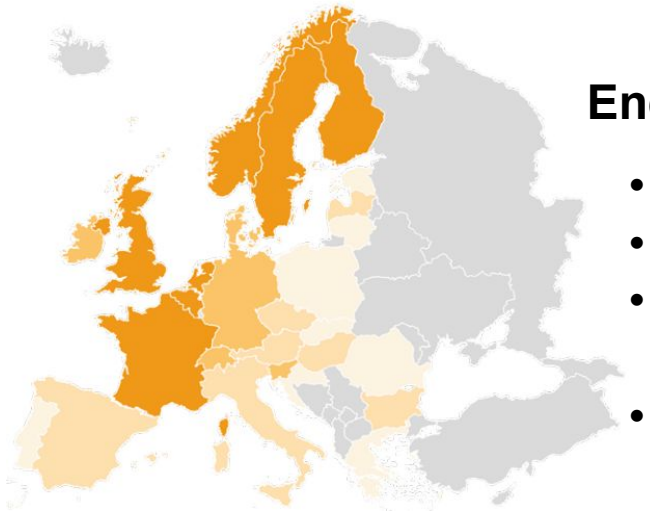
Exploitation and Commercialization

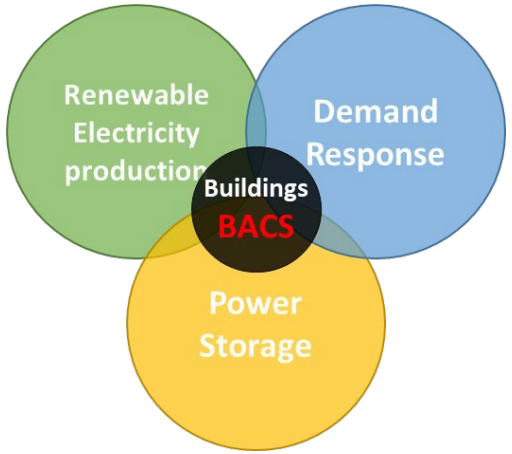


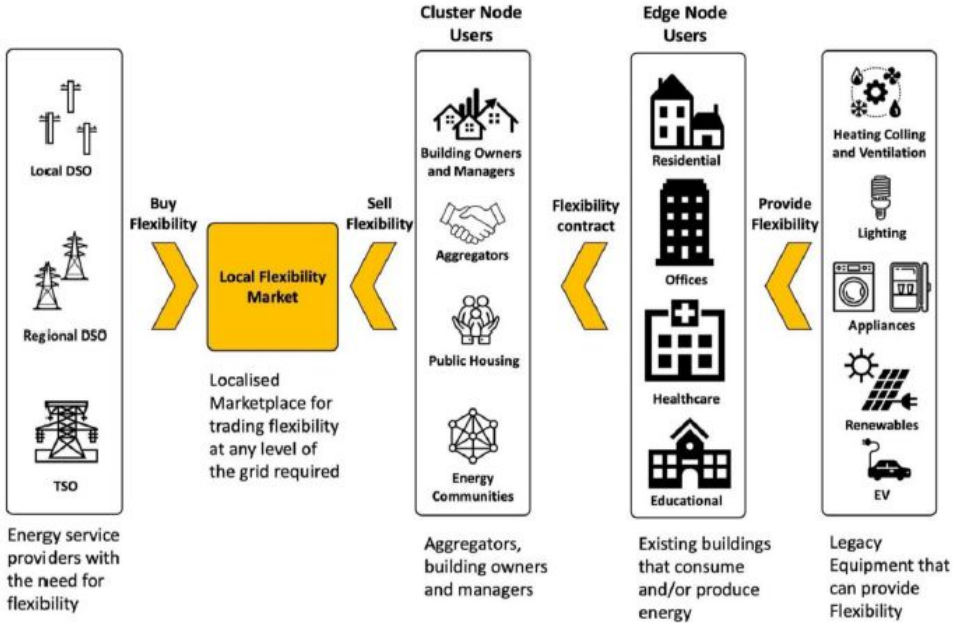
Structure of the Exploitation work package



Energy Flexibility in EU

- Regulatory Progress
- Potential market size
- Local flexibility / Energy Communities
- Future of flexibility





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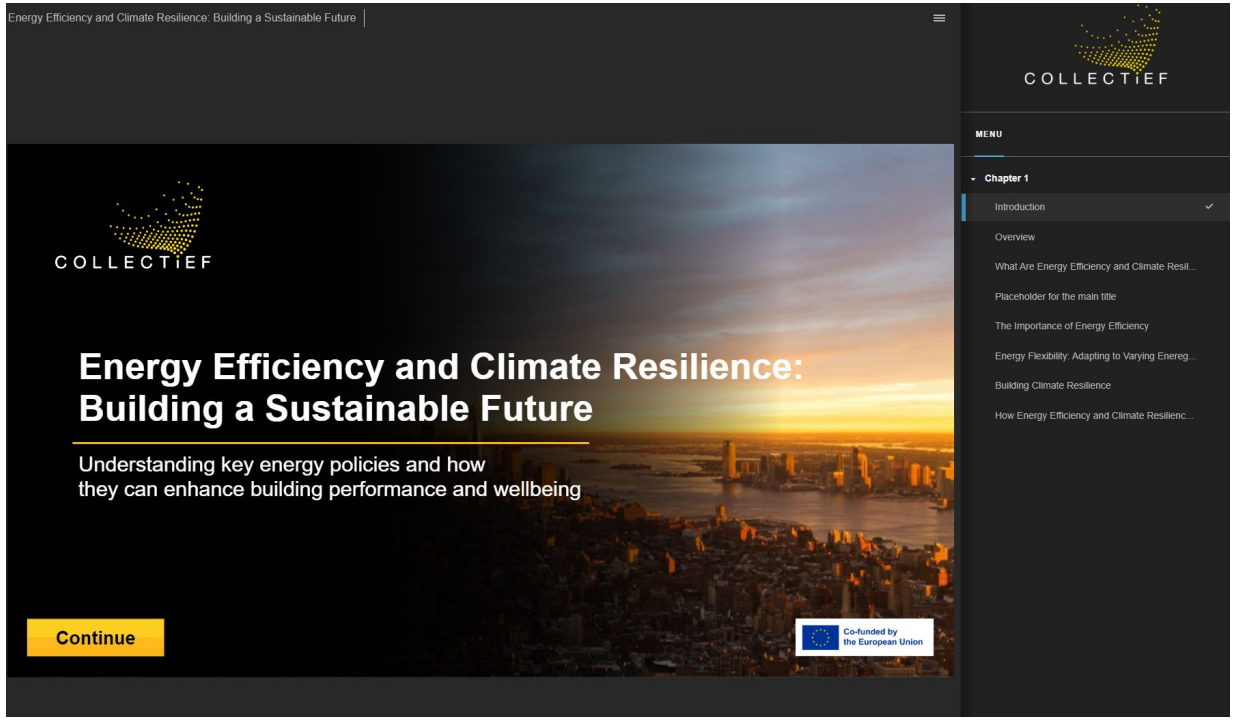
E-learning modules

Module 1: Introduction to Key Topics and EU Policy Background

Module 2:COLLECTiEF System's instruction

Module 3: The Benefits of the COLLECTiEF System

Module 4: The COLLECTiEF Methodology



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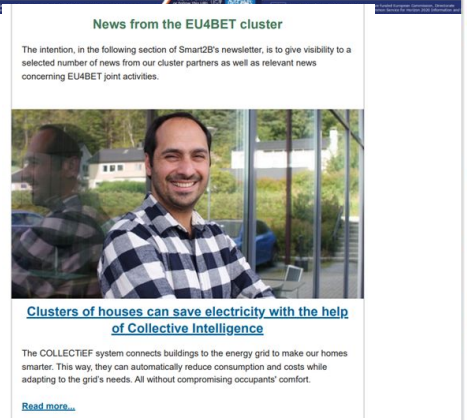
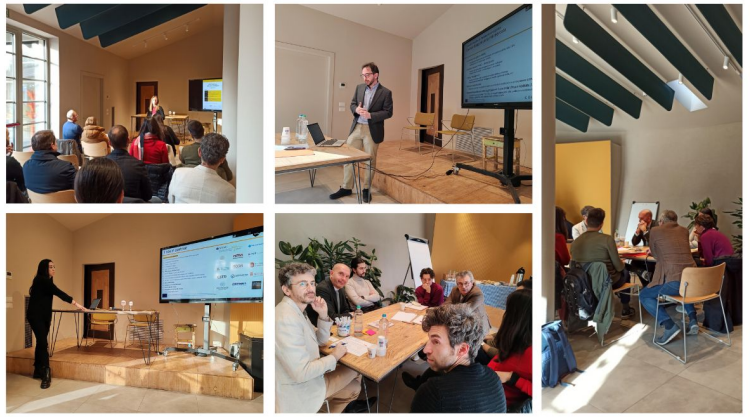
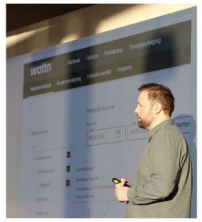
Dissemination, Communication, Synergies and collaborations







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THANK YOU!

Get in touch
Mohammadreza Aghaei
Project Coordinator, NTNU
mohammadreza.aghaei@ntnu.no

info@collectief-project.eu
www.collectief-project.eu

@CollectiefP
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Smartness for energy flexibility and climate resilience

Smart Readiness Indicator for energy flexibility and climate resilience in action: Insights and lessons from the COLLECTiEF project across Europe

Deployment in Italy (installation, challenges...)

Stefano Cera - TEICOS

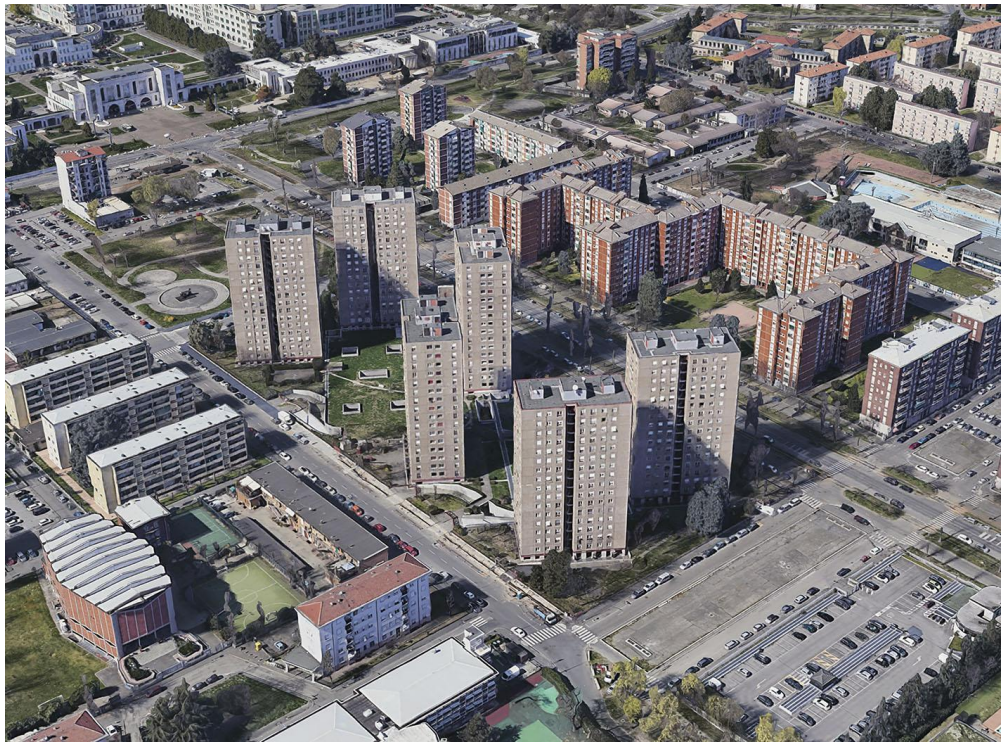
TEICOS Ingegneria nelle costruzioni

30 1995–2025

Nice to meet you…

I’m a Physicist and I’m working for TEICOS, a building company specialized in:

- Renovation of large condos



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Nice to meet you…

I’m a Physicist and I’m working for TEICOS, a building company specialized in:

- Renovation of public buildings

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Nice to meet you…

I’m a Physicist and I’m working for TEICOS, a building company specialized in:

- Conservation of building heritage

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What we are talking about

Deployment of:

- BRIGs («the brain» of the edge node)
- Environmental sensors (to detect parameters usueful to calculate indoor comfort)
- Actuators (to control the radiators of the heating plant)

in Milan pilot buildings

Let's be frank:

Low-intellectual-effort tasks, usually given to the not-so-smart participant in the project…

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Environmental sensors
Sphensors

Environmental sensors to detect a series of parameters insides private homes:

- Temperature
- Humidity
- Pressure
- CO_2
- VOC
- PM_1, $PM_{2.5}$, PM_4, PM_{10}

All the Sphensors need to run on the same Wi-Fi WLAN.
In every building, we created a single Wi-Fi WLAN, placing a lot of repeaters in the common areas.

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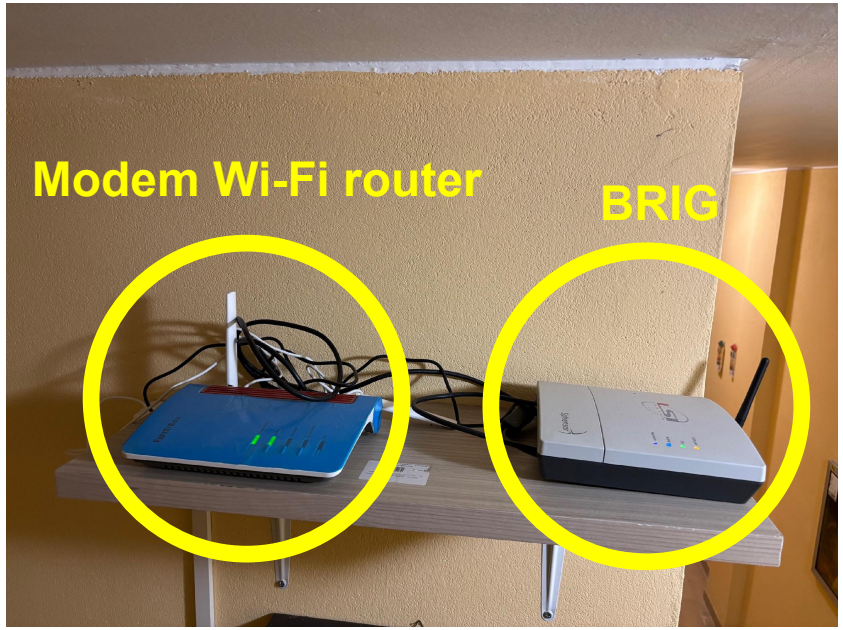
Deployment in common areas
Environmental sensors



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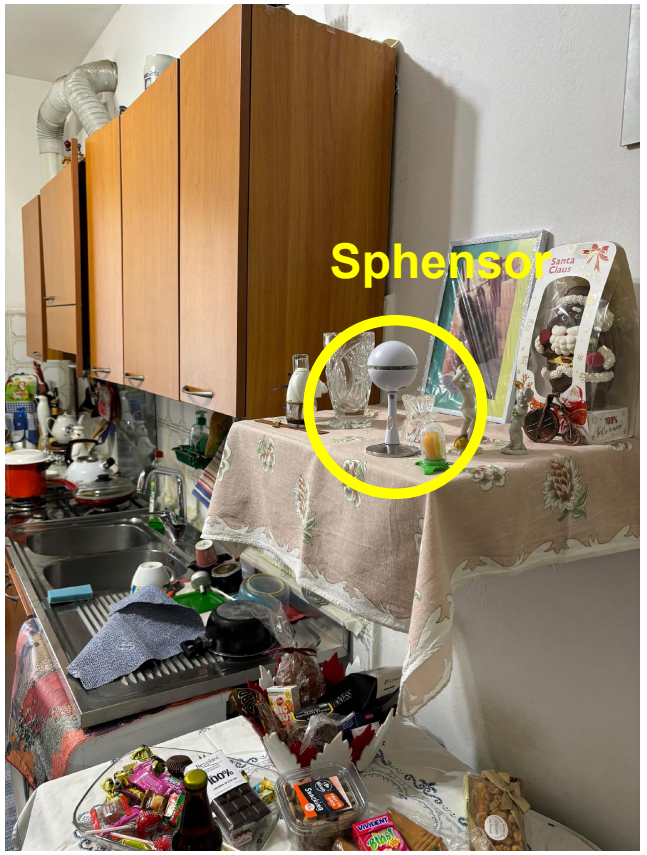
Deployment in private areas
Environmental sensors



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Actuators
Thermostatic valves

We bought smart thermostatic valves, for their ability to be remotely controlled.
We are not interested in using them as additional sensors.
As Sphensors run on Wi-Fi, we choose thermostatic Wi-Fi valves, but something went really wrong and we need to replace them all.

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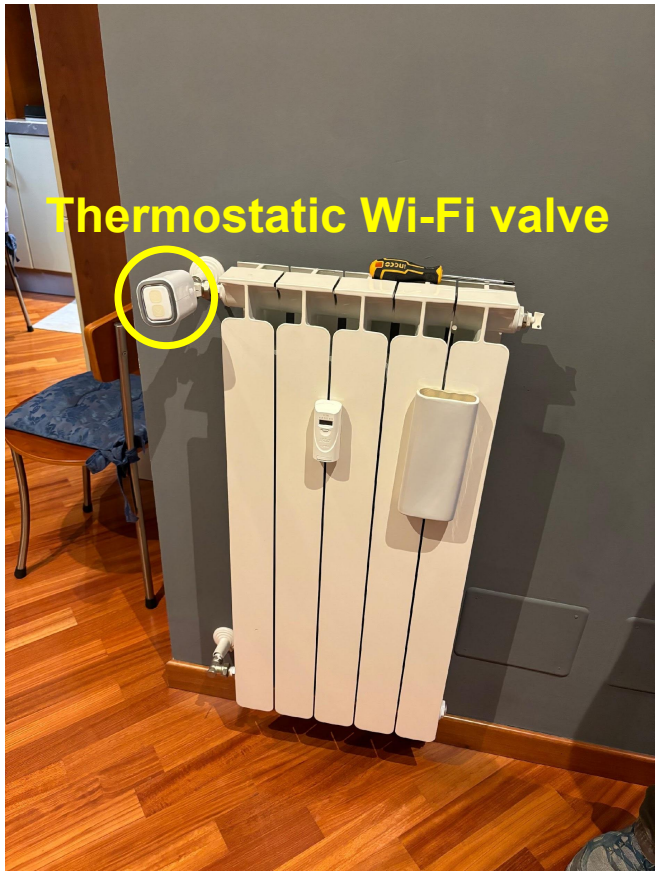
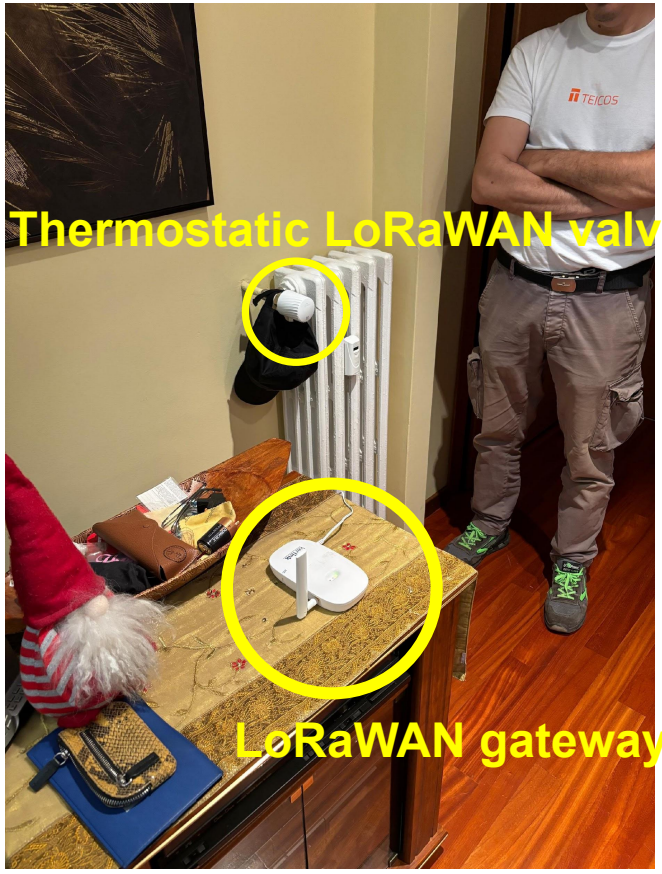
Deployment in private areas
Actuators





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Lessons learned

Let's be frank:
Low-intellectual-effort tasks, usually given to the dumbest participant in the project…

But
….sometimes even from the most stupid tasks you can learn something

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Users finding

People living in Via Valsesia, 66 - Milan

Why?

Because Teicos was renovating their homes

Lesson

You need to have already a relationship with users

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How many users?

12 users

Why?

Some users could leave the project

(and they did it! Now we have 10 users)

Lesson

All users you can find,

more than you need

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Choice of sensors

Wi-Fi vs. LoRaWAN

Why?

Wi-Fi didn’t work due to thickness and typology of the walls

Lesson

Project a small rehearsal

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Sensors vs. Users

Too many visits put a strain on users' patience

Why?

Some user left the project because of that

Lesson

Optimize the number of site visits

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Users’ engagement

Users are lazy in filling questionnaries

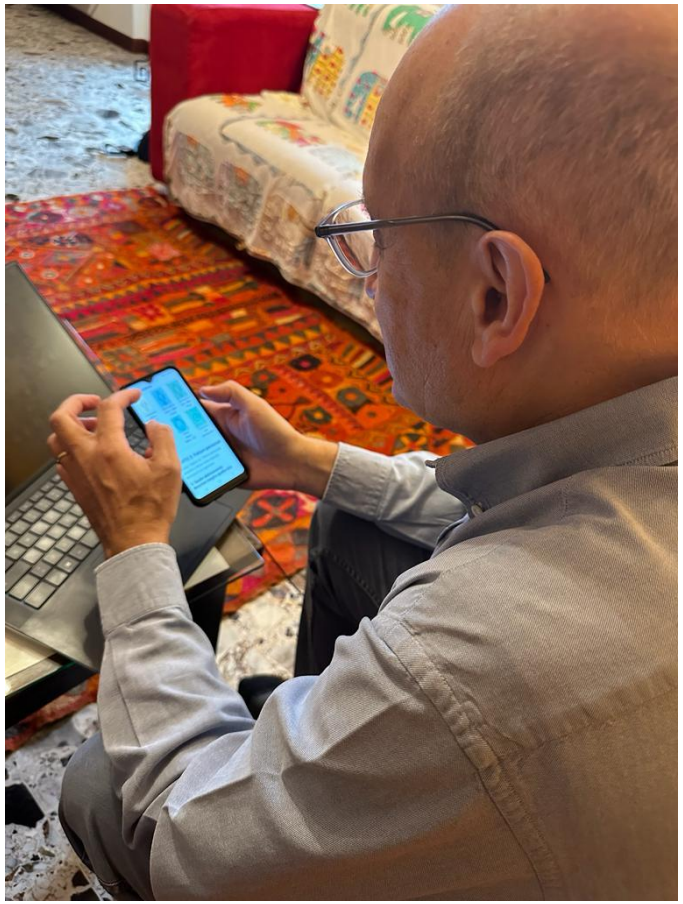
Why?

In their opinions, questionnaries are boring

Lesson

Find ways to get questionnaries filled

(but not too pushy)



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People management, not user management

People talk and it’s a problem

Why?

People outside the project could interfere with the project

Lesson

Take care of inhabitants not taking part of the project

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It’s time to say goodbye…

Thanks to COLLECTiEF project we have understood we have to face the problem of managing scarce and finite energy resources.

For example, how to design and build a condominium EV charging system when kW are limited.

In TEICOS

We believe that only collective solutions can solve this.

Let’s keep in touch!

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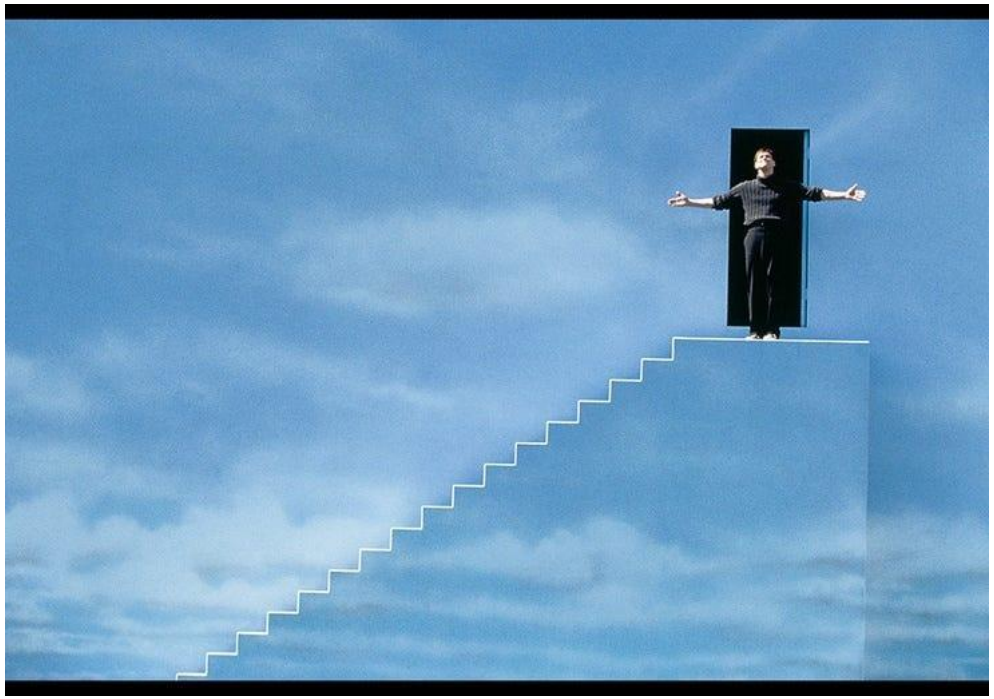

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Thanks for your attention

Stefano Cera
Innovation Manager, TEICOS
s.cera@teicosgroup.com

TEICOS 30 1995–2025
Ingegneria nelle costruzioni
www.teicosgroup.com

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Smartness Assessment of the COLLECTiEF Pilots based on SRI Framework

Mohammadreza Aghaei– Project Coordinator, NTNU

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What is a Smart Building?

- **1988**: The **Intelligent Building Institution** (Washington) defines **intelligent buildings** as those that integrate multiple systems for efficient resource management and occupant performance[1].

- **1997**: **Derek and Clements-Croome** introduce a human-centric approach, emphasizing the importance of addressing human needs in both the short and long term[2].

- **From Intelligent to Smart**: The term **"smart buildings"** has gained popularity, reflecting modern trends in building technology and adaptability.

    - **IEA Annex 81**: Defines **data-driven smart buildings** that use digital technology to optimize energy use, indoor environmental quality (IEQ), and occupant experience[3].
    - **GEB (Grid-Interactive Efficient Buildings)**: Smart buildings capable of managing energy loads for cost efficiency, integrating grid signals like CO2 emissions and energy prices[4].
    - **SRI:** a smart building possess the ability to[5]:
        1. **Optimize energy efficiency**.
        2. **Adapt to occupants' needs**.
        3. **Respond to grid signals** for energy flexibility.

1. J.K.W. Wong, H. Li, S.W. Wang Intelligent building research: a review Autom Constr, 14 (1) (2005), pp. 143-159
2. T. Derek, J. Clements-Croome What do we mean by intelligent buildings? Autom Constr, 6 (5–6) (1997), pp. 395-400
3. S. White et al., “Annex 81: A Data Sharing Guideline for Buildings and HVAC Systems,” Newcastle, Mar. 2023. Accessed: Nov. 07, 2023. [Online]. Available: https://annex81.iea-ebc.org/publications.
4. M. Neukomm, V. Nubbe, R. Fares Grid-Interactive Efficient Buildings, US Dept. of Energy (USDOE), Washington DC (United States); Navigant Consulting Inc, Chicago, IL (United States) (2019)
5. E. Commision. What is the SRI? [Online]. Available: Accessed, Aug. 15 (2023) https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/smart-readiness-indicator/what-sri_en

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COLLECTiEF

The Smart Readiness Indicator (SRI) / Smart Framework

- **Smart Readiness**: Assesses a building's ability to leverage its internal systems and limitations to support smart technologies. It measures **how well a building can optimize its own capabilities**, focusing on improving efficiency, adaptability, and grid interaction within the building's inherent constraints.
- **Smartness**: Measures a building's ability to perform smartly in comparison to other buildings. It evaluates **how advanced a building's technology is relative to others**, helping stakeholders benchmark across different buildings and contexts.

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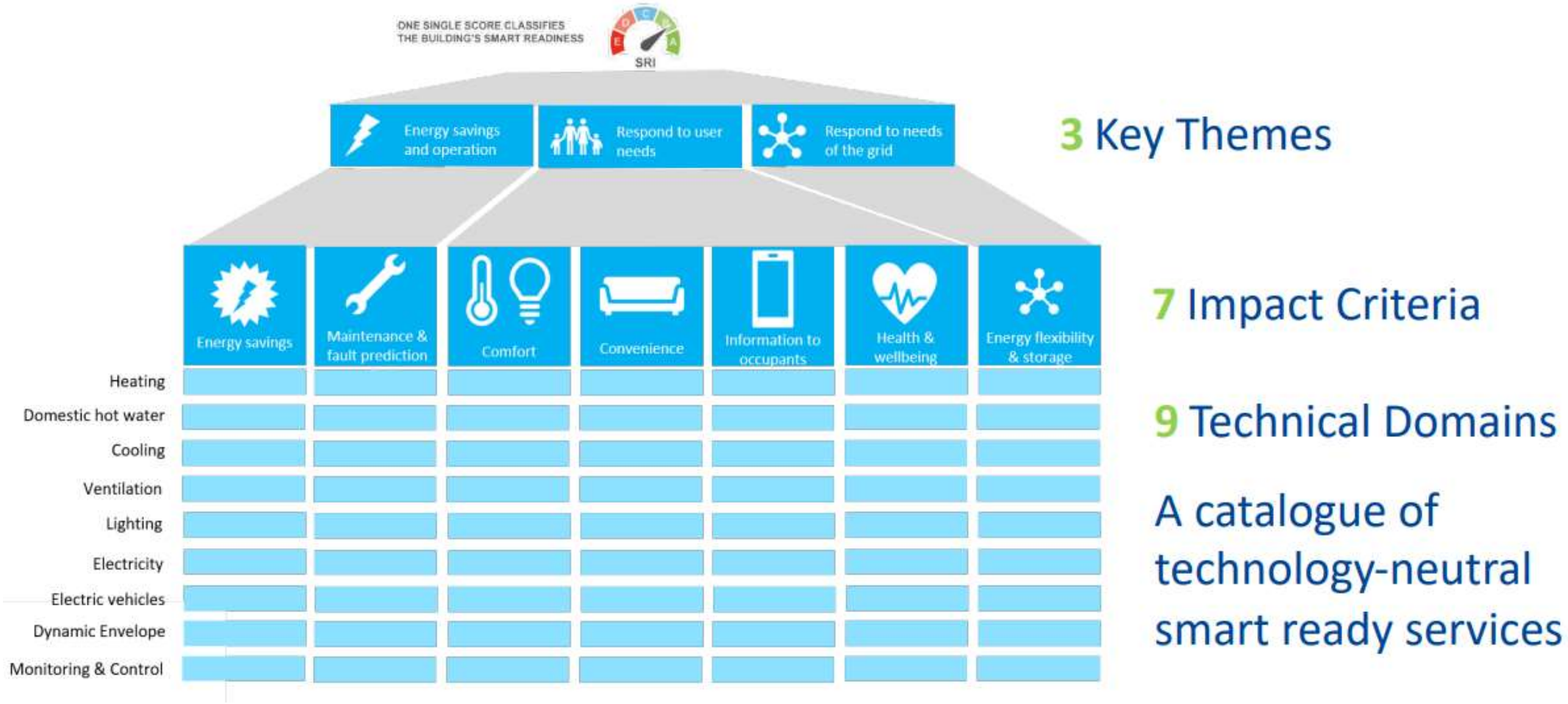
Smart Readiness Indicator (SRI) in Nutshell



https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/smart-readiness-indicator_en

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COLLECTiEF

COLLECTiEF Pilots

Ålesund

Milano

Grenoble

Nicosia

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Norwegian Pilots

EDUCATIONAL BUILDINGS



HEALTH CARE CENTERS


SPORTS ARENA

MEDICAL CENTER

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Norwegian Pilots

- **Location**: Ålesund, Norway (temperate oceanic climate).
- **Buildings**: 7 large municipal buildings, including schools, care/health facilities, and one sports hall.
- **Key Details**:
  - Buildings range in size from **2,000 to 7,000 m²**.
  - Construction dates vary from **1980 to 2022**, including renovations.
  - **Heating Systems**: Include district heating, electric heating, and heat pumps.
  - **PV** and **EVC** in one of the samples.

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Eidet Healthcare Centre, Norway

Building information

- 7039 m^2.
- 4 floors

HVAC system

- Heat pump (borehole) for heating: 2 compressors and control based on climatic curve.
- Air handling unit with heat/cooling coil and heat recuperator.
- Solar collector system.
- PV generation.
- Decentral heating: electric radiators.
- Multiple temperature sensors and PPM for ventilation control.

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SRI assessment in Eidet Healthcare Centre

- Version **4.4**.
- Service catalogue: **B**.
- Definition of the services through information collected in visits and **BMS**' API.
- With ***COLLLECTiEF*** *solutions, it is expected to increase the smartness by at least* ***one class****, with focus in* ***flexibility*** *services.*

Expected changes in SRI

Domain	Code	Smart ready service	Actual functionality level	Expected functionality level
Heating /Cooling	H/C-4	*Flexibility and grid interaction*	1	3
Electricity	*E-4*	*Optimizing self-consumption of locally generated electricity*	0	2
Electricity	*E-8*	*Support of (micro)grid operation modes*	0	1
Monitoring and control	*MC-25*	*Smart Grid Integration*	0	2
Monitoring and control	*MC-28*	*Report demand performance information (DSM)*	0	2
Monitoring and control	*MC-29*	*Override of DSM control*	0	4

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SRI assessment in Eidet Healthcare

SRI Score

#	Building	Current SRI		Expected SRI	
		Class	Score	Class	Score
1	Eidet	E	38%	D	59%

Aggregated Scores

#	Building	Current SRI			Expected SRI		
		Building	User	Grid	Building	User	Grid
1	Eidet	*50%*	*53%*	*13%*	*57%*	*64%*	*56%*

- Improvement of at least **one class** in this building.
- Noticeable improvement in Grid aggregated score:
  - Eidet: **13**% to **56**%
- Slightly improve in *Building* and **User scores**.

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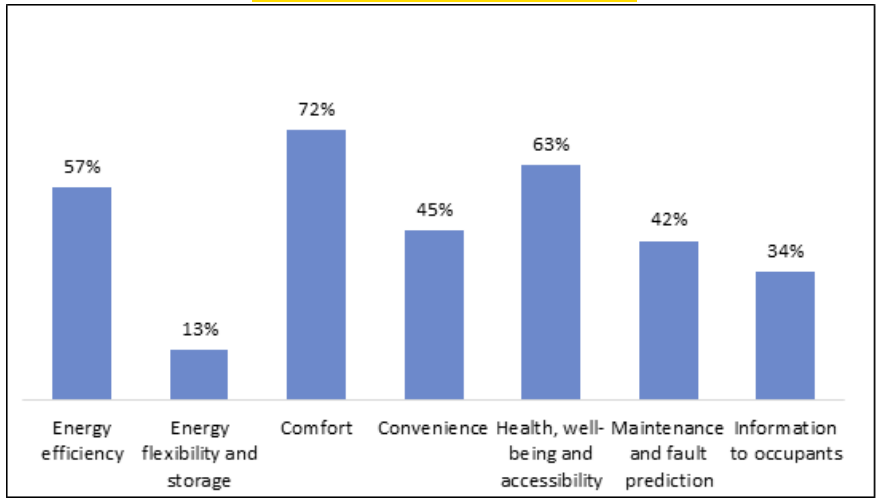
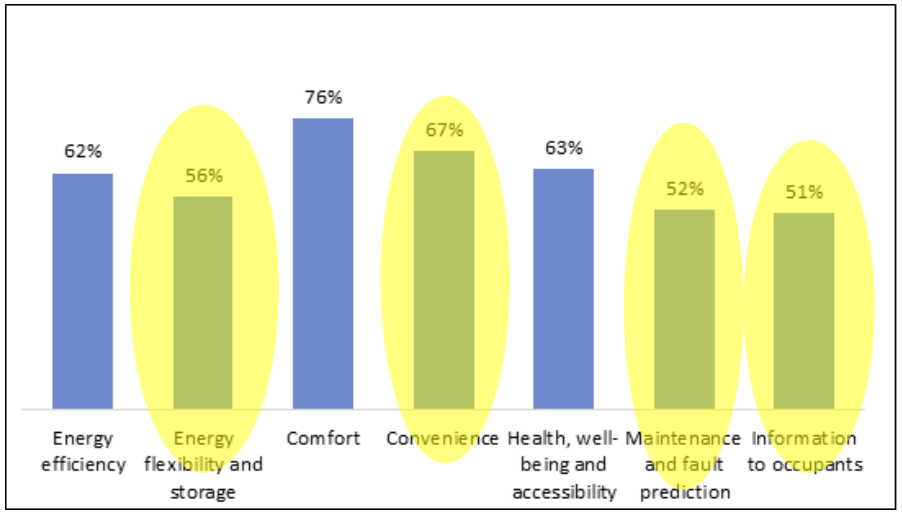
SRI assessment in Eidet Healthcare

Current Status

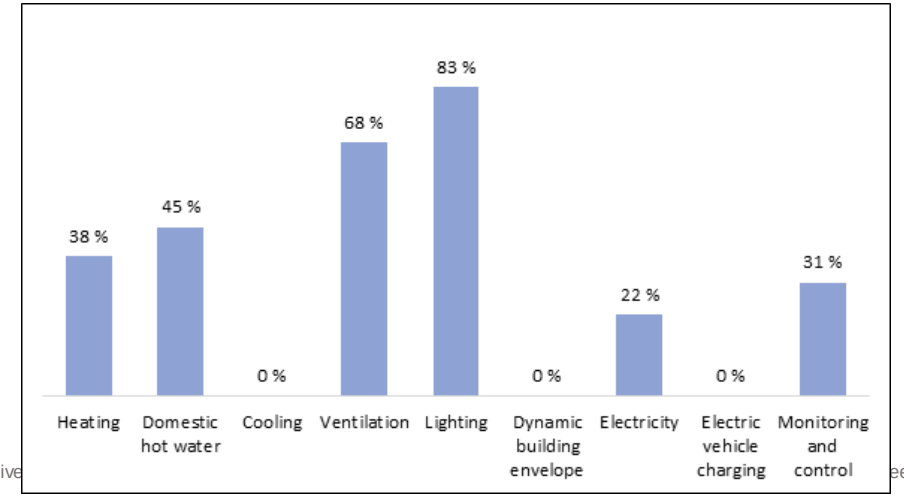
Expected Status

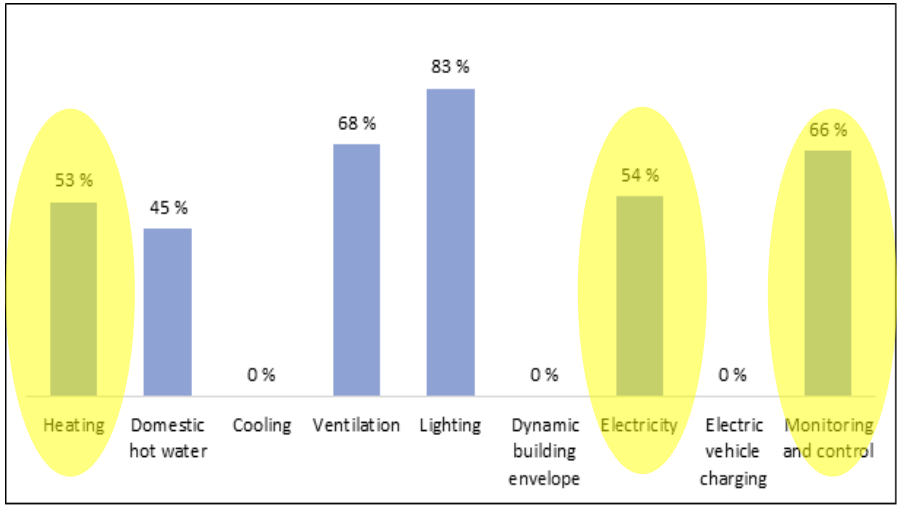
Impact Scores





Domain Scores





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SRI Results for Norwegian Pilots

- The SRI range for the ten buildings is between **20% and 35%**.
  - Best Performers: **B02** (Sports building) and **B04** (Care facility) achieved the **highest** SRI scores.
  - **B01** (Care facility) experienced the largest reduction in score by 3.4 percentage points.
- Aggregated Scores:
  - **Building category**: Scores decreased slightly but stayed within the 35% to 50% range.
  - **Grid category:** Significant variation, with all buildings scoring below 20%.
- The Grid score for B01 dropped by 7.5%, highlighting the building's limited interaction with the grid and low flexibility, especially in terms of energy storage and EV charging impacts.

Building	SRI Score	Aggregated Score		
		Building	User	Grid
B01	30.6 % (−3.4 %)	45.6 % (−2.8 %)	42.1 % (0.0 %)	4.2 % (−7.5 %)
B02	31.7 % (−0.2 %)	42.3 % (−1.3 %)	38.3 % (0.0 %)	14.5 % (0.7 %)
B03	26.3 % (−0.6 %)	42.3 % (−0.2 %)	28.6 % (0.0 %)	7.9 % (−1.6 %)
B04	31.0 % (−0.1 %)	44.3 % (−1.3 %)	35.7 % (0.0 %)	13.0 % (0.9 %)
B05	21.6 % (−0.9 %)	34.6 % (−2.8 %)	26.1 % (0.0 %)	4.1 % (0.2 %)
B06	28.9 % (−0.3 %)	42.0 % (−2.1 %)	37.7 % (0.0 %)	7.0 % (1.1 %)
B07	23.9 % (−1.5 %)	38.9 % (−3.5 %)	28.9 % (0.0 %)	4.0 % (−1.1 %)

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Get in touch
Mohammadreza Aghaei
Project Coordinator, NTNU
mohammadreza.aghaei@ntnu.no

info@collectief-project.eu
www.collectief-project.eu

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COLLECTiEF

SUSTAINABLE PLACES 2025

8-10 October 2025

Milano

COLLECTiEF

TOPIC

WORKSHOP

Smartness for energy flexibility and climate resilience

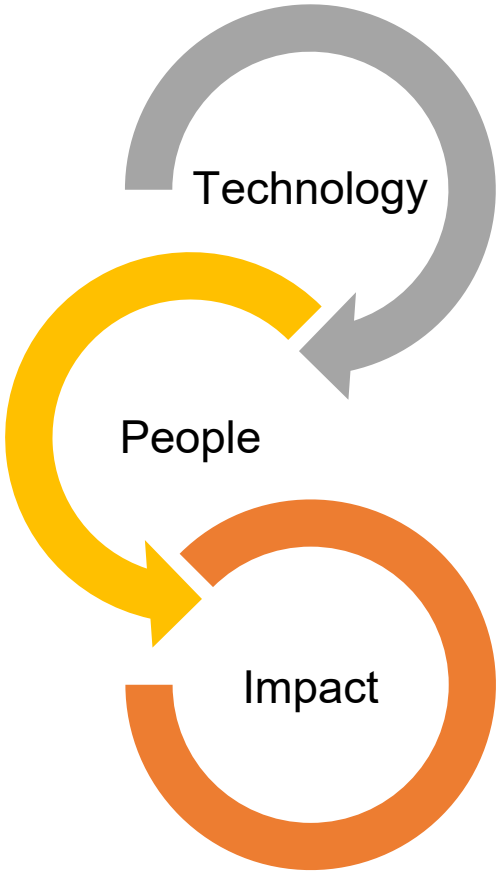
Smart Readiness Indicator for energy flexibility and climate resilience in action: Insights and lessons from the COLLECTiEF project across Europe

Empowering users and stakeholders for long-term impact

Gloria Bevilacqua, Project & Communication Manager, Geonardo

Why user engagement matters

- Adoption depends on **people**, not just technology
- Engagement builds **trust, satisfaction, and real impact**
- Essential for **scaling and long-term sustainability**



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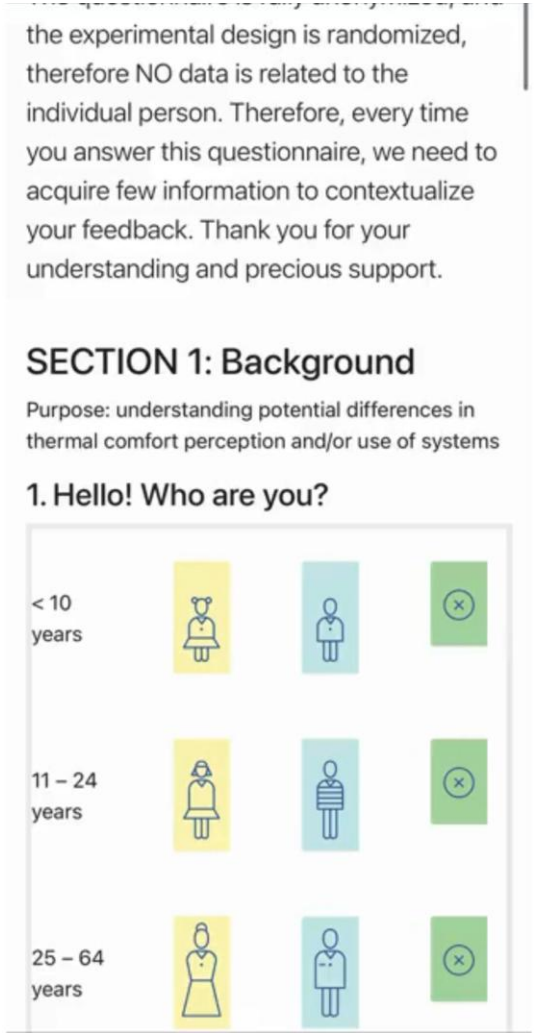
COLLECTiEF

Post-Occupancy Evaluations (POEs)

- Two questionnaires: POE & Satisfaction
- Assess indoor environment (air quality, comfort, lighting) + user satisfaction
- Applied before & after COLLECTiEF deployment
- Involves building managers, teachers, nurses to support participation



the experimental design is randomized, therefore NO data is related to the individual person. Therefore, every time you answer this questionnaire, we need to acquire few information to contextualize your feedback. Thank you for your understanding and precious support.

SECTION 1: Background

Purpose: understanding potential differences in thermal comfort perception and/or use of systems

1. Hello! Who are you?

< 10 years

11 – 24 years

25 – 64 years

COLLECTiEF

Collective Intelligence for Energy Flexibility

Help us improve your thermal comfort in this building!

COLLECTiEF is developing a user-centric energy-management system to smart up the existing European building stock, while improving users' comfort and satisfaction. We are now testing our solutions in different types of buildings across the EU and we want to hear from you!

Scan the QR code and give us your feedback on **your thermal comfort and indoor environment satisfaction.**

It only takes a few minutes to complete! The survey is completely anonymous and does not contain questions that render it possible to identify you based on your response.

We analyse answers from the surveys and data gathered from the sensors to develop our smart control algorithms. Together, we can make this and all European buildings **healthier, smarter, and greener.**

Lorem ipsum dolor sit

PROJECT COORDINATOR

Amin Moazami, Norwegian University of Science and Technology (NTNU)

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www.collectief-project.eu

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POEs: challenges & solutions

Challenges:

- Low response rates
- Connectivity issues
- Sensitive questions

Mitigation:

- Stickers/QR codes in rooms
- WhatsApp & calendar reminders
- Postcards and posters
- Video explainers
- Adjusted surveys for local contexts

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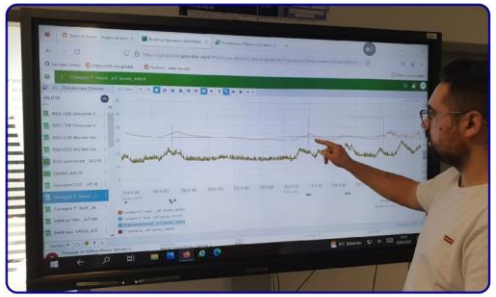
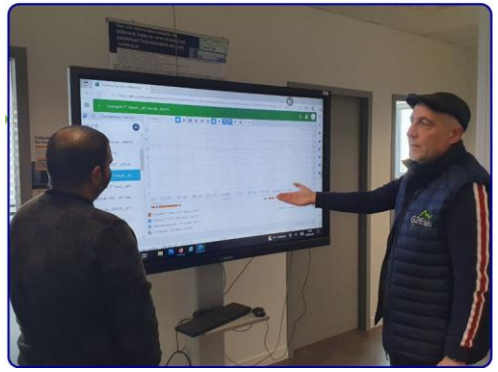
Pilot engagement activities: building trust

- Pilot exhibitions & workshops across Italy, Cyprus, France, Norway
- Clear, trust-based communication with users & owners
- Explained COLLECTiEF benefits, installation process, long-term value
- Interactive formats: quizzes, demos, exhibitions, one-to-one meetings





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Locally tailored strategies

Ålesund

Focus on diverse building types & dispersed sites

- One-to-one meetings with users & facility managers
- Tailored discussions per site
- Feedback on control handover & POE logistics

Milano

Focus on energy efficiency & comfort

- Informal events
- UI demo
- Modelling results

Grenoble

Focus on algorithm testing & POEs

- Regular email reminders
- Hands-on demo of POE tools

Nicosia

Focus on UI design & user interaction

- Interactive interface demo
- POE competition
- Detailed feedback collection

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COLLECTiEF

Stakeholder workshops: ensuring long-term uptake

- Early stakeholder engagement builds trust and shapes solutions.
- Workshops provided valuable feedback for exploitation strategy and business models.
- Cross-sector dialogue strengthens capacity for long-term impact.

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research and innovation programme under Grant Agreement No 10

Locally tailored strategies

Ålesund

Focus: local applicability
Stakeholders: municipalities, building managers, energy providers
Outcome: high relevance for demand response, call for open standards

Milano

Focus: exploitation & business model
Stakeholders: academia, engineering firms, utilities
Outcome: strong interest in integration with building systems, valuable feedback for exploitation strategy

Grenoble

Focus: algorithm testing & validation
Stakeholders: DSOs, energy flexibility experts, certification bodies
Outcome: interest in methodology, calls for clarification, potential in residential housing

Nicosia

Focus: public engagement at European Researchers' Night
Stakeholders: schools, civil society, public administration
Outcome: strong public interest, new collaboration opportunities

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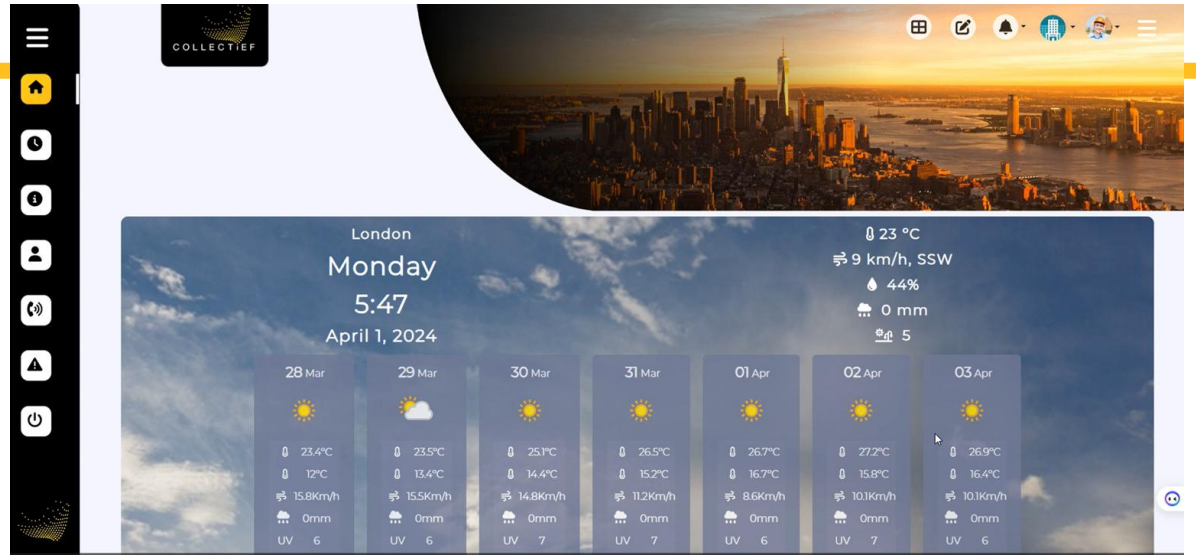
COLLECTiEF

Dashboard: making data visible

- **Data visualisation**: Weather; indoor environment; energy use; system status
- **KPIs display**:Thermal comfort; indoor air quality; visual and acoustic comfort, energy performance and cost; SRI
- **Notifications**: Alerts on monitored data and KPI changes.
- **Predictions**: Forecasts of KPI trends.
- **Scheduling modes**:COLLECTiEF mode; Comfort mode; Economy mode; Energy flexibility mode; Climate resilience mode; Manual mode



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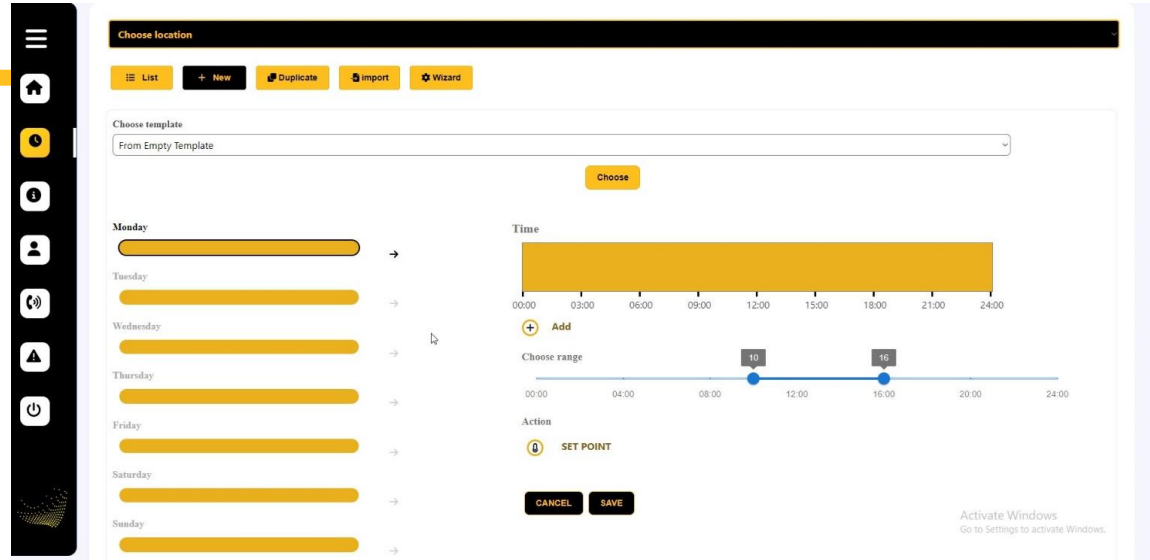
E F

Dashboard: user interaction & benefits

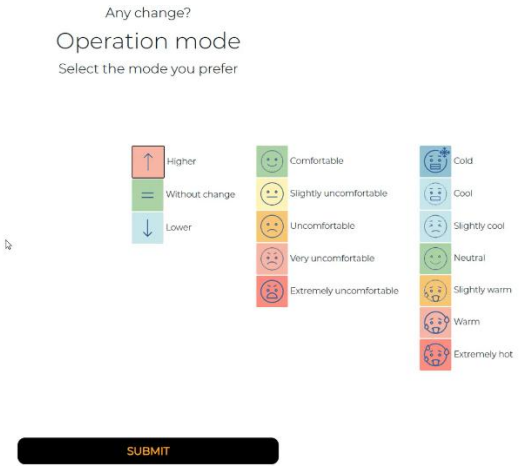
User Interface Structure

- Main options: Login/logout, Dashboard, Scheduling, Sensor Info, Feedback.
- Scheduling tool: Users can customise daily operation modes and set weekly schedules.
- Feedback tool: Ratings, comments, and access to Post-Occupancy Evaluation (POE) questionnaires for continuous improvement.



Benefits

- Improves user trust through transparency.
- Supports informed decision-making.
- Facilitates personalised control of building performance.
- Encourages active user engagement and feedback.



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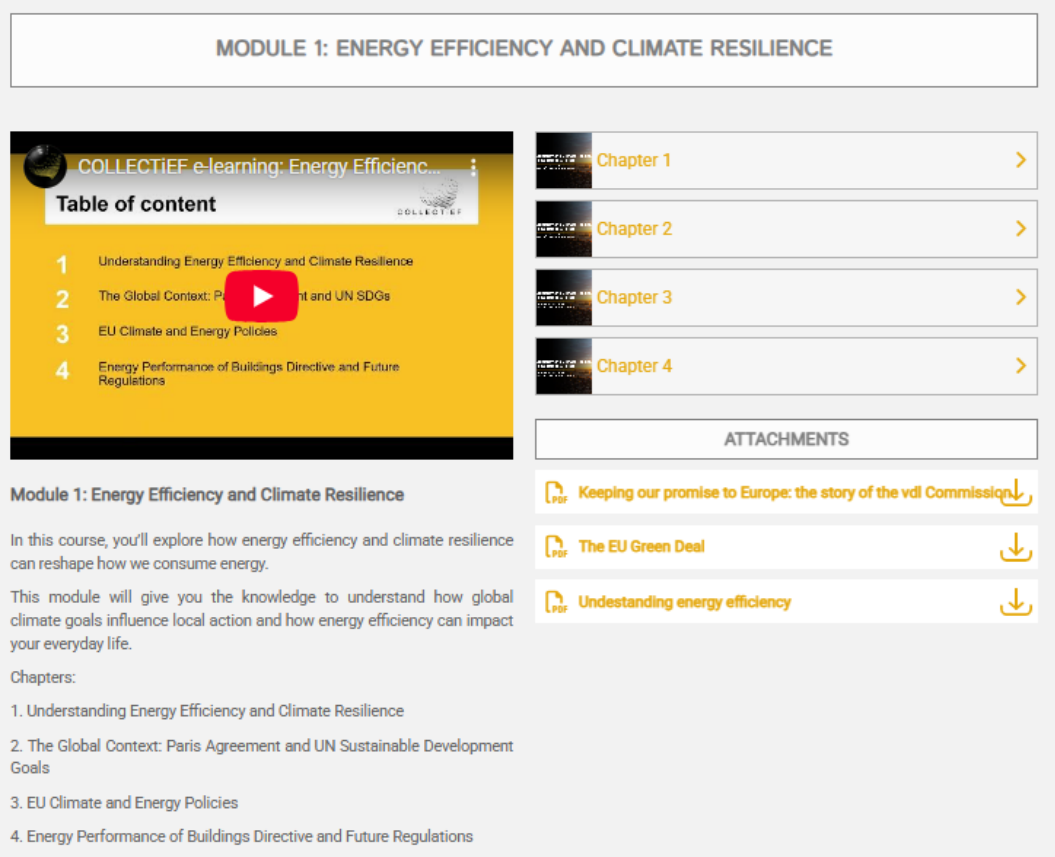
OLLECTiEF

Capacity building through education



The COLLECTiEF e-learning programme empowers building managers, operators, homeowners, researchers, and interested citizens to make smarter, energy-efficient, and climate-resilient choices.

Key Features

- Accessible anytime, designed for long-term impact and scalability
- Interactive learning with quizzes, practical insights, and step-by-step guides
- Modules tailored to different user needs: citizens, professionals, stakeholders

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COLLECTiEF

Capacity building through education

Benefits:

- Step-by-step learning for diverse audiences
- Builds capacity for sustainable energy practices
- Supports adoption of innovative solutions beyond the project

Energy efficiency and EU policy frameworks

1. basic concepts and the policies driving sustainable energy transitions.

Hands-on guidance for using COLLECTiEF

1. installation, operation, and maintenance.

Unlocking COLLECTiEF's benefits

1. energy savings, performance improvements, cost efficiencies, environmental advantages.

COLLECTiEF methodology

- technical foundations, algorithms, and collective intelligence principles

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COLLECTiEF

THANK YOU!

Get in touch
Gloria Bevilacqua
Communication & Dissemination leader, Geonardo
gloria.bevilacqua@geonardo.com

info@collectief-project.eu
www.collectief-project.eu

@CollectiefP
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Smart Readiness Indicator for energy flexibility and climate resilience in action: Insights and lessons from the COLLECTiEF project across Europe

Market opportunities and business models

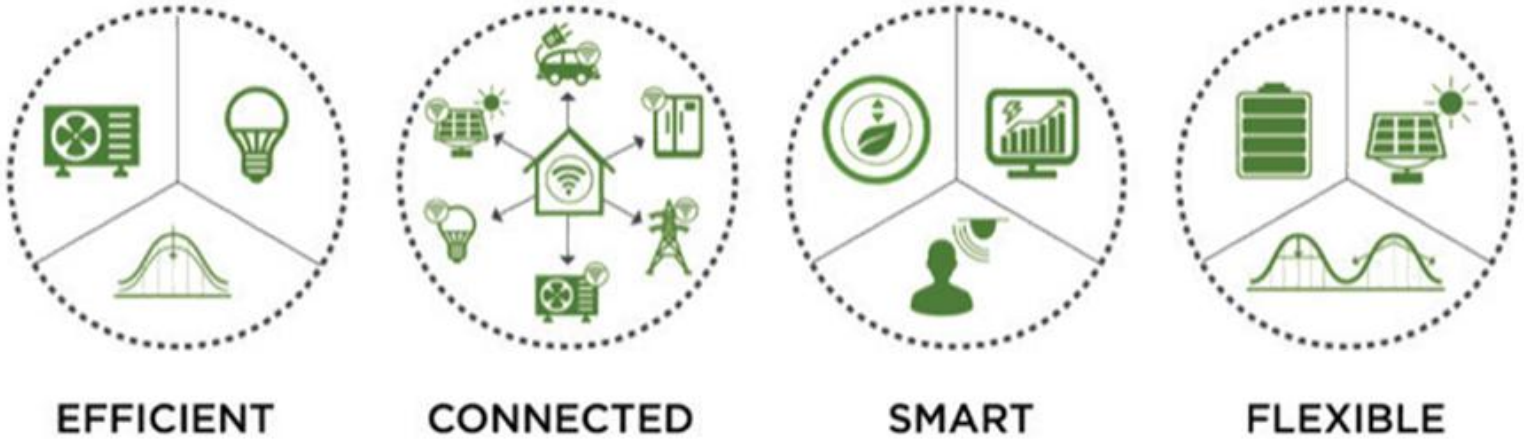
Marco Pietrobon – R2M Solution

R2M SOLUTION
RESEARCH TO MARKET

Innovation
Energy Services & Sustainability
Engineering
ICT & Automation

Smart buildings and energy flexibility

Value from COLLECTiEF system



EFFICIENT	CONNECTED	SMART	FLEXIBLE
Save energy or improve performance with better control.	Connection to energy grids and between buildings / groups of energy consumers.	Better automatic controls, higher building smartness.	Flexibility in energy demand while maintaining performance and comfort.

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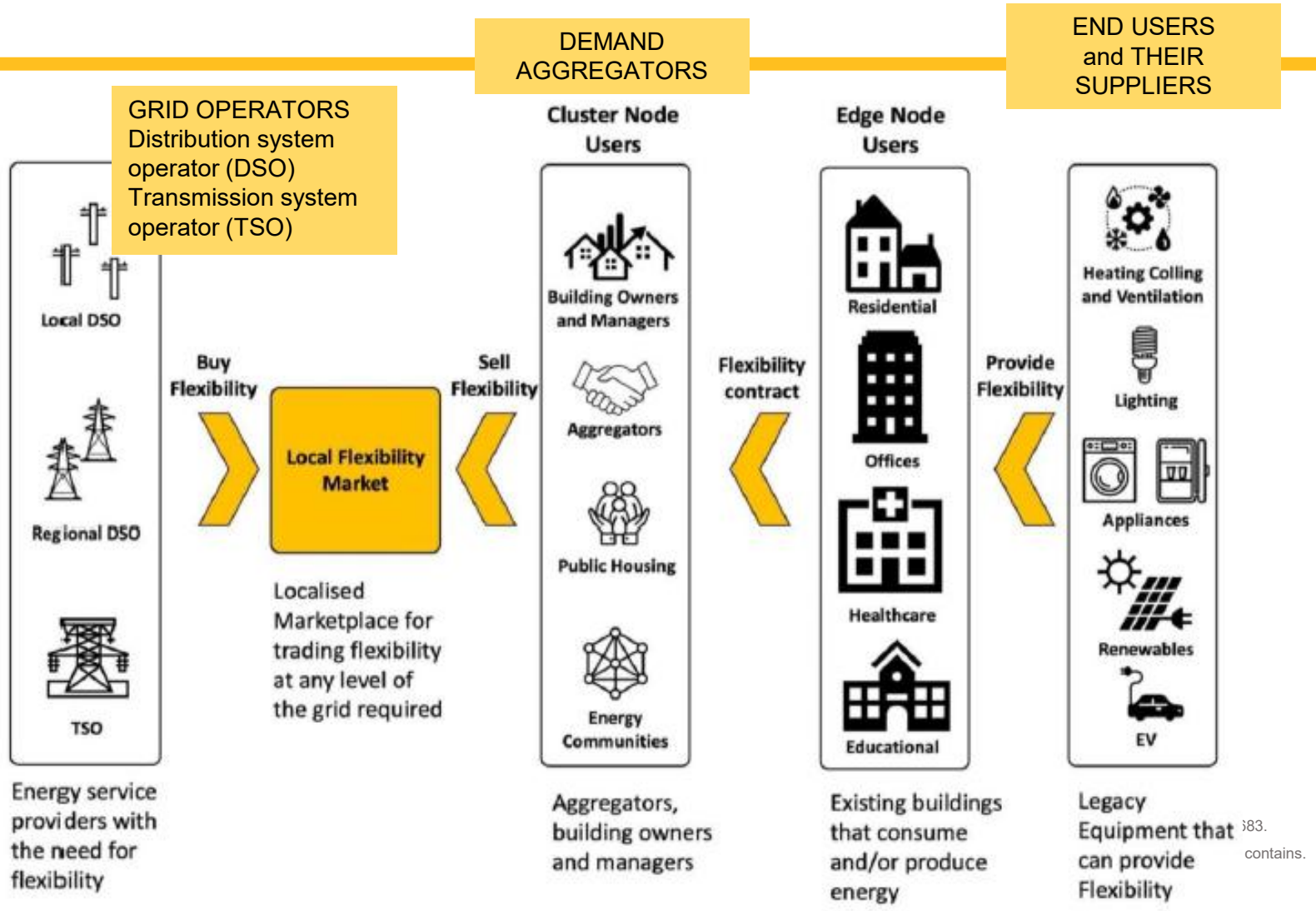
Market landscape



There is a **demand/need for flexibility in energy flows on the networks** , for various purposes:

- Balancing consumption and production
- Securing supplies
- Optimizing the use of renewable sources
- Manage the necessary investments in networks and production plants over time

Related opportunities:

- Obligation, incentive, and remuneration mechanisms
- Services linked by aggregators and other providers
- Improving smart controls in buildings

Minimum Viable Product

Product name:

COLLECTiEF system

General description:

An interoperable and scalable energy management system based on Collective Intelligence (CI) to be integrated into existing buildings and urban energy systems.

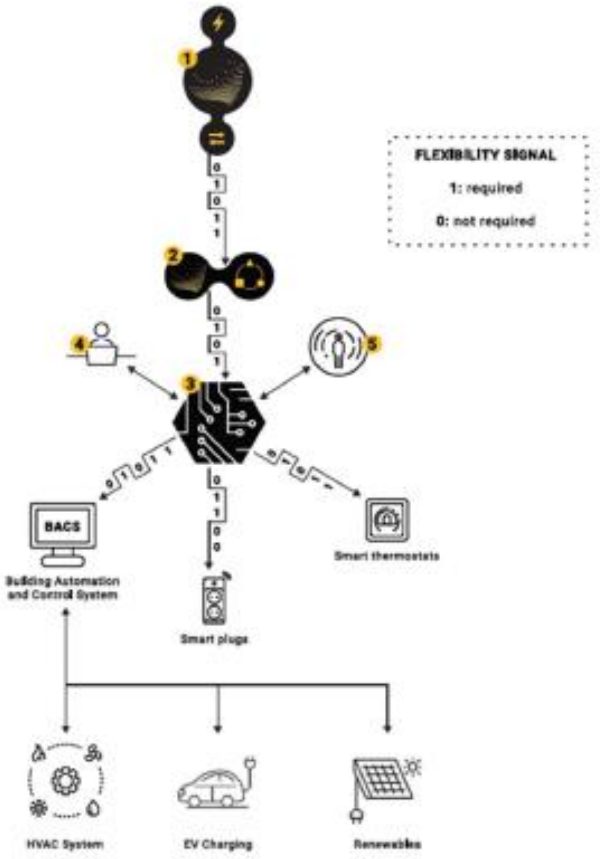
1 Cluster Node

2 Edge Node

3 Interoperability platform (iGateway)

4 Human-Building Interface

5 Occupant-centric sensing unit (SphenSor)



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Minimum Viable Product
variants for specific customers' segments

Five variants of the product:

1. Edge Node **Algorithms**
2. Cluster Node **Algorithms**
3. Edge + Cluster Node **Algorithms**
4. COLLECTiEF **System**
5. Monitoring and optimization **Service**

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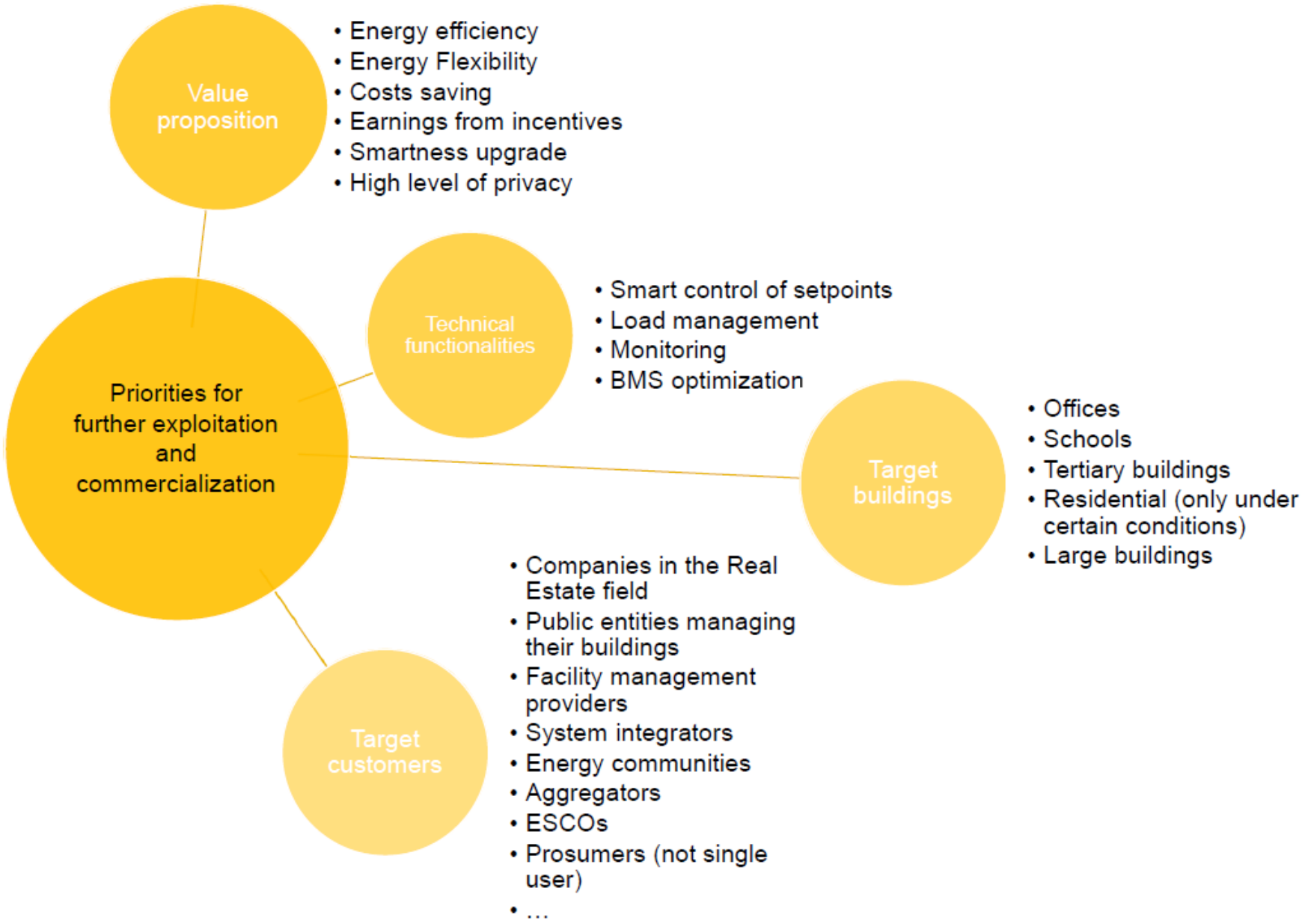
Priority paths for exploitation for exploitation on the market



COLLECTiEF

Examples of opportunities in the market

- Energy Communities
  - Maximize self-consumption of renewable energy produced in renewable energy plants, maximizing incentive revenues.
- HVAC system management – optimizations
  - Making existing heating systems smarter and more efficient through improved and innovative control features.
- Energy management
  - Management of electricity or thermal energy demand over time (with respect to periods of more advantageous tariffs, with respect to power limits, etc.).
- Design services
  - Prescription at the design stage of control systems to replace or integrate existing BMS.
- Demand Response through aggregation of prosumers
  - Contracts between network operators (TSO, DSO) and aggregators, who manage and control energy flexibility, responding to the needs of network operators.

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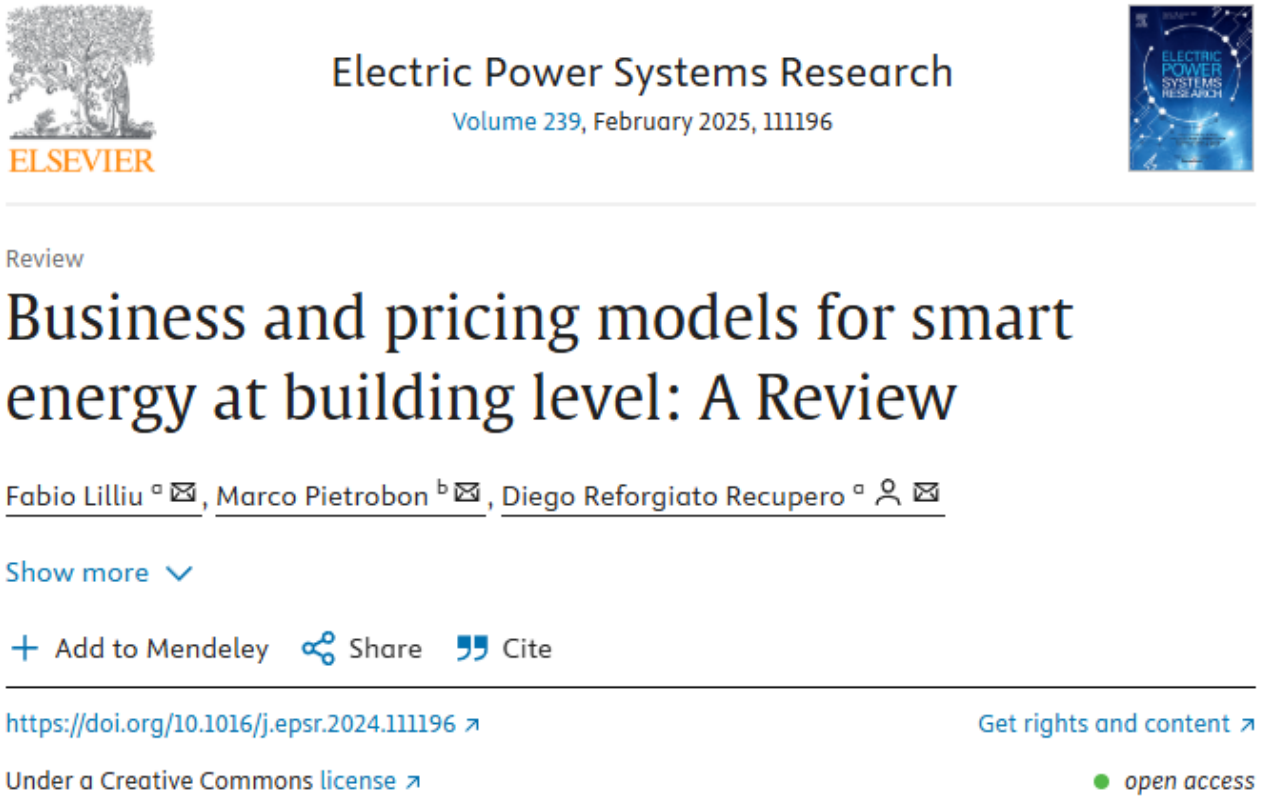
Review of innovative business models in the field

A scientific paper from the analyses carried out in COLLECTiEF



ELSEVIER

Electric Power Systems Research
Volume 239, February 2025, 111196

Review

Business and pricing models for smart energy at building level: A Review

Fabio Lilliu [a], Marco Pietrobon [b], Diego Reforgiato Recupero [a]

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Review of innovative business models in the field

Criteria	1	2	3	4	5	6	7	8	9	10
Granularity	5m	1m	60m	60m	60m	30m	60m	ND	60m	60m
Vector	Elec.	Elec.	Elec. Heat Gas	Elec.	Elec. Heat	Elec.	Elec. Heat	Elec. Heat	Elec.	Elec. Heat
Devices	PV BESS Fuel cells	PV	CHP HP Boiler Storage PV	PV BESS Tidal gen.	HVAC	PV	HVAC BESS	AC	PV	PV BESS HVAC EV
Domain	Res.	Edu.	ND	Office	Res.	Res.	Fact. Office	Res.	Res.	Res. Tert.
Use case	(130) MG	(1) Buil.	(1) RIES	(1) Buil.	(50) Comm.	(72) Apt. comp.	(100) Aggr.	(ND) Aggr.	(48) LEP LEC LEM	(2) Buil.
Customer type	Buil. (Apt. com.)	Buil. (Edu.)	Buil. (Res.)	Buil. (Off.)	Buil. (Res.)	Apt.	Buil. (Fact. Off.)	Buil. (Res.)	Apt.	Buil. (Res. Lib.)
Provider type	TSO DSO	Grid	DSO	TSO DSO	TSO	Netw.	Aggr.	TSO DSO	LEP LEC LEM	Aggr.
Benefits	Profit	Profit Peak	CO2 Comf.	Peak	Peak	Load Peak Self	Profit	Peak Valley	Self	Profit CO2
Constraints	ND	ND	RIES	Tidal gen.	TEG	ND	ND	Cloud	ND	ND
Market readiness	No	No	No	Yes	No	Yes	No	ND	No	No
Methods	ML	ML	Game	ND	Seq. alg.	ND	Game	Cloud	Mat.	Mat.

Some findings

- From 1 minutes to 60 minutes actions
- Solutions mainly for electricity and phototovoltaic
- But some also dealing with heat pumps and in general heat storage
- Different building typlogies
- Energy communities (and aggregators)
- Financial gains as main driver

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Thanks for your attention

Marco Pietrobon
marco.pietrobon@r2msolution.com

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