THIRD PROGRESS REPORT

Project acronym: COLLECTiEF

Project title: Collective Intelligence for Energy Flexibility

Call: H2020-LC-SC3-EE-2020-2

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History of Changes

Date	Changes	
29.05.2023	Section 2	COLLECTiEF implementation procedure (M13-M24) is now updated
	Section 2.2	Action plans and milestones are now updated by M24
	Section 3	A new section on Progress and Achievement by the Second year is added
	Section 4	The engagement strategic activities are now updated by M24
	Section 5.1	Scientific publications activities by M24 are added as a separate table
	Section 5.2	The workshops and seminars are updated
	Section 5.3	Collaboration with the sister projects is updated with the current activities that include Horizon Results Booster
	Section 5.4	The social media campaign by M24 is now updated
	Section 5.3.1	Dissemination materials with questionnaire icons are added
	Section 6	Progress and Action Plan for each WP has been updated by M24
	Section 7	The activities, difficulties, problems, and solutions have been updated
	Section 7.2	Changes in the team members which were reported by partners, have been updated.
	Section 8	The list of the risks and related mitigation plans have been updated to M24

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History

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Executive Summary

The main purpose of this deliverable is to report the progress of the COLLECTiEF project within the second year. The third phase of the project ran from April 2022 to March 2023 (M11-M22) and dealt with the further development of the COLLECTiEF project with a focus on implementing the small-scale demonstration including the algorithms development and deployment of the monitoring systems in the pilot buildings as well as planning for further users/stakeholders' engagement, completing the sensors/devices installation in the pilot buildings and initiating monitoring phase. In this phase, several algorithms including the first version of the Edge Node algorithm based on Reinforcement Learning (RL) and multi-agent control algorithm for the Cluster levels, are also developed and tested in the simulation environment and their overall concept is validated. Furthermore, the first periodic technical report (M01-M18) has been prepared and submitted to the EU by M21. Moreover, the first face-to-face General Assembly meeting was organized by NTNU in Aalesund by M13, Norway and the partners could meet for the first time after the Covid pandemic. Additionally, the COLLECTiEF consortium has several dissemination activities in the second year.

This report aims to present the key achievements and the fulfilled works as well as the status of each work package and the progress/deviation of each objective by the end of M22.

The activities of the consortium for the third period of the COLLECTiEF project, have been initiated on the 1st of April 2022 and the defined milestones, tasks and deliverables have been successfully completed for this period (M11-M22), thanks to all COLLECTiEF partners who actively participated in the project and closely collaborated to achieve the targeted goals and progresses.

During the third phase of the project, the partners had several meetings (internally, WPs, EB etc.) to perform the tasks and complete the foreseen deliverables. Similar to the first year, we have developed, discussed, and updated a new action plan for the second year of the COLLECTiEF project. This plan was aligned with our objectives and milestones, ensuring that we continue to progress towards project goals.

The third progress report is structured as follows:

- *Chapter 1* summarizes the project overview, a well-description of the objectives, the project structure and the work packages.
- *Chapter 2* describes the project implementation strategy including the action plan, engagement strategy and project progress report.
- *Chapter 3* summarizes the progress and achievement by the second year.
- *Chapter 4* expresses the engagement strategy, full timeline and involved tasks.
- Chapter 5 reports the dissemination, promotion, and exploitation activities by M24.

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- *Chapter 6* explains the activities performed by the beneficiaries, progress overview per work package as well as the dissemination, and exploitation activities according to the action plan for the first phase of the project.
- *Chapter 7* gives an overview about the project deviations, difficulties and solutions are discussed in this chapter.
- *Chapter 8* updates the project risks and the related statements.

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List of Acronyms

CI	Collective Intelligence
D	Deliverable
DoA	Description of Action
D&C	Dissemination and Communication
DMP	Data Management Plan
DYK	Did You Know
EB	Executive Board
DET	Dissemination and Exploitation Team
GA	Grant Agreement
GDPR	General Data Protection Regulation
HVAC	Heating, Ventilation, and Air Conditioning
IPPR	Internal Project Progress Report
IPR	Intellectual Property Rights
IEQ	Internal Environmental Quality
KPIs	Key Performance Indicators
M	Month
MS	Milestone
M&V	Measurement & Verification Protocol
nDSM	Novel Demand Side Management
NSD	Norwegian Center for Research Data
Partner	The beneficiary in the COLLECTiEF Project
PM	Person Month
QA	Quality Assurance
QC	Quality Control
RL	Reinforcement Learning
SDG	Sustainable Development Goal
TRL	Technology Readiness Level
WP	Work Package

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1 Project overview

1.1 The project summary and objectives

The European Union (EU) has been at the forehand of international efforts to tackle the global challenge of climate change and emissions of carbon dioxide (CO_2) impact and to deploy affordable, reliable, and modern energy services as well as to increase the share of renewable energy, according to the 7th and 13th Sustainable Development Goal (SDG7[1]& SDG13[2]).

COLLECTiEF research project commits to addressing the reliable and practical solutions for the challenges of climate change impacts and renewable energy penetration, by enhancing energy flexibility and climate resilience through a collective intelligence (CI) approach.

COLLECTiEF is an EU-funded H2020 project, running for 4 years – from 2021 to 2025. COLLECTiEF aims to enhance, implement, test, and evaluate an interoperable and saleable energy management system based on CI that allows easy and seamless integration of legacy equipment into a collaborative network within and between existing buildings and urban energy systems with reduced installation cost, data transfer and computational power while increasing data security, energy flexibility and climate resilience. To achieve this goal, the COLLECTiEF consortium develops software and hardware packages to install and smart up buildings and their legacy equipment on a large scale, meanwhile, to maintain simple and robust communication with the energy grid, see Figure 1.

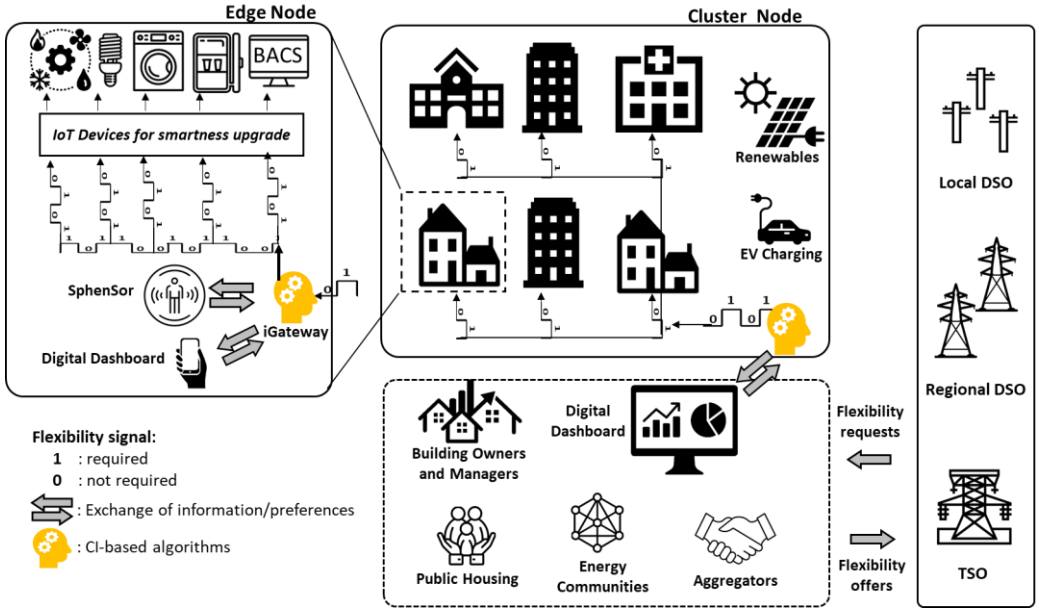

Figure 1 The conceptual design of COLLECTiEF

COLLECTiEF project has six main objectives (presented in Table 1) which assure step-by-step progress over four years to accomplish the project.

[1] EU. (2015). 7th Sustainable Development Goal (SDG7). https://ec.europa.eu/international-partnerships/sdg/clean-energy_en

[2] EU. (2015). 13th Sustainable Development Goal (SDG13). https://ec.europa.eu/international-partnerships/sdg/clean-energy_en

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Table 1 COLLECTiEF objectives

Objective	Description
1	**Enhancement and adaptation of algorithms for creating a CI-based energy-flexible network**
2	**Realization of CI-based cost-effective system components with easy deployment and maintenance**
3	**Demonstration and testing of a CI-based energy network in the real environment**
4	**Testing and implementing a scalable and customizable occupant-centric fusion sensor network for accurate and non-invasive environmental monitoring**
5	**Designing and implementing a smart, user-centric, and user-friendly digital platform for interacting with users and controlling technical building systems**
6	**The new business model for energy services including a clear model for commercialization of the COLLECTiEF system.**

The main core of the COLLECTiEF project is related to enhancing existing and developing further the CI algorithms for control strategies of the COLLECTiEF system. The CI algorithms (Obj.1) will shape the design of the sensor network (Obj.4), the user inputs/interactions and the digital dashboards (Obj.5), and the system components at the edge and cluster nodes (Obj.2). The solutions will be tested in the pilots and ameliorated during the demonstration phase (Obj.3). The final goal is to have the system qualified (TRL8) and ready for commercialization with a new business model (Obj.6). Objective's relations are depicted in Figure 2.

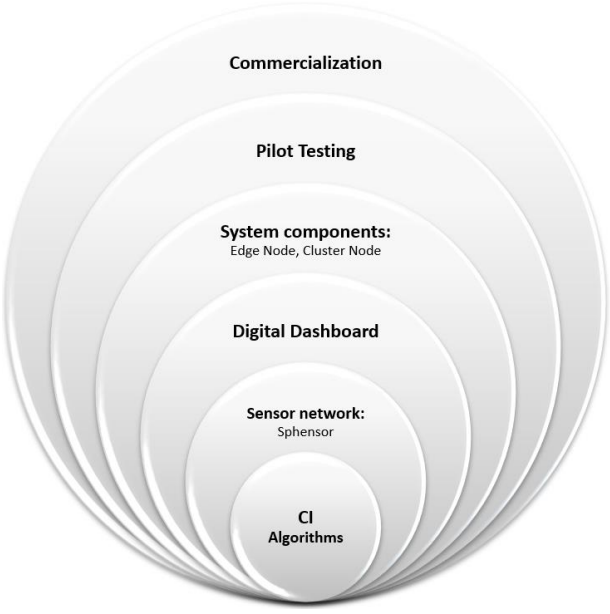

Figure 2 The objectives relations in the COLLECTiEF project

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During the third phase of the project, the consortium has much progress on each objective and obtained several achievements according to the milestones, see the following progress:

Objective 1: The first version of the algorithms in the CI-based control systems at the building and cluster levels has been developed based on Reinforcement Learning (RL) with promising results. The algorithms are being fine-tuned to be implemented at the edge and cluster nodes. The major indicators in developing the algorithms have been energy demand and indoor thermal comfort so far. Depending on the need, the indicators and objectives are updated in future versions of the algorithms. Representative weather data sets have been generated considering several future climate scenarios. The weather data sets have been used in running the algorithms and setting the control strategies to assess their impact in adapting to climate variations and decreasing energy demand while providing indoor comfort as much as possible. Different approaches for modelling and assessing indoor thermal comfort, which are integrated further into the control algorithm have been developed. Moreover, algorithms that include other factors/indicators, such as energy prices are being developed. A functioning platform for data sharing and integration, algorithm development and co-simulation has been created in GitHub and all the relevant users have access to the platform. The virtual test bed using DIMOSIM for algorithms and controls has been developed, and plans have been updated for the relevant partners (NTNU and CyI) to perform their tests.

Objective 2: The Border Router has been adapted by LASTEM LSI on the Raspberry Pi 4 open board to have a platform that can support the computational load anticipated by the COLLECTiEF solutions. The legacy and existing devices in the different pilot buildings were investigated, and the smart devices for interfacing with the field, such as smart plugs and smart thermostats, have been identified and installed in defined zones. To achieve the goals, one of which is the adaptation of the hardware, significant steps have been made. For example, the reference open board (Raspberry Pi 4) that is capable of integrating the edge computing functions envisaged by the project has been selected. The entire hardware platform of the Edge Node- BRiG (Border Route+ iGateway) has been built. The specifications for the use of Raspberry Pi 4 were defined, and the porting of the Border Router firmware (previously based on the less-performing BeagleBone open board) on Raspberry Pi 4 has been implemented. The electronic schematic and PCB of BRiG have been developed. Finally, the different components were mounted on the BRiG prototypes and tested.

Objective 3: As part of the small-scale demonstration, the RL-based algorithm was successfully tested at the living lab (G2Elab) and a very promising result was obtained. Additionally, the consortium has defined a measurement & verification (M&V) plan (D5.1) to evaluate the implementation of the COLLECTiEF solutions targeting not only energy savings and indoor environmental quality (IEQ) but also including the methods to measure and verify the load reduction and management improvement, resulting from the utilization of energy flexibility strategies, and the enhanced climate resilience. The M&V plan includes the methodology and the key performance indicators (KPI) selected to assess the impacts on the smart readiness of buildings, energy performance, indoor environmental quality, energy flexibility and climate resilience. Furthermore, the ongoing performance evaluation of the COLLECTiEF system (D5.2) was implemented in the pilot cases (first version) which presented the methodologies to assess the indoor environmental quality in buildings and shows the progress on the monitoring in the pilots, pointing out lessons learnt and mitigation strategies.

The smart-ready technologies (e.g., smart meters, smart thermostats, sensors and IoT devices) to be installed in the different pilot buildings were selected, and the activities related to the development of communication and development and testing in simulated environments of the algorithms that were able to link to the use of digital technologies and the algorithms for energy, comfort optimization and

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flexibility management are guaranteeing the protection of privacy and security of smart buildings have been initiated.

Objective 4: The occupant-centric fusion sensor network in the pilot buildings was implemented. For most parts, this has been successful, and the communication between the sensors and the BRiG device is now up and running for several months. Placement of the sensors has been done in such a way that it interferes as little as possible with the user environment while it can characterize the indoor environments.

Objective 5: The concept and architecture of the Human-Building Interface were defined and described (D3.8). Moreover, the prototype has been developed including different functions, data insights and authentication mechanisms. Besides, the development of the Human-Building Interface is under further development.

Objective 6: The comprehensive market analysis has been finalized and serves as a base for the development of business models which can fit the market needs for the actual exploitation of the COLLECTiEF solutions. Particularly, R2M provided the analysis of the contexts where the business models operate through the PESTLE analysis and the assessment of the market readiness in the different EU countries. In addition, it also presented analyses of the successful examples and the main potential competitors on the market for the COLLECTiEF solution, providing references and information on their main functionalities and provided services, the ways of commercialization, and the adopted business models. These serve as bases and references for the development of the business models for the exploitation of the COLLECTiEF solutions. The discussions have been carried out to orientate the development of the business models.

COLLECTiEF consortium consists of 14 beneficiaries from universities, institutions, manufacturing/construction companies, and municipal sectors from six countries across Europe. The detailed information and competences of the COLLECTiEF project's beneficiaries are briefly presented in deliverable D1.1. Figure 3 shows the value chain of COLLECTiEF and the involved partners in each stage.

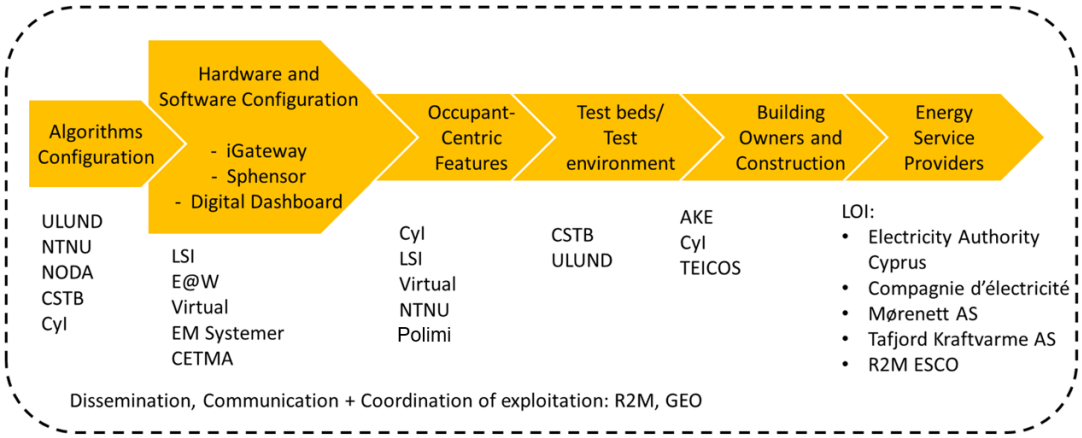

Figure 3 COLLECTiEF value chain

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1.2 The work packages

COLLECTiEF comprises seven work packages (see Figure 4) aligned with each other which aim at developing, implementing, testing, and evaluating the proposed energy management system based on Collective Intelligence (CI). Detailed information about the work packages is provided in Section 6.

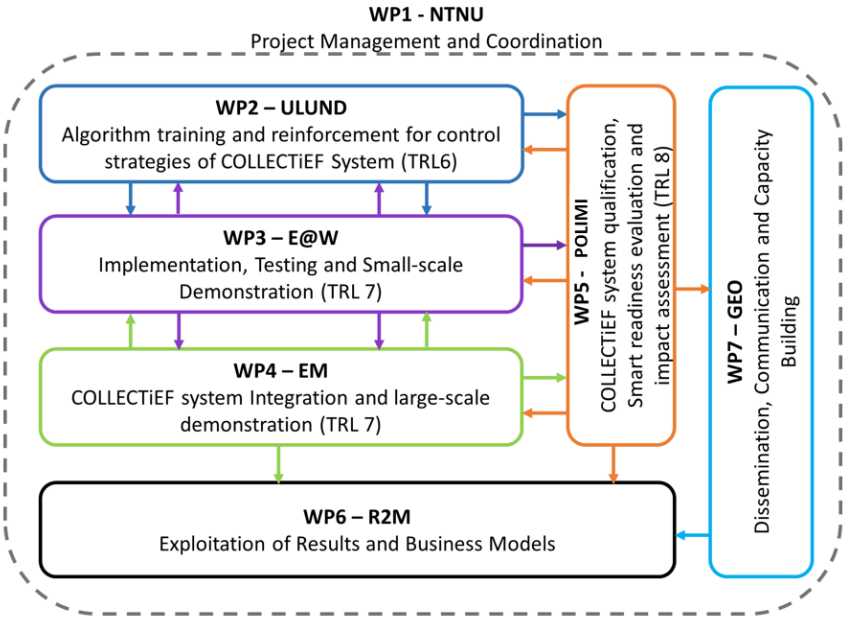

Figure 4 The overview of work packages

The Gantt Chart of the COLLECTiEF project is covering tasks and milestones within 48 months conceived in various phases to carry out the defined tasks as well as ensure to achieve the expected outcomes, see Figure 5.

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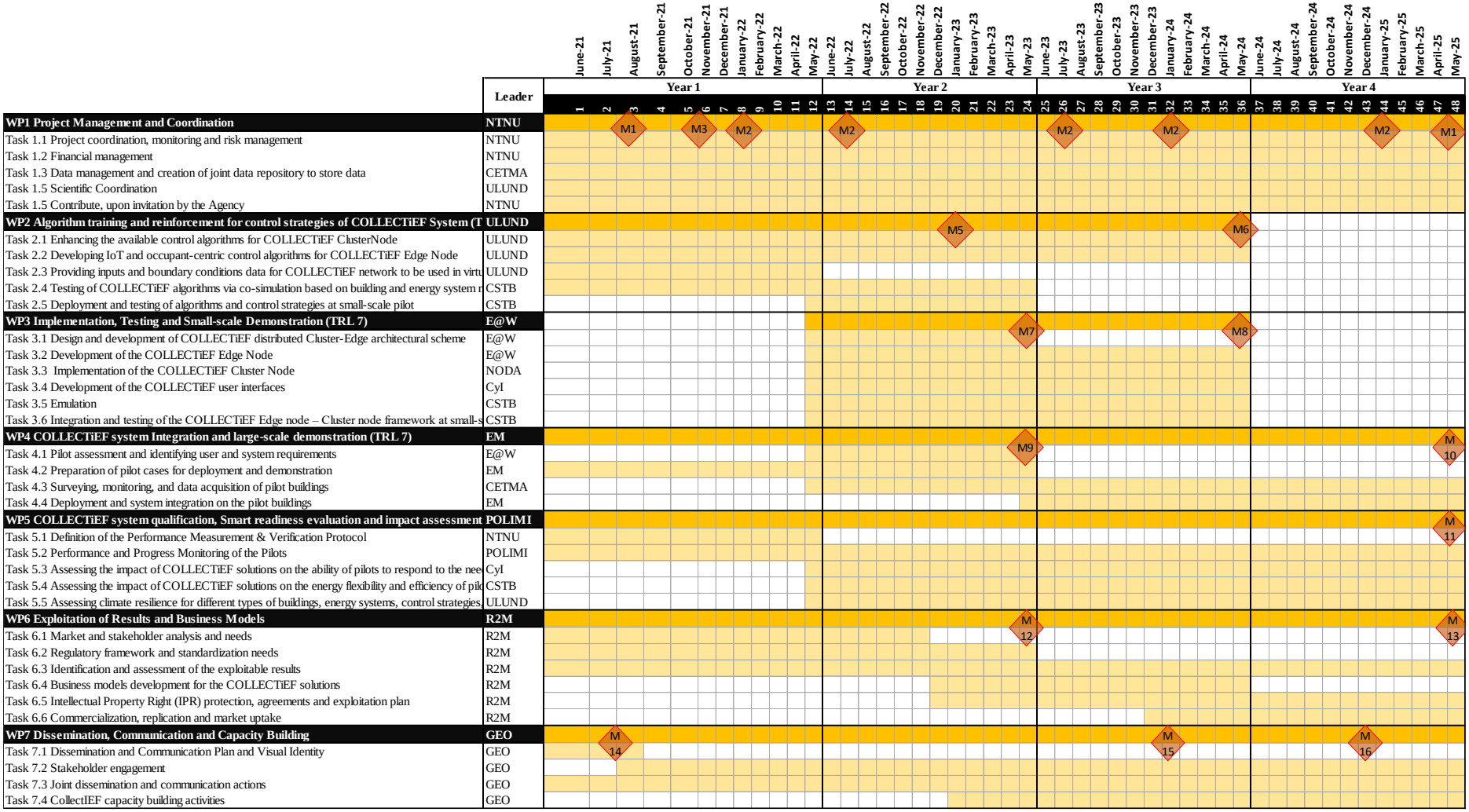

Figure 5 Project Gantt Chart: WPs and tasks distribution (updated by M21)

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2 Project structure

COLLECTiEF project originates from the identification of available technologies within the consortium that have been validated and demonstrated in previous projects and which fall under the technology readiness level (TRL) 5/6. These technologies allow the creation of a complete CI-based energy network and within the 4-year timeline of the project, the main aim is to qualify COLLECTiEF solutions in four real applications, hereafter called “DEMO”, which will bring the overall TRL to 8. Therefore, the project management is divided into two main following phases (see also Figure 6 and Figure 7):

- Before the start of the DEMO
- After the start of the DEMO

This classification aims at organizing and monitoring the defined tasks as well as at providing a better overview of the project's progress. The main activities can be summarized as follows:

Milestones: Before the Start of DEMO (M1-M24)

- General project management concept defined
- Project communication kit developed
- Data management plan
- Control algorithms ready for testing
- Edge Node, Cluster Node, human-building interface, and occupant-centric sensor network ready for testing
- Installation in pilots completed
- Market and stakeholder analysis and regulatory framework analysis completed

Milestones: After the Start of DEMO (M25-M48)

- Testing in small-scale test bed completed
- Stakeholder workshops conducted
- Demonstration phase in large-scale
- Business model defined, showing commercial feasibility
- Capacity training material ready for use
- The demonstration phase in large-scale pilots completed
- System complete and qualified (TRL8)
- Project completed

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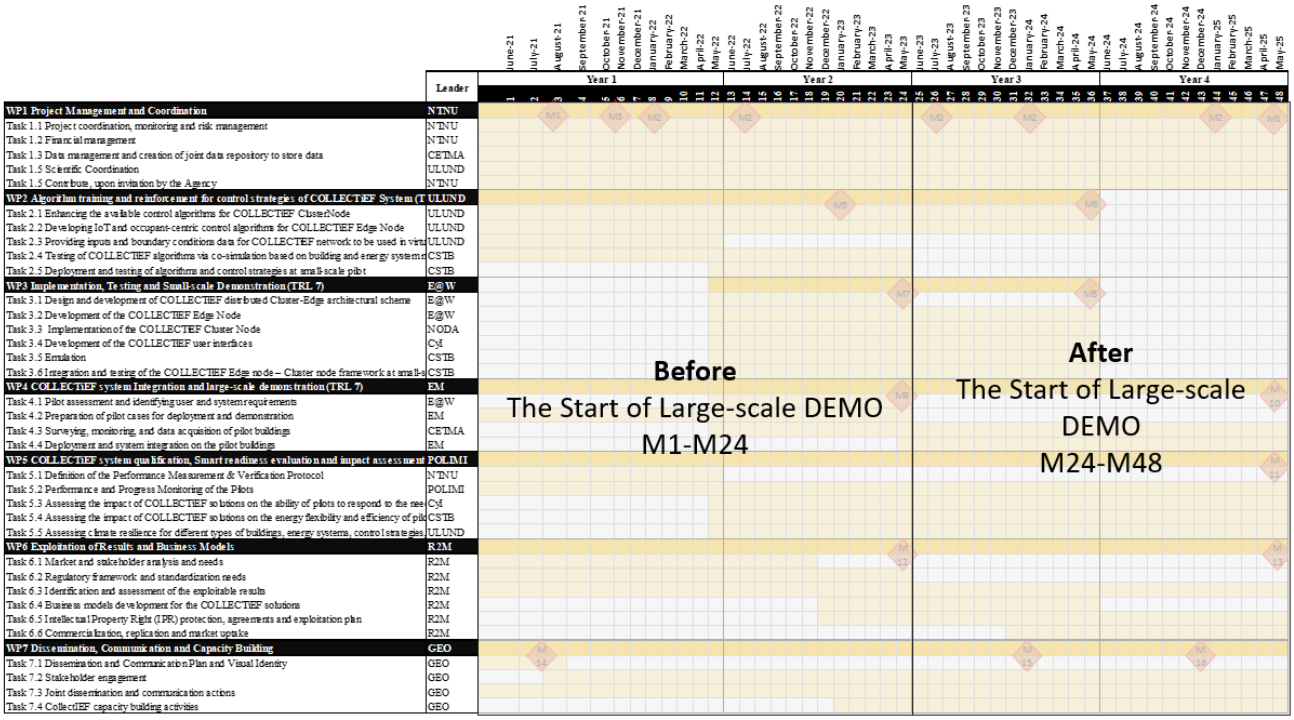

	Leader
WP1 Project Management and Coordination	NTNU
Task 1.1 Project coordination, monitoring and risk management	NTNU
Task 1.2 Financial management	NTNU
Task 1.3 Data management and creation of joint data repository to store data	CETMA
Task 1.5 Scientific Coordination	ULUND
Task 1.5 Contribute, upon invitation by the Agency	NTNU
WP2 Algorithm training and reinforcement for control strategies of COLLECTiEF System (T	ULUND
Task 2.1 Enhancing the available control algorithms for COLLECTiEF ClusterNode	ULUND
Task 2.2 Developing IoT and occupant-centric control algorithms for COLLECTiEF Edge Node	ULUND
Task 2.3 Providing inputs and boundary conditions data for COLLECTiEF network to be used in virtu	ULUND
Task 2.4 Testing of COLLECTiEF algorithms via co-simulation based on building and energy systems	CSTB
Task 2.5 Deployment and testing of algorithms and control strategies at small-scale pilot	CSTB
WP3 Implementation, Testing and Small-scale Demonstration (TRL 7)	E@W
Task 3.1 Design and development of COLLECTiEF distributed Cluster-Edge architectural scheme	E@W
Task 3.2 Development of the COLLECTiEF Edge Node	E@W
Task 3.3 Implementation of the COLLECTiEF Cluster Node	NODA
Task 3.4 Development of the COLLECTiEF user interfaces	CyI
Task 3.5 Emulation	CSTB
Task 3.6 Integration and testing of the COLLECTiEF Edge node – Cluster node framework at small-s	CSTB
WP4 COLLECTiEF system Integration and large-scale demonstration (TRL 7)	EM
Task 4.1 Pilot assessment and identifying user and system requirements	E@W
Task 4.2 Preparation of pilot cases for deployment and demonstration	EM
Task 4.3 Surveying, monitoring, and data acquisition of pilot buildings	CETMA
Task 4.4 Deployment and system integration on the pilot buildings	EM
WP5 COLLECTiEF system qualification, Smart readiness evaluation and impact assessment	POLIMI
Task 5.1 Definition of the Performance Measurement & Verification Protocol	NTNU
Task 5.2 Performance and Progress Monitoring of the Pilots	POLIMI
Task 5.3 Assessing the impact of COLLECTiEF solutions on the ability of pilots to respond to the nee	CyI
Task 5.4 Assessing the impact of COLLECTiEF solutions on the energy flexibility and efficiency of pil	CSTB
Task 5.5 Assessing climate resilience for different types of buildings, energy systems, control strategies	ULUND
WP6 Exploitation of Results and Business Models	R2M
Task 6.1 Market and stakeholder analysis and needs	R2M
Task 6.2 Regulatory framework and standardization needs	R2M
Task 6.3 Identification and assessment of the exploitable results	R2M
Task 6.4 Business models development for the COLLECTiEF solutions	R2M
Task 6.5 Intellectual Property Right (IPR) protection, agreements and exploitation plan	R2M
Task 6.6 Commercialization, replication and market uptake	R2M
WP7 Dissemination, Communication and Capacity Building	GEO
Task 7.1 Dissemination and Communication Plan and Visual Identity	GEO
Task 7.2 Stakeholder engagement	GEO
Task 7.3 Joint dissemination and communication actions	GEO
Task 7.4 CollectiEF capacity building activities	GEO

Figure 6 The project implementation based on the development of a large-scale DEMO

The two periods have been through further breakdown to better identify the main activities within each time section:

- **Before the start of Large-scale DEMO 1st Year (M01-M12)**

Objective: Complete TRL 5 for COLLECTiEF solutions — technology validated in a relevant environment

The technologies were tested in a co-simulation environment DIMOSIM.

- **Before the start of Large-scale DEMO 2nd Year (M13-M24)**

Objective: Complete TRL 6 for COLLECTiEF solutions — technology demonstrated in a relevant environment

The technologies were tested in a small-scale real environment (G2Elab).

- **After the start of Large-scale DEMO 1st Year (M25-M36)**

Objective: Complete TRL 7 for COLLECTiEF solutions — System prototype demonstration in an operational environment

The technologies will be tested in three real applications (overall 12 pilot buildings in Norway, Italy and Cyprus).

- **After the start of Large-scale DEMO 2nd Year (M37-M48)**

Objective: Complete TRL 8 for COLLECTiEF solutions — System complete and qualified

The COLLECTiEF system will be qualified for all the expected impact criteria.

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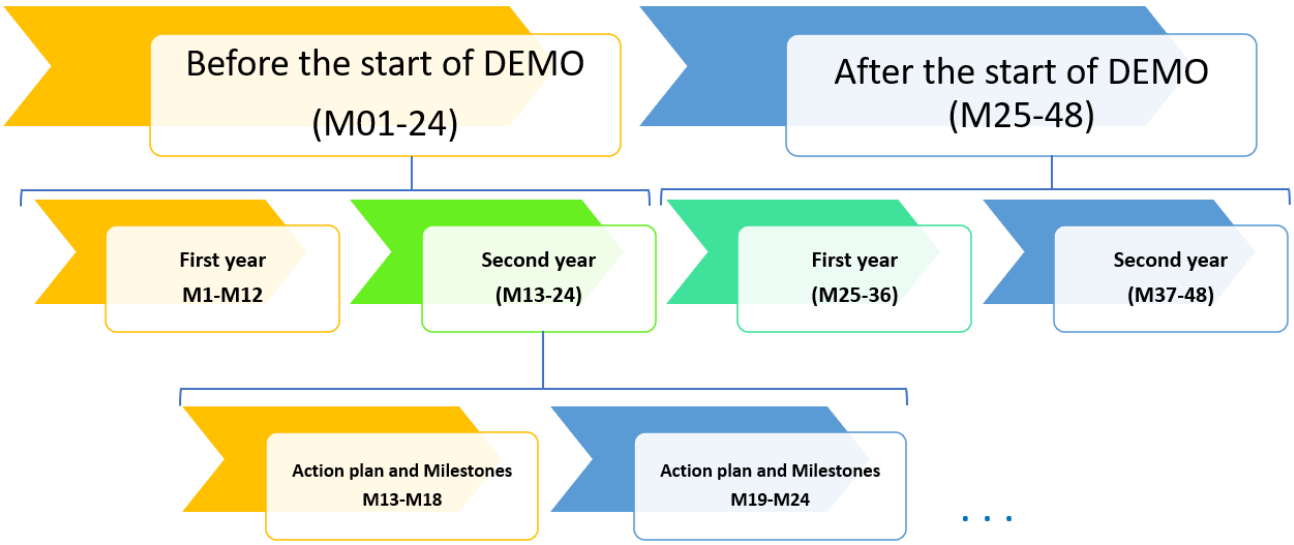

Figure 7 COLLECTiEF implementation procedure (M13-M24)

Pursuing the above-mentioned objectives and milestones for the project, the management team focused on the second year and developed a third action plan for M13-M24. The action plan details the activities per work package, per task, and partner. In the following sections, the logic and strategies for the development of the action plan for M13-M24 are elaborated. The action plan for the third year (M25-M36) will be drafted during the next General Assembly meeting on 8th-9th June.

2.1 Project period: Before the start of Large-scale DEMO Year 2 (M13-M24)

In the second year of the COLLECTiEF project, the consortium focused on developing the control algorithm development and testing, performance, installation and monitoring of the pilots, the definition of the performance measurement & verification protocol, market and stakeholder analysis, regulatory framework, standardization, and exploitation.

During the second year (M12-M24) of the project, the technology of the COLLECTiEF system (TRL 5) was validated in a relevant environment. This means that the algorithms were enhanced, developed, and tested in the simulation environment as well as their overall concept was validated. Additionally, the RL-based algorithm has been tested on G2ELab and the small-scall demonstration has been initiated in this period. There were many interactions between different working packages to implement the dedicated tasks defined in the action plan (see Figure 8).

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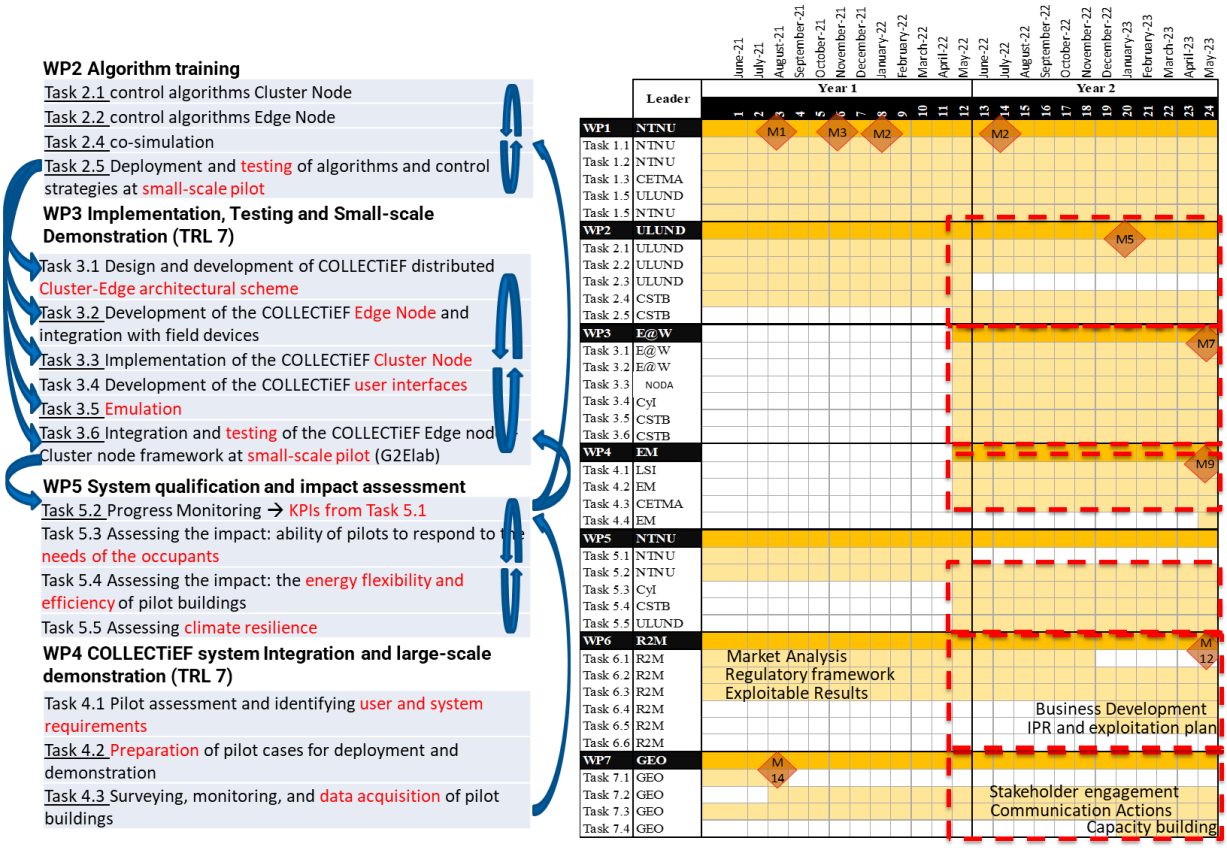

Figure 8 Detailed action plan and the involved tasks – Before the Start of Large-Scale DEMO 2nd Year (M13-M24)

2.2 Action plans and milestones M13-M24

At the beginning of the second year, a new action plan was structured based on the project implementation strategy and milestones for a runtime of one year to follow up and coordinate the whole consortium. Additionally, a list of internal milestones was created and shared with the partners to follow up on the progress expectations during the project timeline. Table 2 lists the internal milestones that the project aimed at by M24.

Table 2 List of internal milestones by M24

WP1	Internal Project Progress Reports (4-5-6-7) are collected
	The fifth GA is held
	The third project progress report is submitted to the EU (D1.6
	The data management plan is updated
WP2	The algorithms are developed to be implemented in test cases
	Control algorithms are further developed.
	The tests are run the NODA solutions and start refactoring it to tun on the NODA self-host
	D2.1 is completed and submitted to the EU

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	D2.3 is completed and submitted to the EU
	D2.5 is completed and submitted to the EU
	D2.9 is completed and submitted to the EU
WP3	D3.1 Cluster-Edge- the architectural scheme is submitted to the EU in M15.
	Edge Node, Cluster Node, Human-Building interface and occupant-centric sensor network ready for testing
	D3.2 is completed and submitted to the EU
	D3.4 is completed and submitted to the EU
	D3.6 is completed and submitted to the EU
	D3.8 is completed and submitted to the EU
WP4	Installation in pilots is completed
	D4.1 is completed and submitted to the EU
	D4.2 is completed and submitted to the EU
WP5	D5.2 is completed and submitted to the EU
WP6	D6.1 is completed and submitted to the EU in M18.
	D6.2 is completed and submitted to the EU in M24
	D6.3 is completed and submitted to the EU in M24
WP7	R2M and GEO will further update the database and prepare a draft market analysis
	Campaign for stakeholder engagement and the advertisement of COLLECTiEF activities, achievements, and the tool on MEDIA- project's website are ongoing

2.3 Internal Project Progress Report (IPPR)

As reported in previous progress reports, the management team has created a system of monitoring and reporting activities using Internal Progress Reports (IPPR). IPPR gives the coordinator a good understanding of the status and progress of the work and allows them to detect any possible, risks, delays, or deviations well in advance. The partners share information about the ongoing and planned work and can assess the percentage of the completed task. Furthermore, the cumulative report serves as a helpful basis for the creation of technical periodic reports. Table 3 lists the schedule plan of IPPR submission due by the project partners.

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Table 3 Schedule for Internal Project Progress Report (IPPR)

Number	Title	Due Date (in months)	Delivered for review
IPPR1	Internal Project Progress Report - M4	4	30-Sep-21
IPPR2	Internal Project Progress Report - M7	7	31-Dec-21
IPPR3	Internal Project Progress Report - M10	10	31-Mar-22
IPPR4	Internal Project Progress Report - M13	13	30-Jun-22
IPPR5	Internal Project Progress Report - M16	16	30-Sep-22
IPPR6	Internal Project Progress Report - M19	19	31-Dec-22
IPPR7	Internal Project Progress Report - M22	22	31-Mar-23
IPPR8	Internal Project Progress Report - M25	25	30-Jun-23
IPPR9	Internal Project Progress Report - M28	28	30-Sep-23
IPPR10	Internal Project Progress Report - M31	31	31-Dec-23
IPPR11	Internal Project Progress Report - M34	34	31-Mar-24
IPPR12	Internal Project Progress Report - M37	37	30-Jun-24
IPPR13	Internal Project Progress Report - M40	40	30-Sep-24
IPPR14	Internal Project Progress Report - M43	43	31-Dec-24
IPPR15	Internal Project Progress Report - M46	46	31-Mar-25

Table 4 demonstrates the IPPR schedule with the Project Progress Reports that are delivered EU Commission during the project.

Table 4 Schedule and period of activities for the project progress report

Number	Due Date (in months)	Collected IPPR	Period Activities Covered
First Progress Report	M6	IPPR1 (M1-M4)	M1-M4
Second Progress Report	M12	IPPR2 (M5-M7), IPPR3 (M8-M10)	M5-M10
Third Progress Report	**M24**	**IPPR4 (M11-M13), IPPR5 (M14-M16), IPPR6 (M17-M19), IPPR7 (M20-M22)**	**M11-M22**
Fourth Progress Report	M30	IPPR8 (M23-M25), IPPR9 (M26-M28)	M23-M28
Fifth Progress Report	M42	IPPR10 (M29-M31), IPPR11 (M32-M34), IPPR12 (M35-M37), IPPR13 (M38-M40)	M29-M40

Through the IPPR template, the project partners have been asked to prepare their inputs according to the defined IPPR template (see Table 5) and report the difficulties and problems faced during project implementation over the reporting period as well as provide their solutions and opinion to the coordinator based on the planned Description of the Action (DoA). Section 6 provides the overview of work progress according to the third-semester action plan (M13-M24) based on IPPR4, IPPR5, IPPR6 and IPPR7 collected from project partners.

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Table 5 Structure of COLLECTiEF's IPPR table for each WP

WPX – [The title of WPX]
Overview of Tasks in WP X: Copy those tasks from the DoA that you are involved in
Explain the work carried out in WPX during the reporting period for your beneficiary! <fill in>
Explain also the overall assessment on percentage complete of your tasks within WPX and the planning of next steps. <fill in>
Explain the reasons for deviations from the DoA, the consequences and the proposed corrective actions. Include explanations for tasks not fully implemented, critical objectives not fully achieved and/or not being on schedule and the impact on other WP/tasks. <fill in if appliable>
- Difficulties – Problems – Solutions – Lessons Learned • Outline and provide the necessary explanation of any difficulties/problems (internal or external) you faced during project implementation over the reporting semester/period. • How did you manage to address / solve those problems (if you have managed to do so)? What were the corrective actions you took and/or plan to take? • What was the outcome of your corrective action(s)? - Changes in the project team • Outline changes (if any) in: • the legal status of your organization; and • the project team from your organization (i.e. those people involved in project activities) - Additional comments or requests for the coordinator.

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3 Progress and Achievement by Second Year

3.1 Deployment of monitoring system in the pilot sites

In the second year of the COLLECTiEF project, the monitoring system including Sphensors units, BRiG, Repeaters, Smart Plugs, Smart Valves and POEs have been installed in the pilot buildings according to the monitoring plan (see Figure 9). The installation procedure was initiated on the 1st of June 2022 and completed by the 31st of August 2022. The troubleshooting and fixing of data communication/flow issues have been performed in September 2022. However, the installation has delayed because some sensors were broken and were not connected to the BRiG due to obstacles in the zones. The activities related to installation and monitoring are continuously supervised and a monthly update is reported by each pilot responsible.

Figure 9 Photographs of the installation of Sphensors, BRiG, Smart Plugs and Valves in the pilot buildings

The installation process includes the placement of posters with QR codes, for the post-occupancy evaluations (see Figure 10). Additional dissemination materials have been distributed, as well. The posters with QR codes that aim to be scanned by end-user for the dedicated survey for each pilot building have been prepared.

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Figure 10 POE posters in Norway

NTNU and CyI have defined the plan of installation of IEQ (Indoor Environmental Quality) sensors in the different pilots and have identified the zones to be monitored, with the support of the Pilot responsible partners. Similarly, the energy meters to be installed or existing have been identified in each pilot building.

3.2 Development of COLLECTiEF algorithms and strategies

The implementation of Demand Side Management (DSM) poses challenges due to system complexity and expensive ICT solutions, which also raise privacy and security concerns. Current methods in controlling building networks and energy grids using Reinforcement Learning (RL) oversimplify energy problems. To address these issues, we proposed Novel Demand Side Management (nDSM), an integrated approach to enhance energy management under climate uncertainties. The control algorithms are developed for edge and cluster nodes based on the initial logic of the COLLECTiEF system, CI-DSM. Th nDSM has been evaluated for the Eidet building in Ålesund, Norway, considering 13 climate scenarios, two adaptation policies and different randomness levels. nDSM achieved above 95-98% indoor comfort in extreme warm summers and approximately 86% in extreme cold winters. The algorithm quickly converged to an optimal solution, improving indoor comfort and energy savings.

3.3 Small-scale demonstration of COLLECTiEF algorithm at G2ELab

The implementation of the developed algorithm/code in COLLECTiEF is carried out on G2ELab in France to test the performance of the algorithm/code. At this stage, the latest version of the nDSM code is utilized for the test.

Code descriptions: In this version, the code applies reinforcement learning to learn and control the indoor conditions of the building based on achieved rewards. The reward is formulated based on energy performance and thermal comfort. The flexibility is activated by a signal generated based on the energy demand at the current time compared to average historic values over a 30-day rolling window. The final version of the code is developed in Python.

Control and monitor: To activate flexibility, the nDSM utilizes two actuators to control the indoor conditions namely (1) temperature setpoint and (2) CO_2 setpoint. The first one controls the heating and cooling setpoint temperature on the hydronic system in the rooms. The second one changes the

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ventilation rate through the air handling unit to maintain the defined CO_2 level. The controls are available through the BMS of the building. To monitor the indoor conditions and learn from the actions, the monitoring points are defined as (1) room air temperature, (2) room CO_2 level, (3) inlet water temperature, (4) outlet water temperature, (5) water flow, and (6) HVAC power. The monitoring points are the sensors from the BMS and the Sphensors in the rooms.

Implementation: To implement the code in the building, the nDSM code is coupled with the BMS. To secure this connection, the code is running on the G2ELab internal server called MHI-Server. To ease access, the code is uploaded to a git repository, and, in case of modification, the latest version is pulled by the server. This could be automatic progress; however, it is done manually to satisfy the current procedures in G2ELab. The monitored data is fetched every 15 minutes from BMS and Sphensors and stored in an SQL database. There is 2 minutes synchronization time for data capturing to consider the connection speed and delay. After the sync time, the nDSM code is run every 15 minutes on the server 2 minutes after each data capture. Therefore, it is certain to get the latest monitored values in the code, if they are available. In each run of the code, the monitored values are fetched from the database via an API (get_sensors). After processing in the nDSM kernel, the values for the actuators are sent to the BMS through another API (post_actuators). The post_actuator function includes a module that checks the values to be within a certain limit to avoid any damage or corruption. Figure 11 demonstrates the overall progress of the implementation. The flowchart of the code is presented on the top right of the picture. The G2ELab's dashboard is used to visualize the data (i.e. sensor and actuator values) in real time.

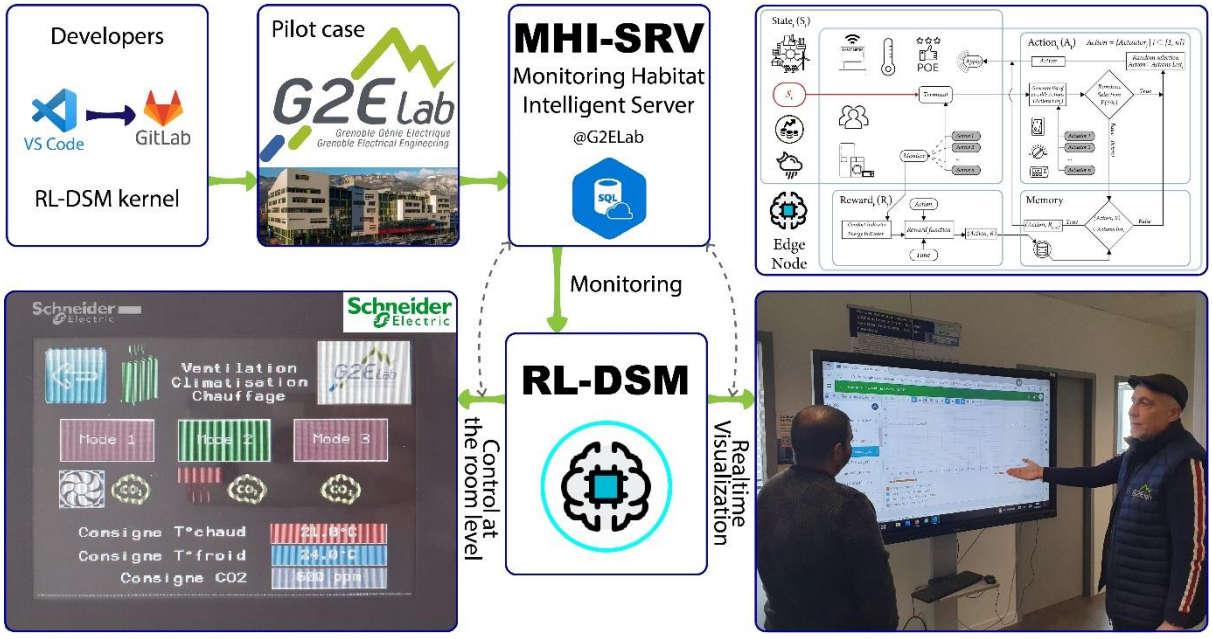

Figure 11 Workflow of the small-scale test in G2ELab. bottom-left: BMS panel in the rooms, top-right: flowchart of the developed algorithm, bottom-right: real-time visualization platform to demonstrate the performance of the code.

Occupants can override the actuator values through the BMS panels in each room. There is also a possibility to fill a POE stored with the timestamp in the SQL server. This POE data can be correlated to the sensor and actuator values to evaluate the performance of the algorithm regarding indoor environment quality. The building is equipped with smart plugs and dimmable lights; however, access to control them is not possible yet through the BMS. The developed pipeline is capable to get more

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actuators and sensors if there are any available in the system. Also, by adapting the get_sensor and post_actuator functions to another API, it is possible to integrate the code with other buildings with the least modifications. If the sensor values come from the Sphensors, then there is no need to modify the function.

Further progress: It is planned to replace the thermal comfort module in the reward function with more indicators. Also, the algorithm will be running until the cooling season to evaluate its performance in summer. Moreover, the signal function will generate the signal based on the PV production to maximize the on-site generation.

3.4 Monitoring and data acquisition of pilot buildings

The data collected from the pilot building of the COLLECTiEF is stored in a relational database located on a server hosted by NTNU. A relational database is a set of information that organizes data into predefined relationships where the data is stored in one or more tables related to each other.

The API for the pilot buildings has been developed (see Figure 12) and access rights were provided to COLLECTiEF project members through the BMS system cloud solution. A database to anonymize and store data from the pilot buildings has been set up according to the project data management plan and in terms of regulatory security measurements.

We have created code to access all data from the BMS systems on the Norwegian pilot buildings and store these on the COLLECTiEF project server/database. All analogue, digital values and energy data from the buildings are being stored every 2 minutes. Data will be used to do an evaluation of the COLLECTiEF project – pre- and post-installation of project algorithms and code. By storing all available data from each pilot BMS system, we collect data that we might need to do a proper identification of the project impacts, without necessarily knowing the exact needs from the beginning.

An interface to extract data from all installed Sphensor units and store these in the database has been created. Data collected from the installed Sphensors on the pilot buildings are obtained through the BRiG device. Data collected are stored in the NTNU server/database and made available to all the participants in the project through a series of API instructions.

A code has been developed to get data from the smart valve/actuator through BRiG This is not fully completed yet, but work is undergoing to finish this task and to populate data in the NTNU server database. The project has developed code to get results from POEs and store these in the NTNU server/database. The POE results are available through an API created on the NTNU server/database.

In addition to API services created to extract data from Sphensors and POEs, a set of API services has been made to support the evaluation of the stakeholder's engagement and to easily evaluate the state of the individual Sphensors™. Further API calls will be created based on the demands of the project.

An analysis to evaluate various services and provide weather data for the different pilot locations and regions, both historical weather and weather forecasts has been done. These data will be part of the project evaluation; pre- and post-installation of the COLLECTiEF solution.

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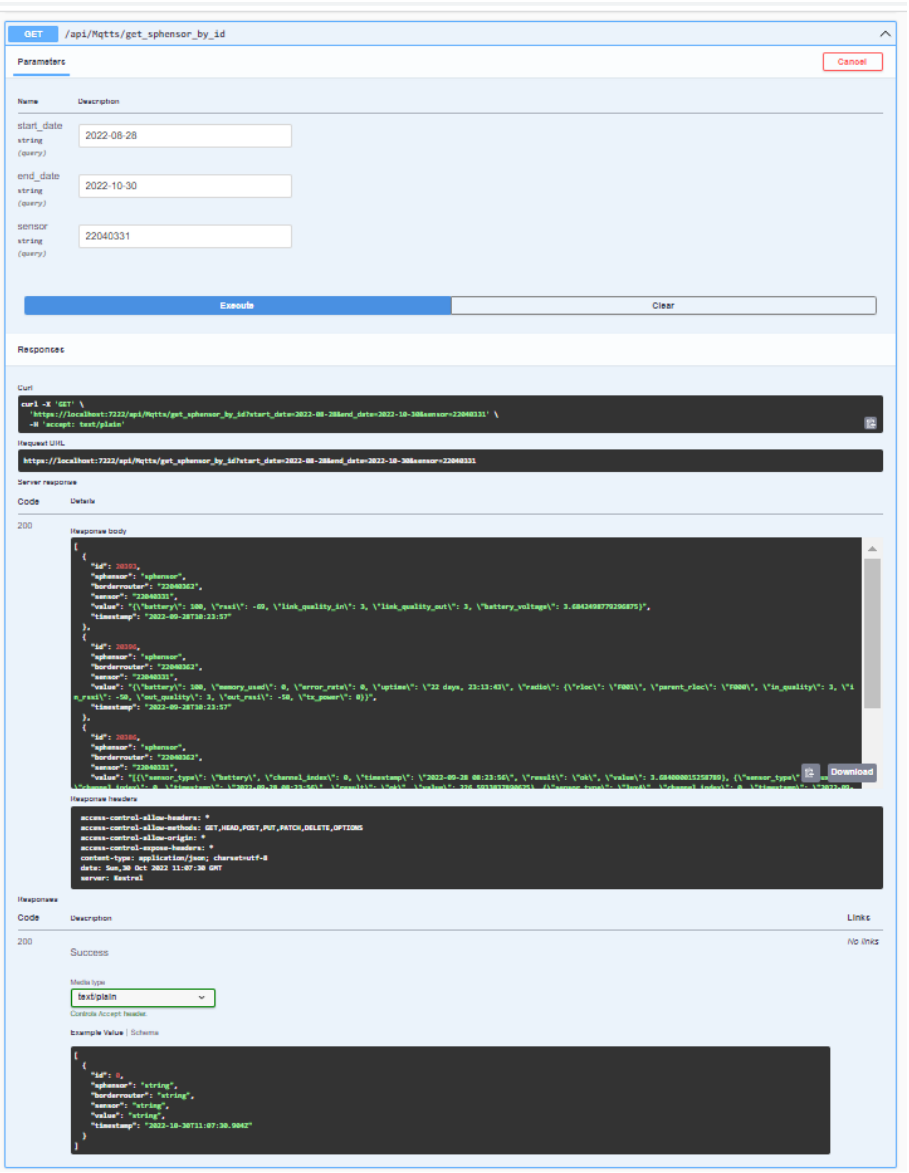

Figure 12 Example of a search of Sphensors by serial number

3.5 COLLECTiEF user Interface

During the second year of the project, the relevant literature and examples of user-friendly Human-Building interfaces were collected and studied. Particularly, the potential technical solutions have been investigated and established to exploit and take as a reference the existing App at G2ELAB in collaboration with CSTB. The questionnaire to collect occupants' feedback and interaction through a digital dashboard has been prepared and shared among the pilots. Based on the collected data, a table for the data accessibility requirements has been created to take into consideration these aspects during the development activities and to create the conceptual architecture of the COLLECTiEF user interfaces. Moreover, the first version of the Human-Building Interface has been developed (see Figure 13). The concept of the COLLECTiEF Human-Building interface is presented in D3.6.

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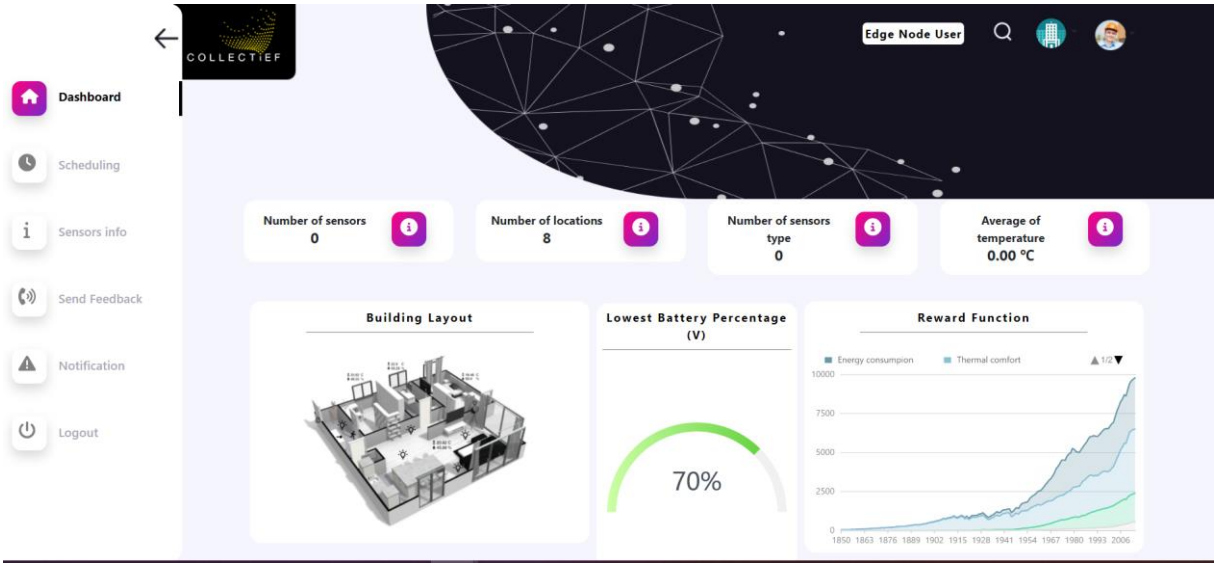

Figure 13 Human-Building Interface Home page

3.6 Data analysis and impact assessment

The COLLECTiEF system is expected to reach the technology readiness level (TRL) 8, which indicates that the system needs to be complete and qualified. To ensure this achievement, the system will be validated and demonstrated in relevant environments, which include simulation environments, testing and demonstration sites. In particular, the project aims to test the solutions in a small-scale demonstration site (G2ELAB, France) and 13 large-scale demonstration sites located in three countries characterized by different climatic conditions (Norway, Italy and Cyprus). The chosen pilot buildings have different uses: education, residential, sports, health care, offices, and laboratory.

To evaluate and test the performance of the COLLECTiEF system, several Key Performance Indicators (KPIs) have been identified and will be calculated using data measured in the pilot buildings and data obtained from calibrated simulations. They will be exploited to assess the impacts deriving from the implementation of the system, which in COLLECTiEF affects five domains: building smart readiness, energy, indoor environmental quality (IEQ), energy flexibility and climate resilience.

According to the Measurement and Verification Protocol developed during the first year of the project and described in deliverable D5.1, the project timeline includes a baseline period, originally planned from M13 to M24 (before the implementation of the systems) and an assessment period from M25 to M48 (after the implementation). During the two periods, energy and indoor environmental quality data will be measured in the selected thermal zones, where, at the same time, occupants will take part in post-occupancy evaluations by answering questionnaires developed within COLLECTiEF. Due to delays in the installation phase and low participation from the users in some of the pilots (linked also to the delay in the installation), the baseline period will be extended to a few months. The ample length of the assessment period (2 years) allows us to postpone the beginning of the assessment phase, once the data necessary to construct the baseline are available.

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Joint action between WP5 and WP4 has been initiated to periodically verify and report the progress of the operating status of the monitoring systems in the Pilots. For IEQ assessment, the first simplified approach to supervise the data acquisition has been upgraded by creating an automatic process which facilitates the control of the monitored data. The process collects data through the project data repository, using the API created for the project members. In this way, the verification of data availability can be done throughout the whole communication chain – from Sphensors, through the MQTT broker and finally on the data repository. An application has been created that allows for this process to be performed and it can be run for any given building for any specified period (see Figure 14). The user can select the start and end time of the report, as well as measurement type (depending on the different types of Sphensors), aggregate interval if the report is to include raw data, data count, POE count or any combination of these.

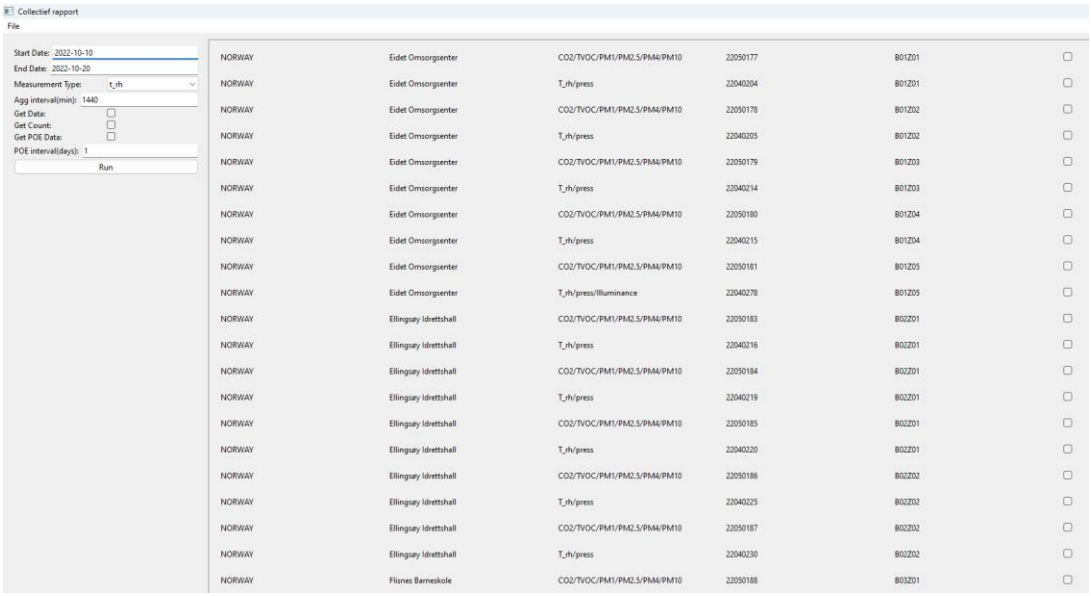

Figure 14 Configuration window data reporting tool

When selecting what buildings to run the report for the application does all the API calls necessary and stores the results in Excel sheets as well as presenting the result for each zone graphically for an easier understanding of the data quality (Figure 15). The report shows min, max and average temperature (or what measurement type was chosen for the report) and can also show the raw data. The report further shows a calculated data count and can also show the data count given from the API directly as a comparison. Lastly, the report shows the POE count for the same time interval so that the project group can get a better indication of user engagement coupled with the information on data availability and quality.

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Figure 15 Example of Data visualization in Eidet Omsorgssenter

In addition, the progress of the monitoring in the pilots is reported synthetically through an Excel file developed to easily detect the presence of malfunction in the IEQ monitoring system, i.e. Sphensors devices (Figure 16) and the engagement of the users in providing feedback through the POEs (Figure 17). The status of the IEQ monitoring systems is double-checked through the Sphensors platform.

Average of days on record	lug-22			ago-22			set-22			ott-22			nov-22			dic-22	
	a	b	LSI Commer	a	b	LSI Commer	a	b	LSI Commer	a	b	LSI Commer	a	b	LSI Commer	a	b
50%	0%	0%		0%	38%		100%	100%		100%	100%		100%	100%		87%	100%
47%	0%	0%		0%	38%		100%	33%		100%	100%		100%	100%		87%	100%
50%	0%	0%		0%	38%		100%	100%		100%	100%		100%	100%		87%	100%
49%	0%	0%		0%	38%		80%	100%		100%	100%		100%	100%		87%	100%
50%	0%	0%		0%	38%		100%	100%		100%	100%		100%	100%		87%	100%
34%	0%	0%		0%	38%		100%	60%		20%	0%		53%	100%		80%	81%
50%	0%	0%		0%	38%		100%	100%		100%	100%		100%	100%		87%	100%
50%	0%	0%		0%	38%		100%	100%		100%	100%		100%	100%		87%	100%
50%	0%	0%		0%	38%		100%	100%		100%	100%		100%	100%		87%	100%
50%	0%	0%		0%	38%		100%	100%		100%	100%		100%	100%		87%	100%

Figure 16 Example of a synthetic report which displays the operating status of the IEQ monitoring system in one of the pilot buildings

Zone type	Average % of target	lug-22	ago-22	set-22	ott-22	nov-22	dic-22	gen-23	feb-23
Classroom	0%	0%	0%	0%	0%	0%	0%	0%	0%
Classroom									
Classroom	0%	0%	0%	0%	0%	0%	0%	0%	0%
Classroom									
Classroom	1%	0%	25%	0%	0%	0%	0%	0%	0%
Classroom									
Classroom	70%	0%	0%	138%	300%	1175%	313%	350%	238%
Classroom									
Classroom	58%	0%	38%	113%	438%	663%	225%	338%	263%
Classroom									
Classroom	51%	0%	13%	1200%	88%	263%	138%	0%	125%
Classroom									
Shared office	0%	0%	0%	13%	0%	0%	0%	0%	0%
Shared office									
Shared office									
Shared office									

Figure 17 Example of a synthetic report which displays the progress in POEs collection in one of the pilot buildings

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Currently, the majority of the IEQ monitoring systems are performing well and measured data are available from September 2022.

For energy assessments and building models' calibration, the process of energy data collection, standardization of data format and study of the energy systems and installed appliances is going on in each pilot. Data information, availability, quality, temporal resolution, and monitoring level (e.g., building, flat, zone) vary between the different pilot buildings and different approaches for calibration and energy assessments are under consideration.

The evaluation of the impacts (see Figure 18) will be performed once the data (measured or simulated) after the implementation of the COLLECTiEF systems will be available. Currently, the methodology to assess the impacts and the related key performance indicators have been identified (see deliverables D5.1 and D5.2). The evaluation of the smart readiness upgrade (impact 1 according to GA numbering) is detailed in section 3.6 of this report. For energy-related impacts 2-3-4, (the numbering is according to the GA and the description is reported in the box in the middle in Figure 18) the evaluation will be done in a hybrid way: (i) by the use of measurement of energy consumption and environmental variables (i.e. independent variables such as weather) on the pilot buildings and (ii) by the use of calibrated models of the pilot sites on which the COLLECTiEF algorithms will apply their optimized operation. For assessing the impact on user satisfaction (impact 5 according to GA and reported in the left box in Figure 18) two questionnaires have been developed: (i) the Post-Occupancy Evaluation (POE) questionnaire and (ii) the Satisfaction questionnaire. To evaluate climate resilience (impact 6 according to GA and reported in the right box in Figure 18) energy simulations under future weather dataset will be carried out.

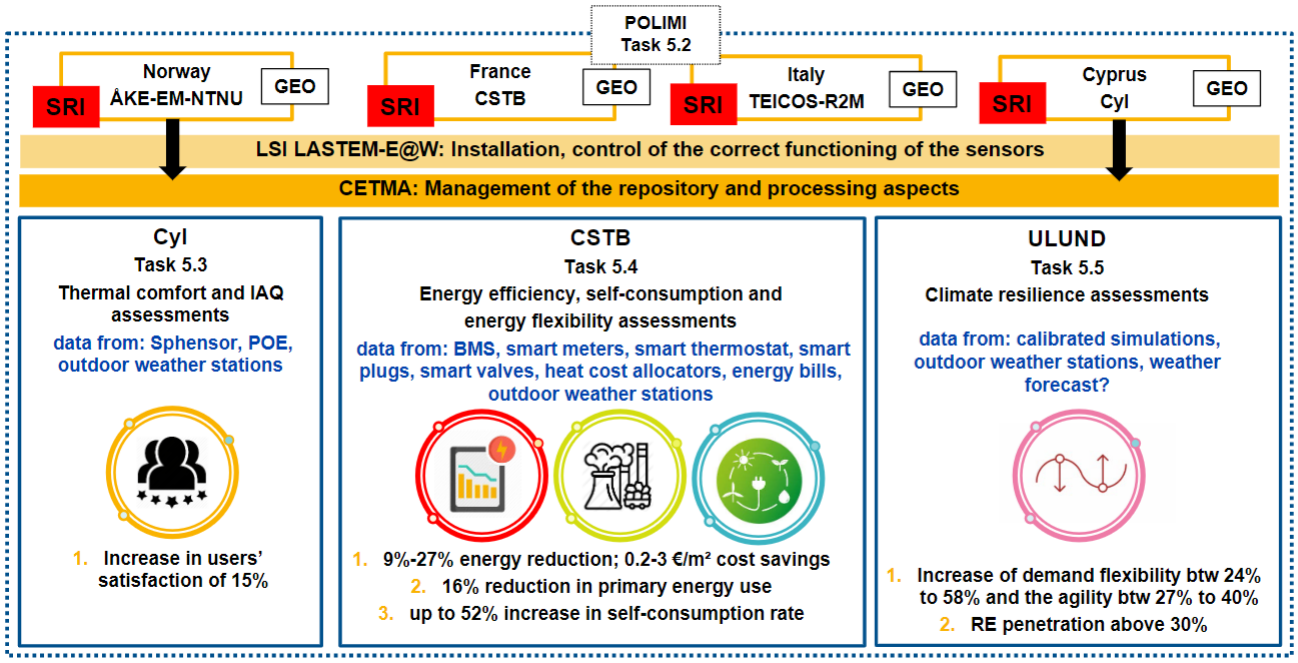

Figure 18 Overview of the impact assessment

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3.6.1 Task 5.3 Thermal Comfort and IAQ Assessments

Here are some results presenting the thermal acceptability assessment performed for the small-scale pilot building i.e., G2Elab located in Grenoble, France, between the 1st of September 2022 and the 30th of April 2023, which covers a big proportion of the baseline period, see Figure 19 and Figure 20. Specifically, based on the POE brief questionnaire data, we are indicating per room the thermal acceptability, following the process defined in D5.2.

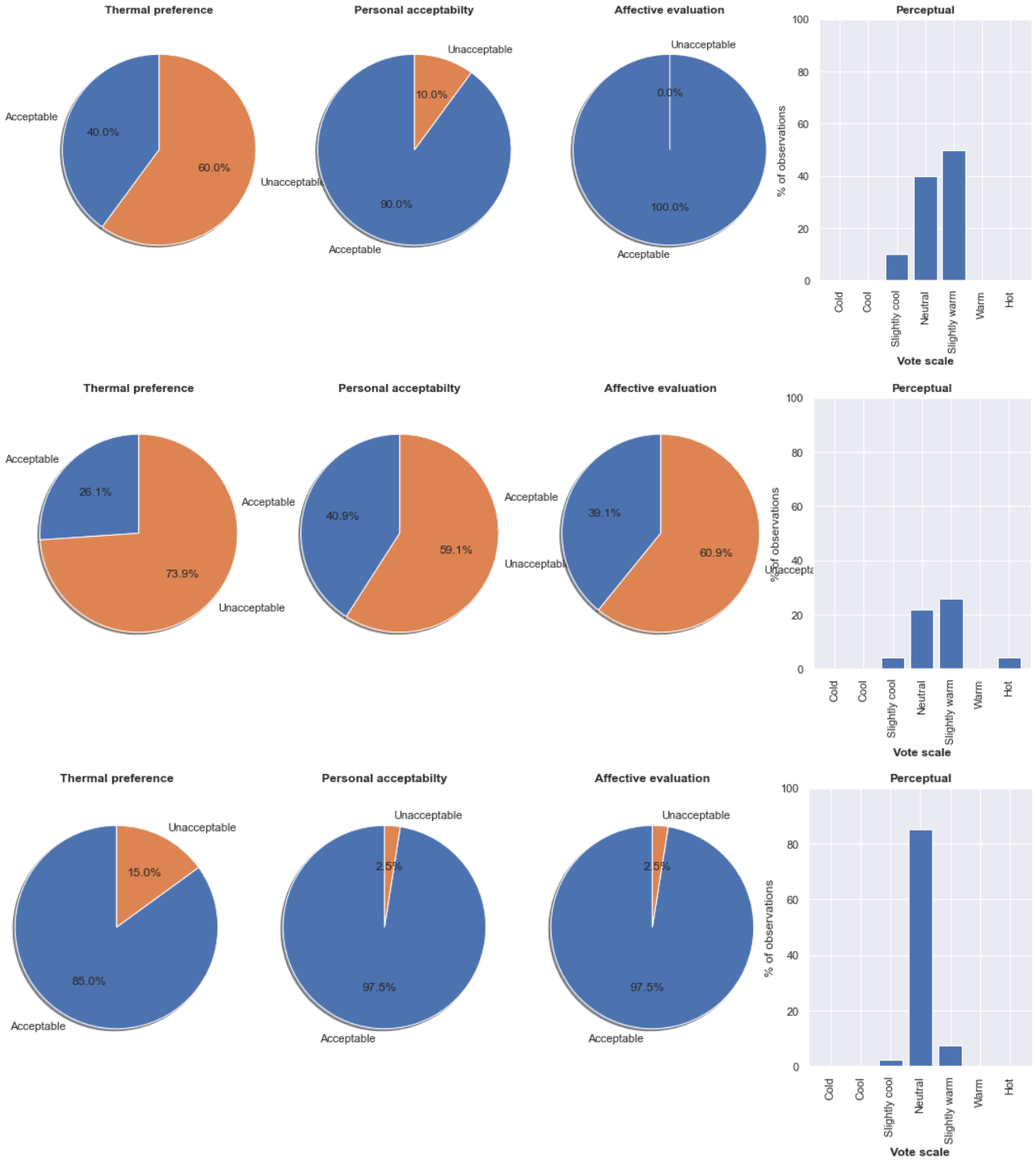

Figure 19 Thermal acceptability assessment for different pilot buildings between 01/09/2022 to 30/04/2023.

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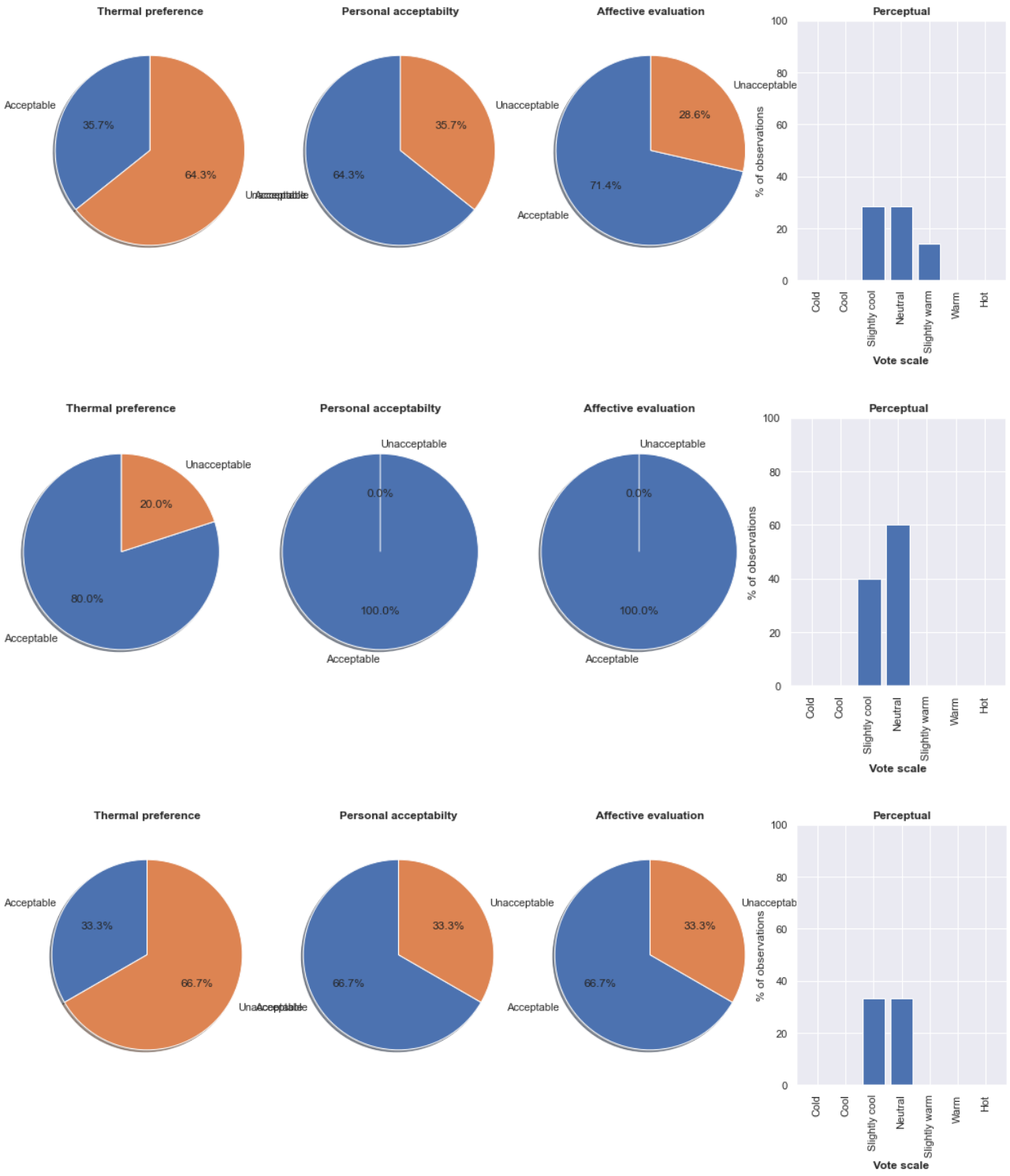

Figure 20 Thermal acceptability assessment for different pilot buildings between 01/09/2022 to 30/04/2023.

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3.6.2 Task 5.4 Assessing the impact of COLLECTiEF solutions on the energy flexibility and efficiency of pilot buildings

Monitoring data with an accurate level of detail is available for G2Elab and the Eidet Omsorgssenter building where simulation models have already been calibrated for the evaluation. This procedure is ongoing. Monitoring data that have enough detail for the calibration of simulation models will be available in June 2023 and the model calibration will follow for these buildings.

Concerning the Italian buildings, the daily indices from heat cost allocators have been made available in spring 2023 and calibration has started. Accessing the electricity consumption and the global gas consumption of the buildings allows us to validate or re-scale the data from heat cost allocators. The work on calibration of the three Italian pilots has started and first will be made available also in June 2023. Figure 21 shows examples from the calibration of the Eidet Omsorgssenter building. Figure 22 depicts the results from the calibration of the G2Elab building. Figure 24 shows the example of calibration results in terms of heating load in the G2Elab living lab.

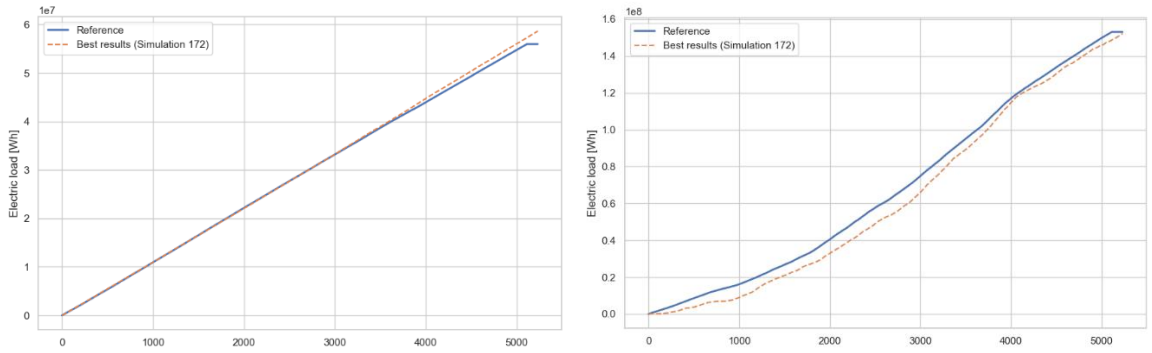

Figure 21 Electric cumulated load from air handling unit (left) and building heat pumps (right)

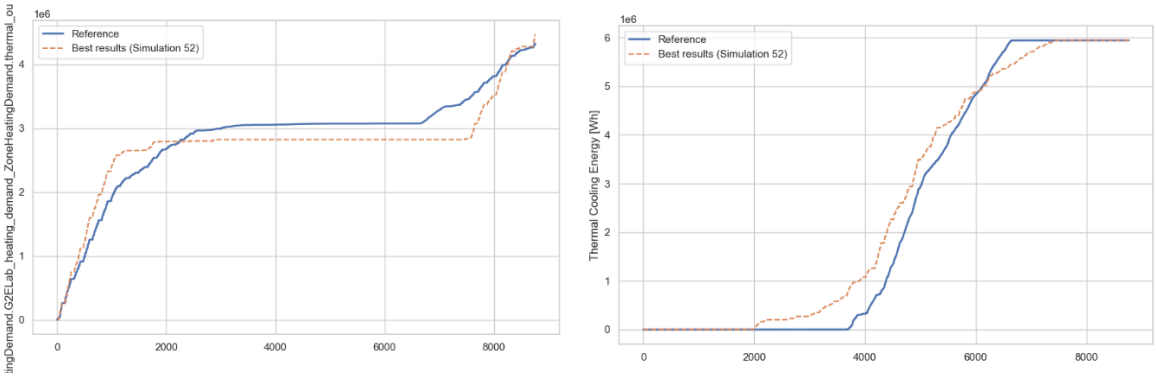

Figure 22 Cumulated load for heating (left) and cooling (right) in the living lab

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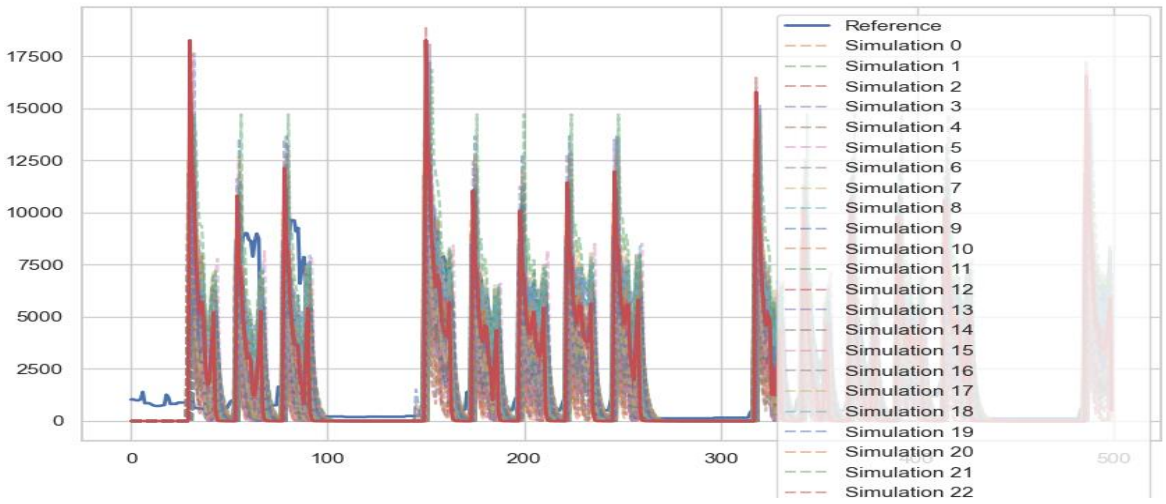

Figure 23 Calibration heating load results in the G2Elab living lab

3.7 SRI assessment in pilot buildings

The COLLECTiEF project consists of 14 pilot buildings in four countries - Cyprus, France, Italy, and Norway. These buildings provide a unique opportunity to evaluate the project's efficacy in several categories like schools, building blocks, health centers, and more. Additionally, each building has unique HVAC equipment, which can result in different impacts of the project on the buildings.

To determine the level of intelligence of a building, the Smart Readiness Indicator (SRI) is used to evaluate its current condition. SRI was developed to address the need for efficient tools that can accelerate building renovation investments while integrating advanced ICT-based technology to enhance energy efficiency, demand flexibility, and user comfort in buildings. The overall SRI score is calculated by combining weighted scores from different three aggregated categories – Building, User, and Grid. Each aggregated score is at the same time dependent on 7 different impact scores. Accordingly, the "Building" category includes weighted scores from "Energy Efficiency" and "Maintenance and Fault Prediction", while the "User" category includes weighted scores from "Convenience", "Comfort", and "Health, Well-being and Accessibility". The "Grid" score, on the other hand, is solely based on the "Energy Flexibility and Storage" impact score. The results for the current SRI and Aggregated scores are presented in Table 6.

Table 6 Overall results of the SRI assessment for the pilot's part of COLLECTiEF.

Building	SRI Range	SRI Class	SRI Score	Aggregated Score		
				Building	User	Grid
Cypriot Pilots						
Guy Ourisson Building	*0%-20%*	*G*	*5.8 %*	*6.6 %*	*10.9 %*	*0.0 %*
Graduate School	*0%-20%*	*G*	*5.7 %*	*6.4 %*	*10.6 %*	*0.0 %*
Novel Technologies Laboratory	*0%-20%*	*G*	*19.1 %*	*24.3 %*	*22.2 %*	*10.7 %*

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French Pilots						
G2Elab	*50%-65%*	*D*	*50.6 %*	*65.2 %*	*64.0 %*	*22.5 %*
Italian Pilots						
Valsesia C2	*0%-20%*	*G*	*12.2 %*	*19.6 %*	*13.7 %*	*3.2 %*
Valsesia C3	*0%-20%*	*G*	*12.2 %*	*19.6 %*	*13.7 %*	*3.2 %*
Valsesia C4	*0%-20%*	*G*	*12.2 %*	*19.6 %*	*13.7 %*	*3.2 %*
Norwegian Pilots						
Eidet Omsorgssenter	*35%-50%*	*E*	*36.9 %*	*48.9 %*	*48.3 %*	*13.4 %*
Ellingsoy Idrettshall	*20%-35%*	*F*	*33.9 %*	*45.0 %*	*43.0 %*	*13.9 %*
Flisnes Barneskole	*20%-35%*	*F*	*27.9 %*	*43.9 %*	*34.3 %*	*5.5 %*
Hatlane Omsorgssenter	*20%-35%*	*F*	*32.5 %*	*46.2 %*	*39.3 %*	*12.1 %*
Moa Helsehus	*20%-35%*	*F*	*25.9 %*	*39.2 %*	*34.5 %*	*3.9 %*
Spjelkavik Ungdomsskole	*20%-35%*	*F*	*30.8 %*	*44.8 %*	*41.6 %*	*6.0 %*
Tennfjord Barneskole	*20%-35%*	*F*	*27.9 %*	*42.4 %*	*36.2 %*	*5.1 %*

Among the pilots, Cypriot and Italian pilots have the lowest overall SRI score, which is part of the lowest SRI range (0%-20%). In the case of the Norwegian pilots, there are 6 in the second lowest category (20%-35%) but three of them with a score over 30%, and one building is in the range of 35% to 50%. In the case of the French pilot, it has the current highest level of smartness of all the pilots.

The “Building” and “User” scores are stably higher for the Norwegian and French Pilots, but low for the Cypriot and Italian. In all these cases, the “Grid” aggregated score represents the lowest aggregated score but represents an opportunity where COLLECTiEF can take advantage to improve the overall score of these buildings.

By implementing COLLECTiEF solutions, the SRI assessments of buildings can be positively impacted, leading to improved aggregated scores. The first solution that directly affects the Grid and Building aggregated scores involves using decision-making algorithms for energy efficiency and flexibility in conjunction with the grid and is complemented using BRiG and smart devices to improve the collective intelligence of a group of buildings. The next solution involves implementing a novel setpoint definition for indoor spaces alongside the decision-making process, resulting in increased user comfort and more efficient and flexible use of HVAC systems (Grid and User aggregated score). Finally, a unified user interface that displays both historical and current consumption data, as well as set points and indoor conditions, can be implemented for further user convenience, increasing the User aggregated score.

Accordingly, Table 8 is presented the SRI assessment score for the pilot buildings with their current status and their expected improvement.

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Table 7 Comparison between the SRI score of the buildings in their current status and the expected SRI score with the application of the measures imposed by the COLLECTiEF project.

#	Building	Current Status		Expected Status		Class Increase
		SRI Score	SRI Class	SRI Score	SRI Class	
	Cypriot Pilots					
1	*Guy Ourisson Building*	*5.8 %*	*G*	*34.6 %*	*F*	*1*
2	*Graduate School*	*5.7 %*	*G*	*41.9 %*	*E*	*2*
3	*Novel Technologies Laboratory*	*19.1 %*	*G*	*45.8 %*	*E*	*2*
	French Pilots					
1	*G2Elab*	*50.6 %*	*D*	*71.1 %*	*C*	*1*
	Italian Pilots					
1	*Valsesia C2*	*12.2 %*	*G*	*39.0 %*	*E*	*2*
2	*Valsesia C3*	*12.2 %*	*G*	*39.0 %*	*E*	*2*
3	*Valsesia C4*	*12.2 %*	*G*	*39.0 %*	*E*	*2*
	Norwegian Pilots					
1	*Eidet Omsorgssenter*	*36.9 %*	*E*	*56.8 %*	*D*	*1*
2	*Ellingsøy Idrettshall*	*33.9 %*	*F*	*52.7 %*	*D*	*2*
3	*Flisnes Barneskole*	*27.9 %*	*F*	*61.0 %*	*D*	*2*
4	*Hatlane Omsorgssenter*	*32.5 %*	*F*	*51.5 %*	*D*	*2*
5	*Moa Helsehus*	*25.9 %*	*F*	*57.5 %*	*D*	*2*
6	*Spjelkavik Ungdomsskole*	*30.8 %*	*F*	*66.9 %*	*C*	*3*
7	*Tennfjord Barneskole*	*27.9 %*	*F*	*63.0 %*	*D*	*2*

It can be noted that all pilots experience a minimum increase of at least one class, but in most cases, the improvement is two classes. The buildings that currently exhibit a higher level of intelligence, such as Eidet Omsorgssenter and G2Elab, display a lesser increase in their score compared to other buildings. This is because some of the services that require updating in the new SRI already have the necessary intelligence with their legacy equipment.

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4 Engagement strategy

The consortium has been actively reaching out to the relevant stakeholders and end-users to maximize the exploitation potential of the COLLECTiEF project under WP7. As part of the overall strategy, a stakeholder database, which is now ready and will be updated throughout the project, consists of relevant stakeholders and end-users such as public authorities, policymakers, energy efficiency practitioners, smart energy storage companies, as well as umbrella and multiplier organizations. The stakeholder database is confidential and serves as a contact base for capacity-building activities; interested parties will be duly informed as to when the industry workshops and educational training start. The stakeholder database is compiled through a) **Partner contributions**, b) "**Associated Partners", and** c) **Newsletters**.

As the project progresses, its achievements and results will be actively conveyed to the target groups to stimulate exploitation; the list of stakeholders will facilitate this task as it will contain names of institutions interested in contributing to COLLECTiEF research and commercial activities or are interested in knowing more technical details on the application of COLLECTiEF solutions.

Within the COLLECTiEF stakeholder engagement strategy, an important part plays the **engagement of building and flat owners** in pilot sites. Relations between property and facilities managers and occupants contribute toward meeting compliance obligations and the achievement of wider project objectives. Our strategy involves a) clarifying the needs and expectations of occupants, b) explaining the functionality of our solutions, c) providing clear timelines for agile installation of the sensor and monitoring system, and d) explaining the benefits of COLLECTiEF solutions. It is also important to establish communication and engagement methods that can be used to share information and evaluate how these needs can be met.

The engagement strategy for the pilot has been also the main focus of the DET meetings organised during the second year of the project. In particular, the partner group met in this setting in October 2022, and January and February 2023 to start conversations around the organisation of the Exhibitions in the pilot sites (Task 7.4.1 in section 6.7.4). Partners in WP5, WP6, and WP7 have been in close contact to share updates in the installation phase, share data on the users' engagement and discuss activities and good practices to implement in the pilots.

Under the coordination of GEO local partners responsible for each pilot site have been actively communicating and engaging with the pilot users through pilot visits, meetings and continuous exchange of updates on the project progress. The activities started during the first and second project phase has continued, with a renewed focus on the second round of workshops and strategies to boost the budling owners' and users' participation in the monitoring activities.

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The activities below document the building owner's engagement activities that were implemented during the second phase of the project by M24:

- Meetings in pilot buildings in the Summer of 2022 to finalize the preparation for the installation of the sensors and prepare all the necessary consent forms for the users to officially join the piloting activities
- On-site meeting for presentation of the project at G2Elab in February 2022
- Preparing new communication materials, such as printed postcards and digital illustrations – the materials have been designed by GEO and translated into Norwegian (ÅKE), Italian (GEO) and French (CSTB)
- Planning of second round of workshop – 1-on-1 meeting between GEO and each pilot responsible partner to develop and implement an action plan for the realization of the meeting in the second half of 2022

The project timeline can be seen in Figure 24 where the past and upcoming activities have been provided. Figure 24 shows the involved tasks in the engagement strategy. Figure 25 shows which tasks are involved in the engagement strategy.

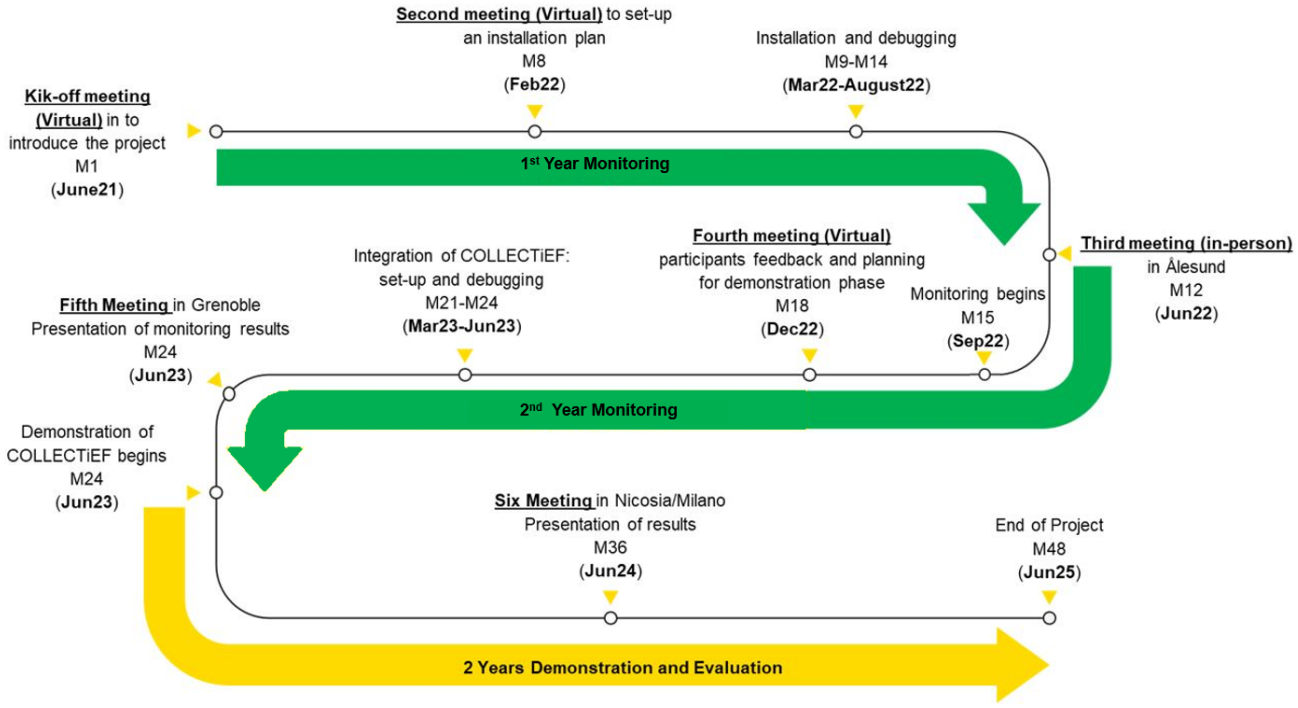

Figure 24 Timeline of engagement strategy (green arrow shows the current state of the project)

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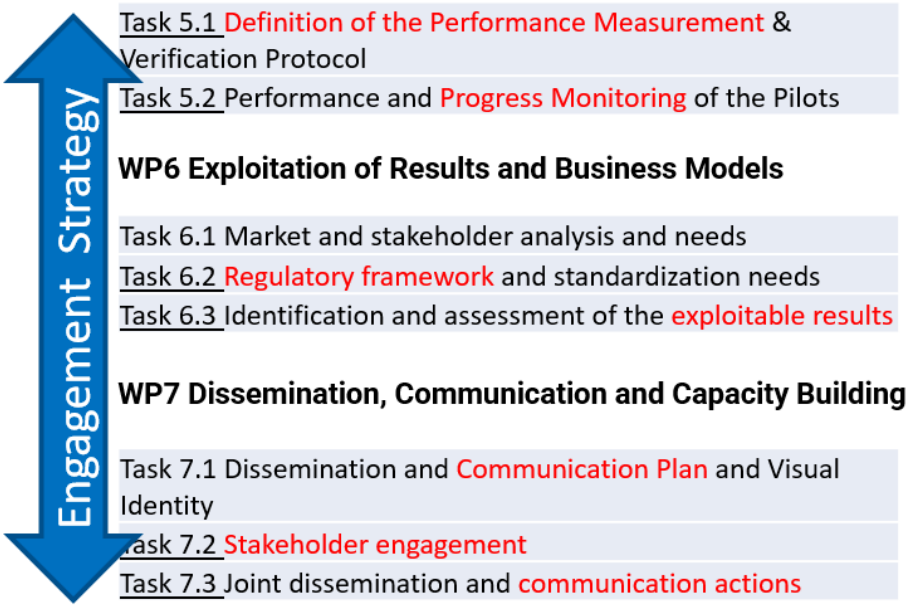

Figure 25 Engagement strategy and involved tasks

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5 Dissemination, promotion, and exploitation activities

At the early stage of the project, dissemination, communication, and exploitation activities have been planned by the DET to involve all partners to be committed to creating impacts via providing promotion and exploitation actions for the COLLECTiEF project. Detailed information on dissemination and communication plan and visual identity has been reported in deliverable D7.1.

In the second period of the project (M6-M12), various dissemination and communication tools such as the website, social media posts, campaigns, scientific articles, and videos are developed and carried out. In this section, the main joint dissemination activities related to Task 7.3 are reported.

5.1 Scientific publications

The following scientific publications have been published as a dissemination activity by M24.

By reporting period, we published the following scientific articles and conference articles with the collaboration of ULUND, NTNU, CyI and CETMA.

- Yang Y, Javanroodi K, Nik VM. “Climate change and energy performance of European residential building stocks – A comprehensive impact assessment using climate big data from the coordinated regional climate downscaling experiment”, Applied Energy, 2021; https://doi.org/10.1016/j.apenergy.2021.117246.
- Nik VM, Moazami A. “Empowering energy flexibility and climate resilience using collective intelligence-based demand side management (CI-DSM)”. J.Phys.: Conf.Ser.2021;2069: 012149.doi.org/10.1088/1742- 6596/2069/1/012149.
- Yang Y, Nik VM. “Assessing the climate change adaptation over four European cities”.Phys. Conf. Ser. ; doi.org/10.1088/1742-6596/2069/1/012069.Javanroodi K, Nik VM, and Scartezzini J-L, “Quantifying the impacts of urban morphology on modifying microclimate conditions in extreme weather conditions”, . Phys. Conf. Ser., vol. 2042, no. 1,
p. 012058, Nov. 2021, doi: 10.1088/1742- 6596/2042/1/012058.
- Mohammad Hosseini, Amin Moazami, Vahid M. Nik, ‘’Collective Intelligence function in Extreme Weather Conditions: High-resolution impact assessment of Energy Flexibility on Building Energy Performance’’, 5th international conference on building energy and environment, was presented in July 2022.
- Hosseini M, Javanroodi K, Nik VM. “High-resolution impact assessment of climate change on building energy performance considering extreme weather events and microclimate – Investigating variations in indoor thermal comfort and degree-days”, Sustainable Cities and Society, vol. 8, p.103634, Mar.2022; doi: 10.1016/j.scs.2021.103634.
- Yang Y, Javanroodi K, Nik VM. “Climate Change and Renewable Energy Generation in Europe – Long-Term Impact Assessment on Solar and Wind Energy Using High-Resolution Future Climate Data and Considering Climate Uncertainties”, Energies, 2022; doi: 10.3390/en15010302.

M. Favero, A. Luparelli, S. Carlucci. Analysis of subjective thermal comfort data: A statistical point of view. Energy and Buildings, v.281p.112755., 2022; DOI: https://doi.org/10.1016/j.enbuild.2022.112755

Hosseini M, Nik VM, Moazami A. “Collective intelligence function in extreme weather conditions: High-resolution impact assessment of energy flexibility on building energy performance”, COBEE 2022.

- Hosseini M, Hajialigol P., Aghaei M, Erba S., Nik VM., Moazami A., “Improving climate resilience and thermal comfort in a complex building through enhanced flexibility of the energy system”, SEST 2022; 10.1109/SEST53650.2022.9898453.
- Perera ATD, Javanroodi K, Mauree D, Nik VM, Florio P, Hong T, et al. Challenges resulting from urban density and climate change for the EU energy transition. Nat Energy 2023;8:397–412. https://doi.org/10.1038/s41560-023-01232-9.

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NTNU and ULUND initiated a discussion on a textbook project with Taylor and Francis (CRC) publisher. The focus of this textbook will be on the fundamentals including the challenges, impacts, and applications that would be useful for the students and lecturers as well as the energy community. The topics would be a combination of Climate change, Energy flexibility, Control, Energy system and Demand Modelling, Demand Side Management, Resilience, and Smart Grid. Scientific partners have five manuscripts based on COLLECTiEF, that are currently under review in top-tier journals and conferences.

5.2 Workshops, conferences, and events

The partners have been introducing and promoting the COLLECTiEF project at various events. Table 8 lists the events, seminars, workshops, and conferences attended by the partners by M24.

Table 8 The events, seminars, workshops, and conferences attended by the partners.

Name of event, seminar, etc.	Date of participation	Venue	Partner	Action and statement
Sustainable Places Conference 2022	8 September 2022	Nice, France	NTNU	Project presentation
Municipality IT-Forum	10 October 2022	Norway	NTNU	Project presentation
“The New European Bauhaus: an opportunity for socially oriented research and Innovation at the Cyprus Institute”	21 October 2022	NTNU Norway	NTNU; CYI	Project presentation
The 5th ESEIA International Conference 2022	2 November 2022	Cyprus	CYI, NTNU	Project presentation
SINTEF AS	2 November 2022	Norway	NTNU	Project presentation
SmartBuilt4EU Nordic Workshop	22 November 2022	Helsinki, Finland	NTNU	Project presentation
Webinar "An end-user approach to smart buildings and energy flexibility"	25 November 2022	Online	NTNU	Project presentation
NTNU Internationalization Conference	7 December 2022	Ålesund, Norway	NTNU	Project presentation
Research group Møre and Romsdal region meeting	26 January 2023	Ålesund, Norway	NTNU	Project presentation

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Training session “IEQ assessment through Smart Sensors and Digitalization, the COLLECTiEF EU Project and the Sphensors sensor”	17 March 2023	Milan, Italy	LSI LASTEM	Project presentation
Meeting with Wattn AS (Electric utility company in Ålesund)	22 March 2023	Ålesund, Norway	NTNU	Project presentation
Conference "Smart Buildings in Europe"	23 March 2023	Brussels, Belgium	NTNU	Project presentation

Collaboration and synergies with the sister research project, the COLLECTiEF project is intensively looking to collaborate with the sister research projects and other related EU projects and initiatives. In the second period of the project (M11-M22), we targeted approaching the sister EU project (e.g., 2ISECAP, ActIonHeat, ARISE, BundleUP NEXT, CEES, crossCert, NEEM, PEER, REGENERATE, SER, SMART2B, Sun4All, etc.) for research collaboration and synergies. Detailed information about the targeted sister projects was provided in deliverable D7.1.

Since its launch, COLLECTiEF has been actively reaching out to other H2020 projects and initiatives to foster mutual support for project activities, co-organize communication activities, campaigns and events, and raise awareness of our common goals. During the first 24 months, we have made contact and joined forces with Auto-DAN, BeSMART, iBECOME, NEEM Hub, PHOENIX, PRECEPT, PRELUDE, SATO, SEEtheSkills, SEIFA, SER - Social Energy Renovations, Smart2B, SmartBuilt4EU, and TIMEPAC.

Moreover, in 2022 COLLECTiEF joined forces with four related H2020 projects - PRECEPT, PRELUDE, SATO, and Smart2B - to create the EU4BET cluster. The cluster aims at:

- Define a knowledge-sharing framework around common goals
- Increase the outreach of each project’s activities and enhance the visibility of EU efforts towards the energy transition
- Enhance and rationalize communication and dissemination and stakeholders’ engagement activities
- Strengthen the relationship between EU-funded projects

On 25 November 2022, the EU4BET Cluster projects organised the first joint webinar focusing on highlighting the end-user point of view on these ambitious EU-funded projects through the stories of the pilots involved in each project. The webinar was addressed to policymakers, industrial stakeholders, building managers, electric utilities and the general public, to share the benefits of the implementation of the different solutions and see first-hand what a smart building would look like. The

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COLLECTiEF project was presented by our former coordinator Amin Moazami (NTNU) and during the presentation we screened a video interview recorded at our pilot site in Ålesund, Norway.

The communication partners and coordinators of each project meet regularly to share project updates and organise joint activities, such as communication campaigns, events and participation in the Horizon Results Booster

5.2.1 Horizon Results Booster

Another joint activity initiated together with the EU4BET Cluster project is the participation in the Horizon Results Booster service. Module A started in October 2022 and was finalized in December 2022 with the delivery of a Portfolio of common research and innovation results. Module B started in January 2023 and is progressing with the development of a video introducing the Cluster and its main objectives and policy briefs for EU policymakers.

5.3 Newsletter, press releases and campaigns

In the first issue of the COLLECTiEF newsletter, published on 3 June 2022, we dedicated a specific section to the promotion of our sister projects. Similarly, COLLECTiEF has been offered to be featured in related projects' newsletters, namely SEIFA and Smart2B. The next newsletter is scheduled to go out in May 2023 to mark the 2nd year of the project and promote the numerous events we will attend in June.

On the occasion of the World Energy Efficiency Day on 5 March 2022, COLLECTiEF joined forces with its sister project Smart2B and launched a week-long social media campaign to engage our audiences and raise awareness of the need to reduce energy consumption through reasonable and sustainable energy use.

To make the campaign more engaging and interactive for our audience, we created a crossword puzzle, designed by GEO, collecting definitions related to energy and key elements of our respective projects. Every day, both COLLECTiEF and Smart2B shared two new definitions each, encouraging our followers to complete the puzzle over the entire week.

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Figure 26 Crossword puzzle created for the campaign

5.3.1 Dissemination materials

A new set of postcards was created and designed by GEO and translated by the partners responsible for the pilot sites in each local language – English (Cyprus), French, Norwegian and Italian. Each partner was responsible for printing and delivering those postcards to the pilot buildings. This campaign aimed to raise awareness of the importance of the users' participation in the project, in particular through the completion of the post-occupancy evaluation online questionnaires and thank them for their contribution to the successful rollout of the COLLECTiEF project.

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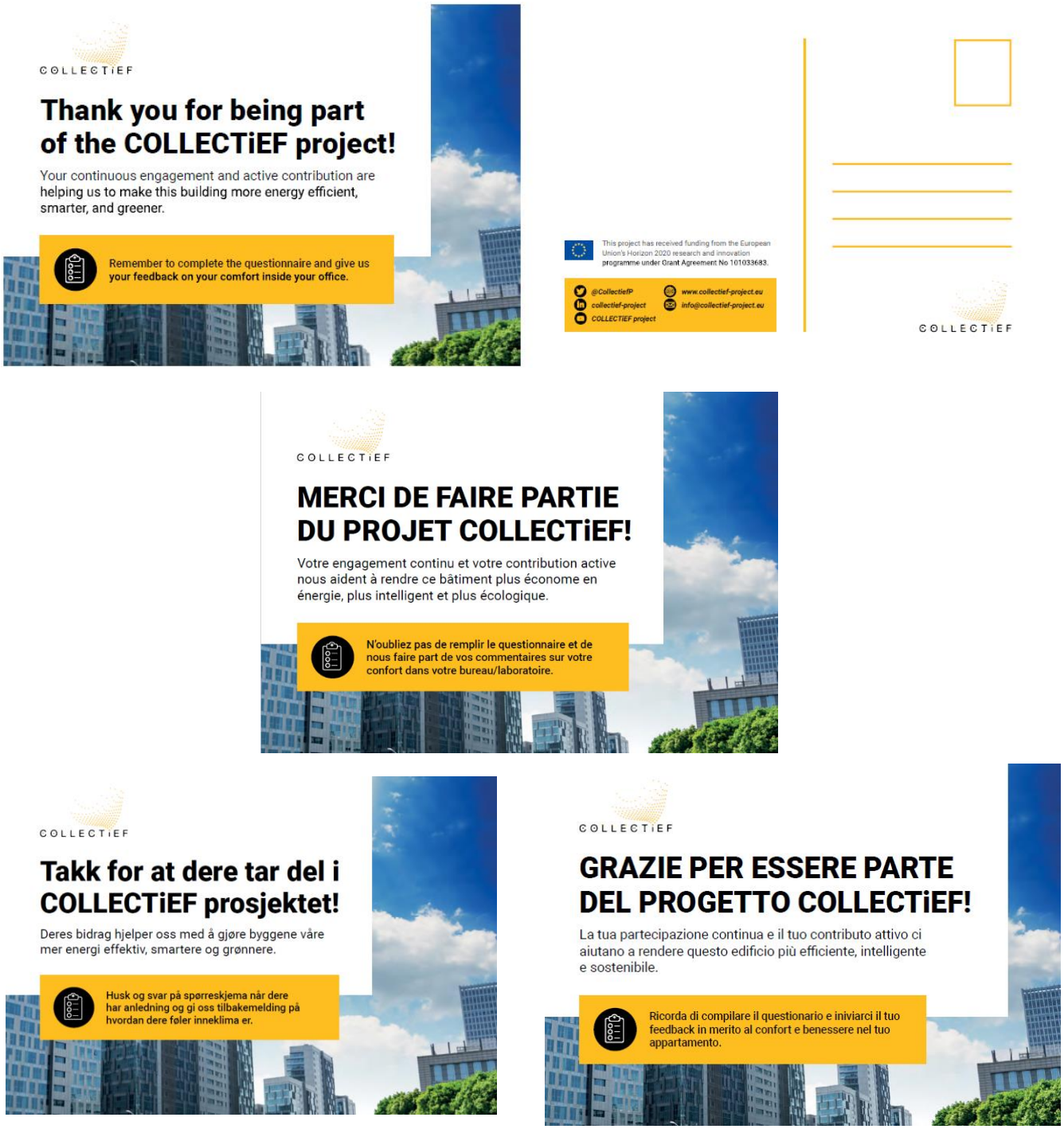

Figure 27 The postcard sent to the end users in local languages.

5.3.2 Satisfaction questionnaire icons

A new set of icons integrating was designed by Geonardo in coordination with CYI for the Satisfaction questionnaire developed by CYI and implemented by CETMA, to integrate the ones already created for the POE questionnaire. The icons as shown in Figure 28 are designed as a visual help for the users who can answer the questions more easily and fast by simply selecting the icon that better represents their perception of the indoor space and comfort levels.

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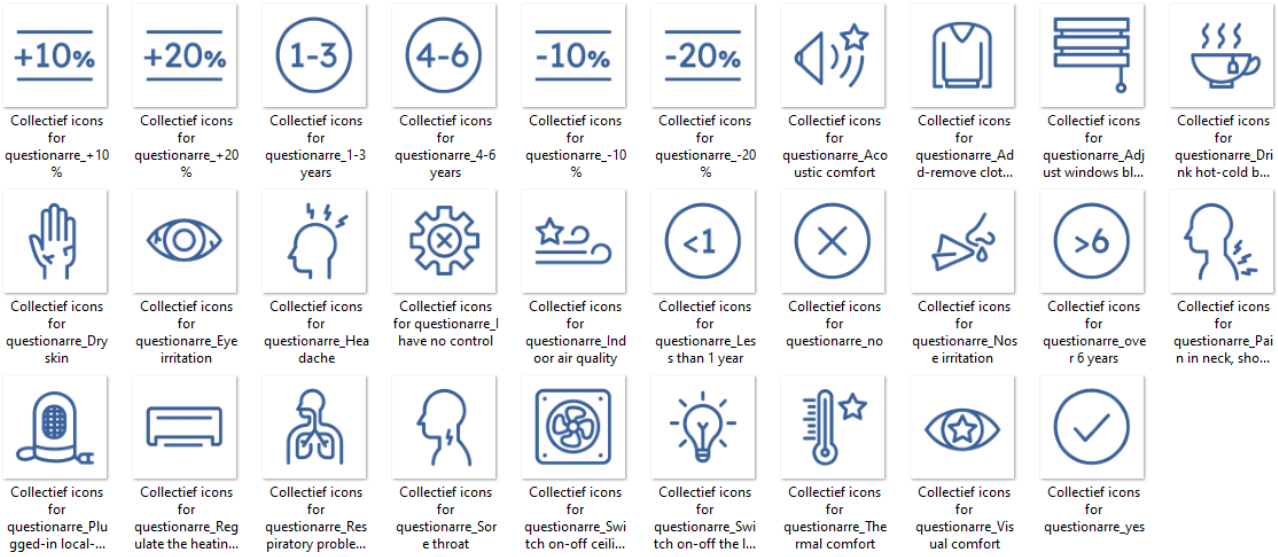

Figure 28 The icons used in the POE questionnaire

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6 Progress and Action Plan for Work Packages

6.1 WP1: Project Management and Coordination (M01-M48)

This work package aims at coordinating the COLLECTiEF project management and administration as well as supervising the activities carried out by all partners according to the defined tasks and the action plan to ensure the consortium implements the activities effectively, produces and submits the deliverables and reports on time and with high quality.

Between M12 and M24, ULUND, NTNU and CyI designed, arranged and announced a joint Special Issue (SI) on "Enhancing energy flexibility and climate resilience of urban energy systems" according to the key points of the COLLECTiEF project in the Journal of Applied Energy & Advances in Applied Energy. The deadline was extended to the 31st of December 2022.

NTNU has organized a series of meetings during the first period of the project (M01-M18) to concrete the relation and communication among the beneficiaries to discuss the prerequisites for initiating the technical activities as well as following up and monitoring the tasks' progress. All partners have actively participated in the project meetings, see Table 9.

Table 9 The Executive and General Assembly Meetings between M11-M24

Meeting	Date
Executive Board n.11	**4/5/2022**
Third General Assembly Meeting	**23-24/06/2022**
Executive Board n.12	**7/9/2022**
Executive Board n.13	**5/10/2022**
Executive Board n.14	**2/11/2022**
Fourth General Assembly Meeting	**12/12/2022**
Executive Board n.15	**11/01/2023**
Executive Board n.16	**8/02/2023**
Executive Board n.17	**1/03/2023**
Executive Board n.18	**3/05/2023**

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6.1.1 Task 1.1: Project coordination, monitoring, and risk management (M01-M48)

Action plan by the coordinator

Actions	Expected Progress by M22 (31 March-22)	Expected Progress by M24 (31-May-22)
IPPR4, IPPR5, IPPR6 and IPPR7 are collected from the partners for preparing the third progress report.	Completed	The third progress report is submitted to the EU (D1.5)
Distributing the doodle for scheduling the fifth General Assembly Meeting at NTNU	Completed	The organization plan and GA meeting arrangement are ready.

Activities performed by partners

Task Leader: NTNU	
Task Contributors: all	
Overall progress and deviations from the action plan (M12-M24)	• The main planned activities of this task are ongoing by M22 and no deviation with regard to the work plan has been identified
Activities performed by partner (s) – (M11-M22)	• NTNU has arranged the third and fourth general assembly and eight executive board meetings. • NTNU submitted a technical report and financial statement to the EU. • NTNU has defined the Action Plan and updated the IPPR for the third progress report. • NTNU has presented the project to various stakeholders including the energy sector (Wattn), university forum meetings and international conferences. • NTNU has collected IPPR4(M11-M13), IPPR5 (M14-M16), IPPR6 (M17-M19) and IPPR7(M20- M22) from the partners. • NTNU has drafted the third project progress report (Deliverable D1.6 – M24). • NTNU was invited by a sister project (SMART2B) to present the COLLECTiEF.
Deliverables	D1.6: Third Progress Report (M24)

6.1.2 Task 1.2: Financial management (M01-M48)

Action plan by the coordinator

Actions	Expected Progress by M22 (31-March-22)	Expected Progress by M24 (31-May-22)
Reporting internal financial process	Completed	
Reporting financial statements in periodic reporting	Completed	-

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Activities performed by the partner

Task Leader: NTNU	
Task Contributors: All	
Overall progress and deviations from the action plan (M11-M22)	• Each partner has submitted their PM for the WPs they have worked on so far. • No serious deviations between the allocated PM and the reported PM.
Activities performed by partner (s) – (M11-M22)	• The consortium submitted a technical report with the financial statement in M18.
Deliverables	-

6.1.3 Task 1.3: Data management and creation of a joint data repository to store data (M01-M48)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-23)	Expected Progress by M24 (31-May-23)
Subcontracting a DPO	Completed	Reviewed the possibility of subcontracting the acquisition of the legal basis to CRclex to help process data. The company works as DPO for COLLECTiEF.

Activities performed by the partner

Task Leader: CETMA	
Task Contributors: NTNU	
Overall progress and deviations from the action plan (M11-M22)	The main planned activities of this task are ongoing by M22 and no deviation with regard to the work plan has been identified.
Activities performed by partner (s) – (M11-M22)	• The QR codes are completed. The QR codes are hosted on a collectief-eu.com hosting space and the data are stored on the NTNU server. • CETMA organized (M11-12) meetings with partners LASTEM, E@W, EM Systemer, CSTB, CYI, R2M, and TEICOS, to verify the technical solutions to collect all the required data from sensors, BMS and G2ELAB. Work was completed to verify the technical solutions to collect all data from BRiG, BMS, Smart Plugs, G2ELAB, cost allocators, and the Coster control system from the pilot buildings in the NTNU server.

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	• In May - June (M12 -13), the implementation and testing of the technical solutions, debugging of the system and data flow from the BRiGs, POEs and BMS was completed and the collection and archiving of data started. • CETMA prepared the necessary paperwork and got three quotations for DPO services. CRclex is now working as DPO. • CETMA started and completed mapping for the next update of the Data Management Plan (M24) which includes data collection methods, data storage systems and stat sharing policies. • CETMA started mapping the project data in the coming months to start identifying sensitive data and carrying out a Data Protection Impact Assessment (DPIA). • CETMA has started implementing strategies and methods to ensure efficiency and effectiveness when querying data structures. • CETMA initiated the modelling of the logical data flow and the modelling of relational structures of a database, ensuring referential integrity, consistency and scalability of data. • For external access to data stored in the NTNU server, CETMA started the development and release of an API. CETMA tested the API to ensure that it works properly and that users can access the data as required. • CETMA with the support of E@W and LASTEM started the activities for the installation of the MQTT broker on the NTNU server (VM with the E@W SW) by testing its communication with the various nodes, to avoid data loss in the future. • CETMA, with the support of E@W and LASTEM, evaluated best practices (MQTTs, TLS etc.) on data transfer mechanisms used to increase security in the transfer from one node to another of the archives to the central server. • CETMA has been conducting tests on the API to ensure its proper functioning and accessibility of data to users as needed. Additional APIs have been developed and relate to APIs for capturing time-aggregated data and APIs for accessing weather information. The newly developed APIs are uploaded to the GitHub repository. • CETMA has been implementing anonymization techniques, specifically based on the 'elimination of identifying variables (minimization of sensitive data). This technique consists of eliminating variables that can be used to directly identify individuals (no data such as names, IP addresses, etc. are captured and transmitted). In addition, sensitive data in the POE are aggregated according to certain characteristics, such as age, and gender. This process reduces the risk of individual identification because the data are presented in aggregated form. • CETMA updated indexes on database tables to speed up ‘query execution and reduce the time required to execute queries, thus improving the overall performance of the system The API code has also been optimized to perform operations more quickly and efficiently.
Deliverables	-D1.3: Data Management Plan M24 (Update)
Updated Risk	• One of the critical objectives that were fully achieved concerns the assumption of a legal basis for assuming the role of the co-processor. Therefore, right after following all the procedures, CETMA subcontracted CRclex as DPO.

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6.1.4 Task 1.4: Scientific Coordination (M01-M48)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
ULUND will actively coordinate the scientific outcomes and plan for further interaction among scientific partners.	Partners are publishing the results of COLLECTiEF	Several publications are in the pipeline.
ULUND and scientific partners have collaborated to develop a set of guidelines aimed at promoting mutual collaboration, and joint publication, resulting in high-quality publications.		Scientific partners approve and adhere to the publication guideline.
COLLECTiEF in collaboration with SATO and Smart2B will attend the European Sustainable Energy Week (EUSEW)	-	-
COLLECTiEF is invited to a panel session at FES 2023 conference at Vaasa, Finland (12-14 June)		Contribution full paper

Activities performed by the partner

Task Leader: ULUND	
Task Contributors: NTNU	
Overall progress and deviations from the action plan (M11-M22)	• NTNU and ULUND initiated a discussion on a textbook project with Taylor and Francis (CRC) publisher. • ULUND, in collaboration with NTNU and CyI designed, arranged and announced a joint Special Issue (SI) on "Enhancing energy flexibility and climate resilience of urban energy systems" according to the key points of COLLECTiEF project, in the Journal of Applied Energy & Advances in Applied Energy. The submission period closed on the 31st of December 2022. • Scientific partners started to have regular meetings as of M23 to plan for the publications and scientific dissemination. The scientific partners have agreed to collaborate on joint publications based on the outputs of each corresponding partner, following the publication agreement between them.
Activities performed by partner (s) – (M11-M22)	• Yang Y, Javanroodi K, Nik VM. "Climate change and energy performance of European residential building stocks – A comprehensive impact assessment using climate big data from the coordinated regional climate downscaling experiment", Applied Energy, 2021; https://doi.org/10.1016/j.apenergy.2021.117246.

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	• Nik VM, Moazami A. “Empowering energy flexibility and climate resilience using collective intelligence-based demand side management (CI-DSM)”. J.Phys.: Conf.Ser.2021;2069: 012149.doi.org/10.1088/1742- 6596/2069/1/012149. • Yang Y, Nik VM. “Assessing the climate change adaptation over four European cities”.Phys. Conf. Ser. ; doi.org/10.1088/1742-6596/2069/1/012069.Javanroodi K, Nik VM, and Scartezzini J-L, “Quantifying the impacts of urban morphology on modifying microclimate conditions in extreme weather conditions”, . Phys. Conf. Ser., vol. 2042, no. 1, p. 012058, Nov. 2021, doi: 10.1088/1742- 6596/2042/1/012058. • Mohammad Hosseini, Amin Moazami, Vahid M. Nik, ‘’Collective Intelligence function in Extreme Weather Conditions: High-resolution impact assessment of Energy Flexibility on Building Energy Performance’’, 5th international conference on building energy and environment, was presented in July 2022. • Hosseini M, Javanroodi K, Nik VM. “High-resolution impact assessment of climate change on building energy performance considering extreme weather events and microclimate –Investigating variations in indoor thermal comfort and degree-days”, Sustainable Cities and Society, vol. 8, p.103634, Mar.2022; doi: 10.1016/j.scs.2021.103634. • Yang Y, Javanroodi K, Nik VM. “Climate Change and Renewable Energy Generation in Europe – Long-Term Impact Assessment on Solar and Wind Energy Using High-Resolution Future Climate Data and Considering Climate Uncertainties”, Energies, 2022; doi: 10.3390/en15010302. M. Favero, A. Luparelli, S. Carlucci. Analysis of subjective thermal comfort data: A statistical point of view. Energy and Buildings, v.281p.112755., 2022; DOI: https://doi.org/10.1016/j.enbuild.2022.112755 Hosseini M, Nik VM, Moazami A. “Collective intelligence function in extreme weather conditions: High-resolution impact assessment of energy flexibility on building energy performance”, COBEE 2022. • Hosseini M, Hajialigol P., Aghaei M, Erba S., Nik VM., Moazami A., “Improving climate resilience and thermal comfort in a complex building through enhanced flexibility of the energy system”, SEST 2022; 10.1109/SEST53650.2022.9898453. • Perera ATD, Javanroodi K, Mauree D, Nik VM, Florio P, Hong T, et al. Challenges resulting from urban density and climate change for the EU energy transition. Nat Energy 2023; 8:397–412. https://doi.org/10.1038/s41560-023-01232-9.
Deliverables	-

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6.2 WP2: Algorithm training and reinforcement for control strategies of COLLECTiEF System (TRL 6) (M01-M48)

This work package focuses on the algorithms and communication logic of the COLLECTiEF system. The partners will test and enhance existing and new solutions using a virtual testbed, DIMOSIM, and in a real environment at G2Elab.

ULUND in cooperation with NTNU and CSTB has organized the following meetings to plan the activities of the task and the implementation procedure. The partners of WP2 and other beneficiaries who are involved in the relevant activities of WP2 have actively participated in the following meetings:

- Meeting with LASTEM on internal communication mechanisms between the BriG main components: 01.04.2022
- Meeting with CyI on integrating adaptive comfort model into nDSM core computational algorithm at edge and cluster nodes, and refining control strategies: 28.10.2022,
- Regular meetings with NTNU on algorithm training and introducing RL into CI-DSM control algorithm at both Edge and Cluster Nodes (nDSM).
- Biweekly meetings with E@W and partners on technical alignment for system development (between WP2 and WP3)
- Meeting with CSTB on the integration of DIMOSIM into control algorithms: 20.01.2023

6.2.1 Task 2.1: Enhancing the available control algorithms for COLLECTiEF Cluster Node (M01-M36)

Action plan by the coordinator

Actions	Expected Progress by M22 (31-March-22)	Expected Progress by M24 (31-May-22)
Further development and fine-tuning of the CI-RL algorithm (ULUND & NTNU).	The first version is completed	Ongoing
NODA to deliver D2.1 Fine-tuned algorithms, ready to implement in CI-based control systems at the building, neighborhood and urban scales (first version)-M20	D2.1 is completed and submitted to the EU	-
Developing the algorithms to be implemented in test cases (All)	The first version is running and producing acceptable results	Ongoing
Accounting for price signal, user preferences/comfort (different models)	Several logics for generating and interpreting, control signals are being tested	Ongoing
Refactor the cluster/edge node solution to run on the NODA self-host.	Ongoing	Ongoing

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Developing the updated version of the control algorithm at the edge node named using Reinforcement Learning and nDSM	Ongoing	The second version is completed
Developing the control algorithms at the cluster level	Ongoing	Ongoing

Activities performed by the partner

Task Leader: ULUND	
Task Contributors: NODA, NTNU, CSTB	
Overall progress and deviations from the action plan (M11-22)	• Plan to extend the forecasting function of the cluster node, i.e., from past aggregated consumption data, past weather data, and future weather data, forecast future aggregated consumption data. • The previous solution turned out to be difficult to debug in the context of co-simulation, and hence the new scheduling system. • The main planned activities of this task are ongoing by M22 and no deviation with regard to the work plan has been identified.
Activities performed by partner (s) – (M11-M22)	• Developed the preliminary CI-DSM (Collective intelligence- Demand-Side Management) algorithm at the cluster nodes. • Studying and working on user comfort as a parameter in decision-making, energy management, and RL reward functions considering different approaches. • Adopting representative weather data sets for the case studies in the preliminary algorithm development. • Developed the preliminary version of the energy management algorithm at the edge and cluster nodes. • Researched options for MPC of thermal RC-model coupled with heat pump. Otherwise on hold while reworking the necessary architecture and design of the framework • Refined the combined solution with a scheduling system that can be executed in simulated time and thereby facilitate the transition from co-simulation to integration testing. And switched the ML backend to another library to the end facilitating the comparison of alternative algorithms.
Deliverables (M11-M22)	-
Updated Risk (M11-M22)	Task 2.1 associated with Cluster Node algorithms did not reach an adequate level of maturity putting at risk Tasks 2.2 and Task 2.5

6.2.2 Task 2.2: Developing IoT and occupant-centric control algorithms for COLLECTiEF Edge Node (M01-M36)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)

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Further development of the control algorithms (ULUND & NTNU).	The first version of the algorithms has been developed and tested	Ongoing
Implementation of user-centric approach in the control algorithms (CyI, ULUND & NTNU).	CyI has developed several models to be integrated/implemented	Ongoing
Provide a running prototype with a black box model targeting indoor thermostats (a workaround to fit the NODA solution with DIMOSIM).	Ongoing	Ongoing
Extend the NODA prototype with occupation-centric metrics.	Ongoing	Ongoing
Refactor the cluster/edge node solution to run on the NODA self-host.	Ongoing	Ongoing
The need for a repository for the codes -->GitHub --> NODA/NTNU/ULUND/CSTB	Completed	-
RL model is developed in connection with the work with CyI	The algorithm will be developed further to be integrated with the CI-based algorithm	Ongoing

Activities performed by the partner

Task Leader: ULUND	
Task Contributors: NODA, NTNU, CSTB, CyI, R2M, E@W, Virtual, EM	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified.
Activities performed by partner (s) – (M11-M22)	• A 4-level building and occupant-centric control scheme are developed for thermal comfort, health improvement, energy flexibility, reducing the cost of energy and climate resilience. The control scheme will be applied at the Edge Node of the COLLECTiEF system and has these functionalities: ○ Level 1: Adaptive Thermal Comfort-based Control Algorithm: The use of the adaptive thermal comfort model for generating daily temperature set points control algorithm, that will ensure occupants' thermal comfort and provide energy flexibility. ○ Level 2: Health improvement Control Algorithm: To improve the health of occupants, the temperature set point will follow a circadian rhythm and it will be set as a sinusoidal signal with an offset defined by the adaptive thermal comfort model. ○ Level 3: Pre-heating/cooling control strategy for enchasing energy flexibility. ○ Level 4: Weather forecast-based building control for mitigating extreme weather events.

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	○ Python coding of the occupant-centric control scheme of the Level 1 and Level 2 functionalities and tested at the G2Elab pilot building during weeks 28-42 of 2022. • Had meetings with CSTB and G2ELab to start working on the small-scale test on G2ELab and being able to run the energy management algorithm remotely. • Successful development of the second version of the energy management algorithm at the Edge level (nDSM). • Further development of the energy management algorithm at the Edge level to integrate the adaptive comfort model in collaboration with CyI. • Preparing D2.3 in collaboration with WP2 partners • The first version of MiniMAS is available through the project GitHub. The solution offers a way to structure code to facilitate the transition from comprehensive integration tests to deployment. The test also demonstrates a simplified version of the NODA solution (Cluster Node + Edge Node).
Deliverables	• D2.3: Fine-tuned and feasible control strategies that address user comfort, cost & energy efficiency, climate change mitigation & adaptation (first version) M22

6.2.3 Task 2.4: Testing of COLLECTiEF algorithms via co-simulation based on building and energy system modelling and analysis (M01-M24)

Action plan by the coordinator

Actions	Expected Progress by M22(30-March-22)	Expected Progress by M24 (31-May-22)
Contributing to further development and fine-tuning of the CI-RL-based algorithms for DIMOSIM (NTNU & ULUND).	The DIMOSIM is made available as a web service through APIs	Ongoing
Further development of pilot building models with the real energy systems and edge node modelling (CSTB).	Ongoing	Ongoing
Calibration of pilot site models based on monitoring data (CSTB).	Ongoing	The overview of baseline data for the calibration of all pilots is ready
Test run the NODA solution and start refactoring it to run on the NODA self-host.	Ongoing	Ongoing

Activities performed by the partner

Task Leader: CSTB	
Task Contributors: NODA, ULUND, ÅKE, CyI, TEICOS, Virtual	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified. • The partners have access to DIMOSIM API with three models of the living lab to test their algorithms via co-simulation

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	• The partners are working on some other publicly available platforms at NTNU, ULUND and CYI

Activities performed by partner (s) – (M11-M22)	• Have checked different strategies for running the algorithm and controlling the building in Ålesund, using nDSM
	• Integrating Reinforcement Learning into energy management and further developing the nDSM algorithm with an advanced version of RL.
	• Had several technical meetings on algorithm development and on testing the preliminary version of the energy algorithm.
	• Improvements of the DIMOSIM API:
	  ○ The updated version of an automatic calibration tool written in Python (launching DIMOSIM API)
	  ○ Possibility to control blind position by the COLLECTiEF algorithms
	  ○ Additional functionalities have been added to the API by enlarging the "variables" of the API to add also parameters that allow to better understand of all parameter settings in DIMOSIM
	  ○ Calibration tool Caliente connected to DIMOSIM, allowing to obtain a calibrated model of a building or a district
	  ○ Ongoing: API calibration for usage by COLLECTiEF partners
	• Development in Pilot model calibration
	  ○ Eidet multizone mode calibration ongoing
	  ○ The overview of baseline data for calibration of all pilots is ready (decisions will be taken in M23 on the availability of necessary data)
	  ○ Calibration of all other pilot models has started
	• CyI participated in a meeting with CSTB to provide them with additional modelling information about the Cypriot pilot. The adaptive thermal comfort model-based control algorithm (developed in T2.2) was tested in a simulation environment using the DIMOSIM example.

Deliverables	-
Updated Risk (M11-M22)	• The verification of the models has not been proceeding as expected and the extension of this task is expected. Fortunately, the delays in this task have not affected the algorithm development and testing so far.

6.2.4 Task 2.5: Deployment and testing of algorithms and control strategies at small-scale pilot (G2ELab) (M12-M24)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
D2.7 A coherent platform for data sharing and integration, algorithm development and co-simulation (CSTB): M18	-	Completed
Further testing and development of the CI-RL-based algorithms using DIMOSIM.	Ongoing	Ongoing

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DIMOSIM models with three LODs for the G2Elab building are being implemented and validated.	Ongoing	Ongoing
D2.9 Report on the small-scale evaluation of COLLECTiEF algorithms and control strategies M24	Ongoing	Completed

Activities performed by the partner

Task Leader: CSTB

Task Contributors: ULUND

Overall progress and deviations from the action plan (M11-M22)	• The test of algorithms in the living lab has started and is ongoing. • The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified.

Activities performed by partner (s) – (M11-M22)	• Had several meetings with CSTB and G2ELab to organize the small-scale test on G2Elab.
	• CyI completed the first set of experiments at the G2elab for testing the occupant-centric control algorithm for occupants' thermal comfort and health (Scenarios 1-5 were conducted in weeks 38-42 of the year 2022.).
	• Developed the code and API to run the algorithm remotely on G2ELab, in collaboration with CSTB, G2ELab, and CyI.
	• Successful implementation of the small-scale test at G2ELab, in collaboration with CSTB, G2ELab, and CyI in February.
	• Ongoing data analysis of the small-scale text at G2ELab in collaboration with CSTB, G2ELab, and CYI.
	• Developments in living lab modelling:
	  ○ 2 different models of living lab calibrated (single zone and multi-zone) and available on the shared Gitlab website
	• Living test testing is still ongoing
	  ○ A methodology for access to the living lab measurement and controls has been developed by a third partner G2elab. Access has been granted to NTNU and CyI.

Deliverables	D2.9 Report on the small-scale evaluation of COLLECTiEF algorithms and control strategies M24
Updated Risk (M11-M22)	During M17 and M19, there were no regular meetings for WP2.

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6.3 WP3: Implementation, Testing and Small-scale Demonstration (M12-M36)

WP3 aims at developing and implementing the prototype of the COLLECTiEF network, including hardware and software technologies for demonstration in a real small-scale environment in the G2Elab.

All the hardware components and circuits identified have been produced (printed circuits) and/or purchased to assemble the BRiG prototype on the main board constituted by the Raspberry Pi 4 platform. Moreover, mechanical processing has been implemented to realize the box for the BRiG device. The BRiG devices and Sphensors have been installed in the pilot sites, and the BRiG capacity to communicate data to external servers has been tested by performing functional tests on the remote E@W server.

First, the Proof of Concept of the multi-agent framework running for simulation purposes has been developed and is under refactoring. The aim is to create a framework for its development, integration, and deployment. The relevant literature and examples of user-friendly Human-Building interfaces were collected and studied. Particularly, the potential technical solutions have been investigated, and collaboration between CyI, Virtual and CSTB has been established to exploit and take as a reference the existing App at G2ELab. Moreover, the first version of the Human-Building Interface has been developed. The emulation test bench has been planned based on the DIMOSIM simulation tool. The tool has been improved for its use as a controller test bed.

The deployment of the COLLECTiEF solution in the Green'ER building for small-scale pilot validation activities has started, and the testing of software algorithms is under development.

6.3.1 Task 3.1: Design and development of COLLECTiEF distributed Cluster-Edge architectural scheme (M12-M24)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Preparation of the 1st draft of the COLLECTiEF Architecture and its development view, examining the requirements, use cases, partners' feedback, programming languages and software technologies	D3.1 Cluster-Edge- the architectural scheme is submitted to the EU in M15.	
Definition of the Dynamic view of the COLLECTiEF platform by using sequence diagrams to represent the consolidated use cases and definition of the deployment requirements which will comprise all the hardware, software and network requirements for real-time application		
Discussion on the first draft of the Architecture and the first version of Dynamic View will be held during the next WP3 meeting		

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The First version of the COLLECTiEF HW and SW Architecture will be defined and delivered by the M15

Activities performed by the partner

Task Leader: E@W	
Task Contributors: EM, NODA, Virtual	
Overall progress and deviations from the action plan (M11-M22)	• Continuous update of the COLLECTiEF project architecture and definition of the detailed edge node architecture and the respective connections • NODA is converging on MQTTS for communication and perhaps NODA self-host for making data from the central database accessible to the cluster and edge nodes. • Definition of the 1st consolidated version of the Cluster-Edge architectural scheme and the requirements for the development of the whole COLLECTiEF system. • Sphensors environmental data collection from all project pilot sites. • NODA initiated an effort to define interfaces to the end of facilitating the future integration of software components. So far, this has resulted in CyI recommending https://brickschema.org/ and substantial discussions on how to tailor this technology to the COLLECTiEF project.
Activities performed by partner (s) – (M11-M22)	• Discussed with the reference partners some updates to be considered concerning the released Architecture in D3.1. • D3.1 completed and submitted to the EU. • E@W has organized the periodic WP3 remote meetings held on 31/01/2023, 24/02/2023 and 28/03/2023. Participated and coordinated the WP3: Meeting on progress and plans organized by NTNU as a project coordinator. • E@W discussed with the reference partners some updates to be considered concerning the released Architecture in D3.1 with a particular focus on the communication flow for the exchanging of data among the different components. • NODA uploaded an early version of Minmas" for minimal Multi-Agent System to the GitLab repository. The current version is a complete rewrite with (1) an on-file database solution to facilitate local development and (2) a hierarchical structure to facilitate complex but still manageable scenarios • NODA plans to set up a NODA Self-host to serve as Cluster Node and integrate it with the central database and MQTT(S). Tasks T2.1 and T2.2 are mutually dependent on T3.1.
Deliverables	-

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6.3.2 Task 3.2: Development of the COLLECTiEF Edge Node and integration with field devices (M12-M36)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Discussion with the partners involved in the development of the tools for flexibility management, optimization services and GUI to define how to embed such functionalities on the BRIG device;	Ongoing	Completed
Evaluation of how to integrate such features on BRIG from the SW/FW point of view to define how to exploit and manage the computational capacity of the new RPi4 board and optimize the data communication	The requirements for the integration of the functionalities of the edge node and border router from the SW/FW point of view have been defined for internal communication between the Border Router and iGateway into the BRiG device and optimize data communication avoiding data congestion and transmission delays.	Ongoing
Finalization of the SW/FW development to support the functions required	Ongoing	Ongoing
NODA/E@W meet and discuss self-host.	Starting from the NODA [self-host] and MQTT protocol specifications the work to integrate the Edge node with the Cluster node has been initiated	Ongoing
D3.2 Report on COLLECTiEF Edge Node(M24)	Ongoing	Completed
Consolidation of the Input/Output Connections & Interfaces between Edge Node and Cluster Node	Currently discussing the priorities and the responsibilities of the noda solution component wrt the edge node's other components as well as improving the data exchange.	Ongoing

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Activities performed by the partner

Task Leader: E@W	
Task Contributors: CETMA, EM, NODA, CSTB, CyI, Virtual, LASTEM	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified. • Progresses in the implementation of BRIG features. • Definition of the connections for the lightweight algorithms to be deployed on the edge node. • Prototyping of the database for the edge node. • Cypriot smart meters data collection implemented. Advancements in the implementation of BRIG features. • LASTEM will evaluate the possibility of developing a procedure to be included in the BRiG capable of re-sending the data recorded within the device memory to the MQTT broker so that any data losses occurring downstream of the system can be compensated for. • FW and architectural design activities to introduce communication protocols with smart valves/plugs
Activities performed by partner (s) – (M11-M22)	• E@W implemented communication with smart meters in the Cypriot pilot. Moreover, the implementation of the communication between BRIG and smart thermostats in the Cypriot pilot and the BMS in the Norwegian pilot is ongoing. • E@W is working on converting communication with the external server and the central database from MQTT to MQTTS. • E@W had an internal communication requirement between Border Router and iGateway into the BRIG device that has been defined. The communication of the Sphensors data to an external server, through Border Router (BRIG), has been tested jointly with LSI-LASTEM. • E@W: Maintenance activity of the external server that is collecting the data from the Sphensors through BRIG (Border Router). Constant improvement of SW / FW components implemented to provide BRIG device with the basic functionalities for the management of the edge node such as subsystems intercommunication, smart devices communication protocol implementation, configuration system, diagnostics, data recording, etc. • E@W: In particular, the whole internal architecture of the edge node with the specific connections has been defined and the prototype of the edge node database has been released and refined in line with feedback from other partners involved in the development of the COLLECTiEF platform. • E@W: There have also been advancements in the definition of the connections for the lightweight algorithms and further developments of drivers for fields data retrieval • NODA [self-host] has been deployed and tested in the E@W laboratory to evaluate how to integrate the Edge node with the Cluster node. • CyI shared the API information (i.e., authorization codes and credentials) for integrating field devices (smart thermostats, smart meters) and local weather station APIs. • CyI has been in contact with the group members to discuss the temporal resolution of monitoring data and how to be optimized according to the application for saving battery and reducing storage. • LASTEM completed the integration between Border Router and i-Gateway • LASTEM updated the software for configuration management of data receiving to obtain simpler usage for external personnel for installation. • LASTEM reconfigured the entire measurement network (all pilots) to use the MQTT broker made available by E@W as the destination of the measured data. • LASTEM provided remote technical support for the configuration, activation and verification of the VPN protocol at the pilot site in France.

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	• LASTEM provided remote technical support for the configuration, activation and verification of the VPN protocol at the pilot site in Cyprus. • LASTEM created and configured 2 new BRiGs to develop the onboard software (serial n. 22110400, 22110401). • LASTEM had a configuration of company firewall and DNS to support direct external access to one of the development devices (serial n. 22110400) • LASTEM has been writing the technical specification for the architectural and software development inside the BRiG device • LASTEM showed the development of the BRiG FW to support local data recording on the MariaDB database and communication management infrastructure between the various internal processes via the MQTT protocol. • There has been also the development of a simulation program running in a Windows environment for the generation of messages and commands via the MQTT protocol and the analysis of the relative responses. •
Deliverables	D3.2. Report on COLLECTiEF Edge Node
Updated Risk	• There was a lack of communication between Wp2 and WP3. ○ Risk-mitigation measures: To mitigate these risks, it will be necessary (1) to intensify the communication among the partners involved in the development activities and (2) to introduce the use of a software versioning system common to all the project partners Development problem: • LASTEM encountered a problem with the product used for radio transmission, in which the communication protocol (Open Thread) was found to be faulty when sending messages that exceed a certain size. This defect required numerous verification activities on our part until it was discovered to be due to a software component from the supplier. The problem was corrected in a relatively short time by the supplier (on the release of the new version of the Thread stack). Following this correction, a lot of resources have been committed, both LASTEMs and those of the pilots, to be able to update the firmware of many sensors, not all of them fortunately, with the correct version of the protocol.

6.3.3 Task 3.3 Implementation of the COLLECTiEF Cluster Node (Lead: NODA; Contributors: CSTB, ULUND, E@W, CETMA) (M12-36)

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Definition of an extended set of information to be exchanged between Cluster Node and Edge Node and how these components have to interact to implement actions on the field level;	Ongoing	Ongoing
D3.4 Report on COLLECTiEF Cluster Node	Ongoing	Completed
Development of the Cluster Node's prototype for the COLLECTiEF system	The First PoC of the multi-agent framework running for simulation purposes has been developed and it is currently under refactoring	Ongoing

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Activities performed by the partner

Task Leader: NODA	
Task Contributors: CSTB, ULUND, E@W, CETMA (M12-36)	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified. • E@W started activities for the definition of the Cluster-Edge architectural scheme and the requirements for the development of the whole COLLECTiEF system.
Activities performed by partner (s) – (M11-M22)	• ULUND has been developing the code and API to run the algorithm remotely on G2ELab • With the support of E@W and LASTEM, the MQTT broker is moving from the E@W server to the NTNU server. The process of migrating the MQTT broker to the NTNU server is well underway and working, however, there are still some aspects to be finalized before finally finalizing the transfer. • the Encrypted Broker has been tested, which allows communication with the outside, to the central database. During transmission, data is encrypted (TLS protocols) and compliant with GDPR requirements. • CETMA is having discussions with partners to implement communication protocols between systems and devices in the COLLECTiEF architecture to ensure the system's interoperability with legacy devices and systems. • CETMA is developing tools for context and data history management and archiving, to facilitate data and trend analysis
Deliverables	D3.4 Report on COLLECTiEF Cluster Node

6.3.4 Task 3.4 Development of the COLLECTiEF user interfaces (Lead: CyI, Contributors: CETMA, LASTEM, CSTB, Virtual, NTNU) (M12-36)

Actions	**Expected Progress by M22 (30-March-22)**	**Expected Progress by M24 (31-May-22)**
To share questionnaires among the partners to understand how to characterize the COLLECTiEF Dashboards and conduct relevant activities for the design of the dashboards	Completed	Completed
To implement visual interfaces to enable the building users in supervising the system status and the control actions (local interface) and to provide optimization and flexibility services for the energy actors (high-level interface)	The potential technical solutions have been investigated and collaboration with CSTB has been established to exploit and take as a reference the existing App at G2ELAB	Ongoing
D3.6 Concept of the COLLECTiEF Human-Building interface (M24)	Ongoing	Completed
D3.8 Fully Integrated Dashboard for Cluster Node and Human-building Interface for the Edge Node (M18)	Completed	-

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Activities performed by the partner

Task Leader: CyI	
Task Contributors: CETMA, LASTEM, CSTB, Virtual, NTNU (M12-36)	

Overall progress and deviations from the action plan (M11-M22)	• A data management plan has a direct impact on the development of the user interface since the data type will determine the design of the user interface.
	• Due to a lack of initial data for the development of the user interface outline, the finalization of the questionnaire is delayed.
	• LASTEM will work on:
	  ○ Integration into the BRiG SW architecture of the application communication protocol for receiving data and sending commands via the A2A cloud platform. Use of the Postman cloud service to simulate the APIs described in the documentation provided by A2A, thus obtaining the responses from its platform before the access credentials are made available and the actual measurement and implementation system is installed.
	  ○ Study of the communication protocol for Sensibo devices and its integration in the BRiG FW.
	  ○ Measurement of system response performance when using MQTT messages concerning access to data stored in the database.
	  ○ Development of access queries to the data measured and recorded in the database to improve compatibility with the data structures required by the calculation and decision models present in the iGateway section of BRiG.
	  ○ Drafting of documentation relating to the development of the SW and the test procedures applied to guarantee its correct functionality.
	• The Human-Building Interface and Dashboard for the edge node have been updated with new functions such as a customizable dashboard, notification functions, assigning sensors to locations and the configuration of login credentials for different users
	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified.

Activities performed by partner (s) – (M11-M22)	CyI assigned and listed several subtasks to each partner. A literature review on user-friendly human-building interfaces is made, which will contribute to the D3.6 Concept of the COLLECTiEF Human Building interface (due date M24). ○ A preliminary questionnaire is proposed to be designed in collaboration with Virtual based on the list of KPIs listed in D5.1 for thermal comfort, air quality, energy efficiency, energy flexibility and climate resilience • CYI, VIRTUAL and E@W have periodic weekly meetings (on 11/10/2022, 09/12/2022, 13/12/2022, 20/12/2022, 10/01/2023, 17/01/2023, 24/01/2023, 31/01/2023, 07/02/2023, 14/02/2023, 07/03/2023, 21/03/2023, 28/03/2023, 04.04.2023, 25.04.2023, 02.05.2023, and 16.05.2023) related to the activities carried out in task T3.4 for the design and development of the COLLECTIF graphic interfaces. • CETMA is joining the meetings organised by CYI to support interactive data management by providing digital indicators, meters and diagrams to visualise information/knowledge. • E@W had periodic weekly calls with LSI-LASTEM to align the work ongoing on the BRIG development and periodic biweekly call held among the developers involved in the WP2 and WP3 activities for the development of the whole COLLECTiEF platform have been held during the reference period. • VIRTUAL developed the first outline of the user interface designed for the G2Elab (associated with the D3.8, which has been reviewed by CyI and submitted to EU in M18). The current version of the user interface can be used as an example for easing the questionnaire development. The concept and the architecture of the

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	user interfaces (App, Human-Building interface, and Fully integrated Dashboard) are designed and are framed in Deliverable D3.6, due to be submitted to the EU in M24) • D3.8 is completed and submitted to the EU • D3.6 is completed and submitted to the EU • CSTB has the first draft method on a new evaluation platform/method of innovative controllers. This method includes test sequences and connectivity definitions between the virtual test rig and the products to be tested
Deliverables	• D3.8: Fully Integrated Dashboard for Cluster Node and Human-building interface for the Edge Node (first version), M18 • D3.6. Concept of the COLLECTiEF Human-building interface, M24
Updated Risk	• Integration of G2Elab's BMS with the COLLECTiEF API for applying the Edge Node control algorithms. • When creating the Human-Building Interface and Dashboard that utilizes many components such as algorithms, hardware configurations, and access to databases, and APIs, there's a risk of making sure that the timeline of all partners' tasks at different stages is met

6.3.5 Task 3.5 Emulation (Lead: CSTB) (M12-36)

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Discuss how to emulate the COLLECTiEF solution before the test in a real environment through the deployment in the pilot sites	The first discussions have started to define the final interface and protocol for the final tests.	Ongoing
Discuss how to utilize the techniques and evaluation methodology defined in T2.4 to evaluate the performance of the complete package and correct operation and robustness (e.g. occupant comfort, stability of room conditions etc.)	Ongoing	Ongoing
Installation of the algorithms on an open board and connection to physical devices and hardware exploiting bus protocols. This represents one step further concerning the simulation and co-simulation, called emulation in the DoA	Ongoing	Ongoing

Activities performed by the partner

Task Leader: CSTB	
Overall progress and deviations from the action plan (M11-M22)	• Requested amendment for the extension of Task 3.5. The task is extended from M24 to M36.
Activities performed by partner (s) – (M11-M22)	• The development of the method for emulation tests of COLLECTiEF products has been started. This method includes test sequences and connectivity definitions between the virtual test rig and the products to be tested • Specifications of the connection between the COLLECTiEF solution and the building emulator (DIMOSIM) via API are ongoing.
Deliverables	-

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6.3.6 Task 3.6 Integration and testing of the COLLECTiEF Edge Node – Cluster Node framework at small-scale pilot (G2Elab) (Lead: CSTB, Contributors: E@W, NODA, ULUND) (M12-36)

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Preparation of the deployment of the whole solution in the Green'ER building for small-scale pilot activities for the validation of the COLLECTiEF solution	Completed	Completed

Activities performed by the partner

Task Leader: G2elab	
Task Contributors: E@W, NODA, ULUND (M12-24)	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified. • To take into consideration all the activities implemented in WP2 and to integrate and test in small scale pilot environment a consolidated COLLECTiEF Edge Node – Cluster Node framework, we propose to extend the deadline of the activities of the T3.6 from M24 to M36 in coherence with what expected by the relative deliverable that is expected to be delivered by M36. • Successful implementation of the small-scale test at G2ELab, in collaboration with CSTB, G2ELab, and CYI in February 2023. • Requested amendment for the extension of Task 3.6. The task is extended from M24 to M36. • Implementation of COLLECTiEF products in the living lab is ongoing
Activities performed by partner (s) – (M11-M22)	• E@W held several calls to discuss issues related to the ongoing activities in WP3 with the partners in charge of the development of the algorithms to be deployed on the Edge Node – Cluster Node infrastructure (on 12/01/2023, 13/01/2023, 16/01/2023 and the 21/02/2023), of the management of central DB (02/02/2023) and the managing of the pilots and sensors installation (G2Elab: 13/01/2023, 30/01/2023, 16/02/2023, 24/02/2023 and 27/02/2023 – Italian pilot site: 13/02/2023, 03/03/2023 and 10/03/2023) • Successful implementation of the small-scale test at G2ELab, in collaboration with CSTB, G2ELab, and CYI in February
Deliverables	-

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6.4 WP4: COLLECTiEF system integration and large-scale demonstration (M01-M48)

In work package 4, the actual systems namely Edge Node, Cluster Node, occupant-centric fusion sensor network, IoT Operating System, and Human-Building interface are demonstrated in an operational environment at a large scale.

The work on the user and system requirements has been started. The template for identifying the user (functional and non-functional) parameters has been found and will fit the COLLECTiEF project requirements. The preparation for an on-site workshop with project partners has started.

WP4 has also started working on pilot cases deployment and demonstration. We have evaluated all the technical installations on the Norwegian buildings to ensure that communication through the BMS API with the BRiG is possible and that controls will be able to be applied to the zones that will be chosen for testing/piloting. All the BMS software has been updated to facilitate API communication with the BRiG device. Furthermore, research and evaluation of equipment to be used in Italian and Cypriot pilot buildings have been done. Smart valves/plugs, heat cost allocators, smart thermostats and smart meters have been identified and tested to facilitate data gathering and to apply controls from the BRiG device Installation of Sphensors, routers, BRiG and other peripheral equipment in all the pilot buildings have been done. Installation/placement of POE posters and stickers has been performed, and there have been meetings with pilot building owners and tenants to explain the COLLECTiEF project and the feedback needed through the POE evaluation. SRI assessment has been performed on all the Norwegian pilot buildings that use SRI methodology.

WP4 has worked also on the API for the Norwegian pilot buildings. We have created a code to access all data from BMS systems on these buildings and store these on the COLLECTiEF project server. An interface to extract data from all installed Sphensor units and store these in the database has been created. Work has been done to evaluate various services to provide weather data for the different pilot locations and regions, both historical weather and weather forecasts.

6.4.1 Task 4.1 Pilot assessment and identifying user and system requirements (Lead: E@W; Contributors: EM, CyI, ÅKE, TEICOS) (M12-M24)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
A complete requirements specification, covering both functional and non-functional requirements	Completed	Completed
D4.1 A complete requirements specification, covering both functional and non-functional requirements, M24	Completed	Completed
The task is completed	Completed	Completed

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Activities performed by the partner

Task Leader: EM	
Task Contributors: CyI, ÅKE, TEICOS, LASTEM	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified. • D4.1 dedicated meeting with Italian partners and NTNU admin to understand how to organize a workshop with Italian stakeholders. This is to collect feedback and non-functional requirements for use with the E@W adjusted template. • All sensors and BRiG installed. There were some issues with signal and stability. • Mains connection to BMS is underway. Hardware is ordered. • All sites have started the POEs.
Activities performed by partner (s) – (M11-M22)	• API access is given to all Norwegian buildings • Administration of API and EMPortal.no access for COLLECTiEF members • Participation in WP4 meetings • Prepared the activities and templates for the definition of the user and system requirements • Prepared questionnaires for stakeholders to be shared online to gather information on the stakeholder needs. • Prepared the D4.1 and submitted it to the EU • CYI contributed to the collection of data and requirements for the design of the COLLECTiEF Cluster-Edge Architectural scheme. • Administration of API and EMPortal.no access for COLLECTiEF members • Discussed the data storage and access
Deliverables	• D4.1: Action plan of implementation activities.

6.4.2 Task 4.2: Preparation of pilot cases for deployment and demonstration (M01-M48)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
D4.2. Action plan of implementation activities, M24	Prepared	Completed

Activities performed by the partner

Task Leader: EM	
Task Contributors: CyI, ÅKE, TEICOS, LASTEM	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified. • D4.2- Finalized the SRI assessment of all the Norwegian pilot buildings and hosted meetings with the other pilot responsible to transfer the knowledge

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	and experience in using the SRI methodology. SRI assessment of all pilot buildings is near final.
	• Completed communications quality analysis program for Sphensors devices and automatic reporting of anomalies to pilot site managers.
	• Provided technical support:
	  • Online support to technicians and problem resolution after reporting by pilot building managers during the monitoring period
	  • to pilot site managers in the diagnosis of problems detected during the use of Sphensors and BRiG devices
	  • to the local technicians to complete and verify the VPN connection of BRiGs in Norway, in particular about the policies related to the existing local network
	  • in the Italian pilot to improve the Wi-Fi radio coverage to the site of the apartments on different floors. This issue will require to better understanding the capabilities of the chosen repeaters and, eventually, add newer items of the same or different model/brand.
	  • for selection and approval of different devices for the smart valves and smart plugs operating in the Italian pilot to substitute or integrate the actual not working devices.

Activities performed by partner (s) – (M11-M22)	• EM participated in the SRI training webinar • EM prepared D4.2 and submitted it to the EU • EM evaluated and extracted Sphensors and POE data • EM verified Sphensors location/ID • EM coordinated WP4 and WP5 • WP4 organized periodic meetings with the involved partners. • LASTEM supplied electronic components for Sphensors production • LASTEM integrated new compatible components on electronic boards • LASTEM printed mechanical parts of Sphensors through 3D printing • LASTEM finished the mechanical parts (painting and logo application) • LASTEM tested and calibrated all the sensors • LASTEM configured personalization according to the zone and building of installation • LASTEM trained online for the installation of Sphensors • LASTEM provided personal support to technicians during installation in Italian pilots and online support to other pilots • LASTEM resolved problems related to the malfunctioning of the Sphensors network in some sites. • LASTEM substituted some not-working sensors and repeaters and supplied 3 repeaters for Norwegian pilots • LASTEM had technical meetings with A2A for smart valves. • LASTEM had meetings for evaluation for A2A devices for Italian pilot: 03/02/23, 10/02/23, 24/02/23, 03/03/23 • LASTEM provided remote technical support for the configuration, activation and verification of the VPN protocol at the pilot site in Norway • LASTEM provided local technical support at the pilot site in Italy to improve the Wi-Fi radio coverage trying to solve the problem related to the Shelly devices (smart valves and smart plugs). • LASTEM reconfigured the Sphensors light diagnostics in some apartments in Italy at the request of local users who consider the light quite disturbing in some circumstances. • LASTEM checked activities for Sphensors radio transmission quality assessment. • LASTEM reconfigured some sensors installed at the pilot site in Italy to meet the needs of the occupants of the apartments (worried or disturbed by radio frequency transmission and sensor light signals). • LASTEM debugged activities to search for a Sphensors disconnection problem from the radio network; a bug detected in the Thread protocol

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	implemented by the supplier; was replaced with a new stack made available by the radio chip manufacturer. • LASTEM fixed a bug related to the timestamp of the messages transmitted by the sensors; this led to a request for firmware updates in the BRiGs (only for sites in Norway). • LASTEM provided technical support and the necessary documentation for updating the Sphensors FW to solve the problem of disconnection from the radio network. • LASTEM reconfigured sensors to remove the flashing that had re-appeared following a firmware update. • LASTEM provided remote technical support for the assessment of problems detected on two repeaters operating at a pilot site in Norway. Reconfiguration of some repeaters to be integrated into the radio network of a pilot site. • LASTEM provided remote technical support for the pilot site in Cyprus for the resolution of a malfunction detected in a BRiG device (ID = 22040370). • LASTEM provided technical support for understanding the tutorial program that can be used for recording the data transmitted by the Sphensors sensor network. • LASTEM analyzed together with E&W and TEICOS for the Italian pilot of the new energy monitoring and actuation solution (smart valves and smart plugs) provided by A2A. • LASTEM provided technical support for the analysis of general communication problems of Sphensors devices, also due to local problems of physical protection of the devices. • LASTEM had periodic control of the quality of the transmitted data communications by analyzing the number of messages compared to the expected total and the communication delay. Notification of the problems identified to the managers of the pilot sites. • LASTEM developed an automatic communication quality analysis program for Sphensors devices and automatic notification via email of detected anomalies. • LASTEM had a meeting for meteorological and energy data access from different platforms, management of data: 13/02/23, 23/02/23 • EM finalized the selection of rooms and sensor allocation • To address the compatibility issue of smart thermostats at the Cypriot pilot buildings, a single-unit smart thermostat, Ecobee lite3, is purchased for testing. An in-field meeting is made with the HVAC installation company (Condair) to agree on the configuration to solve the compatibility issue. Condair is asked to develop an electronic board to enable the control of FCU to the Ecobee smart thermostat. • To address the compatibility issue of the HVAC equipment at the Cypriot pilot buildings, (2) a single-unit smart thermostat, Sensibo, is purchased for testing hardware compatibility, software integration and user acceptability, The Sensibo smart thermostat is installed in the Cypriot case study. • The Ecobee and Sensibo devices are functioning as expected and provide APIs for integrating them into the Edge Node system through the BRiG module.
Deliverables	• D4.2: Action plan of implementation activities.

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6.4.3 Task 4.3: Surveying, monitoring, and data acquisition of pilot buildings (M12-M48)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Energy use in buildings, detail information at the building/apartment level, type of energy carrier	Ongoing	Ongoing
Monitoring indoor physical environments in buildings (air temperature, relative humidity, CO2 concentrations, illuminances, sound level etc.) for assessment of users' thermal, visual, and acoustic comfort and indoor air quality	Equipment installed, installation reports	Ongoing
Monitoring outdoor environment (dry-bulb air temperature, relative humidity, global irradiance on a horizontal plane, CO2 concentration, particulate matter etc.)	Ongoing	Ongoing
Monitoring occupant's interaction with building devices, for example, use of heating and cooling units, operation of windows and blinds, and light switch, for assessing user's preferences.		

Activities performed by the partner

Task Leader: CETMA

Task Contributors: EM, NTNU, CyI, ÅKE, TEICOS

Overall progress and deviations from the action plan (M11-M22)	• TEICOS started monitoring the sensors installed and scheduled the installations for the smart valves and sockets. • TEICOS agreed to fully monitor n.5 apartments and to monitor the others in Italy (one bedroom and one day room) • All radiators in the rooms involved will be equipped with smart valves • CETMA planned to develop an initial database documentation (DBMS), describing the conceptual, logical and physical elements of the project (access and role, entity-relationship schema; definition of entities and attributes; relations and attributes; cardinality, attributes and properties; views; primary keys, foreign keys, etc.). • CETMA is working on collecting, managing and monitoring data from the pilot buildings, ensuring that the information needed for decision-making processes is collected correctly. Several updates to the API for accessing the data have been published. • CETMA is continuing to work on optimizing data structure and database performance. • CETMA continues the description of processes to organize and store data, ensuring accessibility and adequate documentation. • CETMA is developing several procedures for monitoring and correcting data. • CETMA continues to implement procedures for aggregating and anonymizing data. • The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified.

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Activities performed by partner (s) – (M11-M22)	• Discussed BMS data for D4.3
	• TEICOS removed shelly devices from most of the apartments
	• TEICOS carried out a monthly energy assessment to identify the most used rooms in the apartment for the future monitoring
	• Started the preparation of D4.3 Data management and weather API
	• Created software to help with data extraction through API
	• Monitored data flow and other responsibilities
	• TEICOS mapped out and identified the ideal apartments for monitoring
	• Developed an API to retrieve automatically historical and near real-time weather data. An open-source weather database i.e., meteostat is used for accuracy, validation and redundancy.
	• The API is incorporated into the adaptive thermal comfort control algorithm.
	• Thanks to E@W, smart meter data from the Cypriot pilot buildings can be accessible and actions are taken to integrate them on the NTNU server and on the COLLECTiEF' s API. To engage users the following measures have been made:
	  • Stickers with a unique QR code are placed in each room for accessing the POE questionnaires
	  • Location-based calendar reminders have been sent out. The unique POE questionnaire's URL is included for direct access.
	• CETMA created the common repository for data storage and established the communication protocols for data acquisition
	• CETMA participated in meetings with EM Systemer to discuss data reduction strategies and for a general survey on data acquisition procedures from pilot buildings, depending on the different sources.
	• CETMA participated in meetings with NTNU, E@W, LASTEM and to verify the correctness of the data collection and archiving processes implemented for the pilot buildings.
	• CETMA is proceeding with the implementation of procedures to optimize the data structure and performance of the database.
	• CETMA is beginning to describe the processes for archiving and organizing data to ensure that they are easily accessible and properly documented.
	• CETMA is implementing several routines for checking and correcting data, including:
	  • Checking the consistency of values and corrections
	  • Verification of empty periods and their filling
	  • Resampling at a common time step for evaluation
	• These routines will be applied specifically to the following types of measurement data:
	  • States: Temperature, humidity, CO2, etc.
	  • Powers: thermal power, electrical power, gas power
	  • Energy: thermal energy, electrical energy (active), gas energy
	  • Flows: water and air flow rates
	• CETMA is proceeding with the evaluation and implementation of data aggregation and anonymization procedures
	• CETMA has been Implementing post-processing techniques: CETMA is developing post-processing techniques, such as aggregating data at different time intervals, to improve the analysis and calibration of the model and post-retrofit measures. Temporal aggregation functionality of Sphensors data has been added.
	• CETMA has been developing techniques to verify the accuracy of collection and archiving processes: CETMA develops methods to ensure that collection and archiving processes are accurate and reliable. Updates to the API have been produced to improve the speed of execution. While the alerting procedure is still being tested, we are still working on alerts and a first version should be available soon.
	• CETMA has been developing automated procedures for reading and archiving data from pilot buildings: CETMA is evaluating and developing automated

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	procedures to facilitate the collection and archiving of data from pilot buildings (particularly for those in Italy). • CETMA selected and implemented weather data collection service (OpenWeatherMap): CETMA analyzed various weather data collection services and selected OpenWeatherMap as the most suitable. This service was then implemented to collect weather data for all pilot buildings. • Integration of meteorological data: CETMA has integrated meteorological data into the database • CETMA implemented data collection from power meters in the Cyprus pilot: CETMA implemented functionality to collect data from power meters in the Cyprus pilot building, expanding data collection for the project. • CETMA has been developing, testing and release of protocols for database access: CETMA is working on developing, testing and releasing the protocols needed to enable secure access to the project database.
Deliverables	-
Updated Risk	• Delay in finalizing sensor deployment due to shipping and installation time required for the new border router and the 2 new repeaters

6.4.4 Task 4.4 Deployment and system integration on the pilot buildings (Task leader: EM; Contributors: E@W, LASTEM, CyI, ULUND, NODA, Virtual, ÅKE, CETMA) (M24-48)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
The actions will start by M24.	-	-

Activities performed by the partner

Task Leader: CETMA	
Task Contributors: EM, NTNU, CyI, ÅKE, TEICOS	
Overall progress and deviations from the action plan (24)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified.
Activities performed by partner (s) – (M24)	• CETMA started the activities foreseen in T.4.3 WP4, for the acquisition, management, reading, and monitoring of building data based on the parameters identified in Task 5.1 of WP 5 to support the processing of information needed for decision-making processes • Definition of detailed implementation timeframe for the deployment and system integration on the pilot buildings. • Performed an in-house review of the HVAC equipment and market study to identify compatible solutions for smart thermostats. Even though the project does not cover the cost of smart power meter installation in the Cypriots, an action is initiated to cover them through CYI's core funds. • CYI installed border routers, repeaters and Sphensors at the Cypriot Pilot. It was necessary to arrange meetings for Sphensors & BRiG firmware upgrade. To

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	solve communication weakness, CYI prepared a purchase procedure on cor funds (co-financing) for purchasing additional repeaters to address the communication issues due to the distance of Sphensors in Cypriot Pilot • ULUND has been preparing and testing metered data of the Norwegian pilot buildings for the modelling. • ULUND continues working on the monitor and control points at the small-test pilot as the sensors and actuators in the CI-based algorithm • ULUN participated in several technical meetings to update developed algorithms at Edge and Cluster levels based on the available data from Norwegian, Cypriot, and Italian pilot buildings.
Deliverables	-
Updated Risk	• Task 4.4: The indication of 3 different HVAC systems (i.e., fan-coil units, VRV units, AC spit units) in the Cypriot pilot building creates delays in the deployment of smart thermostats.

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6.5 WP5: COLLECTiEF system qualification, Smart readiness evaluation and impact assessment (M01-M48)

Work package 5 aims to qualify the COLLECTiEF system by assessing the following main impacts: (1) the ability of the buildings to optimize operation for the health and comfort of the occupants, (2) the ability to maintain energy efficiency performance and operation of the building through the adaptation of energy consumption, (3) the ability of the buildings for demand response and interoperability to provide energy flexibility, and climate resilience of buildings and energy systems. In this work package, the smart readiness level of the pilot buildings before and after installation of the COLLECTiEF system is evaluated based on SRI.

NTNU was the leader of the WP from M1 to M17 while POLIMI is leading it from M18. Task 5.1 has been developed and finished by the coordination of NTNU with the submission of deliverable D5.1.

Regarding Taks 5.2, NTNU, POLIMI and the contributing partners have performed the following activities:

1) Analysis of the Pilot buildings, collection of materials and synthesis
2) Installation of the monitoring systems and distribution of POE QR codes
3) Interactions with the end-users
4) Data management
5) Definition of the methodologies for assessing thermal comfort and IAQ
6) Pilot site modelling and calibration of energy models
7) Development and submissions of deliverable D5.2

NTNU developed a template for Pilots and related guidelines, which were distributed among the partners in charge with the Pilots. NTNU examined the existing methodology and documentation for the evaluation of the smart readiness functionality level and is carrying out the analysis in all the Norwegian pilot buildings. NTNU and CyI defined the plan for the installation of IEQ sensors in the different pilots and identified the zones to be monitored. Similarly, the energy meters to be installed or existing were identified in each pilot building. The installation of the monitoring system, including Sphensors, Gateway (BRiG) and repeaters was completed by M15. CETMA, with the support of NTNU, CyI, POLIMI and other partners worked on the development of the repository, where the collected data are stored, in the definition of the data quality check procedure and on the processing aspects of the information needed to enable the evaluation of the system`s performance.

NTNU, CyI and POLIMI defined the methodologies to assess thermal comfort and developed the first analyses on the collected data. NTNU and POLIMI defined the methodologies for evaluating indoor air quality and developed the first analyses of the collected data. CSTB identified the methodology to be used for the calibration of energy models and, together with NTNU started the energy modelling and calibration of the pilot buildings.

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6.5.1 Task 5.2: Performance and Progress Monitoring of the Pilots (M01-M48)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Data post-processing, data alignment from different sources	The partners are analyzing the different types of data. The monthly meetings for the evaluation of data started	Ongoing
Calibration of the energy models	CSTB has identified the methodology to be used for the calibration of energy models and, together with NTNU has started the energy modelling and calibration of the pilot buildings	The evaluation is reported in D5.2
Start analyzing data	Template for pilots with guidelines is distributed	The meetings for data analysis have started.
Evaluate KPIs (and possible updates)		
SRI evaluation in the pilots	The methodology and documentation are ready	The analysis in one building has been finalized and presented in D5.2.
Finalizing the installation of the monitoring system	Sphensors, BRiG and repeaters were completed	Smart plugs and smart thermostats installation in a few pilots are finalized by M25

Task Leader: NTNU (M1-17), POLIMI (M18-ongoing)	
Task Contributors: CSTB, CyI, TEICOS, ÅKE, CETMA	
Overall progress and deviations from the action plan (M11-M22)	• A few deviations occurred concerning the original plan of analysis of the measured data and post-occupancy evaluations as a consequence of the delays/problems in the installation of the monitoring systems in the pilots, preparation of the pilot cases and the availability of the API to access the data. However, the mitigation strategies defined at the beginning of the project, such as the initialization of the process of installation in advance, the length of the overall monitoring period (which allows extension of the baseline period) and the opportunity to exploit the existing energy meters (e.g. heat cost allocators in Italy) allows us to contain the risk. • CETMA is continuing to work on managing the repository, making sure that the data are organized and accessed efficiently. It is also dedicated to reading and processing relevant information to enable an accurate assessment of system performance to key performance objectives (KPIs).
Activities performed by partner (s) – (M11-M22)	1) Continuation of the analysis of Pilot buildings, collection of materials and synthesis • One template for each Pilot has been filled out and is available on the project repository for the Partners.

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	• NTNU has examined the existing methodology and documentation for the evaluation of the smart readiness functionality level, applying the procedure in one of the pilot buildings. • NTNU performed the smart readiness assessment in all the Norwegian pilot buildings. POLIMI has reviewed the assessments and developed a synthesis presented in the technical report. NTNU is supporting the development of the rest of the pilots, as part of the joint activities WP4-WP5 • NTNU and POLIMI contributed significantly in writing and reviewing D5.2, sections 1, 2, 3 and part of 6, and supporting the definition of the overall structure of the deliverable. • Cyl contributed to the writing and review of D5.2 (Ongoing performance evaluation of the COLLECTiEF system implemented in the pilot cases (first version)), submitted in M18. Significant contribution in Sections 2 and 4 of the report related to thermal comfort analysis of the monitoring data and reporting of the installation procedure of Cypriot pilot buildings. CSTB has developed sections 5 and 6 of deliverable D5.2 which present -the approach used for energy models calibration developed in Task 5.4. and has reviewed the document.2) Interactions with the end-users • Site visits, calls and meetings with occupants and end-users have occurred to complete the installation of the monitoring systems and get the first feedback. The users have been guided about the use of the QR codes to take part in the surveys. • Site visits, calls and meetings with occupants and end-users have occurred to complete/fix the installation of the monitoring systems and get feedback. The users have been guided about the use of the QR codes to take part in the surveys by the pilot responsible. POLIMI and NTNU are supporting pilots responsible and WP7 in the engagement of the users in the pilots. 3) Installation of the monitoring systems • The installation of the Sphensors units and the smart plugs has started in the different pilots, according to the plan described in D5.1. • The installation of the BRIG, the Sphensors units and the smart plugs has been carried out in the different pilots are correctly working. In a few cases, problems with data transmission occurred. The pilot responsible, together with the installation team, is working to restore the functionality. Smart thermostat installation is ongoing. NTNU has periodically verified and reported the progress on the status of the installation of the monitoring systems in the Pilots. This is available for the whole Consortium in the dedicated Team folder (WP5_Task 5.2). The collection of data from outdoor weather stations is ongoing. 4) Development and distribution of the POE and QR codes • A QR code for each monitored thermal zone has been created and distributed to the different pilots. • CETMA made a statistical analysis of the POE survey (brief survey) with support from the Cyprus Institute: CETMA provided a preliminary statistical analysis of the POE survey to validate the data collected (validating the POE questionnaire data (internal reliability and scale validity, exploratory factor analysis) • CETMA made graphical and interactive changes to the questionnaires: CETMA made graphical and interactive changes to the questionnaires (satisfaction survey) to improve the user experience and obtain more accurate data. • CETMA development of the satisfaction questionnaires: CETMA initiated the analysis and development of satisfaction questionnaires to

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	collect information on user satisfaction with the pilot buildings and implemented technologies. 5) Interactions with legacy equipment and installation of smart plugs • POLIMI is supporting the preparation of the pilots (Task 4.2) including the analysis of the characteristics of legacy equipment in each demonstration building. This will help to orient the choices about the number of smart plugs to be installed in the pilots. 6) Management of the repository • NTNU and POLIMI are supporting CETMA in the development and amelioration of the repository where the collected data will be stored, in the definition of data quality check procedure and processing aspects. • Two pilot sites have been modelled in DIMOSIM as single-zone models for heating, cooling and DHW demand • CSTB uploaded the COLLECTiEF Gitlab • CSTB developed the model calibration of the living lab and that of the Norwegian pilot buildings is ongoing (first version available). • D5.2 submitted to the EU in M18 • WP5 coordinated and participated 9 meetings on Task 5.2 • TEICOS scheduled and monitored the installation of the devices with the residents in Italy. • TEICOS ordered new monitoring devices for thermal and energy consumption. Scheduling the new installation before summer. • TEICOS re-organized the files and checked the correctness of what was reported and recorded the problems faced with the devices installed. • ÅKE has been supporting NTNU in access to buildings and systems when needed. • Other meetings are: ○ 13/10/2022 – Meeting on Task 5.2 ○ 17/10/2022 – Meeting on Task 5.4 ○ 19/10/2022 – Meeting on Task 5.3 ○ 20/10/2022 – Meeting on Task 5.2 ○ 21/10/2022 – Meeting on Task 5.4 ○ 02/11/2022 – Meeting on WP5 ○ 03/11/2022 – Meeting on Task 5.2 ○ 07/11/2022 – Meeting on Task 5.2 ○ 18/11/2022 – Meeting on Task 5.2 ○ 30/11/2022 – Meeting on Task 5.2 ○ 19/12/2022 – Meeting on Task 5.2 ○ 19/01/2023 – SRI training webinar for all Partners ○ 20/01/2023 – Joint meeting WP4 & WP5 ○ 02/02/2023 – Joint meeting WP4 & WP5 ○ 03/02/2023 – Meeting on Task 5.2 ○ 10/02/2023 – Meeting on Task 5.2 ○ 17/02/2023 – Joint meeting WP5 & WP7 ○ 21/02/2023 – Joint meeting WP4&WP5 ○ 21/02/2023 – Meeting on Task 5.3 ○ 03/03/2023 – Meeting on Task 5.2 ○ 14/03/2023 – Meeting on WP5: Progress and future plans
Deliverables	D5.2: Ongoing performance evaluation of the COLLECTiEF system implemented in the pilot cases (first version)- M18
Updated Risk (M11-M22)	• CyI: Not able to validate the control algorithm using DIMOSIM since the pilot buildings are not modelled at the zone level. • CyI: Due to the long distances of Sphensors devices, additional repeaters are required for establishing their connection.

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6.5.2 Task 5.3 Assessing the impact of COLLECTiEF solutions on the ability of pilots to respond to the needs of the occupants (Lead: CyI, Contributors: ÅKE, CSTB, TEICOS, CETMA) (M12-48)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
The management of the repository, reading and processing aspects of the information needed to enable the evaluation of the system`s performance against KPIs	The methodology is defined, research questions are formulated	The D5.2 is submitted
Verification and compilation of measurement results from their buildings as input for the evaluation		

Activities performed by the partner

Task Leader: CyI	
Task Contributors: ÅKE, CSTB, TEICOS, CETMA	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified. • NTNU and CyI have identified the KPIs and relevant parameters to be used for assessing the impact of COLLECTiEF solutions on the ability of pilots to respond to the needs of the occupants • CYI designed and formulated two POE questionnaires: the Brief questionnaire and the Satisfaction questionnaire • CETMA supported the formulation of the POE questionnaire. • NTNU and POLIMI supported the review of the questionnaires. • GEO created the icons and has provided support in graphical design, the pilot responsible Partners have translated the questionnaires, • CETMA created the QR codes and the online version of the questionnaires. CyI provided all the pilot participants with the QR codes and instructed them on how to use them. • POLIMI, NTNU and CYI defined the methodologies to assess thermal comfort • POLIMI and NTNU defined the methodologies to assess indoor air quality. • CYI developed a template to collect data from Sphensors and feedback from POE from the Pilots for continuous monitoring of the progress on the implementation of the action.
Activities performed by partner (s) – (M12-M22)	• CSTB has been developing multizone models and real energy systems is ongoing that will be calibrated in the next months to allow the evaluation of performances of the COLLECTiEF solutions • CyI has been using monitoring data from Task 5.2 to visualise the ongoing indoor environmental quality and user satisfaction. An initial attempt to generate related KPIs for the baseline case. Use of the thermal comfort-related KPIs (such as PMV/PPD model, ALD, percentage of time outside a PMV range, and LTD) and thermal

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	acceptability assessment based on the Post-occupancy evaluation (POE) questionnaires. • Further small refinements to the Brief questionnaire fixed by CETMA and finalisation of the Satisfaction questionnaire together with CETMA and GEO in periodic meetings on 7/3 and 16/3.
Deliverables	•

6.5.3 Task 5.4 Assessing the impact of COLLECTiEF solutions on the energy flexibility and efficiency of pilot buildings (Lead: CSTB; Contributors: ÅKE, CyI, TEICOS, CETMA) (M12-48)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
KPI and parameters for energy flexibility	KPIs are identified	Ongoing
Calibration of energy models and the pilot buildings	Methodology, modelling, and calibration have started	Ongoing
KPIs and relevant parameters for energy savings cost savings and self-consumption	KPIs are identified and delivered in D5.1	-

Activities performed by the partner

Task Leader: CSTB	
Task Contributors: CyI, TEICOS, ÅKE, CETMA	
Overall progress and deviations from the action plan (M12-M22)	• NTNU has started the modelling and calibration of the pilot buildings ○ For two buildings, they have started the evaluation of the building's performances which is reported in D5.2.
Activities performed by partner (s) – (M12-M22)	• CyI completed the pilot description documents and provided the necessary information about the Cypriot pilot buildings to CSTB for generating the calibrated models. • CyI aims to improve modelling accuracy and allow the assessment of room-level control algorithms, CYI proposed to increase the granularity of building models. This will be tested for G2Elab at the moment, and it was not addressed yet by the responsible partner (CSTB). • Within the framework of Tasks 5.2, 5.3 and 5.4 of WP 5, once the common repository for data archiving has been created by CETMA and the communication protocols for data acquisition have been established, it will be necessary to establish the procedures for the detection, monitoring and quality control of the data acquired from the pilot building, to facilitate the interchange, integration, interoperability and sharing, with the lowest level of error, and to facilitate the evaluation of the system performance against the KPIs.
Deliverables	-

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6.5.4 Task 5.5 Assessing climate resilience for different types of buildings, energy systems, control strategies, and weather conditions (Lead: ULUND, Contributors: NTNU, CyI) (M12-48)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Climate resilience models are ready	The assessments are identified	
Existing meteorological stations are located to calibrate the energy models and assess the data	The stations are identified	

Activities performed by the partner

Task Leader: ULUND	
Task Contributors: NTNU, CyI	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified. • The typical and extreme weather datasets to be used in simulations are generated and available for future periods considering 13 future climate scenarios.
Activities performed by partner (s) – (M11-M22)	• An open-access weather data API namely Meteostat will be used for assessing climate resilience for all pilot buildings • To provide the weather data to LUND, CYI integrated an API for the collection of local weather stations for the Cypriot pilot. Contribution to KPI development as part of D5.1.
Deliverables	-

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6.6 WP6: Exploitation of Results and Business Models (M01-M48)

Work package 6 sets the foundation for effective development and exploitation of the project results, with a special emphasis on replicability and upscaling across Europe. It also includes the coordination of the exploitation activities of the IP generated in the COLLECTiEF project.

During the second year of the project, WP6 developed a comprehensive market and stakeholder analysis and provided a submission of the D6.1 (M18). R2M led the process and developed the analyses, while the consortium partners provided feedback and contributions for the different sections, through the exploitation workshop organized during the GA in Aalesund and through bilateral discussions by email and online calls. With cooperation between R2M and GEO as well as all the partners, a database of stakeholders has been developed. It represents a list of subjects addressed exploitation and dissemination process. Furthermore, analysis and literature review have been performed for the regulatory framework and standardization needs based on the content of the PESTLE analysis in task 6.1.

The list of the exploitable results (ERs) has been updated according to the development that occurred during the first reporting period and to the actual level of details for each ERs. The main contact in each partner organization has been defined for the different ERs. A proper template for the description and the analysis of ERs has been developed by R2M and circulated among the partners (an example in the following figure). It allowed us to gather contents and main elements which will be included in the D6.2, such as information related to the value proposition and the SWOT analysis. Different rounds of feedback and contributions by the partners have been performed with the guidance of R2M. Last but not least, the first overview of the knowledge related to the IPR has been introduced during the general assembly meetings. Preliminary discussions have been carried out on possible IPR protection needs on the Human Building Interface and Dashboard between partners Virtual, R2M, and NTNU.

6.6.1 Task 6.1: Market and stakeholder analysis and needs (M01-M18)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Contributions by all the partners on market analysis and stakeholder analysis and needs Market and stakeholder analysis by R2M and GEO Further actions for dissemination towards stakeholders	COMPLETED	

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Activities performed by the partner

Task Leader: R2M	
Task Contributors: GEO + all partners	
Overall progress and deviations from the action plan (M11-M22)	• The task is completed
Activities performed by partner (s) – (M11-M22)	• Bibliographic research and development of analysis for the market analysis particularly for the sections on market segmentation/value chain and potential customers, and on competitors' analysis • The task is completed with some delay
Deliverables	• D6.1 Market and Stakeholder Analysis (M18). Submitted

6.6.2 Task 6.2: Regulatory framework and standardization needs (M01-M24)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Analysis of regulatory framework and standardization needs	Ongoing	D6.2 is submitted

Activities performed by the partner

Task Leader: R2M	
Task Contributors: all partners	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified. • The first analyses and literature review have been performed starting from the contents of the PESTLE analysis in Task 6.1. • A first round of gathering information and references has been performed, with first feedback and contributions by the consortium partners.
Activities performed by partner (s) – (M11-M22)	• Deployment of the form to gather input from partners on regulation and standardization. • Exchange of e-mails with partners on analysis • The preparation of deliverable D6.2 started and submitted • The first discussion with Eubac on the testing methodology for control algorithms that are being developed at CSTB. • CSTB will arrange a meeting will be prepared and held before summer 2023 with Eubac and Certivea.
Deliverables	• D6.2. Analysis of regulatory framework and standardization needs (M24)
Update	• There are some delays in D6.2 and will be submitted by **M25**

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6.6.3 Task 6.3: Identification and assessment of the exploitable results (M01-M48)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Analysis by R2M on identification and assessment of the exploitable results	Ongoing	D6.3 is submitted

Activities performed by the partner

Task Leader: R2M	
Task Contributors: all partners	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified. • The list of the exploitable results (ERs) has been updated according to the development that occurred during the first reporting period and to the actual level of details for each exploitable results • A proper template for the description and analysis of ERs has been developed by R2M
Activities performed by partner (s) – (M11-M22)	• The analysis of exploitable results based on the proposal documents and first information started and updated. • The template for the exploitable results (ERs) has been circulated among partners. • Exchange of e-mails with partners on analysis of results • The D6.3 started and submitted
Deliverables	-D6.3 Identification and assessment of the exploitable results (M24)
Update	There are some delays in D6.3 and will be submitted by **M25**

6.6.4 Task 6.4 Business models development for the COLLECTiEF solutions (Lead: R2M, Contributors: All partners) (M19-36)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Description of Business model	Ongoing	Ongoing

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Activities performed by the partner

Task Leader: R2M	
Task Contributors: all partners	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified.
Activities performed by partner (s) – (M11-M22)	• Preliminary discussions have been carried out with the consortium. • Internal exchanges within R2M staff on first proposals for business models and preliminary call on this with NTNU
Deliverables	• -

6.6.5 Task 6.5 Intellectual Property Right (IPR) protection, agreements and exploitation plan (Lead: R2M, Contributors: all partners) (M19-48)

Action plan by the coordinator

Actions	**Expected Progress by M22 (30-March-22)**	**Expected Progress by M24 (31-May-22)**
IP management and protection Delivery of a comprehensive and effective Exploitation Plan	Ongoing	Ongoing

Activities performed by the partner

Task Leader: R2M	
Task Contributors: all partners	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified.
Activities performed by partner (s) – (M11-M22)	• The first overview of the knowledge related to the IPR has been introduced. • Preliminary discussions and internal exchange of information have been carried out on possible IPR protection.
Deliverables	-

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6.7 WP7: Dissemination, communication, and capacity building (M01-M48)

This work package aims to assure the project's proper visibility and spread pertinent information on its goals, activities and results to the relevant stakeholders and scientific communities.

During M12 and M24, GEO has continued organizing several social media campaigns to engage relevant users and the public, including building owners and prosumers. The energy quiz has been posted bi-weekly on LinkedIn and Twitter, the promotion of activities in pilot buildings, announcing COLLECTiEF participation in conferences, and campaigning for International Mother Earth Day. In general, the posting frequency is one to two weeks per week, and published content encompasses a broad variety of information:

- Project updates, results, promotional and awareness-raising campaigns
- Fun facts and tips related to the energy sector (mainly or the general public)
- Articles, reports, general strategies on buildings, energy efficiency and related topics
- Updates and news shared by sister projects
- Stakeholder engagement activities directing building owners
- European and international days, observances, events

In addition to the promotion of the project, GEO provided a set of materials including rollups. Posters and stickers for pilot sites and translated into Norwegian, French and Italian. These materials include a brief description of the project and a QR code created for each specific area that is being monitored to access the POE questionnaires. To increase engagement with the pilot buildings, there have also been several DET Meetings.

Regarding the stakeholder engagement strategy, to build constructive relations between property owners and flat owners, GEO has developed strategies to approach them with COLLECTiEF solutions. Under the coordination of GEO, local partners responsible for each pilot site have been organising engagement activities with pilot users such as meetings and workshops as well as communication activities. As the monitoring phase progresses, partners in each pilot site have been keeping engaged with the building users with regular visits (Norway), emails (Cyprus and France) and messages through WhatsApp groups (Italy) to collect feedback and questions, explain more in details the functioning of the COLLECTiEF system and encourage them to actively participate by regularly filling out the POE surveys.

6.7.1 Task 7.2: Stakeholder engagement (M03-M48)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Updating the stakeholder database	Ongoing	Ongoing

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Activities performed by the partner

Task Leader: GEO	
Task Contributors: all partners	
Overall progress and deviations from the action plan (M11-M22)	• The stakeholder database is updated regularly. • The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified.
Activities performed by partner (s) – (M11-M22)	• Continuous efforts in building the stakeholder database in collaboration with R2M. • CyI: Prof. S. Carlucci, Wallbox and EKCO Maximum Power Delegations Visit PROTEAS, The Cyprus Institute • Initial contact with Mr. Andreas Ioannides, Research and Development, Electricity Authority of Cyprus (EAC).
Deliverables	-

6.7.2 Task 7.3: Joint dissemination and communication actions (M01-M48)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Keep updating social media accounts; Keep going networking and synergies activities; Campaign for stakeholder engagement; End users' engagement The advertisement of COLLECTiEF activities, achievements, and the tool on MEDIA- project's website	Ongoing	Ongoing

Activities performed by the partner

Task Leader: GEO	
Task Contributors: all partners	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified. • Continuous social media updates established a distinct project visibility and popularity among focus groups • Social media channels are continuously fed with the most recent and relevant information and posts to maximize the visibility of the COLLECTiEF project's activities and results

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	• The activities:
	  ○ Events
	  ○ Networking and synergies
	  ○ Joint campaign
	  ○ Social media
	  ▪ Newsletters
	  ▪ EU4BET Cluster
	  ▪ Horizon Results Booster
	  ○ Articles and publications

Activities performed by partner (s) – (M11-M22)	• Continuous social media activities to engage relevant target groups and the general public, including promotion of COLLECTiEF participation at conferences and events; cross-promotion activities with sister projects; highlights of the activities in the pilots
	  ○ New contacts built with sister projects (Phoenix, iBecome)
	  ○ Auto-DAN, SmartBuilt4EU
	• Creation of a project cluster with Smart2B, SATO, PRELUDE, PRECEPT: planning of joint communication activities and events participation to apply to Horizon Results Booster
	• Horizon Results Booster Dissemination services Module A (October-December 2022): project questionnaire and analysis of stakeholders and KERs for dissemination and exploitation
	• Horizon Result Booster Dissemination Services Module B: meetings and development of a video
	• Joint activities with EU4BET project cluster: webinar “An end-user approach to smart buildings and energy flexibility”
	  ○ meetings to discuss future joint activities (e.g. webinars and workshops)
	• Website updates: new team members; events promotion
	  ○ A new page dedicated to the EU4BET cluster has been designed and implemented
	• Content creation and design for new communication materials (postcards for pilots)
	• Development of the 4th, 5th and 6th D&C Plan (January-April 2023) to be approved by DET
	• Video editing and design for an interview recorded in Norway (NTNU, AKE)
	• Contacts with sister projects about collaborations and joint events
	• Publication of the first issue of the project Newsletter (June 2022)
	• Social media coverage of the General Assembly in Alesund (23-24 June)
	• CyI: Linkedin posting of our activities at the small-scale pilot building G2Elab, Grenoble, France.

Deliverables	-

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6.7.3 Task 7.4 COLLECTiEF capacity building activities and sustainability actions (Task leader: GEO; Contributors: R2M, NTNU, ULUND, ÅKE, CSTB, Cyl, CSTB, TEICOS) (M20-M48)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Empowering end-users, experts and stakeholders on local needs and solutions	Ongoing	Ongoing

Activities performed by the partner

Task Leader: GEO

Task Contributors: all partners

Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified.
Activities performed by partner (s) – (M20-M22)	• The engagement strategy for the pilot buildings is the main focus of the DET meetings. • The DET team has started conversations around the organization of the Exhibitions in the pilot sites. • On-site meeting for presentation of the project at G2Elab in February 2022 • Preparing new communication materials, such as printed postcards and digital illustrations – the materials have been designed by GEO and translated into Norwegian (ÅKE), Italian (GEO) and French (CSTB)
Deliverables	-

6.7.4 Task 7.4.1 Exhibitions (Sub-task leader: GEO; Contributors: ÅKE, Cyl, TEICOS, CSTB) (M21-M31)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
COLLECTiEF exhibitions with the help of partners to engage tenants and users of the facilities/buildings	The task has started	Ongoing

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Activities performed by the partner

Task Leader: GEO	
Task Contributors: all partners	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation with regard to the work plan has been identified
Activities performed by partner (s) – (M21-M22)	• The organisation of DET meetings in January and February to discuss and start planning task 7.4.1 – Exhibitions in the pilot sites
Deliverables	-

6.7.5 Task 7.4.2: Stakeholder workshops (Sub-task leader: LASTEM; Contributors: GEO, NTNU, Cyl, CSTB) (M20-M32)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Workshop with representatives of the consortia, experts, DSOs and utilities, building owners, civil society representatives, policy-makers	The preparations/organization have started	Ongoing

Activities performed by the partner

Task Leader: GEO	
Task Contributors: all partners	
Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified. • The meetings have started to organize the workshops.
Activities performed by partner (s) – (M11-M22)	• Planning of second round of workshop – 1-on-1 meeting between GEO and each pilot responsible partner to develop and implement an action plan for the realization of the meeting in the second half of 2022
Deliverables	-

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6.7.6 Task 7.4.4 European conference Sustainable Places (Sub-task leader: R2M; Contributor: All) (M21 – M48)

Action plan by the coordinator

Actions	Expected Progress by M22 (30-March-22)	Expected Progress by M24 (31-May-22)
Attendance of two European Sustainable places conference	Ongoing	Ongoing

Activities performed by the partner

Task Leader: GEO

Task Contributors: all partners

Overall progress and deviations from the action plan (M11-M22)	• The main planned activities of this task are ongoing by M22 and no deviation regarding the work plan has been identified.
Activities performed by partner (s) – (M11-M22)	• Promotion of COLLECTiEF participation at Sustainable Places Conference 2022; cross-promotion activities with sister projects • Participated in the workshop “Smart buildings: Innovations for upgrading the smartness of buildings” at the 2022 edition of the Sustainable Places Conference in Nice, France, under the guidance of the SmartBuilt4EU project
Deliverables	-

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7 Project difficulties, problems, solutions – lessons learned

7.1 Amendments in the duration of Tasks 3.5 and 3.6

An extension of the activities of tasks T3.5 and T3.6 from M24 to M36 was requested to make consistent the scheduling of the activities in these tasks regarding Deliverable D3.7 and Milestone MS8, expected to be respectively submitted and reached only at M36. In this way, it will be possible to also consider feedback from the other tasks in WP3 related to system development and testing. The amendment request has been submitted to the EU by M19 and waiting for approval.

7.2 Delays in the installation of Smart Valves and Smart Plugs in the Italian Pilots

7.2.1 Installation

The installation of smart valves ad smart plugs was supposed to be completed in the Italian Pilots by the end of M17. However, the installation has been delayed due to the following main reasons: (1) Some sensors were broken by the end users mistakenly; (2) Some sensors were not connected to the BRiG due to obstacles in the zones. Below, we present the reasons and actions to mitigate the delay and the risk.

Justification:

Thanks to the workshop with flat owners in December 2021, TEICOS engaged 12 apartments that decided to participate in the COLLECTiEF project. To comply with their request of having the smart Thermo valves soon, the Italian pilot responsible decided to propose to anticipate the installation for the thermal season of 2022/23 instead of 2023/24 as was foreseen by the project. In this way, the team had also the opportunity to test the system before its effective use. It is also a fact that the team had to monitor the ‘state of the art’ of the energy use of the buildings and apartments involved, without directly operating and with no behavioral change of the occupants during the first year.

Following this engagement strategy Italian team installed not only the monitoring system of energy consumption data of the building heat pump – through meters at the basement of each tower and heating consumption counter from the radiators, and of comfort data (router and Sphensors) but also the smart Thermo-valves and plugs (Shelly brand) with a WI-FI connection provided by a modem (in the staircase of each tower) and Fritz repeaters in every floor between June and July 2022. Afterwards, some problems with the Thermo-valves and plugs were experienced due to connectivity issues. The team tried to reconnect the equipment and use more Fritz repeaters in every single apartment to strengthen the connectivity.

During these site visits, it was found out that the valves must have had plenty of signals to work properly, but this was impossible considering the structure of the building. The tower has a full concrete vertical structure in the staircase and has a reinforced concrete slab between the 5th and the 6th floor, meaning that it is technically impossible to fully cover the most perimetral rooms with a Wi-Fi network installed outside the apartment (in the staircase). That’s why even if the team could have a connection in these perimetral rooms, the signal was never full. The final decision was that the technology had to be changed.

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How will it affect the project?

To install a fully operative system we had to evaluate a new technology. This means a new purchase after we have already spent around 9.000 euros for the equipment and the installation. Moreover, the flat owners were discouraged by the disfunction of the new technology and two flat owners decided to leave the project.

We are confident that the new system will be effective for the project and will be installed in time and before the start of the next heating season which will be in October 2023. We consider reusing the Shelly equipment to spare from other pilots as the system is well functioning from COLLECTiEF intelligence but needs better connectivity. This will give us more budget to spend on the new system.

Foreseen and unforeseen risks:

A foreseen risk might be less engagement among the flat owners, which could affect the project negatively. Another possibility is the risk of not reaching 12 apartments.

Mitigation actions:

The team, in collaboration with the DET members, decided to organize periodic events that will update the flat owners regarding the project updates (once every three months).

Some of the actions are stated below.

- easier and faster communication with a social network platform
- activation of responsibility forms for the participants to help them convince to participate in the project
- incentives for better involvement in the project (it is under discussion with the DET team)
- give them already the possibility of seeing their data on the local platform (waiting for the COLLECTiEF user platform)

7.2.2 Delays in Task 2.4

Task 2.4, Testing of COLLECTiEF algorithms via co-simulation based on building and energy system modelling and analysis (Lead: CSTB, Contributors: NODA, ULUND, ÅKE, CyI, TEICOS, Virtual) (M1-24) was supposed end in M24 but there has been a delay in this task. The reasons and justifications are stated below.

The test of algorithms had been foreseen via co-simulation for both cluster and edge node developments. Two types of test beds have been developed and made available via API:

- Simulation-based on geojson input files for testing either edge node or cluster node algorithms.
- Simulation-based on a simplified input file for virtual districts, specifically for cluster node algorithm.

Both APIs have not been used for all pilots due to several reasons:

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- The edge node algorithms need the use of calibrated models of pilots. While the first calibrated models have been delivered in 2022 for G2elab and Eidet, all other pilots could not be calibrated since measurement data was not available before.
- The cluster node algorithms cannot be directly applied to the COLLECTiEF pilots since no district with a thermal network is available as the pilot (this was the reason for developing the second API for virtual districts, in which district heating or cooling networks can be set up easily)

It must be mentioned that it was not clarified in the DOW (nor known at that stage) that the chosen algorithm approaches needed calibrated models for pretraining the algorithms. This had the consequence that the models were available in time, but calibration could not be carried out due to the availability of calibration data.

Justification:

- Monitoring data for other pilots starts arriving in spring 2023, all other pilot models will thus be calibrated in 2023 as soon as data is available. The algorithms can then be also tested for these pilots.
- The official deliverable is D2.9 in M24, there will be some delay related to this deadline. However, the milestone MS6 called “Testing of algorithms in small scale test bed completed” is due in M36. The work needed to complete this milestone is identical to D2.9, so I would like to ask for some delay, corresponding at least to the start of applying control algorithms in the real pilots, i.e., in autumn 2023. This also corresponds to D3.7 for the test of the COLLECTiEF Edge and Cluster node which is due in M36.
- The methodology of the test will be reported in D2.9 for the G2elab building, demonstrating in this sense the correct operation of the algorithms, via co-simulation and small-scale testing.

How will it affect the project?

- The test of algorithms is tested first on the small-scale pilot to ensure the good operation
- Now, with the availability of monitoring data for model calibration, the algorithms can be applied to all other pilots, before implementing them in the real pilot buildings.
- The impact will thus be low.

Foreseen and unforeseen risks

- None

Mitigation actions

- In the meantime, the calibration procedure has been automated as much as possible to provide a “plug-and-play” version of the calibration module.

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7.3 Changes in the project team

In this period of the COLLECTiEF project, NTNU decided to change the role of a project coordinator to Dr Mohammadreza Aghaei since Dr Amin Moazami has stepped down from coordination of the project and will support it as an advisor (date to be effective: 1st Dec 2022). This request has been communicated with PO and approved.

The leader of WP7 from GEO, Jelena Lazić left the project in July 2022. The project and communication manager, Gloria Bevilacqua took over as the new leader of WP7.

7.3.1 New beneficiary: Politecnico di Milano

The Consortium asks to include Politecnico di Milano (Italy), Department of Architecture and Urban Studies (DAStU), date to be effective was 1st November 2022 (M18).

The justifications for the proposed change were due to: (1) the actual coordinator of WP5, Dr Silvia Erba, Senior Researcher at Politecnico di Milano and, previously, Associate Professor at NTNU, has been leading the activities in the WP since M1 and has been responsible for the definition of the Measurement and Verification protocol for the COLLECTiEF system (D5.1, approved); since November 2022, she has been appointed as senior researcher (RtdB) at Politecnico di Milano. The proposed changes would allow avoiding a change of the WP leader, which could create delays in the project development; (2) the project plans to test the solutions in a small-scale demonstration site (G2ELAB, France) and 13 large-scale demonstration sites located in three countries (Norway, Italy and Cyprus). Each pilot country is supported by a national academic partner from the Consortium, except for Italy. The amendment request has been submitted to the EU by M19 and waiting for approval. Therefore, the amendment will be processed after this reporting period namely after M18, and this beneficiary will be able to claim their costs for the 1st period retroactively (M18) at the end of the 2nd reporting period.

Additionally, several partners reported the following changes in their project teams:

CSTB: Maxime Raynaud who was working in WP5 has left the position. He was replaced by Sarah Juricic, who is one of the team members in WP5. There are two new additions to the team of CSTB. Eunice Herrera has been working for COLLECTiEF, WP2/3 and WP5 since April 2023. The other addition is Etta Grover-Silva who is also working for WP 2/3 and 5.

NTNU: Silvia Erba, PhD who was affiliated with NTNU left the position and started a new position as a researcher at Politecnico di Milano.

ULUND: Assistant professor Kavan Javanroodi join the ULUND team in December 2022.

CyI: Dr Ioanna Kyprianou joined the CyI team in January 2023.

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8 Risk updates and mitigation plan

Risk No.	Risk	WPS	Mitigation Plan	Likelihood (1-3)	Impact (1-3)	Risk Category	Contingency Plan	Progress on action	Status (open – waiting – closed)
R1	One of the partners leaves the consortium	all	Partner's expectations will be continuously verified in order to ensure their commitment to the project	1	3	medium	Depending on project progress, finish the project with the remaining partners or add a new partner	*Update 01/11/2021:* *Partner Virtual was lagging behind at the beginning of the project due to the leave of the employee who was the main contributor in the proposal writing phase. Therefore, extra efforts were put into several meetings to clarify tasks and expectations* for the newly assigned personnel of Virtual. *Update 21/04/2022:* *All the partners have been actively participating in the tasks and no lack of contribution has been observed in this period.* *Update 23/05/2023:* *All the partners have been actively participating in the tasks and there is no lack of contribution. There is an additional partner, POLIMI that contributes actively to the tasks and deliverables.*	Open
R2	Tools and methodologies do not work for all cases/applications: e.g., trained on a specific pool of data	2, 3	Close monitoring of project progress for that aspect	2	2	medium	Train the model again, find another modelling approach	*Update 01/11/2021:* *Extra needed efforts and tools have been identified. For example, upgrading of BMS systems in some of the pilot buildings in*	Open

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								Norway. Required actions to access hourly energy-metered data for the pilots in Italy and Cyprus. *<u>Update 21/04/2022:</u>* *This has been an ongoing risk and a continuous list of actions has been taken to reduce the risks. In this period, the focus has been on ensuring a rich pool of data will be generated from Sphensors, BMS data and POE questionnaires.* *<u>Update 23/05/2023:</u>* There is a risk that some of the appliances intended for control in the COLLECTiEF solutions are not well suited for the designed control scheme. One example is a washing machine that might restart its cycle if powered off/on. Another aspect might be that the project doesn't have enough knowledge and information on the user pattern of the controlled appliance so the control algorithms will be too intrusive and feel burdened in daily life.	
R3	Implementation phase: • Waiting for building permission (administrative and procedural) • Risks of damage to the building/the building management during installation • Decisions of owner take	3, 4	● The COLLECTiEF partners will work closely with the building partners to foresee any complications. ● Engaging pilots partners and involved stakeholders in time during the project actions.	2	3	high	Replace the demo building if necessary. However, the plan of activities entails sufficient time for implementing the innovative solution before the implementation in the pilot cases.	*<u>Update 01/11/2021:</u>* Extra meetings with building managers/owners have taken place to clarify expectations and required help/access for the monitoring and demonstration phase of the project. In addition, two workshops are planned for	Open

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	too long (regulatory)							building owners/users who are going to contribute to the project to ensure a strong engagement and therefore reduce implementation risks *Update 21/04/2022:* Two workshops were held for building owner engagement in Italy and Norway, and several meetings with the building users during this period were part of the effort in reducing this "high" risk category. Details of actions are provided in section 3. Engagement strategy. *Update 23/05/2023:* As the monitoring phase progresses, partners in each pilot site have been keeping engaged with the building users with regular visits (Norway), emails (Cyprus and France) and messages through WhatsApp groups (Italy) to collect feedback and questions, explain more in details the functioning of the COLLECTiEF system.	
R4	Delays in the implementation of the pilots due to restrictions for the COVID situation	4	The coordinator and the involved partners will monitor the COVID situation in the context.	1	3	low	If necessary, some implementation actions could be anticipated respect others, for example, to reduce the contact with the occupants of the building.	*Update 01/11/2021:* COVID restrictions have been reduced or removed in the pilot sites. This created the chance to visit the buildings and meet in person with building managers and establish the	

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								connection that will facilitate future communication if the COVID restrictions return. *Update 21/04/2022:* This risk has been reduced significantly due to the current COVID situation and the severity of the pandemic is fading. But it remains relevant in case of the situation changes back again. *Update 23/05/2023:* The COVID measures have lifted, and the risk is changed from medium to low now.	
R5	Monitoring: ● The data from the buildings may not be correctly acquired; lack of data; missing data ● Failure in placing the sensors at appropriate locations in buildings. ● Damages or faults of the installed components.	5	● The Sphensorsystem has a Border-Router with data logging features to solve online data communication issues. ● The sensors and the electronic components will be placed following mounting guidelines and recommendations in published literature.	2	2	medium	For missing building data: use trend analysis/extrapolation to close the gaps; compare to historical values.	*Update 01/11/2021:* Extensive effort has been put in place in the first semester of the project with the involvement of all the relevant partners to plan in detail the data acquisition during the monitoring period. This included communication protocols for devices, type of sensors, number of sensors, placement of sensors, zones to be monitored, methods for post-occupancy evaluation (POE), technical and physical limitations, user interface, data management and storage, etc. Update 21/04/2022: The following factors have been clarified in this period to ensure a successful lunch of the monitoring campaign from June 2022 in all the pilot buildings.	Open

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								Factors included: communication SW/HW for the Sphensors, specific zones for monitoring, type of sensors for each zone, number of sensors, placement of sensors, methods for post-occupancy evaluation (POE), technical and physical limitations in each zone, data management and storage, robust communication for collecting data from BMS, etc. *Update 23/05/2023:* The smart thermostats chosen for the Cypriot pilot building need to be purchased and installed before deployment can be finalized. There is a risk that this process might be delayed as the installation needs to be performed by a 3rd party electrical utility company. In case there will be delays in the installation the project might swap the NTL building with a building from the Norwegian portfolio currently listed in deployment phase 2. When applying controls based on sensory input, the input must be valid and a live, reliable value. Since the project group, in many of the pilots, are working with sensors, Sphensors, that is a physical objects that can be easily	

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								tampered with by the occupants, this risk is a very likely one. There must be built-in logic in the code to evaluate and verify the validity of the sensor input, and some fallback state in case the sensor value is not alive. There is a delay in installation because some sensors were broken and also were not connected to the BRiG due to obstacles in the zones. The new sensors were ordered, and the second installation process has been started. There are more installed Repeaters to amplify the signals inside the buildings. The installation will be completed by M21. The delay does not affect much on the baseline period much since temperature data for heat allocators were already installed on the zones. Regarding internet connectivity, parts of the controls and logic applied to the pilots are based on an internet connection to work. For example, the connection/interfacing with the BMS system will, in this project, be done through the EMPortal.no cloud solution and the controls on the smart plug/valves will go through the A2A platform. The project group needs to set up notifications that inform the pilot	

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								responsible of problems with internet connection, and connectivity with different field devices in general. This will be part of a notification/alarming scheme created for each pilot building. Since the COLLECTiEF solution is depending on power data for applying controls, there is a risk that these data will not be available at the frequency and saturation required for the project solution to perform properly. In general, the solution will identify challenges and report on them to the project group so that corrective measures can be taken. Also, the design of the algorithms and control logic in the solution will be made robust, with a solution for the lack of sensor or other control input embedded in the code already in place.	
R6	Evaluation: KPIs and methods for assessment not being adequate	5	Our experts from academy and industry in the consortium will ensure the development of appropriate KPIs and assessment methodologies	2	2	medium	KPIs will be adjusted based on the feedback from the small-scale test period at the living lab as well as during the large-scale demonstration phase.	*Update 21/04/2022:* The deliverable D5.1 specifically addresses this risk and will be submitted by M12. In this deliverable, the concepts and methods for performance evaluation of COLLECTiEF solutions, which are developed in this period by the experts in the consortium, are presented. *Update 23/05/2023:*	Open

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								NTNU and CyI have identified the KPIs and relevant parameters to be used for assessing the impact of COLLECTiEF solutions on the ability of pilots to respond to the needs of the occupants. A literature review on the KPIs associated with user satisfaction and some preliminary analysis of the available data is made as part of deliverable D5.2.	
R7	Data protection ● Low participation of occupants in the surveys. ● Low internal validity of survey responses	5	Standardized and already tested questionnaires will be used.	2	2	medium	For lack of response to surveys or low validity of survey data: select interview candidates instead and conduct structured interviews.	*Update 01/11/2021:* POE questionnaire has been planned to be used for thermal comfort assessment before and after the implementation of COLLECTiEF solutions. In this regard, the POE process has been introduced to the building managers and with their help, potential participants have been identified who will facilitate the filling of the POE questionnaires. For example, certain teachers for the school buildings, and certain nurses for the elderly health care centres are identified and invited to join the engagement workshop in December and February. *Update 21/04/2022:* The two engagement workshops have been held In Italy and Norway. The zones and the location of sensors have	Open

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								been identified with the direct help of the building users (owners, teachers, nurses, and managers,). The POE questions and a mock-up of the Sphensors have been shown to them and feedback received. The local technicians have been present during the visits to locate the best spot to place the Sphensors. For example, the issue of providing electricity for the sensors was solved. *Update 23/05/2023:* There is a risk that the project might alienate some of the current participants if the deployment becomes too intrusive or the algorithms malfunction and in the worst case cause higher energy consumption and reduced thermal comfort. This is very important for the Italian pilot stakeholders as the installation and deployment of the COLLECTiEF solution are being done in their private homes. The project group must monitor the deployment phase and evaluate potential challenges and possibly reschedule the deployment time for the Italian pilots if any challenges might interfere with the stakeholder's privacy. With regards to the POE results, the number of	

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								POE collected by M24 is not reaching the expected target in some pilots. To mitigate this risk, site visits, calls and meetings with occupants and end-users have occurred according to the users' engagement plan developed by NTNU and GEO to carry out the installation of the monitoring systems and get the first feedback. There are also stakeholders' engagement activities on the low POE count sites.	
R8	Failure to demonstrate a sustainable business model for the COLLECTiEF system due to equipment costs/willingness to pay or high customization costs based on the climatic situation or the occupants' needs	6	In the demo projects, different climate zones will be taken into account, and the variety of buildings on which the solutions will be demonstrated will reflect a good representation of occupants' needs.	2	3	high	The business models can take these aspects into account and can be adapted, e.g. to specific building typologies, thus reducing the need for customization.	*Update 21/04/2022:* Reducing the need for customization has been a topic of discussion with the technical experts at NODA, E@W and R2M. This was directly connected to the prospect of commercialization and scalability of the solutions.	Open
R9	Conflicts in intellectual property rights (IPR)	6	Proper analysis will be conducted in the dedicated task 6.5, starting from the background declarations from the Consortium Agreement and based on the contributions and activities performed during the projects.	2	2	medium	Support for IPR strategies and agreements will be delivered in the framework of task 6.5.	*Update 21/04/2022:* R2M has initiated the Identification and assessment of the exploitable results via an "Exploitable Results (ER) template" distributed to the relevant partners. The work and discussions in the first year might have brought up other potential ERs not initially considered. In our opinion, it's good to start thinking early from an exploitation perspective and use it to help shape and guide future products/services.	Open

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								Update 23/05/2023: Preliminary discussions have been carried out on possible IPR protection needs on the Human Building Interface and Dashboard among partners. The first feedback is given to the partners.	
R10	Failure to reach and engage a sufficient number of stakeholders at the COLLECTiEF events	7	All consortium partners have extensive professional networks in their respective countries that will be engaged. The dissemination plan will set several verification moments to early identify deviations and develop contingency plans.	1	2	low	Work with “multipliers” in the respective countries (e. g., associations) and equip them with the material needed to inform the stakeholders via their channels; discuss metrics to track attention	*Update 01/11/2021:* The engagement strategy described in section 3, is used to mitigate this risk. *Update 21/04/2022:* In the last two engagement workshops, the building owners and users have shown strong interest. A sufficient number of research participants has been identified. In Italy, participants (private building owners) were additionally encouraged by the possibility of keeping the smart valves and smart plugs after the end of the project. *Update 23/05/2023:* The consortium is now planning a stakeholder workshop starting in M22 in French buildings. Each workshop organizer will be responsible for the arrangement and the invitation. The organization is going efficiently and the stakeholders and end users will be encouraged to join the workshops actively.	Ope

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