

## Smartness upgrades and the Smart Readiness Indicator



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 956936.

# Auto-DAN

Deploying <u>Augmented intelligence</u> solutions in EU buildings using <u>D</u>ata analytics, an interoperable hardware/software <u>A</u>rchitecture and a <u>N</u>ovel self-energy assessment methodology



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The European Smart Buildings Community







1. Create a flexible, smart hardware infrastructure that can be applied to all small-to-medium sized buildings

> 2. Develop an interoperable software architecture that can provide all the analytical capabilities needed to self-assess & self-optimize buildings in the EU

3. Deliver Augmented Intelligence (Aul) solutions to enable buildings and their users to become self-optimising

> 4. Create a live self-energy assessment method that incorporates operational monitoring, appliance/system performance and smart capabilities that will improve the accuracy of current energy assessment procedures

5. Accelerate investment in sustainable energy by EU companies (3rd Parties) & their clients.













# Auto-DAN: Key results and their value proposition



We successfully created a flexible smart Hardware Infrastructure

that was tailored to all the project demo sites for the smart metering of consumption and the provision to building users of the information they need to improve their energy behaviour at an appliance and system level, as well as improving their indoor comfort.



We are developing the interoperable Software Architecture to have both a userfriendly dashboard and social media apps integrating all the analytical capabilities developed within the project



We are working on the Digital Occupancy Model and their integration with the Self Energy Assessment

that will allow to disaggregate energy loads at a system and appliance level assisted by agent-based occupancy models (created within the project), while identifying local energy bill reduction opportunities







## Auto-DAN: Barriers and Challenges

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### Barrier 01.

Difficulties in the installation of the Auto-DAN product in the context of existing buildings with such a wide variability of pre-existing conditions (installations, building use, preexisting configuration).

### Challenge 01.

Grounding a project like Autodan that aims to create a simple and replicable system, but for the variability of context it is very challenging.

### Barrier 02.

Supply chain problems present in this historical period have greatly impacted the possibility of realizing these smart buildings.

### Challenge 02.

Project had challenges on choice of hardware systems also due to problems related to the supply chain of these materials



# Auto-DAN

# Thank you for your attention!

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### COLLECTIEF

**I**NTNU

Norwegian University of Science and Technology

EM SYSTEMER

**NODA** 

Environmental Monitoring Solutions

**GEONARDO**°

**CSTB** 

le futur en constructior

ÅLESUND KOMMUNE

RESEARCH TO MARKET

Collective Intelligence for Energy Flexibility

LUND UNIVERSITY

THE CYPRUS INSTITUTE

> POLITECNICO MILANO 1863

> > work

TEICOS

CICN AND MATERIALS EUROPEAN DECEMPENT OF

VIRTUAL manufacturing.

- 14 partners from 6 European countries
- 4 Years June 2021-May 2025

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• 4 urban pilots in Cyprus, France, Italy and Norway

In COLLECTIEF, we design, test and implement an energy management system based on **Collective Intelligence**.



COLLECTIEF

COLLECTIEF aims at

- Integration of legacy equipment, existing buildings and urban energy systems into a collaborative network.
- Reducing installation cost and the need for data transfer and computational power.
- Increasing data security, energy flexibility, climate resilience, user comfort and cost-effectiveness.

COLLECTIEF's impacts will be

- Upgrading existing buildings to higher smartness levels
- Reducing in energy consumption and costs
- Primary Energy Savings
- Investment in sustainable energy
- Increased user satisfaction
- Increased climate flexibility and resilience in urban areas
- Higher integration of renewable generation

### COLLECTIEF

#### Some COLLECTIEF results (so far!)

A major step that we have taken is developing our novel DSM approach further by combining Collective Intelligence with Reinforcement Learning.

The implications of AI in energy management is very promising. Still we need the human innovation to come up with novel approaches that address our needs.





Adapt & Play Holistic Cost Effective and user-friendly Innovations with high replicability to upgrade smartness of existing buildings with legacy equipment

### **Presentation for the SmartBuilt4EU Final Conference**

Alfonso Ramallo, UMU



This project has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no 893079.



Mission: PHOENIX will provide a portfolio of ICT solutions to increase the smartness of legacy systems and appliances in existing buildings which will increase the SRI and energy efficiency. These improvements will translate in human-centric new services for building users and an improvement on both execution of grid operations and data sharing.

KO1: Allow Adapt-&-Play seamless integration of domestic appliances, legacy equipment and building systems
KO2: Create building knowledge with innovative techniques to upgrade the smartness of existing buildings
KO3: Enable real-time communication with energy stakeholders to optimise the grid operation.
KO4: Provide cost-effective services for building end-users to maximize the energy efficiency and overall performance.
KO5: Allow security and privacy of building data regarding the revised EPBD and the GDPR law
KO6: Create suitable business models and exploitation strategies to target the broad market of smart building
KO7: Develop human-centric approach and training/awareness activities to prepare citizens for smart buildings

This means:

- We need the software, the platform, and the connection means
- We need the hardware
- We need to apply it all to pilots
- And we need to draw conclusions (with good results)



### PHOENIX

### **Project planning**

PHASE 1 [M1-M10] Requirements, design, development, integration and first version of PHOENIX Proof-of-concept (PoC) in 1 pilot site Related to Objectives 01-05	PHASE 2 [M11-M21] Development, Integration & Second Demonstration stage Related to Objectives 01-07	PHASE 3 [M22-M36] Third Integration/Demonstration & Impact maximisation – related to Objectives 02-07	(	Business layer	Network Operators         Aggregators         ESCOs         Retailers         Building Owners         Building Inhabitants           Business         Stakeholder Interface         Building Occupants Visualization Dashboard
<ul> <li>Establishment of strong project management procedures (WP1)</li> <li>Requirements analysis of Regulatory, Business and Social (WP2)</li> </ul>	<ul> <li>Final architecture specifications (WP2)</li> <li>Complete development and integration of second PHOENIX release with all services (WP3-6)</li> </ul>	<ul> <li>Enhanced developments and complete integration of third PHOENIX release (WP3-6)</li> <li>Iterative pilots execution and feedbacks evaluation to achieve TRL 7-8 by M36. (WP7)</li> <li>Stakebolder, engagement (WP8)</li> </ul>		Function layer	Demand Flexibility Management Engine         Smart Contracts Management Engine         Predictive Maintenance Engine           Self-consumption Optimization Engine         SRI/ EPC Evaluation Engine         Comfort, Convenience and Wellbeing Engine
<ul> <li>Design and specifications of PHOENIX architecture and ICT tools (WP2)</li> <li>Development, partial integration and first PHOENIX release (WP3-6)</li> <li>Use-Cases Preparation (WP7)</li> </ul>	<ul> <li>Deployment and evaluation in all Pilot Sites (WP7)</li> <li>Completion of second demonstration and collected feedback (WP7)</li> <li>Scale-up efforts of D&amp;C, innovations</li> </ul>	<ul> <li>Development of training and awareness activities (WP8)</li> <li>Activities completed of D&amp;C, innovations standardisation and exploitation (WP8).</li> </ul>	PHOENIX ICT Platform	Knowledge layer	User-centric services Analytics Engine Al-based Knowledge Engine Engine
<ul> <li>Proof-of-Concept (PoC) (WP7)</li> <li>Launch activities of Dissemination &amp; Communication (D&amp;C) (WP8)</li> </ul>	<ul> <li>standardisation and exploitation (WP7)</li> <li>Successful completion of the project's mid-term review.</li> </ul>	Successful completion of the project's final review.		Integration Layer	Real-Time Data Broker     Platform Data Repository       IoT system     Building EMS System Adapter     External Data Source Adapter
<b>Phase 1 gate</b> : Initial requirements documented and architecture specified. Completed Proof-of-Concept evaluation. (M10) related to MS4	<b>Phase 2 gate:</b> Final version of PHOENIX architecture specifications, <i>Intermediate evaluation of integrated PHOENIX release (M21), related to MS07</i>	<b>Phase 3 gate:</b> Final evaluation of PHOENIX solution demonstrated at TRL 7-8 in real-world buildings scenarios. All activities completed for exploitation, D&C and standardisation; Successful completion of the project (M36).		Asset layer	Wireless Cateway         Image: Control of the control



### PHOENIX

### **Results and impacts**

KPI ID	Data needed to calculate KPI	KPI value	KPI Target
Energy performance measured	- Building energy consumption -Temperatures -Weather data -Questionnaires	Calculation on Energy performance based on measuring data is being done 1.83 W/K·m^2	<ul> <li>Energy performance compare to baseline normalization</li> <li>Energy performance based on measured data</li> </ul>
Improved smartness of buildings and smart readiness indicator (SRI).	-Building energy consumption -PV energy production -Temperatures -Weather data -Questionnaires	First results of SRI automatic were done. SRI before and after interventions: Full catalogue: - From 9% to 41% <u>Triage process:</u> - From 13% to 60%	SRI evaluation framework
Load and demand shifted (% and kWh). Decreasing of 20% on peak power loads. 18% energy cost reduction due to demand shifting on a variable tariff scheme	-Building energy consumption -Temperatures - Energy price - Questionnaires	<ul> <li>18% of demand shifted from high cost period to low cost period. Estimation of 50kWh in the whole building.</li> <li>29% of energy cost reduction.</li> </ul>	20% reduction on peak power loads 18% energy cost reduction
Load and demand shifted (% and kWh). Shifting of 15% of demand towards periods of high renewable production	-Building energy consumption -Energy production -CO2 emissions -Temperatures -Questionnaires	24% demand shifted to high renewable period. Estimation of 50kWh in the whole building.	15% demand shifted towards periods of high renewable production



### Adapt & Play Holistic Cost Effective and user-friendly Innovations with high replicability to upgrade smartness of existing buildings with legacy equipment

### **Any Questions?**

Contact details:

Alfonso Ramallo, UMU



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## Smart Buildings in Europe

SmartBuilt4EU Final public conference

Self Assessment Towards Optimization of Building Energy



LC-SC3-B4E-10-2020 Self-assessment and self-optimisation of buildings and appliances for a better energy performance



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# What's our objective?

#### Create

an IT platform for **automated selfassessment and optimization** of building's energy,

#### capable of

Assessment of real-life building energy use and energy consuming equipment operation

### Impacts

- Increased accuracy in energy performance and energy consumption assessments
- Forward-looking contributions to EPBD, SRI, and labelling approaches
- Consumption reduction to exceed ICT cost and operation
- Significant primary energy savings and reduced greenhouse gas emissions
- Trigger investments in sustainable energy and smart technologies

## BIM-based deployment and interface approach

- Building structure and systems are specified and input through BIM (IFC)
- KPIs and assessments are displayed through BIM

## IoT systems integration and computing services

- Knowledge Graph (KG) for IoT level integration
- Context-awareness layer supports building self-operations
- Automated computational workflows for KPIs, assessments, and services

### BIM and WEB-based interfaces Self-Assessment & Optimization Services Self-Assessment Framework

middleware

### Context-aware self-

### assessment framework

- Dynamic AI predictive framework exploits KG data and context
- Around 40 Assessments in 5 categories are implemented (including SRI)

### Energy management control services

- Simultaneous management of energy efficiency, flexibility, and user satisfaction
  - Hierarchical approach to integrate legacy systems
  - Holistic AI-based control

### **User interfaces**

- BIM-based for service buildings
- WEB-based for residential buildings
- Mobile app for real-life appliance assessment (Performance, efficiency, utilization patterns)

### Lessons learnt & good practices

It is very hard to setup pilots that are on the edge of building capabilities.

Significant untapped potential for data visualization in BIM

Building energy systems and components are **not IOT enabled or open (big problem)**.

There is a need to identify a small set of KPIs that users understand



## **Project pitches and panel session:**

Smartness upgrades and the Smart Readiness Indicator



## Policy recommendations

**Régis Decorme, R2M Solution** 



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### Our policy recommendations are based upon the work done with the Smart Building Innovation Community from February 2021 to July 2022:

• 12 White Papers written by 4 Task Forces:



Task Force 1: Interactions with users

Task Force 2: Efficient building operation

Task Force 3: Interactions with the external environment

**Task Force 4 : Crosscutting issues** 

### Policy recommendations – approach





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### Introduction

he building sector is one of the key enablers to achieve low carbon emission goals for 2050. To use the full potential of this transition, buildings need to transform from passive isolated elements to smart buildings, able to adapt to occupants needs and act as active nodes well integrated to the energy grids and other infrastructures

SmartBuilt4EU supports the innovation ecosystem of the smart building value chain in embracing this challenge through networking and communication actions. The project fosters knowledge-sharing between ongoing R&D (Research and Development) initiatives and developed a Strategic Research Innovation Agenda (SRIA) combined to policy recommendations to support the further uptake of smart buildings.

The ten policy recommendations presented in this booklet have been developed based on the collaborative work done by SmartBuilt4EU Task Forces from February 2021 to September 2022, consolidated by the consortium's expertise as well as desktop research. More than 190 persons contributed to the White Papers produced by the Task Forces. Contributors include members of the SmartBuilt4EU consortium and its Expert Board, and volunteers from the Smart Building Innovation Community (SBIC), of which a large part is involved in EU-funded projects.

SmartBuilt4EU policy recommendations cover the 10 following topics:

01	smart buildings data governance	02	open data culture/framework
03	dynamic building certificates (e.g. logbook)	04	national or local regulations supporting the smartening of the building stock
05	interoperability of umart solutions and flexibility of smart buildings	06	SRI implementation support
07	labelling of devices and building certification	08	regulatory sandboxes
09	(green) public procurement	10	upskilling

The order of these topics is taking into account feedback received during an online consultation on the relative importance of each recommendation. In the next sections, each policy recommendation is introduced by background information and broken down into several key actions. For each key action, levels of intervention (EU, national, local) are also proposed

Define clear rules at EU level for smart buildings data governance (data access, ownership, privacy, usage rights, consent) to build trust and enable new business models

#### Background

The building sector must deliver a smarter, more flexible and resilient data-driven built environment. This includes providing technical solutions and services building upon data (including user behaviour data) gathered from smart devices, Internet of Things (IoT) and embedded sensors. Data storage, protection and access therefore need to be addressed carefully, although data sharing to provide enhanced services and optimise the building operation is highly desirable, buildings cannot turn into 'Big Brothers' with potential cybersecurity breaches. While the General Data Protection Regulation (GDPR) entered into force in 2018 and the European Union (EU) is developing cybersecurity policies and strategy packages, building occupants and end-users are still largely unaware of their rights with regard to data privacy and of the fate of the data they (sometimes unknowingly) agree to share.

The notion of data governance, crucial for cybersecurity, privacy and the integrity of an activity, is becoming essential at a time when data production can hardly be slowed down. According to the EC<sup>1</sup>, the term 'Data governance' means "a set of rules and means to use data, for example through sharing mechanisms, agreements and technical standards. It implies structures and processes to share data in a secure manner, including through trusted third parties".

Several regulations, certification frameworks and standards are relevant to the topic of data governance however none of them are specific to smart buildings.

- New Data Governance Act<sup>23</sup> (DGA) entered into force on 23 June 2022 and applicable from September 2023;
- General Data Protection Regulation (Regulation (EU) 2016/679);
- · Regulation (EU) 2018/1807 on a framework for the free flow of non-personal data in the Ell
- · Directive (EU) 2019/1024 on open data and the re-use of public sector information.

In the revision of the Energy Performance of Buildings Directive (EPBD) proposed by the EC in December 2021, a new Article 14 specific to building data ensures that the building owner, tenant and manager or third parties can have access to building systems' data, so as to facilitate development of new services related to buildings. New rules on data interoperability and access to data are to be laid down by the EC by means of an Implementing Act. According to the proposal, MS shall set up national databases for Energy Performance Certificates of buildings, which also allows to gather data related to building renovation passports and Smart Readiness Indicators (SRI).

https://ec.europa.eu/commission/presscorner/detail/en/qanda\_20\_2103#Data%20governance \* https://digital-strategy.ec.europa.eu/en/policies/data-governance-act https://eur-lex.europa.eu/legal-content/EN/TXT/?uri-CELEX%3A32022R0868





PR1: Define clear rules at EU level for smart buildings data governance (data access, ownership, privacy, usage rights, consent) to build trust and enable new business models





Action 1.1 Design and implement clear guidelines on data collection and data management procedures for smart buildings, in line with the proposal for the revision of the EPBD



Action 1.2 Clearly define the governance framework and the role of trusted third parties as warrant of cybersecurity and data privacy to build trust, in line with the Data Governance Act Action 1.3 Set up a central registry or data space to give users a personal unique interface to make their data available and control it, in a just and safe way

2

## PR2: Develop and enforce an open data culture to improve knowledge sharing and replication on building performances







Action 2.1 Develop a framework for an open-access platform to enable data access and data sharing in buildings and districts, and to promote the replication of successful stories



Action 2.2 Include "open source" requirements in regulation

PR8: Support the roll-out of interoperability of smart solutions and flexibility of smart buildings through data-driven standards and regulation





Action 8.1 Design principles and rules for integration of interoperability in EU regulation

1



Action 8.2 Develop open, modular end-to-end interoperability and data management frameworks



Action 8.3 : Support the development of certifications with the establishment of end-toend interoperability between energy networks, BEMS and devices