PRELUDE

Prescient building Operation utilizing Real Time data for Energy Dynamic Optimization

4

“Smart solutions for sustainable buildings”

NEWSLETTER

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ABOUT

The PRELUDE project represents the improvement of the buildings smartness through minimization of energy utilization, maximization of self-consumption and Renewable Energy Sources investment and personalization, reduction of CO_2 footprint and improvement of comfortable and healthy indoor conditions. This will be possible through the combination of innovative, smart, low-cost solutions and proactive optimization service.

For more information you can visit this website: **www.preludeproject.eu.**

This is the 4th release of the PRELUDE Project newsletter. A detailed report on the final event which took place in Luxembourg on 23-25 September during the Sustainable Places 2024 conference. Specifically, PRELUDE activities, goals and outcomes have been presented on stage on 24 September.

SUSTAINABLE PLACES 2024

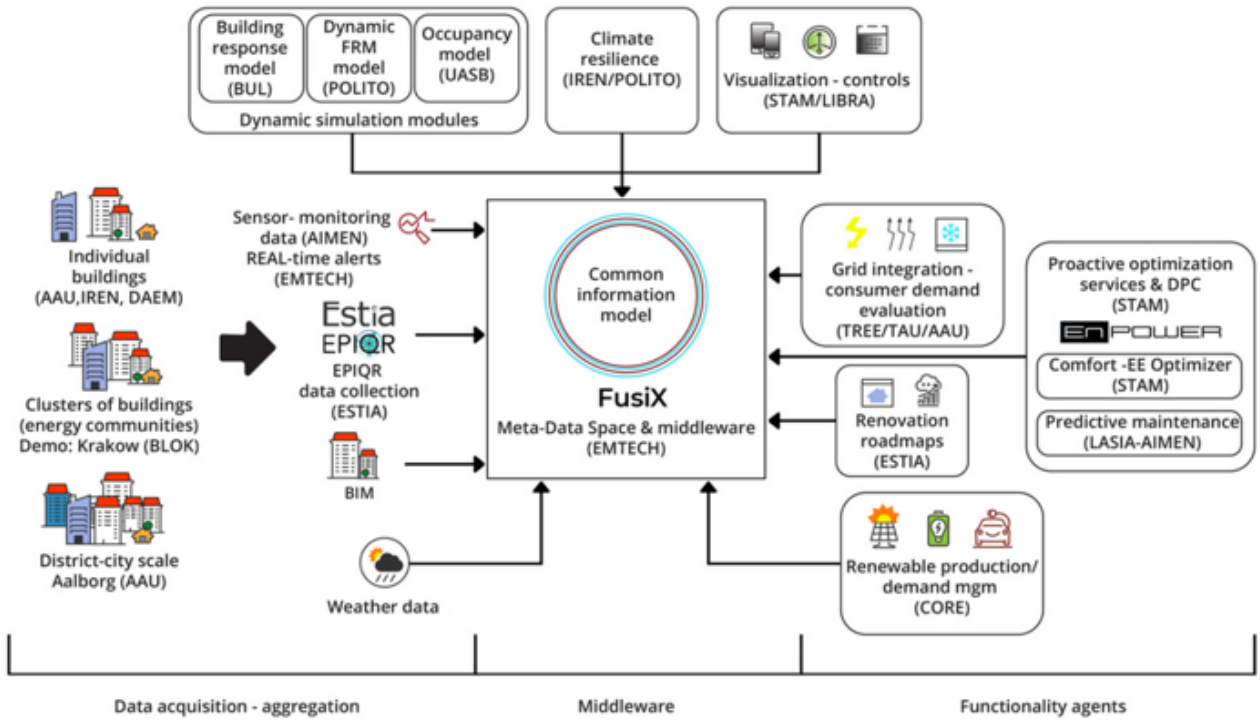
Below you can learn more about what was discussed at **Sustainable Places 2024**. Several technical partners brought their findings.

EMTECH DIASTIKIMIKI MONOPROSOPI IKE

FusiX - PRELUDE Middleware and Portal

FusiX is a domain agnostic framework, developed by EMTECH, that allows the creation decision support and situational awareness systems.

FusiX is being used as the integration point between technology providers and building integrators and facilitates the provision of the project's web user interface.



Middleware positioning in the PRELUDE project

FusiX is a generic framework for the development of DSS applications.

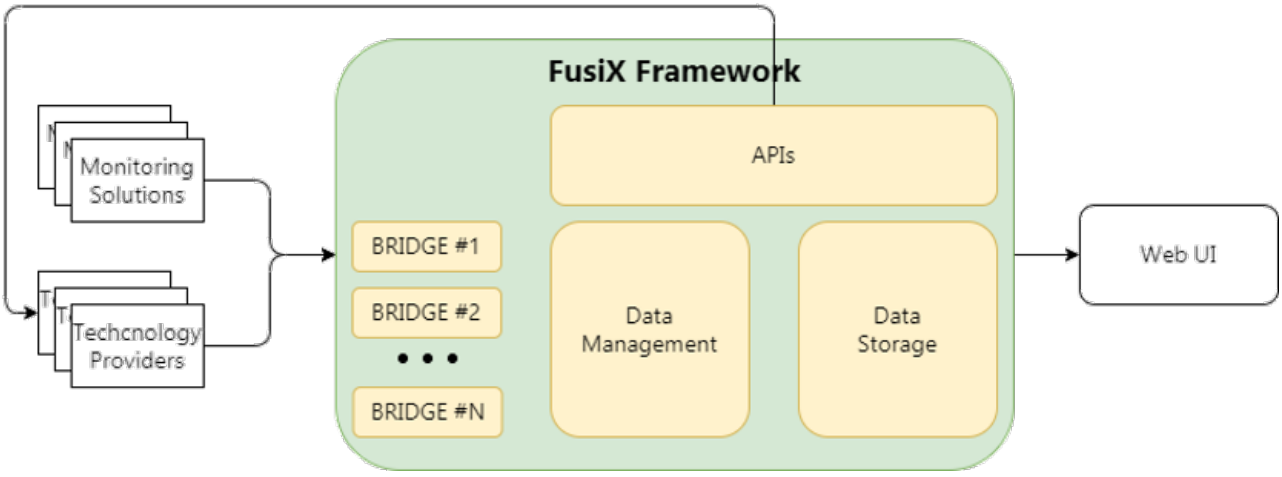
FusiX provides abstraction and virtualization of data resources, enabling seamless interoperability across various systems. The cloud architecture integrated within the framework ensures scalability, allowing the system to grow with the user's needs. Additionally, FusiX supports simulation by leveraging external tools. The platform also offers a dynamic, platform-independent graphical user interface (GUI), ensuring usability across different devices and environments. Furthermore, FusiX includes a comprehensive set of common services.

FusiX applications leverage the framework to perform several critical tasks. First, they collect data from diverse and heterogeneous sources. The data is then abstracted into a common data space, allowing for easier manipulation and processing.

This abstracted data is processed to generate higher-level, valuable information that can be used for decision-making. The results and findings are then reported to end-users, ensuring that the relevant insights are delivered. Lastly, FusiX enables control in a semi-automatic or automatic manner, enhancing efficiency and reducing the need for manual intervention.

The Application has the following high-level blocks:

- Bridges: to interact with external elements
- Data Management: to perform filtering, aggregation and other operations on raw data
- Data storage: to handle database access
- APIs: To allow external elements to interact with FusiX

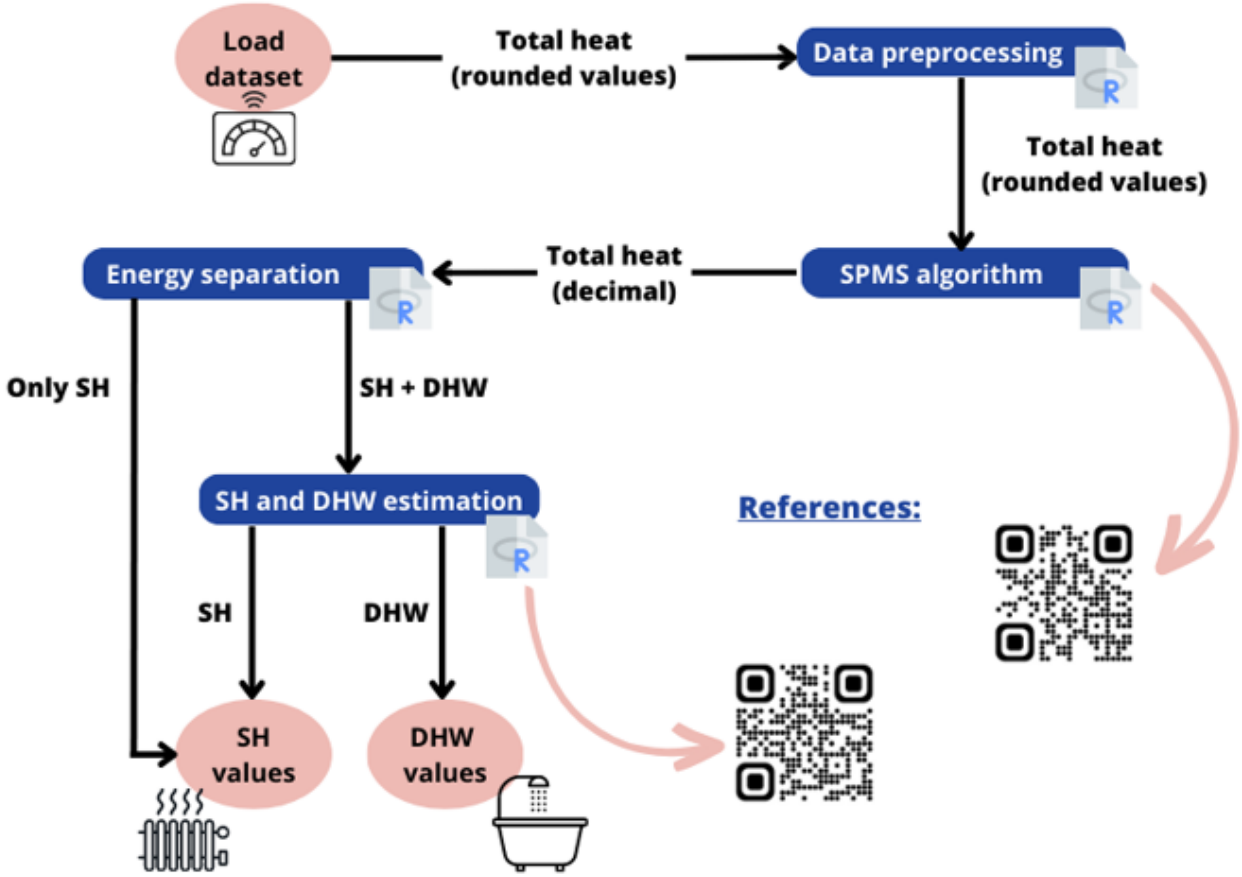


Middleware Application Structure

AALBORG UNIVERSITY

Data-driven methodologies for building efficiency assessment within district heating

The global roll out of smart heat meters creates a new digital reality for buildings. A standard space heat meter comprises several key components: two temperature sensors, a flow sensor, and an integrated computer that calculates and transmits the energy data. This data can be used to much more than only billing the consumers. In PRELUDE project we have gained better understanding of the current potentials and barrier of smart heat meter data. One of the objectives of the PRELUDE project was to develop a method for utilization of smart meter data to enable low- and high-tech buildings to be a proactive component of the energy community. The objective was addressed and facilitated by several activities that concern: validation of disaggregation methods of total heat to heat for domestic hot water and space heating (understanding the importance of rounding kWh), fault detection and diagnosis in which SHM data is supported by fault reports from district heating connected buildings, application of heat use pattern algorithms to facilitate understanding the data series of heat energy use, clustering.

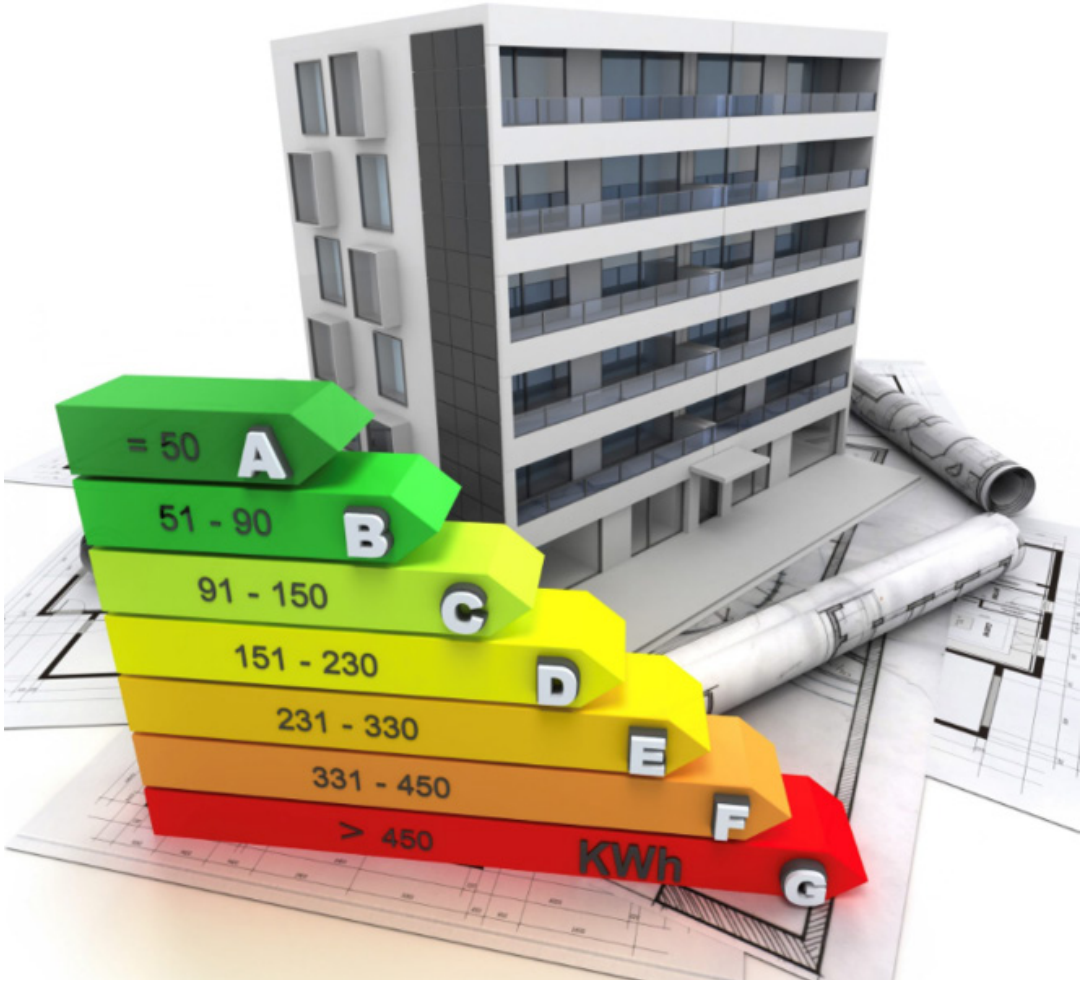


Total heat disaggregation to space heating (SH) and domestic hot water (DHW)

CORE INNOVATION CENTER NPO/CORE IC

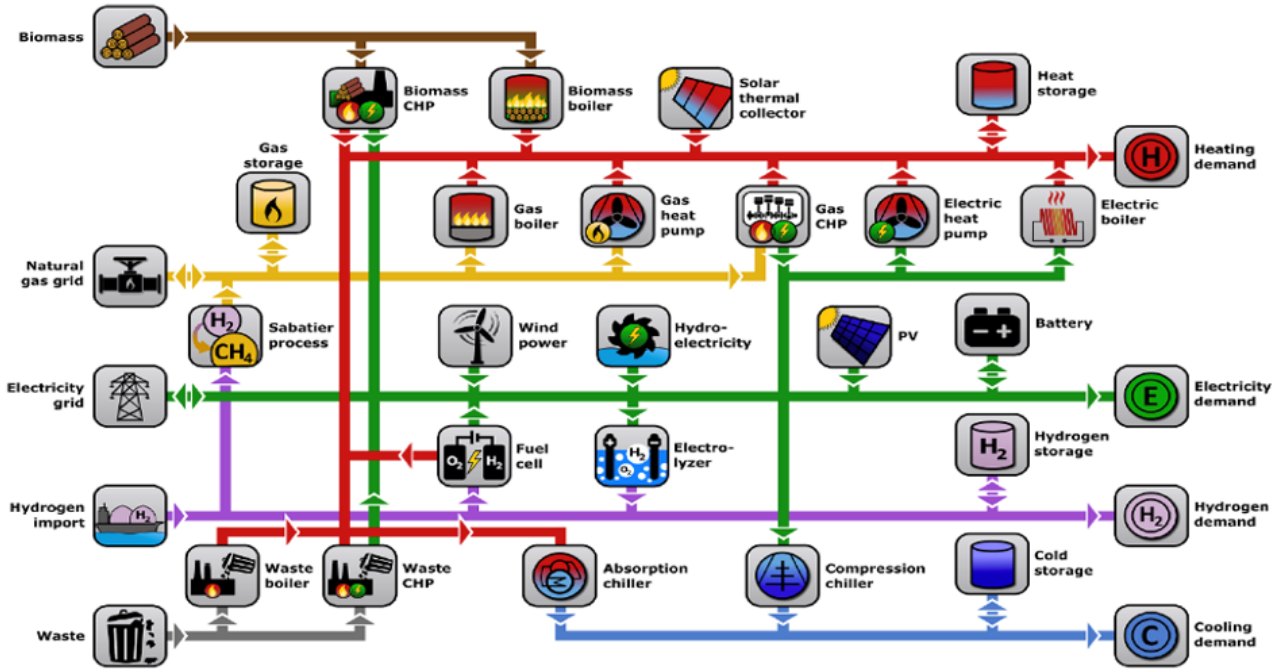
Enhancing Building Energy Efficiency: Exploring Opportunities, Challenges, and Future Pathways in a Sustainable Market

Buildings nowadays face significant challenges in meeting increasingly stringent energy efficiency targets, driven by both regulatory demands and market pressures.



Energy Efficiency in buildings

The need to balance operational performance with sustainability goals creates opportunities to innovate, yet also introduces complexities related to forecasting energy needs, optimizing renovation strategies, and selecting appropriate renewable energy sources (RES).



Total heat disaggregation to space heating (SH) and domestic hot water (DHW)

As these challenges grow, the European PRELUDE project and similar initiatives highlight the importance of developing adaptable and forward-looking approaches to achieve energy savings and carbon reduction in the built environment. CORE is implementing solutions such as renovation roadmaps, advanced forecasting tools, and decision-making frameworks which aim to support stakeholders in navigating this evolving landscape, fostering a shift towards a more sustainable and resilient future for buildings across Europe.

FORSCHUNG BURGENLAND GMBH

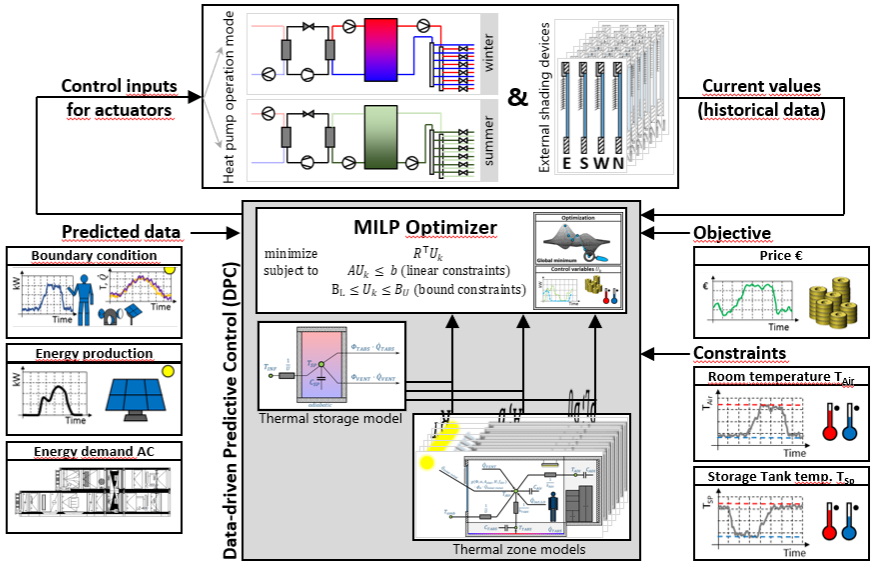
Demonstration results of a low-tech predictive control scheme for demand side flexible heat pump operation in the residential sector

Realizing demand-side flexibility in power-to-heat applications may be a key technology for efficiently integrating fluctuating renewable energy sources into the future zero emission energy system. Predictive control schemes, based on model identification and numerical optimization, show promising results in exploiting the flexibility potential of residential heat-pumps, but usually require extensive data engineering and the availability of high-quality sensor and forecast data. In order to facilitate the wider application of this approach, it is necessary to develop control schemes that are robust and require minimal parameterization, implementation and local sensor data. The presentation will provide an overview of a developed low-tech predictive control scheme for residential heat-pumps to shift the electricity consumption towards local photovoltaic energy production and low dynamic electricity tariffs. Furthermore, the main results of a real-life demonstration in a single-family test house, located in southern Denmark, has been presented.

Investigation of the Long-term Performance of a Data-driven Model Predictive Control system in a Real Office Building

Data-driven Model Predictive Control (DMPC) is a promising solution for improving energy efficiency and demand-side flexibility in modern building systems while maintaining comfort. The presentation demonstrates a centralised adaptive DMPC system implemented and tested in a real office building with large glass facades and thermally activated building structures (TABS) over a year in a temperate climate zone. The system uses reduced-order state-space models for building zones and simplified models for HVAC equipment, integrating 24-hour weather forecasts. By combining DMPC with Energy Conservation Measures (ECMs), the building transitioned from gas boilers and air source heat pump to a ground source heat pump, achieving significant energy savings. Heating and cooling energy consumption was reduced in total by 50%, with an 85% reduction in final energy use for heating and cooling. The study demonstrates DMPC's effectiveness in improving building energy efficiency and contributing to sustainability goals.

The DMPC algorithm with a timestep size Δt=15min. and 24h forecast horizon considers at minimum 13152 control variables with at least 12576 constraints!

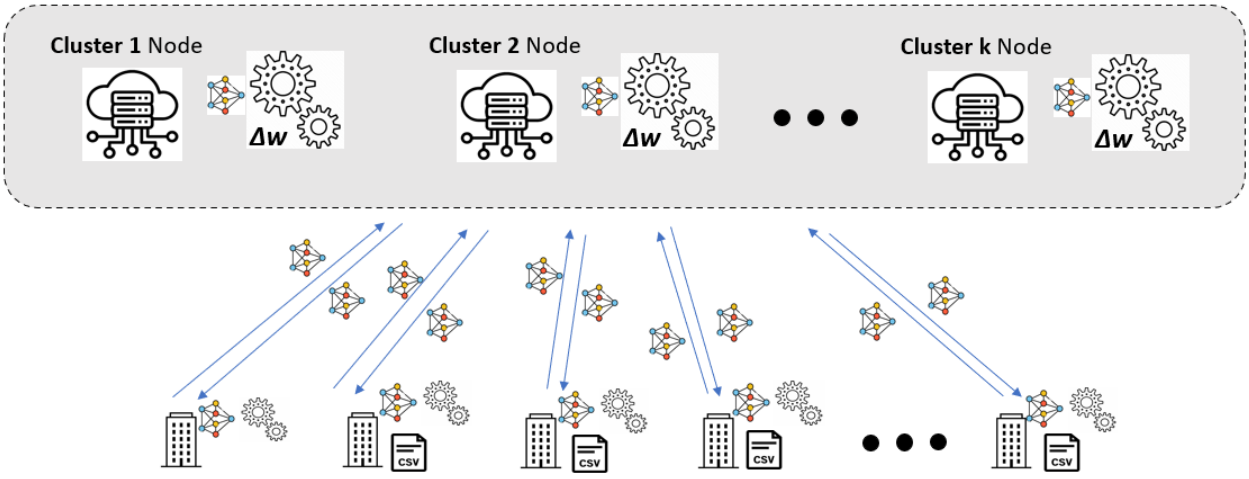


DMPC Approach

TREE TECHNOLOGY SA

Smart District Heating: Scalable and Trustworthy Forecasting with Advanced AI

Effective energy demand forecasting is essential for optimizing energy production at the district or city level, enhancing resource allocation and operational efficiency. Within the PRELUDE project, Tree Technology has developed a demand forecasting model with a 24-hour prediction horizon, adaptable to different scales depending on data availability. This solution employs a Federated Learning approach to (I) ensure scalability and (II) maintain data privacy by keeping information localized. This cutting-edge methodology enables energy producers to make more informed, efficient decisions while protecting sensitive data.



Multi center federated learning

ESTIA SA

Building Renovation Roadmap

In the context of climate change and the environmental and energy constraints we face, it is essential to develop methods to encourage the implementation of efficient solutions for building renovation. One of the objectives of the European PRELUDE project is to develop a “Building Renovation Roadmap”(BRR) aimed at facilitating decision-making to foster and prioritize the most efficient refurbishment actions, the implementation of innovative solutions and the promotion of renewable energy sources in the renovation process of existing buildings. In this context, Estia developed a set of inference rules to make this approach possible.

Based on a diagnosis such as the Energy Performance Certificate, it intends to establish a list of priority actions. The system is based on the development of fuzzy logic rules. This choice was made in order to allow the manipulation of imprecise quantities that can be described by vocabulary elements, and to associate membership functions with truth levels between 0 and 1. These rules have been implemented in an online application developed by CORE Innovation. In addition, a link to the EPIQR database provides an estimate of the cost of some of the work recommended by the renovation roadmap, which tends to facilitate the decision-making process.

		Associated parameter status		
		Very Unfavorable	Unfavourable	Slightly unfavorable
Key parameter status	Moderate	Slight Incentive	-	-
	High	Strong Incentive	Slight Incentive	-
	Very High	Imperative Incentive	Strong Incentive	Slight Incentive

Fuzzy logic: inference rules

		Associated parameter status		
		Very Unfavorable	Unfavourable	Slightly unfavorable
Key parameter status	Moderate	*COULD*	-	-
	High	*SHOULD*	*COULD*	-
	Very High	*MUST*	*SHOULD*	*COULD*

Fuzzy logic: inference rules

Connect with us!

Are you interested to stay updated about PRELUDE project developments?

Are you a professional in the field of building or energy service providers interested in collaborating with PRELUDE partners?

Contact us to share your feedbacks and ideas on this page.

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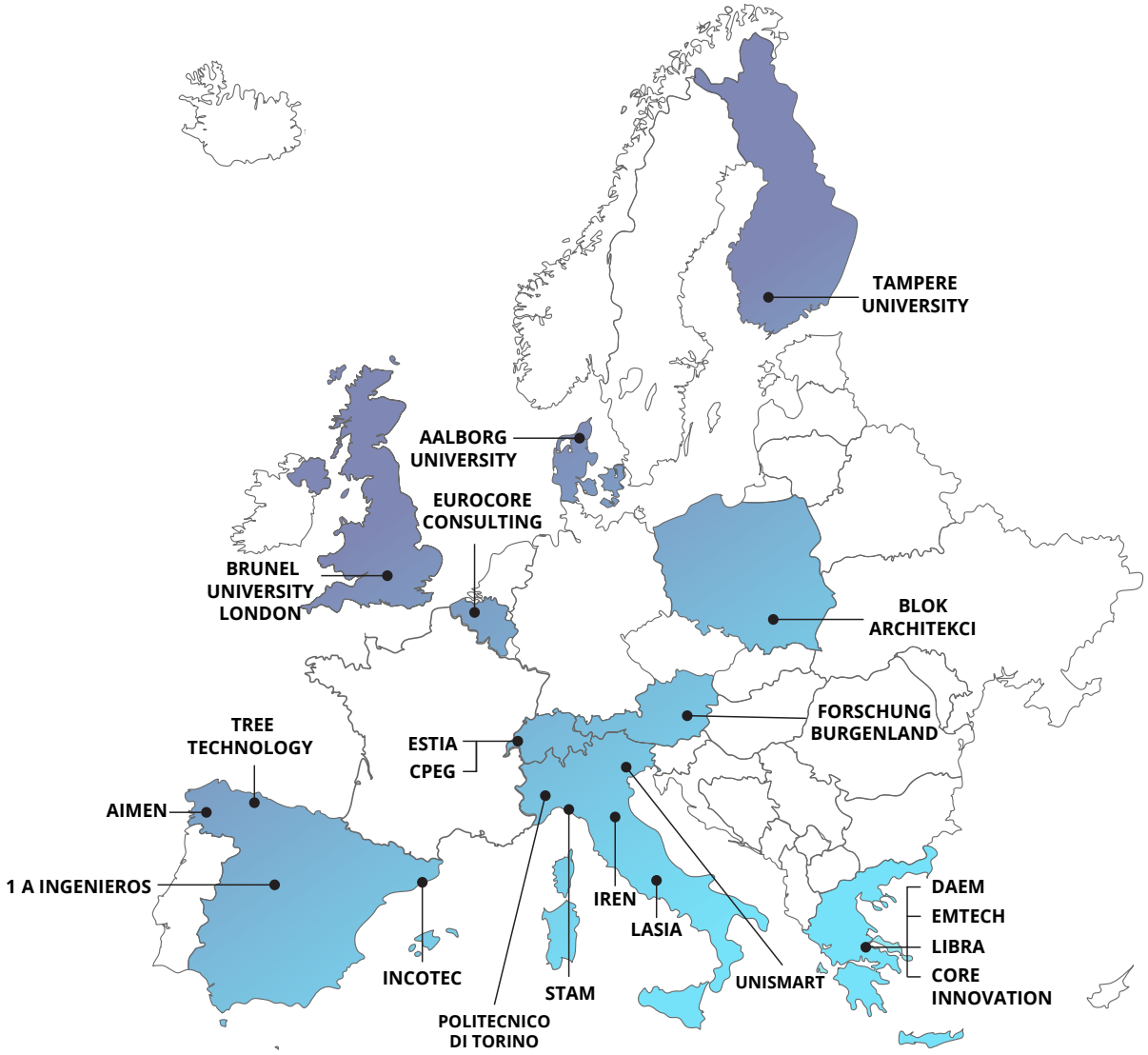

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