European Commission

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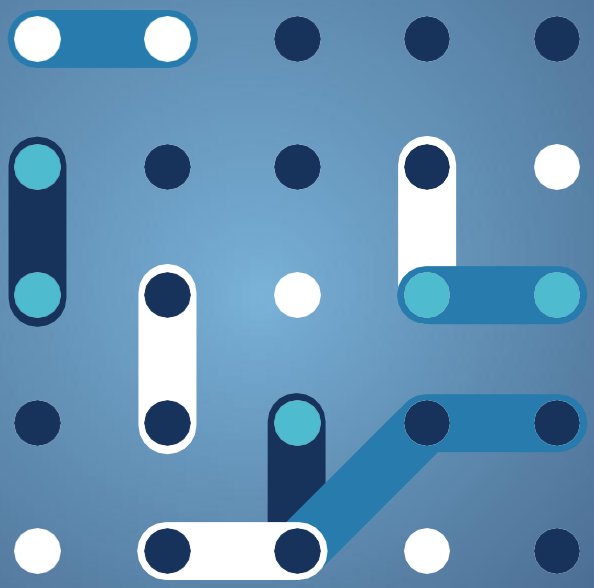
Artificial Intelligence

Case Study #11



September 2025

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0. INTRODUCTION

This paper seeks to develop a series of case studies throughout the contract period (2024-2026), incorporating the outcomes of projects included in the BRIDGE initiative during this timeframe. The objective is to produce two case studies per year, with the 2025 edition focusing on Case Studies #11 and #12. Each case study addresses a distinct thematic area and provides a synthesis that extends beyond individual project results, which offers a comprehensive overview of the evolving research landscape.

Case Study #11 focuses on the applications of artificial intelligence (AI) in the energy system, examining how advancements in this field are driving innovation and transforming consumer engagement and decision-making across multiple sectors. This thematic area facilitates an in-depth exploration of how AI technologies are leveraged to meet user needs, preferences and behaviours, providing tailored solutions and actionable insights. Additionally, Chapter 2 examines recent progress and breakthroughs in the field, emphasising how AI technologies can significantly enhance the efficiency, resilience, and intelligence of contemporary energy systems.

The case studies are designed not only to showcase the diverse achievements within BRIDGE projects but also to demonstrate their alignment with real market needs. This ensures that the generated knowledge is practical and ready for application. By emphasising market relevance, the case studies aim to bridge the gap between research outcomes and practical implementation and to demonstratehow BRIDGE projects contribute to addressing current challenges faced by the industry.

Moreover, the integration and interaction of the results of the different projects will provide a holistic view and a more complete understanding of the collective impact of the BRIDGE initiative. Each case study will offer detailed insights into specific topics, ranging from technological innovations to market adaptations, delivering valuable information to stakeholders on the practical benefits and applications of the research. This structured analysis aims to facilitate the dissemination and exploitation of BRIDGE results, while supporting innovation and growth across relevant sectors.

To achieve these objectives, the paper is structured as follows:

- **Chapter 1** provides an overview of the methodological approach adopted;
- **Chapter 2** presents the insights from the AI cases, presenting discussing the main barriers and potential opportunities for scaling up the project's outcomes;
- **Chapter 3** offers the conclusions of the case study;
- **Annex** includes additional information related the analysis of individual projects.

1. METHODOLOGICAL APPROACH

This chapter presents the methodological framework adopted for data collection and analysis, along with a detailed explanation of the criteria applied for including projects in the case studies.

1.1 DATA COLLECTION ANALYSIS

The data collection activities began with an extensive data extraction from the CORDIS[1] database, which encompasses detailed records of EU-funded research and innovation projects (the project types currently included are from the Horizon 2020[2] and Horizon Europe[3] programmes). This initial step was crucial for identifying key data of BRIDGE projects (e.g. start date, end date, budget, etc.). By applying specific search criteria and filters (which are illustrated more in detail in the Annex), a list of active projects was obtained, which served as a basis for further analysis.

A dual approach was then adopted to ensure the comprehensive mapping and validation of information.

For newly included projects within the BRIDGE initiative, a survey was designed to establish a standardised and unified database that is updated annually. This survey aimed to capture an extensive range of critical information for each project, including keywords, overarching macro-topics, the types of technologies involved, details of demonstrations and pilot projects, as well as other pertinent data. The structured nature of this methodology enabled the collection of consistent and reliable information directly from project coordinators, ensuring the robustness of the dataset and its alignment with the study's objectives.

For projects that had already been mapped, a customised email communication was prepared to address their specific context. This communication requested confirmation regarding the accuracy of the data previously collected or notification of any updates or modifications to ensure the information remained current and accurate. Upon receipt of the completed survey for all projects involved, the responses were analysed. This involved systematically reviewing and categorising the data to extract pertinent information about each project's status and achievements.

The subsequent analysis phase focused on the selection of mature projects, defined as those within twelve months of their planned completion date. This criterion was established to ensure that the chosen projects had achieved a sufficient level of development to provide substantial and meaningful results for the analysis. From the initial dataset, thirty-four projects were identified as meeting this maturity criterion.

To enhance the selection process, a comprehensive filtering methodology based on topics and keywords was employed. This ensured that the projects selected for the case studies were not only mature but also aligned with the specific thematic focus, which in this case was artificial intelligence. However, given the broad nature of this theme, it became necessary to introduce an internal clustering approach to narrow down the scope. This clustering process identified the following sub-categories: Planning Tools and Decision Support Systems (DSS), Energy Management Systems and Platforms, Smart Devices, and Communication and Interaction Frameworks.

The evaluation involved an assessment of the twenty-nine mature projects, considering both their proximity to completion and their potential to deliver substantial results. Following this, the filtering methodology further explored the sub-topics covered by each project. Keywords associated with these sub-topics were utilised to match project descriptions, deliverables, and outcomes, ensuring a precise alignment with the targeted research areas. From the identified clusters, general digital technologies and ICT solutions (AI, cloud computing, IoT, block chain,

[1] CORDIS database: https://cordis.europa.eu/it
[2] European Commission: https://cinea.ec.europa.eu/programmes/horizon-europe/h2020-programme_en
[3] European Commission: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en

open-source software, etc.) were selected, as they were deemed most relevant and sufficiently populated for inclusion in the case studies.

Through this process, **nine projects were ultimately identified,** as presented in the paragraphs below.

After having selected the projects for the case study analysis, a specialised survey[4] focusing on key exploitable results (KERs) was developed to collect detailed information regarding the unique contributions and insights of each project. A comparative analysis of the responses was conducted on the selected nine projects.

The comparative approach allowed us to understand not only the unique contributions of each project, but also how these contributions could be integrated to address broader challenges and opportunities in the sector. This method of analysis provided a more comprehensive view, highlighting areas where collective efforts could lead to significant progress and innovation. Additionally, it was instrumental in drawing comprehensive and well-founded recommendations, which can be found in Chapter 3.

Following this data analysis phase, we held an online meeting with the projects to discuss the case study and to share experience and insights in a roundtable format. This allowed us to identify common themes and challenges and to refine our analysis.

1.2 SELECTION OF PROJECTS

This section briefly outlines the criteria used to identify the most relevant and promising projects for inclusion in the case studies. The selection criteria included:

1. the level of maturity of the projects (projects with less than 12 months to closure),
2. alignment with the macro-topic covered,
3. relevance of the sub-topics to ensure a comprehensive analysis of innovation and market adoption.

The following Table 1 provides the outcomes from the selection process, highlighting the projects that were identified.

Table 1: Project and subtopics selected for the analysis

N. Project	Logo	Project	Cluster
1	COMMUNITAS	COMMUNITAS	Digital twin and predictive maintenance
2	dedalus	DEDALUS	Demand response flexibility
3	EDDIE	EDDIE	Digital twin and predictive maintenance

[4] Survey #2: https://ec.europa.eu/eusurvey/runner/7a874f25-a4bf-a3ce-8c2c-1083d9151f77

N. Project	Logo	Project	Cluster
4		EV4EU	Demand response flexibility
5		HYPERRIDE	Digital twin and predictive maintenance
6		MASTERPIECE	Digital twin and predictive maintenance
7		RE-EMPOWERED	Digital twin and predictive maintenance
8		RESONANCE	Demand response flexibility
9		SENDER	Demand response flexibility

2. CASE STUDY #11: ARTIFICIAL INTELLIGENCE

This chapter looks into Case Study #11, which focuses on the application of AI within smart energy systems and electrification processes. It explores the advancements and innovations in this field, highlighting how AI technologies can effectively contribute to the efficiency, resilience and intelligence of modern energy infrastructures. The analysis encompasses a detailed examination of various AI-based solutions, including their integration, functionalities, and impact on the overall performance and flexibility of energy systems, developed by relevant projects within the BRIDGE initiative. Furthermore, the study presents the main barriers that still hinder the widespread deployment of these technologies and proposes recommendations to facilitate their scaleability, interoperability, and market uptake.

2.1 CONTEXT AND CHALLENGES ADDRESSED

AI is playing an increasingly central role in shaping the future of smart energy systems, providing the necessary tools to manage their growing complexity, decentralisation, and dynamism. As the energy sector undergoes a profound transformation driven by the integration of renewable sources, the electrification of consumption, and the active participation of consumers, AI emerges as a critical enabler to ensure that modern energy systems remain efficient, reliable, and environmentally sustainable.

Research and development efforts have accelerated the application of AI across multiple dimensions of the energy value chain. One of the most prominent areas of application is the development of **forecasting tools** that leverage machine learning techniques to predict energy demand, renewable generation, and market prices with greater accuracy. These AI-based forecasting models are essential to balance increasingly variable energy flows, optimise the integration of distributed energy resources (DERs), and enhance the operation of both local and national grids. Accurate and adaptive forecasts allow for better planning, reduce system imbalances, and contribute to minimising the need for fossil-based backup generation.

Beyond forecasting, AI is being embedded into next-generation energy management systems (EMS), designed to optimise in real time the coordination of flexible resources, storage assets, electric vehicles, and consumer loads. By continuously processing data from heterogeneous sources, such as smart meters, weather stations, or grid sensors, **AI-enabled energy management platforms** can autonomously adjust system operations to changing conditions, predict optimal dispatch strategies, and implement self-healing functions in case of anomalies. This not only increases operational efficiency but also enhances grid stability and supports the broader decarbonisation goals of the energy transition.

At the planning and investment stage, AI is also finding wide application through **decision support systems** (DSS) that assist stakeholders in designing future-proof energy systems. These tools integrate technical, economic, and environmental variables to simulate scenarios, evaluate trade-offs, and recommend optimal configurations for renewable integration, energy community development, and flexibility deployment. AI-powered DSS offer a strategic advantage by enabling more precise, data-driven decisions in a context where energy systems are becoming increasingly complex and interconnected.

Further contributions of AI are evident in the advancement of **smart devices**. AI algorithms embedded in sensors, batteries, and connected appliances facilitate predictive maintenance, dynamic optimisation, and autonomous adjustment to user preferences or external signals. These intelligent devices play a key role in empowering consumers and prosumers to participate more actively in the energy system, responding to market signals, supporting demand-side flexibility initiatives, and optimising their own energy usage.

In parallel, AI is reshaping **customer engagement approaches**. By analysing consumption behaviours and preferences, AI technologies enable the design of tailored services, personalised feedback, and dynamic incentives that foster greater participation in energy management programs. Personalised energy coaching, adaptive demand-

response schemes, and user-centric flexibility offers are some of the innovations made possible through the application of AI at the consumer interface.

Although AI is already demonstrating its potential to enhance the efficiency and flexibility of smart energy systems, its large-scale deployment still faces several hurdles. Persistent challenges include limited access to high-quality data, difficulties in achieving system interoperability, concerns over data protection and cybersecurity, and the absence of common standards to guide AI integration into existing infrastructures. In parallel, as emphasised from the International Energy Agency (IEA)[5], the adoption of AI in critical energy applications introduces specific risks that must be addressed to ensure safe and reliable operation. These include increased exposure to cyberattacks, the possibility of algorithmic errors or biased decision-making, reduced transparency in automated processes, and the significant energy demand associated with training and deploying AI models at scale.

Tackling these issues is essential to unlock the transformative capabilities of AI across the energy sector. In this context, the present case study examines how recent European R&D initiatives are advancing the application of AI within smart energy systems, and highlights pathways to address the main barriers and foster the successful exploitation of key innovations.

2.2 KEY FINDINGS

The analysis of the selected R&D projects highlights several technological domains where AI is playing a crucial role in the development of smart energy systems. Despite the diversity of approaches and application fields, the following common innovation and technologies patterns have been identified:

- Planning Tools and Decision Support Systems (DSS): Artificial intelligence is enabling the next generation of planning and decision-making tools needed to design and manage increasingly complex energy systems. Across the projects analysed, significant efforts are dedicated to developing AI-powered platforms that support the strategic creation of energy communities, the optimisation of investment strategies, and the enhancement of system flexibility. These solutions aim to enable stakeholders to make better-informed, data-driven decisions aligned with the energy transition objectives.
- Energy Management Systems and Platforms: Real-time control and optimisation of energy systems are at the core of many R&D efforts. Projects are focusing on building AI-enhanced platforms that allow for more autonomous, flexible, and resilient system operation. These systems are essential for integrating a growing share of renewable resources, managing decentralised assets, and improving overall system performance in a dynamic environment.
- Smart Devices: Another critical innovation area concerns the integration of AI into smart devices. Research initiatives are working on embedding intelligence into hardware components to enable predictive, adaptive, and decentralised system behaviours. This focus reflects the growing role of consumers and prosumers as active participants in energy markets and highlights the need for device-level intelligence to support grid flexibility and resilience.
- Communication and Interaction Frameworks: The seamless operation of AI-driven energy systems depends on robust and interoperable communication infrastructures. Projects are placing emphasis on developing frameworks that ensure secure, efficient, and standardised data exchange among a wide range of devices and platforms. This work is foundational for enabling the scaleability and interoperability of future AI applications across the energy system.

By leveraging the potential of AI across planning, operation, device intelligence, and communication, these initiatives are contributing to a future where energy systems are not only more efficient and flexible but also better equipped to handle the complexities of a decentralised and electrified energy landscape. Through these technological focus areas, the projects analysed are laying the groundwork for more intelligent, responsive, and sustainable energy systems.

[5] Energy and AI

The contribution of the different projects to the above-presented R&D topics is summarised in Figure 1.

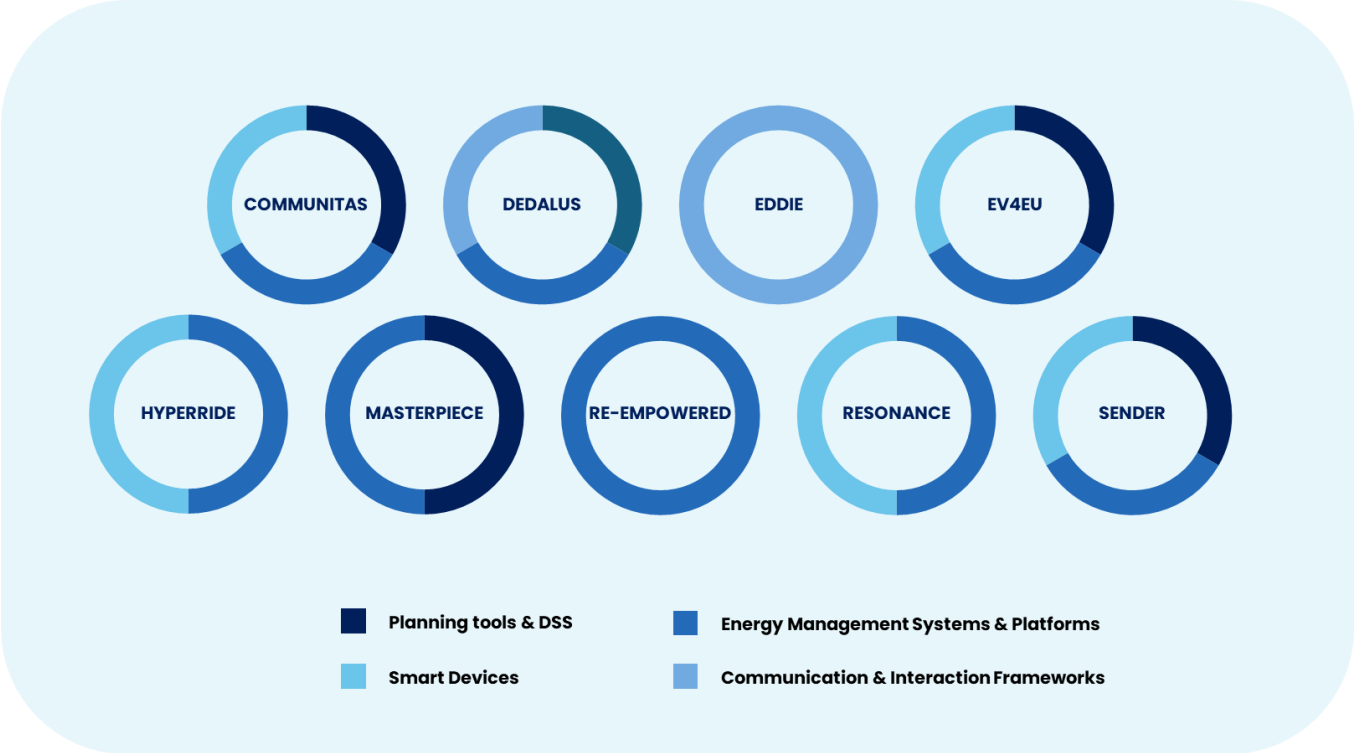

Figure 1: Projects' contribution to different R&D Topics

The following paragraphs present more details on how the different topics are covered by the selected projects.

2.2.1 Planning Tools and Decision Support Systems (DSS)

AI-enabled planning tools and decision support systems (DSS) are critical components in shaping the design, deployment, and management of next-generation energy systems. These tools facilitate strategic scenario modelling, decentralised system configuration, and data-driven decision-making for energy communities, municipalities, and system operators. Among the selected projects the following ones contribute to the introduction of AI in planning tools and DSS.

COMMUNITAS supports the creation and design of energy communities through an AI-based planning tool tailored to energy community managers. The tool enables users to simulate demand, supply, and storage behaviour, supporting evidence-based decisions during the early phases of community formation. By using real-time and historical data, the tool helps stakeholders configure customised, efficient, and participatory energy systems.

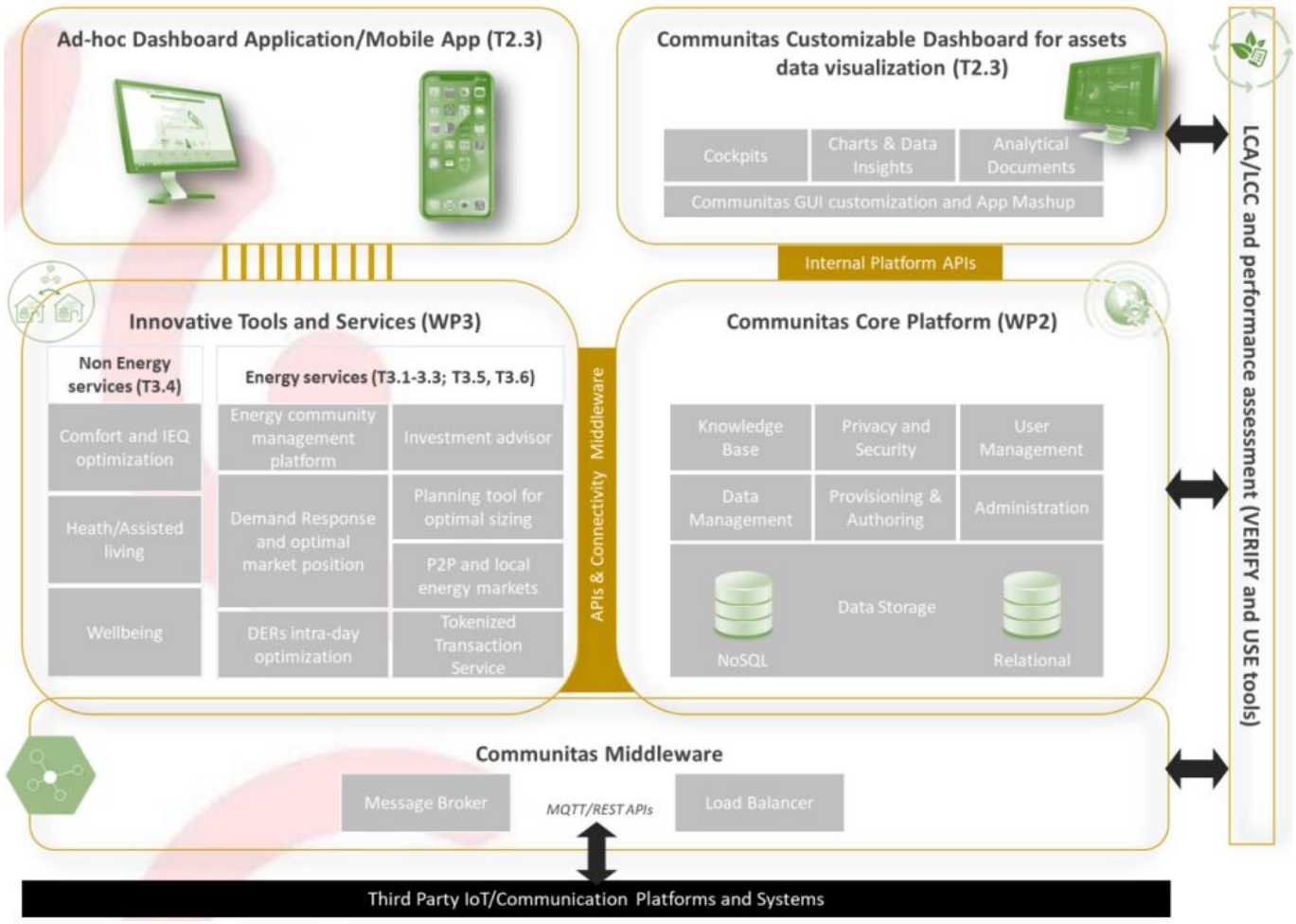

Figure 2: COMMUNITAS Interaction among Platform-Integrated Tools

The major challenges encountered by the project include:

- Limited access to highly granular consumption data at the residential level, required to train AI models and run accurate simulations;
- Initial lack of metering infrastructure in pilot areas, requiring physical installation of smart monitoring devices;
- Complexity in integrating diverse datasets (e.g., PV, storage, load profiles) into a single coherent planning interface;
- Difficulty in forecasting community-level behaviour due to limited historical data on prosumer dynamics.

DEDALUS focuses on enabling citizen-driven planning within smart buildings by developing a suite of AI-supported DSS tools. These include clustering, segmentation, and forecasting modules designed to improve participation in demand response programmes and optimise energy planning. The project seeks to overcome data limitations through AI-based data enrichment and scenario modelling.

The major challenges encountered by the project include:

- Restricted access to energy data due to proprietary building management systems operated by third-party providers;
- Challenges in harmonising heterogeneous data formats from various building energy platforms;
- Difficulty integrating utilities and DSOs into the DSS ecosystem due to siloed infrastructures;
- Legal and technical hurdles related to GDPR-compliant handling of personal and building-level energy data;
- Need for stronger interoperability standards to connect tools across multiple smart building systems.

EV4EU applies AI-enhanced planning tools to optimise the deployment of Vehicle-to-Everything (V2X) management strategies. These tools allow stakeholders to model charging patterns, simulate grid impacts, and support flexible EV integration strategies at local and regional levels. The AI modules forecast vehicle usage, load impacts, and demand peaks, supporting coordinated grid and mobility planning.

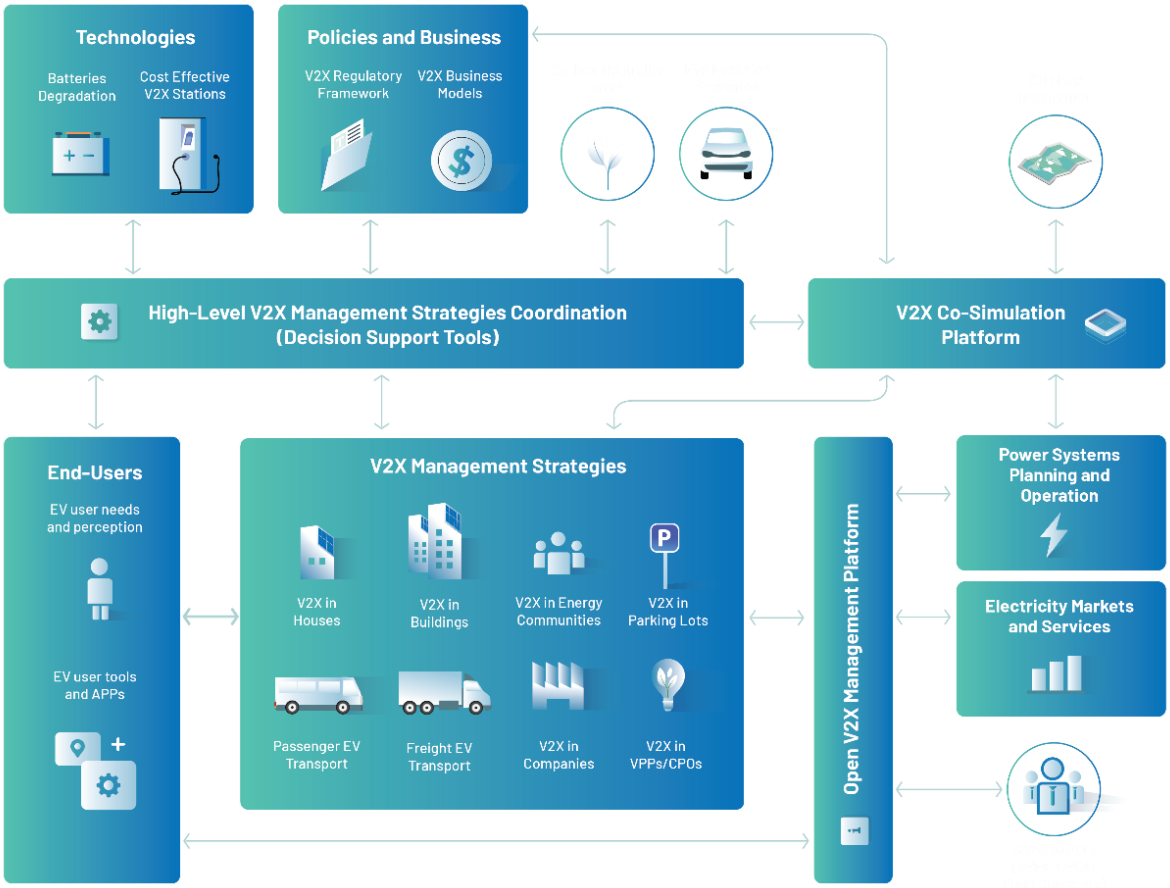

Figure 3: EV4EU V2X management strategies

The major challenges encountered by the project include:

- High variability in user mobility patterns, limiting the accuracy of predictive models;
- Lack of harmonised data-sharing mechanisms between EV infrastructure providers and energy system operators;
- Difficulty in coordinating mobility and energy planning under different regulatory jurisdictions;
- Limited visibility on distributed EV charging assets, making scenario-based planning challenging;
- Interfacing issues between mobility platforms and energy DSS tools due to incompatible APIs and metadata models.

MASTERPIECE offers a comprehensive digital platform designed to support all phases of energy community development, including planning, investment, and operations. Several modules are powered by AI, including energy profiling, demand forecasting, and optimisation engines. The platform helps communities co-design solutions that are both technically efficient and socially inclusive.

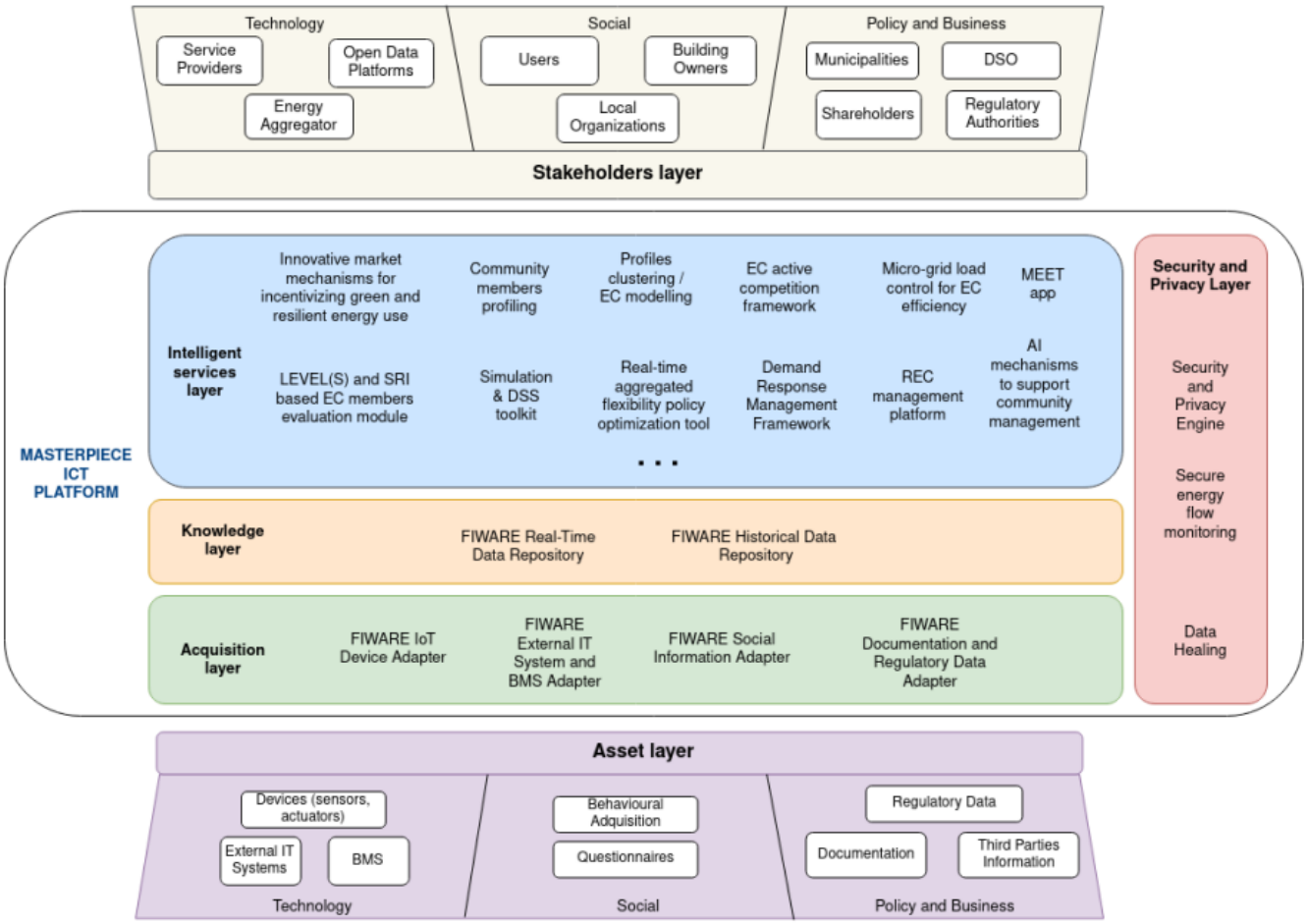

Figure 4: MASTERPIECE ICT Platform High-Level Architecture Mock-Up

The major challenges encountered by the project include:

- Inconsistent data availability across pilot sites, limiting model generalisability;
- High heterogeneity in formats and sources of input data, requiring time-intensive harmonisation;
- Need for significant pre-processing and validation to ensure data suitability for AI-based analysis;
- Variability in digital maturity across end users, creating challenges in tool adoption and usability;
- Difficulties aligning planning recommendations with local legal and infrastructural constraints.

SENDER develops planning and control tools that combine AI-based forecasting with behavioural analytics to support residential flexibility. The tools help design tailored demand response strategies by identifying consumption profiles and optimising incentive schemes. AI models integrate user engagement insights to maximise impact and scaleability.

The major challenges encountered by the project include:

- Limited availability of standardised behavioural datasets for residential consumers;
- Technical and organisational constraints in integrating AI tools with legacy home energy systems;
- Challenges in adapting planning tools to reflect varying digital literacy and the willingness of consumers to participate in flexibility schemes;
- Difficulty in validating behavioural forecasting models in real-world residential environments;
- Lack of customisation and localisation of tools across different EU pilot contexts.

2.2.2 Energy Management Systems and Platforms

The integration of AI into EMS and platforms is a key enabler of smarter, more responsive, and more efficient energy operations. These platforms facilitate real-time monitoring, predictive control, and optimisation of DERs, storage, flexible loads, and electric vehicles. AI algorithms are deployed to analyse real-time and historical data, support fault detection and self-healing functions, and adapt system behaviour to dynamic grid conditions. The following projects provide representative examples of how AI-powered EMS platforms are being deployed to manage increasingly complex energy ecosystems, while emphasising which obstacles still need to be addressed.

COMMUNITAS develops a suite of energy management tools designed to enable consumers within energy communities to actively participate in demand-side flexibility. The platform includes AI-based forecasting and optimisation modules to support real-time energy balancing and demand response strategies tailored to community dynamics. These tools enable community managers to maximise the use of local renewables and storage, reducing dependency on the grid.

The major challenges encountered by the project include:

- Limited availability of real-time consumption data at individual household level;
- Initial reluctance from users to share detailed usage data required for EMS optimisation;
- Technical constraints in adapting AI algorithms to community-scale variability;
- Need for continuous sensor data to maintain forecast accuracy and real-time responsiveness;
- Difficulty in scaling the EMS architecture for different types and sizes of energy communities.

DEDALUS introduces an EMS ecosystem targeting smart buildings, using AI for forecasting, segmentation, and control to support user participation in flexibility services. The system includes features for nudging, behavioural prediction, and modular energy management across residential units. It also accommodates missing or incomplete data through AI-based substitution and enrichment techniques.

Figure 5: DEDALUS EnergiQ Mobile App Screenshots

The major challenges encountered by the project include:

- Fragmented building data ecosystems and proprietary platforms that prevent data sharing;
- Barriers to integrating EMS functionalities with existing building automation systems;
- Difficulty validating AI models due to constrained access to occupant-level data;
- Challenges in aligning building flexibility potential with external market signals;
- Limitations in replicating EMS modules across buildings with different digital readiness levels.

EV4EU applies EMS solutions to support grid-friendly charging of electric vehicles through AI-based load balancing and flexibility management. The platform enables real-time coordination of charging infrastructure with local energy systems to avoid grid congestion and maximise renewable energy usage. AI algorithms predict charging demand and optimise dispatch to match energy availability.

The major challenges encountered by the project include:

- Lack of interoperability between EV platforms and grid-facing EMS tools;
- Inconsistent availability of charging session data across operators;
- Technical difficulties in coordinating mobility and energy flexibility in real time;
- Data privacy and user consent hurdles in integrating EV usage data;
- Regulatory fragmentation limiting integrated planning between transport and energy sectors.

HYPERRIDE focuses on the management of hybrid AC/DC microgrids, developing an EMS that supports secure and stable operation through AI-enabled state estimation, control optimisation, and predictive analytics. The system integrates advanced grid components such as DC breakers, sensors, and converters, and aims to increase automation and resilience of energy distribution.

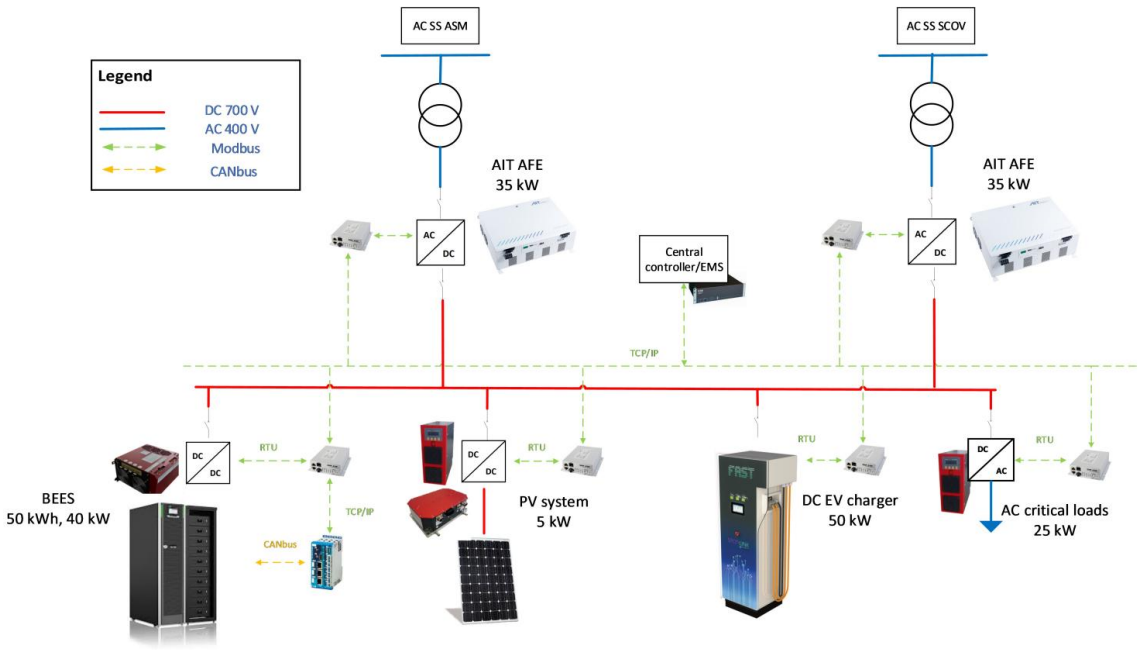

Figure 6: HYPERRIDE Terni Pilot AC-DC Microgrid Concept

The major challenges encountered by the project include:

- Complexity in implementing AI algorithms within hybrid AC/DC environments;
- Gaps in data from physical demonstration sites for validating EMS models;
- Interoperability issues between new EMS modules and existing control systems;
- Scarcity of real-world data for testing predictive maintenance features;

- Lack of standardisation in measurement and protection systems for DC grids.

MASTERPIECE's platform includes EMS capabilities to monitor and optimise energy flows within energy communities. AI is applied to optimise demand response participation, enhance the efficiency of local generation and storage, and adapt control strategies to user profiles. The EMS integrates multiple modules, including visual dashboards for community users.

The major challenges encountered by the project include:

- Disparities in technical infrastructure across pilot sites complicating deployment;
- High effort required for synchronising EMS modules with legacy systems;
- Challenges in adaptingAI models to reflect local usage profiles and climate conditions;
- Data harmonisation difficulties across different energy platforms and formats;
- Constraints in real-time communication infrastructure at pilot sites.

RE-EMPOWERED delivers an AI-powered EMS designed for microgrids, capable of forecasting demand and generation (PV, wind, load) and coordinating resources accordingly. The EMS was tested at four demonstration sites in Europe and India. It incorporates adaptive control schemes and enables user-driven demand response, using AI to optimise local energy use.

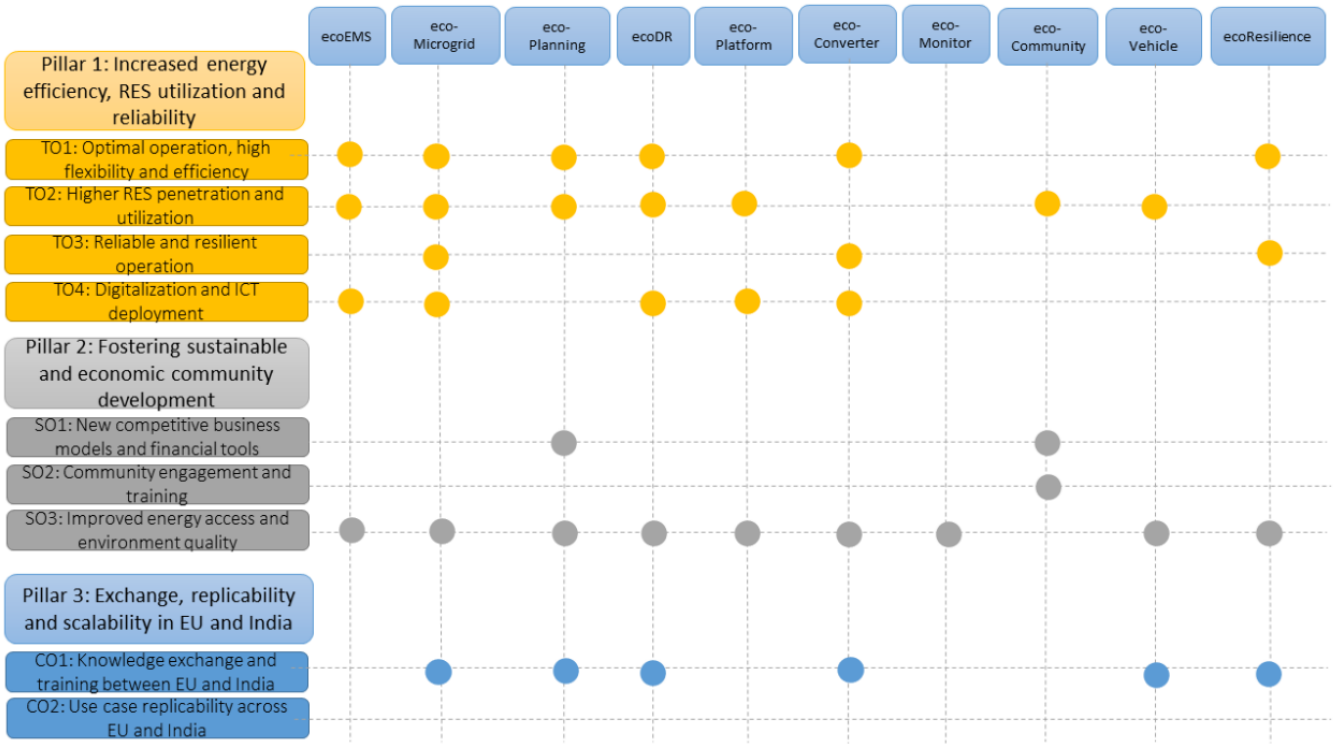

Figure 7: RE-EMPOWERED Objectives and EcoToolset Solutions

The major challenges encountered by the project include:

- Limited trust in AI-based control among local operators and regulators
- Intermittent internet connectivity at remote demo sites disrupting EMS operations;
- Resistance from consumers to participate in automated load-shifting mechanisms;
- Challenges in certifying and integrating non-standard EMS hardware at pilot locations;
- Difficulties in adapting AI models across climatically diverse pilot environments;

RESONANCE develops a modular EMS framework that uses AI for building-level modelling, demand forecasting, and optimisation. It connects smart devices and user interfaces within residential and commercial buildings, allowing

dynamic interaction between consumers, devices, and the local grid. The EMS supports plug-and-play integration and is tested at six pilots.

The major challenges encountered by the project include:

- Incompatibility of device communication protocols hindering EMS integration;
- Difficulty scaling AI models across building types with different thermal profiles;
- Lack of uniformity in smart device capabilities affecting EMS responsiveness;
- Challenges in synchronising EMS modules with user behaviour and occupancy patterns;
- Limited maturity of AI frameworks for semantic interpretation of device states.

SENDER's EMS incorporates AI forecasting and behavioural analytics to enable residential consumers to participate in demand-side flexibility. The platform focuses on tailored energy services that adapt to user preferences and context. AI enables predictive control and energy coaching functionalities embedded in a single interface.

The major challenges encountered by the project include:

- Limited behavioural data for training user-specific AI models;
- High diversity in household energy habits complicating standardisation;
- Technical challenges in integrating EMS with smart home infrastructure;
- Ensuring user-friendly design while maintaining algorithmic sophistication;
- Need for dynamic consent and transparency mechanisms to build user trust.

2.2.3 Smart Devices

The integration of AI into smart devices is enhancing the ability of energy systems to interact with their physical environments in real time, respond dynamically to changing conditions, and support decentralised flexibility. AI-enabled smart meters, sensors, batteries, thermostats, and inverters are increasingly capable of predictive maintenance, autonomous control, and user-adaptive behaviour. These devices play a pivotal role in enabling demand response, optimising energy use, and strengthening the interaction between consumers and the grid. The projects in this group are focused on embedding intelligence at the device level to improve energy efficiency, system responsiveness, and end-user empowerment.

EV4EU uses smart charging infrastructure and AI-enhanced control devices to implement user-centric V2X strategies. These smart devices are designed to optimise EV charging and discharging patterns based on real-time grid signals and user behaviour. The AI models embedded in the devices help predict load patterns, optimise flexibility potential, and enable autonomous participation in demand response schemes.

The major challenges encountered by the project include:

- Inconsistencies in communication standards across EV charging hardware;
- Integration difficulties between smart charging devices and grid-facing platforms;
- Ensuring accurate real-time response under diverse usage and grid conditions;
- Balancing user preferences with system-level flexibility needs in AI decision models;
- Ensuring cybersecurity and user data protection at the edge device level.

HYPERRIDE incorporates AI-based intelligence into smart grid components such as sensors, DC breakers, and power converters. These smart devices are designed for robust fault detection, system diagnostics, and improved automation in hybrid AC/DC networks. Machine learning algorithms are used to improve state estimation and enable predictive control of grid operations.

The major challenges encountered by the project include:

- Technical complexity in adapting AI algorithms to real-time hardware constraints;

- Limited availability of operational data to train predictive maintenance models;
- Need for high precision and synchronisation across distributed devices;
- Integration issues between new AI-enabled devices and legacy grid infrastructure;
- Absence of DC component standards hindering widespread deployment.

RESONANCE deploys plug-and-play smart devices at six pilot sites to create a flexible and interoperable environment for decentralised energy management. AI models embedded in smart thermostats, sensors, and controllers allow for adaptive control based on user habits and building dynamics. The solution is designed to enable seamless communication between diverse devices via a common semantic layer.

The major challenges encountered by the project include:

- Interoperability gaps due to inconsistent communication protocols and device APIs;
- Challenges in replicating smart device solutions across heterogeneous building types;
- Variability in device firmware and hardware limiting uniform deployment of AI features;
- Difficulty in ensuring accurate AI predictions under partial or noisy data inputs;
- Scaleability constraints when attempting to extend solutions across different pilots.

SENDER integrates AI into smart home devices to enable personalised energy services. It uses smart sensors and actuators to gather behavioural data and adjust device operation according to comfort preferences, time-of-use pricing, and flexibility availability. The devices are central to delivering real-time feedback and adaptive control to end users.

The major challenges encountered by the project include:

- Limited interoperability between smart home brands and communication interfaces;
- High variability in user acceptance and device interaction preferences;
- Technical complexity in synchronising real-time data across different device types;
- Lack of user-centric interfaces that remains intuitive while executing complex control logic;
- Difficulty ensuring robust performance of AI algorithms in edge computing environments.

2.2.4 Communication and Interaction Frameworks

Robust and interoperable communication frameworks are foundational for the integration of AI-driven solutions within smart energy systems. These frameworks ensure seamless interaction between diverse devices, platforms, and stakeholders, enabling real-time data exchange, coordinated control actions, and secure management of energy assets. Research and development efforts in this area aim to overcome fragmentation, enhance data accessibility, and ensure cybersecurity while maintaining system flexibility and scaleability. The following projects contribute significantly to advancing communication and interaction infrastructures within the energy sector.

DEDALUS develops a digital ecosystem to support energy-flexible smart buildings, incorporating a communication and interaction layer that connects devices, building management systems, and external energy markets. The project leverages AI to facilitate data enrichment and forecasting, while enabling dynamic interaction between users, energy assets, and service providers. A key benefit is creating interoperable interfaces that allow third-party applications to access and use building energy data securely and efficiently.

The major challenges encountered by the project include:

- Fragmentation of data due to proprietary building management systems limiting interoperability;
- Barriers to integrating building-level data streams into broader energy market platforms;
- Ensuring GDPR-compliance while enabling data sharing among diverse stakeholders;
- Limited standardisation across smart building communication protocols;
- Technical difficulties in harmonising real-time and historical data from heterogeneous sources.

EDDIE introduces a decentralised and distributed energy data space that provides a secure, open-source framework for interoperability and data access across energy systems. Through its AIDA interface, EDDIE streamlines user consent management and facilitates the integration of third-party services, ultimately enabling the future development of AI-based solutions. The framework aims to enhance communication across devices, platforms, and energy services while protecting data privacy and promoting decentralised control architectures.

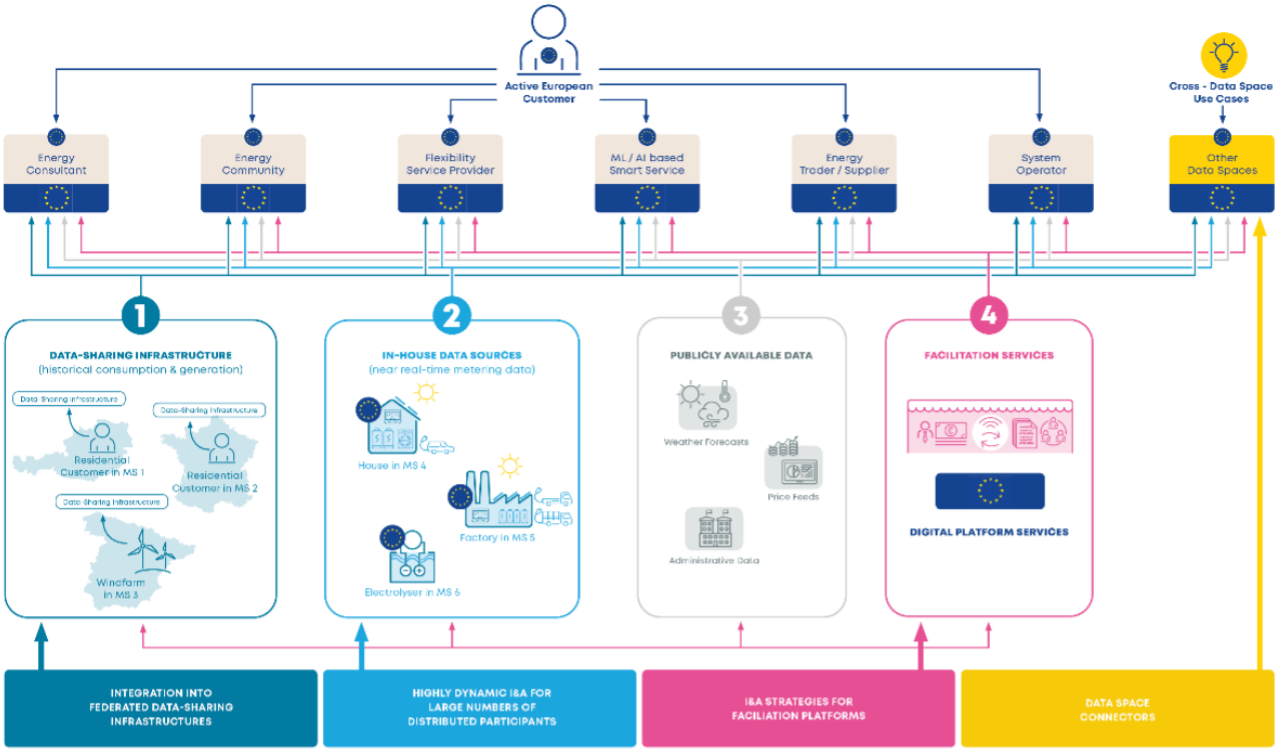

Figure 8: Key Challenges in Energy Data Exchange Assessed by EDDIE

The major challenges encountered by the project include:

- Complexity in managing decentralised consent processes across multiple stakeholders;
- Technical challenges in ensuring interoperability across heterogeneous smart devices and platforms;
- Lack of standardised APIs and ontologies to enable seamless cross-platform communication;
- Difficulty ensuring cybersecurity while maintaining openness and scaleability;
- Potential reluctance from market players to adopt distributed data management models due to regulatory uncertainties.

2.3 DISCUSSION ON THE POTENTIAL OPPORTUNITIES AND STRATEGIES FOR SCALING UP THE PROJECT RESULTS

After identifying the common research areas addressed by the selected projects, a round table was organised with project representatives to validate the topic clustering and collect insights on potential opportunities and strategies for scaling up the project results in the future. In addition, a review of public deliverables and scientific publications produced by the selected projects was carried out.

These activities allowed the identification of a set of recommendations to make AI-based technologies for smart energy systems more scaleable, replicable, and impactful. The recommendations, which will be illustrated in the following paragraphs, mainly concern data accessibility and management, interoperability and standardisation, demonstration and validation needs, user engagement, regulatory support, and financial mechanisms for de-risking investments.

- Data Accessibility and Management: A recurrent barrier identified by many projects concerns the limited availability of high-quality, standardised, and accessible data to train, test, and operate AI models. As highlighted by COMMUNITAS, MASTERPIECE, and DEDALUS, AI applications require granular and real-time datasets to perform accurate forecasting, optimisation, and predictive control. However, access to such data is often constrained by privacy regulations (GDPR), proprietary data ownership models, and technical fragmentation.
  To address this, it is recommended that the European Commission supports initiatives aimed at developing standardised data sharing frameworks, promotes the adoption of pseudonymisation and anonymisation techniques for energy data, and fosters the creation of trusted data spaces for energy systems under initiatives such as the European Data Space for Energy.
- Interoperability and Standardisation: Several projects, including DEDALUS, RESONANCE, and EDDIE, encountered issues linked to the lack of interoperability among devices, platforms, and communication protocols. AI-enhanced smart energy systems require seamless data exchange across heterogeneous devices, buildings and grid infrastructures.
  It is recommended to strengthen standardisation efforts around AI-ready energy communication protocols (e.g., extensions of IEC 61850, IEC 63110 for EVs, or emerging standards for energy data ontologies). The European Commission could promote interoperability-by-design approaches, encourage alignment with emerging smart energy standards, and support cross-domain pilot projects to test and validate interoperable solutions in real-world conditions.
- Demonstration and Validation of AI Solutions: Scaling up AI technologies requires large-scale, real-world demonstration and validation environments. Several projects (e.g., HYPERRIDE, RE-EMPOWERED, SENDER) emphasised the difficulty of moving from simulation environments to operational deployment, especially when dealing with AI algorithms for predictive maintenance, demand response, or flexibility optimisation. It is recommended that future funding calls dedicate specific streams for higher-TRL (Technology Readiness Level) AI demonstration projects, including regulatory sandboxes that allow the testing of new AI-based functionalities in controlled but realistic settings, and that mechanisms be developed to facilitate access to demonstration infrastructure for innovative SMEs.
- User Engagement and Trust in AI Solutions: Projects such as COMMUNITAS, MASTERPIECE, and SENDER highlighted that consumer trust, engagement, and acceptance are critical for the successful deployment of AI-based energy services. However, concerns regarding privacy, control, and transparency can hinder user participation. It is recommended that the development of AI solutions prioritise user-centric design principles, transparent algorithm explainability mechanisms, and dynamic consent management tools. In addition, initiatives promoting consumer education about AI in energy services and the co-creation of solutions with end-users can foster stronger engagement and trust.
- Regulatory Support for AI in Energy Systems: Several barriers encountered by the projects, such as the difficulty of using AI-driven forecasts or control actions within traditional regulatory frameworks (highlighted by RE-EMPOWERED and EV4EU), underline the need for regulatory adaptation. It is

recommended that the European Commission and national regulators explore and support the development of AI-specific guidelines for energy applications, including AI certification schemes, transparency obligations for critical AI functions in grid operations, and frameworks for liability in AI-based decision-making. Regulatory sandboxes could also facilitate early dialogue between innovators and regulators.

- De-risking Investments in AI-Based Energy Solutions: Financial risk is a major bottleneck for the large-scale deployment of AI-based smart energy systems, as indicated across several projects. Perceptions of technological immaturity, regulatory uncertainty, and lack of proven business models discourage private sector investment. It is recommended to develop risk-sharing mechanisms (e.g., guarantees, blended finance schemes), promote the creation of sector-specific insurance products for AI-based energy services, and encourage public-private partnerships that bridge the gap between innovation and market deployment. Dissemination of validated success stories from EU-funded projects could also help build investor confidence.

3. CONCLUSIONS

AI is rapidly establishing itself as a key technology in the digitalisation of energy systems, providing new capabilities for forecasting, optimisation, real-time control, and user engagement. Based on the analysis of the above innovative R&D projects, this study demonstrated the potential of AI to improve the intelligence, flexibility, and resilience of energy infrastructures in Europe.

The selected projects showcased significant advancements in the development of AI-powered planning tools, energy management platforms, smart devices, and communication frameworks. These technological solutions contribute to improving the operational efficiency of smart grids, integrating distributed renewable resources, enabling consumer participation, and strengthening the resilience of decentralised energy systems. However, some common challenges emerged that could limit the widespread adoption and scaling of these innovations. The barriers identified include poor access to high-quality and interoperable datasets, inconsistencies in communication standards, regulatory and market readiness gaps, and the necessity of building user confidence in AI-fuelled solutions.

Through learning from the experiences of the projects, roundtable conversations and reviews of deliverables, it has been possible to identify a number of practicalrecommendations. To realise the potential of AI in smart energy systems there will need to be action taken around data access and interoperability, validation frameworks, user engagement, enabling regulation, and investment de-risking. If European innovation ecosystem stakeholders implement these recommendations, we can collaboratively navigate towards a smarter, greener and more people-focused energy system, in which AI plays a crucial enabling role in achieving climate carbon neutral targets and underpinning sustainable growth.

Table 2: Key Takeaways from the Case Study

AI as a key enabler of the energy transition	AI plays a crucial role in improving forecasting, optimisation, flexibility, and user interaction in increasingly decentralised and complex energy systems.
AI-driven planning and decision support	Planning tools using AI support energy system design, community development, and investment decisions, but face challenges related to data granularity and usability.
Energy Management with AI	AI-based energy management systems allow real-time optimisation of DERs, storage, and demand, yet struggle with legacy system compatibility and regulatory limitations.
Smart devices as flexibility enablers	AI-embedded devices enhance automation, predictive maintenance, and local flexibility but face interoperability and cybersecurity barriers.
Communication and interoperability gaps	Lack of standardised communication protocols and fragmented data models hinder integration of AI solutions across platforms and devices.
Data access and privacy constraints	AI deployment is limited by insufficient access to high-quality, standardised data and concerns related to GDPR and proprietary systems.

Need for real-world demonstration and validation	Many AI tools remain untested at scale; demonstration environments, regulatory sandboxes, and access to validation infrastructure are essential.
User trust and engagement	Transparency, co-design, and intuitive interfaces are key to gaining user trust and encouraging widespread participation in AI-based energy services.
Regulatory adaptation required	Traditional energy regulations are not designed for AI-based forecasting, control, or flexibility services. Specific AI guidelines and certification schemes are needed.
Financing and investment risks	Perceived technological and financial risks deter investors; public-private cooperation and de-risking tools are needed to support market uptake.

4. ANNEX

4.1 Selection criteria

4.1.1 CRITERIA #1: Level of Maturity

This criterion identifies projects that are in their final year and therefore well into the demonstration phases, where key activities and technologies are tested and refined. Such projects have typically overcome initial obstacles and uncertainties, allowing for a more thorough evaluation of their outcomes and impacts. This maturity enables a detailed analysis of how effectively the project achieved its objectives, implemented innovations, and addressed technical and operational complexities. Moreover, projects at this stage provide a clearer picture of their potential for scaleability and replicability, offering valuable insights into their broader applicability within the energy sector.

This approach not only enhances the credibility and relevance of the case studies but also ensures their significant contribution to knowledge dissemination and learning across the sector. Practical lessons and best practices can be derived from projects that have successfully navigated critical stages of development, thus informing future initiatives.

The selection process that led to the presented results is based on all active BRIDGE projects. Among the active projects, only forty-four have reached a developmental stage suitable for the adopted maturity criterion. Of these thirty-four mature projects, thirteen are categorised under the broader theme of AI and have been further clustered into specific sub-categories. Following the theoretical explanation of the maturity criterion, Table 3 illustrates the outcomes derived from applying this criterion to the selected projects, including those within the AI macro-theme and their respective clusters.

Table 3: Projects selected using the Criteria #1: Maturity Level

N. Project	Logo	Project	Full Title	Start Date	End Date	Actual Month/ Final Month	Cluster	Link
1	COMMUNITAS	COMMUNITAS	Bound to accelerate the roll-out and expansion of Energy Communities and empower consumers as fully fledged energy market players	01/01/2023	30/06/2026	30	Digital twin and predictive maintenance	https://cordis.europa.eu/project/id/101096508
2	DATA CELLAR	DATA CELLAR	Data hub for the Creation of Energy communities at Local Level and to Advance Research on them	06/01/2022	30/11/2025	37	Data spaces	https://cordis.europa.eu/project/id/101069694
3	dedalus	DEDALUS	Data-driven Residential Energy Carrier-agnostic Demand Response Tools and Multi-value Services	05/01/2023	30/04/2026	26	Demand response flexibility	https://cordis.europa.eu/project/id/101103998
4	EDDIE	EDDIE	Eddie – smart neurorehabilitation software	01/01/2023	31/12/2025	30	Digital twin and predictive maintenance	https://cordis.europa.eu/project/id/101069510
5	ev4eu	EV4EU	Electric Vehicles Management for carbon neutrality in Europe	06/01/2022	30/11/2025	37	Demand response flexibility	https://cordis.europa.eu/project/id/101056765

N. Project	Logo	Project	Full Title	Start Date	End Date	Actual Month/ Final Month	Cluster	Link
6		Hyperride	Hybrid Provision of Energy based on Reliability and Resiliency by Integration of DC Equipment	10/01/2020	31/05/2025	57	Digital twin and predictive maintenance	https://cordis.europa.eu/project/id/957788
7		IANOS	IntegrAted SolutioNs for the DecarbOnization and Smartification of Islands	10/01/2020	30/09/2024	57	Virtual Power plant	https://cordis.europa.eu/project/id/957810
8		LocalRES	Empowering local renewable energy communities for the decarbonisation of the energy systems	05/01/2021	30/04/2026	50	Virtual Power plant	https://cordis.europa.eu/project/id/957819
9		MASTERPIECE	Multidisciplinary Approaches and Software Technologies for Engagement. Recruitment and Participation in Innovative Energy Communities in Europe	01/01/2023	30/06/2026	30	Digital twin and predictive maintenance	https://cordis.europa.eu/project/id/101096836
10		RE-EMPOWERED	Renewable Energy EMPOWERing European and InDian communities	07/01/2021	30/04/2026	48	Digital twin and predictive maintenance	https://cordis.europa.eu/project/id/101018420

N. Project	Logo	Project	Full Title	Start Date	End Date	Actual Month/ Final Month	Cluster	Link
11		RESONANCE	Replicable and Efficient Solutions for Optimal Management of Cross-sector Energy	01/01/2023	31/12/2025	30	Demand response flexibility	https://cordis.europa.eu/project/id/101096200
12		SENDER	Sustainable Consumer engagement and demand response	10/01/2020	30/09/2024	57	Demand response flexibility	https://cordis.europa.eu/project/id/957755
13		SYNERGIES	Innovating Preparedness by Leveraging SYNERGIES and Enhancing Results of DRM Projects	09/01/2022	28/02/2026	34	Data spaces	https://cordis.europa.eu/project/id/101069839

4.1.2 CRITERIA #2: Macro-topics covered by the projects

In collaboration with the Commission, it was decided that the analysis of the projects featured in the BRIDGE Brochure 2025[6] would focus on macro topic (see Figure 9) closely related to the theme of digitalisation. This was to ensure that the selected projects directly address the most relevant challenges within the context of the digital transformation of the energy sector.

The categorisation of projects through these macro topics enabled the team to identify those that significantly contribute to the integration of digital technologies into energy systems, such as smart grids, intelligent energy management, and consumer-oriented digital solutions. The goal was to highlight how these projects can accelerate innovation and respond to emerging market needs.

Through this approach, projects that demonstrate a high level of maturity were selected. These projects serve as ideal case studies for better understanding the impact of digital technologies and for identifying best practices that can be applied to future initiatives.

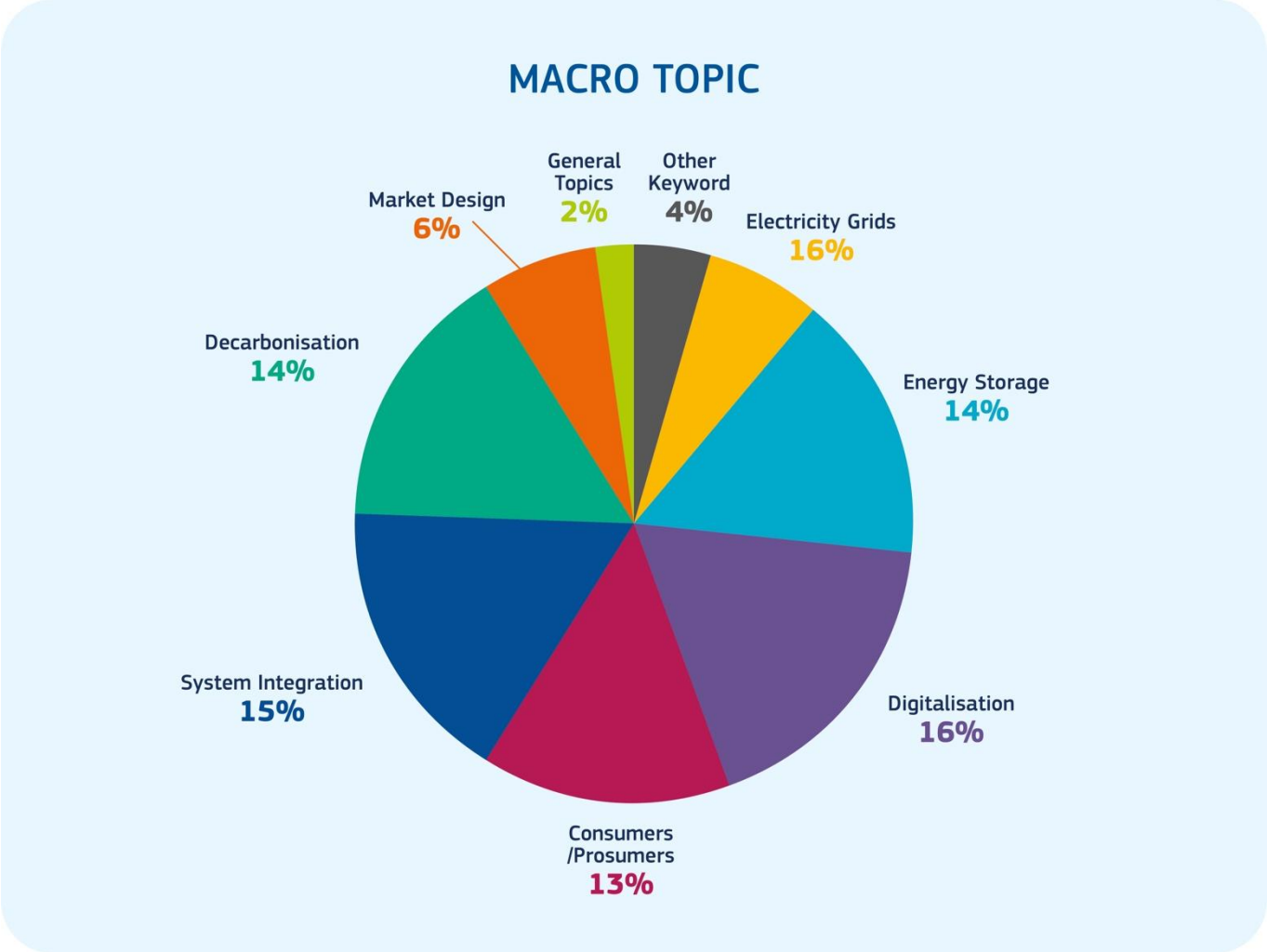

Figure 9: Project selection for keyword

[6]Bridge Brochure 2025: BRIDGE initiative presents its 2025 brochure: supporting Europe's energy transition | Bridge

4.1.3 CRITERIA #3: Sub-topics covered by the projects

After identifying the macro items, the team decided to increase the accuracy of the analysis. The initial survey sent to the projects included the specific subtopics addressed by each project, which were then subjected to thorough examination. This approach ensured that the selection process effectively captured the finer details of each project's contributions, aligning with the study's objectives to pinpoint key themes and insights from the data collected.

Table 4: Keyword & Sub-topics in analysis presents the empirical outcomes of macro and subtopics obtained through the application of the project maturity criterion.

Table 4: Keyword & Sub-topics in analysis

Keyword	Sub-topics
Electricity grids	Grid technologies – transmission system
	Grid technologies – distribution system
	Grid technologies – smart grids
	Power electronics, Direct Current (DC) grids and technologies
	Grid planning
	Grid operations / system resilience
	TSO-DSO cooperation
	System flexibility
Energy storage	Large scale - energy storage
	Distributed energy storage
Digitalisation	Digital tools and technologies for smart grids (energy management systems, Supervisory control and data acquisition - SCADA, digital twins, grid modelling, forecasting, etc.)
	General digital technologies and ICT solutions (AI, cloud computing, IoT, block chain, open-source software, etc.)
	Data exchanges and interoperability
	Cybersecurity
Technology for Consumers/prosumers	Consumer empowerment and development of skills
	Energy communities and collective flexibility
	Technologies for consumers (demand response, smart appliances, heating/cooling peak load management, etc.)

Keyword	Sub-topics
System integration	**Energy system integration (across different energy carriers)**
	Electrification and Distributed Energy Resources
	Energy services
Decarbonisation	Energy efficiency (including co-generation)
	Renewable energy sources
	Renewable heating & cooling
	Hydrogen and other low-carbon fuels
Market structure	Wholesale markets
	Cross-border collaboration
	Flexibility markets
General topics	Energy islands
	Innovative business models
	Recycling and circular economy
	Energy poverty
	Energy justice
	Engagement and empowerment
	Indicators

The methodology for selecting projects from the previously identified group of sixteen mature projects involved a detailed analysis aimed at identifying prominent categories within the domain Technologies for consumers. This focus on AI was made based on its emergence as the most prevalent subtopic among the mature projects. This category encompasses projects focusing on demand response, smart appliances, heating/cooling peak load management.

Table 5 features the logo and name of the project, as well as the sub-topics associated with the project, which specify which projects have been chosen for analysis in this case study analysis.

Table 5: Project and subtopic selected for the analysis

N. Project	Logo	Project	Sub-topics selected for analysis	Case studies topic
1	COMMUNITAS	COMMUNITAS	General digital technologies and ICT solutions (AI, cloud computing, IoT, block chain, open-source software, etc.)	Artificial Intelligence
2	dedalus	DEDALUS	General digital technologies and ICT solutions (AI, cloud computing, IoT, block chain, open-source software, etc.)	Artificial Intelligence
3	EDDIE	EDDIE	General digital technologies and ICT solutions (AI, cloud computing, IoT, block chain, open-source software, etc.)	Artificial Intelligence
4	ev4eu	EV4EU	General digital technologies and ICT solutions (AI, cloud computing, IoT, block chain, open-source software, etc.)	Artificial Intelligence
5	Flow	FLOW	Distributed energy storage	E-mobility (electric vehicle)
6	HYPERRIDE THE FUTURE OF POWER DISTRIBUTION	Hyperride	General digital technologies and ICT solutions (AI, cloud computing, IoT, block chain, open-source software, etc.)	Artificial Intelligence
7	islander	ISLANDER	Distributed energy storage	E-mobility (electric vehicle)
8	MAESHA	MAESHA	Distributed energy storage	E-mobility (electric vehicle)
9	Masterpie	MASTERPIECE	General digital technologies and ICT solutions (AI, cloud computing, IoT, block chain, open-source software, etc.)	Artificial Intelligence
10		PARMENIDES	Distributed energy storage	E-mobility (electric vehicle)
11	RE-EMPOWERED Renewable Energy EMPOWERing European & InDian Communities	RE-EMPOWERED	General digital technologies and ICT solutions (AI, cloud computing, IoT, block chain, open-source software, etc.)	Artificial Intelligence

N. Project	Logo	Project	Sub-topics selected for analysis	Case studies topic
12	reschool	RESCHOOL	General digital technologies and ICT solutions (AI, cloud computing, IoT, block chain, open-source software, etc.)	Artificial Intelligence
13	RESONANCE	RESONANCE	Distributed energy storage	E-mobility (electric vehicle)
14	Sender	SENDER	General digital technologies and ICT solutions (AI, cloud computing, IoT, block chain, open-source software, etc.)	Artificial Intelligence
15	SUSTENANCE	SUSTENANCE	Distributed energy storage	E-mobility (electric vehicle)
16	XL-CONNECT	XL-Connect	Distributed energy storage	E-mobility (electric vehicle)

4.2 Project description

4.2.1 COMMUNITAS

COMMUNITAS **Bound to accelerate the roll-out and expansion of Energy Communities and empower consumers as fully fledged energy market players**	COMMUNITAS
The European Commission's "Clean Energy for all Europeans" package (CEP) has introduced concepts for Renewable Energy Communities (RECs) and Citizen Energy Communities (CECs). Aiming to promote energy citizenship and active participation in energy markets. COMMUNITAS aims to overcome barriers and streamline these concepts. delivering a Knowledge Base and innovative tools using technologies like IoT. Blockchain. and Cloud Computing. The project also involves citizens in Social and Policy Labs to incorporate their feedback and needs into core developments. positioning them at the centre of energy markets.	
General context and scope of project	**Context:** The European Commission has introduced the concepts of renewable energy communities (RECs) and citizen energy communities (CECs). By doing so, it is promoting a more active role of EU citizens in the energy markets. However,

COMMUNITAS **Bound to accelerate the roll-out and expansion of Energy Communities and empower consumers as fully fledged energy market players**	
	there are several barriers that need to be lifted. In this context, the EU-funded COMMUNITAS project will promote energy citizenship, empowering citizens to take control of the path towards sustainability by becoming active elements of the energy markets. To that end, the project will deliver a knowledge base providing users with technical, administrative and legal information on energy communities as well as set tools that enable citizens to participate in different energy markets. **Objective**: With its "Clean Energy for all Europeans" package (CEP), the European Commission formally recognised and instrumentally brought forward community energy projects, including definitions for "Renewable Energy Communities" (RECs) and for "Citizen Energy Communities" (CECs). The new concepts introduced in the CEP set the course for a more active role of EU citizens in the energy markets. To fully realise the benefits envisioned by the CEP, a myriad of barriers needs to be overcome, and progress needs to be done to clarify and streamline the concepts of REC and CEC, enabling its uptake by all interested citizens. Motivated by that challenge, COMMUNITAS will promote energy citizenship, enabling citizens to take control of their own path towards sustainability by becoming an active element of the energy markets. The project will deliver a Knowledge Base that will provide users with technical, administrative, and legal information on ECs, streamlining the creation and expansion of this concept. COMMUNITAS will also deliver an innovative set of tools - capitalising on technologies such as IoT, blockchain and Cloud Computing - to unlock citizens' active participation in energy markets and communities (all integrated into an open, digital "one-stop-shop" COMMUNITAS Core Platform (CCP)), allowing EC members to have an aggregated position in the energy markets or explore ancillary services using different energy assets or load profiles of the community. As a project that aims to position citizens in the centre of energy markets, COMMUNITAS has citizens at the centre of its own approach: citizens will be involved in Social and Policy Labs throughout the whole project, in order to frequently factor in their feedback, wishes, needs into the core developments of the project.
Organisational features of the project, including Consortium description	**Coordinator:** • EDP Labelec (Portugal) **Partner:** • SMART ENERGY LAB - ASSOCIATION (Portugal)

COMMUNITAS **Bound to accelerate the roll-out and expansion of Energy Communities and empower consumers as fully fledged energy market players**	
	• UNINOVA-INSTITUTO DE DESENVOLVIMENTO DE NOVAS TECNOLOGIAS- ASSOCIACAO (Portugal) • UNIVERSIDADE NOVA DE LISBOA (Portugal) • ETRA INVESTIGACION Y DESARROLLO SA (Spain) • COOPERATIVA ELECTRICA BENEFICA SAN FRANCISCO DE ASIS SOCIEDAD COOPERATIVA VALENCIANA (Spain) • RINA CONSULTING SPA (Italy) • AZIENDA CONSORZIALE SERVIZI MUNICIPALIZZATI SPA (Italy) • FONDAZIONE BRUNO KESSLER (Italy) • ENERGY@WORK SOCIETA' COOPERATIVA A R.L. (Italy) • ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS (Greece) • WATT AND VOLT ANONIMI ETAIRIA EKMETALLEYSIS ENALLAKTIKON MORFON ENERGEIAS (Greece) • EUROPEAN GREEN CITIES APS (Denmark) • ASM - CENTRUM BADAN I ANALIZ RYNKUSPOLKA Z OGRANICZONA ODPOWIEDZIALNOSCIA (Poland) • SVEUCILISTE U ZAGREBU, FAKULTET STROJARSTVA I BRODOGRADNJE (Croatia) • NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO (Netherlands) • COOPERATIEVE VERENIGING GRUNNEGER POWER UA (Netherlands) • EMAC EMPRESA MUNICIPAL DE AMBIENTEDE CASCAIS EM SA (Portugal)
Geographical coverage	Croatia, Denmark, Greece, Italy, Netherlands, Portugal, Spain
Project call name	Supporting the actions of consumers in the energy market and guide them to act as prosumers. communities and other active forms of active participation in the energy activities
Project call number	HORIZON-CL5-2022-D3-01-08
Budget	5.999.602,50 €
Desired impacts (expectations at beginning of project)	N/A
Technologies and services that the project has the ambition to develop and serve	N/A
KER Type	Software; Business Models and Strategies

COMMUNITAS

Bound to accelerate the roll-out and expansion of Energy Communities and empower consumers as fully fledged energy market players

KERs of the Project

KER 1	COMMUNITAS Core Platform
Leader	E@W
Contributors	Not available yet
Country	Italy
KER info	Not available yet

KER 2	Energy community management platform
Leader	EDP
Contributors	Not available yet
Country	Portugal
KER info	Not available yet

KER 3	Investment advisor for household- and community-level sustainable investments (Knowledge base)
Leader	EDP
Contributors	Not available yet
Country	Portugal
KER info	Not available yet

KER 4	Investment advisor for household- and community-level sustainable investments
Leader	EDP
Contributors	Not available yet
Country	Portugal
KER info	Not available yet

KER 5	Energy Community Planning Tool
Leader	RINA
Contributors	Not available yet
Country	Italy
KER info	Not available yet

KER 6	MultiFASE – near real-time optimisation of ECs' Distributed Energy Resources (DERs)
Leader	CERTH
Contributors	Not available yet
Country	Greece

COMMUNITAS

Bound to accelerate the roll-out and expansion of Energy Communities and empower consumers as fully fledged energy market players

KER info	Not available yet

KER 7	Demand Response and optimal market position (we have more KERs buy they don't fit in this table)
Leader	UNINOVA
Contributors	Not available yet
Country	Portugal
KER info	Not available yet

Technology Readiness Levels (TRL) of the Priority Project Components (PPC) upon completion of the project

Value of Consumer/Customer acceptance and engagement: TRL 6-8

Cross-sectorial flexibility use cases: TRL 6-8

Initial TRL – Final TRL

KER	Initial TRL	Final TRL
KER1	5	7
KER2	6	8
KER3	5	7
KER4	N/A	N/A
KER5	6	8
KER6	5	7
KER7	5	7

Hypothesis of product or service that could be marketed if the project meets TRL 8/9 criteria

N/A

4.2.2 DEDALUS

DEDALUS **Bound to accelerate the roll-out and expansion of Energy Communities and empower consumers as fully fledged energy market players**	
The DEDALUS project focuses on boosting residential energy efficiency and consumer participation in demand response through an energy carrier-agnostic ecosystem that integrates electricity, heat, and natural gas. Its main objectives are to design, develop, and demonstrate an SSH-driven, AI-enabled framework that empowers households and communities to actively engage in energy management, fostering flexibility, interoperability, and social innovation across multiple scales — from individual homes to entire districts.	
General context and scope of project	**Context:** Residential energy consumption is often inefficient, with many households lacking the tools or incentives to participate in demand response (DR) programmes. This results in missed opportunities to reduce energy costs, optimise energy usage, and lower environmental impact. Additionally, current DR systems are limited to specific energy carriers like electricity, leaving out the potential for integration with heat or natural gas. Social engagement and community participation in energy management are also underdeveloped. In this context, the EU-funded DEDALUS project will create a multi-value, energy carrier-agnostic DR ecosystem. It uses AI, digital twins, and social science incentives to empower residential consumers, from individual homes to entire districts, and integrates multiple energy sources for maximum efficiency. **Objective**: DEDALUS will design, develop and demonstrate SSH-driven multi-value energy carrier-agnostic micro (home/apartment)-to macro(building & district-scale) participatory Demand Response (DR) ecosystem, aimed to: (a) facilitate and scale up residential energy consumers massive participation to DR; (b) adapt to a variety of different mono-carrier (electricity, heat) or multi-carrier synergetic scenarios (electricity vs heat and natural gas) at building/district scale, while strengthening social interactions within respective communities. To this aim, we will deploy: 1) a Social Science Framework for multi-dimensional incentives and nudging interventions tools; 2) AI-based individual/building/districts consumers clustering and segmentation algorithms; 3) Open APIs for DR-ready smart appliances; 4) Energy DataSpace adaptation for extended DR interoperability and privacy-preserving DLT/BlockchAIn Data Governance and flexibility coordination; 5) Digital Twins for consumers-aware DR flexibility planning; 6) Comfort-based flexibility models and tools for serviced apartments for elderly people; 7) flexibility management tools for building and physical/virtual districts energy communities, based on pre-aggregation and shared DR assets; 8) Optimal aggregation of flexible energy assets for district heating and decentralised power2heat 9) Business Sandbox with novel sharing economy social innovation-based business models. DEDALUS solutions will be validated by 5 Front Runners full-scale pilots and replicated by 2 Multipliers in 7 countries, deployed at the

DEDALUS **Bound to accelerate the roll-out and expansion of Energy Communities and empower consumers as fully fledged energy market players** 	
	interplay of energy, and non-energy (comfort/healthcare, ageing, social innovation) sectors, and operated by different stakeholders (social housing operators, building operators, aggregators, energy communities, retailers/suppliers, DSOs/District Heating Network operators). Capacity building and blueprints will support policy makers and regulators to enable market take-up and EU-wide replication of residential DR.
Organisational features of the project, including Consortium description	**Coordinator:** • ENGINEERING - INGEGNERIA INFORMATICA SPA (Italy) **Partner:** • ETHNICON METSOVION POLYTECHNION (Greece) • FUNDACION CARTIF (Spain) • UNIVERSITA POLITECNICA DELLE MARCHE (Italy) • ARCELIK A.S. (Türkiye) • COMSENSUS, KOMUNIKACIJE IN SENZORIKA, DOO (Slovenia) • OURPOWER ENERGIEGENOSSENSCHAFT SCE MIT BESCHRANKTER HAFTUNG (Austria) • GREEN-POINT 62 GMBH (Austria) • BLUEPRINT ENERGY SOLUTIONS GMBH (Austria) • FAELLESBO (Denmark) • NEOGRID TECHNOLOGIES APS (Denmark) • EUROPEAN GREEN CITIES APS (Denmark) • HERON SINGLE MEMBER S.A. ENERGY SERVICES (Greece) • DOMX IDIOTIKI KEFALAIOUCHIKI ETAIREIA (Greece) • ISTITUTO PER SERVIZI DI RICOVERO E ASSISTENZA AGLI ANZIANI (Italy) • DYNAME SRL (Italy) • CENTRE INTERNACIONAL DE METODES NUMERICS EN ENGINYERIA (Spain) • PRODUCTORA ELECTRICA URGELLENCA SA (Spain) • ROMUR RENOVALBES SL (Spain) • CENTRICA BUSINESS SOLUTIONS BELGIUM (Belgium) • UNIVERSITATEA TEHNICA CLUJ-NAPOCA (Romania) • SMART INNOVATION NORWAY AS (Norway) • FONDAZIONE ICONS (Italy)
Geographical coverage	Austria, Belgium, Denmark, Greece, Italy, Norway, Slovenia, Spain, Romania, Türkiye
Project call name	Renewable-intensive. energy positive homes

DEDALUS **Bound to accelerate the roll-out and expansion of Energy Communities and empower consumers as fully fledged energy market players**	
Project call number	HORIZON-CL5-2021-D3-01-01
Budget	5.999.801,25 €
Desired impacts (expectations at beginning of project)	**Objectives:** Increased potential benefits, trust and acceptability of demand-response solutions for residential consumers. Advanced asset control and aggregation approaches that enable the participation of residential buildings in commercial demand response. **Expected impacts:** Technological and socio-economic breakthroughs for achieving climate neutrality and the transition to zero pollution of the building stock by 2050, Address the large but untapped potential of the residential sector for Demand Response with a view to support the energy transition at system level while respecting user privacy, comfort and ownership.
Technologies and services that the project has the ambition to develop and serve	N/A
KER Type	Technological results; Scientific Results (scientific knowledge, discoveries, or insights generated as a result of the project); Software
KERs of the Project	**KER 1** — **Social Science Framework, innovative multidimensional incentives and nudging interventions for residential DR** Leader: ENGINEERING Ingegneria Informatica SpA Contributors: ENGINEERING - INGEGNERIA INFORMATICA SPA (ENG); ETHNICON METSOVION POLYTECHNION (NTUA) FUNDACION CARTIF (CARTIF) UNIVERSITA POLITECNICA DELLE MARCHE (UNIVPM) ARCELIK A.S. (ARC) COMSENSUS, KOMUNIKACIJE IN SENZORIKA, DOO (COMS) OURPOWER ENERGIEGENOSSENSCHAFT SCE MIT BESCHRANKTER HAFTUNG (OURPOWER) GREEN-POINT 62 GMBH (GREENPOINT) BLUEPRINT ENERGY SOLUTIONS GMBH (BLUEPRINT) FAELLESBO (FAELLESBO)

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	NEOGRID TECHNOLOGIES APS (NEOGRID) EUROPEAN GREEN CITIES APS (GREEN CITIES) HERON SINGLE MEMBER S.A. ENERGY SERVICES (HERON) DOMX IDIOTIKI KEFALAIOUCHIKI ETAIREIA (DOM-X)
Country	Austria, Denmark, Greece, Italy, Slovenia, Spain, Türkiye
KER info	We will make use of SSH-based tools and methodologies, such as deliberative citizen engagement, intersectionality, co-creation and experimental scenario-based research, as well as Design Thinking methodologies, in order to support the design of an innovative concept for participatory, multi-value and energy carrier-agnostic residential DR.

KER 2	**AI-based individual and building-level-level consumers clustering and market segmentation algorithms.**
Leader	ENGINEERING Ingegneria Informatica SpA
Contributors	ENGINEERING - INGEGNERIA INFORMATICA SPA (ENG); ETHNICON METSOVION POLYTECHNION (NTUA) FUNDACION CARTIF (CARTIF) UNIVERSITA POLITECNICA DELLE MARCHE (UNIVPM) ARCELIK A.S. (ARC) COMSENSUS, KOMUNIKACIJE IN SENZORIKA, DOO (COMS) OURPOWER ENERGIEGENOSSENSCHAFT SCE MIT BESCHRANKTER HAFTUNG (OURPOWER) GREEN-POINT 62 GMBH (GREENPOINT) BLUEPRINT ENERGY SOLUTIONS GMBH (BLUEPRINT) FAELLESBO (FAELLESBO) NEOGRID TECHNOLOGIES APS (NEOGRID) EUROPEAN GREEN CITIES APS (GREEN CITIES) HERON SINGLE MEMBER S.A. ENERGY SERVICES (HERON) DOMX IDIOTIKI KEFALAIOUCHIKI ETAIREIA (DOM-X)
Country	Austria, Denmark, Greece, Italy, Slovenia, Spain, Türkiye
KER info	Nudging techniques and multiple concepts, such as socio-economic privilege, gender, age and behavioural analyses, will be mobilised to promote an inclusive engaging dynamic with residential energy consumers, in order to identify a number of social, environmental, geographical, financial, and personal preferences, and related KPIs against which buildings and consumer characteristics will be segmented and clustered thanks to AI-based algorithms.

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KER 3	Open APIs for DR-ready smart appliance IoT platform
Leader	ENGINEERING Ingegneria Informatica SpA
Contributors	ENGINEERING - INGEGNERIA INFORMATICA SPA (ENG); ETHNICON METSOVION POLYTECHNION (NTUA) FUNDACION CARTIF (CARTIF) UNIVERSITA POLITECNICA DELLE MARCHE (UNIVPM) ARCELIK A.S. (ARC) COMSENSUS, KOMUNIKACIJE IN SENZORIKA, DOO (COMS) OURPOWER ENERGIEGENOSSENSCHAFT SCE MIT BESCHRANKTER HAFTUNG (OURPOWER) GREEN-POINT 62 GMBH (GREENPOINT) BLUEPRINT ENERGY SOLUTIONS GMBH (BLUEPRINT) FAELLESBO (FAELLESBO) NEOGRID TECHNOLOGIES APS (NEOGRID) EUROPEAN GREEN CITIES APS (GREEN CITIES) HERON SINGLE MEMBER S.A. ENERGY SERVICES (HERON) DOMX IDIOTIKI KEFALAIOUCHIKI ETAIREIA (DOM-X)
Country	Austria, Denmark, Greece, Italy, Slovenia, Spain, Türkiye
KER info	A set of extended data models and Open APIs, which will facilitate turning over smart appliance/devices/assets into flexible and DR ready ones, will be the basis for the flexibility exploitation at building level together with the prediction algorithms for that flexibility.

KER 4	Energy Data Space adaptation for extended DR interoperability, and privacy-preserving DLT/BlockchAIn Data Governance and flexibility exchange
Leader	ENGINEERING Ingegneria Informatica SpA
Contributors	ENGINEERING - INGEGNERIA INFORMATICA SPA (ENG); ETHNICON METSOVION POLYTECHNION (NTUA) FUNDACION CARTIF (CARTIF) UNIVERSITA POLITECNICA DELLE MARCHE (UNIVPM) ARCELIK A.S. (ARC) COMSENSUS, KOMUNIKACIJE IN SENZORIKA, DOO (COMS) OURPOWER ENERGIEGENOSSENSCHAFT SCE MIT BESCHRANKTER HAFTUNG (OURPOWER) GREEN-POINT 62 GMBH (GREENPOINT) BLUEPRINT ENERGY SOLUTIONS GMBH (BLUEPRINT)

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Country	Austria, Denmark, Greece, Italy, Slovenia, Spain, Türkiye
KER info	A Blockchain-driven market place will be set up and evolved for allowing the P2P trading of the flexibility against other energy and non-energy assets, enabling the control, aggregation (i.e. prosumers, buildings, community, etc.), and valorisation of small-scale residential flexibility via tokenisation

KER 5	**Digital Twins for optimal assets vs consumers flexibility planning and decentralised DR management**
Leader	ENGINEERING Ingegneria Informatica SpA
Contributors	ENGINEERING - INGEGNERIA INFORMATICA SPA (ENG); ETHNICON METSOVION POLYTECHNION (NTUA) FUNDACION CARTIF (CARTIF) UNIVERSITA POLITECNICA DELLE MARCHE (UNIVPM) ARCELIK A.S. (ARC) COMSENSUS, KOMUNIKACIJE IN SENZORIKA, DOO (COMS) OURPOWER ENERGIEGENOSSENSCHAFT SCE MIT BESCHRANKTER HAFTUNG (OURPOWER) GREEN-POINT 62 GMBH (GREENPOINT) BLUEPRINT ENERGY SOLUTIONS GMBH (BLUEPRINT) FAELLESBO (FAELLESBO) NEOGRID TECHNOLOGIES APS (NEOGRID) EUROPEAN GREEN CITIES APS (GREEN CITIES) HERON SINGLE MEMBER S.A. ENERGY SERVICES (HERON) DOMX IDIOTIKI KEFALAIOUCHIKI ETAIREIA (DOM-X)
Country	Austria, Denmark, Greece, Italy, Slovenia, Spain, Türkiye
KER info	We will adapt and evolve data-driven models, algorithms and flexible assets DTs developed in other projects in order to deploy innovative end-user-driven DTs for flexible assets. Final outcomes will consist of DTs for optimal assets vs consumers flexibility planning, and data-driven flexibility assessment and valorisation models and algorithms which trade-off financial against non-financial (e.g. comfort) criteria for DR participation

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KER 6	Comfort-based flexibility models and DR optimal management tools for individual residential consumers and/or serviced apartments
Leader	ENGINEERING Ingegneria Informatica SpA
Contributors	ENGINEERING - INGEGNERIA INFORMATICA SPA (ENG); ETHNICON METSOVION POLYTECHNION (NTUA) FUNDACION CARTIF (CARTIF) UNIVERSITA POLITECNICA DELLE MARCHE (UNIVPM) ARCELIK A.S. (ARC) COMSENSUS, KOMUNIKACIJE IN SENZORIKA, DOO (COMS) OURPOWER ENERGIEGENOSSENSCHAFT SCE MIT BESCHRANKTER HAFTUNG (OURPOWER) GREEN-POINT 62 GMBH (GREENPOINT) BLUEPRINT ENERGY SOLUTIONS GMBH (BLUEPRINT) FAELLESBO (FAELLESBO) NEOGRID TECHNOLOGIES APS (NEOGRID) EUROPEAN GREEN CITIES APS (GREEN CITIES) HERON SINGLE MEMBER S.A. ENERGY SERVICES (HERON) DOMX IDIOTIKI KEFALAIOUCHIKI ETAIREIA (DOM-X)
Country	Austria, Denmark, Greece, Italy, Slovenia, Spain, Türkiye
KER info	The human-oriented models, algorithms and DTs will increase the predictability of energy consumers' participation in DR, as well as the predictability of the latent flexibility to be mobilised

KER 7	Electrical flexibility management tools for building-level energy communities, energy districts and virtual cluster of buildings, based on pre-aggregation and shared DR assets
Leader	ENGINEERING Ingegneria Informatica SpA
Contributors	ENGINEERING - INGEGNERIA INFORMATICA SPA (ENG); ETHNICON METSOVION POLYTECHNION (NTUA) FUNDACION CARTIF (CARTIF) UNIVERSITA POLITECNICA DELLE MARCHE (UNIVPM) ARCELIK A.S. (ARC) COMSENSUS, KOMUNIKACIJE IN SENZORIKA, DOO (COMS) OURPOWER ENERGIEGENOSSENSCHAFT SCE MIT BESCHRANKTER HAFTUNG (OURPOWER) GREEN-POINT 62 GMBH (GREENPOINT)

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Country	Austria, Denmark, Greece, Italy, Slovenia, Spain, Türkiye
KER info	Suitable multi-value data-driven services will be adapted, deployed and validated to support the optimal flexibility aggregation for DR aggregators, building managers, suppliers and/or DR service providers. In particular, we will deploy: (i) mono-carrier electrical flexibility assessment, valorisation and optimal management at building-level, while leveraging on building-level pre-aggregation; (ii) mono-carrier optimal electrical energy and flexibility management at district-scale or virtual cluster of buildings, based on shared DR assets (e.g. district-scale shared battery storage) and/or self-consumption; (iii) cross-domain heat-centred and electricity-centred decentralised flexibility aggregation and assessment (e.g. District Heating Network, heat pumps, natural gas boilers) to optimise the overall electrical and heat flexibility, and achieve optimal data-driven control of flexible multi-energy assets

KER 8	
Leader	ENGINEERING Ingegneria Informatica SpA
Contributors	ENGINEERING - INGEGNERIA INFORMATICA SPA (ENG); ETHNICON METSOVION POLYTECHNION (NTUA) FUNDACION CARTIF (CARTIF) UNIVERSITA POLITECNICA DELLE MARCHE (UNIVPM) ARCELIK A.S. (ARC) COMSENSUS, KOMUNIKACIJE IN SENZORIKA, DOO (COMS) OURPOWER ENERGIEGENOSSENSCHAFT SCE MIT BESCHRANKTER HAFTUNG (OURPOWER) GREEN-POINT 62 GMBH (GREENPOINT) BLUEPRINT ENERGY SOLUTIONS GMBH (BLUEPRINT) FAELLESBO (FAELLESBO) NEOGRID TECHNOLOGIES APS (NEOGRID) EUROPEAN GREEN CITIES APS (GREEN CITIES) HERON SINGLE MEMBER S.A. ENERGY SERVICES (HERON) DOMX IDIOTIKI KEFALAIOUCHIKI ETAIREIA (DOM-X)

DEDALUS

Bound to accelerate the roll-out and expansion of Energy Communities and empower consumers as fully fledged energy market players

	Country	Austria, Denmark, Greece, Italy, Slovenia, Spain, Türkiye
	KER info	Suitable multi-value data-driven services will be adapted, deployed and validated to support the optimal flexibility aggregation for DR aggregators, building managers, suppliers and/or DR service providers. In particular, we will deploy: (i) mono-carrier electrical flexibility assessment, valorisation and optimal management at building-level, while leveraging on building-level pre-aggregation; (ii) mono-carrier optimal electrical energy and flexibility management at district-scale or virtual cluster of buildings, based on shared DR assets (e.g. district-scale shared battery storage) and/or self-consumption; (iii) cross-domain heat-centred and electricity-centred decentralised flexibility aggregation and assessment (e.g. District Heating Network, heat pumps, natural gas boilers) to optimise the overall electrical and heat flexibility, and achieve optimal data-driven control of flexible multi-energy assets
Technology Readiness Levels (TRL) of the Priority Project Components (PPC) upon completion of the project	N/A	

Initial TRL – Final TRL

KER	Initial TRL	Final TRL
KER1	5	7
KER2	6	7
KER3	5	7
KER4	6	6
KER5	5	6
KER6	5	7
KER7	5	7
KER 8	5	7

Hypothesis of product or service that could be marketed if the project meets TRL 8/9 criteria

N/A

4.2.3 EDDIE

EDDIE **Eddie – smart neurorehabilitation software**	
"The Clean Energy Package establishes customer rights to access energy data and share it with chosen eligible parties, fostering the development of new data-driven services within and beyond the energy sector. The lack of standardised procedures across the EU poses a significant obstacle to the implementation of such solutions. Currently. actors adhere to national practices. hindering interoperability and limiting growth opportunities. **To address these issues. EDDIE introduces a decentralised, distributed, open-source Data Space. allowing energy service companies to operate and compete seamlessly in a unified European market."**	
General context and scope of project	**Context:** To move from fossil fuels towards cleaner energy and deliver on the Paris Agreement commitments for reducing greenhouse gas emissions, the EU's Clean Energy Package is a big step towards an energy union strategy. The package establishes the rights to access energy data to customers and share it with eligible parties of their choice. The lack of uniform procedures in the EU, however, poses a challenge. In this context, the EU-funded EDDIE project will create a decentralised, distributed, open-source Data Space to lower data integration costs and boost competition. This will also improve the quality and functionality of energy-data-based services. Aligned with European directions on interoperability, the project will allow for easy access by everyone, from service companies to end-user customers. **Objective**: The Clean Energy Package establishes the rights to access energy data to customers and share it with eligible parties of their choice. This enables new energy data-based services within and beyond the energy sector. The main barrier for this development is the lack of large-scale and uniform procedures in the EU. Players are tied to national practices, which limits their interoperability and growth perspective. These constraints have an industrial, economic and social dimension on a European level and beyond. As a solution, EDDIE creates a de-centralised, distributed, open-source Data Space, aligned with directions of the work on the Implementing Acts on Interoperability and other European activities. This European Distributed Data Infrastructure for Energy (EDDIE) lowers data integration costs drastically because the resulting EDDIE Framework lets energy service companies work and compete in a common European market. EDDIE's vision is to make it cheap and easy for smart, data-based energy-related services to operate on a common European Energy Data Space. EDDIE will feature a streamlined, uniform European interface to energy data usable by everyone from service companies to end-user customers. EDDIE also targets the social problem of limited access to energy data. European customers across Member States will have a far greater choice between solutions. This

EDDIE **Eddie – smart neurorehabilitation software**	
	boosts competition, quality and functionality of energy-data-based services by reducing cost-per-customer and leveraging economies of scale. EDDIE tackles the lack of access to measurements of in-house sensors. The Administrative Interface for In-house Data Access (AIIDA) provides the basis to share data streams close to real time with remote services on a manageable consent basis. All EDDIE components enable interoperable solutions based on energy data available online and in-house. These components will be extendable and form the nucleus for a Common European Energy Data Space.
Organisational features of the project, including Consortium description	**Coordinator:** • AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH (Austria) **Partner:** • COPENHAGEN BUSINESS SCHOOL (Denmark) • EUROPEAN UNIVERSITY INSTITUTE (Italy) • UNIVERSITAT WIEN (Austria) • FH OO FORSCHUNGS & ENTWICKLUNGS GMBH (Austria) • THE LISBON COUNCIL FOR ECONOMIC COMPETITIVENESS ASBL (Belgium) • PONTON GMBH (Germany) • ASOCIACION DE EMPRESAS DE ENERGIA ELECTRICA (Spain) • DIMOSIA EPICHEIRISI DIKTYON DIANOMIS AERIOU • MONOPROSOPI ANONYMI ETAIREIA (Greece) • EDA ENERGIEWIRTSCHAFTLICHER DATENAUSTAUSCH GMBH (Austria) • SUDTIROLER ENERGIE VERBAND GENOSSENSCHAFT (Italy) • FLEXIDAO S.E.S., SOCIEDAD LIMITADA (Spain) • DIGITAL4GRIDS (France) • EUROPEAN ASSOCIATION FOR THE STREAMLINING OF ENERGY EXCHANGEGAS (France) • ENTARC.EU (Austria)
Geographical coverage	Austria, Belgium, Denmark, France, Germany, Greece, Italy, Spain
Project call name	Establish the grounds for a common European energy data space
Project call number	HORIZON-CL5-2021-D3-01-01
Budget	7.989.333,01 €
Desired impacts (expectations at beginning of project)	**Challenges:** **Scope objectives:**

EDDIE **Eddie – smart neurorehabilitation software**	
Technologies and services that the project has the ambition to develop and serve	N/A
KER Type	Technological results; Scientific Results (scientific knowledge, discoveries, or insights generated as a result of the project); Software

KERs of the Project

Ker 1	**EDDIE Framework**
Leader	FH OO FORSCHUNGS & ENTWICKLUNGS GMBH - FH OOE
Contributors	COPENHAGEN BUSINESS SCHOOL - CBS EUROPEAN UNIVERSITY INSTITUTE - ISTITUTO UNIVERSITARIO EUROPEO UNIVERSITAT WIEN - UNIVIE AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH - AIT THE LISBON COUNCIL FOR ECONOMIC COMPETITIVENESS ASBL - THE LISBON COUNCIL PONTON GMBH EDA ENERGIEWIRTSCHAFTLICHER DATENAUSTAUSCH GMBH DIGITAL4GRIDS - DIGITAL4GRIDS EUROPEAN ASSOCIATION FOR THE STREAMLINING OF ENERGY EXCHANGE-GAS - ASSOCIATION EUROPEENNE POUR LA RATIONALISATION DES ECHANGES D'ENERGIE-GAZ ENTARC.EU
Country	Austria, Belgium, Denmark, France, Germany, Italy
KER info	A dependable, scaleable and extensible European Distributed Data Infrastructure for Energy Framework (EDDIE Framework), opensource and free to use and change. The EDDIE Framework will be installable in the domain of eligible parties with the need of access to energy data on a customer consent basis. There will be no need for additional centralised intermediaries. This main outcome is aligned with European interoperability, digitalisation and data-related legislation, and also provides means to feed back into these initiatives, leading in turn to better informed decision-making.

KER 2	**AIIDA**
Leader	FH OO FORSCHUNGS & ENTWICKLUNGS GMBH - FH OOE
Contributors	COPENHAGEN BUSINESS SCHOOL - CBS

EDDIE

Eddie – smart neurorehabilitation software

	EUROPEAN UNIVERSITY INSTITUTE - ISTITUTO UNIVERSITARIO EUROPEO UNIVERSITAT WIEN - UNIVIE AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH - AIT THE LISBON COUNCIL FOR ECONOMIC COMPETITIVENESS ASBL - THE LISBON COUNCIL PONTON GMBH EDA ENERGIEWIRTSCHAFTLICHER DATENAUSTAUSCH GMBH DIGITAL4GRIDS - DIGITAL4GRIDS EUROPEAN ASSOCIATION FOR THE STREAMLINING OF ENERGY EXCHANGE-GAS - ASSOCIATION EUROPEENNE POUR LA RATIONALISATION DES ECHANGES D'ENERGIE-GAZ ENTARC.EU
Country	Austria, Belgium, Denmark, France, Germany, Italy
KER info	AIIDA is an Administrative Interface for In-house Data Access (AIIDA), easily integrable in domestic software systems like smart home solutions or edge devices, making use of existing or additional hardware to be easily deployed in consumer houses: First, to provide customers with a new solution to make available data streams from the standardised near real-time interface on the smart meter (priority) and a variety of in-house sensors. Second, for allowing customers to share their data with services using the EDDIE Framework, on a secure, clean and manageable consent basis.

KER 3	**Knowledge on energy data sharing and interoperability**
Leader	FH OO FORSCHUNGS & ENTWICKLUNGS GMBH - FH OOE
Contributors	COPENHAGEN BUSINESS SCHOOL - CBS EUROPEAN UNIVERSITY INSTITUTE - ISTITUTO UNIVERSITARIO EUROPEO UNIVERSITAT WIEN - UNIVIE AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH - AIT THE LISBON COUNCIL FOR ECONOMIC COMPETITIVENESS ASBL - THE LISBON COUNCIL PONTON GMBH EDA ENERGIEWIRTSCHAFTLICHER DATENAUSTAUSCH GMBH DIGITAL4GRIDS - DIGITAL4GRIDS EUROPEAN ASSOCIATION FOR THE STREAMLINING OF ENERGY EXCHANGE-GAS - ASSOCIATION EUROPEENNE POUR LA RATIONALISATION DES ECHANGES D'ENERGIE-GAZ

EDDIE

Eddie – smart neurorehabilitation software

	ENTARC.EU
Country	Austria, Belgium, Denmark, France, Germany, Italy
KER info	Real-world experience and knowledge on various aspects of energy data-sharing and interoperability, from a social, economic and technological point of view. The academic institutions within the EDDIE consortium will care about a scientific assessment from energy and behavioural economics, regulatory and legislative, and system safety and security aspects. For all prototypes, we put a focus on human-centred design and user research to support the social acceptance of new energy technologies and increase participation of consumers in energy.

KER 4	**EDDIE Market Place**
Leader	FH OO FORSCHUNGS & ENTWICKLUNGS GMBH - FH OOE
Contributors	COPENHAGEN BUSINESS SCHOOL - CBS EUROPEAN UNIVERSITY INSTITUTE - ISTITUTO UNIVERSITARIO EUROPEO UNIVERSITAT WIEN - UNIVIE AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH - AIT THE LISBON COUNCIL FOR ECONOMIC COMPETITIVENESS ASBL - THE LISBON COUNCIL PONTON GMBH EDA ENERGIEWIRTSCHAFTLICHER DATENAUSTAUSCH GMBH DIGITAL4GRIDS - DIGITAL4GRIDS EUROPEAN ASSOCIATION FOR THE STREAMLINING OF ENERGY EXCHANGE-GAS - ASSOCIATION EUROPEENNE POUR LA RATIONALISATION DES ECHANGES D'ENERGIE-GAZ ENTARC.EU
Country	Austria, Belgium, Denmark, France, Germany, Italy
KER info	The EDDIE Data Services Market Place as a web-based and/or mobile solution, which allows end users to easily access applications based on the EDDIE Framework, learn about the services offered, use services of interest and participate in the data-sharing community. End-users must and will always retain full control over their own and private data at all times. The EDDIE Data Services Market Place will also contain all demonstrated prototypes.

Technology Readiness Levels (TRL) of the Priority Project	Value of Consumer/Customer acceptance and engagement: TRL 6-8

EDDIE

Eddie – smart neurorehabilitation software

Components (PPC) upon completion of the project	Plug-and-play devices and IoT [internet of things] including security by design: TRL 3-5 Utilisation of communication networks including cyber security: TRL 6-8 Cross-sectorial flexibility use cases: TRL 3-5
Initial TRL – Final TRL	
Hypothesis of product or service that could be marketed if the project meets TRL 8/9 criteria	N/A

KER	Initial TRL	Final TRL
KER1	2	7
KER2	2	7
KER3	1	6
KER4	2	7

4.2.4 EV4EU

EV4EU **Electric Vehicles Management for carbon neutrality in Europe**	
The EV4EU project aims to accelerate the mass deployment of EVs in Europe by developing user-centric V2X management strategies. These strategies focus on minimising the impact on batteries. meeting user needs. enhancing power systems. integrating with energy markets. and facilitating urban transformation. Key objectives include testing V2X approaches across four demo sites. evaluating technology and system impacts. developing tools and apps for EV users. and creating an open platform for data exchange. The project seeks to propose new services. demand response programs. and regulatory frameworks to encourage EV adoption.	
General context and scope of project	**Context:** With the rate at which electric vehicles (EVs) are populating our roads, it is estimated they will have largely replaced Internal Combustion Engine cars by 2040. Vehicle-to-everything (V2X) enables data exchanges between a vehicle and its surroundings as well as energy exchange (charging and discharging the batteries). Both perspectives are important for the global adoption of EVs. The EU-funded EV4EU project will design and implement V2X management strategies that facilitate EVs´ mass deployment. Various approaches will be tested taking into consideration user needs and existing conditions in cities. Project work will include the development of tools and apps targeted at EV users as well as an open information exchange platform for stakeholders and systems. The new approaches will be validated at four demonstration sites. **Objective**: The Electric Vehicles Management for carbon neutrality in Europe (EV4EUThe Electric Vehicles Management for carbon neutrality in Europe (EV4EU) project will propose and implement bottom-up and user-centric Vehicle-to-Everything (V2X) management strategies creating the conditions for the mass deployment of electric vehicles. The strategies will consider the impact on batteries, the needs of the users, power systems, the integration with energy markets, and cities' transformation. The proposed V2X management strategies will be tested in four demonstration sites, allowing an evaluation of the proposed methodologies and tools, the definition of the appropriate implementation conditions, and a consolidation of the most promising solutions and business models. Technology providers will test different V2X management approaches, evaluating their feasibility and adequacy for the existing conditions in cities. System Operators will estimate the impact of V2X on transmission and distribution levels, proposing new services to profit from V2X flexibility, mitigating the effect of V2X, and supporting the development of both V2X and renewables. Tools and Apps for electric vehicle users will be developed to provide valuable information about the use of electric vehicles and available energy services. An open platform that considers interoperability, scaleability, security, and privacy requirements will ensure the information exchange between stakeholders and systems. The impact of V2X management strategies

EV4EU Electric Vehicles Management for carbon neutrality in Europe	
	in different cities will be evaluated in a co-simulation tool considering different perspectives, namely, the power network, cities constraints (existing parking lots, buildings characteristics, etc.), electric vehicle use patterns, and, finally, V2X management strategies. New services (Green Charging, Sharing Charging, and Surge Pricing), Demand Response programs, and flexible capacity contracts will be designed and a regulatory framework promoting user adoption will be proposed.
Organisational features of the project, including Consortium description	**Coordinator:** • Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento em Lisboa - INESC-ID (Portugal) **Partner:** • UNIVERZA V LJUBLJANI (SLOVENIA) • DANMARKS TEKNISKE UNIVERSITET (DENMARK) • SMART ENERGY LAB- ASSOCIATION (PORTUGAL) • ELEKTRO CELJE D.D. (SLOVENIA) • BORNHOLMS ENERGI OG FORSYNING AS (DENMARK) • DIACHEIRISTIS ELLINIKOU DIKTYOU DIANOMIS ELEKTRIKIS ENERGEIAS AE (GREECE) • CAMPUS BORNHOLM (DENMARK) • AIGLON ANONYMI VIOMICHANIKI KAI EMPORIKI ETAIREIA AYTOKINITON (GREECE) • ABB INZENIRING DOO (SLOVENIA) • SECRETARIA REGIONAL DOS TRANSPORTES TURISM E ENERGIA (PORTUGAL) • CNET CENTRE FOR NEW ENERGY TECHNOLOGIES SA (PORTUGAL) • GEN-I, TRGOVANJE IN PRODAJA ELEKTRICNE ENERGIJE, D.O.O. (SLOVENIA) • DIMOSIA EPICHEIRISI ILEKTRISMOU ANONYMI ETAIREIA (GREECE) • CIRCLE CONSULT APS (DENMARK) • EDA – ELECTRICIDADE DOS ACORES SA (PORTUGAL) • OBCINA KRSKO (SLOVENIA) • OBMOCNA OBRTNO-PODJETNISKA ZBORNICAKRSKO (SLOVENIA) • REGIONALNA RAZVOJNA AGENCIJA POSAVJE (SLOVENIA) • NISSAN MOTOR MANUFACTURING (UNITED KINGDOM) • ASSOCIAÇÃO NACIONAL DE TRANSPORTES PÚBLICOS RODOVIÁRIOS MERCADORIAS (PORTUGAL) • VESTAS WIND SYSTEMS A/S (DENMARK)
Geographical coverage	Denmark, Greece, Portugal, Slovenia, United Kingdom

EV4EU **Electric Vehicles Management for carbon neutrality in Europe**	
Project call name	System approach to achieve optimised Smart EV Charging and V2G flexibility in mass-deployment conditions (2ZERO)
Project call number	HORIZON-CL5-2021-D5-01-03
Budget	8.989.682,00 €
Desired impacts (expectations at beginning of project)	**Challenges:** 1. User adoption is a critical barrier for mass EV deployment. Users may have a lack of trust in EV technology due to security aspects (battery explosion or over-heating), not being environmentally friendly (use of lithium for battery manufacturing, emissions in electricity generation), unreliability (doubtful about the batteries and their degradation with time), immaturity of technology (compared with ICE technology), range anxiety, charge duration, and emotional attachment. 2. Carbon neutrality: In Europe, the transport sector is responsible for 23% of Greenhouse Gas Emissions, and it is 92% dependent on oil, of which 84% is imported, representing a cost of around €187 billion a year. The road transport industry is transitioning towards electrification of the offered vehicle models. The massive use of EVs will also significantly contribute to carbon neutrality targets for 2050 defined by the European Commission. **Objective:** 1. Demonstrate the Impact of Mass Deployment of V2X Technologies: in both cities and power systems by considering users' behaviour, Developing a co-simulation platform allowing the joint simulation of the city traffic, the distribution network, and the V2X management strategies. 2. Propose and evaluate different business Model options to promote the adoption of V2X and its integration into electricity markets and power systems and promote the benefits for the end users, considering the impact of gender in this market. **Expected impacts:** 1. Development and Demonstration of Innovative V2X Management Systems: Develop and demonstrate new algorithms for houses, buildings, and energy communities' management considering V2X capability, and new algorithms to be used by companies allowing the optimal management of EVs considering the travel needs and the charging needs. 2. Engagement and Evaluation of User Adoption: Evaluate the users' engagement in V2X adoption. New services, DR programs, algorithms, and business models will be tested at the demonstrations. The impact

EV4EU

Electric Vehicles Management for carbon neutrality in Europe

	on user adoption and perception will be evaluated considering appropriated KPIs.
Technologies and services that the project has the ambition to develop and serve	The EV4EU project addresses all the challenges, scope objectives, and expected impacts identified
KER Type	Scientific Results (scientific knowledge, discoveries, or insights generated as a result of the project); Software
KERs of the Project	

KER 1	V2X Stations
Leader	SMART ENERGY LAB - ASSOCIATION (SEL)
Contributors	N/A
Country	Portugal
KER info	Cost-effective V2X/charging station to be used in parking lots allowing the charge of multiple vehicles simultaneously (multioutlet).

KER 2	Parking lot Energy Management System
Leader	SMART ENERGY LAB - ASSOCIATION (SEL)
Contributors	DTU
Country	Denmark, Portugal
KER info	Energy management system to be used in parking lots considering different assumptions in terms of use, communications availability, power grid capacity, coordination with RES, integration with the reservation system.

KER 3	Houses/Building energy management
Leader	SMART ENERGY LAB - ASSOCIATION (SEL)
Contributors	INESC-ID
Country	Portugal
KER info	Houses/Building energy management system considering V2X management, consumer behaviour and comfort, and devices modelling.

KER 4	Tools Decision Support tools for VPPs (partner GEN-I) and CPOs
Leader	SMART ENERGY LAB - ASSOCIATION (SEL)
Contributors	GEN I PPC
Country	Greece, Portugal, Slovenia

KER info	Decision support tools to be used by CPOs and VPPs, including the optimal management of V2X and the participation of V2X flexibility in different energy markets and energy services.

KER 5	Open V2X management platform
Leader	SMART ENERGY LAB - ASSOCIATION (SEL)
Contributors	PPC
Country	Greece, Portugal
KER info	Open V2X management platform assuring interoperability, scaleability, security, and privacy. Apps and tools for end-users will also be integrated.

KER 6	Integration of V2X management in DMS
Leader	SMART ENERGY LAB - ASSOCIATION (SEL)
Contributors	ELCE EDA HEDNO BEOF
Country	Denmark, Greece, Portugal, Slovenia
KER info	V2X flexibilities activation algorithms to be integrated into DMS operated by the DSO. The activation should be coordinated with CPO/VPPs.

KER 7	Co-simulation platform for V2X
Leader	SMART ENERGY LAB - ASSOCIATION (SEL)
Contributors	INESC ID UL
Country	Portugal, Slovenia
KER info	A co-simulation platform allowing the joint simulation of traffic in a city, the distribution network, and the V2X management strategies will be developed.

KER 8	V2X management strategies: high-level coordination tool
Leader	SMART ENERGY LAB - ASSOCIATION (SEL)
Contributors	INESC ID DTU
Country	Portugal, Denmark
KER info	Decision support tool providing information about the V2X station needs. The tool should provide the optimal

	location and type of V2X stations to be installed at a city level.

KER 9	Green Charging (New Solution)
Leader	SMART ENERGY LAB - ASSOCIATION (SEL)
Contributors	HEDNO
Country	Greece, Portugal
KER info	Incentive to promote coordination between V2X and RES. This incentive will be managed by the DSO in coordination with CPOs or VPPs.

KER 10	Demand Response for V2X
Leader	SMART ENERGY LAB - ASSOCIATION (SEL)
Contributors	HEDNO
Country	Greece, Portugal
KER info	Demand Response Programs considering the flexibility and costs of V2X. These services should be defined by regulators and managed by retailers, system operators, and aggregators.

KER 11	Flexible capacity contracts for V2X (New Solution)
Leader	SMART ENERGY LAB - ASSOCIATION (SEL)
Contributors	INESC ID
Country	Portugal
KER info	Flexible capacity contracts to reduce the cost of V2X connection to the distribution system. These contracts are defined by the DSO and negotiated with Aggregators or intensive consumers (EV users).

KER 12	Participation of V2X in markets and services
Leader	SMART ENERGY LAB - ASSOCIATION (SEL)
Contributors	GEN-I
Country	Portugal, Slovenia
KER info	A VPP can operate V2X flexibilities and, jointly with other RES, can be negotiated in electricity markets and services. The benefits should be shared between the VPP and the V2X owners.

Technology Readiness Levels (TRL) of the Priority Project	Technical and economic implication of decarbonisation of transport sector: TRL 6-8

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Electric Vehicles Management for carbon neutrality in Europe

Components (PPC) upon completion of the project	Enhancing effectiveness of energy system operation and resilience with electromobility: TRL 6-8
Initial TRL – Final TRL	

KER	Initial TRL	Final TRL
KER1	4	7
KER2	5	8
KER3	5	7
KER4	6	8
KER5	5	8
KER6	4	5
KER7	2	5
KER8	2	8
KER9	2	5
KER10	4	6
KER11	2	5
KER12	5	8

Hypothesis of product or service that could be marketed if the project meets TRL 8/9 criteria	Parking lot Energy Management System - Energy management system to be used in parking lots considering different assumptions in terms of use, communications availability, power grid capacity, coordination with RES, integration with the reservation system. / Decision Support tools for VPPs - Decision support tools to be used by CPOs and VPPs, including the optimal management of V2X and the participation of V2X flexibility in different energy markets and energy services. Open V2X management platform - Open V2X management platform assuring interoperability, scaleability, security, and privacy. Apps and tools for end-users will also be integrated. / Participation of V2X in markets and services - A VPP can operate V2X flexibilities and, jointly with other RES, can be negotiated in electricity markets and services. The benefits should be shared between the VPP and the V2X owners.

4.2.5 HYPERRIDE

HYPERRIDE

Hybrid Provision of Energy based on Reliability and Resiliency by Integration of DC Equipment

The HYPERRIDE project aims to implement DC and hybrid AC/DC grids to enhance energy distribution efficiency and resilience. Key objectives include technological advancements in DC grid components. resilience enhancement through fault mitigation and cybersecurity solutions. and renewable energy integration. Demonstrations in multiple countries validate the technologies, with outcomes including improved grid reliability. increased renewable energy penetration. and development of business models for new products/services. The project's focus lies in advancing grid technology. enhancing resilience. and facilitating renewable energy integration to support European energy efficiency and sustainability

General context and scope of project	**Context:** Global climate change is critically related to human activity and the energy that powers it. Enhancing energy efficiency and sustainability is thus a key pillar of most policy initiatives. Currently, most power grids rely on alternating current (AC) because generators, motors and transformers use the induction principle. With increasing contributions from internal direct current (DC) based renewable energy sources, electromobility and battery storages, low-voltage DC grids or DC coupled with AC in a hybrid network could enable more stable, efficient and sustainable electricity distribution at lower costs. The EU-funded HYPERRIDE project is developing the technologies to make this possible with planned demonstrations in a variety of use cases. All this will be accompanied by business models for the resulting products, services and applications. **Objective**: The project HYPERRIDE (HYbrid Provision of Energy based on Reliability and Resiliency via Integration of DC Equipment) contributes to the field implementation of DC and hybrid ACDC grids. Starting with the definition of most relevant fields of application for DC grids (local microgrids, grid enforcement to overcome congestions, coupling of AC grid sections, etc.), the enabling technologies will be specified in detail on different levels. Starting from the system perspective, guidelines for grid planning and operation are developed. To optimise invest for the use case dependent use of assets available sizing tools are adapted for the field of DC grids. DC circuit breakers are key technologies for grid protection needed to overcome the main concerns related to these infrastructures. Therefore, HYPERRIDE will raise the TRL of the most promising approaches currently available with a main focus on MVDC breakers. To enable grid automation DC sensors are developed further to provide field ready devices to create data for optimal grid automation. Automation algorithms will be created, validated in a test platform and transferred towards demonstration. This also involves concepts and solutions for cyber security and fault detection. In case of grid faults

HYPERRIDE **Hybrid Provision of Energy based on Reliability and Resiliency by Integration of DC Equipment**	
	necessary solutions are developed to prevent cascading effects. For fault prevention databases are created to trigger preventive measures. With demonstrations in three countries (Aachen/Germany, Lausanne/Switzerland, Terni/Italy) the project will showcase relevant and above-mentioned enabling technologies within a wide range of use cases. Benefits of the solutions will be evaluated, especially the integration potential of renewables with respect to conventional AC grids. Finally, business models are created for the products, services and applications in HYPERRIDE. Consequently, HYPERRIDE will actively identify and provide solutions to overcome barriers for a successful roll-out of new infrastructure concepts throughout Europe.
Organisational features of the project, including Consortium description	**Coordinator:** • AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH (AUSTRIA) **Partner:** • SCIBREAK AB (Sweden) • RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN (Germany) • EATON ELEKTROTECHNIKA SRO (Czech Republic) • ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE (Switzerland) • DR. TECHN. JOSEF ZELISKO FABRIK FUR ELEKTROTECHNIK UND MASCHINENBAU GMBH (Austria) • ENGINEERING - INGEGNERIA INFORMATICA SPA (Italy) • ASM TERNI SPA (Italy) • FLEXIBLE ELEKTRISCHE NETZE FEN GMBH (Germany) • EMOTION SRL (Italy)
Geographical coverage	Austria, Czech Republic, Germany, Italy, Sweden, Switzerland
Project call name	DC – AC/DC hybrid grid for a modular. resilient and high-RES share grid development
Project call number	LC-SC3-ES-10-2020
Budget	6.965.520,50 €
Desired impacts (expectations at beginning of project)	**DSO electricity grid challenges:** 1. (local) peak power bottlenecks in balancing fluctuating new high-power loads (EV, heat pumps) and generation profiles (PV, wind), 2. vulnerable grids in context of cascading fault effects and cyber security issues due to multiple new ICT access points from

HYPERRIDE

Hybrid Provision of Energy based on Reliability and Resiliency by Integration of DC Equipment

	application side. Objectives: modular, resilient and high-RES share grid development by hybrid AC-DC technologies. **Impacts:** 1. HYPERIRDE shall develop and demonstrate key enabling technologies and automation solutions on target TRL 5-8 and 2. shall foster the low carbon energy transition in facilitation planning and targeting investments in the sector.
Technologies and services that the project has the ambition to develop and serve	There were no omitted at all.
KER Type	Technological results: Scientific Results (scientific knowledge, discoveries, or insights generated as a result of the project); Hardware; Software; Business Models and Strategies
KERs of the Project	

KER 1	**5 kV VARC MVDC Circuit Breaker (SCiBREAK) and 14 kV MVDC Circuit Breaker based on VI technology (Eaton).**
Leader	AIT
Contributors	EPFL
Country	Austria, Switzerland
KER info	Hardware and software development of the MVDC circuit breaker, test and validation at SCiBreak and EATON laboratories and at the German pilot site (5 kV breaker).

KER 2	**Active DC Front End Converter for LV grids**
Leader	AIT
Contributors	RWTH Aachen
Country	Austria, Germany
KER info	With its controlled neutral line, the AC connection is suitable to provide positive, negative and neutral sequence currents and hence it is capable of AC balancing functions in addition to the DC droop control. This includes all necessary means to act as a smart active front end in a hybrid AC-DC grid including low voltage ride through and base functions towards the DC side (droop control functions).

KER 3	**MVDC-LVDC power conversion technologies based on DAB (RWTH) and MMC (EPFL) technologies**

Leader	AIT
Contributors	EMOTION (SME)
Country	Austria, Italy
KER info	DC transformers using Dual Active Bridge (DAB) and LLC converter topology which enable full and bidirectional power control and power flow optimisation.

KER 4	**Current and voltage sensors for MVDC**
Leader	AIT
Contributors	ENGINEERING
Country	Austria, Italy
KER info	For an intelligent, "smart" power grid and active load management it is indispensable to install current and voltage measurement at the relevant points in the medium voltage MVDC grid. Sensor concept and development for accurate measurement of MVDC voltage.

KER 5	**DMU (DC Measurement Units) for AC-DC grids, device and software**
Leader	AIT
Contributors	Eaton
Country	Austria, Czech Republic
KER info	DMU-M provides UTC synchronised accurate measurements for monitoring purposes. DMU-P provides UTC synchronised fast measurements for protection purposes.

KER 6	**Open and secure ICT platform for modular hybrid AC-DC grids**
Leader	AIT
Contributors	SciBreak (SME)
Country	Austria, Sweden
KER info	including adapted tool for threat detection (SUCCESS Toolbox extension).

KER 7	**Grid control algorithms for DC and hybrid microgrid applications**
Leader	AIT

HYPERRIDE

Hybrid Provision of Energy based on Reliability and Resiliency by Integration of DC Equipment

Contributors	Zelisko
Country	Austria
KER info	Droop curve, local control, central control, virtual impedance, control algorithm, virtual microgrid, Input: optimisation regime, local droop curve parameters.

Technology Readiness Levels (TRL) of the Priority Project Components (PPC) upon completion of the project

Technical barriers and technical measures for integration of RES at multiple levels and sector: TRL 6-8

Control and operation tools for a RES-based energy system: TRL 6-8

Planning of a resilient system with massive penetration of RES: TRL 6-8

Technical and economic implication of decarbonisation of transport sector: TRL 6-8

Enhancing effectiveness of energy system operation and resilience with electromobility: TRL 6-8

Initial TRL – Final TRL

KER	Initial TRL	Final TRL
KER1	5	7
KER2	6	9
KER3	4	5
KER4	5	7
KER5	5	7
KER6	5	7
KER7	5	8

Hypothesis of product or service that could be marketed if the project meets TRL 8/9 criteria

Active DC Front End for LV grids (AIT Smart Grid Converter) will be sold based on licensed manufacturing.

4.2.6 MASTERPIECE

MASTERPIECE

Multidisciplinary Approaches and Software Technologies for Engagement. Recruitment and Participation in Innovative Energy Communities in Europe

"MASTERPIECE focuses on creating a digital arena to facilitate the creation and operation of Energy Communities across Europe. Main objectives: i) Empowering energy consumers and fostering collaboration paving the way towards a new energy market paradigm; ii) Creating user-centric solutions to naturally accelerate citizens' involvement.

iii) Proposing innovative business strategies and incentives mechanisms to activate market participants' reaction; iv) Establishing standardised cybersecurity infrastructure to protect citizens and privacy; v) Demonstrating the feasibility and replicability of project's innovations across diverse geographical and frameworks real-life pilots.

General context and scope of project	**Context:** Energy communities hinge on the open participation of members and the local community. There are thousands of energy communities in Europe. Providing support for the creation and development of energy communities on a local scale is top priority in the EU. In this context, the EU-funded MASTERPIECE project will create a digital coordination and cooperation arena that will facilitate the creation and operation of energy communities throughout Europe. The project's overall objectives are to empower traditional energy consumers and to make them active agents of collaborative energy communities. It will also create user-centric solutions based on participatory approaches such as cocreation and naturally accelerate citizens' involvement. MASTERPIECE will demonstrate the applicability of methodological, technical and business innovations in several real-life pilots. **Objective**: MASTERPIECE aims at creating a digital coordination and cooperation arena that will facilitate the creation and operation of energy communities throughout Europe. The facilities given to members of the community to contribute to services and other developments will represent the distinction of the solution offered in this proposal, making it participative-by-design. The project's objectives are: i) to develop technical and social innovations to empower traditional energy consumers and to make them active agents of collaborative energy communities, paving the way towards a new energy market paradigm; ii) to create user-centric solutions that are based on participatory approaches such as co-creation and naturally accelerate citizens' involvement; iii) to propose new business strategies and incentive mechanisms that activate the reactions of market participants craving for business opportunities that imply energy use and cost reduction; iv) to configure a standardised and sound cyber-security infrastructure so the active citizens are

MASTERPIECE Multidisciplinary Approaches and Software Technologies for Engagement. Recruitment and Participation in Innovative Energy Communities in Europe	
	protected against cyberattacks, at the same time that privacy is defended in accordance with the revised EPBD and the GDPR law; and v) to demonstrate the applicability and replicability of methodological, technical and business innovations in a variety of real-life pilots in different geographical locations, with heterogeneous social and economic environments and different regulatory/administrative frameworks. MASTERPIECE will follow a staged implementation approach, utilising use cases with different maturity and TRLs. To demonstrate and evaluate the proposed innovations, it will leverage 4 pilot cases in different geographical areas and within different operational/policy frameworks (France, Italy, Sweden and Turkey).
Organisational features of the project, including Consortium description	**Coordinator:** • UNIVERSIDAD DE MURCIA (Spain) **Partner:** • ALGOWATT SPA (Italy) • UNIVERSIDAD DE MURCIA (Spain) • ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS (Greece) • R2M SOLUTION S.R.L. (Italy) • ODIN SOLUTIONS S.L. (Spain) • EXPERIENTIA GLOBAL SA (Switzerland) • TROYA CEVRE DERNEGI (Turkey) • ULUDAG ELEKTRIK DAGITIM A.S. (Turkey) • UNIVERSITA' COMMERCIALE LUIGI BOCCONI (Italy) • SUSTAINABLEINNOVATION I SVERIGE AB (Sweden) • UNIVERSITE D'AIX MARSEILLE (France) • RDIUP (France) • ACEA PRODUZIONE SPA (Italy) • GRID ABILITY SCARL (Italy) • NGENIC AB (Sweden) • UPPSALA KOMMUN (Sweden) • AGENCE LOCALE DE L'ENERGIE ET DU CLIMAT - MÉTROPOLE BORDELAISE ET GIRONDE – ALEC (France) • COMUNE DI BERCHIDDA (Italy) • PLATE-FORME EFFICACITÉ ÉNERGÉTIQUE SEINE AVAL SEINERGY LAB (France)
Geographical coverage	France, Greece, Italy, Spain, Sweden, Switzerland, Turkey

MASTERPIECE Multidisciplinary Approaches and Software Technologies for Engagement. Recruitment and Participation in Innovative Energy Communities in Europe	
Project call name	Supporting the action of consumers in the energy market and guide them to act as prosumers. communities and other active forms of active participation in the energy activities
Project call number	HORIZON-CL5-2022-D3-01-08
Budget	5.996.628 €
Desired impacts (expectations at beginning of project)	**CHALLENGES** #1 Demonstrate in real life interactive communication and support tools to engage citizens in the energy transition and to support them throughout the process of creating, constituting and developing an energy community, which are developed and fine-tuned based on field tests. #2 Engagement of distributed active consumers and energy communities at broad scale, including through innovative incentive mechanisms. **SCOPE OBJECTIVES** #1 Innovative tools and tailored solutions should be developed and tested in order to fully enable new types of interactions between citizens as consumers, prosumers and (members of) energy communities and foster participation in energy (in particular electricity) markets. To this aim, projects should link citizens, technologies, regulation and markets together. #2 Tools should be developed to support demonstration of the energy community paradigm shift within the mentioned context using suitable digital platforms for putting the citizens in direct contact with each other, suppliers, aggregators and other involved market stakeholders and to increase prosumers' satisfaction and participation. **EXPECTED IMPACTS** #1 Demonstrate in real life interactive communication and support tools to engage citizens in the energy transition and to support them throughout the process of creating, constituting and developing an energy community, which are developed and fine-tuned based on field tests; #2 Developing mechanisms to support the creation, growth and capacity building of energy communities.

MASTERPIECE

Multidisciplinary Approaches and Software Technologies for Engagement. Recruitment and Participation in Innovative Energy Communities in Europe

Technologies and services that the project has the ambition to develop and serve	N/A
KER Type	

KERs of the Project

KER 1	**MASTERPIECE service platform**
Leader	R2M
Contributors	All partners
Country	Spain, Turkey, Greece, Italy, France, Sweden, Switzerland
KER info	A platform of integrated digital and energy technologies offered to Public Administrations, ESCOs, utilities and other stakeholders for facilitating the LEC scaling and acquisition of new active members/prosumers

KER 2	**Intervention Program 2a) Recommendations for policymakers 2b) Replicability study**
Leader	R2M
Contributors	All partners
Country	Spain, Turkey, Greece, Italy, France, Sweden, Switzerland
KER info	A large-scale real-life experiment program tested in real pilots to assess how behavioural and economic incentives can shape new collaboration patterns

KER 3	**Model of incentives**
Leader	R2M
Contributors	R2M, UB
Country	Italy
KER info	A model of incentives for creation of benefits at different levels (economic, social, environmental, etc.) that provides knowledge and guidance through the platform services

KER 4	**EC participation toolkit**
Leader	R2M
Contributors	EXP, CERTH

MASTERPIECE

Multidisciplinary Approaches and Software Technologies for Engagement. Recruitment and Participation in Innovative Energy Communities in Europe

Country	Greece, Italy, Switzerland
KER info	Toolkit describing the path and services that users are offered to participate in energy community, with simulation and decision-making support

KER 5	MEET app
Leader	R2M
Contributors	N/A
Country	Italy
KER info	mobile app

KER 6	Energy Community DSS
Leader	R2M
Contributors	ALWA
Country	Italy
KER info	The DSS will include simulations tools to model, simulate and evaluate sustainable energy investments for new members of energy communities

KER 7	Energy Community Management Platform
Leader	R2M
Contributors	ALWA
Country	Italy
KER info	The platform will enable the seamless management of differentiated energy communities in different application domains and sectors

KER 8	Community DR mechanisms
Leader	R2M
Contributors	UMU, CERTH
Country	Greece, Italy, Spain
KER info	Holistic approach to DR and flexibility, combining the technical solutions with social motivational factors.

KER 9	Micro-grid load control
Leader	R2M
Contributors	CERTH

MASTERPIECE

Multidisciplinary Approaches and Software Technologies for Engagement. Recruitment and Participation in Innovative Energy Communities in Europe

Country	Greece, Italy
KER info	Fine-tuned load managers to optimise energy consumption and consumers convenience / comfort to maximise flexibility

KER 10	EC Business models
Leader	R2M
Contributors	R2M, UB
Country	Italy
KER info	Innovative business models to ensure sustainability of different models of energy communities

KER 11	MASTERPIECE Pilots
Leader	R2M
Contributors	Pilot owners
Country	France, Italy, Sweden, Turkey
KER info	Implementation of MASTERPIECE services in pilot environments

Technology Readiness Levels (TRL) of the Priority Project Components (PPC) upon completion of the project

Value of Consumer/Customer acceptance and engagement: TRL 6-8

Plug-and-play devices and IoT [internet of things] including security by design: TRL 6-8

Utilisation of communication networks including cyber security: TR L6-8

Cross-sectorial flexibility use cases: TR L6-8

Value assessment of the integration of buildings, infrastructure and smart communities in a RES based energy system: TRL 6-8

Control and operation tools for the integration of buildings and smart communities: TRL 6-8

Planning for resilient integration of buildings and infrastructures in an integrated energy system: TRL 6-8

Initial TRL – Final TRL

KER	Initial TRL	Final TRL
KER1	3	8
KER2	3	7
KER3	4	N/A
KER4	6	7

MASTERPIECE

Multidisciplinary Approaches and Software Technologies for Engagement. Recruitment and Participation in Innovative Energy Communities in Europe

	KER5	4	6
	KER6	6	7
	KER7	6	7
	KER8	4	7
	KER9	5	7
	KER10	3	7
	KER11	3	7
Hypothesis of product or service that could be marketed if the project meets TRL 8/9 criteria	FIWARE IoT platform with by design security & privacy features for data		

4.2.7 RE-EMPOWERED

RE-EMPOWERED **(Renewable Energy EMPOWERing European and Indian communities)**	
The main goal of RE-EMPOWERED is to develop and demonstrate solutions for the energy transition of local energy systems based on multi-energy microgrids, interconnecting multiple energy vectors. A complete set of solutions for local energy systems has been developed that will be demonstrated in four pilot sites, two European and two Indian. The solutions range from planning tools for designing or upgrading energy systems, to control and optimisation tools for the management of microgrids, interoperable platforms for the integration of the available energy carriers, the digitisation of the systems, community engagement mobile application and advanced power electronic interfaces.	
General context and scope of project	**Context**: Microgrids are small-scale power distribution systems integrating renewable energy. They can improve electric reliability, increase resilience, support clean energy and reinforce the central grid. In this context, the EU-funded RE EMPOWERED project is developing and demonstrating innovative tools to provide a complete solution for all phases of a microgrid/energy island and multi-microgrid applications. The tools include energy planning, ranging from microgrid design to upgrading existing installations to high renewable energy sources systems. To reach the optimal operation of larger and smaller energy systems, exploiting synergies with other available energy carriers, the project has developed advanced energy management tools. The tools are being tested at four demo sites with a weak or non-existing grid in Europe and India. **Objective**: The "RE-EMPOWERED" project aims to develop and demonstrate novel tools to provide a complete solution for all stages of a Microgrid/Energy Island and Multi-Microgrid applications. The tools include energy planning ranging from the design of Microgrids from scratch to the upgrade of existing installation to high-RES systems. Planning is guided by decision-making about the generation size and other infrastructure parameters, based on economic and reliability criteria. Advanced Energy Management tools and solutions, building on existing proven technologies developed within other EU projects, have been further developed to achieve optimal operation of larger and smaller energy systems considering Demand Side Management (DSM) capabilities. In addition, management tools are exploiting synergies with other available energy carriers, including electricity, heating, cooling, e-mobility, considering availability, operational, security, and reserve constraints. These will be demonstrated to leverage on the advantages load management offers, like greater flexibility and more efficient use of energy infrastructure and resources. From the citizen perspective, this entails the cultivation of higher efficiency mentality and self-sufficiency by an autonomous energy supply culture, when relevant. Concrete actions are taken for customer driven approaches, supported by dynamic pricing, the establishment of local energy communities and local community training. A specialised tool has been developed and is being demonstrated to support active involvement of citizens in their own energy generation and

RE-EMPOWERED (Renewable Energy EMPOWERing European and Indian communities)	
	management. Moreover, dedicated converters, electric vehicles and resilient infrastructures have been developed. All the above-mentioned tools and solutions are being demonstrated in four demo sites with weak or non-existing grid, two in Europe, (Bornholm in Denmark and Kythnos in Greece), and two in India (Ghoramara and Keonjhar).
Organisational features of the project, including Consortium description	**Coordinator:** • INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS- NATIONAL TECHNICAL UNIVERSITY OF ATHENS (ICCS -– NTUA) (European Coordinator) • INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR (IIT KHARAGPUR) (Indian Coordinator) **Partner:** • IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE (IMPERIAL) • DANMARKS TEKNISKE UNIVERSITET (DTU) • BORNHOLMS VARME AS (BV) • PROTASIS APPLICATION AND STUDIES OF PROTECTION, CONTROL AND SUPERVISION OF ELECTRICAL ENERGY NETWORKS SOCIETE ANONYME (PROTASIS) • DELOITTE ADVISORY, S.L. (DelAdv) • DIKTYO AEIFORIKON NISON TOY AIGAIOUAE (DAFNI) • INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR (ITT Bhubaneswar) • VISVESVARAYA NATIONAL INSTITUTE OF TECHNOLOGY NAGPUR (VNIT Nagpur) • COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH - CENTRAL MECHANICAL ENGINEERING RESEARCH INSTITUTE (CSIR-CMERI) • INDIAN INSTITUTE OF SCIENCE (IISC) • INDIAN INSTITUTE OF TECHNOLOGY DELHI • LAB CONCERN INDIA
Geographical coverage	Denmark, Greece, India, Spain, United Kingdom
Project call name	Integrated local energy systems (Energy islands): International cooperation with India
Project call number	LC-SC3-ES-13-2020
Budget	€ 2,987,287.50
Desired impacts (expectations at beginning of project)	**Challenges:** • Optimise the electricity system operation in synergy with other energy carriers/vectors to increase the hosting capacity for renewables, not just for electricity but also for heating/cooling, transport and/or industry in a sector coupling approach.

RE-EMPOWERED
(Renewable Energy EMPOWERing European and Indian communities)

- Optimise network architecture, planning and development based on the opportunities offered by integrated local energy systems and enabled by digitalisation and power electronics.

Scope:

- Develop and demonstrate solutions which analyse and combine, in a well delimited system, all the energy vectors that are present and interconnect them, where appropriate, to optimise their joint operation that is demonstrated by an increased share of renewables in and higher energy efficiency of the local energy system.
- Present a preliminary analysis of the local case as part of the content of the proposal and propose to develop solutions and tools for the optimisation of the local energy network that also have a high replication potential across Europe and India.

Expected Impact:

- Validate solutions for decarbonisation of the local energy system while ensuring a positive impact on the wider energy infrastructure, on the local economy and local social aspects, and local air quality

- Enhance the involvement of local energy consumers and producers, preferably by creating energy communities in the development and the operation of local energy systems and test new business models.

- Validate approaches, strategies and tools to safely and securely operate an integrated local energy system across energy vectors (electricity, heating, cooling, water, wastes, etc.) so that it is able to integrate higher shares of renewables (than it would in case of separate operation of infrastructures)

- Benchmark technical solutions and business models that can be replicated in many local regions and that are acceptable by local citizens.

Challenge 1:

This challenge is addressed by the project by the ecoTools ecoEMS and ecoMicrogrid. ecoEMS is an energy management system (EMS) Aiming at optimising the overall performance of isolated and weakly interconnected energy systems by increasing the share of RES. ecoEMS, as a modular system, comprises the forecast of load and RES, unit commitment and economic dispatch, as well I as online security assessment functions, Aiming to the highest exploitation of RES potential, at reasonable costs. Multi-vector optimisation has been incorporated dealing with expansion planning of the electrical system. The algorithm permits the deployment of different scales of power systems and cooperates with other modules, such as forecasting, both for load and RES generation. Similarly, ecoMicrogrid, optimises the performance of off-grid microgrids. ecoEMS performs a co-optimisation of

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electricity and heating systems, while rogrid co-optimises electricity and cooling.

Challenge 2:

This challenge is addressed by the project by the ecoTool ecoPlanning. ecoPlanning is an application that performs simulations that support the decision-making process regarding the deployment of new electricity generation units (conventional and renewable) on the electric systems of non-interconnected-islands, the RES hosting capacity of the energy system and the interconnection of non-interconnected-islands with the mainland power system. y-systems considering the flexibility provided by DR and other energy carriers, such as cooling. An optimisation algorithm determines the most economic generation mix considering the locally available energy sources and guides decisions on the time and size of different types of generation, energy-storage and other infrastructure parameters.

Scope objective 1:

This scope objective is the heart of the project. The solutions were developed in WP3 (ecoPlanning), WP4 (ecoEMS, ecoMicrogrid) and WP5 (ecoCommunity, ecoPlatform) and are currently being deployed/demonstrated in the four demo sites (WP7) and are being integrated with the existing energy vectors there like the heating district network in the Danish demo site (Bornholm). Upon deployment, the ecoTools will be demonstrated (WP7) so their impact and potential replication can be assessed (WP8).

Scope objective 2:

This scope objective was covered in the proposal by choosing as demo sites of the project, four demo sites that are complementary in terms of size, organisational and technical maturity (2 in Europe, 2 in India). The tool deployment/demonstration in Europe and India is ongoing, aiming to foster future replicability. The replication potential is covered in Task 8.6 ""Potential for replication in EU and India"" which will be completed in December 2024.

Expected Impact 1:

The project activities are already providing important benefits to the local communities. In the Indian demo sites hundreds of houses have been provided with electric power, improving social welfare and creating new business opportunities. Reducing the operational cost is a target for all demo sites. ecoMonitor tool specifically monitors the air quality.

A co-optimisation framework for energy systems consisting of multiple vectors (e.g., electricity, heating, cooling, mobility, etc.) has been developed and adequately shaped for the needs of the demo sites. Accordingly, the

RE-EMPOWERED (Renewable Energy EMPOWERing European and Indian communities)	
	development of economic & financial models for each demo site has been completed, including an analysis of the existing financial tools. **Expected Impact 2:** A cooperative society has already been formed at Keonjhar demo site in India. This is an important milestone as this is a legal entity (with bank accounts, etc.) that was created in the framework of the project and will be responsible for the management, maintenance and sustainability of the microgrid. Moreover, appropriate business models have been defined. Several community engagement activities have taken place at all demo sites, while particular attention is paid on training to ensure the sustainability of the systems. **Expected Impact 3:** This impact will be validated in 2024 in the Danish demo site of Bornholm. ecoEMS will be deployed aiming at optimising the overall performance of the energy system by increasing the share of RES. ecoEMS, as a modular system, comprises the forecast of load and RES, unit commitment and economic dispatch, as well as online security assessment functions, Aiming to the highest exploitation of RES potential, at reasonable costs. Multi-vector optimisation has been incorporated dealing with expansion planning of the electrical system. In this case, the demo site includes a District Heating Network which recently employed electric boilers. The cost-efficient usage of the electrical boilers on the heat plant will be controlled through input from the ecoEMS and ecoPlatform. **Expected Impact 4:** The defined use case architecture and business models aim that the solutions of the project will be replicable. In addition, during the development process of the ecoTools special attention was paid to the adjustability of the tools to different energy systems. Replicability is currently being addressed towards the end of the project.
Technologies and services that the project has the ambition to develop and serve	Energy planning. Energy management. ICT for energy. Power electronic converters. Resilient PV and Wind structures. Air quality monitoring.
KER Type	Technological results; Hardware; Software; Business Models and Strategies
KERs of the Project	**KER 1** | **ecoEMS** Leader | ICCS-NTUA Contributors | Imperial College of London, DTU, Varme, PROTASIS, DAFNI, Deloitte Advisory

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Country	Greece, United Kingdom, Denmark, Bornholm, Denmark, Spain
KER info	ecoEMS is an energy management system (EMS) Aiming at optimising the overall performance of isolated and weakly interconnected energy systems by increasing the share of RES. ecoEMS, as a modular system, comprises the forecast of load and RES, unit commitment and economic dispatch, as well as online security assessment functions, Aiming to the highest exploitation of RES potential, at reasonable costs. Multi-vector optimisation has been incorporated dealing with expansion planning of the electrical system. The algorithm permits the deployment of different scales of power systems and cooperates with other modules, such as forecasting, both for load and RES generation.

KER 2	**ecoPlanning**
Leader	ICCS-NTUA
Contributors	Imperial College of London, DTU, Varme, PROTASIS, DAFNI, Deloitte Advisory
Country	Greece, United Kingdom, Denmark, Spain
KER info	ecoPlanning is an application that performs simulations that support the decision-making process regarding the deployment of new electricity generation units (conventional and renewable) on the electric systems of non-interconnected-islands, the RES hosting capacity of the ES and the interconnection of non-interconnected-islands with the mainland power system. ecoPlanning makes it possible to design and develop high-RES energy systems considering the flexibility provided by DR and other energy carriers, such as cooling. An optimisation algorithm determines the most economic generation mix considering the locally available energy sources and guides decisions on the time and size of different types of generation, energy-storage and other infrastructure parameters.

KER 3	**ecoPlatform**
Leader	DTU

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Contributors	Contributors: ICCS-NTUA, Imperial College of London, Varme, PROTASIS, DAFNI, Deloitte Advisory
Country	Greece, United Kingdom, Denmark, Spain
KER info	ecoPlatform is a lightweight, cloud-based platform with the primary objective of providing the RE-EM POWERED tools with a secure and reliable interface to the deployed distributed energy infrastructure. In addition, ecoPlatform will be capable of managing, processing and handling the heterogeneous data and command stream from the RE-EMPOWERED tools, metering infrastructure, supervisory control and data acquisition (SCADA) systems, microgrid central controllers (MGCCs) and selected controllable assets. ecoPlatform will provide a platform as a service that can integrate the solutions in one software structure.

KER 4	**ecoCommunity**
Leader	Imperial College of London (ICL)
Contributors	Contributors: ICCS-NTUA, DTU, Varme, PROTASIS, DAFNI, Deloitte Advisory
Country	Greece, United Kingdom, Denmark, Spain
KER info	ecoCommunity is a digital platform Aiming to enhance citizen engagement, active participation, and technology acceptance. The ecoCommunity displays consumption and dynamic prices, electronic billing, payment, feedback portal, etc. and provides an innovative approach for DSM by providing a set of time slots to connect loads. This approach makes sure that the preferences of the consumers are considered and reduces curtailment of generation/overloading of the system. The manager access level provides access to various tool modules for consumers who are unable to use the tool due to the unavailability of smartphones/internet (e.g. in developing countries).

KER 5	**ecoMicrogrid**
Leader	ICCS-NTUA
Contributors	Imperial College of London, DTU, Bornholms Varme, PROTASIS, DAFNI, Deloitte Advisory

RE-EMPOWERED (Renewable Energy EMPOWERing European and Indian communities)		
	Country	Greece, United Kingdom, Denmark, Spain
	KER info	ecoMicrogrid is an EMS for microgrids and small off-grid systems, where synergies with different energy vectors are considered by the advanced management algorithms deployed targeting to optimise the performance. All the key components of the microgrid are monitored by the ecoMicrogrid, addressing the required actions (load-shedding, diesel generator start-up/shutdown, RES power curtailment) to achieve the desired optimisation goals. Its features include: - Multi-vector optimisation capable to be integrated at different scales of microgrids. - Predictive control strategies utilise forecasts to proactively engage assets and loads to achieve maximum system performance. - Data acquisition and archiving of different energy assets from different vendors.
Technology Readiness Levels (TRL) of the Priority Project Components (PPC) upon completion of the project	Control and operation tools for a RES-based energy system: TRL 6-8 Planning of a resilient system with massive penetration of RES: TRL 9 Value of Consumer/Customer acceptance and engagement: TRL 6-8 Plug-and-play devices and IoT [internet of things] including security by design: TRL 6-8	
Initial TRL – Final TRL		

KER	Initial TRL	Final TRL
KER1	6	7
KER2	9	9
KER3	5	8
KER4	3	6
KER5	5	8

Hypothesis of product or service that could be marketed if the project meets TRL 8/9 criteria	**ecoPlanning** is an application that performs simulations that support the decision-making process regarding the deployment of new electricity generation units (conventional and renewable) on the Electric Systems of Non-Interconnected islands, the RES hosting capacity of the ES and the interconnection of NI ls with the mainland power system. ecoPlanning makes it possible to design and develop high-RES energy systems considering the flexibility provided by DR and other energy carriers, such as cooling. **EcoPlatform** is a lightweight, cloud-based platform with the primary objective of providing the RE-EM POWERED tools with a secure and reliable interface to the deployed distributed energy infrastructure. In addition, ecoPlatform will be capable of managing, processing and handling the heterogeneous data and command stream from the RE-EMPOWERED tools, metering infrastructure, supervisory control and data acquisition (SCADA) systems, microgrid central controllers (MGCCs) and selected controllable assets. It provides a platform as a service that can integrate the solutions in one software structure.

RE-EMPOWERED (Renewable Energy EMPOWERing European and Indian communities)	
	EcoMicrogrid is an EMS for microgrids and small off-grid systems, where synergies with different energy vectors are considered by the advanced management algorithms deployed targeting to optimise the performance. All the key components of the microgrid are monitored by the ecoMicrogrid, addressing the required actions (load-shedding, diesel generator start-up/shutdown, RES power curtailment) to achieve the desired optimisation goals. Its features include: • Multi-vector optimisation capable to be integrated at different scales of microgrids. • Predictive control strategies utilise forecasts to proactively engage assets and loads to achieve maximum system performance. • Data acquisition and archiving of different energy assets from different vendors.

4.2.8 RESONANCE

RESONANCE **Replicable and Efficient Solutions for Optimal Management of Cross-sector Energy**	
Creating a plug-and-play framework for tailored Customer Energy Manager (CEM) solutions. Implementing hybrid modelling approaches for flexible assets and baseline loads. Developing consumer-centric Artificial Intelligence for automated demand response. Enhancing interoperability. trust. security. and privacy in energy management. Measurable outcomes include increased efficiency in demand-side flexibility. consumer empowerment. reduced carbon emissions. and technological advancements in energy management. The project addresses topics such as software development. AI integration. and market integration.	
General context and scope of project	**Context:** Recent changes and innovations in the energy sector have showcased the possible benefits of utilising demand-side flexibility management (DSFM) solutions for improving overall efficiency. Customer energy managers and resource managers are crucial tools for this purpose, being efficient, practical and promising DSFM solutions. The EU-funded RESONANCE project will integrate DSFM in Europe by developing a revolutionary software framework that will allow for the easy and fast incorporation of customer energy manager and resource manager solutions. To achieve this, it will cooperate with stakeholders and sector actors to encourage the adoption of customer energy managers and showcase their lower costs and work requirements. **Objective**: The RESONANCE project develops an innovative software framework that provides means for rapid development and plug-and-play deployment of standard-compliant Customer Energy Manager (CEM), Resource Manager (RM), and their aggregation solutions. The CEM, specified in the EN 50491-12 standard family, is the next-generation demand-side flexibility management (DSFM) solution in Europe. CEM is a software agent that automates DSFM by interacting with smart appliances (represented by RMs), aggregators, and the markets to maximise customer benefits. According to the new EN 50491-12-2 standard, CEMs are envisioned to 1) provide a more deterministic demand response, and 2) be able to optimise consumer benefits with respect to multiple incentives and optimisation targets. To achieve this, there is a need for accurate models of flexible assets (smart appliances) and model predictive control techniques to automate the decision-making within the customer premises. The RESONANCE Framework will facilitate the adoption of CEMs as the next generation DSFM system by significantly reducing the development efforts and costs. This is achieved with 1) a standard-compliant and modular system architecture, and 2) an innovative modelling pipeline that combines automated machine learning (AutoML) with physics-based modelling to provide accurate and robust models of flexible assets with minimum effort. The project brings together 19 partners (including a cluster with 40 organisations) with inter-disciplinary expertise and forms a basis for a cross-

RESONANCE **Replicable and Efficient Solutions for Optimal Management of Cross-sector Energy**	
	sector energy ecosystem that significantly contributes to the mobilisation of DSFM at a large scale. Large scale piloting in six member states with a variety of consumer sectors, flexible assets (e.g. electric vehicles, HVAC systems, and white goods), stakeholders, and market settings (including sector integration with district heating) is utilised for demonstrating and validating the scaleability and replication potential of the solutions.
Organisational features of the project, including Consortium description	**Coordinator:** • VTT TECHNICAL RESEARCH CENTRE OF FINLAND LTD [VTT] (FI) **Partner:** • CAVERION SUOMI OYJ (FI) • ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS (EL) • FORTISS GMBH (DE) • TRIALOG SAS (FR) • CHECKWATT AB (SE) • ENERIM OY (FI) • INSTITUT "JOŽEF STEFAN" (SI) • SMART COM D.O.O. (SI) • EUROPEAN DYNAMICS S.A. (EL) • CONSOLINNO ENERGY GMBH (DE) • BOVLABS (FR) • IN-JET (DK) • CLUBE (EL) • ECE D.O.O. (SI) • AMIBIT, ENERGETSKI SISTEMI, D.O.O. (SI) • MÖLNDAL ENERGI AB (SE) • ELEKTRO CELJE D.D. (SI) • MUNICIPALITY OF EORDAIA (EL)
Geographical coverage	Denmark, Finland, France, Germany, Greece, Slovenia, Sweden
Project call name	Replicable solutions for a cross sector compliant energy ecosystem
Project call number	HORIZON-CL5-2022-D3-01-12
Budget	8.032.034,75 €

RESONANCE Replicable and Efficient Solutions for Optimal Management of Cross-sector Energy	
Desired impacts (expectations at beginning of project)	Among the call challenges, RESONANCE definitely addresses the one "to provide viable interoperable solutions and products available to all levels of the grid including within the home which makes it simple to increase flexibility energy in energy consumption and have a positive impact in balancing demand/response with an increasing share of renewable energy sources" and the one "to provide a catalogue of services and flexibility potential of appliances tailor made for specific consumer groups as well as the combining IT-tools that can help them providing flexibility services to the energy market and system". Among the scope objectives and expected impacts, the RESONANCE project already addressed (i) the provision of "new business models supported by innovative and interoperable solutions enabled by connecting systems from different sectors", and (ii) the creation and population of "a commonly agreed catalogue of energy smart home appliances (including EV charging and storage), services and hardware/software solutions compliant to a set of standards for minimum interoperability". **Objective:** 1. Design and facilitate the co-development of the RESONANCE framework providing cost efficient deployment of seams and their aggregation solutions into different sectors. The software framework has been established. 2. Develop common interfaces and dominated modelling tools that enable plug-and-play setup and deployment of resource managers (RMs) for flexible assets in different sectors. Common interfaces have been established in the Customer Energy Manager (CEM) and RM levels, while the aggregator level and the market integration are still pending. 3. Provide secure and interoperable interfaces and automated flexibility management services enabling cost efficient replication of Customer Energy Managers (CEMs) at a large scale. The achievement of this goal is well advanced regarding the interoperability aspect. 4. Develop CEM aggregation solutions, sustainable market places, and business model supporting scaleability uptake of CEM solutions in different markets and geographical settings. Business model analysis has been initiated, while the services and data market place framework have been established. 5. Demonstrate and validate the replication potential of the RESONANCE solutions in different member states. While different solutions have been developed in various pilot countries of the project, the replication aspect is planned to be addressed in the second phase of the project.

RESONANCE Replicable and Efficient Solutions for Optimal Management of Cross-sector Energy	
	6. Promote and facilitate the adoption of the CEMs as the next generation cross-sector DSFM solution within the EU and worldwide. This objective is still pending.
Technologies and services that the project has the ambition to develop and serve	**Objective:** 1. Design and facilitate the co-development of the RESONANCE framework providing cost efficient deployment of seams and their aggregation solutions into different sectors. The software framework has been established. 2. Develop common interfaces and dominated modelling tools that enable plug-and-play setup and deployment of resource managers (RMs) for flexible assets in different sectors. Common interfaces have been established in the Customer Energy Manager (CEM) and RM levels, while the aggregator level and the market integration are still pending. 3. Provide secure and interoperable interfaces and automated flexibility management services enabling cost efficient replication of Customer Energy Managers (CEMs) at a large scale. The achievement of this goal is well advanced regarding the interoperability aspect. 4. Develop CEM aggregation solutions, sustainable market places, and business model supporting scaleability uptake of CEM solutions in different markets and geographical settings. Business model analysis has been initiated, while the services and data market place framework have been established. 5. Demonstrate and validate the replication potential of the RESONANCE solutions in different member states. While different solutions have been developed in various pilot countries of the project, the replication aspect is planned to be addressed in the second phase of the project. 6. Promote and facilitate the adoption of the CEMs as the next generation cross-sector DSFM solution within the EU and worldwide. This objective is still pending. Definition of standardised interfaces at the aggregator level, or regarding the connection of the aggregators to the electricity market places are still to be established. Moreover, high volatility in energy production in combination with bid optimisation strategies of producers and consumers in multiple levels of electricity markets may create news forms of system instability. Accuracy of demand/price forecasting affects optimal strategies, the implementation of which in turn affect the forecasting accuracy, in a chicken and egg problem.
KER Type	Technological results; Software

RESONANCE

Replicable and Efficient Solutions for Optimal Management of Cross-sector Energy

KERs of the Project

KER	
Leader	
Contributors	
Country	
KER info	

Technology Readiness Levels (TRL) of the Priority Project Components (PPC) upon completion of the project

N/A

Initial TRL – Final TRL

KER	Initial TRL	Final TRL
KER1	3	7
KER2	3	7
KER3	3	7
KER4	3	7
KER5	3	7
KER6	3	7
KER7	3	7
KER8	3	7
KER9	3	7
KER10	3	7
KER11	3	7
KER12	3	7
KER13	3	7
KER14	3	7
KER15	3	7
KER16	3	7
KER17	3	9

Hypothesis of product or service that could be marketed if the project meets TRL 8/9 criteria

Optimisation of energy consumption and energy production of CHP

4.2.9 SENDER

SENDER **(Sustainable Consumer Engagement and Demand Response)**	
The project focus is to develop and test the next generation of energy-service applications for demand-response, home automation and convenience. Objectives are to develop innovative strategies to co-create demand response mechanisms, generate new models to identify consumer patterns and better forecast consumption, develop digital twins to leverage demand-side flexibility potential, develop an innovative business model that shares profits between consumers and grid operators, and contribute to the creation of a legal and regulatory framework that accelerates and facilitates the implementation of pattern-based DR technologies.	
General context and scope of project	**Context**: As the EU moves towards sustainable energy, co-creation is the future of the energy service market. This entails a shift in the balance of power, turning customers into a new generation of collaborators and putting them at the heart of the energy sector. The EU-funded SENDER project will develop energy service applications for proactive demand response (DR), home automation convenience and security mechanisms. By engaging customers in a co-creation process, the project will shift DR from a reactive to a proactive approach. Consumer data will be collected and processed to identify typical consumption patterns, mirror them by digital twins (DTs) based on artificial intelligence technologies and aggregate the DTs' supply/demand characteristics. **Objective**: SENDER will develop the next generation of energy-service applications for demand-response, home-automation, -convenience and -security. It puts consumers at the heart of the energy market by engaging them in a co-creation process with other actors from the energy domain during the specification of proactive DR mechanisms to cater for the consumers' long-term incentivisation. Grid operators are the 2nd group of SENDER core beneficiaries. The project results will increase the efficiency/hosting capacity of distribution networks by improving the quality of load forecasts and providing access to load flexibility, which will allow to improve frequency stability, congestion management and increased RES integration. In addition, monetarization on the flexibility potential will be provided by the participation in balancing/regulatory power markets. SENDER shifts DR from a reactive to a proactive approach. Consumer data will be collected and processed by means of sensor data from its premises in a cyber-secure way to identify typical consumption patterns, mirror them by digital twins (DT) based on artificial intelligence technologies and aggregate the DTs supply/demand characteristics. The clustering of the

SENDER (Sustainable Consumer Engagement and Demand Response)	Sender
	consumer DTs will be conducted based on societal science approaches at three demonstration sites. Allowing interoperability with legacy systems and third-party applications, SENDER envisions business models (BM) that based on the condition that the consumer receives a fair share of the DSOs profit from flexibility use. BMs will focus on the role of the DSO as a facilitator, but also on energy communities/cooperatives as local actors that will manage their members´ flexibility assets. Based on the co-creation process, consumers will also be actively involved into the BM design. The SENDER wider roll-out after the project will be prepared by exploitation plans and implementation guides for the co-creation process and the SENDER soft- and hardware.
Organisational features of the project, including Consortium description	**Coordinator:** • SMART INNOVATION NORWAY AS **Partner:** • HYPERTECH ANONYMOUS INDUSTRIAL TRADING COMPANY OF INFORMATION AND NEW TECHNOLOGY • TRIALOG • UNIVERSITY OF APPLIED SCIENCES UPPER AUSTRIA (Austria) • ECOSERVEIS • WEIZER ENERGY AND RESEARCH CENTRE (Austria) • PARAGON • AUSTRIAN INSTITUTE OF TECHNOLOGY • CENTRE FOR ADVANCED STUDIES, RESEARCH AND DEVELOPMENT IN SARDINIA • NXTECH • NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY • EUROQUALITY • DISTRIBUTION OF ELECTRICAL ENERGY OF ALGINET • TECHNICAL RESEARCH CENTRE OF FINLAND • QUE TECHNOLOGIES
Geographical coverage	Austria, Finland, France, Greece, Italy, Norway, Spain
Project call name	H2020-LC-SC3-2018-2019-2020
Project call number	LC-SC3-EC-3-2020
Budget	€ 5,836,574.96

SENDER (Sustainable Consumer Engagement and Demand Response)	
Desired impacts (expectations at beginning of project)	**Challenges:** To put consumers / prosumers at the heart of the energy market and to develop and test new cost-effective solutions for consumers based on the next generation of energy services for consumers that are beneficial to the integration of RES into an efficient operation of the grid and of the power system that will allow to better predict and incentivise consumer behaviour. Decentralised (renewable) energy production and digitalisation allow for new ways for consumers to engage in the energy transition. **Objectives:** Develop and test novel solutions and tools for demand response and energy services; demonstrate services that bring a fair share of benefits to consumers and to the energy system, in particular the electricity grid. **Expected impacts:** Increased use of demand response across the European energy system; Increased number and types of consumers engaged in demand-response across Europe." **Challenges:** Co-creation process and engagement strategies (D7.1). Use cases (D2.4) **Objectives:** D3.1 Architecture, WP7 latest deliverables will show the benefits of the solution adopted for the users. **Expected impacts:** WP7's latest deliverables will show the benefits of the solution adopted for the users. The challenge is the complexity to engage consumers to adopt solutions vs the effort & budget that it takes. And the results are not the expectations at the beginning. The deployment of the complex solutions for flexibility needs more human resources and budget, because many households need a lot to adapt, so a standard gap is there, it should be more standardised the electricity installations, even though the households are old. It would help to push adaptations/updates from national governments legislations.
Technologies and services that the project has the ambition to develop and serve	Interoperable digital communication solutions; Increased data protection and privacy for customers; Improved modelling of the flexibility levers from the new energy services.

SENDER (Sustainable Consumer Engagement and Demand Response)	Sender

KER Type	N/A

KERs of the Project

KER 1	SENDER Smart Box
Leader	Smart Innovation Norway
Contributors	Hypertech, Paragon, QUE, Trialog, Nxtech, CSR4, NTNU, AIT
Country	Norway, Greece, France, Italy, Austria
KER info	An integrated Smart Home Gateway, enabling e.g. end-to-end interoperable communication between various Distributed Energy Resources (DER) elements (PV, battery storage, heat pumps, domestic hot water (DHW)) as well as intra-building IoT sensing and control equipment and providing a gateway between the building area network and the SENDER system that also offers monitoring and control access to system modules and contractually authorised stakeholders (Aggregator, Facility Managers, ESCOs). There is a wide area of exploitation opportunities that covers e.g. energy cooperatives, supply companies or facility management companies.

KER 2	SENDER Flexibility profiling and management
Leader	Smart Innovation Norway
Contributors	Hypertech, Paragon, QUE, Trialog, Nxtech, CSR4, NTNU, AIT
Country	Norway, Greece, France, Italy, Austria
KER info	A tool that will deliver holistic context-aware flexibility profiles, reflecting real-time demand and storage flexibility as a function of multiple parameters that will be continuously updated, thus providing a robust framework for monitoring and analysing energy-related behaviour and corresponding flexibility features. Also, the exploitation of this tool is not limited to the SENDER context but could be e.g. sold to facility management companies or integrated with appliance providers.

KER 3	**Smart charging EV energy management system and the methodology to design, integrate, validate and assess interoperable, secured and scaleable flexibility-based systems.**
Leader	Smart Innovation Norway

SENDER
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Contributors	Hypertech, Paragon, QUE, Trialog, Nxtech, CSR4, NTNU, AIT
Country	Norway, Greece, France, Italy, Austria
KER info	An innovative EMS going from basic charging to smart charging and possibly to V2G as well as going from flex activation "blindness", i.e. an activation signal is sent without any feedback, to flex activation assurance and traceability. This offers the opportunity for the evaluation and supply of EV-based flexibility as a support to public grid, private grid, local energy community, energy markets. This component of the SENDER package has extremely high stand-alone marketing potential that is related but not limited to charging station operators, grid operators or aggregators.

KER 4	**Front-end application**
Leader	Smart Innovation Norway
Contributors	Hypertech, Paragon, QUE, Trialog, Nxtech, CSR4, NTNU, AIT
Country	Norway, Greece, France, Italy, Austria
KER info	QUE will design and develop appropriate ambient user interfaces to improve user experience and enable the provision of an easy-to-use, intuitive module that facilitates display of data streams at different spatiotemporal granularity and designed in a way to ensure consumer awareness, engagement and motivation to participate in DR schemes. This interface comes together with an aggregator front-end tool to support portfolio management. Therefore, also this bundle has a broad range of application opportunities in the areas of DR operators, smart home systems, grid operators and aggregators.

KER 5	**Smart water heating system**
Leader	Smart Innovation Norway
Contributors	Hypertech, Paragon, QUE, Trialog, Nxtech, CSR4, NTNU, AIT
Country	Norway, Greece, France, Italy, Austria
KER info	A smart Control Interface (CI) solution with local algorithms, sensors and control for using the water heater tank as a flexible battery by regulating the amount of water with the highest temperature in the tank. Thus, optimising the energy needed to provide enough hot water during the day and storing

SENDER
(Sustainable Consumer Engagement and Demand Response)

	excess energy from the household. The CI will include smart temperature sensing, set temperature control, relay for heater element control, energy measurement and communication interface as well as edge computing. The stand-alone commercialisation of this solution is more than realistic e.g. in a cooperation with water and heat product manufacturers, DR service providers, aggregators or as an addition to the product portfolio of existing smart home system suppliers.

KER 6	Digital twin
Leader	Smart Innovation Norway
Contributors	Hypertech, Paragon, QUE, Trialog, Nxtech, CSR4, NTNU, AIT
Country	Norway, Greece, France, Italy, Austria
KER info	The digital twin solution offers the opportunity to integrate user group specific characteristics and segmentations for the modelling of future consumer behaviour. This will in the context of SENDER allow for a definition of consumer patterns and tailored demand response schemes. However, the technological background that is used to develop the digital twin offers the opportunity to also market it in a huge number of other contexts where the innovative pairing of the physical world with virtual assets enables close-to-reality analysis and prediction of consumer behaviour that promises economic revenues.

KER 7	Forecasting algorithm tool
Leader	Smart Innovation Norway
Contributors	Hypertech, Paragon, QUE, Trialog, Nxtech, CSR4, NTNU, AIT
Country	Norway
KER info	This probabilistic forecast tool for loads and DER generation is based on models that use statistical and machine learning postprocessing of smart meter data, user profiles as well as on meteorological forecasts from publicly available global forecasting services. Due to the precision of its methodology, it is potentially of high interest for

SENDER (Sustainable Consumer Engagement and Demand Response)	
	grid operators, utilities, energy cooperatives, aggregators or integrated forecast service suppliers.
Technology Readiness Levels (TRL) of the Priority Project Components (PPC) upon completion of the project	Value of Consumer/Customer acceptance and engagement: TRL 6-8 Plug-and-play devices and IoT [internet of things] including security by design: TRL 6-8 Utilisation of communication networks including cyber security: TRL 9 Cross-sectorial flexibility use cases: TRL 6-8
Initial TRL – Final TRL	
Hypothesis of product or service that could be marketed if the project meets TRL 8/9 criteria	N/A

KER	Initial TRL	Final TRL
KER1	6	8
KER2	5	7
KER3	5	7
KER4	5	8
KER5	6	8
KER6	4	6
KER7	4	6

4.3 Project Key Exploitable Results

The KER details summarising the survey responses provided by the projects are presented in a table below. These responses, as reported in Chapter 1, were instrumental in formulating our analysis, providing comprehensive data highlighting key aspects of each project, including objectives, progress, and significant results. This detailed information facilitated a thorough understanding and evaluation of the projects, ensuring a robust and thorough analysis.

Table 6: Summary of survey responses

Project name	COMMUNITAS	DEDALUS	EDDIE	EV4EU	Hyperride	MASTERPIECE	RE-EMPOWERED	RESONANCE	SENDER
KER 1	COMMUNITAS Core Platform	Social Science Framework, innovative multidimensional incentives and nudging interventions for residential DR	EDDIE Framework	V2X Stations	5 kV VARC MVDC Circuit Breaker (SCiBREAK) and 14 kV MVDC Circuit Breaker based on VI technology (Eaton).	MASTERPIECE service platform	ecoEMS	Smart EV Charging & Implicit / Explicit DR	SENDER Smart Box (KER1 - HPT)
KER 2	Energy community management platform	AI-based individual and building-level-level consumers clustering and market segmentation algorithms.	AIIDA	Parking lot Energy Management System	Active DC Front End Converter for LV grids	Intervention Program 2a) Recommendations for policymakers 2b) Replicability study	ecoPlanning	Bringing flexibility to the grid	SENDER Flexibility profiling and management (KER2 - HPT)
KER 3	Investment advisor for household- and community-level sustainable investments	Open APIs for DR-ready smart appliance IoT platform	Knowledge on energy data sharing and interoperability	Houses/Building energy management	MVDC-LVDC power conversion technologies based on DAB (RWTH) and	Model of incentives	ecoPlatform	Automated Implicit Demand Response	Smart charging EV energy management system and the methodology to design, integrate,

Project name	COMMUNITAS	DEDALUS	EDDIE	EV4EU	Hyperride	MASTERPIECE	RE-EMPOWERED	RESONANCE	SENDER
	(Knowledge base)				MMC (EPFL) technologies				validate and assess interoperable, secured and scaleable flexibility-based systems (KER3&4 - TRIALOG)
KER 4	Investment advisor for household- and community-level sustainable investments	Energy Data Space adaptation for extended DR interoperability, and privacy-preserving DLT/Blockchain Data Governance and flexibility exchange	EDDIE Market Place	Tools Decision Support tools for VPPs (partner GEN-I) and CPOs	Current and voltage sensors for MVDC	EC participation toolkit	ecoCommunity	Explicit Demand-Side Flexibility	Front-end application (KER5 – QUE)
KER 5	Energy Community Planning Tool	Digital Twins for optimal assets vs consumers flexibility planning and decentralised DR management		Open V2X management platform	DMU (DC Measurement Units) for AC-DC grids, device and software	MEET app	ecoMicrogrid	Direct Load Management by External Actor	Smart water heating system (KER6 - NXT)
KER 6	MultiFASE – near real-time optimisation of ECs' Distributed Energy Resources (DERs)	Comfort-based flexibility models and DR optimal management tools for individual		Integration of V2X management in DMS	Open and secure ICT platform for modular hybrid AC-DC grids	Energy Community DSS		Manage mixed energy systems	Digital twin (KER7 – PARA)

Project name	COMMUNITAS	DEDALUS	EDDIE	EV4EU	Hyperride	MASTERPIECE	RE-EMPOWERED	RESONANCE	SENDER
		residential consumers and/or serviced apartments							
KER 7	Demand Response and optimal market position (we have more KERs buy they don't fit in this table)	Electrical flexibility management tools for building-level energy communities, energy districts and virtual cluster of buildings, based on pre-aggregation and shared DR assets (KER7); Optimal aggregation of flexible energy (heat, electrical) assets for district heating and decentralised cross-commodity electricity vs heat management (KER8).		Co-simulation platform for V2X	Grid control algorithms for DC and hybrid microgrid applications	Energy Community Management Platform		Local Energy Management	Forecasting algorithm tool (KER8 – CRS4)

Project name	COMMUNITAS	DEDALUS	EDDIE	EV4EU	Hyperride	MASTERPIECE	RE-EMPOWERED	RESONANCE	SENDER
KER 8				V2X management strategies: high-level coordination tool		Community DR mechanisms		DHO Flexibility Procurement	
KER 9				Green Charging (New Solution)		Micro-grid load control		End-user Cross-sector Energy Optimisation	
KER 10				Demand Response for V2X		EC Business models		DHO Energy Management	
KER 11				Flexible capacity contracts for V2X (New Solution)		MASTERPIECE Pilots		Direct load and/or storage management	
KER 12				Participation of V2X in markets and services				Manage Mixed Energy System like heat pumps with PV, Storage Battery	

Project name	COMMUNITAS	DEDALUS	EDDIE	EV4EU	Hyperride	MASTERPIECE	RE-EMPOWERED	RESONANCE	SENDER
KER 13								Time and Tariff synchronisation	
KER 14								Flexible start of a smart device	
KER 15								Provide local power managing capabilities	
KER 16								Direct Load Control to Limit Consumption	
KER 17								Utilising Thermal Inertia for Combined Heat and Power (CHP) Production Optimisation	

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