European Commission

bridge

Technologies for consumers

Case Study #10

October 2024

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0. INTRODUCTION

This paper sets out to develop a series of case studies over the course of the contract period (2024-2026), each incorporating the results of projects that will be part of the BRIDGE[1] programme during the period. The aim is to complete two case studies annually (with case studies #9 and #10 being the focus of this year's analysis), with each case study addressing a specific thematic area. These studies aim to go beyond the scope of individual project results, providing a broad and comprehensive synthesis of multiple results in order to present an integrated overview of the research landscape.

Case Study #10 specifically delves into *Technologies for Consumers*, analysing how advancements in this area are contributing to enhancing consumer engagement and empowerment in the energy sector. This thematic focus allows for a detailed examination of how technological innovations are being leveraged to cater to consumer needs, preferences, and behaviours in energy consumption (Chapter 2).

In pursuing this objective, the case studies will not only highlight the diverse achievements within the BRIDGE projects but also demonstrate how these outcomes align with and respond to real market demands. This approach ensures that the acquired knowledge is not merely theoretical but has practical applicability and potential for exploitation. By focusing on market needs, these case studies aim to “bridge” the gap between research and application, showcasing how BRIDGE projects can contribute to solving current industry challenges.

Furthermore, the integration and interaction of the different projects and their outcomes will enable a more comprehensive understanding of the collective impact of the BRIDGE initiative. Each case study will provide detailed insights into specific topics, ranging from technological innovations to market adaptations, thus offering stakeholders valuable insights into the practical benefits and potential applications of the research. This structured analysis will support the effective dissemination and exploitation of BRIDGE project results, ultimately promoting innovation and growth in the relevant sectors.

In light of the above, this paper is structured as follows:

- Chapter 1 provides an overview of the methodological approach employed;
- Chapter 2 presents the digital tools and technologies for smart grids under analysis;
- Chapter 3 discusses on the potential opportunities and strategies for scaling up the project results;
- Chapter 4 provides the case study conclusions;
- The Annex section presents the tables with the single project’s analysis.

[1] BRIDGE Website: https://bridge-smart-grid-storage-systems-digital-projects.ec.europa.eu/

1. METHODOLOGICAL APPROACH

This chapter outlines the methodological approach employed by the project team for data collection and analysis, while also detailing the criteria used to select projects for inclusion in the case studies.

1.1 DATA COLLECTION ANALYSIS

The data collection activities began with an extensive data extraction from the CORDIS[2] database, which encompasses detailed records of EU-funded research and innovation projects (the project types currently included are from the Horizon 2020[3] and Horizon Europe[4] 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, a list of active projects was obtained, which served as a basis for further analysis.

Following the data extraction, the project team developed a detailed survey[5] to establish a unified database. The survey was designed to capture a comprehensive range of information about each project, including keywords/macro topic, types of technologies, demonstrations, pilots, and other relevant details. This structured approach ensured the collection of consistent and thorough data directly from project coordinators.

Upon receipt of the completed survey for all project involved, a thorough analysis of the responses was conducted. This involved systematically reviewing and categorising the data to extract pertinent information about each project's status and achievements.

The next analysis phase centred on selecting mature projects, defined as those within twelve months of their scheduled completion. This criterion was designed to ensure that the selected projects had reached a sufficient stage of development to yield substantial and meaningful results for analysis. From the initial dataset, nineteen projects were identified as meeting the maturity criterion.

To further refine the selection process, a comprehensive keyword-based filtering methodology was employed. This approach was designed to ensure that the projects selected for the case studies were not only mature but also closely aligned with the specific thematic focus, in this instance, *Technologies for Consumers*. The selection process began with an evaluation of nineteen mature projects, each of which was scrutinised for its level of maturity—defined by their proximity to completion and readiness to deliver substantial results.

Subsequently, the filtering process delved into the *Sub-topics* covered by each project. These keywords were used to match project descriptions, deliverables, and outcomes, ensuring a detailed alignment with the targeted research areas.

Through this rigorous process, nine projects were ultimately identified.

After having selected the projects for the case study analysis, a specialised survey[6] focusing on key exploitable results (KERs) was developed and distributed. The purpose of this questionnaire was to collect detailed information regarding the unique contributions and insights of each project. A thorough 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

[2] CORDIS database: https://cordis.europa.eu/it
[3] European Commission: https://cinea.ec.europa.eu/programmes/horizon-europe/h2020-programme_en
[4] European Commission: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en
[5] Survey #1: https://ec.europa.eu/euSurvey/runner/bridgeSurvey2023
[6] Survey #2: https://ec.europa.eu/eusurvey/runner/7a874f25-a4bf-a3ce-8c2c-1083d9151f77

method of analysis provided a more comprehensive view, highlighting areas where collective efforts could lead to significant progress and innovation. Additionally, this comparative process was instrumental in drawing comprehensive and well-founded conclusions, 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 rigorous criteria applied to identify the most promising projects to include in our case studies. These 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 (these are macro topics that were used in the bridge Brochure[7])
3. relevance of the sub-topics to ensure a comprehensive analysis of innovation and market adoption.

Please refer to the attached document for further details regarding the selection criteria specifications.

The following table provides a detailed overview of the outcomes from the selection process, highlighting the projects that were identified based on the established criteria.

Table 1: Project and subtopics selected for the analysis

N. Project	Logo	Project
1	accept – active communities & energy prosumers for the energy transition	ACCEPT
2	CREATORS	CREATORS
3	MAESHA	MAESHA
4	POCITYF	POCITYF
5	RE-EMPOWERED – Renewable Energy EMPOWERing European & InDian Communities	RE-EMPOWERED

[7] Bridge Brochure 2024: https://op.europa.eu/en/publication-detail/-/publication/79e30192-4a3f-11ef-acbc-01aa75ed71a1/language-en/format-PDF/source-337202064

N. Project	Logo	Project
6		RENergetic
7		SENDER
8		SERENE
9		SUSTENANCE

2. CASE STUDY #10: TECHNOLOGIES FOR CONSUMERS

This chapter looks into Case Study #10, which examines emerging technologies designed to enhance consumer engagement and empowerment in the energy sector. By focusing on innovations that directly impact consumer experiences and behaviours, the analysis sheds light on how these technologies are transforming energy consumption, improving user interfaces, and fostering greater energy efficiency and sustainability, and what the barriers are to be overcome for their large-scale deployment.

2.1 CONTEXT AND CHALLENGES ADDRESSED

Energy transition and decarbonisation are two key drivers for the development and adoption of consumer-empowering technologies, i.e. innovations that allow citizens to manage their own energy usage better, reducing associated GHG emissions and contributing positively to the overall energy system. Smart-home technologies, next-generation energy storage systems, electric vehicles and renewable energy integration are paving the way to this transformation.

The focus will be on key consumer-empowering technologies, including photovoltaic plants and microgrid development, residential energy storage solutions, digital platforms and energy management systems for consumers as well as peer-to-peer energy trading platforms. Additionally, this report discusses emerging technologies such as machine learning and Internet of Things (IoT) applied within smart home technologies as well as fast-charging networks and V2G technology.

Photovoltaic plants and microgrid developments allow for renewable energy integration at the consumer level. PV modules are becoming increasingly more efficient and affordable, with families and communities being in addition to generate their own clean energy. Such energy can be effectively controlled and distributed using microgrid systems, most of which also connect with home or community-level battery systems in addition to the main grid. These systems are able to operate independently during grid outages, providing a continuous supply of power, or to be integrated at community level, minimising the exchange of energy with the main grid throughout the day and the year. Smart inverters manage the flow of electricity between solar panels, battery storage, and the grid to make optimal use of energy and enhance efficiency.

Energy storage solutions are increasingly available for consumers and their price is becoming more competitive, allowing a strong increase of their penetration and consequently the integration of renewable energy sources. Smart batteries allow excess energy produced by photovoltaic plants during the day to be stored and used at night or during a power outage, therefore playing a key role in terms of reliability and energy independence. Improving energy density, reducing costs, and extending lifetime of these energy storage solutions is a key focus of R&I efforts, especially on lithium-ion and solid-state batteries.

Digital platforms and energy management systems provide consumers with granular insights into their patterns of energy use. Taken in combination, these digital platforms give dynamic personalised suggestions for reducing use and cost through real-time data. They are able to enable demand response whereby consumers can be induced to trim or shift their energy use from times of peak demand. Through the availability of these programs, customers are not only afforded the opportunity to save on energy costs but also assist in grid stability and reduce carbon emissions overall.

Peer-to-peer energy trading platforms allow consumers to sell their excess renewable energy produced directly to other peers or buy from other peers, avoiding traditional utility companies. This decentralised approach could yield competitive pricing and higher adoption of renewable sources. Smart contracts within blockchain systems will automate and secure these transactions, guaranteeing fairness and reliability.

The **technologies in smart homes** are indeed influential in changing how people interact with their energy use. They include smart thermostats, intelligent lighting systems, and other energy-efficient appliances that are very common, but also in electric vehicles charging systems. These apply machine learning algorithms and IoT connectivity to improve energy consumption. For instance, smart thermostats learn user behaviour and adjust heating and cooling schedules as to not waste any energy while at the same time maintaining comfort. Something similar occurs with the smart lighting system, which dims or brightens depending on occupancy and availability of natural light, reducing the consumption of excess energy.

State-of-the-art consumer technologies are therefore a key player for the achievement of energy transition and decarbonisation targets: consumers, empowered by these innovations, could contribute to significant reductions in GHG emissions, increases in the degree of energy independence, and the production of a more sustainable, reliable and resilient energy system.

2.2 KEY FINDINGS

Based on the analysis of the project results, three research topics in the field of technologies for consumers were identified, namely: Energy communities

- Platforms/Tools: R&D projects are focused on developing integrated platforms and tools, including energy management systems (EMS). These platforms incorporate AI, IoT, and blockchain technologies to facilitate real-time data exchange, improve grid operations, and enhance cybersecurity. User-friendly interfaces enable consumers to actively participate in energy markets and optimise their energy usage;
- Flexibility: R&D projects are exploring innovative solutions to enhance system flexibility, including demand response programs and the integration of distributed energy resources. These projects aim to provide dynamic balancing of energy supply and demand, crucial for accommodating the variability of renewable energy sources. Flexible energy systems are vital for ensuring grid stability and optimising resource use;
- Consumers aggregation: Research projects are focusing on the formation and management of energy communities, enabling local stakeholders to collectively generate, manage, and consume energy. These initiatives promote renewable energy adoption and enhance local energy resilience. By empowering communities with tools and frameworks, these projects facilitate sustainable energy practices and stronger community engagement. This topic is connected with Bridge Case Study #5 on Energy Communities.

By addressing these key areas, research and development projects are paving the way for a more resilient, efficient, and sustainable energy future. The strategic focus on digital twins, community engagement, accurate forecasting, integrated platforms, sophisticated management systems, and enhanced flexibility will drive innovation and ensure effective energy management for consumers.

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

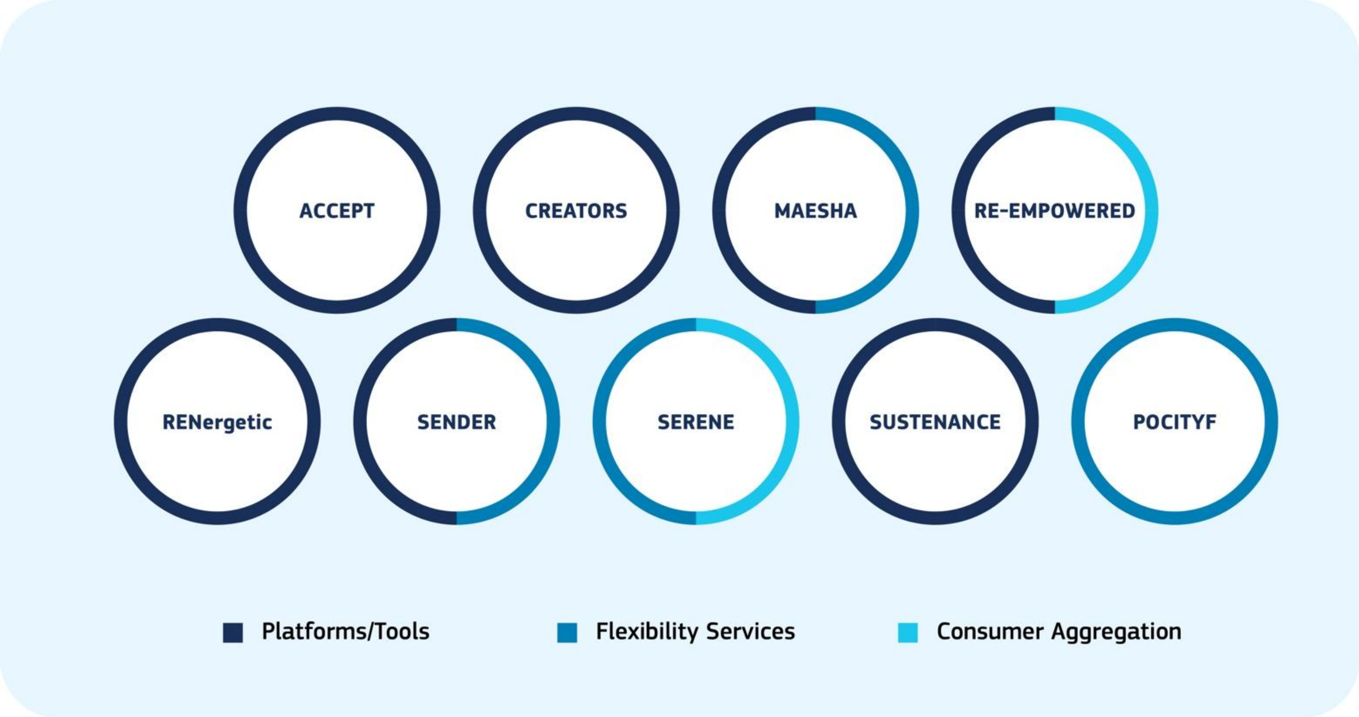

Figure 1: Projects Contribution to different R&D Topic

The following paragraphs present more details on how the different topics are covered by the selected projects and on the general trends of research activities carried out in the field.

2.2.1 Platforms/Tools

Digital platforms and tools are transforming community energy uses towards greater efficiency, flexibility and sustainability. These tools allow for real-time monitoring, controlling, and optimisation of energy uses, enabling consumers to make knowledgeable choices with full participation in energy markets. Key enablers include user-friendly applications for energy use insights, dynamic pricing and demand response strategies, while the application of digital twins can model consumer behaviour to optimise energy use. To overcome the challenges in consumer engagement, technology complexities, data privacy/security and system integration, the solutions under development need to be integrated with intuitive interfaces and robust cybersecurity measures and adaptable designs across many local conditions.

ACCEPT is producing an integrated suite of digital tools for improving consumer energy management in energy communities, including the Consumer Digital Twin, a model that simulates consumer behaviour and household energy use-and the Citizen Application, a mobile app, which allows users to monitor and remotely control energy consumption, data visualisation, and appliances. In addition, the project is also working on an On-Demand Flexibility Manager, which will optimise the energy consumption patterns based on historical data. The challenges encountered by the project are related to:

- engaging consumers in demand-response: ACCEPT deals with this by integrating electro-mobility and assisted living into energy services, making energy services more appealing to consumers;
- variable renewable energy source integration: the project addresses this through the development of the On-Demand Flexibility Manager and other optimisation tools that make use of demand flexibility;

- technological complexity of IT systems for end users: in this case: ACCEPT overcomes the issue by developing a user-friendly interface to connect with these tools and being adaptable to various building types and consumer segments.

CREATORS has as a key tool under development: the CES-as-a-Service platform, which embeds energy management software for the real-time monitoring, control, and optimisation of energy systems within community energy projects. As part of this platform, consumers will be empowered through their direct access to a digital twin of their energy systems, and they will be able to perform scenario analyses to make informed decisions. The project also has an ongoing operations management system with trading and settlement tools for local energy markets, whose integration will provide flexibility, efficiency, and sustainability in community energy systems. The challenges encountered by the project are related to:

- technical integration of various renewable energy sources with digital tools in CES: the project meets this challenge by adopting a modular approach, so the different components are developed and tested separately and then integrated in CES;
- market readiness: the CES-as-a-Service model is not commercially ready yet; to answer this, the project has set the objective to further develop and refine the service to achieve market readiness for the less advanced modules;
- consumer engagement: the project will meet this challenge by providing the most user-friendly interfaces for the set of services envisaged under the CES-as-a-Service concept;
- economic viability: the project incorporates detailed financial assessments and connects with the European Investor Confidence Project through cost reduction to attract investment.

MAESHA is developing innovative demand response solutions and virtual power plants that pool residential and industrial energy assets, therefore advancing the consumer energy management tool. Such tools empower consumers to be active participants in energy markets-to optimise their energy use and contribute to grid stability. A smart platform aggregates flexibility services, allowing real-time adjustments in energy consumption according to supply and demand conditions. The project is also working on developing a user-friendly residential demand response toolbox, thereby providing incentives and ways through which consumers can reduce energy use during peak periods. All of these tools are specifically tailored to the needs of island communities. The challenges encountered by the project are related to:

- consumer engagement: MAESHA plans to offer monetary rewards and educational campaigns to create awareness and participation;
- technological complexity: advanced demand response systems incorporate logics that can be difficult to understand by the end user; MAESHA reduces these complications by developing user-friendly interfaces and by training consumers and local stakeholders;
- interoperability: adding new tools in energy systems that have grown organically over time is generally challenging; MAESHA works to develop solutions that take into consideration the wide range of existing devices to generate interoperable solutions that can be easily fitted into existing infrastructures;
- data privacy and security: MAESHA integrates strong cybersecurity and GDPR-compliant measures into its solutions to make data secure while allowing efficient energy management;
- scalability: the adaptation of the tools for wide usage across different islands is challenging; MAESHA designs solutions that are flexible and modular, scaling to meet conditions of different islands.

RE-EMPOWERED creates tools for consumer energy management like the ecoCommunity platform, which will provide consumers with an interactive interface regarding energy consumption monitoring, dynamic pricing, and demand response programs, the energy management system named ecoEMS, and the tool for ecoMicrogrid support efficient operation through optimisation of renewable energy use and coordination among different energy carriers. Integrated into smart devices and local energy infrastructure, these tools enable informed consumer decisions about energy use, thereby contributing to a more sustainable energy future. Demonstrations across the four pilot sites in Europe and India are validating these solutions, increasing consumer engagement, and encouraging the development of local energy communities. The challenges encountered by the project are related to:

- limited awareness and engagement: a large number of consumers have very limited knowledge about the benefits active energy management can offer; the ecoCommunity platform educates users by engaging them with understandable information and easy-to-use tools;
- data privacy and security: consumers may be reluctant to share their energy data; the ecoPlatform offers a specific way of handling and storing data, thereby alleviating privacy-related concerns while allowing for effective energy management;
- multivariant technical infrastructures: grids differ from one region to another; the project customises tools to fit this difference to ensure that the implementation is effective in all pilot sites;
- complexity due to multi-energy systems: the integration of multi-energy vectors at higher challenging in some sense, from a technological standpoint; advanced tools from both ecoEMS and ecoMicrogrid offer an integral suite of tools for managing and optimising these complex systems;
- long-term consumer interest: it may be difficult to hold consumer interest in such a project over a long enough period of time; the project will ensure continuous feedback, training, and dynamic pricing-related stimuli that will keep consumers engaged for long-term participation and impact.

SENDER focuses on developing and testing energy service applications for demand-response and home automation. It aims to create innovative strategies for co-creating demand response mechanisms, generating models to identify consumer patterns, and forecasting energy consumption more accurately. It also develops methodologies for digital twins, enabling maximum demand-side flexibility, and delivers an innovative business model that shares the generated profit between consumers and grid operators. The project collects and processes consumer data in a cyber-secure way, with the use of artificial intelligence for the creation of digital twins modelling actual consumption patterns; the results are then aggregated for the analysis of supply and demand characteristics. An overview of SENDER architecture is shown in the following figure.

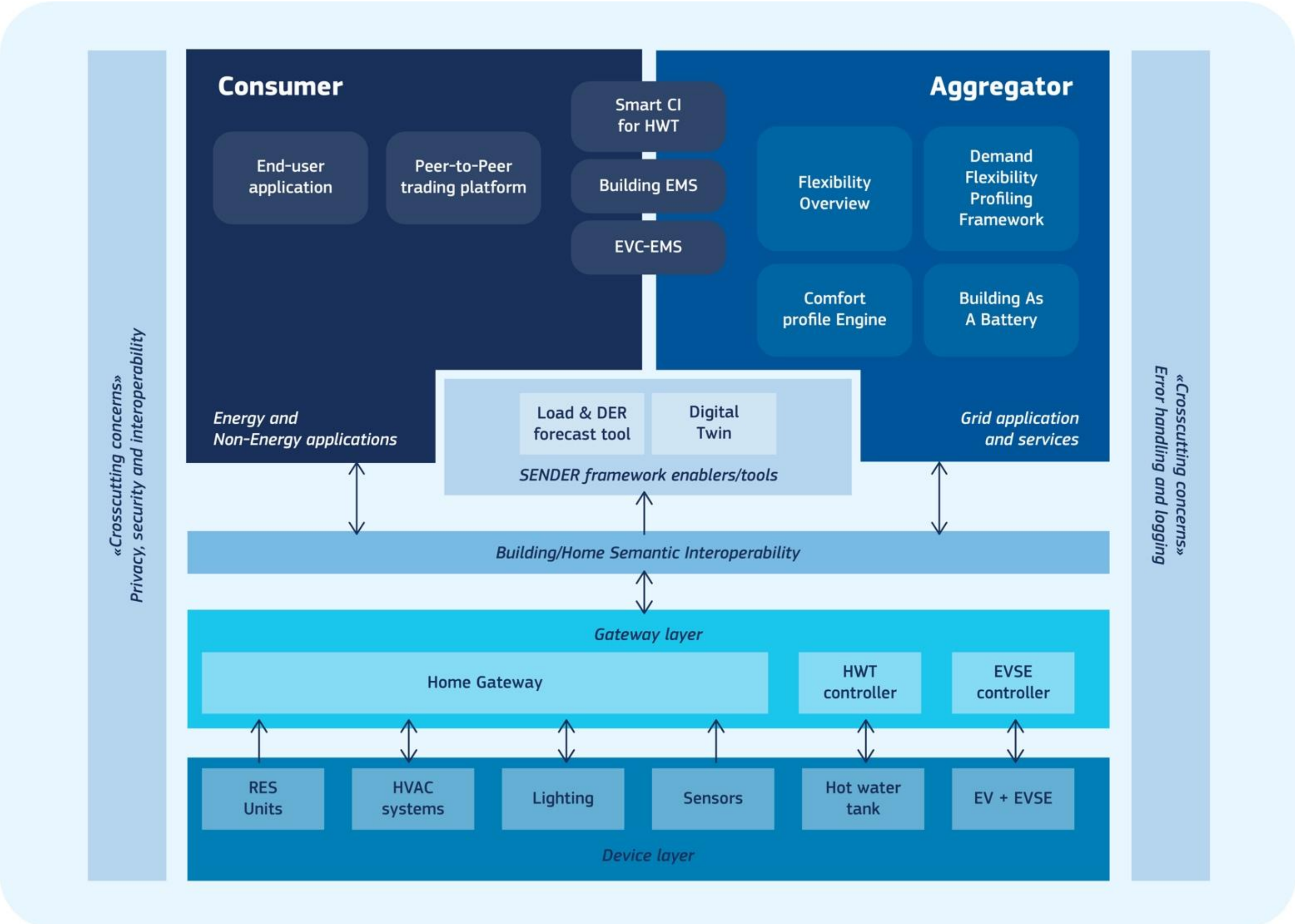

Figure 2: SENDER Architecture

The challenges encountered by the project are related to:

- consumer engagement: SENDER addresses this by involving consumers in the co-creation process, ensuring the services meet their needs and providing incentives through a fair profit-sharing model;
- data privacy and security: SENDER uses cyber-secure data collection and processing methods to ensure privacy while still enabling the creation of accurate consumption models;
- technical interoperability: the project applies an “interoperability by design” approach and develops digital communication solutions based on IEC standards that can work with various legacy systems and third-party applications;
- scaling solutions across diverse regions: adapting solutions for diverse regional infrastructures and consumer bases is complex; SENDER addresses this by deploying demonstrations across multiple countries and tailoring solutions to local needs and conditions.

SUSTENANCE is developing smart technological solutions that enable local communities to move towards a carbon-neutral energy system. This includes energy management systems that optimise the consumption of locally produced renewable energy, integrated with multiple energy vectors like electricity, heat, water, and waste transportation. Examples include the Community Energy Management System by Neogrid and the Intelligent Energy Management System by STAY-ON Energy Management. They help in balancing energy supply and demand through real-time data and predictive algorithms, but also are user-friendly, putting less burden on the users, while increasing auto-consumption and reducing energy supply costs. The USEF framework is used in the development of SUSTENANCE tools. This provides a common standard for building all smart energy products and services, with flexibility and efficiency among the key objectives and with a market-based coordination mechanism that recognises four operational regimes for grids, compared to the only two operational regimes envisaged by conventional grids, as shown in the following Figure.

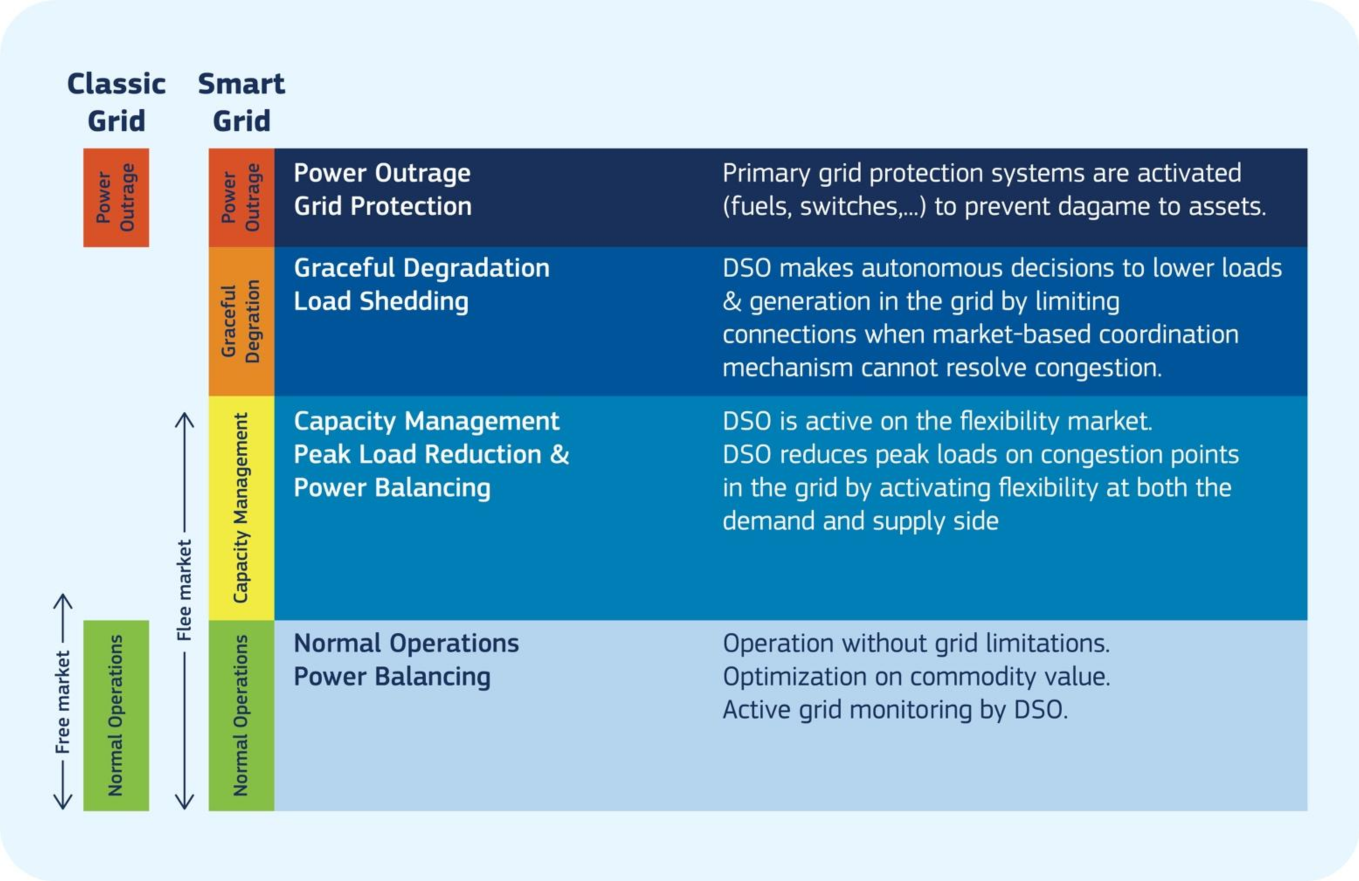

Figure 3: SUSTENANCE - Overview of the USEF framework[8]

The challenges encountered by the project are related to:

- regulatory barriers: fast approval for new technical solutions acting on grids is complicated due to different local regulations; SUSTENANCE is cooperating actively with policymakers to facilitate the respective processes;
- local energy community adoption: most countries currently lack established frameworks for LECs; SUSTENANCE is helping to establish governance structures to support their creation;
- technical integration: coordinating the electricity system/market and other energy systems/markets remains complicated but is needed because sector-coupling is useful to maximise decarbonisation potential; SUSTENANCE develops solutions that are more versatile, including both the electricity and district heating/cooling markets;
- consumer engagement: to motivate consumers to join energy communities, SUSTENANCE is designing user-friendly tools and running awareness campaigns to increase engagement levels;
- data management: huge volumes of information and data need to be managed securely; SUSTENANCE has opted for advanced digital tools with cybersecurity and privacy protection measures to handle data efficiently and securely.

[8] https://h2020sustenance.eu/wp-content/uploads/2024/03/D3.2.pdf

2.2.2 Flexibility Services

Flexibility services are one of the enablers of the upgrade of energy grids, which make it possible to integrate renewables efficiently and balance dynamically supply and demand. Indeed, with the increasing decentralisation of energy resources, flexibility is needed to manage their variability to maintain stability in the grid.

These services draw on digital platforms to adjust energy production or consumption in real time to meet grid needs and optimise energy flows at household, community and regional levels. Predictive models and algorithms dynamically balance the loads by responding to fluctuations in demand or renewable energy supply, or by applying smart technologies that shift energy uses based on grid signals. Flexibility can be monetised by providing services like congestion management, benefiting both consumers and operators.

MAESHA, in addition to the tools described in the previous paragraph, develops systems that advance energy grid flexibility for geographical islands. This mainly relates to a smart platform aggregating flexibility service that can enable higher penetration of renewable sources. This is named Flexibility Management and Trading Platform and integrates real-time and long-term energy-economic models so to achieve the optimal operation of the island grid through dynamic balancing of supply and demand. The challenges encountered by the project are related to:

- technical integration: the integration of various energy systems in a seamless way poses difficulty; hence, interoperability standards and in-depth system testing are being achieved by this project;
- regulatory hurdles: it is complicated to develop flexibility services that are seamlessly applicable to various regulatory frameworks across different countries; MAESHA addresses this through the development of specific market and regulatory frameworks that can be adapted to the local contexts;
- community buy-in: the acceptance of communities is crucial but usually not easy to obtain; at its pilot sites, MAESHA has developed a community-based approach under which local people participate actively, and their concerns are considered in every step of the process;
- scaling across islands: MAESHA does this by creating a publicly available toolkit and by monitoring replication across follower islands for adaptability and effectiveness.

POCITYF is advancing flexibility services for energy grids by enabling consumers to actively participate in optimising energy flows. It is deploying tools like the Flexibility Aggregation Platform, which utilises flexibility from distributed energy resources to provide services such as congestion management to distribution system operators and monetise value in multiple energy markets. The project is also developing flexibility control algorithms to manage energy use from controllable devices, reducing peak loads and minimising costs for both consumers and grid operators. Additionally, the Energy Router integrates energy production, storage, and consumption at the building and district levels, facilitating more efficient grid interaction and enhancing grid stability. These efforts aim to support the shift towards decentralised, consumer-driven energy markets, maximising the use of renewable resources. An overview of the three-step energy management model implemented in POCITYF is shown in the following Figure.

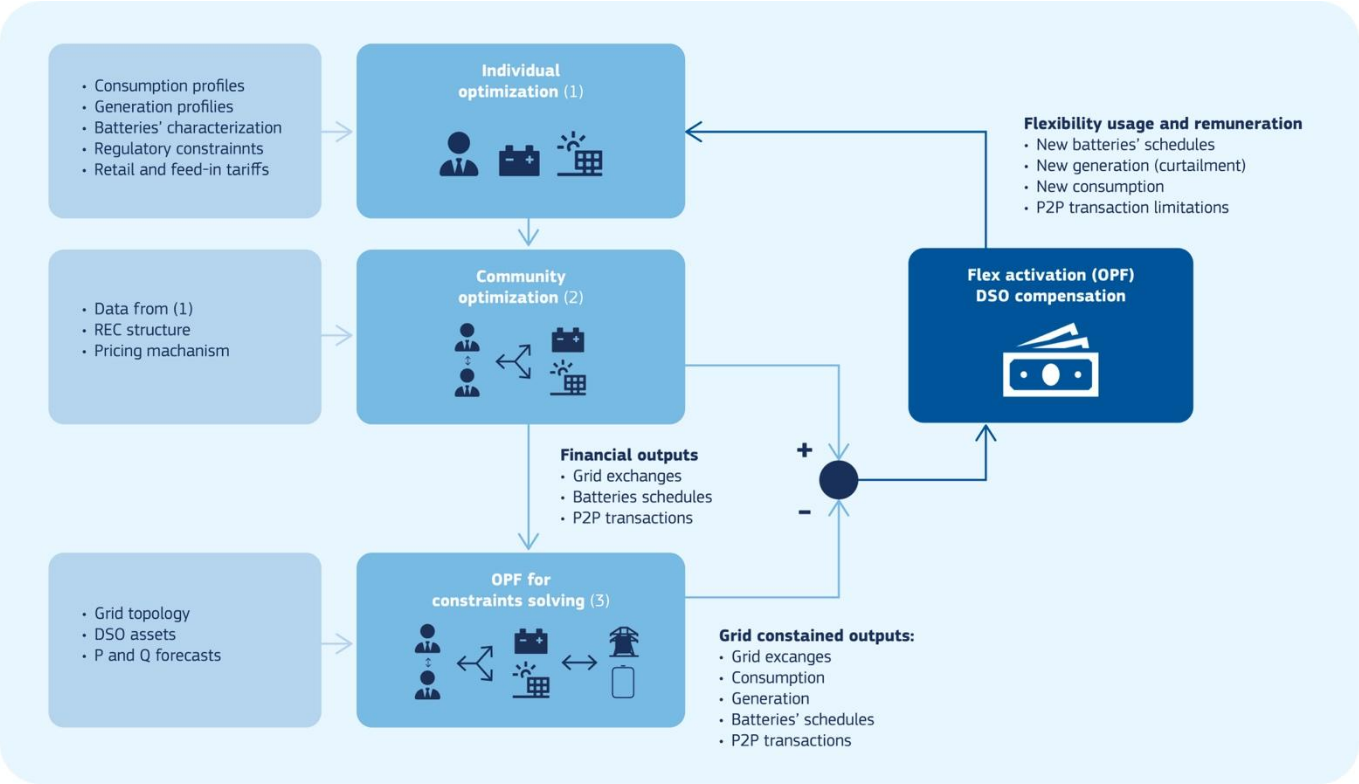

Figure 4: POCITYF Three-Stage Energy Management Model[9]

The challenges encountered by the project are related to:

- ensuring reliable grid operations with high levels of distributed energy: this is addressed by developing advanced control algorithms that optimise flexibility use;
- limited consumer awareness and participation: this is overcome by implementing engaging digital tools that educate consumers about their role in energy flexibility;
- financial constraints and cost barriers: this is mitigated by demonstrating the economic benefits of grid flexibility through pilot projects and scalable models.

SENDER focuses on developing advanced demand-response mechanisms to enhance energy grid flexibility by engaging consumers in the energy market through an integrated Smart Home Gateway to be applied at residential level and a flexibility profiling and management tool to be applied at grid or community level. By using digital twins applied to consumer data, the project aims to shift demand response from a reactive to a proactive model. The business model for SENDER has applied the current principles of sharing financial benefits among consumers and grid operators through flexibility services, based on market incentives, in order to make such services mainstream and move towards a resilient and efficient energy system. The challenges encountered by the project are related to:

- resource intensity: implementing flexibility solutions demands substantial human resources and budget, especially for adapting older households with outdated systems;
- standardisation issues: the lack of standardised electrical systems in many households complicates deployment, necessitating additional efforts to ensure compatibility;
- legislative support: gaps in national legislation make it challenging to push for necessary updates and adaptations, slowing down project progress;
- technology integration: ensuring seamless integration of new technologies with existing systems poses

[9] https://pocityf.eu/wp-content/uploads/2023/04/three-stage-model-to-manage-energy-communities_compressed.pdf

technical and logistical challenges that require careful management.

SERENE develops flexibility services for smart grids, enabling local communities to optimise their energy consumption and production. It integrates various energy flexibility measures, including demand response systems that enable real-time adjustments in electricity consumption based on actual grid conditions, down to energy storage systems, which also include the concepts of heat and water storage with batteries. The project will also integrate intelligent controls for electric vehicle charging, a heating system, and control energy supply and demand in dynamic balance. The project further stabilises the grid with the integration of renewables, mainly PV systems, and increases the share of renewables in local consumption. In fact, SERENE develops an energy management system that balances the need versus the availability of energy at a local level with an active contribution of the community. SERENE will enable smart grid operations to be more responsive and adaptive. Guidelines and roadmaps are also being developed for actively engaging households, municipalities and developers in providing flexibility services with the ultimate aim of increasing resilience and efficiency in smart grids. The challenges encountered by the project are related to:

- difficulty in coordinating multiple stakeholders, from households to municipalities; addressed by developing clear guidelines and roadmaps for engagement and participation in flexibility services.
- insufficient user participation and acceptance; overcome by involving communities in demonstrations and showcasing the economic and environmental benefits of active participation in smart grids.
- regulatory constraints impacting the deployment of flexibility services; managed by analysing and adapting project models to align with the legal frameworks of different countries.
- variability in the performance of renewable energy sources and storage systems; addressed by using real-time data and smart control systems to optimise grid operations and maintain reliability.

2.2.3 Aggregation of Consumers

Aggregating consumers means offering a community the possibility to manage and optimise its energy resources. Indeed, it allows the creation of energy communities and cooperatives, where current microgrid management operations are performed jointly by the consumers, and it offers the possibility to integrate various energy carriers such as electricity, heating and cooling by deploying smart energy management systems to optimize energy use. The aggregation of consumers can be for instance achieved by providing citizens with information on energy uses and dynamic pricing through digital platforms, thus engaging them in demand-side management. Moreover, strong training and capacity building initiatives are needed to support citizens in their decisions and ensure a long-term involvement.

RE-EMPOWERED approaches consumer aggregation by involving local communities in creating energy cooperatives, thus increasing active consumer participation in microgrid management. Energy consumption is optimised by combining different energy vectors (e.g. electricity, heating and cooling) through an advanced energy management system. The engagement at community level is ensured in each demonstration site by training supported by digital tools: the ecoCommunity platform itself showing energy consumption and dynamic pricing allows consumers to take an active role in demand-side management; this, in turn, enhances the flexibility of the energy systems and opens up new business perspectives for energy sharing and local governance. The challenges encountered by the project are related to:

- limited digital literacy in rural areas: this issue can be overcome by the use of simplified user interfaces and training programmes for the local community.
- financial barriers for initial setup: community-driven business models address this, and cooperative funding mechanisms.
- energy system reliability: predictive control and real-time system monitoring avoid interruptions, thereby increasing the service's reliability.

SERENE aggregates consumer demand and renewable energy production for sustainable and integrated energy solutions in local communities. Demonstration projects set in villages in Denmark, the Netherlands, and Poland, integrate energy carriers like electricity, heating and cooling with renewable generation systems. New technologies to be investigated in the project include electric and thermal storage systems, smart control systems and electric vehicle charging to balance energy demand and supply locally. Consumer engagement plays an important part in this process, since communities are involved in the planning and operating these energy systems. The project investigates the replicability of its findings across Europe and the world, considering geographical, social, environmental, and economic parameters. Its objective is to enable the development of energy management systems for optimal energy usage coupled with reduced carbon emissions while creating business models and a legal framework that will contribute to the actual development of renewable energy communities. The challenges encountered by the project are related to:

- difficulty in integrating diverse energy carriers and technologies into a cohesive system: SERENE is overcoming this by developing flexible energy management systems that adjust dynamically to varying conditions.
- lack of consumer awareness and engagement in new energy solutions: SERENE is addressing this through community-driven demonstrations and informative campaigns to showcase technical opportunities and business cases.
- regulatory barriers across different countries impacting project replicability: SERENE is mitigating these by analysing legal aspects and adapting solutions to local contexts.
- limited availability of energy storage technologies and infrastructure: SERENE is combating this by investing in innovative storage solutions like mobile all-in-one energy storage systems.
- variability in local geographic, social, and economic conditions; SERENE is addressing this by tailoring solutions to specific community needs and characteristics.

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

After identifying the common topics of research of the selected projects, a round table was organised among the selected project to validate the topics mapping activities carried out and gather insights from the projects on potential opportunities and strategies for scaling up the project results in the future. Moreover, a review of the public deliverables and of the scientific publications released by the selected projects has been carried out.

These activities allowed the identification of a set of recommendations to make technologies for consumers more replicable in the future. These recommendations are related to interoperability and standardisation, data acquisition and management, development of integrated platforms, technical support to end users, regulatory barriers and de-risking investments:

- Interoperability and Standardisation: according to IEC TS 61850-2, interoperability can be defined as the ability of two or more devices to exchange information and use it for correct cooperation to perform the required functions. Therefore, two or more devices or components are interoperable if they can work cooperatively by using information that is exchanged. As highlighted by SENDER, RENergetic and by MAESHA (which has applied an “interoperability-by-design” approach), challenges exist with reference to compatibility across different systems involved in technologies for consumers, and a need for more standardised solutions to facilitate project implementation has been identified. For instance, more than ten different standards exist for the interaction of devices like residential demand-response systems, electric vehicles and energy storage systems, and the improvement of their compatibility in line with IEC standards (e.g. IEC 60870-5 for distributed energy production systems and IEC 63110 for electric vehicles, but also IEC SRD 63200 on Smart Grid Architecture Model) could be beneficial. This could be taken into account both by technology providers and by the European Commission that could promote a more unified and standardised approach.
- Data Acquisition and Management: since technologies for consumers mainly work with data owned by the final users, there are difficulties in acquiring these data for use in digital tools, due to a range of topics that range from data privacy concerns to technical connectivity issues; this leads to significant issues in the

effective use of energy management tools. As highlighted by ACCEPT, which has embedded in its Peer-2-Peer Blockchain Exchange Platform component some specific security mechanisms and policies, the use of technologies for consumers of data "masking" purposes, like pseudonymisation, anonymisation and encryption supports the protection of consumers' personal data. Linked with the previous recommendations, an initiative by the European Commission aimed at standardising communication protocols by energy management devices and overcoming GDPR-related issues in the collection of energy use data could support the development of innovative energy technologies for consumers.

- Development of Integrated Platforms: linked with the previous two topics, the analysis has highlighted how multiple digital tools and platforms are available to manage energy from the consumer side. The identification of optimal and standard solutions to ensure interoperability and proper data acquisition and management could lead to the development of robust, user-friendly platforms that would ensure comprehensive energy services. For example, a success case can be represented by the ACCEPT suite of digital tools that includes a Consumer Digital Twin, an On-Demand Flexibility Manager and a Citizen Application with user-friendly interfaces.
- Technical support to end users: most end users are not fully aware of the potential that technologies for consumers have in the achievement of energy transition and decarbonisation targets while reducing energy supply costs and increasing security of supply. ACCEPT has highlighted with surveys that the engagement of consumers in the energy system/market is something appealing and promising for the future, but citizens lack organisational capacity, technical skills and time available to carry out the necessary tasks. Moreover, SENDER has engaged consumers in co-creating demand-response services to ensure that the solutions meet their needs and has developed a smart box for demand-response management, enabling users to interact with energy services. Similarly, SERENE has developed community-oriented interfaces, highlighting the importance of user-friendly designs to enhance consumer participation. Drawing on the high interest of customers for these topics and to overcome the lack of knowledge, the European Commission could set up more initiatives for the provision of technical assistance to end users in the deployment of energy technologies for consumers and in the consequent setup of energy communities and positive energy districts.
- Regulatory Barriers: the complexity of national laws and the differences among different EU Member States make it difficult to deploy the technologies demonstrated in the projects, and more generally to deploy energy communities and positive energy districts in Europe. Examples of these differences include different incentives for renewable energy production (feed-in-tariffs, net-metering and net billing, etc.), alternative tariff methods (dynamic electricity prices, time-of-use grid tariffs, etc.) and mechanisms to reward grid flexibility services. This is often connected, as highlighted by SERENE, to the fact that energy markets still maintain some regulations that date back to the times in which they were centralised and with large-scale energy producers. Moreover, RENergetic has highlighted that in some Member States multiple authorities need to be involved in the permitting of projects implemented at community level, thus making project implementation more complex. All of these issues could be addressed by the European Commission by harmonising regulations in order to facilitate the widespread adoption of innovative energy solutions for consumers.
- De-risking investments: projects related to technologies for consumers in smart grids are difficult to finance because of the high perception of risk by banks and investors, which is mainly related to the lack of knowledge of non-technical experts on these topics. As highlighted by CREATORS and by POCITYF, financial institutions are highly reluctant to engage with projects with significant uncertainty. However, the common categorisation or standardisation of projects and the related risk assessments, as well as the engagement of the public sector in these projects can make financing easier. These targets can be achieved by exploiting R&I projects to disseminate the generated knowledge with potential investors and to establish cooperation between the public and the private sector.

3. CONCLUSIONS

The technologies for consumers studied in the context of the selected BRIDGE projects have been analysed to highlight their level of development and the remaining challenges. The systematic analysis included the collection of data, a survey-based evaluation, the screening of the public documents available and a thematic filtering. This was to first identify mature projects with substantial results and then to obtain a set of takeaways, which are summarised in the following table.

Table 2: Key Takeaways from the Case Study

Enhanced Digital Platforms and Tools	Advanced digital platforms and tools, like energy management systems, provide real-time data and dynamic control over energy consumption, enabling consumers to actively participate in smart grids. They enable citizens to manage their flexible energy uses, like those related to white goods, to heating&cooling, and to electric vehicles recharge, in a smart way that allows energy supply costs and associated GHG emissions to be minimised.
Energy Flexibility Services	Developing flexibility services, such as demand response programs, allows smart grids to dynamically balance energy supply and demand, ensuring stability and efficiency. In many cases, these flexibility services are made possible by digital tools and by their interaction with smart devices including energy storage systems, electric vehicles and technologies for sector coupling. A prerequisite for this is the deployment of smart meters that should provide reliable and real-time data to digital tools for flexibility services.
Interoperability and Standardisation	Achieving interoperability among diverse systems through standardisation of protocols is critical for integrating various consumer technologies into smart grids. Currently, many standards are available for the management of smart devices and their communication with digital tools, and this does not guarantee that any system is able to communicate with any other. The use of IEC standards and/or of the Smart Grid Architecture Model facilitates the interoperability of devices and systems.
Consumer Aggregation Models	Energy cooperatives and consumers aggregation models facilitate the collective management of energy resources, improving the local grid resilience. They can be created by drawing on the sense of community and on the interest of citizens in participating in the energy transition but require a dedicated design to overcome the initial concerns and the lack of technical knowledge of some citizens and to ensure their long-term engagement.
Improved Data Management	Secure and efficient data management practices, including data anonymisation and encryption, are necessary to protect consumer data while optimising smart grid operations. The adoption of GDPR-compliant methods for the collection, management and storage of data on citizens' energy uses is paramount, and working on the prevention of cyberattacks and related frauds is equally important.
Integration of Smart Home Technologies	Smart home technologies, such as IoT-enabled thermostats, lighting systems, electric vehicles charging systems, play a significant role in optimising household energy use and contributing to overall grid efficiency. They should work based on pre-defined algorithms but also allow citizens to customise their energy management in line with their habits.

Regulatory Harmonisation	Simplifying and harmonising regulations across regions is vital to reduce barriers to the adoption of consumer technologies in smart grids. Specifically, issues are related to permitting processes for the installation of technologies interacting with the grid, and to incentives, especially for the provision of flexibility services to the grid. Overcoming these issues would make the development of technologies for consumers easier to spread across different countries.
Support for Local Energy Communities and Consumer Engagement	Encouraging the formation of energy communities through capacity building and financial incentives helps local stakeholders to manage and optimise energy use collectively. Moreover, fostering collaboration among technology developers, energy providers and consumers is key to drive innovation and adopting new and user-friendly technologies in smart grids.
De-risking Investments	Establishing financial mechanisms and regulatory support to reduce investment risks can attract private funding for consumer technologies in smart grids. Indeed, financial institutions are highly reluctant to engage with projects with significant uncertainty, and the support of the public sector is useful to overcome these barriers.

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 allows a detailed analysis of how effectively the project achieved its objectives, implemented innovations and addressed technical and operational complexities. Furthermore, projects at this stage offer a clearer picture of their potential for scalability and replicability, providing valuable insights into their broader applicability in the energy sector.

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

The selection process leading to the presented results are based on all active BRIDGE projects. Among 105 active projects, only nineteen have reached a developmental stage suitable for the adopted criterion. Following the theoretical explanation of the criterion, Tabel 3 illustrates the outcomes derived from applying the project maturity criterion.

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

N. Project	Logo	Project	Full Title	Project Call	Start Date	End Date	Actual Month/ Final Month	Link
1		ACCEPT	ACtive Communities & Energy Prosumers for the energy Transition	LC-SC3-EC-3-2020: Consumer engagement and demand response	01/2021	06/2024	42/42	https://cordis.europa.eu/project/id/957781
2		CREATORS	CREATing cOmmunity eneRgy Systems	H2020-LC-SC3-2018-2019-2020: Decarbonisation of the EU building stock: innovative approaches and affordable solutions changing the market for buildings renovation	09/2020	06/2024	46/46	https://cordis.europa.eu/project/id/957815
3		ELECTRON	rEsilient and seLf-healed EleCTRical pOwer Nanogrid	SU-DS04-2018-2020: Cybersecurity in the Electrical Power and Energy System (EPES): an armour against cyber and privacy attacks and data breaches	01/2021	09/2024	35/36	https://cordis.europa.eu/project/id/101021936
4		eNeuron	greEN Energy hUbs for local integRated energy cOmmunities optimizatioN	LC-SC3-ES-3-2018-2020: Integrated local energy systems (Energy islands)	11/2020	10/2024	46/48	https://cordis.europa.eu/project/id/957779

N. Project	Logo	Project	Full Title	Project Call	Start Date	End Date	Actual Month/ Final Month	Link
5	Hestia	HESTIA	Holistic dEmand response Services for European residenTIAl communities	LC-SC3-EC-3-2020: Consumer engagement and demand response	11/2020	09/2024	46/47	https://cordis.europa.eu/project/id/957823
6	HYPERRIDE THE FUTURE OF POWER DISTRIBUTION	Hyperride	Hybrid Provision of Energy based on Reliability and Resiliency by Integration of Dc Equipment	H2020-LC-SC3-ES-10-2020: DC – AC-DC hybrid grid for a modular, resilient and high RES share grid development	10/2020	09/2024	47/56	https://cordis.europa.eu/project/id/957788
7	IANOS	IANOS	IntegrAted SolutioNs for the DecarbOnization and Smartification of Islands	H2020-LC-SC3-2020-EC-ES-SCC: Decarbonising energy systems of geographical Islands	10/2020	10/2024	47/56	https://cordis.europa.eu/project/id/957810
8	int:net	Intnet	Interoperability Network for the Energy Transition	HORIZON-CL5-2021-D3-01-03: Interoperability community	05/2022	05/2025	28/36	https://cordis.europa.eu/project/id/101070086

N. Project	Logo	Project	Full Title	Project Call	Start Date	End Date	Actual Month/ Final Month	Link
		localRES	Empowering local renewable energy communities for the decarbonisation of the energy systems	LC-SC3-ES-3-2018-2020: Integrated local energy systems (Energy islands)	05/2021	04/2026[10]	40/60	https://cordis.europa.eu/project/id/957819
10		MAESHA	deMonstration of smArt and flExible solutions for a decarboniSed energy future in Mayotte and other European islAnds	H2020-LC-SC3-2020-EC-ES-SCC: Decarbonising energy systems of geographical Islands	11/2020	10/2024	46/48	https://cordis.europa.eu/project/id/957843
11		OMEGA-X	Orchestrating an interoperable sovereign federated Multi-vector Energy data space built on open standards and ready for GAia-X	HORIZON-CL5-2021-D3-01-01: Establish the grounds for a common European energy data space	05/2022	04/2025	28/36	https://cordis.europa.eu/project/id/101069287

[10] From the outset of our analysis, the LocalRES project met the maturity criterion (less 12 months to the end), with an initial completion date foreseen for April 2025. However, during the course of the study, the project was extended to April 2026. Given that this extension was confirmed when the analysis was nearly completed, we deemed it appropriate to keep the project within the scope of the study, considering the significant results it had already achieved.

N. Project	Logo	Project	Full Title	Project Call	Start Date	End Date	Actual Month/ Final Month	Link
12	PLOTEC	PLOTEC	PLOCAN Tested Optimised Floating Ocean Thermal Eenergy Conversion Platform	HORIZON-CL5-2021-D3-03-10: Innovative foundations, floating substructures and connection systems for floating PV and ocean energy devices	11/2022	04/2025	22/30	https://cordis.europa.eu/project/id/101083571
13	POCITYF	POCITYF	A POsitive Energy CITY Transformation Framework	H2020-LC-SC3-2018-2019-2020: Building a low-carbon, climate resilient future: Secure, Clean and efficient energy	10/2019	09/2024	59/60	https://cordis.europa.eu/project/id/864400
14	RE-EMPOWERED Renewable Energy EMPOWERing European & InDian Communities	RE-EMPOWERED	Renewable Energy EMPOWERing European and InDian communities	LC-SC3-ES-13-2020: Integrated local energy systems (Energy islands): International cooperation with India	07/2021	12/2024	38/58	https://cordis.europa.eu/project/id/101018420
15	RENergetic	RENergetic	Community-empowered Sustainable Multi-Vector Energy Islands	H2020-LC-SC3-2018-2019-2020: Building a low-carbon, climate resilient future: Secure, Clean and efficient energy	11/2020	10/2024	46/46	https://cordis.europa.eu/project/id/957845

N. Project	Logo	Project	Full Title	Project Call	Start Date	End Date	Actual Month/ Final Month	Link
16	Robinson	Robinson	Smart integRation Of local energy sources and innovative storage for flexiBle, secure and cost-efficIent eNergy Supply ON industrialised islands	LC-SC3-ES-4-2018-2020: Decarbonising energy systems of geographical Islands	10/2020	09/2024	47/48	https://cordis.europa.eu/project/id/957752
17	Sender	SENDER	Sustainable Consumer engagement and demand response	LC-SC3-EC-3-2020: Consumer engagement and demand response	10/2020	09/2024	47/48	https://cordis.europa.eu/project/id/957755
18	SERENE	SERENE	Sustainable and Integrated Energy Systems in Local Communities	H2020-LC-SC3-2020-EC-ES-SCC: Integrated local energy systems (Energy islands)	05/2021	04/2025	40/48	https://cordis.europa.eu/project/id/957682

N. Project	Logo	Project	Full Title	Project Call	Start Date	End Date	Actual Month/ Final Month	Link
19	SUSTENANCE	SUSTENANCE	Sustainable energy system for achieving novel carbon neutral energy communities	H2020-LC-SC3-2020-NZE-RES-CC: Integrated local energy systems (Energy islands): International cooperation with India	07/2021	12/2024	38/42	https://cordis.europa.eu/project/id/101022587

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 2024[11] would focus on macro topic (see Figure 5) 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.

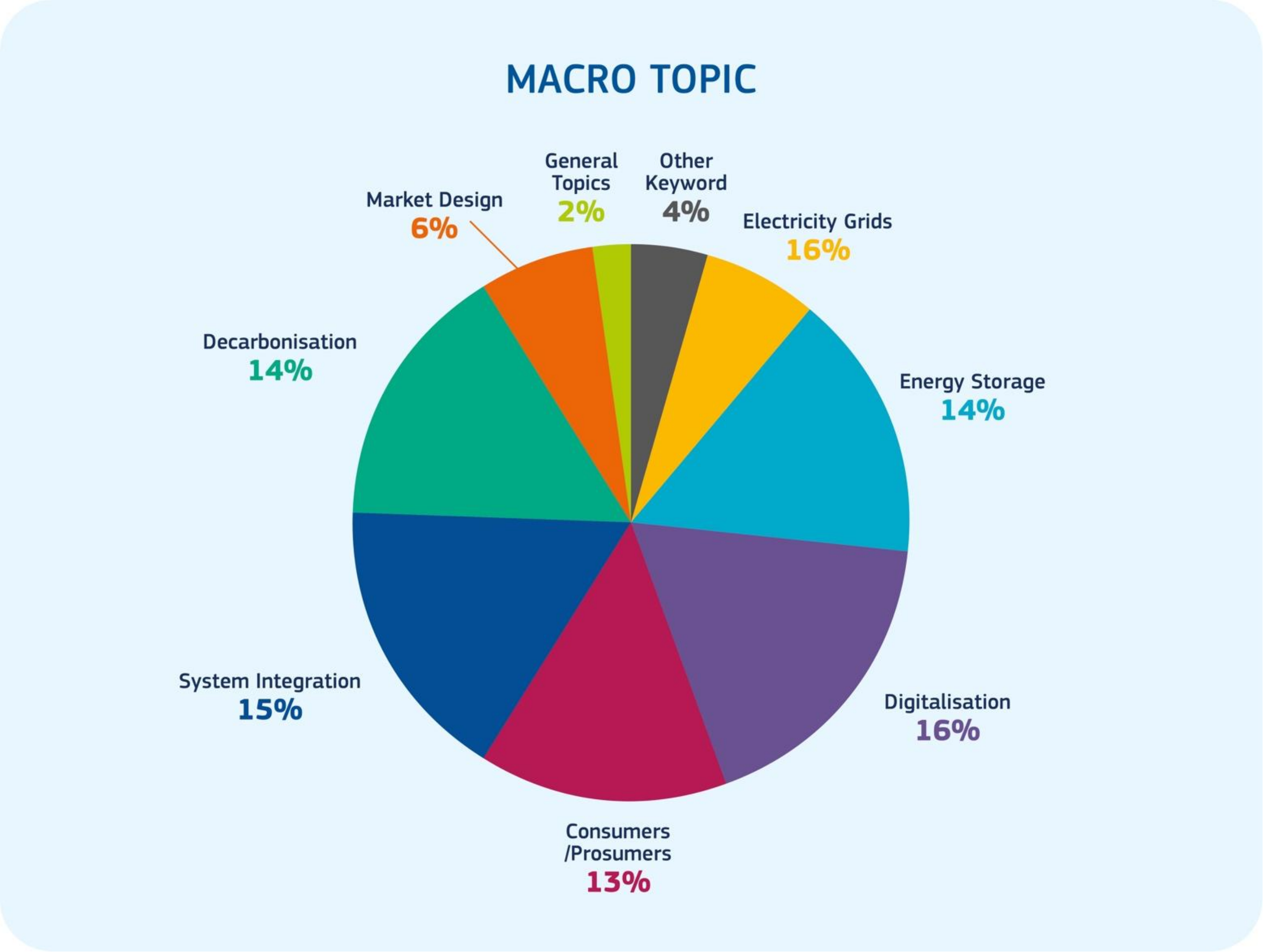

Figure 5: Project selection for keyword

[11] Bridge Brochure 2024: https://op.europa.eu/en/publication-detail/-/publication/79e30192-4a3f-11ef-acbc-01aa75ed71a1/language-en/format-PDF/source-337202064

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 meticulous 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.

Errore. L'origine riferimento non è stata trovata. 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 nineteen mature projects involved a detailed analysis aimed at identifying prominent categories within the domain Technologies for consumers. This focus on *Technologies for consumers* 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
1		ACCEPT	Technologies for consumers (demand response, smart appliances, heating/cooling peak load management, etc.)
2		CREATORS	Technologies for consumers (demand response, smart appliances, heating/cooling peak load management, etc.)
3		ELECTRON	Out of Scope
4		eNeuron	Out of Scope
5		HESTIA	Out of Scope
6		Hyperride	Out of Scope
7		IANOS	Out of Scope
8		Intnet	Out of Scope
9		LocalRES	Out of Scope
10		MAESHA	Technologies for consumers (demand response, smart appliances, heating/cooling peak load management, etc.)
11		OMEGA-X	Out of Scope

N. Project	Logo	Project	Sub-topics selected for analysis
12		PLOTEC	Out of Scope
13		POCITYF	Technologies for consumers (demand response, smart appliances, heating/cooling peak load management, etc.)
14		RE-EMPOWERED	Technologies for consumers (demand response, smart appliances, heating/cooling peak load management, etc.)
15		RENergetic	Technologies for consumers (demand response, smart appliances, heating/cooling peak load management, etc.)
16		Robinson	Out of Scope
17		SENDER	Technologies for consumers (demand response, smart appliances, heating/cooling peak load management, etc.)
18		SERENE	Technologies for consumers (demand response, smart appliances, heating/cooling peak load management, etc.)
19		SUSTENANCE	Technologies for consumers (demand response, smart appliances, heating/cooling peak load management, etc.)

4.2 Project description

4.2.1 ACCEPT

ACCEPT **(ACtive Communities & Energy Prosumers for the energy Transition)**	
Community-led energy projects have a huge potential to drive the energy transition and offer new and attractive opportunities for decarbonising local energy systems. However, the design, planning and operation of RECs are still a great challenge for most cu4.	
General context and scope of project	**Context**: Grid integration of variable renewable energy sources poses major challenges with respect to system stability due to demand-supply imbalances. Energy communities are emerging as a promising element to promote citizen involvement in the energy transition. However, ICT tools are required to extract and optimize the flexibility of residential energy resources to create financially viable operations based on citizen needs. The EU-funded ACCEPT project intends to develop and deliver such a digital toolbox that allows energy communities to offer innovative digital services and access revenue streams that can financially support their functions and secure their sustainability and effectiveness. The ACCEPT framework will be demonstrated and validated in four pilot sites in Greece, the Netherlands, Spain and Switzerland involving more than 3 000 people and 750 residences. **Objective**: Penetration of renewables is a no-regrets option for energy system decarbonisation. Despite their benefits for the energy system, the grid integration of variable RES presents major challenges in matching their non-deterministic output to electricity demand. Resolving this necessitates the deployment and penetration of several solutions, a key on being demand response, which in turn depends on the role of prosumers with regards to their engagement with the energy system. Demand flexibility from residential buildings is the main untapped source of flexibility currently in the market and promises significant flexibility potential, especially taking into account the electrification of heat and transport mega-trends. Energy communities are a promising organisational vehicle for involving citizens – who directly control residential demand - in the energy transition, but currently lack the necessary tools to exploit the available opportunities and create financially viable operations based on the provision of services that citizens want. ACCEPT aims to fill this gap by delivering a digital toolbox that energy communities can use to i) offer innovative and desired digital services, complementing their existing non-digital services to their members and customers, and ii) gain access to revenue streams that can financially support their operations and ensure longevity and well-functioning of the community itself. To achieve this, the ACCEPT consortium is framing the citizen engagement and business modelling activities in the same priority as the technical development ones. Their intertwined implementation will be the critical success factor for the

ACCEPT (ACtive Communities & Energy Prosumers for the energy Transition)	
	delivery of the ACCEPT solution as a minimum viable product that has already passed preliminary market testing and financial viability checks. The ACCEPT outcomes will be demonstrated and validated in four pilot sites in the Netherlands, Spain, Switzerland and Greece, directly involving more than 750 residences and 3000 citizens.
Organisational features of the project, including Consortium description	**Coordinator:** • HYPERTECH (CHAIPERTEK) ANONYMOS VIOMICHANIKI EMPORIKI ETAIREIA PLIROFORIKIS KAI NEON TECHNOLOGION **Partner:** • CIRCE • GECO GLOBAL • QUE TECHNOLOGIES • ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS - CETH • WITSIDE INTERNATIONAL MARKETS LIMITED • UNIVERSITY COLLEGE CORK • RINA CONSULTING SPA • MYTILINEOS SA GR) • EDRIJFSBUREAU ENERGIE SAMEN BV • COOPERATIEF ENERGIE DIENSTENBEDRIJF RIVIERENLAND BA • MY ENERGIA ONER SL • LA SOLAR ENERGIA SOCIEDAD COOPERATIVA • AZIENDA ELETTRICA DI MASSAGNO (AEM) SA • VIESGO DISTRIBUCION ELECTRICA SL • EUROPAISCHES ZENTRUM FUR ERNEUERBARE ENERGIE GUSSING GMBH
Geographical coverage	Austria, Cyprus, Denmark, Greece, Ireland, Italy, Netherlands, Norway, Spain, Switzerland
Project call number	Consumer engagement and demand response
Project call name	LC-SC3-EC-3-2020
Budget	€ 5,862,476.38
Desired impacts (expectations at beginning of project)	**Challenges**: • Engage consumers and prosumers in demand-response mechanisms and other energy services to bring benefits to consumers and to the energy system. • Develop and test new cost-effective solutions for consumers based on the next generation of energy services for consumers that will allow to better predict and incentivise consumer behaviour. **Scope Objectives:**

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- Develop and test solutions and tools for demand response and other energy services, using real consumption data and feedback from testing of services to improve predictability of consumption and consumer behaviour.
- Rely on automation, ICT tools and approaches (e.g. IoT, big data, AI, blockchain) communication protocols & interoperability.
- The participation of local energy communities, energy cooperatives, aggregators and local actors is encouraged.

Expected Impacts:

- Increased number and types of consumers engaged in demand-response across Europe.
- Demonstrated and improved viability of innovative energy services, best practices and effective incentives that can be replicated at large scale.

Citizen participation in DR schemes benefits consumers and the energy system by reducing costs, increasing renewable energy penetration, and reducing emissions, but fatigue often hinders participation. ACCEPT aims to demonstrate the complete solution – technology and business model – to evaluate this claim and provide a quantified assessment of its results. The challenge has been successfully addressed to date, with energy communities and their members across four different European countries engaging in demand response schemes and demonstrating significant benefits to consumers (increased cost and energy savings), the communities as a whole (increased self-sufficiency), and the energy system (increased self-consumption and grid robustness). The ACCEPT vision aims to enhance citizens' living experiences with advanced technical solutions, exploring various service delivery models and cross-selling energy services with more desirable or critical services like electro-mobility and assisted living. This way, the average consumer is typically more likely to purchase such services with their disposable income rather than invest in pure energy services. Achieving this goal requires a technological foundation that can support such intertwined services seamlessly. ACCEPT will deliver such a foundation that can be replicated across building typologies and customer segments across Member States, focusing on the market of residences and similar ones, hospitality, including elderly care homes. Demonstration activities during the project will showcase the value and validate user acceptance, performance, and financial aspects in four different countries and settings (building typology, energy governance structure, citizen energy awareness level, consumer needs, etc.). The ACCEPT proposal proposes a digital solution that encompasses the necessary IoT system and software stack to take full advantage of real-time big data streams, using artificial intelligence and machine learning techniques to infer human activities, patterns, and preferences in a non-intrusive manner and eventually optimising demand patterns. This is based on a tested and validated, data-driven turnkey solution and tools that automatically self-adapt and configure to the specificities of each different residence and human resident, offering truly personalised services to residents. The solution demonstration in the project pilot sites

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	serves two purposes: performing user acceptance testing under real-life circumstances to co-create services together with critical stakeholders and obtain feedback for fine-tuning implementation in anticipation of commercialisation efforts. The ACCEPT activities, comprising digital tool delivery and demonstration, citizen engagement, and replication/exploitation plans, are generic and can be configured and fine-tuned to cover a wide spectrum of real-world needs. Successfully addressed the Scope Objective by involving four energy communities with pilot leaders representing different energy market actors, including DSOs, Aggregators, Suppliers/Retailers, ESCos, and Energy Cooperatives. The ACCEPT demonstration activities aim to engage over 770 citizens as pilot participants in four countries, reaching a wider cycle of more than 3700 people indirectly during the project activities. The pilot sites cover a wide typology of individuals and target use cases for the ACCEPT solution. Swiss and Greek pilot sites are focusing on energy-related concerns, with Swiss pilot sites focusing on elderly care homes and Greek pilot sites involving factory workers and their families in remote villages, leveraging community dynamics to evaluate energy communities. The Dutch and Spanish pilot sites involve two existing energy communities who are interested in different use cases. Regulation and the general financial situation in Spain force community members to strive for lower energy costs through self-consumption of renewables, while the situation in the Netherlands allows citizens to adopt new technologies (electro-mobility, heat-pump-based community heating) faster and to engage with ancillary service markets. The ACCEPT solution, developed by a consortium, aims to address diverse energy environments by demonstrating its value and validating its application. This will enable market segmentation and solution customisation. The solution will reach over 1 million citizens already part of energy communities. The toolbox, used by conventional market actors like retailers, ESCOs, aggregators, and facility managers, will open up the target market to all residential energy customers. Citizen-led energy communities (ECs) are a promising way to stimulate energy market consumers, receiving incentives in several EU Member States. The European Commission's Green Deal supports these communities. ACCEPT will assess the effectiveness of these incentives across four pilot sites in countries with diverse collectivism and environmental awareness cultures. There is room for expanding energy services to other energy vectors beyond electricity, such as heating and cooling, gas and hydrogen. Cross-vector services and efficiencies are also a topic which could benefit from further research and development. With regards to smart grids and demand response schemes, I think including real-life tests with commercial, industrial and tertiary buildings could prove beneficial.

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Technologies and services that the project has the ambition to develop and serve	SO: The project did not include other types of consumers other than residential in the demonstration activities (e.g., industrial, commercial and tertiary), although such consumers were available at the Swiss pilot (e.g., swimming pools, warehouse building, etc.). These consumers were only considered under the community-level use cases as a type of load that needs to be considered when optimising generation allocation within a community. SO: The project did not eventually cooperate with any of the projects supported under the topic LC-SC3-ES-5-2018-2020 that approach the challenge more from a grid perspective. Instead, the project cooperated with sister projects funded under this call, as well as other relevant initiatives and projects where consortium members participate.
KER Type	Scientific Results (scientific knowledge, discoveries, or insights generated as a result of the project); Software
KERs of the Project	

KER 1	Building Information Management Layer
Leader	QUE
Contributors	CERTH, Hypertech, Witside, Mytilineos, EDBR, MIWenergia, LaSolar, AEM
Country	Greece, Cyprus, Germany, Netherland, Spain, Swiss
KER info	IoT and Software solution to accurately capture, cleanse and process ambient and metering data to provide energy-related services and home automations.

KER 2	Consumer Digital Twin Model
Leader	Hypertech
Contributors	QUE, CERTH, Witside
Country	Greece, Cyprus, Germany
KER info	The Consumer Digital Twin model contextualises data from the BIML on household occupants and transforms them into meaningful information which are then used by the same component for an accurate representation of the occupant and its household appliances/devices. The component effectively creates a complete profile of the "consumer", the characteristics of the combination of person(s) residing in a specific building so that the energy market actor can have a deep understanding of the energy-related behaviour behind the meter for improved predictability and forecasting.

KER 3	On-Demand flexibility Management Tool
Leader	Hypertech

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(ACtive Communities & Energy Prosumers for the energy Transition)

Contributors	QUE, Witside
Country	Greece, Cyprus
KER info	The On-Demand flexibility Management Tool ensures an optimal utilisation of the resources of the building in order to achieve specific objectives, such as the delivery of energy flexibility or the increase of self-consumption. It relies on previously developed components of the ACCEPT project (e.g., the Building Information Management Layer, the integrated Consumer Digital Twin) to acquire information/data and thereupon solve the necessary optimisation problems.

KER 4	P2P Energy/Flex Exchange Platform
Leader	QUE
Contributors	Hypertech, CIRCE, CERTH, Witside
Country	Greece, Spain, Cyprus
KER info	Blockchain based trading platform, with Smart Contract capabilities to enable trade of energy and flexibility between prosumers and to promote the Amenity-as-a-Service model for energy-related services.

KER 5	District Asset Management Component
Leader	CIRCE
Contributors	Hypertech, QUE
Country	Spain, Germany
KER info	Multi-energy management tool of district-level Assets.

KER 6	ACCEPT Citizen App
Leader	CERTH
Contributors	Hypertech, CIRCE, Witside, AEM, Mytilineos, MIWenergia, ESB
Country	Greece, Germany, Spain, Cyprus, Swiss, Netherland
KER info	Citizen Application (C-App) is a web-based app with energy and non-energy services with the purpose to facilitate citizen engagement. The provided services include domains such as energy, smart living, health collaboration, mobility, etc.

KER 7	Energy Behaviour change method & tools
Leader	SIN

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(ACtive Communities & Energy Prosumers for the energy Transition)

Contributors	Hypertech, UCC, RINA-C, Mytilineos, ESB, MIWenergia, LaSolar, AEM, EEE
Country	Finland, Germany, Italy, Netherland, Spain, Swiss, Austria
KER info	The Energy Behaviour change method & tools consist in a detailed methodology to empower individuals to adopt sustainable habits and actively manage their energy consumption. One of these tools comprehends the identification of the so-called personas, which represent reference profiles of the users/customers involved in a system. KER 7 has been fine-tuned for the EC and DR application.

KER 8	**Energy Community Tools**
Leader	Hypertech
Contributors	QUE, Witside, CIRCE, CERTH, Mytilineos, AEM, LaSolar, ESB, MIWenergia
Country	Greece, Cyprus, Spain, Germany, Swiss, Netherland
KER info	The Energy Community Tools (ECTs) include all components that interface or support the business cases of the market actors and/or the energy communities. ECTS are supported by User Interfaces (UIs) and Business Intelligence (BI) suite, which provide valuable, data-driven insights of the ACCEPT solution. The ECTs component includes certain vertical and horizontal sub-components. The vertical sub-components (V-ECTs) aim to capture the different roles that can be undertaken by an energy community within the ACCEPT project, AND are related to the ESCo Tools, Aggregator Tools and Retailer tools. On the other hand, the horizontal sub-components (H-ECTs), are core components that serve horizontally service requests, mainly optimisation requests, originated from different V-ECTs based on ACCEPT use case scenarios.

KER 9	**UIs and business intelligence tools**
Leader	Witside
Contributors	Hypertech, QUE, Mytilineos, EDBR, LaSolar, MIWenergia, AEM, CIRCE, CERTH
Country	Germany, Netherland, Spain, Swiss
KER info	KER 9 comprehends different horizontal functionalities for energy and flexibility management & dispatch on top of which three distinct modules are developed to support the business intelligence of the community as an ESCO, as an Aggregator and as an energy Retailer.

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	Well-defined interfaces combining context with consistency facilitate user monitoring and decision-making.

KER 10	Dynamic SRI-based performance rating framework
Leader	Hypertech
Contributors	QUE
Country	Greece, Germany
KER info	The Dynamic SRI Performance Rating introduces a new approach on the calculation of the Smart-Readiness Indicator. The component enables the dynamic determination of the SRI scores -in any number of buildings- through an iterative calculation process eliminating, this way, any dependence on on-site visits by certified auditors. It steps on pre-existing data sources (i.e., circulated energy audits and building systems/IoT configuration) to derive and deliver the SRI results through specialised user interfaces. Such a tool allows the end users to be informed on their building's level of smartness and extremely facilitates the recalculation of the SRI score when any type of "smart" changes occur in the building.

KER 11	Optimised biomass boiler scheduling for grid flexibility services
Leader	CIRCE
Contributors	AEM
Country	Spain, Swiss
KER info	Novel control algorithm for district-hating boilers to provide electricity flexibility through their pumping system.

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

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 9

Initial TRL - Final TRL

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

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KER5	4	7
KER6	5	8
KER7	5	7
KER8	5	8
KER9	9	9
KER10	4	9
KER11	1	7

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

The following products could be commercialised post-project. The list below is non-exhaustive.

- The Building Information Management Layer (BIML): It is the digital, cloud-based tool responsible for the collection, storage and cleansing of data from IoT equipment (incl. sensors, meters, etc.) installed in buildings.
- The On-Demand Flexibility Manager (ODFM): It is the digital tool responsible for the accurately predicting consumption and generation patterns, based on historical generation and consumption data (from smart meters, sub-meters, etc.), as well as optimising the operation of flexible/controllable loads under various scenarios and services (e.g., energy cost minimisation, self-consumption maximisation, etc.).
- The Consumer Digital Twin: Consists of three components, the Citizen Digital Twin, the Building Digital Twin and the Dynamic SRI framework, and it models accurately the behaviour of consumers and the buildings they live in (creates a digital replica of the consumer and their building), as well as allows the data-driven calculation of the smart readiness of the building.
- The Citizen Application, a mobile app that allows end users (consumers) to visualise their energy data and information, their household's indoor conditions, as well as insights with regards to their appliances' operation and available flexibility. It also allows them to control remotely some of their appliances. Finally, the app provides information on available on-site generation, achieved savings from participating in specific energy-related services, and access information on (should this be available) EVs and EV charging.

The District Asset Manager tool, which gathers consumption and generation data from district-level assets (incl. district heating systems, shared PVs, BESS and EV chargers), and calculates generation, demand and storage forecasts.

4.2.2 CREATORS

CREATing cOmmunity eneRgy Systems	CREATORS
The project "CREATORS" focuses on accelerating the integration of community energy systems (CES) across Europe. It aims to enhance the commercial readiness of CES by supporting local actors in deploying CES-as-a-service models. Key objectives include unlocking local renewable energy generation, increasing flexibility in grid balancing, empowering consumers, and activating prosumers. The project will develop applications and service packages demonstrated in pilot sites across Belgium, Estonia, Slovenia, and Spain, targeting significant cost reductions (60% in preparation and operational costs, 20-35% in CAPEX) and job creation within CES communities. Ultimately, CREATORS seeks to advance CES	
General context and scope of project	**Context**: Local community energy systems (CES) initiators lack the capacity for high-quality simulation, business modelling and automated operations. Local CES lack the services that allow them to employ advanced energy system technology. The EU-funded CREATORS project will support technical, financial and social processes that support local initiators to establish and operate advanced CES. The project will be deployed in four sites in Belgium, Spain, Slovenia and Estonia and reproduced in another six sites in Bulgaria, France, the Netherlands and Spain. The delivered services will reduce preparation and operational costs by 60 %, ensure 99.95 % uptime, reduce capital expenditure by up to 35 % and increase additional incomes by 40 %, resulting in local energy price reduction and job growth across CES. **Objective**: CREATORS enables local initiators to create and operate advanced Community Energy Systems (CES) by supporting technical, financial and social processes. With the sector moving beyond inventor-lead pilots, local CES initiators lack the capacity for high-quality simulation, business modelling and automated operations that are required in communities with a range of vectors, 1000s of mixed members, and balancing/ trading that requires controls in milliseconds. Leading engineering firms Cordeel and COMSA work with specialists in simulation and energy trading (i.LECO) emulation for digital twins (Typhoon HIL), and financing (EnergyPro) to develop services that enable local professionals to apply state-of-the-art energy system technologies. These applications and integrated packages will mature from TRL5-6 to TRL7-8 and eventually be offered as ´CES-as-a-Service´. The services will deliver 60% preparation and operational costs reductions, ensuring 99,95% uptime, 20-35% CAPEX reduction, and up to 40% additional incomes. The results are 5-10% local energy price reduction (below €0.18 kWh) in systems covering all vectors, with 10^3 - 10^4 participants. The approach creates 2 fte jobs in each CES, whilst for partners remote services could reach 10% the system turnover, in what is a high-growth market. In standardizing simulation and assessment tools in close collaboration with local stakeholders

CREATing cOmmunity eneRgy Systems	CREATORS
	(30 LoS), the BRIDGE initiative and lenders (industry-lead Investor Confidence Protocols), CREATORS significantly advances commercial readiness (CRI3). The applications will be developed in 4 sites (Belgium, Spain, Slovenia, Estonia), and replicated in another 6 (the Netherlands, Bulgaria, France, Spain). The pilots mix vectors, participants and business models, covering in total >2000 households, >500SMEs and >5 industrial sites. Ten more prospective CES will be supported in feasibility studies through a competitive process, which also aims to prepare for commercial market entry.
Organisational features of the project, including Consortium description	**Coordinator:** • FRAUNHOFER GESELLSCHAFT ZUR FORDERUNG DER ANGEWANDTEN FORSCHUNG EV **Partner:** • VOLBAS SA • MACHINEFABRIEK OTTO SCHOUTEN BV • COOLREC BV • TREEE SRL • FUNDACION GAIKER • TRANSFERCENTER FUR KUNSTSTOFFTECHNIK GMBH • EREMA ENGINEERING RECYCLING MASCHINEN UND ANLAGEN GESELLSCHAFT MBH • CENTRE SCIENTIFIQUE & TECHNIQUE DEL'INDUSTRIE TEXTILE BELGE ASBL • MAIER SCOOP • MAIER TECHNOLOGY CENTRE S COOP • DAW SE • CYCLEFIBER SL • FUNDACION CIDAUT • KUHNE LOGISTICS UNIVERSITY GGMBH • OPENBARE VLAAMSE AFVALSTOFFENMAATSCHAPPIJ • WUDARCZYK ROBERT • ITRB LTD
Geographical coverage	Austria, Belgium, Cyprus, Germany, Italy, Netherlands, Spain
Project call name	SOCIETAL CHALLENGES - Secure, clean and efficient energy
Project call number	H2020-LC-SC3-2018-2019-2020
Budget	€ 4,985,853.75
Desired impacts (expectations at beginning of project)	Develop and demonstrate solutions which analyse and combine all the energy vectors that are present and interconnect them where appropriate.

CREATing cOmmunity eneRgy Systems	CREATORS
	Optimise their (energy vectors) joint operation that is demonstrated by an increased share of renewables in and higher energy efficiency of the local energy system solutions that have high replication potential across Europe. Create and advance the Simulation Emulation Engine that allows to design, analyse, test and combine different energy projects and scenarios and afterwards integrate it within our approach CESaaS. Support development and advancement of CES in Europe Find 10 Tier 3 replication sites to test our CES-as-a-Service
Technologies and services that the project has the ambition to develop and serve	N/A
KER Type	Software; Business Models and Strategies
KERs of the Project	(see table below)

KER 1	**Simulation Emulation Engine**
Leader	Auge
Contributors	Typhoon HILL
Country	Belgium, Serbia
KER info	The SEE is one of the main outcomes of the CREATORS project and represents the key enabling technology for creation of CES in a multi-staged approach. As part of WP2 “Simulation and emulation engine (SEE) for community energy Systems” the SEE Engine has been constituted by advancing, integrating and aligning both the simulation and emulation environments. The SEE engine consists of a front-end simulation service and a “point-specific” emulation solution and additionally plugins for the assessment of renewable energy potential. This engine determines the renewable potential and perfect mix of renewables for a project, allowing to run scenarios and obtaining the best techno-economic approach and the revenue streams and business cases. Finally, in emulation mode, the SEE makes it possible to validate simulated business models and operations using real-time models of specific distributed sources, digital twins of the community energy system, at a specific site either on the basis of historical or real-time data. The SEE facilities creation of digital twins, a Digital Twin is a high-fidelity virtual model of an asset or process that gives an overview on its operation in real-life conditions, bridging the physical and the digital world. Moreover, Digital Twins allow us to test and validate, identify potential issues, analyse performance and assess long-term scenarios. It consists

CREATing cOmmunity eneRgy Systems CREATORS

	of a library of flexible and scalable models for community energy systems will reduce up to 80% costs in testing and validation, and service models covering all energy vectors that will allow to quickly create the digital twin of the community and also incorporating the LES (Layered Energy System) market model which will be used in operations as the actual energy community market model. It helps to define the final configuration of the project, run scenarios and take decisions towards implementation.

KER 2	Management platform for CES projects
Leader	Auge
Contributors	N/A
Country	Belgium
KER info	This is linked to WP3 "CREATORS energy management and trading platform for CES", where the aim of this WP is the advancement of the CREATORS community energy management and control platform into a scalable and replicable "energy community service" platform. Energy management software solutions that allow to monitor, control and operate the overall performance and operations of energy systems and in addition focus on trading and settlement for establishing real local marketplaces. Through specific hardware that is required to be installed, it will be possible to control the assets and thus introduce flexibility to the energy community.

KER 3	Financing/contracting protocols
Leader	EP Group
Contributors	N/A
Country	United Kingdom
KER info	This is linked with WP4 "Financing and contractual procedures for community energy systems". The financing/contracting protocols aims to link the innovation service solutions with simple contractual and financing procedures for CES initiators and investors. Successful alignment of project documentation between initiators, investors and facilitators significantly reduces transaction costs of financing, and could allow qualifying projects for lower risk brackets, which would lead to both access to capital and lower cost of finance. CREATORS will align to the framework of the European ´Investor Confidence Project´ (ICP Europe) – recognised by the International Energy Agency and

	Energy Efficiency Financial Institutions Group - to deliver standardised project development and independent project assessment for energy efficiency projects. The approach is based on quality-assuring a project while meeting the information needs of the financial sector, providing common typologies and definitions, decision trees, open-book calculations of baseline energy profiles and savings, design/build certifications, and operations, monitoring and maintenance plans.

KER 4	CES-as-a-Service (combined)
Leader	Joint service - Aims to bring together all the tools and services developed within the project
Contributors	N/A
Country	All in the joint service
KER info	CES-as-a-Service (CESaaS) is a software-based model specialised for energy community projects that offers support to a customer in the whole lifecycle of an energy community project. It can be thought of as a platform that integrates various software tools and technologies to manage and optimize the energy system. CREATORS CESaaS can be thought of as a platform that integrates various software tools that can target the full journey of a CES project, composed of modular services targeting each stage of development of an energy community project. This service will be offered by the figure of the CESaaS provider and due to its modular approach, it can be used to offer either a full service or a specific service for any of the phases of an energy community project. CESaaS is a software-based service offering different modules covering all the required software that an energy community needs. All the hardware-related needs of the client, such as the deployment of assets, construction, maintenance, etc. are not covered by the CREATORS service and should be taken care of by the client or strategically the third party acting as CESaaS provider. Nevertheless, to ensure a correct functioning of technology, CREATORS will offer advice on specifications for certain assets such as smart meters, gateways, etc. CES-as-a-service will cover all the activities related to design of the CES, digital twin creation and decision-making, support on financing opportunities and contracting and management platform to operate the energy community. As mentioned, the CES-as-a-Service will be composed of 4 modules, one per each phase of the energy community lifecycle. For the initiation phase the first module will offer a feasibility study to design the energy community

CREATing cOmmunity eneRgy Systems	CREATORS
	from a technical, financial and governance perspective. The result of this module is a document with the best techno-economic solution for your project and recommendations for the governance and legal figures for the energy community. For the planning phase, the second module will offer a digital twin of the energy community that allows to run scenarios and clearly see all results of the community. The result of this module is a dashboard can be accessed by the client to see the digital twin of the energy community and see all the results and scenarios to make choices towards implementation. For the implementation phase, the third module offers support for funding opportunities and legal contracting requirements for the project. The result is a report with a proposal for financiers, financial arrangements and the possibility of contract acquisition. Finally, for the operation phase, the fourth module offers a management platform for the energy community that enables the monitoring and optimisation of the community. The result of this module is a management platform that can be accessed by the client to have visibility and monitor all the energy flows within the community. Validated hardware communication solutions will need to be installed for the proper control of assets.
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 9 Value assessment of the integration of buildings, infrastructure and smart communities in a RES-based energy system: TRL 9 Control and operation tools for the integration of buildings and smart communities: TRL 9 Planning for resilient integration of buildings and infrastructures in an integrated energy system: TRL 9
Initial TRL – Final TRL	see table below
Hypothesis of product or service that could be marketed if the project meets TRL 8/9 criteria	A common outcome of the workshop was that CES-as-a-Service is not yet commercially ready, and thus instead of focusing on a commercial strategy, first the service needs to be further developed to reach market readiness. Most of the partners agreed that the current level is CRL6: Controlled Demonstration. This means that the CES-as-a-Service is a functional prototype that has been

Initial TRL – Final TRL:

KER	Initial TRL	Final TRL
KER1	1	6
KER2	5	7
KER3	1	7
KER4	1	6

CREATing cOmmunity eneRgy Systems	CREATORS
	created and tested in controlled environments. It is important to note that the prototype still encounters certain limitations and needs additional refinement. However, it could be accurate to grade the modules independently considering the advancement level of the modules independently and was graded this way: Module 1: Feasibility study is market ready (CRL9), followed by Module 4: Control and management that is on a very advanced stage (CRL7/8) already being tested in several pilots and sites with real conditioner approaching commercialisation. However, this team considered that Module 2: Simulation Emulation with the CREATORS developed Simulation Emulation Engine (SEE) and Module 3: Financing and Funding are less market ready and still under validation of the prototype (CRL5)

4.2.3 MAESHA

MAESHA (deMonstration of smArt and flExible solutions for a decarboniSed energy future in Mayotte and other European islAnds)	
MAESHA aims to decarbonize the energy systems of geographical islands. MAESHA will develop the necessary flexibility, storage, and energy management solutions to facilitate a large penetration of renewable energies on island energy systems, and i) develop of a smart platform aggregating flexibility services, ii) reach up to 70 to 100% of RE penetration iii) create synergies between electricity and other sectors, iv) activate local communities, v) demonstrate the solutions on Mayotte, vi) ensure the replicability of the solutions through monitoring with follower islands, and vii) create a public available toolkit for wide replicability.	
General context and scope of project	**Context**: There are more than 2 200 inhabited islands in the EU, many of which depend on expensive fossil fuel imports for their energy supply. The large-scale deployment of local renewable energy sources and storage systems would contribute to decarbonising the energy system. However, this endeavour requires flexible solutions, new tools and efficient frameworks that can be adapted to local needs. The EU-funded MAESHA project will develop smart and flexible methods of storage and energy management as well as modelling tools and technical systems with the aim of promoting the transition towards sustainable energy. Designed with respect to the interests of the local communities, adapted to the market and ready to be disseminated, the new approaches will serve as a demonstration for the future decarbonisation of the Mayotte and other European islands. **Objective**: Aiming at decarbonising the energy systems of geographical islands, MAESHA will deploy the necessary flexibility, storage and energy management solutions for a large penetration of Renewable Energies. Cutting-edge technical systems will be developed and installed, supported by efficient modelling tools and adapted local markets and business frameworks. A community-based approach will be adopted to ensure the constant consideration of local populations' best interests throughout the project. Putting together 10 SMEs, 3 industrial partners, 2 universities and 6 public organisations from 9 countries, MAESHA gathers strong partners with the needed expertise to develop and disseminate relevant solutions for a universally beneficial energy transition on islands. After establishing the proper use cases and architecture designs to ensure interoperability (WP1), MAESHA will develop modelling tools from real-time to long-term energy-economy observations (WP2) together with adapted business, market and regulatory frameworks (WP4). In parallel the community-based approach will be launched (WP3). All these activities lay the foundation for the technical development of management systems for aggregating flexibility (WP5) and devices based on synergies with assets of the territories (WP6), optimised together through a flexibility aggregating platform (WP7).

MAESHA (deMonstration of smArt and flExible solutions for a decarboniSed energy future in Mayotte and other European islAnds)	
	After systems integration (WP8), the solutions will be fully demonstrated in Mayotte (WP10) and their replicabilities will be studied in five follower islands (WP10). Indicated WPs for communication, dissemination (WP11) and management (WP12) will maximise the impacts. With its activities, MAESHA is expected to lead to at least 70% RE penetration and reach more than 90% of Mayotte's population. Through its strong local implantation and the focus put on replication and dissemination activities, MAESHA will deeply modify insular energy features throughout Europe and its impacts will be felt far beyond the project's framework.
Organisational features of the project, including Consortium description	**Coordinator:** • TECHNISCHE UNIVERSITAT BERLIN **Partner:** • COBRA INSTALACIONES Y SERVICIOS S.A • CENTRICA BUSINESS SOLUTIONS BELGIUM • TRIALOG • E3-MODELLING AE • CYBERGRID GMBH • TECSOL • CREARA CONSULTORES SL • BOVLABS SAS • HIVE POWER SA • HUDARA GGMBH • ELECTRICITE DE MAYOTTE • ASSOCIATION LEONARD DE VINCI • TERRITOIRE DES ILES WALLIS ET FUTUNA (Wallis and Futuna) • COLLECTIVITE DE SAINT-BARTHELEMY • CONSORCIO PARA EL DISENO, CONSTRUCCION, EQUIPAMIENTO Y EXPLOTACION DE LA PLATAFORMA OCEANICA DE CANARIAS • COMUNE DI FAVIGNANA • THE GOZO BUSINESS CHAMBER ASSOCIATION • CONFERENCE DES REGIONS PERIPHERIQUES MARITIMES D EUROPE • GREENINGTHEISLANDS.NET SRL • EUROQUALITY SAS
Geographical coverage	Austria, Belgium, France, Germany, Greece, Italy, Malta, Spain, Switzerland
Project call name	Decarbonising energy systems of geographical Islands
Project call number	H2020-LC-SC3-2020-EC-ES-SCC
Budget	€ 8,879,045.51

MAESHA
(deMonstration of smArt and flExible solutions for a decarboniSed energy future in Mayotte and other European islAnds)

Desired impacts (expectations at beginning of project)

Challenges:

Energy production costs on geographical islands are up to ten times higher than on the mainland; therefore, the large-scale deployment of local renewable energy sources and storage systems brings economic benefits and, at the same time, contributes to decarbonising the energy system of the island, reducing greenhouse gases emissions and improving, or at least not deteriorate, air quality.

Scope objectives:

1) Improve integration and use of digitalised smart grids and/or thermal networks based on high flexibility services from distributed generation, local power balancing, demand response and storage of electricity, heating and cooling, water, etc., including innovative approaches to energy storage at different scales. 2) Practical recommendations arising from project experience on:

- regulatory and legal aspects;
- gender and socio-economics (Social Sciences and Humanities);
- storage and flexibility solutions (from short to seasonal timescales);
- data management, data processing and related cyber security.

Impacts:

Reduce significantly fossil fuel consumption, by developing renewable energy-based systems (including heating and cooling and storage) that allow the island to go towards full-decarbonisation goals in a shorter time frame; 2) Facilitate the creation and/or increase the number of renewable energy communities"

Technologies and services that the project has the ambition to develop and serve

Impacts: "enhance stability of the power network for islands that are grid connected with the mainland." omitted, because not applicable for project island(s)

KER Type

Technological results: Scientific Results (scientific knowledge, discoveries, or insights generated because of the project); Software

KERs of the Project

KER 1	Energy-Economy Model
Leader	TUB
Contributors	E3M, HIVE Power, CENTRICA, CyberGrid, CENTRICA
Country	Germany, Greece, Switzerland, Belgium, Austria
KER info	Easily accessible and modifiable energy system and economic model; trainings

KER 2	Long-term Energy Assessment Model
Leader	TUB

MAESHA
(deMonstration of smArt and flExible solutions for a decarboniSed energy future in Mayotte and other European islAnds)

Contributors	E3M, HIVE Power, CENTRICA, CyberGrid, CENTRICA
Country	Germany, Greece, Switzerland, Belgium, Austria
KER info	Development of energy transition scenarios

KER 3	Forecasting of S&D Algorithms
Leader	TUB
Contributors	E3M, HIVE Power, CENTRICA, CyberGrid, CENTRICA
Country	Germany, Greece, Switzerland, Belgium, Austria
KER info	Forecasting tool for electricity generation, demand, and system stability

KER 4	Energy Flexibility and Market Framework
Leader	TUB
Contributors	E3M, HIVE Power, CENTRICA, CyberGrid, CENTRICA
Country	Germany, Greece, Switzerland, Belgium, Austria
KER info	Report detailing the energy and flexibility market framework and product design details, specifically tailored towards geographical islands

KER 5	Flexibility Management and Trading Platform
Leader	TUB
Contributors	E3M, HIVE Power, CENTRICA, CyberGrid, CENTRICA
Country	Germany, Greece, Switzerland, Belgium, Austria
KER info	Platform for management of local flexibility options on the island

KER 6	Residential Demand Response Toolbox
Leader	TUB
Contributors	E3M, HIVE Power, CENTRICA, CyberGrid, CENTRICA
Country	Germany, Greece, Switzerland, Belgium, Austria
KER info	Report on the assets, tools and incentives for residential DR

KER 7	Industrial Demand Response Toolbox
Leader	TUB
Contributors	E3M, HIVE Power, CENTRICA, CyberGrid, CENTRICA
Country	Germany, Greece, Switzerland, Belgium, Austria
KER info	

MAESHA (deMonstration of smArt and flExible solutions for a decarboniSed energy future in Mayotte and other European islAnds)	
Technology Readiness Levels (TRL) of the Priority Project Components (PPC) upon completion of the project	Next generation of DMS: TRL 6-8
Initial TRL – Final TRL	see table below
Hypothesis of product or service that could be marketed if the project meets TRL 8/9 criteria	KER3: replicable forecasting algorithm (can be applied for any island worldwide); Use on Mayotte; model of other geographical islands. The methodology developed and used in this task is completely generalisable and can be replicated worldwide for any other similarly sized island. KER5: Use on Mayotte, possible replication by follower islands, some microservices will be integrated into CGRID's commercial VPP platform. EDM can directly deploy and use FMTP on Mayotte. Based on a monthly licence fee, continued utilisation after the end of the projects will be possible. Furthermore, CGRID aims to offer FMTP to system operators of larger Islands in Europe or even worldwide. KER6: Use on Mayotte, possible replication by follower islands. The main outcome here is the virtual power plants which consist of residential of industrial assets and which could connect to FMTP (see KER5) to provide flexibility services. KER7: Use on Mayotte, possible replication by follower islands. The main outcome here is the virtual power plants which consist of residential of industrial assets and which could connect to FMTP (see KER5) to provide flexibility services.

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

4.2.4 POCITYF

POCITYF (A POsitive Energy CITY Transformation Framework)	POCITYF
POCITYF is an EU-funded smart city project that will help historical cities to become greener, smarter and more liveable while respecting their cultural heritage and attending to their citizens' needs. By implementing and testing Positive Energy Districts in its 8 cities, POCITYF will support Europe in the race to become the first carbon-neutral continent by 2050. Two cities, Alkmaar and Évora, are so-called Lighthouse cities as they will serve as testbed for POCITYF's innovative solutions. Six Fellow cities, Bari, Celje, Granada, Hvidovre, loaning and Ujpest, will observe and replicate the model that POCITYF will apply to support the energy transition of the Lighthouse cities.	
General context and scope of project	**Context**: The key to making cities safer, greener and more responsive to the needs of their citizens, businesses and organisations is to add layers of smartness as regards infrastructures, technologies and services. The EU-funded POCITYF project will deliver a set of positive energy blocks in the lighthouse cities of Alkmaar (Netherlands) and Évora (Portugal), and their fellow cities Hvidovre (Denmark), Ioannina (Greece), Ujpest (Hungary), Bari (Italy), Celje (Slovenia), and Granada (Spain). These blocks refer to a limited and socially well-embedded geographic area where the average local renewable generation exceeds its consumption. POCITYF aims to transform these cities mixed-urban environments, with a strong emphasis on cultural and historical protected areas, into healthier and more accessible, reliable and competitive spaces for their citizens with a strong emphasis on cultural and historical protected areas. **Objective**: POCITYF supports the Lighthouse cities of Evora (PT) and Alkmaar (NL) and their Fellow cities Granada (ES), Bari (IT), Celje (SI), Ujpest (HU), Ioannina (GR) and Hvidovre (DK) to address their urgent need to deliver positive energy blocks and districts in their cities, towards rendering their mixed urban environment (also including the case of cultural protected buildings) into cheaper, better accessible, healthier and more reliable. By demonstrating in overall 10 integrated solutions (ISs), comprising 73 individual innovative elements (technologies, tools, methods), rooted under existing City Information Platforms (CIPs), POCITYF quantifies their value, and connects interests of many different stakeholders in innovative business models, allowing for upscale and replication of those solutions in a form of a validated roadmap for sustainable cities across Europe and worldwide. To achieve this, POCITYF works along 4 Energy Transition Tracks (ETTs), encompassing the ISs according to the role each one serves for. ETT#1 focuses on the examination and application of ISs transforming existing and new building stock into Energy Positive, while ETT#2 focuses on the application of a) grid flexibility strategies and b) storage systems, supported by DSM platforms for optimising energy flows to maximise self-consumption and reduce grid stress. ETT#3 with its merit of innovation offers the integration of e-Mobility to as well promote the decarbonisation of the mobility sector. The 3 ETTs under the coordination of ETT#4, which links

POCITYF (A POsitive Energy CITY Transformation Framework)	
	existing CIPs with innovative apps and other instruments, offers inclusive and holistic services for interdisciplinary citizen engagement and co-creation of them with the city stakeholders and industry, towards the development of each city's own bold city vision up to 2050. Through POCITYF the two LHs will achieve a local RES penetration of 16.2 GWh/y, energy savings of 2.32 GWh/y and an emission reduction of 9,743 tons CO2eq/y within their districts.
Organisational features of the project, including Consortium description	**Coordinator:** • LABELEC ESTUDOS DESENVOLVIMENTO E ACTIVIDADES LABORATORIAIS SA **Partner:** • CAMARA MUNICIPAL DE EVORA • UNINOVA-INSTITUTO DE DESENVOLVIMENTO DE NOVAS TECNOLOGIAS-ASSOCIACAO • UNIVERSIDADE DE EVORA • UBIWHERE LDA • DECSIS SISTEMAS DE INFORMACAO S.A. • SCHNEIDER ELECTRIC SPA • PACT PARQUE DO ALENTEJO DE CIENCIAE TECNOLOGIA • MC SHARED SERVICES SA • ELERGONE ENERGIA, LDA • MODELO CONTINENTE HIPERMERCADOS S.A. • ONYX SOLAR ENERGY SL • TEGOLA CANADESE SPA • IWIS INSULATION WATERPROOFING INDUSTRIAL SYSTEMS SRL • BETTERIES AMPS GMBH • KIMATICA MONOPROSOPI ETAIREIA PERIORISMENIS EUTHYNIS • INESC TEC - INSTITUTO DE ENGENHARIADE SISTEMAS E COMPUTADORES, TECNOLOGIA E CIENCIA • GEMEENTE ALKMAAR
Geographical coverage	Germany, Greece, Italy, Netherlands, Portugal, Spain
Project call name	Building a low-carbon, climate resilient future: Secure, Clean and efficient energy
Project call number	H2020-LC-SC3-2018-2019-2020
Budget	€ 22,181,749.16
Desired impacts (expectations at beginning of project)	Cross sector integration; Integrating local markets; Integrating digitalisation services; Energy system business; Simulation tools for electricity and energy systems; Integrating flexibility in generation, demand, conversion and storage technologies; Efficient heating and cooling for building and industries in view of system integrating of flexibilities

POCITYF (A POsitive Energy CITY Transformation Framework)	POCITYF
	Challenges: • To rapidly reduce greenhouse gas emissions and adapting to climate change. The EU is committed to implementing the 2030 Agenda for Sustainable Development, including … Goal 11 ('Make cities inclusive, safe, resilient and sustainable')." by demonstrating highly replicable and scalable solutions that a) ensure access for all to adequate, safe and affordable housing, b) provide access to safe, affordable, accessible and sustainable transport systems, c) enhance inclusive and sustainable urbanisation and d) reduce the adverse per capita environmental impact of cities. Both LH Cities of POCITYF have already strong commitments to reduce their CO2 emissions by at least 20% until 2020, whereas both LH and all FCs will capitalise the experiences gained during POCITYF to set ambitious targets (at least 40% CO2 reduction by 2030 and >80% to positive energy cities until 2050. • To achieve the necessary energy transition in cities, it is essential to increase energy systems integration and to push energy performance levels significantly beyond the levels of current EU building codes… by facilitating the necessary energy transition in the two lighthouse cities involved, creating a solid framework for deploying various intelligent, RES based innovative solutions with different technology maturity levels. Those solutions are tailor-made and dynamically designed to be informed by users. Intelligent system integration supports the installation of the different solutions and is a key driver of value creation in POCITYF. Through POCITYF, the LH cities will achieve total net energy savings of 2,322 MWh/year within their PEBs and increase the percentage of total net energy covered by local RES to 178% (for Alkmaar PEB) and 114%, 125% and 124% (for Evora PEB1, PEB2 and PEB3 respectively). **Scope objectives**: • Demonstrate solutions at building and district level that enable the increase of energy self-consumption, energy savings and high share of locally produced renewable energy – leading to energy positive districts, located in mixed use urban districts including that of cultural heritage ones. • Demonstrate P2P energy management and storage solutions supporting grid flexibility and curtailment reduction. **Expected impacts**: • Number of Positive Energy Blocks (PEBs) deployed at the end of POCITYF: 4. • Number of Positive Energy Districts/PEBs deployed due to POCITYF until 2030: 4/12" **Actions to reach the target:** Demonstration and validation of the POCITYF integrated solutions; Development and testing of POCITYF novel business models; POCITYF exploitation planning. Obstacles/ barriers: Low acceptability/ rate of adoption of multi-stakeholder business models; Negative disposition on novel business

POCITYF (A POsitive Energy CITY Transformation Framework)	POCITYF
	novels; Limitations in scalability; Insufficient risk reduction; Lack of commitment from local authorities after the end of the project. jet lifetime: Iterative testing and evaluation to identify and address room for improvement; reach and cooperate with relevant external organisations/initiatives (e.g. the Covenant of Mayors); Joint development of plans. **Status for the 3rd reporting period:** While most KPIs are expected to be achieved in the next reporting period, the demonstration and validation of the POCITYF integrated solutions have been taking place, with the installation of solutions in the two LH Cities of Evora and Alkmaar. Particularly in Alkmaar, where most solutions are currently implemented, the consortium has had the possibility of visiting solutions in the latest General Assembly, which proved very enriching for all partners, especially FCs. The development and testing of POCITYF novel business models have been initialised in WP5, which the first deliverable on this topic produced, and the continuation of this work is expected for the next reporting period. As for POCITYF exploitation planning, a list of the top KERs has been produced, and in the next reporting period the analysis will be focused on the KERS leading to the most promising results. This last step of the exploitation activity will focus on commercial results (mainly technologies), which will also be evaluated based on their TRL level. In parallel, the consortium has been actively working and discussing citizen engagement strategies (WP4) and collaborating with several relevant external organisations/initiatives (namely in WP9) to increase the pathways in terms of meeting EU climate mitigation and adaptation goals.
Technologies and services that the project has the ambition to develop and serve	PEDs can be used as tools to leverage the Energy Transition process across European Cities, especially for the increase of locally produced energy and for greater energy efficiency, in turn lowering GHG emissions. However, the holistic view for a smart city transition based on PEDs can be a barrier in certain regions due to local legal restrictions, high financial cost, length of implementation time and need of strong political commitment / governance structures. These topics need to be further studied, namely in cities with different geographies and in heritage protected cities.
KER Type	Technological results: Scientific Results (scientific knowledge, discoveries, or insights generated as a result of the project); Software; Business Models and Strategies
KERs of the Project	**KER 1** — **REFLEX** Leader: ICONS Contributors: TNO, Inholland, NEROA, TNO, EDP L, UNINOVA Country: Italy, Netherlands, Portugal KER info: A flexibility aggregation platform, already integrated in TNO portfolio, that seeks to exploit the flexibility of many DER's in such a way that the value can be monetised on multiple energy markets in parallel, as

POCITYF (A POsitive Energy CITY Transformation Framework)

	well as by providing congestion management services to DSOs.

KER 2	Citizens' engagement and energy awareness app
Leader	ICONS
Contributors	TNO, Inholland, NEROA, TNO, EDP L, UNINOVA
Country	Italy, Netherlands, Portugal
KER info	The "Citizen's Engagement App" is an instrument to generate engagement and leverage knowledge of sustainable solutions and involvement in the neighbourhood. The apps raise the awareness and sense of urgency of tenants of housing corporations and citizens on energy transition. Also, it unlocks the way to trustworthy information on energy solutions.

KER 3	Energy data architecture and KPI platform
Leader	ICONS
Contributors	TNO, Inholland, NEROA, TNO, EDP L, UNINOVA
Country	Italy, Netherlands, Portugal
KER info	This result consists of a dedicated database created for educational purposes, that can be used by students for data analytics. The data architecture could be implemented in other cities aiming to become smart. The platform is fed with open data from the pilot areas, including sensor data that is imported automatically to the database.

KER 4	Monitoring software for the energy assets to send data to the monitoring platform
Leader	ICONS
Contributors	TNO, Inholland, NEROA, TNO, EDP L, UNINOVA
Country	Italy, Netherlands, Portugal
KER info	This result refers to the modules that feed the dEF-Pi platform to connect to each flexible energy-related device. The dEF-PI platform and associated modules can be used by different actors for various ends. Public actors can use this to monitor energy use to take energy-saving measures efficiently. Private parties can improve the flexibility of the energy system. In the project, NEROA demonstrates that with this architecture and standards, it is possible to avoid vendor-lock-in and re-use the software in other projects. NEROA and TNO defined different actors that can benefit from the use of the flexible platform,

POCITYF (A POsitive Energy CITY Transformation Framework)

	resulting in a comprehensive list of potential customers to be targeted after the project's end.

KER 5	REC Management Tool
Leader	ICONS
Contributors	TNO, Inholland, NEROA, TNO, EDP L, UNINOVA
Country	Italy, Netherlands, Portugal
KER info	This tool aims provide the citizens of a renewable energy community with a interface that they can use to see the energy analysis and cost-benefit of the renewable energy community and their individual results.

KER 6	Energy Router
Leader	ICONS
Contributors	TNO, Inholland, NEROA, TNO, EDP L, UNINOVA
Country	Italy, Netherlands, Portugal
KER info	Energy Router, based on innovative modular power electronics building blocks, will be able to fully integrate energy components (renewable production, storage, grid and home connection) and optimally managing the energy flux between them. Energy routers increase buildings' load matching and decreasing grid interaction factors, respecting users' comfort needs and preferences. Their coordinated operation, at city level, will allow higher performance levels to be achieved making use of the distinct load profiles of the several buildings and of the higher renewable energy production potential.

KER 7	Flexibility control algorithms
Leader	
Contributors	TNO, Inholland, NEROA, TNO, EDP L, UNINOVA
Country	Italy, Netherlands, Portugal
KER info	Usage of the energy flexibility provided by new or existing controllable devices. Flexibility Control Algorithms will characterise and make use of the energy flexibility provided by different types of controllable devices bringing benefits for both

POCITYF (A POsitive Energy CITY Transformation Framework)	
	consumers (e.g. lower energy costs) and power systems operators (e.g. lower peak loads).
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 9 Control and operation tools for a RES-based energy system: TRL 6-8
Initial TRL – Final TRL	see table below
Hypothesis of product or service that could be marketed if the project meets TRL 8/9 criteria	Not yet defined

KER	Initial TRL	Final TRL
KER1	7	8
KER2	4	4
KER3	4	9
KER4	5	8
KER5	3	7
KER6	6	7
KER7	N/A	N/A

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

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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 development of economic & financial models for each demo site has been completed, including an analysis of the existing financial tools.

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	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	(see table below)

KER 1	ecoEMS
Leader	ICCS-NTUA
Contributors	Imperial College of London, DTU, Varme, PROTASIS, DAFNI, Deloitte Advisory
Country	Greece, United Kingdom, Denmark, Bornholm, Denmark, Spain

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

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
Contributors	Contributors: ICCS-NTUA, Imperial College of London, Varme, PROTASIS, DAFNI, Deloitte Advisory

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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
Country	Greece, United Kingdom, Denmark, Spain

<table>
<tr><th colspan="2">RE-EMPOWERED
(Renewable Energy EMPOWERing European and Indian communities)</th></tr>
<tr><td></td><td><table><tr><td>KER info</td><td>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 optimize 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.</td></tr></table></td></tr>
<tr><td>Technology Readiness Levels (TRL) of the Priority Project Components (PPC) upon completion of the project</td><td>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</td></tr>
<tr><td>Initial TRL – Final TRL</td><td><table><tr><th>KER</th><th>Initial TRL</th><th>Final TRL</th></tr><tr><td>KER1</td><td>6</td><td>7</td></tr><tr><td>KER2</td><td>9</td><td>9</td></tr><tr><td>KER3</td><td>5</td><td>8</td></tr><tr><td>KER4</td><td>3</td><td>6</td></tr><tr><td>KER5</td><td>5</td><td>8</td></tr></table></td></tr>
<tr><td>Hypothesis of product or service that could be marketed if the project meets TRL 8/9 criteria</td><td>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 Is 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. I provide a platform as a service that can integrate the solutions in one software structure. 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 optimize the performance. All the key</td></tr>
</table>

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

4.2.6 RENergetic

RENergetic **(Community-empowered Sustainable Multi- Vector Energy Islands)**	
The project focuses on enhancing energy autonomy and efficiency in urban areas through the establishment of energy islands empowered by citizen communities. Key objectives include maximising renewable energy integration, fostering community engagement, and enhancing economic viability. Measurable outcomes include increased energy autonomy levels, community participation rates, economic attractiveness of renewable systems, and replicability potential across Europe. Research areas cover energy optimisation, community empowerment, legal viability, and environmental impact assessment.	
General context and scope of project	**Context**: In line with the EU's Clean Energy Package goals, the EU-funded RENergetic project empowers people – engaging them from the beginning – with a higher level of control over the energy infrastructure surrounding them. RENergetic demonstrates that urban energy islands increase the share of renewables in local areas and the energy efficiency of the local energy systems. To reach this endeavour, innovative technologies are considered e.g. AI-based smart control algorithms and digital twins creation. RENergetic integrates electricity, heat and waste vectors in three energy islands: New Docks in Ghent, Warta Campus in Poznan and San Raffaele Hospital and Research campus in Segrate-Milan. Beyond RENergetic, the impact of urban energy islands is ensured by considering technical, socioeconomic and legal viability, while safeguarding economic viability. **Objective**: The current EU 'Clean Energy Package' aims to place local consumers at the heart of the energy transition. In the context of local energy systems with a weak or non-existing grid connection this implies to give the power of operating a renewable-based energy infrastructure to the local people, energy consumers and producers. Private people and organisations should be involved to establish energy island communities, which are based on self-management and -operation. Simultaneously, those communities will improve social cohesion and technical optimisation of all energy vectors existing in the specific energy island. The goal of RENergetic is to integrate and demonstrate solutions that will foster a substantial increase of 1) energy efficiency and 2) the level of renewable energies and energy autarky by integrating three main energy vectors (electricity, heat, waste) in three heterogeneous urban energy islands, with an early involvement of the communities and a long-term economic viability: The New Docks in Ghent, Belgium (energy-aware housing), the Warta Campus in Poznan, Poland (data centre heat for a campus) and the Hospital and Research campus in Segrate-Milan, Italy (demand response, including electric vehicles).

RENergetic (Community-empowered Sustainable Multi- Vector Energy Islands)	
	This transdisciplinary endeavour is supported by innovative activities in all relevant areas. On the technical level, optimisation and demand response approaches for cross-sector scenarios are combined in a hierarchical approach. This concept integrates innovative smart control strategies and machine learning based-forecasting methods. A thorough regulation analysis feeds into the creation of novel business models, market strategies and value networks on the economic and legal level. This ensures seamless integration with existing energy management systems and cooperation with external networks. Finally, an iterative approach of empowering the energy island communities with participatory structures will be applied on the social level.
Organisational features of the project, including Consortium description	**Coordinator:** • INETUM ES **Partner:** • INETUM • CLEAN ENERGY INNOVATIVE PROJECTS • GENT UNIVERSITY • POZNAN UNIVERSITY OF TECHNOLOGY • VEOLIA • POZNAN SUPERCOMPUTING AND NETWORKING CENTER • OSPEDALE SAN RAFFAELE • COMUNE DI SEGRATE • UNIVERSITY OF PAVIA • ENERGY KOMPASS GMBH • UNIVERSITY OF MANNHEIM AND PASSAU
Geographical coverage	Austria, Belgium, France, Germany, Italy, Poland, Spain
Project call name	Building a low-carbon, climate resilient future: Secure, Clean and efficient energy
Project call number	H2020-LC-SC3-2018-2019-2020
Budget	€ 5,959,425.75
Desired impacts (expectations at beginning of project)	The topic “Integrated local energy systems (Energy islands)” [LC-SC3-ES-3-2018-2020] in the focus area “Building a low-carbon, climate resilient future (LC)” of the Horizon 2020 work programmed no. 10 “Secure, clean and efficient energy. 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.

RENergetic
(Community-empowered Sustainable Multi- Vector Energy Islands)

	Optimise the joint operation of energy vectors 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. Local consumers, small to medium industrial production facilities and/or commercial buildings should be involved in the projects from the start, preferably by creating renewable energy communities. Include a task on the analysis and communication of obstacles to innovation and foresee the coordination on policy relevant issues (e.g. regulatory framework, business models, data management, consumer engagement) with similar EU-funded projects through the BRIDGE initiative.
Technologies and services that the project has the ambition to develop and serve	N/A
KER Type	Scientific Results (scientific knowledge, discoveries, or insights generated as a result of the project); Software
KERs of the Project	

KER 1	Multi-Vector and domain-specific optimizers
Leader	Different Partners
Contributors	Uni Passau, Inetum, University of Ghent, PSNC, CEIP, University of Seeburg, PUT, University of Stuttgart, Segrate, Energie-kompass
Country	Germany, Spain, Belgium, Poland, Austria, Germany, Italy
KER info	Multi-Vector Optimizer & Electricity-Supply Optimizer

KER 2	Multi-vector Forecasting Services
Leader	Different Partners
Contributors	Uni Passau, Inetum, University of Ghent, PSNC, CEIP, University of Seeburg, PUT, University of Stuttgart, Segrate, Energie-kompass
Country	Germany, Spain, Belgium, Poland, Austria, Germany, Italy
KER info	Heat Demand Forecasting & Heat Supply forecasting & Electricity Demand Forecasting & Electricity Supply forecasting & Anomaly Detection.

RENergetic
(Community-empowered Sustainable Multi- Vector Energy Islands)

KER 3	Demand Response Recommendations Demand Response Recommendations Demand Response Recommendations Demand Response recommendations
Leader	Different Partners
Contributors	Uni Passau, Inetum, University of Ghent, PSNC, CEIP, University of Seeburg, PUT, University of Stuttgart, Segrate, Energie-kompass
Country	Germany, Spain, Belgium, Poland, Austria, Germany, Italy
KER info	Automated Rule-based Heat Dr & Automated Reinforcement-learning based EV DR (simulations) & Automated Reinforcement-learning based EV DR (implementation) & Semi-automated scenario-based Heat DR & Manual rule based Electricity DR & Sufficiency Heat Demand & Electricity Demand Response (Local Energy markets).

KER 4	Communication and Interaction Strategies
Leader	Different Partners
Contributors	Uni Passau, Inetum, University of Ghent, PSNC, CEIP, University of Seeburg, PUT, University of Stuttgart, Segrate, Energie-kompass
Country	Germany, Spain, Belgium, Poland, Austria, Germany, Italy
KER info	Public Dashboard & Private Dashboards & Virtual Reality tool & Automated Calculation and visualisation of technical KPI's & Social Toolbox Energy Awareness and Implementation of technical solutions.

KER 5	Local waste heat simulator
Leader	Different Partners
Contributors	Uni Passau, Inetum, University of Ghent, PSNC, CEIP, University of Seeburg, PUT, University of Stuttgart, Segrate, Energie-kompass
Country	Germany, Spain, Belgium, Poland, Austria, Germany, Italy
KER info	Local waste heat simulator

KER 6	IR occupancy predictor
Leader	Different Partners
Contributors	Uni Passau, Inetum, University of Ghent, PSNC, CEIP, University of Seeburg, PUT, University of Stuttgart, Segrate, Energie-kompass

RENergetic
(Community-empowered Sustainable Multi- Vector Energy Islands)

Country	Germany, Spain, Belgium, Poland, Austria, Germany, Italy
KER info	IR occupancy predictor

KER 7	RENergetic System Core (software)
Leader	Different Partners
Contributors	Uni Passau, Inetum, University of Ghent, PSNC, CEIP, University of Seeburg, PUT, University of Stuttgart, Segrate, Energie-kompass
Country	Germany, Spain, Belgium, Poland, Austria, Germany, Italy
KER info	Ingestion API, Backend API, Kubeflow, GUI, Grafana, Databases, Keycloak

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

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	4	6
KER2	5	7
KER3	4	6
KER4	5	7
KER5	4	6
KER6	5	7
KER7	4	6

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

N/A

4.2.7 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 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
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

<table>
<tr><td></td><td>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.</td></tr>
<tr><td>Technologies and services that the project has the ambition to develop and serve</td><td>Interoperable digital communication solutions; Increased data protection and privacy for customers; Improved modelling of the flexibility levers from the new energy services.</td></tr>
<tr><td>KER Type</td><td>N/A</td></tr>
<tr><td>KERs of the Project</td><td><table><tr><th>KER 1</th><th>SENDER Smart Box</th></tr><tr><td>Leader</td><td>Smart Innovation Norway</td></tr><tr><td>Contributors</td><td>Hypertech, Paragon, QUE, Trialog, Nxtech, CSR4, NTNU, AIT</td></tr><tr><td>Country</td><td>Norway, Greece, France, Italy, Austria</td></tr><tr><td>KER info</td><td>An integrated Smart Home Gateway, enabling e.g. end-to-end interoperable communication between various Distributed Energy Resources (DER) elements</td></tr></table></td></tr>
</table>

	(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 scalable flexibility-based systems.**
Leader	Smart Innovation Norway
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 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 usergroup 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 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

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

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

4.2.8 SERENE

SERENE (Sustainable and Integrated Energy Systems in Local Communities)	
Community-led energy projects have a huge potential to drive the energy transition and offer new and attractive opportunities for decarbonising local energy systems. However, the design, planning and operation of RECs are still a great challenge.	
General context and scope of project	**Context**: Integrating different energy system carriers and new renewable generation units in local communities is key to developing sustainable, integrated, cost-effective and customer-centric solutions. The EU-funded SERENE project will establish demonstrators in local villages in Denmark, the Netherlands and Poland. The findings will be reviewed for replicability in other European Union countries and beyond. New energy systems may involve battery energy, heat storage or water storage, electric transportation systems, and the integration of new renewable generation sources mainly in the form of photovoltaics (PV). The project will investigate local renewable and balanced energy supply for buildings, neighbourhoods and entire villages using solar PV, storage, insulation, smart control, and bioenergy sources. **Objective**: The aim of the SERENE project is to develop and demonstrate sustainable, integrated, cost-effective and customer-centric solutions for local communities. The idea is to integrate different energy system carriers and new renewable generation units in the local communities based on their social and technical status today to meet their energy needs in the coming years. The users must be involved in the changes of the energy system and be informed about different technical opportunities and business cases to make decisions about their participation. Depending on the actual site, the new energy system involves different storage technologies (battery energy storage, heat storage, water storage systems), demand response systems to enhance the flexibility of the systems (activating for instance electric vehicle charging stations and heat demand supplies), electric transportation systems like electrical vehicles or buses, heating system improvements using heat pumps and integration of new renewable generation sources mainly in form of photo voltaic. The SERENE project will establish demonstrations in local villages in three European countries - Denmark, The Netherlands and Poland. The experiences gained at the demonstration sites will be analysed and evaluated for replicability in firstly Europe but also worldwide. Technical benchmark models and solutions will be set up together with their business models, and it is evaluated how different legal aspects from the involved countries will affect the possibility for replication. Further, the needed user involvement and their

SERENE (Sustainable and Integrated Energy Systems in Local Communities)	
	interest to join are evaluated seen from both geographic, social, environmental and economic conditions and characteristics.
Organisational features of the project, including Consortium description	**Coordinator:** • AALBORG UNIVERSITY AAU **Partner:** • SKANDERBORG MUNICIPALITY • AURA ENERGI (UTILITY COMPANY) • NEOGRID TECHNOLOGIES APS. • SUNTHERM APS: SNT • BJERREGAARD CONSULTING APS.: BJC • UNIVERSITEIT TWENTE • STICHTING SAXION:SAX • VEREINIGING AARDEHUIS OOST NEDERLAND • LOQIO SERVICES B.V. • GMINA PRZYDWICH: CCC • INSTYTUT MASZYN PREEPLYWOWYCH IM ROBERTA SWEWALSKIEGO POLSKIEJ AKADEMII NA • ENERGA OPERATO SA • STAY-ON PAWEL GRABOWSKY
Geographical coverage	Denmark, Netherlands, Poland
Project call name	Integrated local energy systems (Energy islands)
Project call number	H2020-LC-SC3-2020-EC-ES-SCC
Budget	€ 5,112,163.39
Desired impacts (expectations at beginning of project)	**The two most relevant challenges:** • Decarbonising local energy systems. • Optimise the electricity systems 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-coupled approach. **Two scope objectives:** • Proposals will 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.

SERENE
(Sustainable and Integrated Energy Systems in Local Communities)

	• Local consumers, small to medium industrial production facilities and/or commercial buildings should be involved in the projects from the start, preferably by creating energy renewable energy communities. **Two expected impacts:** • 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); • 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. All the above-mentioned challenges, scopes and impacts have been addressed during the project period, but partners have actually addressed all set up challenges, scopes and objectives of the call in our project, some, of course, with higher or lower intensity. There are still a lot of perspectives to be explored in relation to integrated energy system, the first being looking at industrial areas and ports how symbioses can be obtained between the different energy vector, taking governance structures, markets and regulations into account. new projects concerning energy communities in relation to actual implementation of regulations, business models and governance structures according to national implementation of the policy for local energy communities into account still also needs to be explored. how can municipalities be involved and speed up the processes for initiation of local energy communities.
Technologies and services that the project has the ambition to develop and serve	None were omitted in the call partners were as mentioned addressing all areas.
KER Rype	Technological results: Scientific Results (scientific knowledge, discoveries, or insights generated as a result of the project); Intellectual Property - IP (patents, copyrights, trademarks, and other forms of intellectual property resulting from the project); Software; Business Models and Strategies
KERs of the Project	see table below

KER 1	Community optimised energy consumption
Leader	Neogrid
Contributors	N/A
Country	Denmark
KER info	The result is the energy management system (EMS) that controls devices and RES on the household and community scale. It helps to balance local energy demand and production of intermittent renewable energy sources (RES) on the community level by using

SERENE
(Sustainable and Integrated Energy Systems in Local Communities)

	the energy flexibility. It targets local communities, housing associations, private households and real estate developers.

KER 2	Mobile all-in-one energy storage system
Leader	STAY-ON Storage Engineering
Contributors	N/A
Country	Poland
KER info	This result is a fully integrated energy storage system dedicated for households, municipalities and business with up to 50kWp PV installations. Unique design of a cabinet holds a complete power system including power conversion system with grid, PV and genset inputs, battery system and EMS.

KER 3	Energy flexibility provision from local communities
Leader	Aalborg University, Skanderborg Commune, AURA, The Municipality of Przywidz, Energy-Operator, VERENIGING AARDEHUIS OOST NEDERLAND (VAON)
Contributors	N/A
Country	Denmark, Poland, The Netherlands
KER info	The result is a roadmap for households/municipalities/developers/DSOs how to engage private households in local communities to provide energy flexibility for the local grid. The result type is “guidelines”

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 6-8

Cross-sectorial flexibility use cases: TRL 6-8

Value assessment of the integration of buildings, infrastructure and smart communities in a RES-based energy system: TRL 3-5

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

SERENE
(Sustainable and Integrated Energy Systems in Local Communities)

Initial TRL – Final TRL

KER	Initial TRL	Final TRL
KER1	3	8
KER2	4	8
KER3	2	7

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

KER1: Neogrid is commercialising the Community Energy Management System (CEMS), which will be applicable to energy communities in all sizes. From the smallest apartment building with heat pump and PV, to entire villages (or clusters of villages) that have assets of various types within their community.

The NEOGRID CEMS will be able to structure all the available assets in the backend, to provide the energy community with relevant metering data, as well as controlling the controllable assets based on various optimisation schemes (lowest cost, lowest CO2 emission, maximise self-consumption and more)

KER2: All-in-one Energy Storage System (ESS)

STAY-ON developed an energy storage system for residential and light commercial use. All-in-one ESS includes batteries, inverter, energy management system and electrical switchgear to simplify on-site installation. System is pre-integrated in an aesthetically designed cabinet, making it suitable for stationary as well as mobile applications. ESS delivers functionalities such as: renewable balancing, uninterruptible power supply and time-of-use strategies with dynamic energy prices support.

4.2.9 SUSTENANCE

SUSTENANCE **(SUSTainable ENergy system for Achieving Novel Carbon neutral Energy communities)**	
SUSTENANCE aims to set up sustainable energy systems for achieving novel carbon neutral energy communities. The project focuses on the development of smart technological concepts enabling a green transition of the energy systems with higher share of local renewable energy and more efficient integrated energy solutions for the electrical, heat, water, waste as well as transportation infrastructure. **Results will demonstrate cost-effective, sustainable, and customer-centric solutions in the form of technical and business models and guidelines, for the effective integration of various energy vectors. Solutions will additionally have good socioeconomic and environmental impact.**	
General context and scope of project	**Context**: The ambitious journey to carbon-neutral energy cities is being lined with smart technologies. The EU-funded SUSTENANCE project is also moving in this direction. It is developing sustainable energy systems to ensure a green transition with a higher share of local renewable energy and more efficient integrated energy solutions for electrical, heat, water, waste and transportation infrastructure. It will demonstrate the systems in Denmark, India, the Netherlands and Poland – four countries with different local energy resources, socioeconomic character, user behaviour, political structures, and market conditions and regulations. The results are expected to show that the same technical concepts such as storage solutions, intelligent control schemes and digitalisation can be applied in all cases. **Objective**: The overall purpose of the SUSTENANCE project is to set up sustainable energy systems for achieving novel carbon neutral energy communities. The project focus on the development of smart technological concepts ensuring a green transition of the energy systems with higher share of local renewable energy and more efficient integrated energy solutions for the electrical, heat, water, waste as well as transportation infrastructure. The set-up solutions will at the same time have good socioeconomic impact in the local communities and ensure ecofriendly solutions and good infrastructures, which provides support to sustaining the essentials of life. The demonstration activities are set up in four countries: Denmark, India, Netherlands and Poland. These countries have different local energy resources, socioeconomic, user behaviour, political structures, market conditions and regulations. The project will show how same technical concepts such as coupling of different energy vectors, storage solutions, demand response, intelligent control schemes and digitalisation can be applied to all demonstration cases despite the huge differences in the local conditions and regulations. Roadmaps will be set up based on these technical solutions together with guidelines for methods for user engagement and ensuring cooperation among the users in relevant cases leading to cooperatives. Finally, business cases will be set up for the different

SUSTENANCE (SUSTainable ENergy system for Achieving Novel Carbon neutral Energy communities)	
	demonstration sites seen from both user perspective, small enterprises and utility point of view taking into account the local conditions. In this way, synergy effects with inputs from the different demonstration sites are expected and the results give abundant possibilities for maximum impact and replication in other local communities in the four countries as well as in societies worldwide.
Organisational features of the project, including Consortium description	**Coordinator:** • Aalborg University (AAU) **Partner:** • SKANDERBORG KOMMUNE (SKM) • AURA ENERGI (AER) • NEOGRID (NGD) • BJERREGAARD CONSULTING (BJC) • UNIVERSITY OF TWENTE (UTE) • SAXION UNIVERSITY OF APPLIED SCIENCE (SAX) • THE INST. OF FLUID-FLOW MACHINERY OF THE POLISH ACADEMY OF SCIENCES (IMP) • ENERGA-OPERATOR SA (EOR • STAY-ON ENERGY MANAGEMENT (SON) • KEZO FOUNDATION AT POLISH ACADEMY OF SCIENCE RESEARCH CENTRE (KEZ) • INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY (IITB) • INDIAN INSTITUTE OF SCIENCE, BANGALORE (IISC) • INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR (IITKGP) • INDIAN INSTITUTE OF TECHNOLOGY, DELHI (IITDE) • NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI (NITT) • NATIONAL INSTITUTE OF TECHNOLOGY
Geographical coverage	Denmark, India, Netherlands, Poland,
Project call name	Integrated local energy systems (Energy islands): International cooperation with India
Project call number	H2020-LC-SC3-2020-NZE-RES-CC
Budget	€ 3,491,307.13
Desired impacts (expectations at beginning of project)	The SUSTENANCE project addresses the following two challenges: 1. decarbonising local energy systems as well as 2. integrating other energy carriers to increase hosting capacity in a sector coupling approach. **The two most relevant scope objectives are linked to:**

SUSTENANCE (SUSTainable ENergy system for Achieving Novel Carbon neutral Energy communities)	
	• Demonstrating local energy systems 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. • Analysis of obstacles to innovation in both the EU and Indian context and foresee the coordination on policy relevant issues (e.g. regulatory framework, business models, data management, consumer engagement) **The two main expected impacts are related to:** • 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); • 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. In relation to the identified challenges, scope objectives, and expected impacts, all the areas mentioned above have been addressed. Additionally, other challenges, objectives, and impacts outlined in the call have been considered, with primary focus given to those specified. A key issue remains the actual understanding of what constitutes a local energy community and establishing governance structures for a properly organised local energy community. One of the big challenges still is to ensure a fast approval for different technical solutions in relation to actual regulations. Also, that the concept of local energy communities is still not very implemented in several countries within the EU as local regulations, so it is difficult to set up conditions for the actual formation of the local energy communities. in relation to technical solutions there is also still a need to have even more solutions for integrated energy systems, taking both electricity market, district heating/cooling markets, etc. into account.
Technologies and services that the project has the ambition to develop and serve	As mentioned, our project has addressed all the challenges, scope objective and expected impacts of the call to a higher or lesser extent, but all are addressed.
KER Type	Technological results; Intellectual Property - IP (patents, copyrights, trademarks, and other forms of intellectual property resulting from the project); Software; Business Models and Strategies
KERs of the Project	see table below

KER 1	User-friendly energy management system for private households
Leader	Neogrid
Contributors	N/A
Country	Denmark

SUSTENANCE
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KER info	This result will help maximise the consumption from the grid at the times when costs are lowest (and where grid capacity is plentiful). It helps to balance local energy demand and production of intermittent renewable resources on the community level by using the energy flexibility that is provided by devices such as heat pumps, EV chargers and batteries.

KER 2	iEMS- Intelligent Energy management System
Leader	STAY-ON Energy Management
Contributors	N/A
Country	Poland
KER info	This result integrates all energy systems components into one major system components, being “Local iEMS” and “iEMS Cloud”, and translates complicated algorithms into an easy solution, without necessary input from stakeholders, which optimises cost and usage of energy and maximises auto-consumption at the same time.

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 6-8

Cross-sectorial flexibility use cases: 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	9
KER2	4	9

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

Neogrid is commercialising the Community Energy Management System (CEMS), which will be applicable to energy communities in all sizes. From the smallest apartment building with heat pump and PV, to entire villages (or clusters of villages) that have assets of various types within their community.

The NEOGRID CEMS will be able to structure all the available assets in the backend, to provide the energy community with relevant metering data, as well as controlling the controllable assets based on various optimisation schemes (lowest cost, lowest CO_2 emission, maximise self-consumption and more).

SUSTENANCE (SUSTainable ENergy system for Achieving Novel Carbon neutral Energy communities)	
	Intelligent Energy Management System (iEMS). STAY-ON developed an energy management system dedicated to monitor and coordinate energy assets in the community with a focus on energy storage systems and EV charging infrastructure. iEMS enables communication between installation nodes to manage energy flows between community according to predefined objective (i.e. to maximise renewable self-consumption or minimise energy cost). iEMS combines edge devices and cloud service to integrate multiple sites in a single system.

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	ACCEPT	CREATORS	MAESHA	POCITYF	RE-EMPOWERED	RENergetic	SENDER	SERENE	SUSTENANCE
KER 1	Building Information Management Layer	Simulation Emulation Engine (Typhoon HILL + AUGE)	Energy-Economy Model	Implementation and demonstration of solar roofs and facades	Eco EMS	Multi-Vector and domain-specific optimizers	SENDER Smart Box	Community optimised energy consumption	User-friendly energy management system for private households
KER 2	Consumer Digital Twin Model	Management platform for CES projects (Auge)	Long-term Energy Assessment Model	Solar energy-producing screens	Eco Planning	Multi-vector Forecasting Services	SENDER Flexibility profiling and management	Mobile all-in-one energy storage system	iEMS- Intelligent Energy management System
KER 3	On-Demand flexibility Management Tool	Financing/contracting protocols (EP GROUP)	Forecasting of S&D Algorithms	Smart solar charging for buses	Eco Platform	Demand Response Recommendations	Smart charging EV energy management system and the methodology to design, integrate, validate and assess interoperable, secured and scalable	Energy flexibility provision from local communities	-

Project name	ACCEPT	CREATORS	MAESHA	POCITYF	RE-EMPOWERED	RENergetic	SENDER	SERENE	SUSTENANCE
							flexibility-based systems		
KER 4	P2P Energy/Flex Exchange Platform	CES-as-a-Service (combined)	Energy Flexibility and Market Framework	Citizens' engagement and energy awareness app	Eco Community	Communication and Interaction Strategies	Front-end application	-	-
KER 5	District Asset Management Component	-	Flexibility Management and Trading Platform	Energy management platform development (Def-Pi)	Eco Microgrid	Local waste heat simulator	Smart water heating system	-	-
KER 6	ACCEPT Citizen App	-	Residential Demand Response Toolbox	Citizen Engagement Methodology	-	IR occupancy predictor	Digital twin	-	-
KER 7	Energy Behaviour change method & tools	-	Industrial Demand Response Toolbox	Smart V2G EVs Charging	-	RENergetic System Core (software)	Forecasting algorithm tool	-	-

Project name	ACCEPT	CREATORS	MAESHA	POCITYF	RE-EMPOWERED	RENergetic	SENDER	SERENE	SUSTENANCE
KER 8	-	-	-	Energy data architecture and KPI platform	-	-	-	-	
KER 9	-	-	-	Monitoring software for the energy assets to send data to the monitoring platform	-	-	-	-	-
KER 10	-	-	-	REC Management Tool	-	-	-	-	-
KER 11	-	-	-	Energy Router	-	-	-	-	-
KER 12	-	-	-	Flexibility control algorithms	-	-	-	-	-

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