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active communities & energy prosumers for the energy transition

GRANT AGREEMENT NUMBER 957781

WP2 – Foundations

D2.1 – ACCEPT business scenarios, use cases & requirements

Responsible organisation	RINA-C
Contributing organisation(s)	Hypertech, MiWenergia, Mytilineos
Due date of Deliverable	31/08/2021
Actual date of submission	31/08/2021
Type of deliverable	Report
Dissemination level	Public

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Version history

Version	Date	Comments
0.0	16.02.21	Table of Contents
1.0	30.04.2021	Regulatory framework analysis included
2.0	12.05.2021	Introduction and Users' requirements methodology defined
3.0	13.07.2021	Included Use Cases description and Use Cases' requirements
4.0	03.08.2021	All chapters finalized except B2C and B2B surveys results. Comments on UCs and UC requirements have been included.
5.0	23.08.2021	Comments from all the partners included. First round of review from reviewers' partners
6.0	30.08.2021	B2B and B2C survey results included
7.0	31.08.2021	Comments from partners included. Finalized version for submission on EC portal

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Denmark
- Geco Global APS

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1. Table of Contents

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Glossary

Prosumer	An end-user (residential, small and medium-sized enterprises, or industrial) that no longer only consumes energy, but also produces energy. The term can also be used for end-users that have controllable assets (Active Demand & Supply) and are thereby capable of offering flexibility.
Active Demand & Supply (ADS)	All types of systems that either demand or supply energy which can be actively controlled. This enables the ADS device to respond to price and other signals from the Aggregator and to provide flexibility to the energy markets via the Aggregator. The Prosumer owns the device and defers responsibility for controlling its flexibility to the Aggregator. The Prosumer has final control over its assets, which means the Aggregator's control space is limited by the Prosumer's comfort settings. Hence the Prosumer is always in control of its comfort level; if the associated remuneration is high enough however, the Prosumer might be willing to compromise on its comfort levels. In this context we also use the terms units, assets or resources when referring to ADS.
Aggregator	Actor with the role to accumulate flexibility from Prosumers and their ADS and sell it to the BRP or Supplier, the DSO, or (through the BSP) to the TSO. The Aggregator's goal is to maximize the value of that flexibility by providing it to the service that has the most urgent need (or value) for it. The Aggregator must cancel out the uncertainties of non-delivery from a single Prosumer so that the flexibility provided to the market can be guaranteed. This prevents Prosumers from being exposed to the risks involved in participating in the flexibility markets. The Aggregator is also responsible for the invoicing process associated with the delivery of flexibility. The Aggregator and its Prosumers agree on commercial terms and conditions for the procurement and control of flexibility.
Supplier	Actor with the role to supply energy, to buy the energy, hedge its position across all timeframes, manage the energy and the associated risks, and invoice energy to its customers. The Supplier and its customers agree on commercial terms for the supply and procurement of energy. A Supplier is a specialization of the Trader role as it exchanges energy with Prosumers as well.
Producer	Actor with the role to feed energy into the energy grid with the primary objective of operate its assets at maximum efficiency. It plays an important role in the security of the energy supply. Though its responsibility remains unchanged, the introduction of demand-side flexibility and changes to the merit order can alter its operating conditions quite drastically, since renewable energy sources such as wind and solar power have a relatively low operating expense and compete with existing power generation units.
Balance Responsible Party (BRP)	Actor responsible for actively balancing supply and demand for its portfolio of Producers, Suppliers, traders, Aggregators, and Prosumers, with the means granted by those actors. In principle, everyone connected to the grid is responsible for his individual balance position and hence must ensure that at each imbalance settlement period (ISP), the exact amount of energy consumed is somehow sourced in the system, or vice versa in case of energy production. The Prosumer's balance responsibility is generally transferred to the BRP and this is usually contracted by the Supplier. Hence, the BRP holds the imbalance risk for each connection in its portfolio of Prosumers.
Distribution System Operator (DSO)	Actor responsible for the active management of the distribution grid, i.e. the cost-effective distribution of energy while maintaining grid stability in each region. To this end the DSO will check whether demand-side flexibility activation within its network can be safely executed without grid congestion and may purchase flexibility from the Aggregators to execute its system operations tasks.
Transmission System Operator (TSO)	Actor with the role of transport energy in each region from centralized Producers to dispersed industrial Prosumers and DSO over its high-voltage grid. The TSO safeguards the system's long-term ability to meet electricity transmission demands and is responsible for keeping the system in balance by deploying regulating capacity, reserve capacity, and incidental emergency capacity.
Flex Requesting Party (FRP)	A (market) party interested in using flexibility for a specific service.
Common Reference Operator (CRO)	Actor responsible for operating the Common Reference, which contains information about connections and Congestion Points in the network.
Meter Data Company (MDC)	Actor responsible for acquiring and validating meter data. The MDC plays a role in USEF's flexibility settlement process and the wholesale settlement process. In many countries, this role is performed by the DSO.

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Allocation Responsible Party (ARP)	Actor responsible, within a metering grid area, for establishing and communicating the realized consumption and production volumes per ISP, either on the consumer level or on the aggregated level. The realized volumes are primarily based on actual measurements but can also be based on estimates. The allocation volumes are input for the flexibility settlement process and the wholesale settlement process.
Balancing Service Provider (BSP)	Market participant providing Balancing Services to the TSO. Each Balancing Energy bid from a Balancing Service Provider is assigned to one or more Balance Responsible Parties. In the USEF framework we have considered a BSP as a specific type of BRP and, therefore, did not make this role explicit. Note that the BSP role is not distinguished in all EU member states.
Trader	Actor who buys energy from market parties and re-sells to other market parties on the wholesale market, either directly on a bilateral basis (over the counter) or via the energy exchange (day-ahead, intraday) etc.
Exchange	Actor who provides brokering between Traders, Suppliers, BRPs and Aggregators.
Energy Service Company (ESCo)	Actor who offers all kind of energy-related services to Prosumers (e.g.: insight services, energy optimization services, services that facilitate the joint purchase and maintenance of (shared) assets). If the Supplier or DSO is applying implicit demand-side flexibility through (for example) Time-of-Use or kWmax tariffs, the ESCo can provide energy optimization services based on these tariffs. Unlike the Aggregator, the ESCo is not active (nor exposed) to wholesale or balancing markets.
LEC Manager	Actor who manages the energy community that could be a DSO, ESCo, Retailer etc…

Source: USEF White Paper - Energy and Flexibility Services for Citizens Energy Communities - Appendix. 2019 [1]

Table of Abbreviations and Acronyms

ACER	Union Agency for the Cooperation of Energy Regulators
B2B	Business to Business
B2C	Business to Customer
BC	Business Case
CECs	Citizen Energy Communities
CEP	Clean Energy Package
DERs	Distributed Energy Resources
DSO	Distribution System Operators
EC	European Commission
EEE	Europäisches Zentrum für erneuerbare Energie Güssing
EPBD	Energy Performance of Buildings Directive
ESCO	Energy Service Company
EU	European Union
KPI	Key Performance Indicator
LL	Living Lab
MS	Member States

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P2P	Peer-to-peer
PMV	Performance Measurement and Verification
REC	Renewable Energy Community
RED	Renewable Energy Directive
RESS	Renewable Electricity Support Scheme
SCC	Self-Consumption Community
UC	Use Case
WP	Work Package

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Executive summary

This report represents the work carried out in Task 2.1 of ACCEPT project regarding market actor, prosumer requirements and business scenario definition, developed within Work Package 2 (WP2).

In particular, for the Deliverable D2.1 of Task 2.1, business and citizen/user requirements for the ACCEPT framework were defined and analysed, driven by business scenarios and use-cases to allow communities, prosumers and other market actors to easily grasp the intention, functionality and use of the project results.

In a desk research the **current legislative** policy framework and main regulatory instruments at the European Union (EU) level for the Energy Efficiency, Renewable Energy and Electricity Market Design were analysed, to have a view of current EU and national regulatory framework scenario. The main identified regulatory instruments, as **transposition at local/country** level of the latest European Commission (EC) Directives on Renewable Energy and the Electricity Market Design, were preliminary shared with all ACCEPT partners in order to check if they comply with the regulatory instruments identified during the desk research, or other regulatory instruments as well as the position of government and the presence of non-technical aspects including legislative and regulatory barriers/restrictions and how to overcome these barriers/restrictions.

The Use Case (UC) represents the important element for the design, development and implementation of all the ACCEPT solutions and will drive the demonstration campaign. Thanks to the involvement of the whole consortium, and specifically of the partners that will work on the development of ACCEPT tools, fourteen UC have been identified:

UC1 Monitoring and Visualization of Metering & Sensor Energy Data in community buildings
UC2 Building self-consumption employing Virtual Thermal Energy Storage optimisation
UC3 Consumer demand-side flexibility forecasting and optimisation taking into account comfort boundaries, activity patterns and possible requirements
UC4 Demand elasticity profiling-forecasting-aggregation and analysis in community level
UC5 Intra-day district-level DER flexibility management for community self-balancing
UC6 Day-ahead smart charging flexibility quantification via EV usage pattern profiling and forecasting
UC7 Community-level P2P flexibility/ energy exchange based on locally produced renewable energy
UC8 Participation in explicit Demand Response schemes
UC9 Participation in implicit Demand Response schemes
UC10 Community flexibility bundling for local congestion management service
UC11 Retailer day-ahead optimal pricing configuration for aggregated portfolio balancing
UC12 Optimal scheduling and operation of heating generation for a cost-efficient district-level DER management
UC13 Increase self-consumption at local community level
UC14 Active Citizen and LEC Engagement

Considering the ACCEPT Use Cases, seven different Business Cases have been analyzed to the purpose of defining possible business scenarios that, along with use cases, drive the user requirement definition process.

BC1 Energy Community as Flexibility Aggregator for Ancillary Service provision to System Operators and Balance Responsible Parties including network constraints management services, such as congestion management, and balancing services, such as frequency regulation.
BC2 Energy Community as an Energy Service Company (ESCO) offering energy management services to community members, such as energy awareness and self-balancing on community level.
BC3 Energy Community as an Energy Service Company (ESCO) facilitating P2P flexibility trading (shadow administration).
BC4 Energy Community as a Retailer supplying the community members with energy models and potentially participate in the wholesale market the locally aggregated energy surplus.
BC5 Energy Community optimized operation via P2P flexibility trading based on locally produced energy.

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BC6 Heating-as-a-Service Provider models under schemes in which electric heating is utilized as a controllable load or alternatively through carrier coupling with DH networks leveraging the higher predictability of individual load behavior to offer heating under predefined contractual terms.
BC7 Prosumer engagement in Implicit Demand Response for local energy profile optimization (Time-of-Use optimization).

Finally, to capture the views and requirements of all types of stakeholders and end-users, from "Business to Business (B2B)" stakeholders to provide the grid service perspective as energy supplier, pricing operator, ESCOs and DSOs or the local municipalities to "Business to Customer (B2C)" stakeholders as prosumer or consumer:

- **suitable questionnaires** were produced and sent to the ACCEPT project **pilot sites stakeholders**;
- focus group discussions were organized under the auspices of the ACCEPT Living Lab (T3.1 ACCEPT Living Labs design & establishment) as part of the open innovation approach introduced in the project.

From the results of the two surveys, it was possible to collect stakeholders needs and feedbacks on ACCEPT as a whole and on the different services that will be developed through the Use Cases. 115 answers were collected among the four pilot for the B2C and 19 for the B2B.
The main **results** of the **B2C survey** could be summarized in:

- ACCEPT project has been seen very appealing especially to the customer stakeholders of the pilot sites located in Spain (LaSolar) and Greece (Mytilineos), mainly for social/environmental aspects. On the other hand, Swiss (AEM) and Dutch (ESR) end-users, have also expressed neutral opinions related to the concerns about the possible lack of community members collaboration and possibility of dispersion with time of interest for the services proposed
- All community customer stakeholders agree on having personal advantages from the proposed services especially for increasing comfort and social awareness and increase the understanding of their energy consumption.
- Most of the respondents also agree that ACCEPT services provide benefits also to the whole community, and not only just to their self, especially for promoting self-management and a better use of energy
- As main results, all the respondents strongly agree or agree on willing to adopt ACCEPT services
- Mostly of the barriers that may limit the success of the roll out of ACCEPT services have been identified as ***technical*** issues

The **main results** of the **B2B survey** are:

- ACCEPT project has been seen very appealing mainly for its innovative opportunity in the business relation with consumers and to find a "new energy system" more transparent, honest and democratic
- **Main challenges** of the ACCEPT concept for its effective marketability have been stressed as people's resistance to change, the data management for privacy of members of community and the need to provide a clear guidance to the end-users in order to avoid trust issues and communicate with transparency and information
- Mostly of the barriers that may limit the success of the roll out of ACCEPT services have been identified as ***technical*** issues, as for the B2C survey
- Mostly of business pilot sites stakeholders agreed with the implementation and utility of the services since they can increase social awareness, energy/system efficiency and providing economic advantages related to the reduction of the electricity price

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1. Introduction

1.1. Scope of the Deliverable

This deliverable aims to define and detail the ACCEPT Use Cases that will be then deployed and validated in the four pilot sites (Spain, Switzerland, The Netherlands, Greece). The Use Cases will serve as a starting point to define the ACCEPT system architecture and the Performance Measurement and Verification (PMV) Methodology and will drive the demonstration activities as well as the tools development. The Use Cases has been grouped under different business scenarios, here properly analyzed. Business scenarios and use-cases have driven the requirement definition process for the ACCEPT framework to allow communities, prosumers and other market actors to easily grasp the intention, functionality and use of the project results. The Users' requirements have been identified also through suitable surveys to capture the views and requirements of the end-users, via the Living Lab (LL) approach developed within Task 3.1.

All these activities and evaluations have been performed considering the current EU and National regulations on energy communities. Detailed analysis of the National regulations and barriers over the design and creation of energy communities are here reported and have driven the development of the business scenarios.

1.2. Structure of the Deliverable

Within this Deliverable, besides Chapter 1 that constitutes the present Introduction, the following sections are included:

- **Chapter 2** outlines the regulatory framework at both European and ACCEPT partners national level, that will serve as the starting point to evaluate the business scenarios and their applicability to the pilot sites;
- **Chapter 3** defines the 14 UCs identified in the first six months of the project. The methodology followed for their definition and description will be reported together with the final description, including representations on how the 14 UCs are interconnected each other;
- **Chapter 4** presents the seven business cases identified within ACCEPT. A description of each of them will be reported together with a detailed analysis of the barriers for their implementation, specifically related to each pilot site;
- **Chapter 5** describes the users' requirements identified both from the end-users via dedicated surveys and all the requirements related to the 14 UCs;
- **Chapter 6** draws the conclusion remarks and next steps.

1.3. Interdependencies with Other Tasks and Deliverables

The activities contained in this deliverable are part of the foundation of the ACCEPT project, as they aim to construct the system architecture and specifications as a guide towards project tools development, based on user requirements. The activities reported in this Deliverable have been performed in strictly collaboration with WP3 for what concern the engagement of end-users and stakeholders in all the pilots and to collect feedback from B2C and B2B surveys. The results will drive the development of ACCEPT tools and solutions within WP4 and WP5 as well as will support the validation campaign and demonstration activities within WP6 and WP8.

The figure below shows the interdependencies of D2.1 with other tasks and Deliverables.

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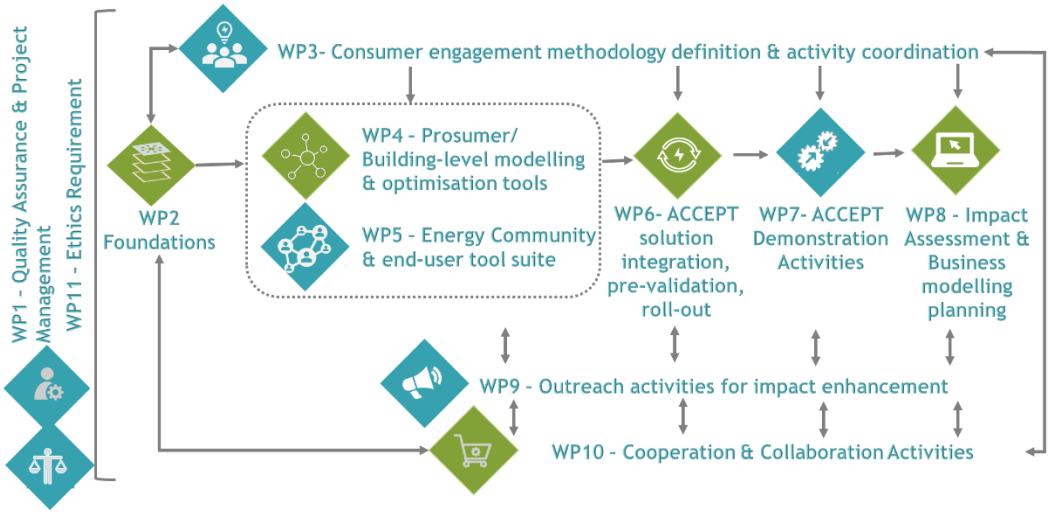

Figure 1: ACCEPT Work Package interdependency Graph

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2. Regulatory Framework Overview

In order to develop compatible business scenarios, deeply analysed in Chapter 4, that can facilitate the implementation of energy communities of different types (e.g. Citizen Energy Communities or CECs, Renewable Energy Communities or RECs, etc.) and other market actors, in this section, firstly the latest main legislative policy framework regarding energy efficiency and energy community at the EU level have been listed, with detail in buildings, and their provisions.

Then, RINA-C investigated the possible transposition of these regulations at national level, preparing and submitting a short questionnaire to all ACCEPT partners. Within the survey RINA-C also explored views/requirements of different types of stakeholders/end-users in order to provide the grid service perspective, while considering regulatory, legal and market barriers imposed in the EU.

The regulatory framework questionnaire template is shown in Annex I. The regulatory framework is indeed and important step to be evaluated for the development of suitable business scenarios that comply with European and National legislation.

1.1. European Context

Here below the main policy initiatives related to energy efficiency and energy community (Directives, Regulations, Proposal etc.) and their requirements identified during a desk research are described.

The following regulatory framework is included in the "*Energy Union Winter Package - Clean Energy for All Europeans*", in short, referred to as the Clean Energy Package (CEP), that is a range of directives and regulations acts on the energy performance of buildings, renewable energy, energy efficiency, governance and electricity market design; the regulatory framework was designed to improve energy efficiency and increase the share of renewable energy in Europe, while establishing regulations to foster the adoption of distributed-generation assets.

- The **Energy Performance of Buildings Directive (EPBD)** [1][1] 2018/844/EU, which amends the 2010/31/EU Directive, sets specific provisions for better and more energy–efficient buildings.
  Its recent provision on the Smart Readiness Indicator [3] for buildings which introduces new techniques and tools for the classification and measurement of several aspects that make a building smart and directly influence its impact on the residents, environment, grid, etc.
  The main developments brought about by the amendment are:
  - obligation for EU countries to establish stronger **long-term renovation strategies**;
  - the support of **e-mobility** through minimum requirements for large buildings' car parks and for smaller buildings;
  - the further promotion of **smart technologies**, including on devices that regulate temperature at room level;
  - the obligation of cross-national **comparability** of national energy performance requirements;
  - a common European scheme for **rating** the smart readiness of buildings;
  - the promotion of **health and well-being** of building users;
  - set technical building **system requirements** in respect of the overall energy performance, the proper installation, and the appropriate dimensioning, adjustment and control of the technical building systems which are installed in existing buildings. Member States may also apply these system requirements to new buildings;
  - regular **inspections** of the accessible parts of heating systems or of systems for combined space heating and ventilation, with an effective rated output of over 70 kW, such as the heat generator, control system and circulation pump(s) used for heating buildings.

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- **Energy Efficiency Directive** 2018/2002/EU [4], which amends the 2012/27/EU Directive, set an efficiency target of 20% identifying measures that separate the EU from reaching the target set for 2020. It also includes provisions extending energy savings obligation and heat meters remote reading; in particular it provides that heat meters and meters installed after October 25th, 2020 must be readable remotely. By 1st January 2027, even those already installed must be equipped with a remote reading system;

  In 2018, the updated Directive:

  - confirms the EU EE target of 20% by 2020, but it introduces the new target of at least 32.5% for 2030; the Commission is required to assess the target and to propose revising it upwards by 2023;
  - confirm the mandatory EE scheme in the period 2021 - 2030, with a target of 0.8% per year (and no longer 1.5%) of new savings in final energy consumption;
  - lays down rules designed to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy and provides for the establishment of indicative national EE targets and contributions for 2020 and 2030;
  - strengthened rules on individual metering and billing of thermal energy (better information for consumers);
  - in its Annex V, the Directive describes common methods and principles for calculating the impact of EE obligation schemes or other policy measures.

- **Governance of the Energy Union Regulation** 2018/1999/EU [5]: sets a new governance system for the Energy Union. Each MS is to establish an integrated 10-year National Energy and Climate Plan (NECP) for 2021 to 2030, with a longer-term view towards 2050. The plan is to outline how the MS achieve its respective targets;
- **Electricity Regulation** 2019/943/EU [6]: sets principles for the internal EU electricity market. It focuses mainly on the wholesale market as well as network operation. In that regard, the Regulation includes provisions that affect certain articles in the electricity network codes and guidelines. It sets, for instance, a new bidding zone review process and establishes the regional coordination centres, replacing the regional security coordinators, and complementing the transmission system operators' roles on a regional scope;
- **Risk Preparedness Regulation** 2019/941/EU [7]: requires the Member States to prepare plans on how to deal with potential future electricity crises. They are to use common methods and identify the possible electricity crisis scenarios, at both national and regional levels. Risk preparedness plans shall be based on these scenarios;
- **ACER Regulation** 2019/942/EU [8]: updates the role and functioning of the European Union Agency for the Cooperation of Energy Regulators (ACER). The Clean Energy Package also increases the competence of the ACER in cross-border cooperation. Moreover, it adapts the ACER's tasks to the new regulatory framework established by the Clean Energy Package, such as for the decision on the system operation regions and the monitoring of regional coordination centres.

Moreover, the package includes the revised **Renewable Energy Directive (RED II)**, 2018/2001/EU [9], sets a binding target of 32% for renewable energy sources (RES) in the EU's energy mix by 2030, with a possible review for an increase in 2023. It also includes provisions for mainstreaming RES in the transport and heating & cooling sectors. As an enabler for this transition, RED II also introduces the concept of Renewable Energy Communities to enhance citizens participation and impact toward Clean Europe.

Article 2 (16) of the directive contains a definitions of *"Renewable Energy Community"* as legal entity:

(a) which, in accordance with the applicable national law, is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity;

(b) the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities;

(c) the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits.

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The figure below shows the timeline for renewable energy in the EU, including the revision of the EU Directive.

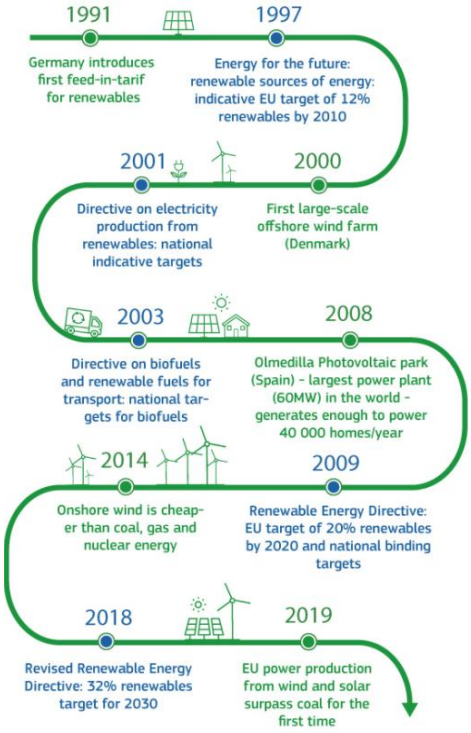

Figure 2: Timeline for renewable energy in the EU.
Source: https://ec.europa.eu/energy/topics/renewable-energy/directive-targets-and-rules/renewable-energy-directive_en

Finally, CEP includes the **Electricity Market Directive** (**EMDII**) EU/2019/944 [10] on common rules for the internal market in electricity recast strengthens the Electricity Directive's language surrounding demand response and smart metering, systematically including demand response as a resource in the provisions for all organized electricity markets, alongside storage and generation. This proposal also requires that provisions for balancing and wholesale markets accommodate renewable energy sources and increase demand responsiveness. Most importantly though, this directive introduces officially the concept of Citizen Energy Communities, the main governance and legal vehicle for the proliferation of energy communities in the near future around Europe.

Article 2 (11) of the directive contains a definition of *"Citizen Energy Community"* as legal entity:

> (a) is based on voluntary and open participation and is effectively controlled by members or shareholders that are natural persons, local authorities, including municipalities, or small enterprises;
>
> (b) has for its primary purpose to provide environmental, economic or social community benefits to its members or shareholders or to the local areas where it operates rather than to generate financial profits;
>
> (c) may engage in generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles or provide other energy.

2.1. National Context

To pursue the objective of the study, and in particular users' requirement, the analysis of **regulatory framework** at a national level was based on the following steps:

1) **Desk research** based on literature review on documents, papers from the European Commission and other significant sources in order to have an overview of the main regulatory instruments of current practice in the EU and their transposition at National level (also in relation to Recover Fund);

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2) Then, the main identified national regulatory instruments were shared with ACCEPT consortium partners. The **partners**, through a **short questionnaire**, were required to check if they were aligned with these regulatory instruments, clarify if they complied also with other regulatory instruments and specified if there were national government incentives for energy transition as well as regulatory/legal/socio-economic/market barriers facing energy communities in their country.

   ACCEPT consortium partners were identified as Respondent because ACCEPT topic specialists and covering most EU countries. Moreover, to speed up the simultaneous exchange of preliminary information with all the four demonstrators, the questionnaire was sent by mail and it could have been followed by a Microsoft Teams videocall, in case the questions were not clear, or some aspects wanted to be deepened further;

3) Information collected from the partners were assessed.

At a general level, it should be noted that the transposition of EC directives into national legislation of Member States regarding energy communities is slow, and even more importantly heavily diversified. The concept of energy cooperatives or energy communities has existed in the legislative framework of several MS in the past, but the associated rights, obligations, conditions have been very different [11].

Moreover, from RINA-C investigation of the barriers towards promoting and developing energy communities the following aspects emerged:

- The existing **regulatory framework** seems complex, fragmented and not designed to promote energy community creation;
- Need for policies to **oblige major's DSO** to share information and solutions to new technical advances;
- Lack of **organizational & administrative** effort: difficulties for especially small energy communities in the implementation of necessary structure and cover high administrative costs, big players can easily take over the market of energy community;
- Access to **funding**: there is a need for customers to have a monetary benefit, but in many EU Member States it is complex, expensive and bureaucratic for the municipalities to get grants. Also, municipalities may need to go through a tendering process to acquire additional services that they may need to operate energy communities. For small municipalities without many staff resources simplifications are therefore needed;
- Incentive programs/**financial incentives** are focused on the single "devices" and not on systems, making economically challenging to substitute old fossil heating systems with renewable ones. Costs other than the device, if transferred directly on the energy community, will results in higher energy costs pro kWh compared to the situation without a Self-Consumption Community (SCC).

The table below shown the main results collected, partner by partner, about the National regulatory framework on Energy Community. The national regulatory framework survey has been reported in Annex II.

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Table 2.1: National Regulatory Framework and Barriers

Country	Regulatory framework	Government position	Barriers facing energy communities	Remuneration schemes
Austria	• Amendment of the electricity act (ElWOG 2017) [12] • Renewables Expansion Law (Erneuerbaren-Ausbau-Gesetz, EAG) [13]	National policies related to energy communities still not implemented	• Existing legislation do not promote energy community creation: considering necessary structure and high administrative costs big players can easily take over the market; to support energy communities with administrative, "One Stop Shops (OSS)" system is planned to be implemented • Need for organizational & administrative effort • Need for monetary benefit for customers, in addition to a green edge with the electricity from the EC	Supporting schemes (feed in tariffs, invest funds) on national and regional level established, which should partly be replaced by the new law (EAG)
Cyprus	Adoption of the "Clean Energy for All Europeans" [14]	No government policies available	No government policies available	No existent remuneration schemes
Denmark	Proposal for the amendment of the Danish Electricity Supply Act published for consultation in 2020 [15]	• Denmark's Green Future Fund will contribute to a national and global green transition • Broad parliamentary majority agreed that the Government is to prepare a proposal for a green tax reform (Climate Agreement for Energy and Industry 2020), including short-term adjustments to the energy taxation aimed at a homogeneous CO2e tax in the long term	Administrative barriers are planned to be removed to enable enterprises to increase their solar energy investments	\
Greece	Law on Energy Communities (No. 4513/2018) [16]	• Regulation has affected positively the motivation to create energy communities and towards the first steps of lifting any regulatory and legal boundaries • Need for the regulatory framework to create a federation of Energy Communities in Greece to exchange experiences, facilitate the flow of information and organize collective actions to promote the schemes	• Expensive and complicated administrative procedures • Complex and fragmented regulatory framework • Problematic access of energy communities to funding (i.e.: policies related to funding and licensing procedures): Law 4759/2020 [17], to be applied from January 2022, lifts any incentives for energy communities • Formal investigation of the barriers towards promoting and developing energy communities still to be done	• Individual prosumers: feed-in tariffs and feed-in-premia for individual prosumers (i.e.: energy surplus is transmitted back to the grid and transformed into a reduction of energy billed cost to the owner of a PV system) • Energy Community: no remuneration process on the collective level • Energy efficiency: building (house and business), promotion of access to e-mobility infrastructure

Country	Regulatory framework	Government position	Barriers facing energy communities	Remuneration schemes
Ireland	Renewable Electricity Support Scheme (RESS) 2020 [18]	• National municipalities have less level of power than other MS • Difficult grid access for RES developments • Need for a unique national group representing energy communities to coordinate and help to drive policy • Need for an effective energy agency in each county • Need for policy not in place for 'novice' community energy projects but organizations (i.e.: Tipperary Energy Agency, SEAI) • Need for energy communities to access core funding supports, and to expertise and knowledge that encourages best practice with regard to governance, technoeconomic feasibility, innovative finance all need to be factored in	• Relative ineffectiveness of local government to drive change • Problem in access to funding, except funding via SEAI or indirectly through the Rural Regeneration and Development Fund, Community Development Associations and Leader Funding, and Enterprise Ireland • Lack of real culture/experience of district heating • Difficulties accessing investment and/or finance as a community group. Need for a national CLG, co-operative or similar to support energy communities on governance related issues and support • Need of credit unions to provide innovative financial products/services to support community groups in bringing about community development projects	The Renewable Electricity Support Scheme (RESS), operated by the SEAI is one example, but as this is a competitive auction, it will have limited overall impact in Ireland
Italy	Law on self-consumption and REC (Law No. 8/2020) [19]	• Specific development fund for energy communities • Pilot project started in 2021 monitored by National Agency	• Restrictive constraint on electricity market is that the participation demand-side resources are not allowed to access certain markets, on the grounds that they cannot robustly guarantee delivery of contracted services	Subsidy for self-consumers on self-consumed electricity. This incentive will last 20 years and it is aimed to pay back the renewable plant investment.
Netherlands	Electricity Act 1998 (last amendment in 2018) [20]	• Specific development fund for energy communities • New law coming that will benefit local communities, definition of energy communities and support policies can be created to give them equal access to the market	Heavy administrative load to act on energy markets for small energy communities equal to supplier	Idea on (partly) level out on a yearly basis a production surplus to reduce extra costs for tax and transportation
Spain	• Royal Decree 244/2019, amends the Spanish Electricity Sector Act 24/2013 of 26 December [21] • Pending to transpose EU Directive 2019/944 [10]	• Need for clearer legislation and more open self-consumption policies to citizenship and more restricted to DSO (equal access to the market) • Development of EU Recovery Fund in the next three years for Green activities in which "just and inclusive energy transition" is one of the reform levers of the Spanish Plan.	• Need for quick, clear and detailed legislation for energy communities • Need to review self-consumption policies and include new technical possibilities to be used by Coops • Need for policies to oblige majors DSO to share information and solutions to new technical advances	• Most of retailer companies remunerate surplus energy at daily market price • No existing remuneration schemes for prosumers.
Switzerland	• Energy law 2016 (Energiegesetz, EnG) [22]	• Positive affect on the establishment of SCCs (financially supporting the deployment of PV plants and renewable heating devices) • Energy legislation on SCC is clearly defined and acknowledged by the government	• Incentive programs/financial incentives focus on the single "devices" and not on systems, making economically challenging to substitute old fossil heating systems with renewable ones. Costs other than the device, if transferred directly on the energy community, will results in higher energy costs pro kWh compared to the situation without an SCC	Incentives for users of the SCC for buying and selling energy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957781.

Country	Regulatory framework	Government position	Barriers facing energy communities	Remuneration schemes
	• Energy decree 2017 (Energieverordnung, EnV) [23] • Federal Law on Electricity Supply (StromVG, 2007) [24] • Electricity Supply Ordinance (StromVV, 2008) [25]	• Many government tools to incentivize the energy transition at national and local level with different scopes (e.g. promote the substitution of inefficient large appliances, support the installation of PV systems and renewable heating systems, allow to experiment new technologies and business models) and demonstration programs, which allow the real field testing of new technologies, provided they are aligned with current legislation	• Need to establish of a SCC depends on the willingness of the DSO to "privatize" part of its grid as SCC have to be connected to one LV line • Need for alternative business model to cover the costs of the system, not only the "device" • Creation of SCCs with increased self-consumption will have a negative effect on the turnover of energy producers and distribution operators in the short term; in the long term this could be positive and more economically sustainable also for DSOs and retailers (finding alternative business models and value propositions)	

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 957781.

3. ACCEPT Use Cases

A Use Case (UC) defines the necessary actions performed by a system that will provide an impact. The impacts should be of interest for certain stakeholders (meaning that they are in line with their business goals) and should be measurable through specific metrics that are formulated in conjunction with the UC analysis and development procedure. A UC should describe in a practical but precise manner the interactions amongst the various actors of the system that will facilitate the accomplishment of the objectives of the relevant functionalities which are going to be deployed in the system.

3.1. Methodology for the definition of Use Cases

To proper address ACCEPT objectives, a set of Use Cases has been identified and strategically designed and formulated to demonstrate the ACCEPT business cases, as well as to disseminate project results and engage relevant stakeholders.
Through their description, Project consortium members were able to describe and define key processes and functionalities of the intended solutions aimed at achieving the project objectives.
The UC creation methodology is derived from the software engineering discipline, and the straightforward manner it offers for describing the intended functionalities (static as well as dynamic) of the system under study renders it also appropriate for application in the smart grid environment. This is the reason why numerous European projects focusing on smart grids have adopted the UC creation as their starting point [26] [27] [28].

The definition of Use Cases and their description is a fundamental step of ACCEPT project, since their description will affect all the other project activities (e.g.: KPIs panels, ACCEPT system architecture, demonstration activities, ACCEPT tools development etc.). The methodology adopted by ACCEPT Consortium for the formal definition of the UCs included the steps outlined below:

DEFINITION OF USE CASES
Two workshops have been held with all ACCEPT partners to refined and finalized the list of the UCs starting from the one included in the Grant Agreement. In the Table below the final list of UCs has been reported. The UCs have been divided based on what they refer to. More specifically, the following colour coding is followed: Orange: Building assets, Blue: Energy communities, Green: Distributed Energy Resources (DERs).

Table 3.1: ACCEPT Use case

UC1	Monitoring and Visualization of Metering & Sensor Energy Data in community buildings
UC2	Building self-consumption employing Virtual Thermal Energy Storage optimisation
UC3	Consumer demand-side flexibility forecasting and optimisation taking into account comfort boundaries, activity patterns and possible requirements
UC4	Demand elasticity profiling-forecasting-aggregation and analysis in community level
UC5	Intra-day district-level DER flexibility management for community self-balancing
UC6	Day-ahead smart charging flexibility quantification via EV usage pattern profiling and forecasting
UC7	Community-level P2P flexibility/ energy exchange based on locally produced renewable energy
UC8	Participation in explicit Demand Response schemes
UC9	Participation in implicit Demand Response schemes
UC10	Community flexibility bundling for local congestion management service
UC11	Retailer day-ahead optimal pricing configuration for aggregated portfolio balancing
UC12	Optimal scheduling and operation of heating generation for a cost-efficient district-level DER management
UC13	Increase self-consumption at local community level
UC14	Active Citizen and LEC Engagement

During such workshops, the pilot site responsible have been involved as well to identify which UC will be deployed and tested within ACCEPT project at their pilot site, to associate each UCs to the pilot sites where it will be deployment, tested and validated. This association is important also to evaluate specific remarks tailored to each pilot site.

Table 3.2: ACCEPT Use case and pilot site association

Use case (shortened name)	Pilot Site 1 Aspra Spitia *Greece*	Pilot Site 2 REC Buildings *Spain*	Pilot Site 3 Eva Lanxmeer Community *Netherlands*	Pilot Site 4 Arena Innovation Community & Care home La Sosta *Switzerland*
UC1: Metering & Sensor Energy Data	X	X	X	X
UC2: Virtual Energy Storage optimisation	X		X	
UC3: Consumer demand-side flexibility forecasting	X	X	X	X
UC4: Demand elasticity profiling-forecasting-aggregation	X	X	X	
UC5: Intra-day district-level DER flexibility management			X	X
UC6: Day-ahead smart charging flexibility quantification			X	
UC7: Community-level P2P flexibility				
UC8: Participation in explicit Demand Response schemes	X	X	X	X
UC9: Participation in implicit Demand Response schemes	X	X	X	X
UC10: Community flexibility bundling for local congestion management service			X	
UC11: Retailer day-ahead optimal pricing configuration	X	X	X	
UC12: Optimal scheduling and operation of heating generation				X
UC13: Increase self-consumption at local level		X	X	X
UC14: Active Citizen and LEC Engagement	X	X	X	X

Please note that UC7, even if it will not be tested in any of the ACCEPT Pilot site, the possibility of testing and validating UC7 under a simulation, lab or small-scale environment is currently being investigated.

DEFINITION OF RESPONSIBLE PARTNERS

For each UCs, a responsible partner and a secondary partner have been identified based on partners' role in the project, expertise and knowledge. The Responsible partner was responsible for the definition and description of the associated UCs, with the support of the secondary partner. The following table presents the responsible partners for each UCs.

Table 3.3: Responsible partners for each Use Case

USE CASE (shortened name)	Responsible partner	Secondary partner
UC1: Metering & Sensor Energy Data	QUE	CERTH
UC2: Virtual Energy Storage optimisation	HYPERTECH	QUE
UC3: Consumer demand-side flexibility forecasting	HYPERTECH	CIRCE
UC4: Demand elasticity profiling-forecasting-aggregation	WITSIDE	CIRCE
UC5: Intra-day district-level DER flexibility management	CIRCE	HYPERTECH
UC6: Day-ahead smart charging flexibility quantification	CERTH	HYPERTECH
UC7: Community-level P2P flexibility	QUE	CIRCE
UC8: Participation in explicit Demand Response schemes	CERTH	UCC

USE CASE (shortened name)	Responsible partner	Secondary partner
UC9: Participation in implicit Demand Response schemes	CERTH	UCC
UC10: Community flexibility bundling for local congestion management service	CIRCE	CERTH
UC11: Retailer day-ahead optimal pricing configuration	WITSIDE	MIWEnergia
UC12: Optimal co-generation scheduling and operation	CIRCE	CERTH
UC13: Increase self-consumption at local level	HYPERTECH	CERTH
UC14: Active Citizen and EC Engagement	GECO	UCC

USE CASE TEMPLATE PREPARATION

A UC definition template has been developed by RINA-C with the support of the Project Coordinator Hypertech. The template, reported in Annex I, follow the standardised IEC 62559 methodology [29] and includes the following sections: a) general description, scope and objectives, b) use case diagram and sequence diagram, c) technical details (actors, triggering events, preconditions and assumptions), d) scenarios and steps, e) exchanged information, f) interconnection with other Use Case.

USE CASE DEFINITION

For filling-in the template and to assure a common approach between the UCs, four different rounds have been performed:

1) In the *first stage*, the Scope, Objectives and Actors of the UCs have been included by the responsible partners. This phase was necessary to assure a common terminology among the UCs as well as to avoid any overlap between the UCs.
2) During the *second round*, a complete definition of each UCs has been provided by the responsible partners specifying all the technical details, with the support of the secondary partner.
3) A *third round* was necessary, together with a dedicated conference call, to resolve pending challenges, as well as to reach an agreement on how the different UCs are interconnected. Within this third round, all the UCs were aligned as much as possible also in terms of terminology and concepts.
4) During the *fourth round*, the four pilots' site responsible (LaSolar, Mytilineos, AEM and ESR) had the chance to look at the final draft of the Use Cases associated to their demo, provide comments as well as remarks for their deployment and validation at their demo site.

Finally, RINA-C, as Task leader, refined the obtained inputs and prepared a consolidated definition of the different UCs, reported in the following sections.

3.2. UC1 Monitoring and Visualization of Metering & Sensor Energy Data in community buildings.

1 Description of the Use Case

1.1 Name of Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case
1	Area: Component Layer, Communication Layer Domains: DER, Customer Premises Zones: Building, Operation	Monitoring and Visualization of Metering & Sensor Energy Data in community buildings

1.2 Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
01	07.04.2021	QUE	First proposal of use case	Draft
02	24.05.2021	QUE	Comments addressed; sections 2,4 & 5 added	Draft
03	06.07.2021	QUE, RINA-C	Final proposal of use case	Final

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The scope of the current use case is to enable collection of high-quality metering and sensing data from a modular and interoperable IoT gateway platform that will also allow for secure communication across actors and components. Also, to provide data visualization means for more efficient communication of events, behaviors and profiles that will allow for deeper understanding. This use case will examine the high value achieved by providing an integrated solution that can be assembled from market available components, act as a hub for off-the-self sensors, meters and actuators, and be compatible for all building types. Depending on the building, different sensors may be needed that need to be integrated into the system
Objective(s)	1. Enable the assembling of the IoT gateway from market available components 2. Integrate off-the-self sensors, actuators and meters according to detailed specifications 3. Enable data collection, ingestion and management through IoT Gateway software components. 4. Provide the means for efficient and meaningful data visualization through apps that will give insight and deeper understanding to the users.
Related business case(s)	BC1 Flexible Aggregator BC2 ESCO offering energy management services BC3 ESCO facilitating P2P flexibility trading BC4 Retailer BC5 Optimized operation via P2P BC6 Heating as a Service provider BC7 Prosumer engagement

1.4 Narrative of Use Case

Narrative of Use Case
Short description
Precise measurement and quantification of flexibility requires precise collection of data while ensuring a secure and seamless information flow across components and actors. The necessary hardware will consist of market available components and off-the-self sensory and measuring equipment that will operate under a common software stack.
Complete description

The key for the accurate measurement and quantification of the available demand flexibility, the participation in energy markets, and achieving high level of self-consumption requires to have access to high quality real-time energy information for consumption and production, inputs from sensory equipment and finally to be able to implement control strategies. The variety of scenarios and the case specific needs require a modular solution, compatible with most building types. Therefore, the infrastructure that will allow the data collection, ingestion and management, as well as the seamless information flow across components and actors will be assembled from market available hardware and off-the-self sensors, actuators and meters. Energy needs, consumption patterns, building/user profiles will be presented through a data visualization scheme that will increase the engagement of the user.

1.5 General Remarks

General Remarks
Measuring and quantifying flexibility requires: • Identification and classification of available building types. • Identification and classification of existing loads. Commissioning and installation of equipment in buildings. Off-the-self meters, sensors and actuators can provide agility and flexibility however ex-ante pilot surveys are necessary for accurate planning, development of the correct methodology and foreseeing obstacles. Also, a set of minimum requirements has to be set for eligible candidates, such as an internet connection. End users in this use case include consumers, prosumers, building/facility managers and building occupants but also all the various market actors. Specific remarks for LaSolar: - availability of space in the electric board to install consumption meters - Related to the previous one → user's reluctance to have visible wires or large devices. Specific remarks for Mytilineos: - Pilot User acceptance regarding interventions within his/her premise. - GDPR Compliance Specific remarks for AEM: - Limited space available within the electric boards, especially at consumer premises - Limit the use of visible wires and cable, especially if consumer spaces are involved - While electricity meters are widely used, heat meters are not - Every new installed device requires approval of end-users

1.6 Further Information to the Use Case for Classification / Mapping

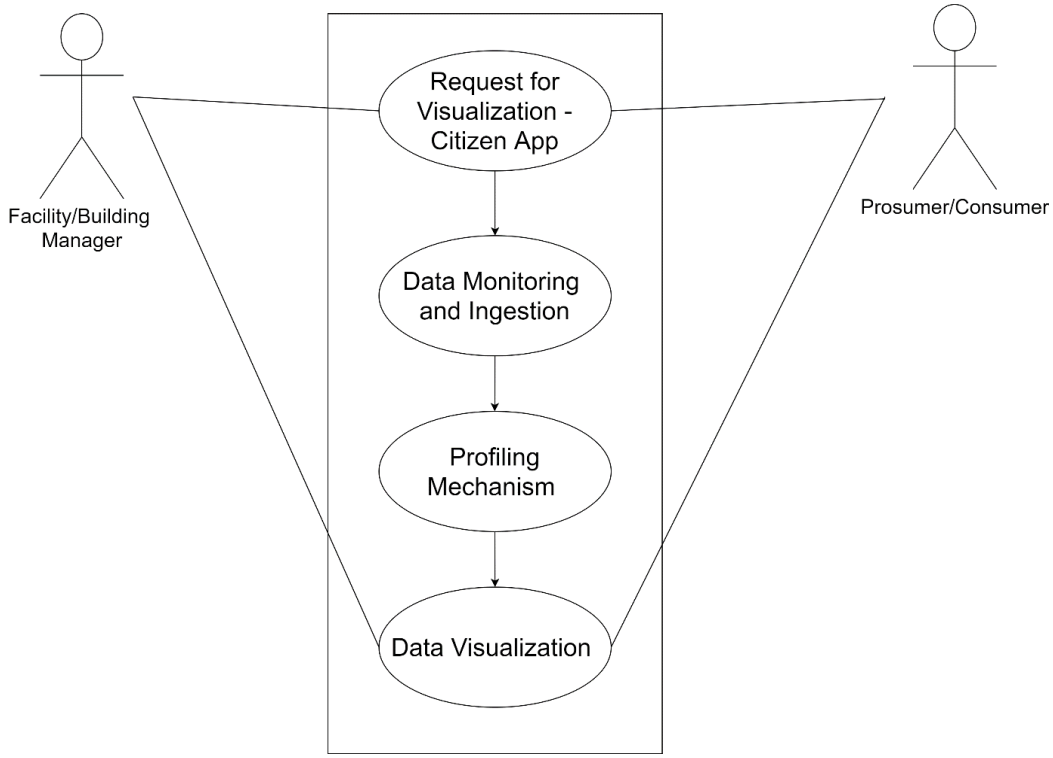
The following table presents further Information for the classification of this use case:

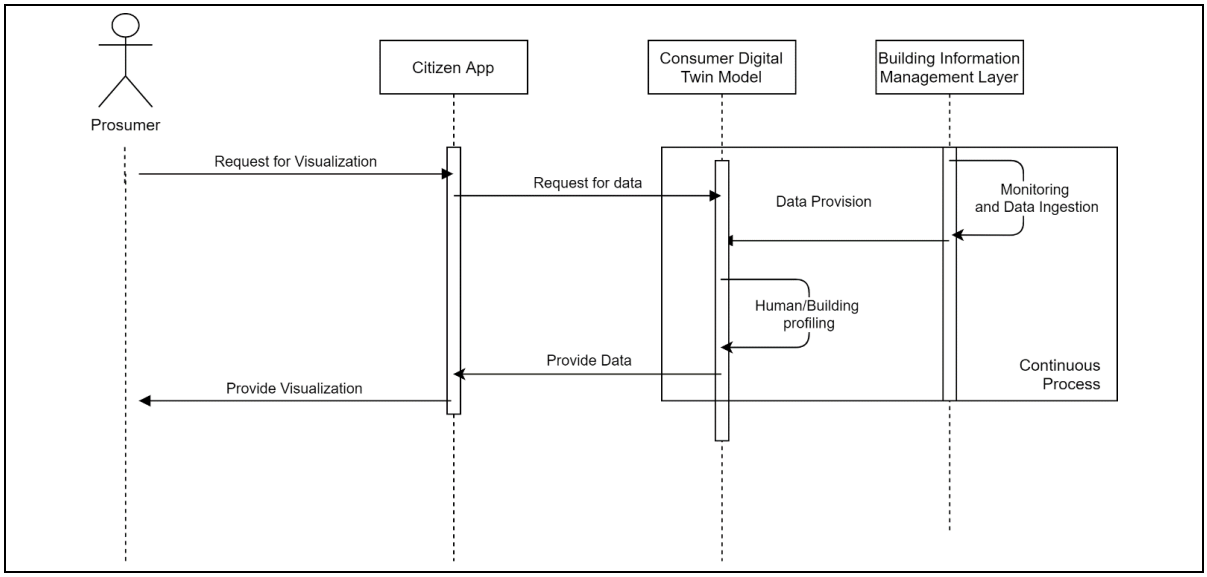
Classification Information
Relation to Other Use Cases
UC2 "Building self-consumption employing Virtual Thermal Energy Storage optimisation " To achieve and optimize self-consumption accurate monitoring and measurements are necessary. UC3 "Consumer demand-side flexibility forecasting" UC1 acts as a starting point in the pipeline from monitoring and metering of building assets towards modeling of the building/occupant and forecasting of flexibility. UC4 "Demand elasticity profiling-forecasting-aggregation" Monitoring and visualization of devices from UC1 contributes to profiling and aggregation of prosumers UC8 "Participation in explicit Demand Response schemes" Participation in explicit Demand Response schemes requires accurate monitoring and metering UC9 "Participation in implicit Demand Response schemes" Participation in implicit Demand Response schemes requires accurate monitoring and metering UC13 "Increase self-consumption at local community level" To maximize self-consumption at community level accurate monitoring and measurements are required.
Level of Depth
Medium
Prioritization

High
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keywords for Classification
Monitoring, IoT gateway, Sensors, Actuators, Data Ingestion, Data Cleansing, Data Visualization

2 Diagrams of Use Case

The diagram aims to illustrate the structure of the use case.

Diagram(s) of Use Case
[Use Case Diagram]    [Sequence Diagram]



3 Technical Details

3.1 Actors

The following table presents the actors involved in this use case:

Actors			
Actor Name	Actor Type	Actor Description	Further information specific to this Use Case
Prosumer/Consumer	Stakeholder	The end user that consumes or produces also in the case of the prosumer	The term refers to all prosumers/consumers that will provide flexibility and could me either residential or commercial
Building Occupant	Stakeholder	The end user that consumes electricity but is not directly charged	The term refers to actors that occupy a building and through their actions or profiles determine the available flexibility. For example, workers, customers etc.
Facility/Building Manager	Stakeholder	Person who manages property, usually not the end user of electricity but is responsible for billing and maintenance.	Can be both for commercial and residential buildings. Managing a facility or a building. Responsible for maintenance and paying the bill

3.2 Triggering Event, Preconditions, Assumptions

The following table presents the triggering events, pre-conditions and assumptions of this use case:

Use Case Conditions			
Actor/System/Information/ Contract	Triggering Event	Pre-conditions	Assumption

Prosumer/Consumer	Monitoring of an asset for user profiling	IoT Gateway + Sensors/Meters have been installed in premises	Registration of user in DR scheme
Prosumer/Consumer	Monitoring of an asset to provide flexibility	IoT Gateway +Sensors/Meters have been installed in premises	A training and calibration period for the given user with operational and environmental historical data

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

The following table presents the scenarios associated with this use case

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition
S01	Request for Visualization	Prosumer	Data are requested to be fed in the profiling engine for a specific upcoming time horizon	•Installation of essential monitoring and metering infrastructure (e.g. sensors and meters) •Establishment of communication pathway •Prosumer UI Interoperability between subsystems is essential	A request is sent through the Prosumer App
S02	Data Monitoring and Ingestion	Prosumer	Sensors and meters are sending data to the application Layer of the Building Information Management Layer	• Data Handling Infrastructure • Suitable physical and communication infrastructure established in asset	Data are collected, normalized and cleansed (if necessary)
S03	Profile Mechanism	Prosumer	Normal and cleansed data are fed into the models of the profiling mechanism	Profile algorithms have been properly trained	User profile is created/updated
S04	Data Visualization	Prosumer	User profile is sent to the Prosumer App	Prosumer App has access to the network	Visualization is created

4.2 Steps per scenario

The following tables present the steps of each of the scenarios associated with this use case as well as the respective requirements:

Scenario Name:	S01- "Data Monitoring and Ingestion"

Step No.	Event	Name of Process/ Activity	Description of Process/ Activity	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirements, R-ID
St01	Response	Receiving Data from sensors	The BIML receives data form the various sensors	management	Sensors	BIML	INF 1.1 Sensing and metering data	Sensors and meters have been installed properly
St02	Response	Data Ingestion	Data that have been received from sensors are identified, cleansed and normalized	Management	BIML	-	INF 1.2 Processed and cleansed sensing and metering data	-

Scenario Name:	S02- "Profile Mechanism"							
Step No.	*Event*	*Name of Process/ Activity*	*Description of Process/ Activity*	*Service*	*Information Producer (Actor)*	*Information Receiver (Actor)*	*Information Exchanged*	*Requirements, R-ID*
St01	Response	Continuous data flow from BIML to Digital Twin	Data received and processed from BIML are sent to the Digital Twin	Management	BIML	Digital Twin Model	INF 2.1 Processed and cleansed data	Internet connection established
St02	Response	Human/Building Profiling	Data from sensors and meters are fed into the models to create consumer and building profile	management	Digital Twin Model	-	INF 2.2 User Preferences	Models are calibrated and trained

Scenario Name:	S03- "Data Visualization"							
Step No.	*Event*	*Name of Process/ Activity*	*Description of Process/ Activity*	*Service*	*Information Producer (Actor)*	*Information Receiver (Actor)*	*Information Exchanged*	*Requirements, R-ID*

St01	Request	Request for visualization	User through the Citizen App requests data for visualization	Prosumer UI	Citizen App	Consumer Digital Twin Model	INF 3.1 Request parameters	Internet Connection
St02	Response	Provide Visualization	User receives visualization of data from Citizen App	Prosumer UI	Consumer Digital Twin Model	Citizen App	INF 3.2 Visualized data	Internet Connection

5 Information Exchanged

The following table presents the information exchanged in the context of this use case:

Information Exchanged			
Information exchanged (ID)	**Name of information**	**Description of Information Exchanged**	**Requirements to information data**
INF 1.1	Sensing and metering data	Raw data that have been received from meters and sensors (temperature, humidity, luminance etc.)	
INF 1.2	Processed and cleansed sensing and metering data	Data that have been cleansed	
INF 2.1	Processed and cleansed data	Cleansed and normalized data	
INF 2.2	User Preferences	Profile of user and building	
INF 3.1	Request parameters	Parameters for data to be visualized (type of data, time period etc.)	
INF 3.2	Visualized data	Data read to be visualized	

6 Interconnection with other UCs

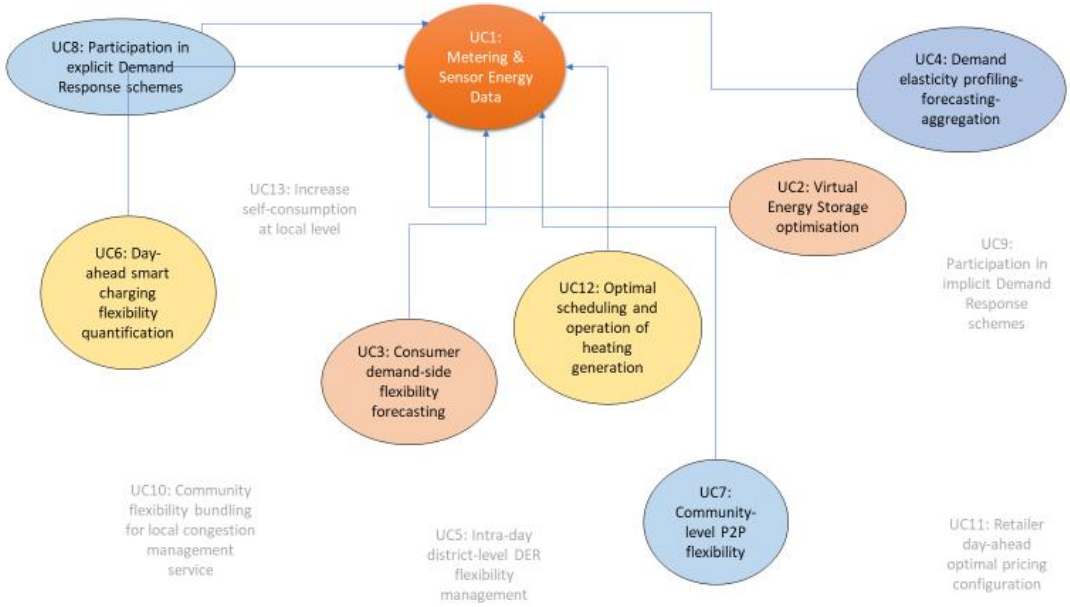


Figure 3.1: UC1 interconnection with other UCs

3.3. UC2 Building self-consumption employing Virtual Thermal Energy Storage optimization

1 Description of the Use Case

1.1 Name of Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case
2	Area: Energy Community Domain: DER, Consumption Zone: Building, Operation, Market	Building self-consumption employing Virtual Energy Storage optimisation

1.2 Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
0.1	09/04/2021	Hypertech	First proposal of use case	Draft
0.2	26/05/2021	Hypertech	Second proposal of use case	Draft
0.3	06.07.2021	Hypertech, RINA-C	Final proposal of use case	Final

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case

Scope	The scope of this UC is to establish an optimization framework for maximizing the use of self-generated energy, having a building asset as its focus. Relevant components from the ACCEPT architecture are: Building Digital Twin, On-Demand Flexibility Management
Objective(s)	1. Reduce residential energy bills through increase self-consumption of renewable energy 2. Share of total consumption is covered by local green energy.
Related business case(s)	BC2 ESCO offering energy management services BC5 Optimised operation via P2P BC7 Prosumer engagement

1.4 Narrative of Use Case

Narrative of Use Case
Short description
This Use Case (UC) deals with the optimal scheduling of operation for HVAC resources at building/apartment level, combined with the heat energy storage capabilities offered by the building envelope or hot water storage tanks, so as to increase the consumption of self-generated electricity via renewable resources. Consequently, the UC's objective is also to minimize the dependence of a single consumer from the grid, by making him/her self-sufficient.
Complete description
The concept of Virtual Energy Storage (VES) is tightly connected to the demand-side management on intra-building thermal loads. The building envelope and available hot water storage tanks are examined as thermal storage devices, whilst the building also serves as the energy sink. Local Power-to-Heat units operate as energy sources, and the heat generated can be either utilized directly to satisfy the occupants' comfort needs or stored to be utilized in a later moment in time. The significance of such functionality increases considerably when the building is equipped with Renewable Energy Resources (RES), such as Photovoltaic (PV) panels. This free resource of energy, due to its intermittent nature, does not commonly match the end-user demand and thus cannot always be readily consumed. One solution to this is energy trading to/from the grid, this though poses issues of energy balancing and management to the grid operator. Self-consumption is another way to minimize the loss of freely produced renewable energy. In this setting, the combined effect of being able to store thermal energy and modify to some extent the thermal demand leads to the best intra-building utilization of self-production. VES is an inherent part of the building Digital Twin model and is also tightly dependent on input from the Citizen Twin module. It combines the thermal properties of the building envelope and hot water storage with the usage patterns of its occupants and their comfort perception, so as to perform a short or mid-term optimization on use of resources that maximize the use of any renewable energy generated in the premises.

1.5 General Remarks

General Remarks
This UC has mostly the same requirements as UC13. The text is to large effect repeated in the two UCs. The UC on increasing self-consumption is driven by regulations and general financial situation in certain EU countries (e.g. Spain, Greece), where it appears to be the most efficient way to lower energy costs. To successfully implement this UC, certain technical requirements need to be satisfied, in terms of infrastructure, monitoring, communication and operation. More specifically, renewable resources connected to energy storage devices that can be monitored and modelled is highly important. Furthermore, communication and operation of building assets should be made at the same level and granularity. Specific remarks from Mytilineos: In terms of the Greek Pilot Site where no renewable energy sources are to implement this use case is mostly restricted to the optimal scheduling of operation for HVAC resources at building/apartment level, combined with the heat energy storage capabilities offered by the building envelope or hot water storage tanks.

1.6 Further Information to the Use Case for Classification / Mapping

The following table presents further Information for the classification of this use case:

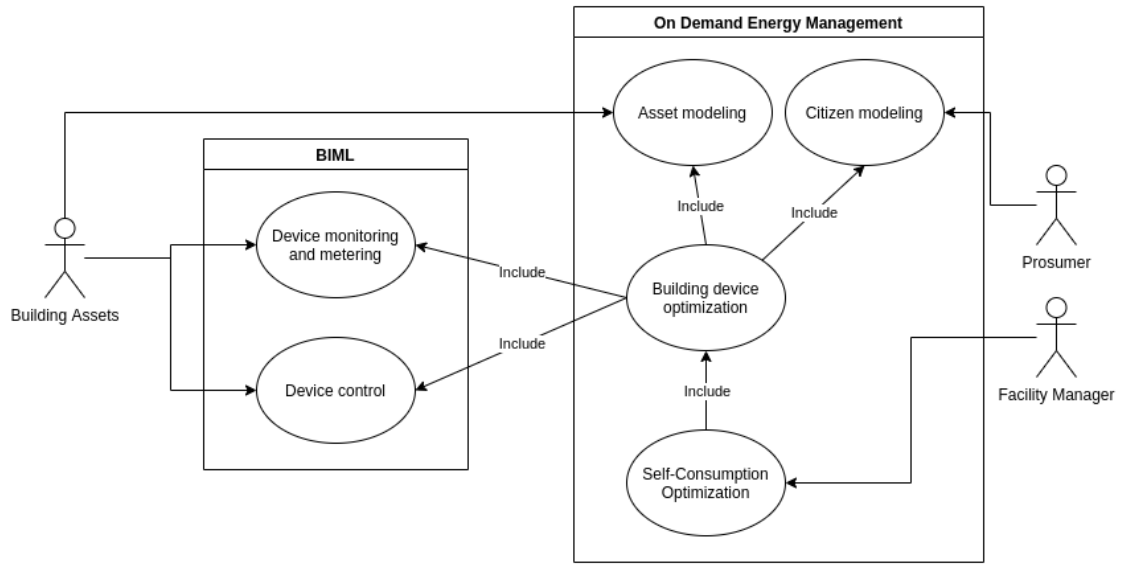
Classification Information
Relation to Other Use Cases
UC02 is generalized by UC13 (building to community level self-consumption) UC02 includes UC01 (requires the monitoring and metering functionality prescribed in that UC)
Level of Depth
Medium
Prioritization
High
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keywords for Classification
Virtual Thermal Energy Storage, Flexibility, Model Predictive Control

2 Diagrams of Use Case

The diagram aims to illustrate the structure of the use case.

Diagram(s) of Use Case

[Use Case Diagram]



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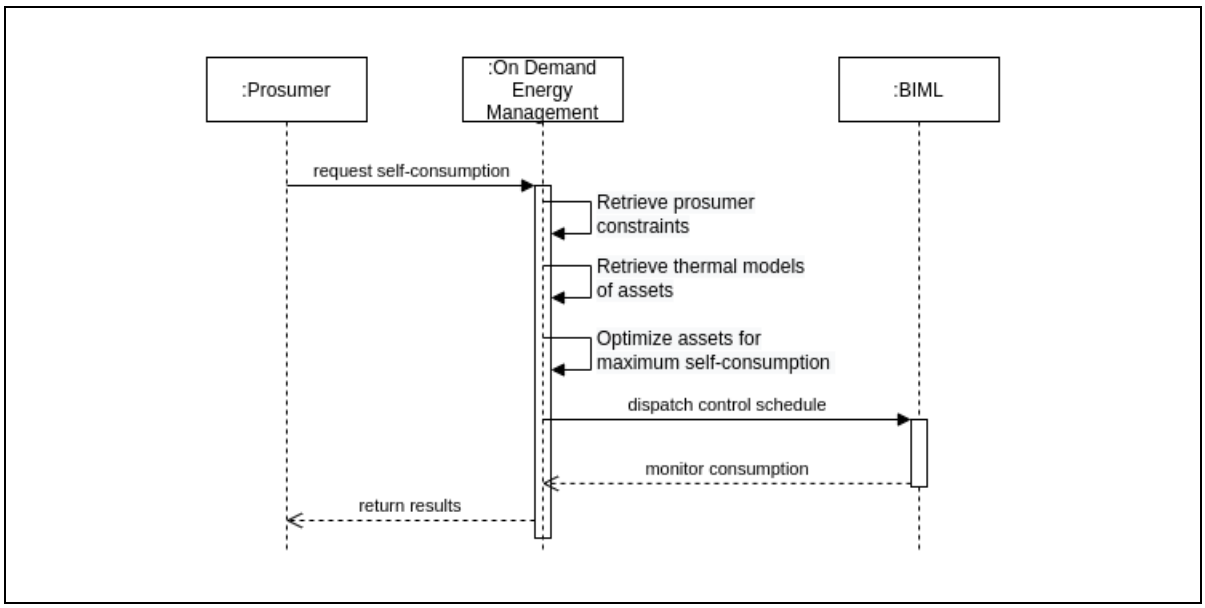


3 Technical Details

3.1 Actors

The following table presents the actors involved in this use case:

Actors			
Actor Name	Actor Type	Actor Description	Further information specific to this Use Case
Prosumer/ Facility Manager	Stakeholder	End-user that consumes energy but also produces energy	In the present UC, the term refers to all consumers/ flexibility providers either residential, commercial or industrial.
Building assets	Device	Required infrastructure	
BIML - Information/Communication Layer	System	ACCEPT system for enabling building data monitoring and control	
On Demand Flexibility Management	System	ACCEPT collection of modules responsible for the management of building assets	
Citizen Apps	System	ACCEPT UI for interacting with the end user	

3.2 Triggering Event, Preconditions, Assumptions

The following table presents the triggering events, pre-conditions and assumptions of this use case:

Use Case Conditions			
Actor/System/Information/ Contract	Triggering Event	Pre-conditions	Assumption

Prosumer of facility manager	The actor triggers the system to perform a day-ahead or intra-day optimization of certain assets.	Establishment of monitoring and communication infrastructure, establishment of digital twin models, Characterization of resources	It is assumed that the stakeholder representing the energy community can initiate the optimization process either for the complete portfolio or for individual buildings

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

The following table presents the scenarios associated with this use case

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition
S01	Self-Consumption maximization	Prosumer or Facility Manager	The primary actor triggers the system to perform a day-ahead or intra-day self-consumption optimization of the apartment/building.	Establishment of monitoring and communication infrastructure, establishment of on-demand flexibility tools and citizen UIs, Characterization of assets	Operation of building devices is performed based on the self-consumption maximization schedule

4.2 Steps per scenario

The following tables present the steps of each of the scenarios associated with this use case as well as the respective requirements:

Scenario Name:		Self-Consumption Maximization						
Step No.	Event	Name of Process/ Activity	Description of Process/ Activity	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirements, R-ID
St01	Request	Initiate optimization	User requests via the UI the optimal scheduling for the apartment/ building	External	Prosumer or Facility Manager	Citizen Apps	INF 01 Request notification, INF 03 building/asset ID, INF 02 datetime, horizon, timestep	UI, Infrastructure for monitoring and control in place. Software modules for optimization

St02	Request	Request optimization	Request is passed on to the on-Demand flexibility management engine	Module to Module	Citizen Apps	On-Demand Flexibility Management	INF 01 Request notification, INF 03 building/asset ID, INF 02 datetime, horizon, timestep	Infrastructure for monitoring and control in place. Software modules for optimization
St03	Request	Get end user activity/comfort constraints	Request the information (comfort/occupancy/activity) of the occupants in order to define the required constraints for the energy optimization	Module to Module	On-Demand Flexibility Management	Citizen Digital Twin	INF 03 building/asset ID, INF 02 datetime, horizon, timestep	BIML, Citizen Digital Twin Module
St04	Request	Get Building/ Asset information	Request the thermal modelling and characteristics of the apartment/ building zones and the relevant equipment	Module to Module	On-Demand Flexibility Management	Building Digital Twin	INF 03 building/asset ID, INF 02 datetime, horizon, timestep	BIML, Citizen Digital Twin Module
St05	Computation	Run self-consumption optimization	Run optimization algorithm based on retrieved constraints	Internal	On-Demand Flexibility Management	On-Demand Flexibility Management	-	Software modules for optimization
St06	Response	Present information	Present the optimal schedule to the requesting actor	Module to Module	On-Demand Flexibility Management	Citizen Apps	INF 04 Timeseries of power consumption to follow per device	UI
St07	Request	Apply schedule for building assets	Request the optimal operation of all building assets included	Module to Module	On-Demand Flexibility Management	BIML	INF 06 Timeseries of control actions to follow per device	Infrastructure for monitoring and control in place.

St08	Response	Monitor event	Provide information of metered data	Module to Module	BIML	On-Demand Flexibility Management	INF 04 Timeseries of power consumption	-
St09	Response	Monitor event	Provide information of scheduled operation	Module to Module	On-Demand Flexibility Management	Citizen Apps	INF 04 Timeseries of power consumption, INF 05 comparison between scheduled operation	-
St10	Response	Monitor Event	Visualize results of operation at community level	External	Citizen Apps	Prosumer / Facility Manager	INF 04 Timeseries of power consumption, INF 05 comparison between scheduled operation	UI

5 Information Exchanged

The following table presents the information exchanged in the context of this use case:

Information Exchanged			
Information exchanged (ID)	**Name of information**	**Description of Information Exchanged**	**Requirements to information data**
INF 01	Request notification		
INF 02	Datetime, horizon and timestep	The information is required in order to establish the time period for which the optimization is requested	
INF 03	Building/asset ID	The information is required for the correct communication between the modules. The key actor may have the ability to select which assets/zones should be considered each time	
INF 04	Timeseries of Power consumption	Information exchanged between the different modules and presenting the results of the self-consumption optimization. May be a timeseries of consumption per asset or aggregated per building.	
INF 05	Comparison between scheduled and actual operation	A timeseries object highlighting the requested vs actual consumption from assets at each timestep	

INF 06	Timeseries of control actions	Control actions for each specific resource in order to follow the requested consumption schedule	

6 Interconnection with other UCs

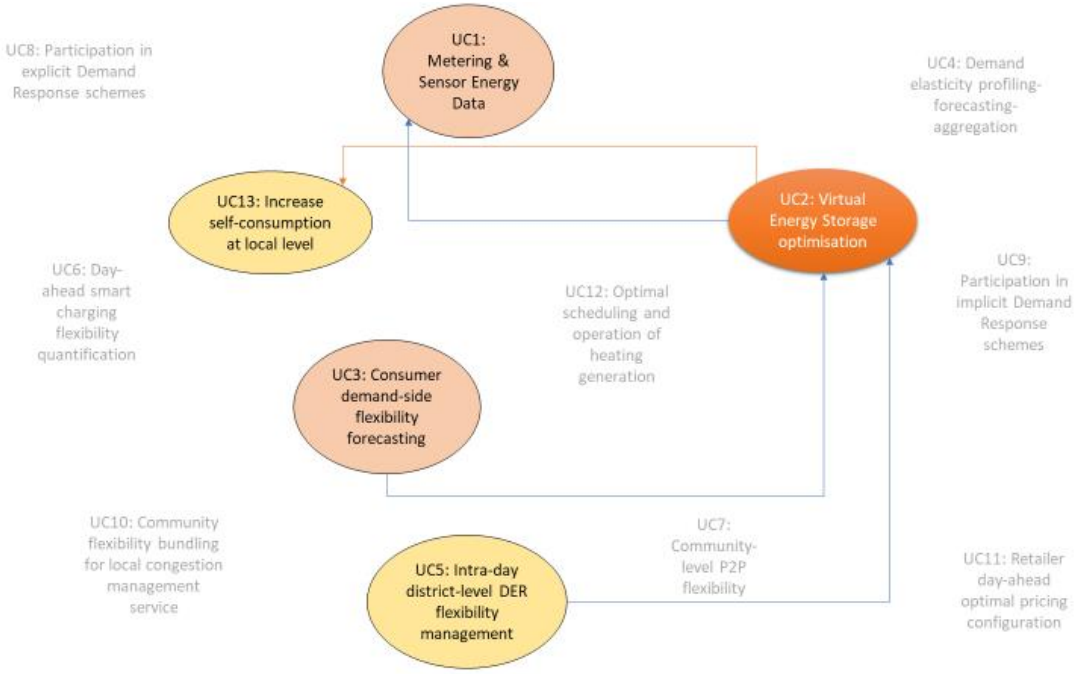


Figure 3.2: UC2 interconnection with other UCs

3.4. UC3 Consumer demand-side flexibility forecasting and optimisation taking into account comfort boundaries, activity patterns and possible requirements

1 Description of the Use Case

1.1 Name of Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case
2	Area: Building Domain: DER, Consumer Premises Zone: Station, Operation, Enterprise	Consumer demand-side flexibility forecasting and optimisation taking into account comfort boundaries, activity patterns and possible requirements

1.2 Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
0.1	13/04/2021	Hypertech	First proposal of use case	Draft

0.2	26/05/2021	Hypertech	Second proposal of use case	Draft
0.3	06.07.2021	Hypertech, RINA-C	Final proposal of use case	Final

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The scope of this UC is to establish the pipeline from monitoring and metering of building assets, to occupant and device modelling, flexibility forecasting and finally application of control actions to the flexible resources. Relevant components of the ACCEPT system are: Building Digital Twin, Building Citizen Twin, On-Demand Flexibility Management (additionally: BIML, citizen apps, community portfolio management)
Objective(s)	1. Provide intra-day and day-ahead forecasts of flexibility (possibility for upwards of downwards regulation of a building/asset consumption), based on the energy resources installed in the premises. 2. Translate flexibility requests to the building into scheduling operations for the electricity resources in the building/apartment/thermal zones.
Related business case(s)	BC1 Flexible Aggregator BC2 ESCO offering energy management services BC3 ESCO facilitating P2P flexibility trading BC5 Optimised operation via P2P BC6 Heating as a Service provider BC7 Prosumer engagement

1.4 Narrative of Use Case

Narrative of Use Case
Short description
The Use Case (UC) captures one of the core functionalities to be provided by the on-demand Flexibility Management component of the ACCEPT solution. In order for consumers to participate into energy markets, it is necessary to be able to provide forecasts of their baseline demand, as well as any upwards or downwards regulations of this baseline that can be provided, at specific future time intervals. The process depends on the modelling of the characteristics of the building, combined with the installed heating/cooling, resources DHW and other small electrical resources, as well as the modelling of the occupants' behaviour. Both of the above are translated into mathematical constraints that allow the execution of a number of numerical optimizations, that yield the quantitative forecasts in terms of baseline and flexibility offered by the asset.
Complete description

Aggregators and energy communities are anticipated to contribute significantly to the coming years in the opening of energy markets to demand flexibility. The way to do so is through aggregation of flexibility from individual consumers or district wide assets. This UC concentrated mainly on the first part and aims to enable the participation of consumers at building level to such markets. One of the first and necessary steps towards implementing this business scenario, is the forecasting of demand flexibility potential for each asset. To achieve this, individual consumer data, such as occupancy, device operational statuses, environmental conditions, metering and price data, along with occupants' comfort preferences need to be monitored. Upon establishing this information management layer, the algorithms implemented in the citizen twin module process the data to identify the comfort and activity preferences of the occupants. In parallel, the building digital twin module must model the electricity resources and thermal characteristics of the building. These models are then fed to the flexibility demand management component, which also takes as input forecasts of the environmental conditions and is able to estimate the future requirements and flexibility, in terms of energy, of each device/apartment/building. The computed flexibility forecasts can then be sent to the community flexibility management layer for realizing the participation in the energy market.

1.5 General Remarks

General Remarks
The realization of this UC requires the establishment of real-time metering, monitoring and control infrastructure in the buildings. Furthermore, it is important to note that the specific way that flexibility reports is structures depends heavily on the market requirements. Specific remarks from Mytilineos: This is a use case that will be slightly altered for the Greek Pilot Site as there is no flexibility market yet established within Greece in terms of end consumers. Specific remarks from AEM: - Flexibilities such as heat pumps, HVACs and other larger devices (usually with high inertia) work well towards the objectives of this UC, however smaller devices (e.g. lights) may have a minor impact on the flexibility market and their control is subjected to the approval by the end-users (privacy and comfort limits) - The reality of buildings within the same area is that available infrastructure may vary strongly (new/old devices, electric/gasoil devices, well-insulated/not insulated walls, etc.)

1.6 Further Information to the Use Case for Classification / Mapping

The following table presents further Information for the classification of this use case:

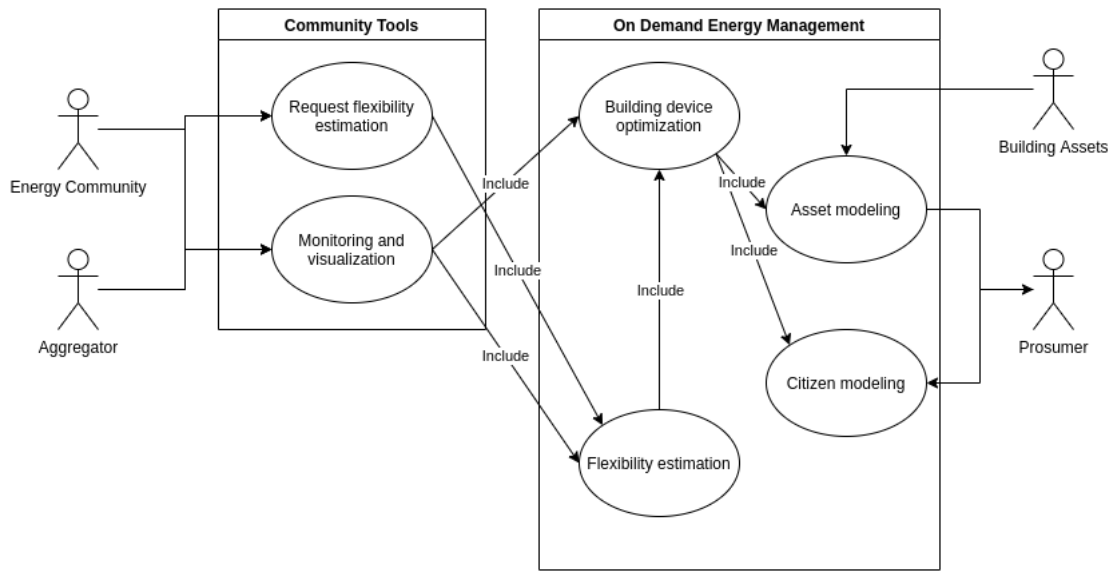
Classification Information
Relation to Other Use Cases
UC03 includes UC01 (requires the monitoring and metering functionality prescribed in that UC) UC03 is included in UCs 07, 08 and 13 (UC07 and UC08 and UC13 use functionality from UC03)
Level of Depth
Medium
Prioritization
High
Generic, Regional or National Relation
Regional
Viewpoint
Prosumer
Further Keywords for Classification
Flexibility estimation/forecasting, demand side management, demand response

2 Diagrams of Use Case

The diagram aims to illustrate the structure of the use case.

Diagram(s) of Use Case

[Use Case Diagram]



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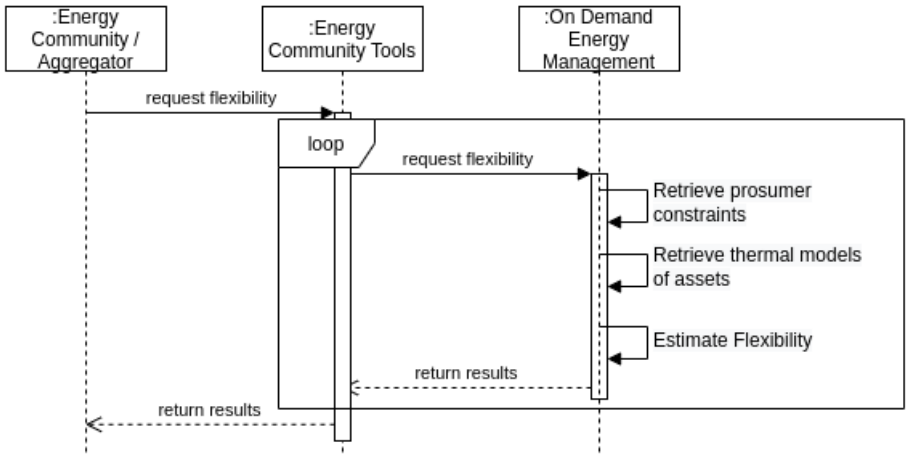


3 Technical Details

3.1 Actors

The following table presents the actors involved in this use case:

Actors			
Actor Name	Actor Type	Actor Description	Further information specific to this Use Case
Prosumer	Stakeholder	End-user that consumes and may produce energy from local RES	

Aggregator/Energy Community	Stakeholder	Actor that trades flexibility in the energy market	
Building assets	Device	Required infrastructure	
BIML - Information/Communication Layer	System	ACCEPT system for enabling building data monitoring and control	
On Demand Flexibility Management	System	ACCEPT collection of modules responsible for the management of building assets	
Citizen Apps	System	ACCEPT UI for interacting with the end user	
Energy community tools	System	ACCEPT system responsible for community level optimization	

3.2 Triggering Event, Preconditions, Assumptions

The following table presents the triggering events, pre-conditions and assumptions of this use case:

Use Case Conditions			
Actor/System/Information/ Contract	**Triggering Event**	**Pre-conditions**	**Assumption**
Aggregator/Energy Community via the community tools	Depending on the market, the actor requests short- or mid-term forecasts for the portfolio. The portfolio management layer distributes these requests to the individual buildings/assets.	The realization of this UC requires the establishment of real-time metering and monitoring infrastructure, as well as the development of suitable models for device and flexibility modelling	The type, horizon and granularity of the forecasts are dependent on the respective market requirements

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

The following table presents the scenarios associated with this use case

Scenario Conditions					
No.	**Scenario Name**	**Primary Actor**	**Triggering Event**	**Pre-Condition**	**Post-Condition**
S01	Building Demand Flexibility Estimation	Energy Community/Aggregator	The primary actor triggers the system to perform a day-ahead or intra-day estimation of available flexibility	Establishment of monitoring and communication infrastructure, establishment of on-demand flexibility	Flexibility information is available to the primary actor and the citizens

			for an apartment/building.	tools and citizen UIs, Characterization of resources	

4.2 Steps per scenario

The following tables present the steps of each of the scenarios associated with this use case as well as the respective requirements:

Scenario Name:		Building Demand Flexibility Estimation						
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
St01	Request	Request flexibility from a building	User or system requests the available flexibility of a building	External	Energy Community/Energy Community Tools	On-Demand Flexibility Management	INF 01 Request notification, INF 03 building/asset ID, INF 02 datetime, horizon, timestep	UI, Infrastructure for monitoring and control in place. Software modules for optimization
St02	Request	Get end user activity/comfort constraints	Request the information (comfort/occupancy/activity) of the occupants in order to define the required constraints for the energy optimization	Module to Module	On-Demand Flexibility Management	Citizen Digital Twin	INF 03 building/asset ID, INF 02 datetime, horizon, timestep	BIML, Citizen Digital Twin Module
St03	Request	Get Building/ Asset information	Request the models and characteristics of the building zones and the relevant equipment	Module to Module	On-Demand Flexibility Management	Building Digital Twin	INF 03 building/asset ID, INF 02 datetime, horizon, timestep	BIML, Building Digital Twin Module
St04	Computation	Estimate flexibility	Run flexibility estimation algorithm based on retrieved constraints	Internal	On-Demand Flexibility Management	On-Demand Flexibility Management	-	Software modules for optimization

St05	Response	Return flexibility forecast	Return the flexibility forecast of devices to the energy community tool as well as the citizen app	Module to Module	On-Demand Flexibility Management	Energy Community Tools, Citizen App	INF 04 Timeseries of baseline and flexibility per asset	
St6	Response	Present information	Present the optimal schedule to the requesting actor	External	Energy Community Tools, Citizen App	Energy Community, Prosumer		UI

5 Information Exchanged

The following table presents the information exchanged in the context of this use case:

Information Exchanged			
Information exchanged (ID)	**Name of information**	**Description of Information Exchanged**	**Requirements to information data**
INF 01	Request notification		
INF 02	Datetime, horizon and timestep	The information is required in order to establish the time period for which the flexibility estimation is requested	
INF 03	Building/Asset ID	The information is required for the correct communication between the modules. The energy community may have the ability to select which assets (buildings/apartments) should be considered each time	
INF 04	Timeseries of baseline and flexibility	Set of timeseries showing the baseline consumption forecast and the available upwards and downwards flexibility	

6 Interconnection with other UCs

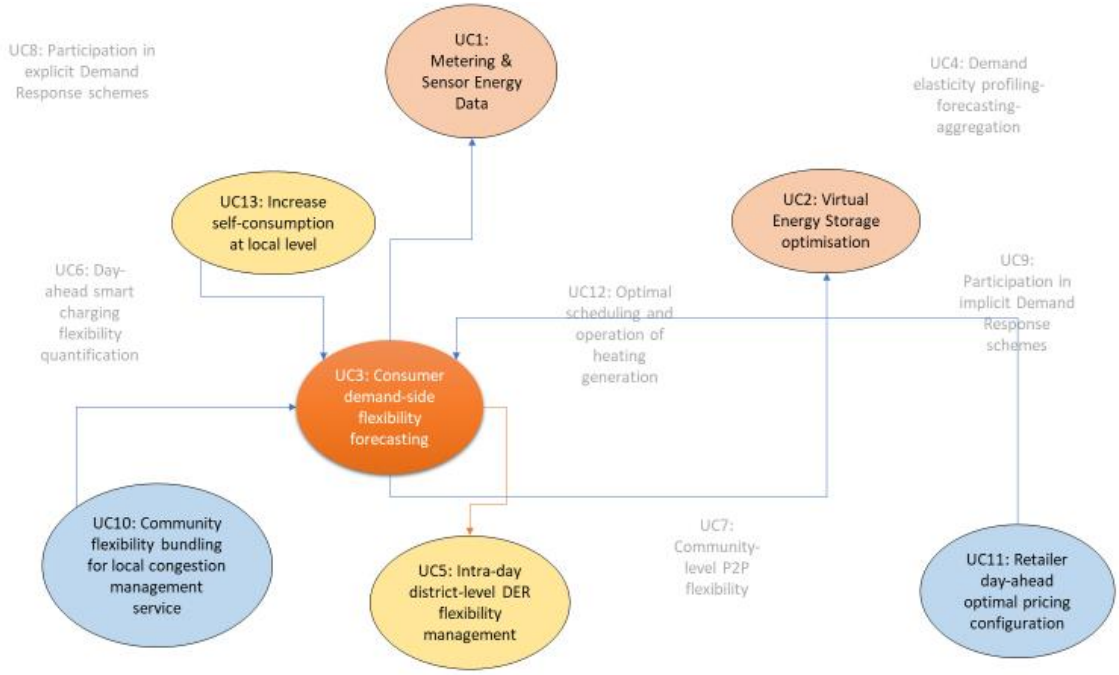


Figure 3.3: UC3 interconnection with other UCs

3.5. UC4 Demand elasticity profiling-forecasting-aggregation and analysis in community level

1 Description of the Use Case

1.1 Name of Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case
4	Area: Energy community Domain: Consumption, Distribution, DER Zone: Residential Buildings	Demand elasticity profiling-forecasting-aggregation and analysis in community level

1.2 Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
01	09.04.2021	WITSIDE	First proposal of use case	Draft
02	18.06.2021	WITSIDE	Final proposal of use case	Draft
03	06.07.2021	WITSIDE, RINA-C	Final proposal of use case including pilot site responsible feedbacks	Final

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The scope of this use case is to meet and facilitate the resident's profiling needs in order energy suppliers to purchase the ideal amount of energy. This enables energy suppliers to offer variable pricing schemes and to take advantage of the potential dynamic pricing schemas.
Objective(s)	• Address the profiling needs of the building residents • Analyse and aggregate the energy profiles • Estimate the total energy consumption profiles • Offer dynamic pricing schemas
Related business case(s)	BC4 Retailer BC5 Optimized operation via P2P BC6 Heating as a Service provider BC7 Prosumer engagement

1.4 Narrative of Use Case

Narrative of Use Case
Short description
Demand elasticity profiling-forecasting-aggregation and analysis at community level followed by consumption pattern optimisation through price signalling. The main goal is to capture consumers' behavior and at the same time optimize the amount of energy needed for the whole market. The optimization process would start by analyzing profiles, deploying pricing schemes and evaluate consumers' response.
Complete description
In order to achieve the main scope, this UC aims to address the profiling needs. The profiles have different behaviour as consumers but the main objective is to purchase the optimal amount of energy from the energy market in total. The most important step of this process is to analyse the profiles and after aggregation to manage to purchase in the wholesale market the optimum energy prices. Energy consumption and pricing data streams are established and the elasticity of demand is estimated. Flexible pricing schemas forecasts are also created according to the learnt-profiles and after evaluation the new pricing schemas are produced.

1.5 General Remarks

General Remarks
Specific remarks from ESR: In the Netherlands we're interested also in the effect on behaviour of customers that own solar panels on their roofs. Real time power from own roof will (in the future) be the cheapest energy, not only in summer when there is a lot of sun but also because Dutch legislation will stop with 'salderen', the rule that repurchased power can be discounted on purchased energy on moments without sun. Specific remarks from Mytilineos: As main Constraint here we see the willingness of the end users to actually change their energy behavior enabling the testing of these services.

1.6 Further Information to the Use Case for Classification / Mapping

The following table presents further Information for the classification of this use case:

Classification Information
Relation to Other Use Cases
UC1, UC7, UC9, UC11, UC13 The connection with the other UCs is assumed as a sharing information chain. Specifically, UC1 provides with data/information to UC4 and at the same time gets data/information from UC7, UC9, UC11 & UC13.
Level of Depth
Low

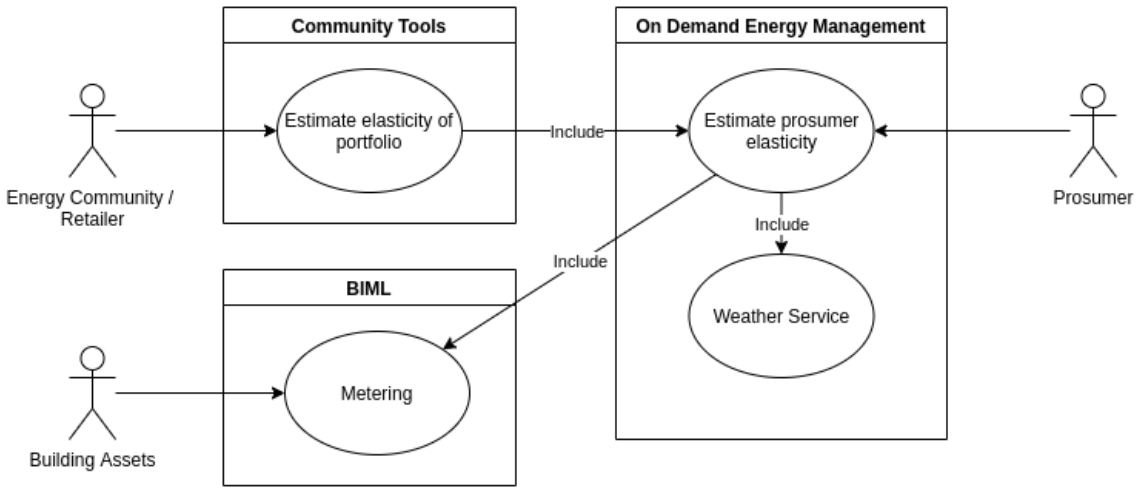
Prioritization
High
Generic, Regional or National Relation
Regional
Viewpoint
Business
Further Keywords for Classification
Elasticity

2 Diagrams of Use Case

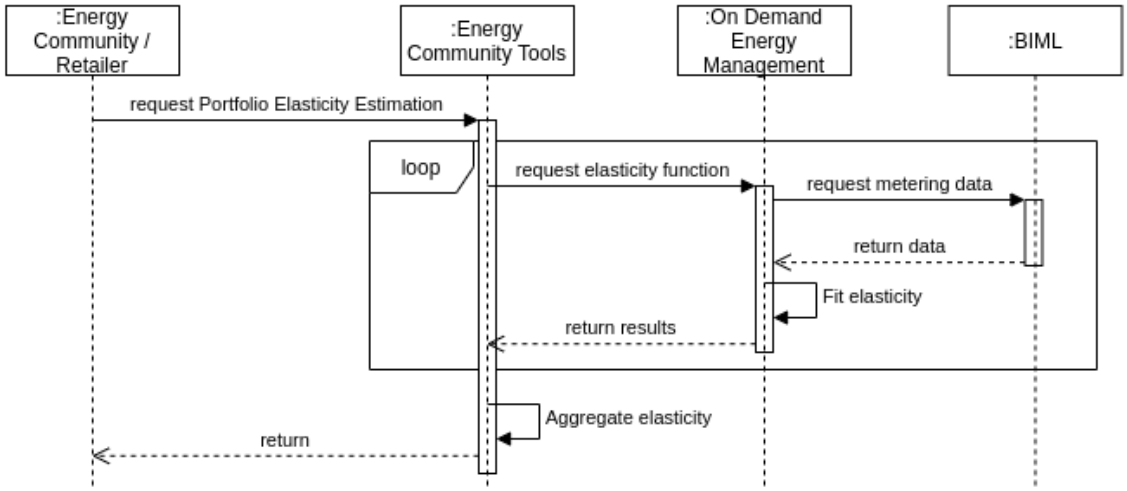
The diagram aims to illustrate the structure of the use case.

Diagram(s) of Use Case

[Use Case Diagram]



[Sequence Diagram]



3 Technical Details

3.1 Actors

The following table presents the actors involved in this use case:

Actors			
Actor Name	Actor Type	Actor Description	Further information specific to this Use Case
Prosumers/Consumers	Stakeholders	End-user that consumes and/or produce energy	Provide the required energy profiling data
Energy Suppliers	Stakeholders	Market Stakeholder	Analyses profiles and provides flexible pricing schemes
Building assets	Device	Required infrastructure	

3.2 Triggering Event, Preconditions, Assumptions

The following table presents the triggering events, pre-conditions and assumptions of this use case:

Use Case Conditions			
Actor/System/Information/ Contract	Triggering Event	Pre-conditions	Assumption
Contract between the supplier and the customers	Customer's demand for energy consumption meets supplier's services.	Clear and well-established communication process between the customers and the suppliers.	Customers are pricing constraints are valid and the suppliers can fulfil customers' needs.
Price triggers from energy supplier	Supplier identifies potential pricing schema options that would give a better result.	Clear and well-established profiling of the consumers.	Consumers' segments are well defined, potential pricing margins are considered as well.
Weather/production forecast	Supplier can forecast a priori any potential energy consumption changes related to demand's factors such as weather or production.	Clear and valid weather/production forecast.	It has been validated that weather or production needs have a serious effect on energy consumption.

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

The following table presents the scenarios associated with this use case

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition
S01	Monitoring and exploitation of Demand	Energy Suppliers	Data are requested to be fed in the profiling engine for a	• Installation of essential monitoring and metering infrastructure	Metering and Sensing data streams are fed to the Profiling Engine.

	Elasticity and pricing data.		specific upcoming time horizon.	• Data Handling Infrastructure • Establishment of communication pathway	
S02	Demand Flexibility profiling, aggregation, and analysis mechanism	Energy Suppliers	Flexibility profiles are requested to be delivered over a specific time horizon. Aggregated Analysis is requested as input for pricing optimization.	• Flexibility and optimisation algorithms defined and implemented. • Results are reviewed, what-if pricing scenarios are examined.	• Flexibility profiles, segments and forecast estimates are produced. • Estimation of accumulated flexibility potential and "What-if analysis" over the portfolio available under different pricing strategies. • Compliance with constraints of individual prosumers within the portfolio.
S03	Automated optimal pricing method	Energy Suppliers	Daily demand elasticity or customer behavioural changes are identified, resulting in modifying pricing policies accordingly.	Customers' demand requirement has been sufficiently segmented to control signals by the supplier.	• Automated optimized control of pricing method, in order to satisfy customers' request. • New ambient conditions are within user comfort boundaries.

4.2 Steps per scenario

The following tables present the steps of each of the scenarios associated with this use case as well as the respective requirements:

Scenario Name:	S01- "Monitoring and Exploitation of Demand Elasticity and pricing data."							
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
St01	Request	Load/Monitoring	Monitoring of demand data and price elasticity	Monitoring and data exploring	Smart Metrics	Data exploration	Inf01: Ambient Conditions, Consumption, Inf 03: Feedback from customers	Ability to receive monitoring data at any time

St02	Response	Data streaming for Profiling	Forward data streams to manager for processing and profiling	Management	Data exploration	Management	Inf01 Ambient Conditions, Consumption, Inf03 Feedback from customers	Pre-processing at the management for data cleaning and normalization

Scenario Name:		S02- "Demand Flexibility profiling, aggregation and analysis mechanism"						
Step No.	Event	Name of Process/ Activity	Description of Process/ Activity	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirements, R-ID
St01	Response	Demand & Price elasticity profiling	Data provided by the asset gateway are utilised for the profiling and optimisation	Management	Management	Management		Pricing and profiling algorithms defined and implemented

Scenario Name:		S03- "Automated optimal pricing method"						
Step No.	*Event*	*Name of Process/ Activity*	*Description of Process/ Activity*	*Service*	*Information Producer (Actor)*	*Information Receiver (Actor)*	*Information Exchanged*	*Requirements, R-ID*
St01	Request	Price elasticity/demand signal to suppliers	Signal is dispatched to the management	Management	Management	Management	Inf2: Pricing modifications & customer requirements	Valid and actionable customer signal
St02	Response	New Status Review	Retailer is notified about the pricing event, the new status of the customer is revised if needed.	Customer UI	Management	Suppliers UI	Inf3: New customer status	User friendly/ Comprehensible graphical visualisation of data provided to the supplier.

5 Information Exchanged

The following table presents the information exchanged in the context of this use case:

Information Exchanged			
Information exchanged (ID)	Name of information	Description of Information Exchanged	Requirements to information data
Inf1	Ambient conditions	Ambient conditions: o Temperature (ºC) o Humidity (HR) o Solar radiation (W/m2)	Access to weather conditions data through API
Inf2	Pricing Modifications & customer requirements	Minor changes in pricing schemas if it is demanded to satisfy customer needs optimally.	Demand elasticity is well defined
Inf3	New customer status	Optimizing customer segments if it is necessary.	Customer segments are well defined.

6 Interconnection with other UCs

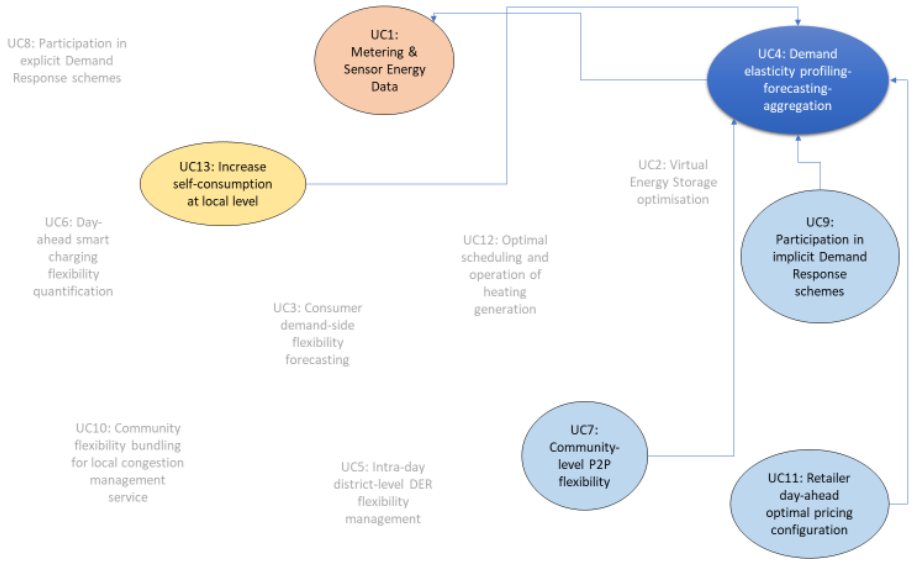


Figure 3.4: UC4 interconnection with other UCs

3.6. UC5 Intra-day district-level DER flexibility management for community self-balancing

1 Description of the Use Case

1.1 Name of Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case

5	Area: Building Domain: DER, Consumer Premises Zone: Station, Operation, Enterprise	Intra-day district-level DER flexibility management for community self-balancing

1.2 Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
01	12.04.2021	CIRCE	First proposal of use case	Draft
02	10.05.2021	CIRCE	Comments addressed	Draft
03	06.07.2021	CIRCE, RINA-C	Final proposal	Final

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	Develop a management tool for district-level assets to provide them with flexibility capabilities based on forecasting and local control optimization.
Objective(s)	1. Implement mid-term (intra-day) and sort-term (hour ahead) generation forecast. 2. Improving the scheduling of generation and reducing the use of reserves. 3. Provide a bi-directional interface with the various DER systems.
Related business case(s)	BC1 Flexible Aggregator BC2 ESCO offering energy management services

1.4 Narrative of Use Case

Narrative of Use Case
Short description
Distributed energy resources (DER) are becoming more relevant in electric power systems, and the main challenge at the distribution level consists in the optimal orchestration of all assets to provide the best load/generation distribution and from a more user-oriented perspective consider the economic impact caused by the dynamic pricing scheme.
Complete description
The asset management component of the district comprises different modules such as generation/demand management, storage management, other district assets management, all of such approaches involve determining the amount of energy that will be available/needed throughout the day, due to the varying nature of the energy generated by DERs, the forecast will rely on meteorological, geographical and weather-related data to feed a specific self-trained regression model for each DER to be used by the energy community tool. Input features include status information, time variables, temperature data and historical energy measurements, a bi-directional interface within the DERs will allow sending control commands based on the scheduling and dispatching performed by the energy community tool, as well as receiving status and monitoring information.

1.5 General Remarks

General Remarks
The realization of this UC requires the establishment of real-time metering, monitoring and control infrastructure at district level. Furthermore, it is important to note that the specific way that flexibility reports is structures depends heavily on the market requirements. Specific remarks from AEM:

- Flexibilities such as heat pumps, HVACs and other larger devices (usually with high inertia) work well towards the objectives of this UC, however smaller devices (e.g. lights) may have a minor impact on the flexibility market and their control is subjected to the approval by the end-users (privacy and comfort limits) - The reality of buildings within the same area is that available infrastructure may vary strongly (new/old devices, electric/gasoil devices, well-insulated/not insulated walls, etc.)

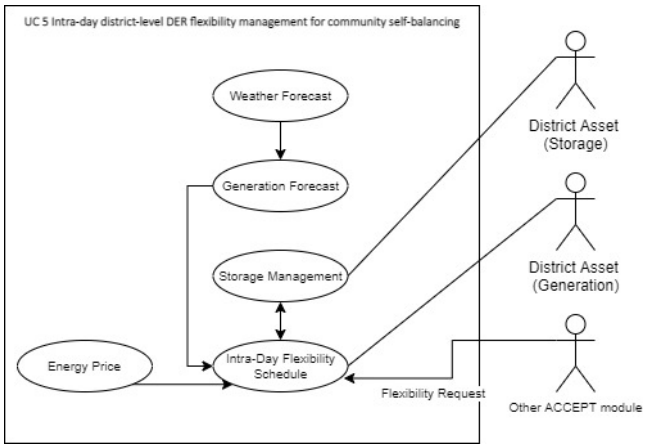
1.6 Further Information to the Use Case for Classification / Mapping

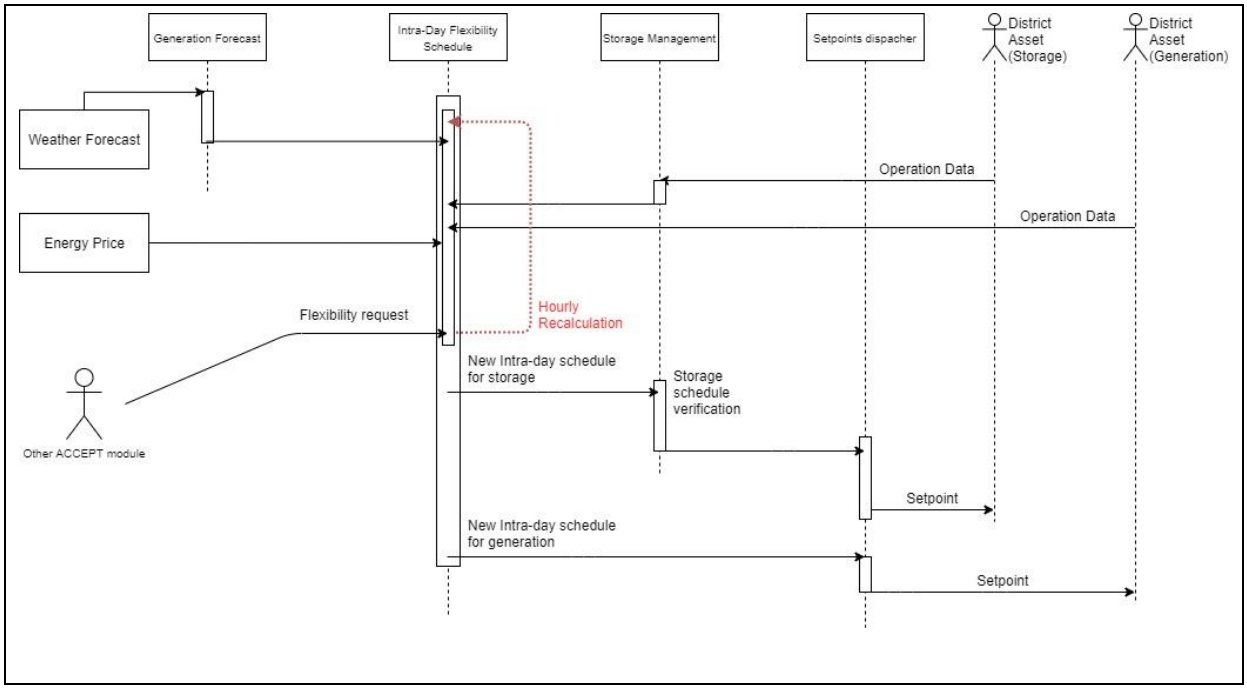
The following table presents further Information for the classification of this use case:

Classification Information
Relation to Other Use Cases
UC1, UC3, UC10
Level of Depth
Medium
Prioritization
High
Generic, Regional or National Relation
Regional
Viewpoint
Prosumer
Further Keywords for Classification
Flexibility estimation/forecasting, demand side management, demand response

2 Diagrams of Use Case

The diagram aims to illustrate the structure of the use case.

Diagram(s) of Use Case
[Use Case Diagram]    [Sequence Diagram]



3 Technical Details

3.1 Actors

The following table presents the actors involved in this use case:

Actors			
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
Consumers	Stakeholder	End-user that consumes energy	
Aggregator/Energy Community	Stakeholder	Actor that trades flexibility in the energy market	
DSO	Stakeholder	Actor that owns and manages distribution grid Asks for flexibility	
Community Flexibility management	System	ACCEPT system responsible for initiating the flexibility requests to specific assets	
Renewable Generation Devices	Device	Required infrastructure	
Energy Storage devices	Device	Required infrastructure	
BIML - Information/Communication Layer	System	ACCEPT system for enabling data monitoring	
Flexibility Management - Optimization Layer	System	ACCEPT collection of modules responsible for the flexibility estimation	

BIML - Operation Layer	System	ACCEPT system responsible for the operation of the devices	

3.2 Triggering Event, Preconditions, Assumptions

The following table presents the triggering events, pre-conditions and assumptions of this use case:

Use Case Conditions			
Actor/System/Information/ Contract	Triggering Event	Pre-conditions	Assumption
Regular Operation	Hourly Schedule recalculation	The realization of this UC requires the establishment of real-time metering and monitoring infrastructure.	The type, horizon and granularity of the forecasts are dependent on the respective market and grid requirements
Flexibility / Operation request	Intra module Flexibility / Operation request	An Energy Community tool request from another module	External signal from another ACCEPT module to modify and set operational points of the DERs assets (at district level) + schedule recalculation

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

The following table presents the scenarios associated with this use case

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition
S01	Regular Operation	Community Flexibility management	Hourly Schedule recalculation	Previous schedule + live data from DERs + weather forecasting + Energy cost	Flexibility Schedule for the next 24H + Setpoint for DERs
S02	Flexibility / Operation request	Community Flexibility management	Explicit Flexibility request	Previous schedule + live data from DERs + weather forecasting + Energy cost + Flexibility required	Flexibility Schedule for the next 24H + Setpoint for DERs

4.2 Steps per scenario

The following tables present the steps of each of the scenarios associated with this use case as well as the respective requirements:

Scenario Name:	S01- "Regular Operation"							
Step No.	Event	Name of Process/ Activity	Description of Process/ Activity	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirements, R-ID

St01	request	Weather forecast API	Get weather forecast	external	External API	Energy community tools	Weather forecast (DAT01)	Receive W. forecast
St02	request	Energy Price	Get energy price	external	External API	Energy community tools	Energy Price (DAT02)	Receive energy cost
St03	request	DER current operation (generation)	Operational data from field	Monitoring	Energy community tools	Energy community tools	Active and Reactive power (DAT03)	Receive power values / time stamp
St04	request	DER current operation (storage)	Operational data from field	Monitoring	Energy community tools	Energy community tools	Active and Reactive power + Remaining charge (DAT04)	Receive power values + value of charge / time stamp
St05	request	Demand Forecast	Long term demand forecast	Module to module	Energy community tools	Energy community tools	Long-term demand profile forecast (24H ahead)	data storage
St06	calculation	Generation forecast	Long term generation forecast	Internal	the module itself	Energy community tools	Long-term generation profile forecast (24H ahead) DAT05	data storage
St07	control	Storage management	Charge / discharge cycle profile calculation	internal	the module itself	the module itself	Charge / discharge profile (24H ahead) DAT05	data storage
St08	calculation	Intra-Day Flexibility Schedule	Calculation of scheduling for reduce use of reserves and cost	internal	the module itself	Energy community tools	24H ahead setpoint DERs definition	Data storage + setpoint dispatcher

Scenario Name:	S02- "Flexibility / Operation request"							
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
St01	request	Weather forecast API	Get weather forecast	external	External API	Energy community tools	Weather forecast (DAT01)	Receive W. forecast
St02	request	Energy Price	Get energy price	external	External API	Energy community tools	Energy Price (DAT02)	Receive energy cost
St03	request	DER current operation (generation)	Operational data from field	Monitoring	Energy community tools	Energy community tools	Active and Reactive power (DAT03)	Receive power values / time stamp

St04	request	DER current operation (storage)	Operational data from field	Monitoring	Energy community tools	Energy community tools	Active and Reactive power + Remaining charge (DAT04)	Receive power values + value of charge / time stamp
St05	request	Demand Forecast	Long term demand forecast	Module to module	Energy community tools	Energy community tools	Long-term demand profile forecast (24H ahead)	data storage
St06	calculation	Generation forecast	Long term generation forecast	Internal	the module itself	Energy community tools	Long-term generation profile forecast (24H ahead) DAT05	data storage
St07	control	Storage management	Charge / discharge cycle profile calculation	internal	the module itself	the module itself	Charge / discharge profile (24H ahead) DAT05	data storage
St08	control	DER operation	Explicit Flexibility / operation Request	Module to module	Energy community tools	Energy community tools	Requested flexibility / operation	Operation request flag + flexibility value
St09	calculation	Intra-Day Flexibility Schedule	Calculation of scheduling for reduce use of reserves and cost	internal	the module itself	Energy community tools	24H ahead setpoint DERs definition	Data storage + setpoint dispatcher

5 Information Exchanged

The following table presents the information exchanged in the context of this use case:

Information Exchanged			
Information exchanged (ID)	**Name of information**	**Description of Information Exchanged**	**Requirements to information data**
DAT01	Weather Forecast	Weather forecast from external provider (e.g. OWP)	External API integration
DAT02	Energy price	Energy price	External API integration
DAT03	DER current operation (generation)	Real time data from Generation DERs	
DAT04	DER current operation (storage)	Real time data from Storage	
DAT05	Demand Forecast	Long-term demand profile scheduling	
DAT06	DER operation request	Value of flexibility / operation to DERs assets at district level	

6 Interconnection with other UCs

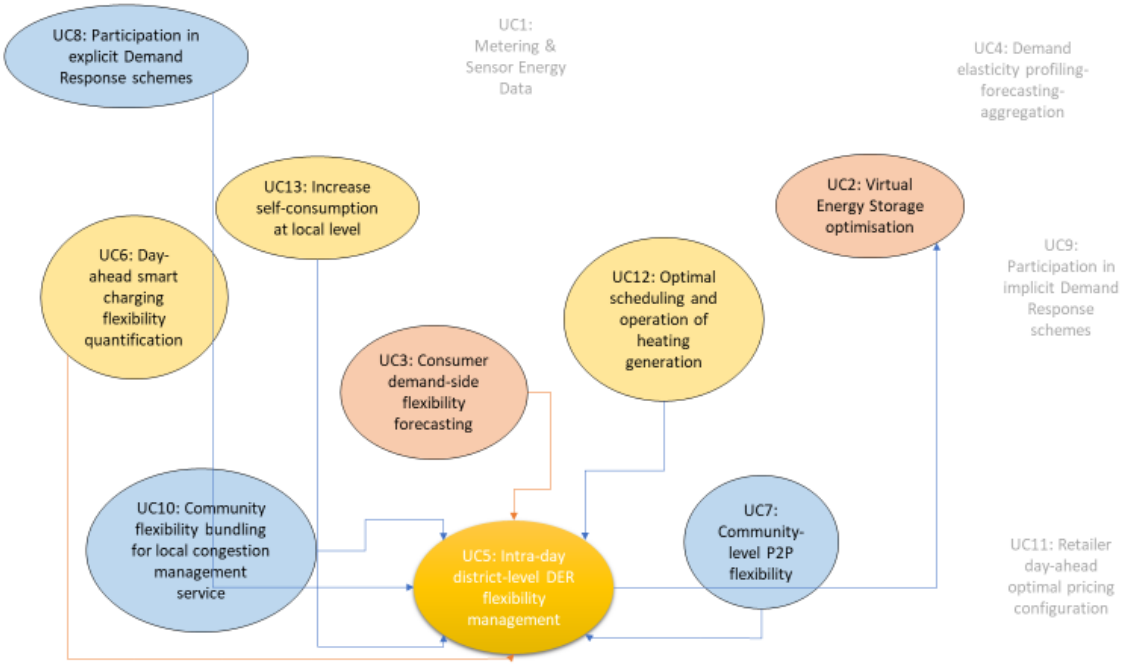


Figure 3.5: UC5 interconnection with other UCs

3.7. UC6 Day-ahead smart charging flexibility via EV usage pattern profiling and forecasting

1 Description of the Use Case

1.1 Name of Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case
1	Area: Component Layer, Communication Layer Domains: DER, Customer Premises Zones: Process, Field, station, Operation	Day-ahead smart charging flexibility via EV usage pattern profiling and forecasting

1.2 Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
01	27.04.2021	CERTH	First proposal of use case	Draft
02	06.07.2021	CERTH, RINA-C	Final proposal of use case	Final

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case

Scope	Develop or enhance already existing tools for providing the flexibility potential of EV charging.
Objective(s)	1. Create EV charging profile 2. Extract forecasting of EV charging 3. Calculate the potential flexibility of EV charging
Related business case(s)	BC1: Flexible Aggregator BC2: ESCO offering energy management services BC3: ESCO facilitating P2P flexibility trading BC5: Optimized Operation via P2P BC7: Prosumer Engagement

1.4 Narrative of Use Case

Narrative of Use Case
Short description
EV charging, is a very demanding energy consumption. It is also one of the few that are dispatchable. Thus, it can prove quite useful, when contemplating demand-side management schemes, especially at an aggregated level, such as the one in an energy community.
Complete description
District Asset Management Tool, alongside the Citizen Application with respect to mobility services towards the end-users, will collaborate to provide the optimal and most suited schedule of EV charging for the EV owners. This schedule could include both G2V and V2G schedules, if profitable and allowed by the end-user. Additionally, the transaction could take place either directly between the end-user and the aggregator, or among the end-users of the same energy community, via the p2p blockchain tool. For this to occur, an extraction of the flexibility potential of the EV charging schemes should be calculated and forecasted. This flexibility potential should be calculated at both end-user level, in order for every user to be aware of the capabilities of the EV while charging, and also at Local Energy Community level as a potential flexibility service that can be sold to an aggregator, or even directly to the electricity market, wholesale or local. Machine or deep learning techniques will be utilized to perform such a task and provide the forecasted EV charging along with its lower and upper flexibility boundaries, in order to be included in the tool responsible for managing further the Demand.

1.5 General Remarks

General Remarks
Requirements for this UC are the real-time measurements of EV chargers and historical data of EV charging

1.6 Further Information to the Use Case for Classification / Mapping

The following table presents further Information for the classification of this use case:

Classification Information
Relation to Other Use Cases
UC01 “Monitoring and Visualization of Metering & Sensor Energy Data in community buildings” UC03 “Consumer demand-side flexibility forecasting” UC04 “Demand elasticity profiling-forecasting-aggregation” UC07 “Community-level P2P flexibility” UC08 “Participation in explicit DR schemes” UC09 “Participation in implicit DR schemes” UC14 “Active Citizen and LEC Engagement”
Level of Depth
Medium
Prioritization
High
Generic, Regional or National Relation

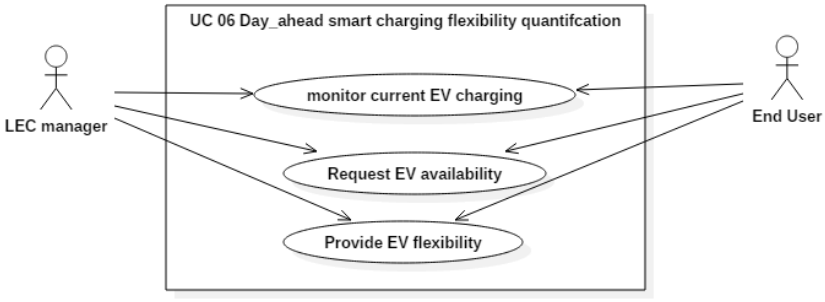
Regional
Viewpoint
Business
Further Keywords for Classification
EV, V2G, forecasting, demand flexibility, flexibility potential, machine learning techniques

2 Diagrams of Use Case

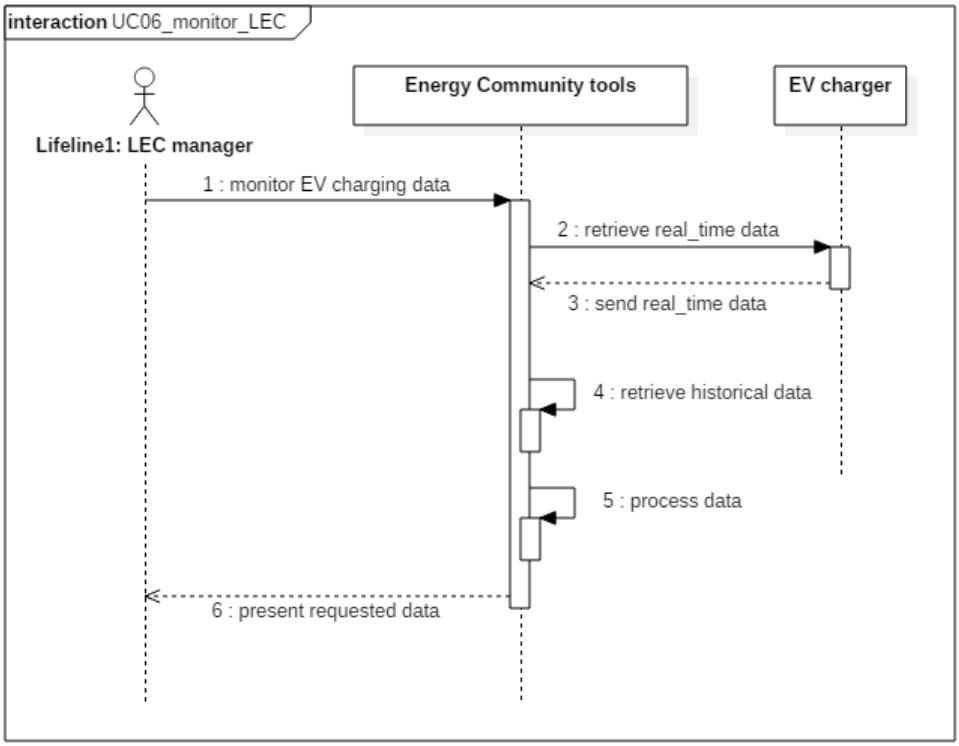
The diagram aims to illustrate the structure of the use case.

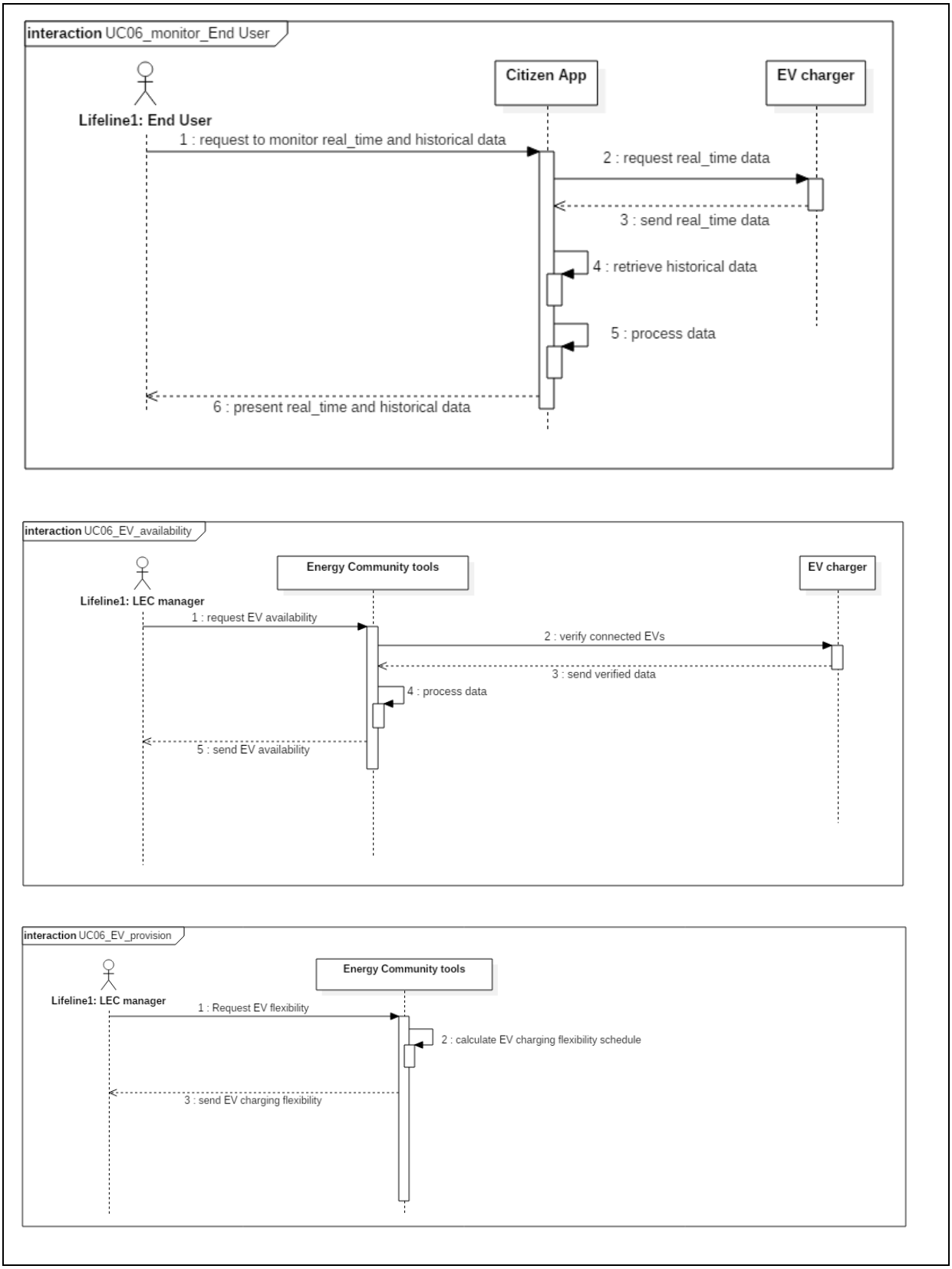
Diagram(s) of Use Case

[Use Case Diagram]



[Sequence Diagram]





3 Technical Details

3.1 Actors

The following table presents the actors involved in this use case:

Actors			
Actor Name	Actor Type	Actor Description	Further information specific to this Use Case
Prosumer/Consumer	Stakeholder	The owner of the EV	The term refers to all consumers/consumers that should be aware of their EV Charging flexibility potential, in order to make the appropriate decision making.
Local Energy Community Manager (Aggregator, Retailer, ESCO)	Stakeholder	Managing the local Energy Ecosystem	Responsible for the representation of the Local Energy community to the Electricity market, should be aware of all the demand-side flexibility potential, including EV charging, in order to elaborate any transaction efficiently, both within the energy community and outwards.
EV Charger	Device	Point of connection between EVs and the grid	Required infrastructure for EV charging/discharging

3.2 Triggering Event, Preconditions, Assumptions

The following table presents the triggering events, pre-conditions and assumptions of this use case:

Use Case Conditions			
Actor/System/Information/ Contract	Triggering Event	Pre-conditions	Assumption
Prosumer/End-User	Connecting EV to charger	Smart contract has been agreed upon	Historical data available Measuring infrastructure in place
LEC manager	Time triggered/ requesting flexibility from Assets	Awareness of Charging EVs ID and current condition (SoC, Time of Arrival, Time of Departure etc.) and Charger IDs and location	Historical data available Measuring infrastructure in place

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

The following table presents the scenarios associated with this use case

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition

S01	Monitor of EVs	LEC manager / End User	Request flexibility from Assets / connecting EV to charger	Historical data available Measuring infrastructure in place	Create potential EV flexibility
S02	EV availability	LEC Manager	Request flexibility from Assets	Historical data available Measuring infrastructure in place	Create potential EV flexibility
S03	EV flexibility provision	LEC Manager	Request flexibility from Assets	Historical data available Measuring infrastructure in place EV availability is provided	Monetize EV flexibility provided

4.2 Steps per scenario

The following tables present the steps of each of the scenarios associated with this use case as well as the respective requirements:

Scenario Name:	S01- "monitor of EVs"							
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
St01	Request	Monitor connected EVs status	LEC Manager / End User requests to monitor via the UI the current and past status of connected EVs	management	Energy Community tools / Citizen App	LEC Manager / End User	EVs current and historical data on EV battery SoC, time of Arrival/departure, level of charger connected to, mode of charger (V0G, V1G, V2G), EV battery capacity, smart contract agreed, charger ID, EV ID, flexibility provided currently, or past.	Historical data available Measuring infrastructure in place and operational

St02	Request	Data request from historical data repository and chargers	Data requested from historical data repository and EV chargers		Energy Community Tools / Citizen App	Historical repository / chargers	EVs current and historical data on EV battery SoC, time of Arrival/departure, level of charger connected to, mode of charger (V0G, V1G, V2G), EV battery capacity, smart contract agreed, charger ID, EV ID, flexibility provided currently, or past.	Historical data available Measuring infrastructure in place and operational
St03	response	Data retrieval from historical data repository and EV chargers	Data retrieved from historical data repository and EV chargers		Historical repository / chargers	Energy Community Tools / Citizen App	EVs current and historical data on EV battery SoC, time of Arrival/departure, level of charger connected to, mode of charger (V0G, V1G, V2G), EV battery capacity, smart contract agreed, charger ID, EV ID, flexibility provided currently, or past.	Historical data available Measuring infrastructure in place and operational
St04	response	Data visualization to LEC Manager / End User	Data visualized to LEC Manager / End User		Energy Community Tools / Citizen App	LEC Manager / End User	EVs current and historical data on EV battery SoC, time of Arrival/departure, level of charger connected to, mode of charger (V0G, V1G, V2G), EV battery capacity, smart contract agreed, charger ID, EV ID, flexibility provided currently, or past.	Historical data available Measuring infrastructure in place and operational

Scenario Name:		S02- "Request EV availability"						
Step	Event	Name of	Description	Service	Information	Information	Information	Requirements,

No.		Process/ Activity	of Process/ Activity		Producer (Actor)	Receiver (Actor)	Exchanged	R-ID
St01	Request	Request EV availability in LEC-level	Request for potential EV availability in LEC-level	management	LEC Manager	Energy Community Tools	EV availability	Communication infrastructure in place and operational
St02	Request	Request EV availability in End User level	Request to provide potential EV availability in End User level for the upcoming time period, i.e. Day-ahead or intra-day	M2M	Energy community tools	Citizen App	EV availability	Communication infrastructure in place and operational
St03	Response	Provide EV availability	Provide potential EV availability for the upcoming time period, i.e. Day-ahead or intra-day	M2M	Citizen App	Energy community tools	EV availability	Communication infrastructure in place and operational
St04	Response	Present EV availability	Present potential EV availability for the upcoming time period, i.e. Day-ahead or intra-day	monitoring	Energy Community Tools	LEC Manager	EV availability	Communication infrastructure in place and operational

Scenario Name:		S03- "Provide EV flexibility"						
Step No.	*Event*	*Name of Process/ Activity*	*Description of Process/ Activity*	*Service*	*Information Producer (Actor)*	*Information Receiver (Actor)*	*Information Exchanged*	*Requirements, R-ID*
St01	Request	Request EV flexibility	Request EV flexibility	Monitoring	LEC Manager	Energy Community tools	EV flexibility	Received favoured price signal

St02	notification	Notification for EV flexibility request	Send notification to Citizen App for the End user to verify EV participation in EV flexibility provision	M2M	Energy Community Tools	Citizen App	EV flexibility participation	Communication infrastructure in place and operational
St03	response	Response for EV flexibility request	Send response for EV flexibility request participation	M2M	Citizen App	Energy Community tools	EV flexibility participation	Communication infrastructure in place and operational
St04	process	Calculation of EV flexibility	Calculate EV flexibility	internal	Energy community tools	Energy community tools	EV flexibility	Related data, historical and current are available and accessible.
St05	response	Provision of EV flexibility	Provide and present EV flexibility data	visualization	Energy community tools	LEC Manager	EV flexibility	Communication infrastructure in place and operational

5 Information Exchanged

The following table presents the information exchanged in the context of this use case:

Information Exchanged			
Information exchanged (ID)	**Name of information**	**Description of Information Exchanged**	**Requirements to information data**
Inf01	EV ID (string)	An EV ID, in order to create its charging pattern	
Inf02	EV charger ID (string)	An EV charger ID, in order to identify where an EV is charged	
Inf03	EV capacity (float)	Maximum Energy capacity of the EV	
Inf04	EV charger level (int)	Level of charging, i.e. 1, 2, 3	
Inf05	EV charger operation mode (int)	Operation mode for the EV charger, i.e. V0G, V1G, V2G	
Inf06	SoC (float)	Current State-of-Charge (SoC)	
Inf07	Upper/lower flexibility boundary (timeseries)	Upper/Lower boundary of EV charging flexibility	
Inf08	Time of arrival/departure (timestamp)	Estimated time of Arrival/Departure for each EV	

Inf09	End User preferences (configuration)	End User preferences, such as desired min SoC, operation default mode etc.	

6 Interconnection with other UCs

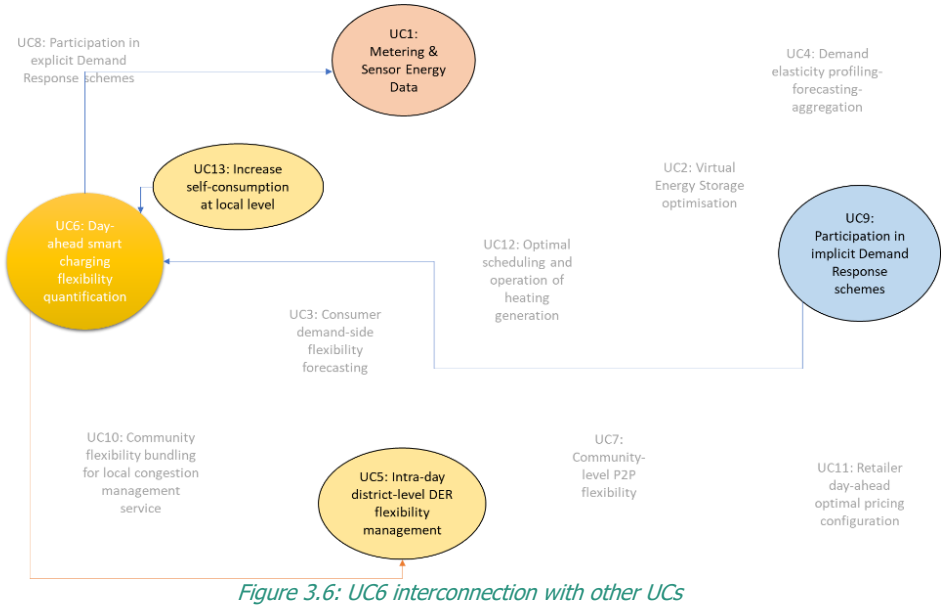


Figure 3.6: UC6 interconnection with other UCs

3.8. UC7 Community-level P2P flexibility/energy exchange based on locally produced renewable energy

1 Description of the Use Case

1.1 Name of Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case
7	Area: Business Layer Domains: DER, Customer Premises Zones: Market	Community-level P2P flexibility/energy exchange based on locally produced renewable energy

1.2 Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
01	04.04.2021	QUE	First proposal of use case	Draft
02	24.05.2021	QUE	Comments addressed; sections 2,4 & 5 added	Draft
03	06.07.2021	QUE, RINA-C	Final proposal of use case	Final

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	Participation in a community level P2P flexibility/energy exchange platform based on locally produced renewable energy in order to collectively achieve demand and supply optimization. This use case will examine the benefits of fair, transparent and optimal energy/flexibility exchange between peers on a community level.
Objective(s)	1. Provide a platform and enable community members to participate in P2P transactions of energy/flexibility in a fair and transparent way 2. Minimization of exchange/transaction costs to promote collaboration between community members 3. Enhance privacy of data and increase trust between trading parties 4. Promote servitization of electricity 5. Allow community to facilitate various business models (trading, collective self-consumption etc.)
Related business case(s)	BC3 ESCO facilitating P2P flexibility trading BC5 Optimized operation via P2P

1.4 Narrative of Use Case

Narrative of Use Case
Short description
Optimization of consumption and production on a community level requires close cooperation between individuals. P2P exchange of energy/flexibility in a fair and transparent way can increase cooperation by optimally sharing common renewable sources.
Complete description
Achieving high levels of optimization in energy production and consumption is a multivariant and complex challenge that requires accurate forecasting, energy behaviour profiling, building modelling, device control scheduling, local generation and storage etc. By having members of a community cooperating closely by exchanging energy and flexibility on a P2P exchange platform, optimization can be further increased. The exchange platform will be designed and implemented in a transparent and fair way to increase trust and security among the members of the community. This will be achieved by: • Recording in a trustworthy manner consumption, production, shares and offering of electricity • Enhancing transparency between trading parties • Securing data and privacy of the involved parties To increase commitment and further enhance collaboration, local transactions will be executed in a seamless way with a significantly lower cost compared to conventional transactions with national electricity retailers. Additionally, the P2P trading platform will further enhance servitization of energy and flexibility by providing the foreground for the implementation and monitoring of innovative Service Level Agreements in a clear and transparent way.

1.5 General Remarks

General Remarks
In order to facilitate transactions assigning credits or an alternative trading scheme might be necessary. An automated P2P trading platform can be implemented only if it is complemented by a fully automated load control scheme, continuous monitoring, accurate forecasting, user profiling and building modelling. Pilot sites need to be equipped with the necessary equipment. Equipment modification might also be necessary during testing period. Community trading and optimization might require a minimum number of participants and DERs to be effective and efficient.

Trading and exchange mechanisms should and will prevent free riders and abusing behaviour from community members, ensuring equality and fairness.

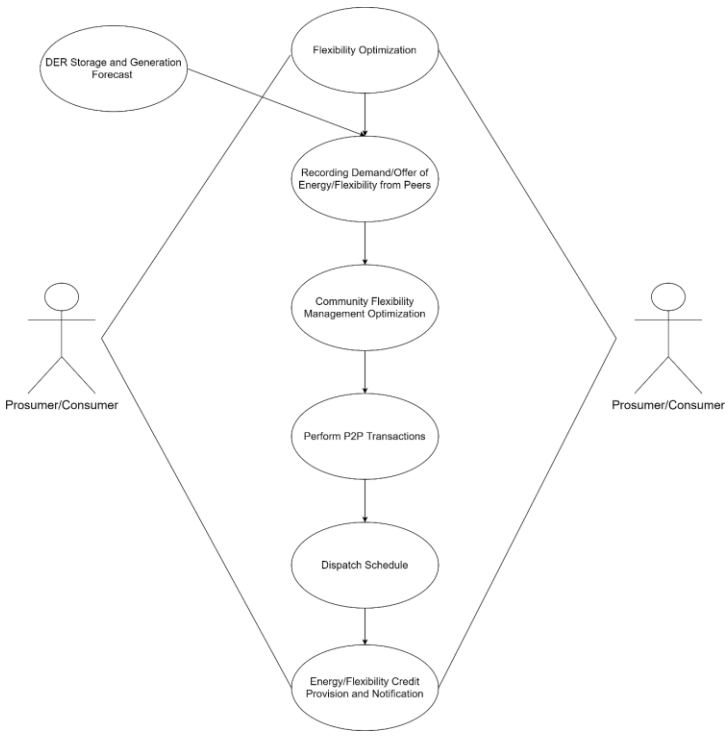
1.6 Further Information to the Use Case for Classification / Mapping

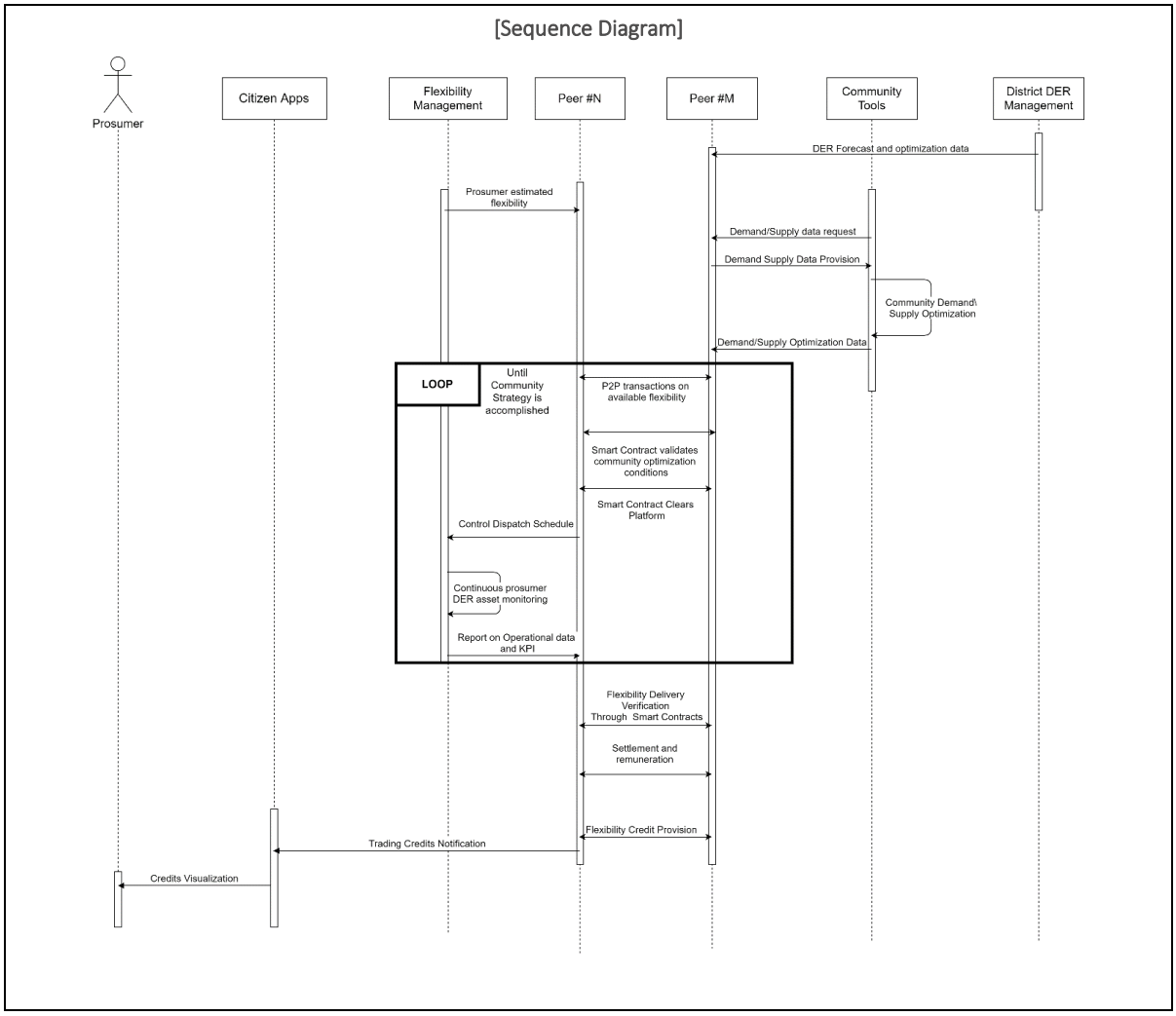
The following table presents further Information for the classification of this use case:

Classification Information
Relation to Other Use Cases
UC8 "Participation in explicit Demand Response schemes" Explicit demand response schemes are going to be implemented through blockchain enabled P2P transactions UC9 "Participation in implicit Demand Response schemes" Implicit demand response schemes are going to be implemented through blockchain enabled P2P transactions UC10 "Community flexibility bundling for local congestion management service" Community flexibility is going to be implemented through community level blockchain enabled P2P transactions UC11 "Retailer day-ahead optimal pricing configuration for aggregated portfolio balancing" Pricing and aggregated wholesale portfolio management are going to be implemented through P2P transactions
Level of Depth
Medium
Prioritization
High
Generic, Regional or National Relation
Generic
Viewpoint
Technical
Further Keywords for Classification
P2P Exchange Platform, Energy/Flexibility Exchange, Community level optimization

2 Diagrams of Use Case

The diagram aims to illustrate the structure of the use case.

Diagram(s) of Use Case
[Use Case Diagram] 



3 Technical Details

3.1 Actors

The following table presents the actors involved in this use case:

Actors			
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
Prosumer/Consumer	Stakeholder	End user that consumes but also produces energy	In the current UC, the actor is also an active participant in the P2P trading platform
Facility Manager	Stakeholder	User that owns DER but cannot control consumption – if any	In the current UC, the actor owns/manager the DER or the facility but consumption is up to residents/owners. For example, office spaces, nursing homes etc. Moreover, in this UC Facility Manager might own district DERs.
Retailer	Stakeholder	Market stakeholder in charge of supplying and billing electricity to the end users.	In the current UC, the community can collectively act as a retailer by purchasing or selling the surplus of electricity.

Aggregator	Stakeholder	Market stakeholder that acquires flexibility from prosumers and creates services that draw on the accumulated flexibility for different markets and market players	In the current UC, the community can collectively act as an aggregator.
ESCo	Stakeholder	Energy Service Company, third party that of energy optimization services	In the current scenario the community can act as an ESCo, optimizing energy consumption and production to collectively achieve self-sufficiency.
DSO	Stakeholder	Distribution System Operator	Distribution system operators (DSOs) are the operating managers (and sometimes owners) of energy distribution networks, operating at low, medium and, in some member states, high voltage levels (LV, MV). In the current scenario the DSO can affect a local P2P market by imposing tariffs to avoid grid congestion

3.2 Triggering Event, Preconditions, Assumptions

The following table presents the triggering events, pre-conditions and assumptions of this use case:

Use Case Conditions			
Actor/System/Information/ Contract	**Triggering Event**	**Pre-conditions**	**Assumption**
Prosumer	Prosumer has/forecasts a surplus of locally generated renewable energy to be exchanged/traded on the P2P platform	The actor has installed an IoT system and has already forecasts on production and consumption	Training calibration period with historical data and models for the prosumer and the rest of the peers in the platform
Facility Manager	Facility Manager has/forecasts a surplus of locally generated renewable energy from district DER to be exchanged/traded on the P2P platform	The actor has received forecasts for generation and storage	Training and calibration period for accurate forecasting with, weather data, historical data and models for the specific DERs that the actor operates
DSO	DSO forecasts grid congestion, imposes tariffs and strives implicit demand response	DSO has proper equipment installed to forecast congestion, prosumers own DERs	Existence of accurate context-aware demand flexibility profiles (per connection point smart meter) and appropriate KPIs that will be used as a basis for the overall optimization process of the aggregator's portfolio
Aggregator	DR signal from the DSO	Availability of information about flexibility and response capability of the consumers	Optimised Decision supported by specific prosumer equipment and response capability. Existing commercial arrangement between aggregator and prosumer

Retailer	Signal for surplus of locally produced energy from DER	Availability of accurate models for energy generation and consumption	• Community is willing to participate in wholesale market trading. • DSO does not forecast congestion

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

The following table presents the scenarios associated with this use case

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition
S01	Record Demand/Offer of Energy/Flexibility from Peers and district DERs	Prosumer/ Facility Manager	P2P Exchange Platform receives forecast on generation, demand and available flexibility.	• Flexibility Manager has delivered a DER management and operational schedule • District DER Manager has produced long term (day ahead) and short term (hour ahead) accurate generation and storage forecasting	Blockchain records individual member consumption share/offering KPIs in a trustworthy manner (from individual peers and district DERs)
S02	Community Flexibility Management Optimization	DSO/ ESCo/ Retailer	Receives monitoring and forecast data (KPIs) from flexibility sources.	• Tool-suite is adapted to the local boundary conditions • Tool-suite is adapted to particularities of building assets	Delivers a collective self-consumption, flexibility aggregation and trading optimization
S03	Perform P2P Transactions	Prosumer/ Facility Manager	Receives collectively optimized data (KPIs) to facilitate P2P transactions and business models	• Community members participate to collective business schemes • A trading mechanism with or without credits has been established. • Smart Contracts have been deployed	Energy and Flexibility has been exchanged/traded

S04	Energy/ Flexibility Credit Provision and Notification	Prosumer/ Facility Manager	P2P transactions have been completed and DER scheduling has been performed	• User has access to internet connection	User receives notification

4.2 Steps per scenario

The following tables present the steps of each of the scenarios associated with this use case as well as the respective requirements:

Scenario Name:	S01- "Record Demand/Offer of Energy/Flexibility from Peers and district DERs"							
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
St01	Response	Record of prosumer operational schedule	Prosumer operational schedule of DER with optimized energy production/ Consumption and flexibility offer KPIs are recorded on blockchain	Management	On-Demand Flexibility Management	P2P Energy / Flexibility Exchange Platform	INF1.1 Energy Demand/ Production KPIs INF 1.2 Flexibility demand/Offer KPIs	Ability to receive monitoring data at any time
St02	Response	Record of district DER forecasts	P2P platform records long term (day ahead) and short term (hour ahead) accurate generation and storage forecasting KPIs from district DER	Management	District Asset Management	P2P Energy / Flexibility Exchange Platform	INF 1.3 Generation Forecast KPIs INF 1.4 Storage Forecast KPIs	Ability to receive forecast data at any time
St03	Response	Verify and Create Block with data	When data are received the Blockchain Network will verify the validity (with other nodes) of the data and create a block	Management	-	P2P Energy / Flexibility Exchange Platform - Registry	INF 1.1, INF 1.2, INF 1.3, INF 1.4 (see above)	P2P Platform achieves consensus over the exchanged information

Scenario Name:	S02- "Community Flexibility Management Optimization"

Step No.	Event	Name of Process/ Activity	Description of Process/ Activity	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirements, R-ID
St01	Request	Demand/Supply KPIs request	Community tools requests data from BC platform	Management	P2P Platform	Community Tools	INF 1.1, INF 1.2, INF 1.3, INF 1.4 (see above)	Has established secure connection (NOTE: Details need to be clarified with the respective partner)
St02	Response	Demand/Supply KPIs provision	BC sends data to Community tools	Management	Community Tools	P2P Platform	INF 1.1, INF 1.2, INF 1.3, INF 1.4 (see above)	Has established secure connection (NOTE: Details need to be clarified with the respective partner)
St03	Response	Community Demand Supply Optimization KPIs	Community tools optimizes community strategy	Management	Community Tools	Community Tools	INF 1.1, INF 1.2, INF 1.3, INF 1.4 (see above)	Community tools has continuous feed from wholesale markets (NOTE: Details need to be clarified with the respective partner)
St04	Response	Demand/Supply Optimization KPIs	Community tools sends community strategy data to BC	Management	P2P Platform	Community Tools	INF 2.1 Community Strategy Optimization data	Has established secure connection (NOTE: Details need to be clarified with the respective partner)

Scenario Name:	S03- "Perform P2P Transactions"							
Step No.	*Event*	*Name of Process/ Activity*	*Description of Process/ Activity*	*Service*	*Information Producer (Actor)*	*Information Receiver (Actor)*	*Information Exchanged*	*Requirements, R-ID*

St01	Response	P2P transactions on available flexibility	Peer trade available flexibility based on given constraints and optimized strategy	Management	Peer #M	Peer #N	INF1.1, INF 1.2 (see above)	Peers are online
St02	Response	Smart Contract validates community optimization conditions	Smart Contract validates the transactions were performed according to grid constraints and optimized community strategy	Management	Smart Contract	Peers	INF 2.1	Peers are online
St03	Response	Smart Contract Clears Platform	Smart Contract validates transactions	Management	Smart Contract (P2P Platform)	Peers (P2P Platform)	INF 1.1, INF 1.2	Peers are online
St04	Response	Control Dispatch Schedule	Control dispatch schedule is sent according to exchanged flexibility	Management	Peers (P2P Platform)	Flexibility Management	INF 1.1, INF 1.2	Peers are online
St05	Response	Continuous prosumer DER asset monitoring	Flexibility Manager monitors DERs for proper scheduling execution	Monitoring	-	-	INF 1.1, INF 1.2	
St06	Response	Report on Operational data and KPI	Flexibility Manager reports metrics and KPIs to P2P platform	Management	Flexibility Manager	P2P platform	INF 1.1, INF 1.2 INF 3.1 KPIs	Has established secure connection

Scenario Name:	S04- "Energy/ Flexibility Credit Provision and Notification"							
Step No.	Event	Name of Process/ Activity	Description of Process/ Activity	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirements, R-ID

St01	Response	Flexibility Delivery Verification Through Smart Contracts	Verification of exchanged energy/ flexibility according to optimization scheduling	Management	Smart Contract (P2P Platform)	Peer (P2P Platform)	INF 1.1, INF 1.2, INF 3.1	Peers are online
St02	Response	Settlement and Remuneration / Flexibility Credit Provision	Exchanging energy flexibility credits according to consumed/ produced energy and flexibility	Management	Peer (P2P Platform)	Peer (P2P Platform)	INF 4.1 Energy credits	Peers are online
St03	Response	Trading Credits Notification / Credits Visualization	Citizens apps gets notification about the credits gained/consumed	Prosumer UI	P2P Platform	Citizen Apps	INF4.1 Energy credits	Has established secure connection

5 Information Exchanged

The following table presents the information exchanged in the context of this use case:

Information Exchanged			
Information exchanged (ID)	Name of information	Description of Information Exchanged	Requirements to information data
INF 1.1	Energy Demand/ Production KPIs	Energy demand/production on a prosumer level as it is acquired from the Flexibility Manager	
INF 1.2	Flexibility demand/Offer KPIs	Flexibility demand/production on a prosumer level as it is acquired from the Flexibility Manager	
INF 1.3	Generation Forecast KPIs	Generation Forecast from district DER as it is acquired from DER Manager	
INF 1.4	Storage Forecast KPIs	Storage Forecast from district DER as it is acquired from DER Manager	
INF 2.1	Community Strategy Optimization KPIs	Data Related to the optimization strategy that are acquired from the Community Tools	(NOTE: Details need to be clarified with the respective partner)
INF 4.1	Energy credits	Credits that are assigned to the exchange of Energy/Flexibility	

6 Interconnection with other UCs

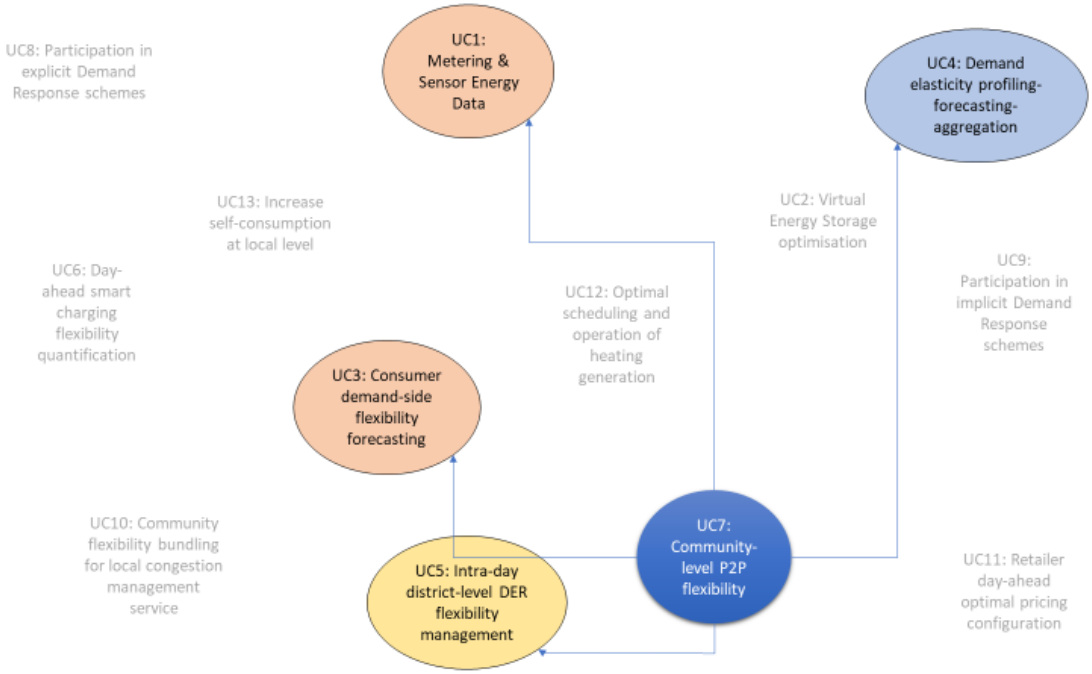


Figure 3.7: UC7 interconnection with other UCs

3.9. UC8 Participation in explicit Demand Response schemes

1 Description of the Use Case

1.1 Name of Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case
1	Area: Component Layer, Communication Layer Domains: DER, Customer Premises Zones: Building, Operation	Participation in explicit Demand Response schemes

1.2 Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
01	27.04.2021	CERTH	First proposal of use case	Draft
02	06.07.2021	CERTH, RINA-C	Final proposal of use case	Final

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case

Scope	Establish the most appropriate sequence of actions and collaboration among the available tools, in order at both end-user level and Energy Community (LEC) Level to participate in an explicit DR event, based on flexibility potential
Objective(s)	1. Provide optimal solutions at LEC Level, according to the agreed role, i.e. Aggregator, Retailer, ESCO, and based on inputs such as demand/generation flexibility, forecast etc. 2. Provide optimal solutions at end-user level, according to the agreed role of LEC, i.e. Aggregator, Retailer, ESCO, and based on inputs such as demand/generation flexibility, forecast of the particular end-user, in order for the latter to accept or reject any DR events that are offered to him/her.
Related business case(s)	BC1 "EC as Flexible aggregator for ancillary service provision" BC3 "EC as ESCO facilitating P2P flexibility trading" BC4 "EC as Retailer"

1.4 Narrative of Use Case

Narrative of Use Case
Short description
Provide DR events at both LEC Level and end-user level, in order to provide appropriate services to the electricity market
Complete description
Regardless of their role, that is ESCO, Retailer or Aggregator, LECs can provide valuable services to both the electricity market and the local DSO, if so requested. Utilizing the appropriate assets available at the moment, their potential and forecast, the decision support system can provide the available option to the Local Energy community manager, and he/she can decide upon the appropriate course of action. This decision will trigger to send the appropriate DR signals to the assets available at that time. These assets can range from a local PV plant to an appliance connected to the grid. The availability of such assets, along with their rated power, current power, flexibility potential and forecast for that time period should be made aware to the LEC manager, in order to assign the appropriate DR signals to the appropriate assets. The availability of those assets is retrieved via notifying the end-users accordingly and having retrieved their informed consent. To that end an appropriate mathematical formulation of the optimization problem at hand will be shaped and the most suitable optimization techniques will be employed, ranging from mixed-integer linear programming to metaheuristics and robust optimization, depending on the circumstances.

1.5 General Remarks

General Remarks
Real-time metering, monitoring and control infrastructure is required in the buildings for the UC to be realized. It also depends heavily on the integration of the forecast, flexibility and decision-making tools. Specific remarks from Mytilineos: This use case depends heavily on the overall acceptance of the users and their engagement. Similar Constraints already mentioned for the Greek Pilot Site

1.6 Further Information to the Use Case for Classification / Mapping

The following table presents further Information for the classification of this use case:

Classification Information
Relation to Other Use Cases
UC01 "Monitoring and Visualization of Metering & Sensor Energy Data in community buildings" UC03 "Consumer demand-side flexibility forecasting" UC04 "Demand elasticity profiling-forecasting-aggregation" UC05 "Intra-Day district Level DER flexibility management for community self-balancing" UC06 "Day-ahead smart charging flexibility quantification via EV usage pattern profiling and forecasting"

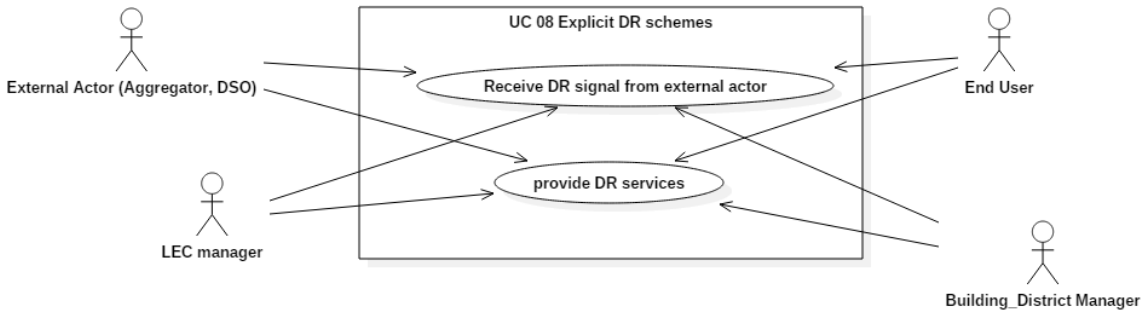
UC12 “Retailer day-ahead optimal pricing configuration for aggregated portfolio balancing”
Level of Depth
Medium
Prioritization
High
Generic, Regional or National Relation
Regional
Viewpoint
Prosumer/End-User and Local Energy Community in all its roles (ESCO, Retailer, Aggregator)
Further Keywords for Classification
Explicit Demand Response, Aggregator, DER, prosumer, end-user

2 Diagrams of Use Case

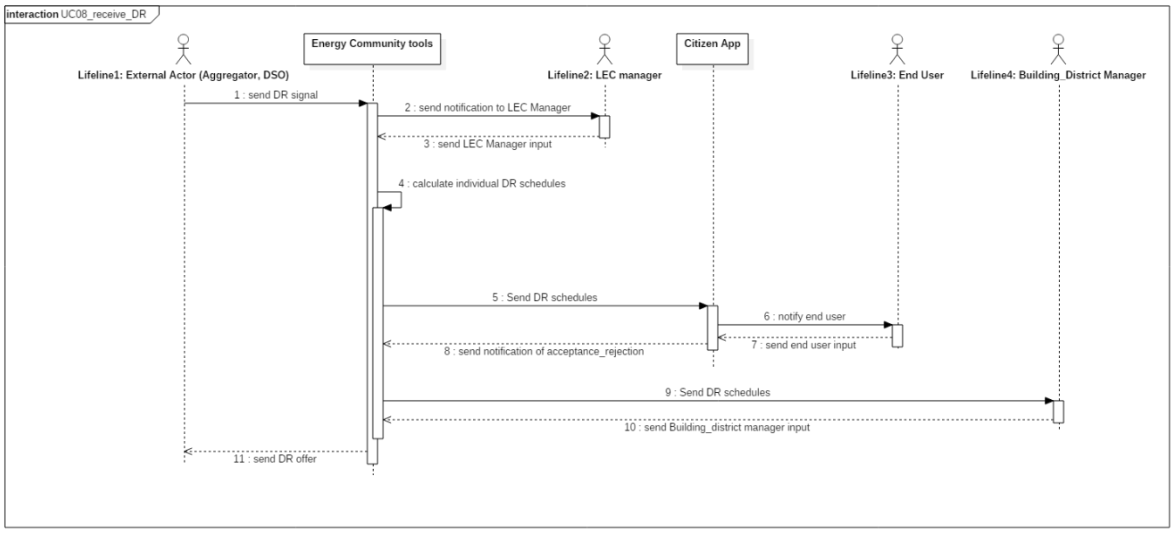
The diagram aims to illustrate the structure of the use case.

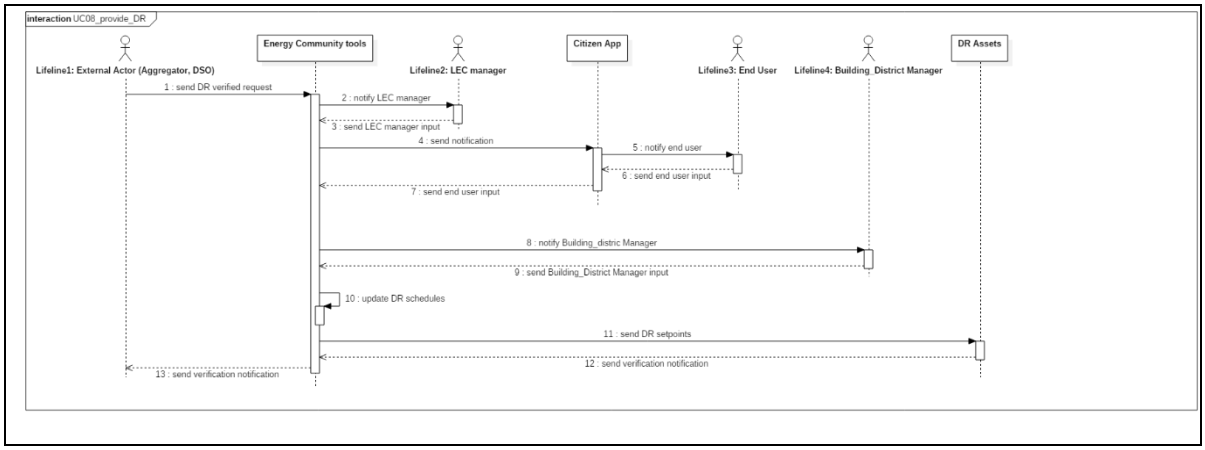
Diagram(s) of Use Case

[Use Case Diagram]



[Sequence Diagram]





3 Technical Details

3.1 Actors

The following table presents the actors involved in this use case:

Actors			
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
Prosumer/Consumer	Stakeholder	The end user that consumes or produces also in the case of the prosumer	The term refers to all consumers/consumers that can participate in DR events and are available at that time and could be either residential or commercial
Building/district Manager	Stakeholder	Person who manages property or district assets, usually not the end user of electricity but is responsible for billing and maintenance.	Can be both for commercial and residential
LEC manager (Aggregator, Retailer, ESCO)	Stakeholder	Person who manages the whole LEC ecosystem	Responsible for the participation of the LEC to the electricity market
Aggregator, DSO	Stakeholder	External Actor to the LEC strict ecosystem	Responsible of a broad end-user portfolio or for managing the Distribution System. He/she is in in-/direct communication with the LEC ecosystem.

3.2 Triggering Event, Preconditions, Assumptions

The following table presents the triggering events, pre-conditions and assumptions of this use case:

Use Case Conditions			
Actor/System/Information/ Contract	**Triggering Event**	**Pre-conditions**	**Assumption**

LEC manager (Aggregator, Retailer, ESCO)	Electricity Market requests/DSO	Awareness of current Asset Availability, forecast, flexibility etc.	Real-time metering, monitoring and control works properly

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

The following table presents the scenarios associated with this use case

Scenario Conditions					
No.	**Scenario Name**	**Primary Actor**	**Triggering Event**	**Pre-Condition**	**Post-Condition**
S01	Receive DR request	External Actor (Aggregator, DSO)	Electricity Market/DSO Request	Measuring and controlling infrastructure is in place an operational	DR events offer is created.
S02	Provide DR	External Actor (Aggregator, DSO)	Electricity Market/DSO Request	Measuring and controlling infrastructure is in place an operational	DR events are acknowledged and monetized accordingly.

4.2 Steps per scenario

The following tables present the steps of each of the scenarios associated with this use case as well as the respective requirements:

Scenario Name:	**S01- "Receive DR request"**							
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
St01	Send DR signal	Send DR signal	DR signals are sent by an external entity e.g. (Aggregator , DSO)	API	External Actor	Energy community tools	- INF01 No. of events for the day. - INF02 Time period for each. - INF03 Energy amount to be in-/de-creased	
St02	Notify LEC manager	Notify LEC manager	A notification is sent to the LEC manager interface and input is requested.	M2M	Energy community tools	LEC manager	- INF01 No. of events for the day. - INF02 Time period for each. - INF 03 Energy amount to be in-/de-creased.	

St03	Create DR	Create DR	DR events are created according to the information available	M2M	Energy community tools	Energy community tools	- INF01 No. of events for the day. - INF02 Time period for each. - INF03 Energy amount to be in-/de-creased - INF04 End user preferences - INF05 End user energy consumption profile - INF06 End user DR engagement profile	

Scenario Name:		S02- "Provide DR"						
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
St01	Send verified DR request	Send verified DR request	the DR offer send earlier is verified by the external actor and send to be implemented	M2M	External actor	Energy community tools	- INF01 No. of events for the day. - INF02 Time period for each. - INF03 Energy amount to be in-/de-creased	
St02	Notify LEC manager	Notify LEC manager	A notification is sent to the LEC manager interface and input is requested.	M2M	Energy community tools	LEC manager	- INF01 No. of events for the day. - INF02 Time period for each. - INF03 Energy amount to be in-/de-creased	
St03	Notify end users	Notify end users	End users to be included in the upcoming DR events are notified for the upcoming DR events that they are to participate	M2M	Energy community tools	Citizen App/ building manager UI	- INF01 No. of events for the day. - INF02 Time period for each. - INF 03 Energy amount to be in-/de-creased - Suggestion of appliances to be switched on/off etc.	

St04	Send DR setpoints	Send DR setpoints	DR setpoints are sent to the devices directly, after confirming with the end user or building/District managers	M2M	Energy community tools	DR assets	- INF 07 Timestamp - INF05 Energy consumption/generation control signal	

5 Information Exchanged

The following table presents the information exchanged in the context of this use case:

Information Exchanged			
Information exchanged (ID)	**Name of information**	**Description of Information Exchanged**	**Requirements to information data**
INF01	No. DR Events (integer)	Number of DR events requested for the upcoming period	
INF02	DR duration (float)	The duration of the DR events requested for the upcoming period	
INF03	Energy increase/decrease (float)	The amount of energy to be in-/de-creased during the DR event	
INF04	End user preferences (string)	Any specific preferences the end user may pertaining the DR events, such as, preferred period for participating in a DR event, preferred appliances for engaging in a DR event (e.g. washing machine, clothe dryer etc.), his/her availability for participating in DR events for the upcoming period, etc.	
INF05	End user energy consumption profile (timeseries)	Forecast for the end user energy consumption baseline and upper/lower boundaries.	
INF06	End user DR engagement profile (float)	A metric of how actively or non-actively engaged is the end user regarding DR events.	
INF07	timestamp	A time instant, which the DR event is to start/end.	
INF08	DR control signal	An appropriate DR signal to be sent to a particular device, in order to in-/de-crease	

6 Interconnection with other UCs

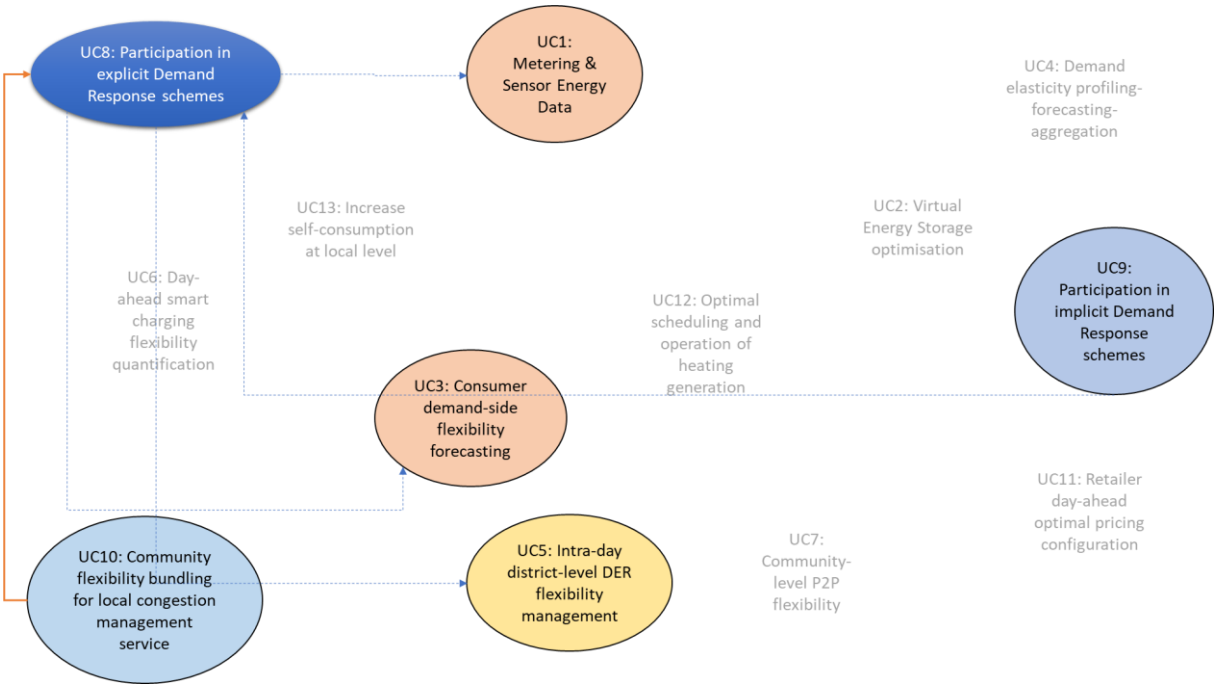


Figure 3.8: UC8 interconnection with other UCs

3.10. UC9 Participation in implicit Demand Response schemes

1 Description of the Use Case

1.1 Name of Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case
1	Area: Component Layer, Communication Layer, Domains: DER, Customer Premises Zones: Operation, Enterprise, Market	Participation in implicit Demand Response schemes

1.2 Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
01	27.04.2021	CERTH	First proposal of use case	Draft
02	06.07.2021	CERTH, RINA-C	Final proposal of use case	Final

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case

Scope	Establish the most appropriate sequence of actions and collaboration among the available tools, in order in both end-user level and Local Energy Community (LEC) Level to participate in an implicit DR event, based on time-dependent energy supply and dynamic network tariffs.
Objective(s)	1. Provide optimal solutions at LEC Level, according to the agreed role, i.e. Aggregator, Retailer, ESCO, and based on inputs such as demand/generation flexibility, forecast, devices/Assets availability etc. 2. Take into account the least possible amount of end-user discomfort and disturbance in the process.
Related business case(s)	BC07 Prosumer engagement

1.4 Narrative of Use Case

Narrative of Use Case
Short description
Provide optimal DR signals to the LEC assets available, without raising the end-users' discomfort above agreed or acceptable levels.
Complete description
Regardless of their role, that is ESCO, Retailer or Aggregator, LECs can provide valuable services to both the electricity market and the local DSO, if so requested. Utilizing the appropriate assets available at the moment, their potential and forecast, the decision support system can provide the available option to the Local Energy community manager, and he/she can decide upon the appropriate course of action. This decision will trigger to send the appropriate DR events to the owners of the respective assets, informing them on any upcoming Demand/Generation request. This information can be provided in the form of smart contract containing the time of the request, the reward and the penalty if declared to participated but failed to do so. Thus, indirectly requesting a response to the electricity prices of the wholesale market by the individual community participant and consequently the energy community as a whole. The End-user in turn will respond by accepting or rejecting such a request, and thus notifying the LEC manager for his/her decision. At the end of the day, a clearance will be made, in order to establish what has taken place and distribute the rewards or/and penalties to the DR participants, accordingly. To that end an appropriate mathematical formulation of the optimization problem at hand will be shaped and the most suitable optimization techniques will be employed, ranging from mixed-integer linear programming to metaheuristics and robust optimization, depending on the circumstances.

1.5 General Remarks

General Remarks
Real-time metering, monitoring and control infrastructure is required in the buildings for the UC to be realized. It also depends heavily on the integration of the forecast (including pricing triggers), flexibility, disaggregation and decision-making tools.

1.6 Further Information to the Use Case for Classification / Mapping

The following table presents further Information for the classification of this use case:

Classification Information
Relation to Other Use Cases
UC01 "Monitoring and Visualization of Metering & Sensor Energy Data in community buildings" UC03 "Consumer demand-side flexibility forecasting" UC04 "Demand elasticity profiling-forecasting-aggregation" UC05 "Intra-Day district Level DER flexibility management for community self-balancing" UC06 "Day-ahead smart charging flexibility quantification via EV usage pattern profiling and forecasting" UC10 "Community flexibility bundling for local congestion management services (LCMS) provision in organized markets" UC11 "Retailer day-ahead optimal pricing configuration for aggregated portfolio balancing"
Level of Depth

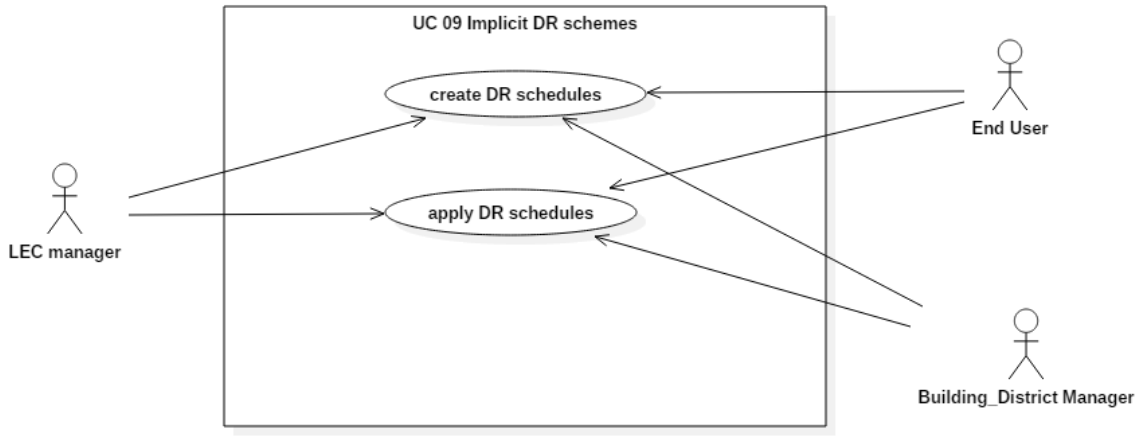
Medium
Prioritization
High
Generic, Regional or National Relation
Regional
Viewpoint
Prosumer/End-User and Local Energy Community in all its roles (ESCO, Retailer, Aggregator)
Further Keywords for Classification
Implicit Demand Response, price signals, DER, prosumer, end-user, disaggregation

2 Diagrams of Use Case

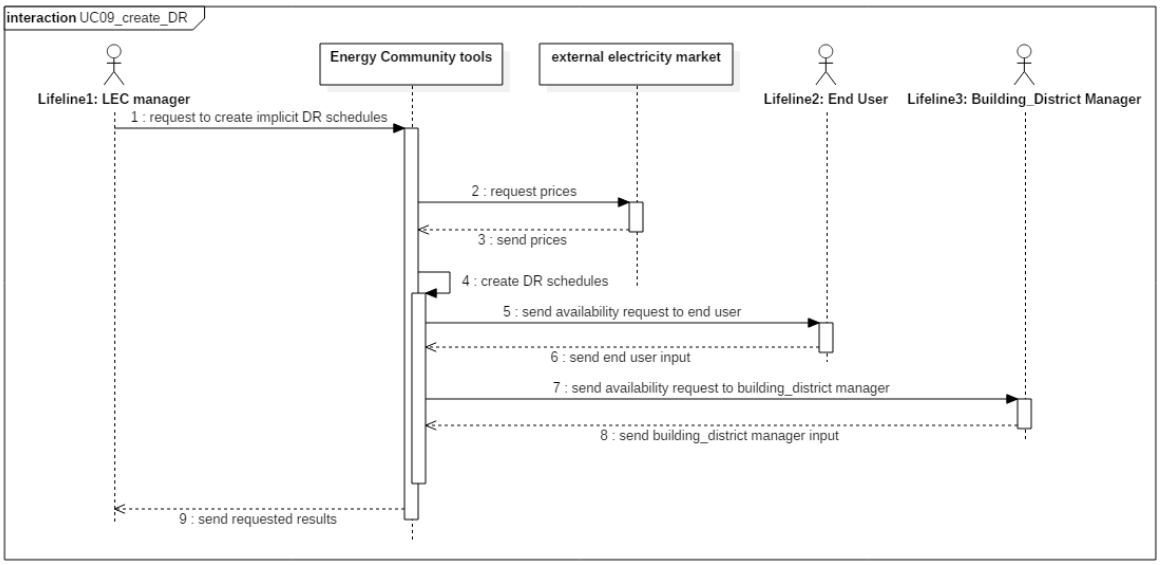
The diagram aims to illustrate the structure of the use case.

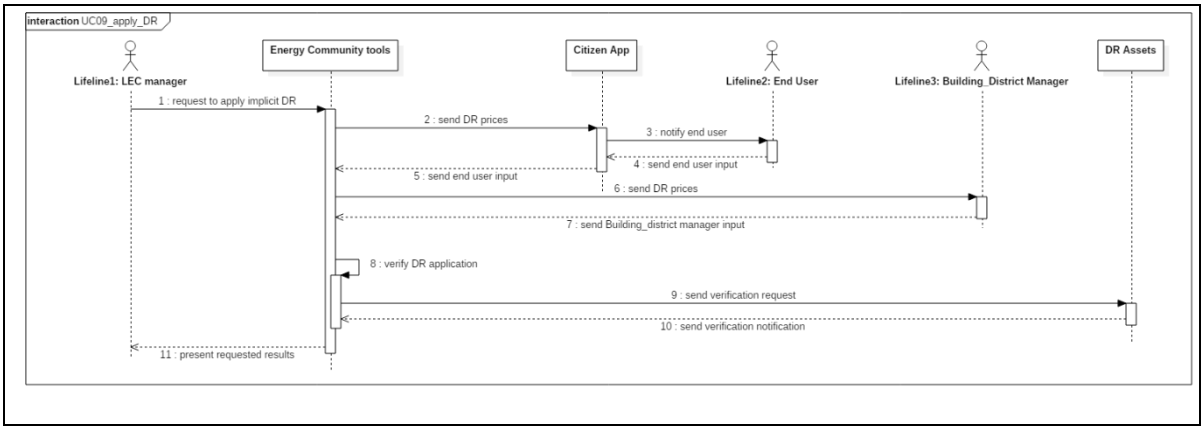
Diagram(s) of Use Case

[Use Case Diagram]



[Sequence Diagram]





3 Technical Details

3.1 Actors

The following table presents the actors involved in this use case:

Actors			
Actor Name	Actor Type	Actor Description	Further information specific to this Use Case
Prosumer/Consumer	Stakeholders	The end user that consumes or produces also in the case of the prosumer	The term refers to all consumers/consumers that can participate in DR events and are available at that time and could be either residential or commercial
Facility/Building Manager	Stakeholders	Person who manages property, usually not the end user of electricity but is responsible for billing and maintenance.	Can be both for commercial and residential
LEC manager (Aggregator, Retailer, ESCO)	Stakeholders	Person who manages the whole LEC ecosystem	Responsible for the participation of the LEC to the electricity market

3.2 Triggering Event, Preconditions, Assumptions

The following table presents the triggering events, pre-conditions and assumptions of this use case:

Use Case Conditions			
Actor/System/Information/ Contract	Triggering Event	Pre-conditions	Assumption
Prosumer/Consumer	DR events request from the LEC manager	Prosumer has provided his/her availability for DR events for that set time period	Smart contract has been agreed upon

LEC manager (Aggregator, Retailer, ESCO)	Electricity Market requests/DSO	Prosumers have provided their availability for DR events for that set time period	Smart contracts have been agreed upon for the set time period Real-time metering, monitoring and control works properly

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

The following table presents the scenarios associated with this use case

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition
S01	Create DR	LEC Manager	Electricity Market requests/DSO	Awareness of current Asset Availability, forecast, flexibility etc.	Apply DR
S02	Apply DR	LEC Manager	Create DR process	Awareness of current Asset Availability, forecast, flexibility etc.	Verify DR event

4.2 Steps per scenario

The following tables present the steps of each of the scenarios associated with this use case as well as the respective requirements:

Scenario Name:	S01- "Create DR"							
Step No.	Event	Name of Process/ Activity	Description of Process/ Activity	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirements, R-ID
St01	Request DR schedules	DR request	Request from LEC manager to create DR schedules	management	LEC Manager	Energy community tools	Request signal	
St02	Receive Electricity Market prices	Electricity prices receive	Requesting and receiving electricity price information from market actor	API	Electricity market API	Energy community tools	Electricity price timeseries	
St03	Notify end users	Notify end users	Notify end users	notify	Energy community tools	End user	DR availability Local electricity prices	

Scenario Name:	S02- "Apply DR"

Step No.	Event	Name of Process/ Activity	Description of Process/ Activity	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirements, R-ID
St01	Request for applying DR events	Request for applying DR events	Request to apply the created DR events	management	LEC manager	Energy community tools	Request for DR application	
St02	Send DR prices	Send DR prices	Send DR appropriate prices to end user via the citizen app	management	Energy community tools	Citizen app	DR prices timeseries	
St03	Verify DR participation	Verify DR participation	Verify the participation of DR assets via communicating directly with them	M2M	Energy community tools	DR Asset	Energy consumption/generation timeseries	

5 Information Exchanged

The following table presents the information exchanged in the context of this use case:

Information Exchanged			
Information exchanged (ID)	Name of information	Description of Information Exchanged	Requirements to information data
Inf01	Electricity market price (timeseries)	Electricity price from wholesale market	
Inf02	DR price (timeseries)	Appropriately electricity prices send to end users, in order to participate in DR events	
Inf03	End user energy consumption forecasting (timeseries)	Forecasting for end user energy consumption	
Inf04	End user energy consumption flexibility (timeseries)	Forecasting for end user energy consumption flexibility	

6 Interconnection with other UCs

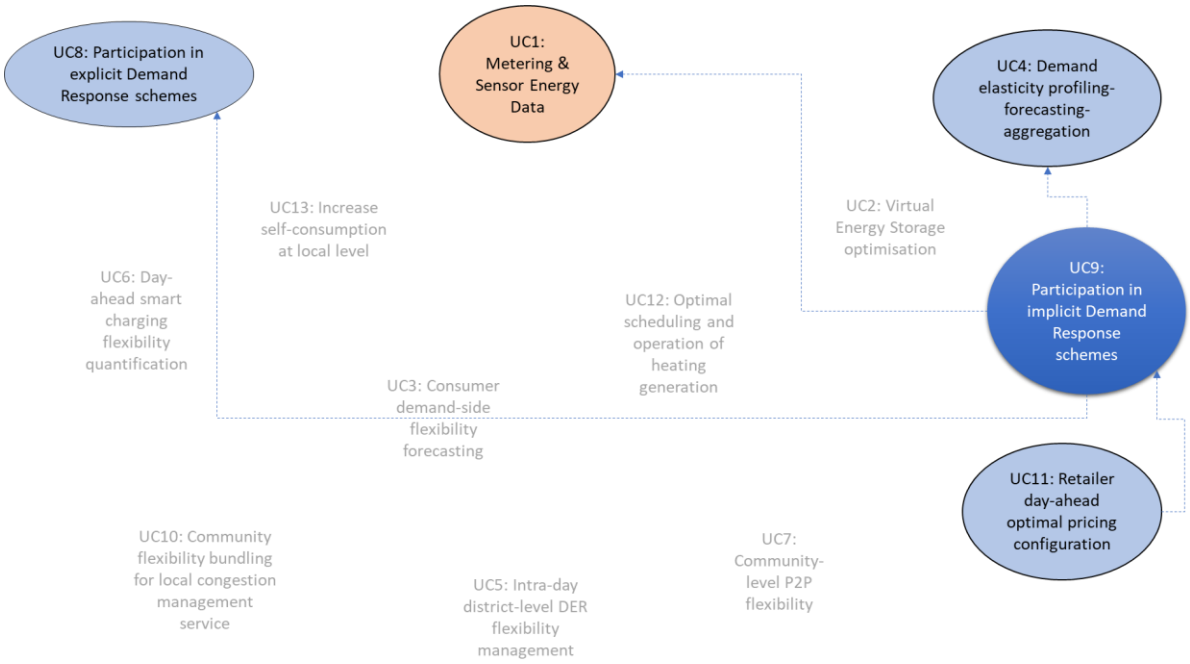


Figure 3.9: UC9 interconnection with other UCs

3.11. UC10 Community flexibility bundling for local congestion management service

1 Description of the Use Case

1.1 Name of Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case
10	Area: LV and MV grid Domain: DER, Consumer Premises Zone: Process, Market	Community flexibility bundling for local congestion management service

1.2 Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
01	12.04.2021	CIRCE	First proposal of use case	Draft
02	10.05.2021	CIRCE	Comments addressed	Draft
03	06.07.2021	CIRCE, RINA-C	Final proposal of use case	Final

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case

Scope	Unleash the potential of the community as an aggregator for local congestion management for DSO.
Objective(s)	Provide a district-level monitoring and control tool to: 1. Determine the real-time status of the network. 2. Forecast congestion events from demand/generation forecasting. 3. Enable a flexible operation module to send setpoints to the different assets.
Related business case(s)	BC1 "EC as Flexible aggregator for ancillary service provision "

1.4 Narrative of Use Case

Narrative of Use Case
Short description
This use case covers the development of a tool that allows flexibility of distribution network assets at the district level for storage and generation and all the other district assets and at the user level for demand to avoid or mitigate network congestion.
Complete description
The large-scale integration of distributed generation based on renewables and highly variant loads, such as electric vehicles and heat pumps, into the distribution network is expected to lead to grid congestion and voltage problems; during a congestion event, a section or element of the distribution network exceeds its transfer capacity. Traditionally DSO mitigates congestion by providing network reinforcement (lines, transformers and feeder capacity), which results in increased cost and due to the inherent complexity of the distribution system this method may not lead to the desired results. This is where a flexibility scheme becomes important, by coordinating the elements involved in the network, the problems associated with network congestion can be reduced more effectively. The objective of this use case will be to provide an active platform that allows to identify and evaluate the sections of the grid that could present congestion and act accordingly to avoid it, sending precise adjustments to the corresponding elements such as HPs, EVCs and PVs.

1.5 General Remarks

General Remarks
The realization of this UC requires the establishment of real-time metering, monitoring and control infrastructure in the building-level and district-level assets, electric grid and central HP. Furthermore, it is important to note that the specific way that flexibility reports is structures depends heavily on the market requirements.

1.6 Further Information to the Use Case for Classification / Mapping

The following table presents further Information for the classification of this use case:

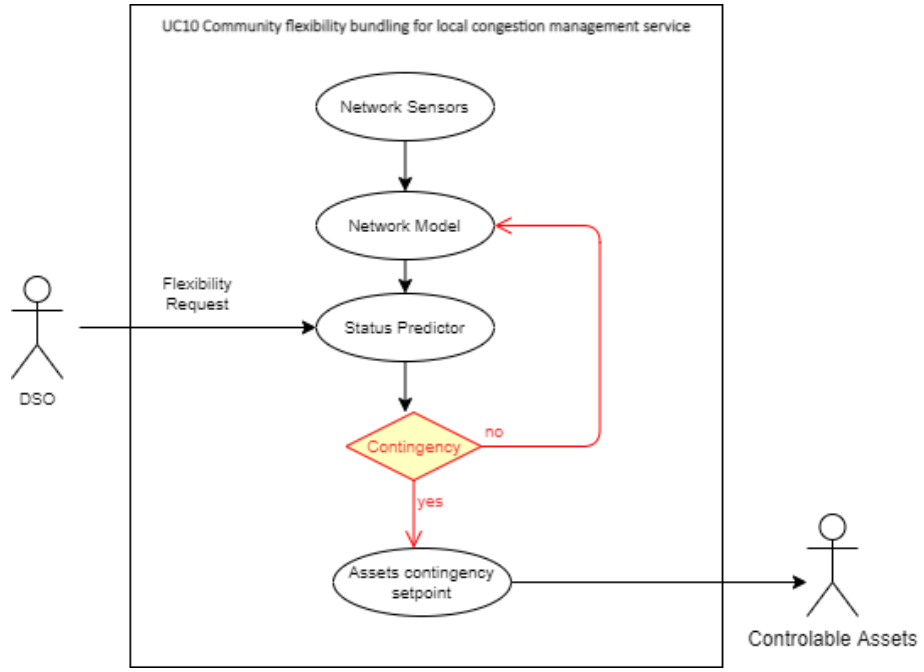
Classification Information
Relation to Other Use Cases
UC1, UC3, UC5,
Level of Depth
High
Prioritization
High
Generic, Regional or National Relation
Regional
Viewpoint
Business
Further Keywords for Classification
Grid operation, flexibility

2 Diagrams of Use Case

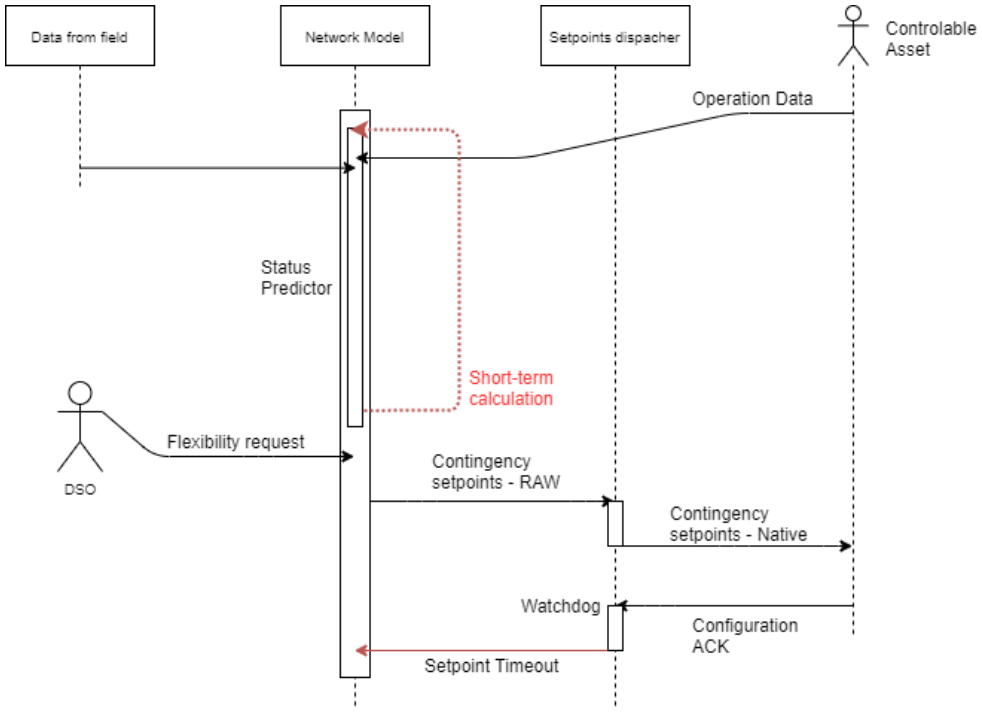
The diagram aims to illustrate the structure of the use case.

Diagram(s) of Use Case

[Use Case Diagram]



[Sequence Diagram]



3 Technical Details

3.1 Actors

The following table presents the actors involved in this use case:

Actors			
Actor Name	Actor Type	Actor Description	Further information specific to this Use Case
Consumer	Stakeholder	End-user that consumes energy	
Aggregator/Energy Community	Stakeholder	Actor that trades flexibility in the energy market	
DSO	Stakeholder	Actor that owns and manages distribution grid	
Community Flexibility management	System	ACCEPT system responsible for initiating the flexibility requests to specific assets	
Renewable Generation Devices	Device	Required infrastructure	
Energy Storage devices	Device	Required infrastructure	
Building HVAC devices	Device	Required infrastructure	
Central HVAC devices	Device	Required infrastructure	
EV Chargers	Device	Required infrastructure	
BIML - Information/Communication Layer	System	ACCEPT system for enabling data monitoring	
Flexibility Management - Optimization Layer	System	ACCEPT collection of modules responsible for the flexibility estimation	
BIML - Operation Layer	System	ACCEPT system responsible for the operation of the devices	

3.2 Triggering Event, Preconditions, Assumptions

The following table presents the triggering events, pre-conditions and assumptions of this use case:

Use Case Conditions			
Actor/System/Information/ Contract	Triggering Event	Pre-conditions	Assumption
Local Contingency detection	Predicted local congestion event	Flexibility assets operation enabled	-
DSO request	DSO explicit request	Flexibility assets operation enabled	The DSO asks for flexibility to avoid grid congestions.

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

The following table presents the scenarios associated with this use case

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition
S01	Local Contingency detection	Device	Network Status predictor flag	Predicted contingency event on local grid	Setpoints to avoid predicted condition
S02	DSO request	Device	Explicit request from DSO	Predicted contingency event (DSO level)	Setpoints to provide flexibility operations

4.2 Steps per scenario

The following tables present the steps of each of the scenarios associated with this use case as well as the respective requirements:

Scenario Name:	S01- "Contingency detection"							
Step No.	Event	Name of Process/ Activity	Description of Process/ Activity	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirements, R-ID
St01	request	Demand / Gen Forecast	Get Demand /generation forecast	Module to module	the module itself	Energy community tools	Demand / Gen Forecast (DAT01)	Data storage
St02	request	User's assets flexibility available	Get Flexibility schedule	Module to module	the module itself	Energy community tools	Flexibility schedule (DAT02)	Data storage
St03	request	District assets flexibility available	Get Flexibility schedule	Module to module	the module itself	Energy community tools	Flexibility schedule (DAT03)	Data storage
St04	request	Network sensors	Get active and reactive power in nodes	Module to module	the module itself	Energy community tools	Real time active and reactive power (DAT04)	Data storage
St05	request	flexibility potential	Get flexibility potential of EV charging	Module to Module	Flexibility potential of EV charging module	Energy community tools	flexibility potential of EV charging schedule. (DAT07)	Data storage
St06	Calculation	Local network model	Definition of voltages and currents on local network	internal	the module itself	the module itself	Voltages profiles and line loads	Data storage

St07	Calculation	Network Status	Determine a future contingency event	internal	the module itself	the module itself	contingency operation request	Contingency flag
St08	Control	Contingency setpoint	Determine optimal setpoint of the assets to avoid the contingency	internal	the module itself	Energy community tools	Flexibility request and setpoints (DAT06)	Operation request flag + flexibility value for assets

Scenario Name:	S02- "DSO request"							
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
St01	request	Demand / Gen Forecast	Get Demand /generation forecast	Module to module	the module itself	Energy community tools	Demand / Gen Forecast (DAT01)	Data storage
St02	request	User's assets flexibility available	Get Flexibility schedule	Module to module	the module itself	Energy community tools	Flexibility schedule (DAT02)	Data storage
St03	request	District assets flexibility available	Get Flexibility schedule	Module to module	the module itself	Energy community tools	Flexibility schedule (DAT03)	Data storage
St04	request	Network sensors	Get active and reactive power in nodes	Module to module	the module itself	Energy community tools	Real time active and reactive power (DAT04)	Data storage
St05	request	flexibility potential	Get flexibility potential of EV charging	Module to Module	Flexibility potential of EV charging module	Energy community tools	flexibility potential of EV charging schedule. (DAT07)	Data storage
St06	Calculation	Local network model	Definition of voltages and currents on local network	internal	the module itself	the module itself	Voltages profiles and line loads	Data storage
St07	control	DSO request	Explicit flexibility request from DSO	external	DSO	the module itself	Energy community tools (DAT05)	Contingency flag

St08	Control	Contingency setpoint	Determine optimal setpoint of the assets to avoid the contingency	internal	the module itself	Energy community tools	Flexibility request and setpoints (DAT06)	Operation request flag + flexibility value for assets

5 Information Exchanged

The following table presents the information exchanged in the context of this use case:

Information Exchanged			
Information exchanged (ID)	**Name of information**	**Description of Information Exchanged**	**Requirements to information data**
DAT01	Demand / Gen Forecast	Load and generation forecast profile	
DAT02	User's assets flexibility available	Flexibility schedule of all controllable assets	
DAT03	District assets flexibility available	Flexibility schedule of all controllable assets	
DAT04	Network sensors	Get active and reactive power in nodes	
DAT05	DSO request	Explicit flexibility request from DSO	
DAT06	Setpoints	Operation request flag + flexibility value for assets	
DAT07	Schedule	flexibility potential of EV charging	

6 Interconnection with other UCs

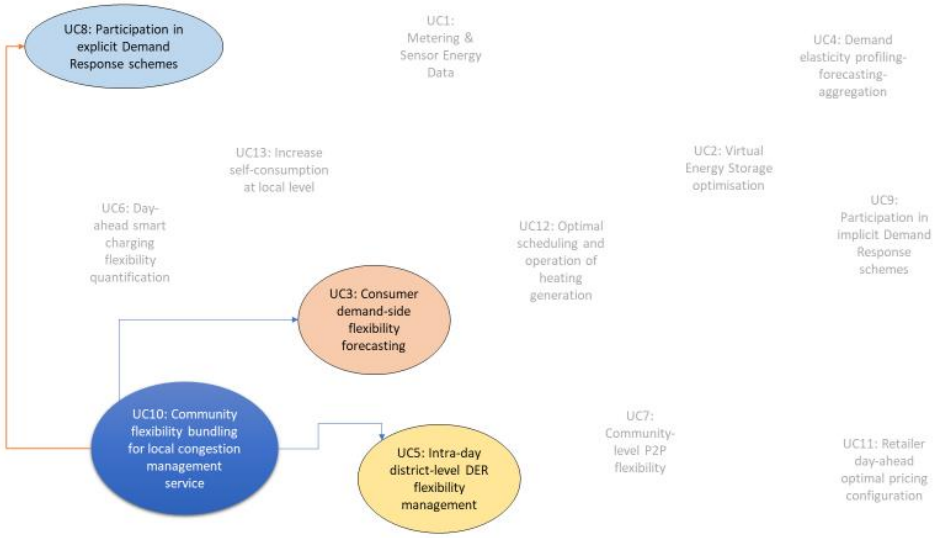


Figure 3.10: UC10 interconnection with other UCs

3.12. UC11 Retailer day-ahead optimal pricing configuration for aggregated portfolio balancing

1 Description of the Use Case

1.1 Name of Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case
11	Area: Building; Domain: Pricing, Consumption, Monitoring, Optimization Zone: Portfolio, Operation, Market	Retailer day-ahead optimal pricing configuration for aggregated portfolio balancing

1.2 Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
01	09.04.2021	WITSIDE	First proposal of use case	Draft
02	18.06.2021	WITSIDE	Final proposal of use case	Draft
03	06.07.2021	WITSIDE, RINA-C	Final proposal of use case including comments from pilot site	Final

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	Digital, automated and ex-ante process in optimizing pricing configuration, enabling us to achieve aggregated portfolio balancing. This use case will examine the high value achieved through optimal pricing methodology in increasing impact of optimal pricing configuration demand method and subsequently portfolio balancing, in relative programmes. The main outcome of this UC is due to elasticity, forecasting and aggregation the energy supplier to avoid imbalances and to encourage consumers to proceed with the new dynamic pricing schemas.
Objective(s)	• Facilitate Day-ahead pricing mechanisms in an optimal way. • Data gathering and cleansing, pertaining consumption, customer profiles, market information, competition strategy. • Classification of customers into clusters with similar characteristics. • Anomaly and outlier detection based on statistical analysis of the data sample. • Visualization and management through the dedicated retailer visualization toolkit. • Pricing models implementation, identification of the best one in terms of portfolio balancing.
Related business case(s)	BC1: Energy Community as Flexible Aggregator for Ancillary Service provision. BC3: ESCO facilitating P2P flexibility trading. BC4: Energy Community as a Retailer.

1.4 Narrative of Use Case

Narrative of Use Case
Short description
Customer's behaviour profiling-forecasting-aggregation by deploying day-ahead pricing strategies, DER estimated production and analysis in community level followed by pricing method optimisation through price signalling while ensuring portfolio balancing.
Complete description
The main purpose of this case is to facilitate retailer's participation in day-ahead pricing strategies without hampering portfolio balance parameters, appropriate metering, monitoring and price elasticity calculations. The data collected is fed through established communication streams to the profiling mechanisms that provide information on the potential demand specifications as well as on the customers' preferences. This information is utilised for the estimation of optimised demand flexibility profiles considering potential constraints. Based on the building-level demand pricing models, the aggregators create their pricing portfolio through clustering and summation of the available pricing related data, to reach the optimal price value requirements under different business scenarios. Furthermore, continuous optimisation of aggregated demand profiles takes place focusing on price values. The optimisation is a continuous, dynamic, automated procedure steered by market requirements and/or customers' signal as well as flexibility portfolio possibilities, e.g., assets availability and specifications, DR reliability, contractual constraints, opt-out events, etc. Based on the day-ahead pricing optimisation, framework and upon the receipt of price response signal, the aggregator decides upon the implementation of price optimization strategies that ensure portfolio's balance and sustainability.

1.5 General Remarks

General Remarks
In order to have a baseline, the consumption for each user must be gathered via smart meter that will send the data to the project server and will generate demand profiles. Information from the available generation DERs must be collected along with external data, such a weather conditions, in order to estimate the production from the generation DER. End-users must allow to change their tariff to flexible tariffs to be able to offer different prices each day, or at least, have an agreement to offer some incentives. There must be a tool where retailer/pilot responsible can study different price configuration and the end-users have to have access to an app where they will receive the information about the final day-ahead price configuration. Possible constraints: • App must be user-friendly to facilitate price scheme information in a convenient and comprehensive way. • Energy savings may not be high enough to attract domestic end-users. • No possibility or willingness from the end-users to automate smart devices minimizing the impact of the actions. • Difficulties to measure energy patterns' changes, and thus give the rewards, if different prices for each day can´t be applied

1.6 Further Information to the Use Case for Classification / Mapping

The following table presents further Information for the classification of this use case:

Classification Information
Relation to Other Use Cases
UC3, UC4 The connection with the other UCs is assumed as a sharing information chain. Specifically, UC11 provides with data/information to UC4 and at the same time gets data/information from UC3.
Level of Depth
Low
Prioritization
High
Generic, Regional or National Relation
Regional

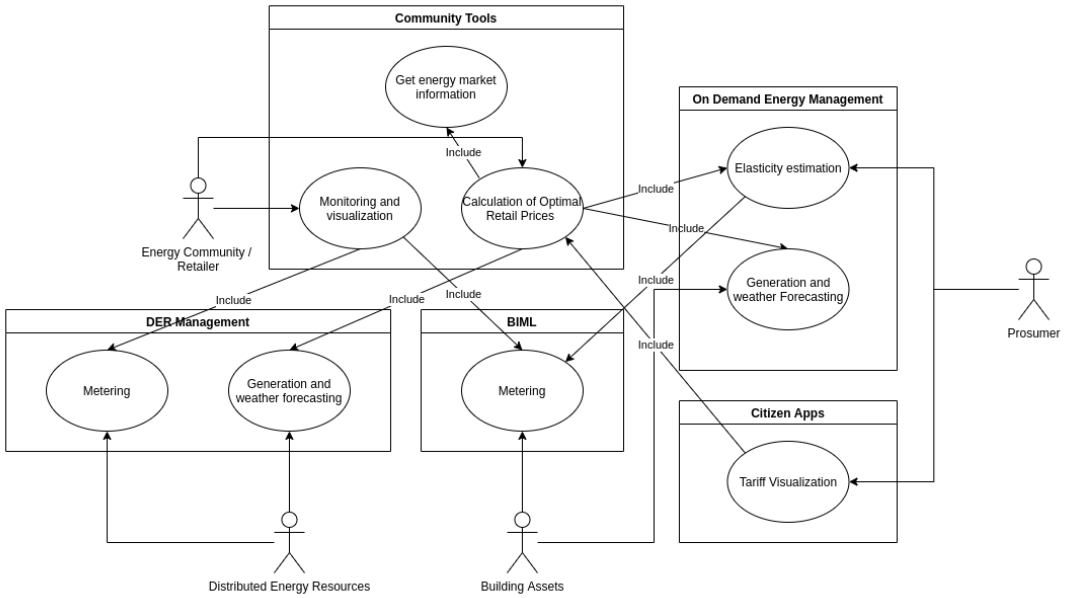
Viewpoint
Business
Further Keywords for Classification
Pricing

2 Diagrams of Use Case

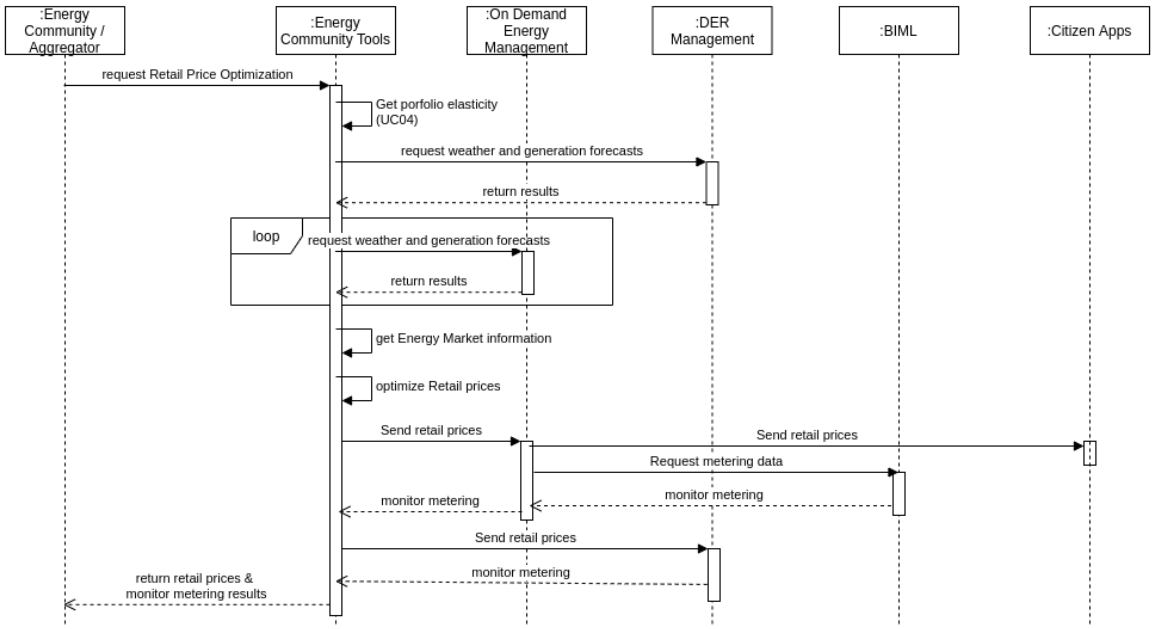
The diagram aims to illustrate the structure of the use case.

Diagram(s) of Use Case

[Use Case Diagram]



[Sequence Diagram]



3 Technical Details

3.1 Actors

The following table presents the actors involved in this use case:

Actors			
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
Consumer/Prosumer	Stakeholder	End-user that consumes products/services	The term refers to all consumers, either residential, commercial or industrial.
Manager	Stakeholder	Provides the intermediary service of monitoring of the pricing methodology	By default, it is applicable to commercial consumers.
Retailer	Stakeholder	Market stakeholder in charge supplying/ billing products & services to end-user.	The Retailer can assume the role of Aggregator, i.e., the one of the market stakeholders that acquires flexibility from prosumers and creates services that draw on the accumulated flexibility for different markets and market players.
Pricing Operator	Stakeholder	A person (or a team) who manages and operates the day-ahead pricing procedure while respecting portfolio balancing constrains.	
Distributed Energy Resources	Device	Required infrastructure	
Building assets	Device	Required infrastructure	

3.2 Triggering Event, Preconditions, Assumptions

The following table presents the triggering events, pre-conditions and assumptions of this use case:

Use Case Conditions			
Actor/System/Information/ Contract	**Triggering Event**	**Pre-conditions**	**Assumption**
Prosumer/Manager/Pricing operator	Real-time monitoring and short-term forecasting of ambient & operational conditions that lead to optimal pricing.	Establishment of accurate and dynamic forecasting model.	Training/Calibration period preceding with historical data of operational and pricing conditions.
Prosumer/Manager/Pricing operator	Short-term forecasting of demand flexibility possibilities/ what-if scenarios.	Real-time metering and sensor data concerning operational and ambient conditions feed the profiling modules.	Extraction of accurate user/zone comfort profiles & and building optimal pricing model behaviour.

Retailer/Pricing operator/Manager	Management and analysis of accumulated demand flexibility in terms of pricing.	Availability of all data necessary to facilitate the process of estimating, bundling and bidding flexibility.	Existence of accurate context-aware demand flexibility and appropriate KPIs that will be used as a basis for the overall optimization process of the retailer's portfolio.

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

The following table presents the scenarios associated with this use case.

Scenario Conditions					
No.	**Scenario Name**	**Primary Actor**	**Triggering Event**	**Pre-Condition**	**Post-Condition**
S01	Monitoring and Visualization of Demand Elasticity and pricing data.	Prosumer/Manager	Data are requested to be fed in the profiling engine for a specific upcoming time horizon.	• Installation of essential monitoring and metering infrastructure • Data Handling Infrastructure • Establishment of communication pathway	Metering and Sensing data streams are fed to the Prosumer Context-Aware Flexibility Profiling Engine.
S02	Demand Flexibility profiling, aggregation and analysis mechanism	Prosumer/Manager/Retailer	Flexibility profiles are requested to be delivered over a specific time horizon. Aggregated / Portfolio Analysis is requested as input for explicit Day-ahead price optimization.	• Flexibility and optimisation algorithms defined and implemented. • Results are reviewed, what-if pricing scenarios are examined. • Market information and applicable business scenarios.	• Flexibility profiles, segments and forecast estimates are produced. • Estimation of accumulated flexibility potential and "What-if analysis" over the portfolio available under different pricing strategies. • Compliance with constraints of individual prosumers

					within the portfolio.
S03	Customers' segmentation/clustering, optimal price configuration and portfolio balance sustainability	Retailer/Pricing operator	Pricing optimisation algorithms & what-if scenarios, resulted in the best day-ahead pricing method. Consequences in the portfolio balancing are examined and treated appropriately.	• Input from market. Testing pricing model accuracy. • Monitoring of flexibility portfolio / continuous update	• Specific load control strategy •Compliance with constraints of individual prosumers within the portfolio.
S04	Automated Day-ahead optimal pricing method	Retailer	Daily demand elasticity or customer behavioural changes are identified. Pricing forecasting models capture these changes and modify pricing accordingly.	Customers' demand requirement has been sufficiently segmented to control signals by the retailer and the corresponding control signals have been dispatched to local flexibility managers.	• Automated optimized control of pricing method, to satisfy DR request. • New ambient conditions are within user comfort boundaries.

4.2 Steps per scenario

The following tables present the steps of each of the scenarios associated with this use case as well as the respective requirements:

Scenario Name:	S01- "Monitoring and Visualization of Demand Elasticity and pricing data."							
Step No.	**Event**	**Name of Process/ Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
1.1	Request	Load/Monitoring	Monitoring of demand data and price elasticity	Monitoring and data exploring	Smart Metrics	Data exploration	Info1 - Ambient Conditions. Info2- Consumption data,	Ability to receive monitoring data at any time

1.2	Response	Data streaming for Profiling	Forward data streams to manager for processing and profiling	Management	Data exploration	Management	Info1- Ambient Conditions, Info2- Consumption,	Pre-processing at the management for data cleaning and normalization
1.3	Response	Data Visualisation	Forward data streams to prosumer visualisation platform	Prosumer UI	Management	Prosumer UI	Info1- Ambient Conditions, Info2- Consumption, Info3- Feedback from customers	Pre-processing at the management for data cleaning and normalization

Scenario Name:		S02- "Demand Flexibility profiling, aggregation and analysis mechanism"						
Step No.	**Event**	**Name of Process / Activity**	**Description of Process/ Activity**	**Service**	**Information Producer (Actor)**	**Information Receiver (Actor)**	**Information Exchanged**	**Requirements, R-ID**
2.1	Response	Demand & Price elasticity profiling	Data provided by the asset gateway are utilised for the profiling and optimisation	Management	Management	Management	Info4- Customer profiles and forecasts,	Pricing and profiling algorithms defined and implemented

Scenario Name:		S03- "Customers' segmentation/clustering, optimal price configuration and portfolio balance sustainability"						
Step No.	*Event*	*Name of Process/ Activity*	*Description of Process/ Activity*	*Service*	*Information Producer (Actor)*	*Information Receiver (Actor)*	*Information Exchanged*	*Requirements, R-ID*

3.1	Response	Customer's segmentation	Profiles are shaped in a clear and well-established way. Key consumption characteristics are identified.	Management	Management	Management	Info4- Customer profiles and forecasts, Info5- Conditions of price calculation (e.g., what-if scenarios checking customers response to price changes, price elasticity examination)	Manager handles individually the customer profiles provided by each segment. Robust Forecasting tool providing possibilities for drill-down analysis
3.2	Response	Price forecasting optimization & Portfolio Analysis	Estimation of accumulated price flexibility potential and investigation of optimal utilization through segmentation/ clustering of the portfolio balance	Price operator	Price operator	Management/Price operator		Continuous reporting of behavioural changes from customers. Available feedback from market. Available business scenario(s)/ strategies
3.3	Response	Result Visualisation	What-if Analysis result Visualisation by the user	Retailer UI	Management	Retailer UI	Info6- Price configuration for portfolio balancing	Robust visualisation platform providing graphical information upon alternative segmentation scenarios

Scenario Name:		S04- "Automated Day-ahead optimal pricing method"						
Step No.	*Event*	*Name of Process/ Activity*	*Description of Process/ Activity*	*Service*	*Information Producer (Actor)*	*Information Receiver (Actor)*	*Information Exchanged*	*Requirements, R-ID*

4.1	Request	Price elasticity/demand signal to retailers	Signal is dispatched to the management	Management	Management	Management	Info7- Pricing modifications & customer requirements (changes in pricing policy to satisfy customer needs, if necessary)	Valid and actionable customer signal
4.2	Response	New Status Visualisation	Retailer is notified about the pricing event, the new status, revised ambient conditions.	Retailer UI	Management	Retailer UI	Info8-New customer status, Info1- ambient conditions	User friendly/ Comprehensible graphical visualisation of data provided to the retailer.

5 Information Exchanged

The following table presents the information exchanged in the context of this use case:

Information Exchanged			
Information exchanged (ID)	**Name of information**	**Description of Information Exchanged**	**Requirements to information data**

Info1	Ambient conditions	• Ambient conditions:
		  ○ Temperature (ºC)
		  ○ Humidity (HR)
		  ○ Solar radiation (w/m2)
			Access to weather conditions data through API

Info2	Consumption Data	• Consumption data (kWh)	
Info3	Feedback from customers	• Feedback from user (e.g., not necessarily in a direct way, it could be customer's behaviour that creates important signals, considered as feedback) - Alphanumeric message	
Info4	Customer profiles and forecasts	• Customer profiles and forecast: expected kWh per each of the following 24 hours. • Customer flexibility: expected	
Info5	Contextual Conditions of price calculation	• Constraints that may take place (e.g. insights from customers that are not evaluated with the proper significance)	
Info6	Price configuration for portfolio balancing	• Price configuration: €/kWh per each of the following 24 hours	

Info7	New customer status and ambient conditions	• New customer status	

6 Interconnection with other UCs

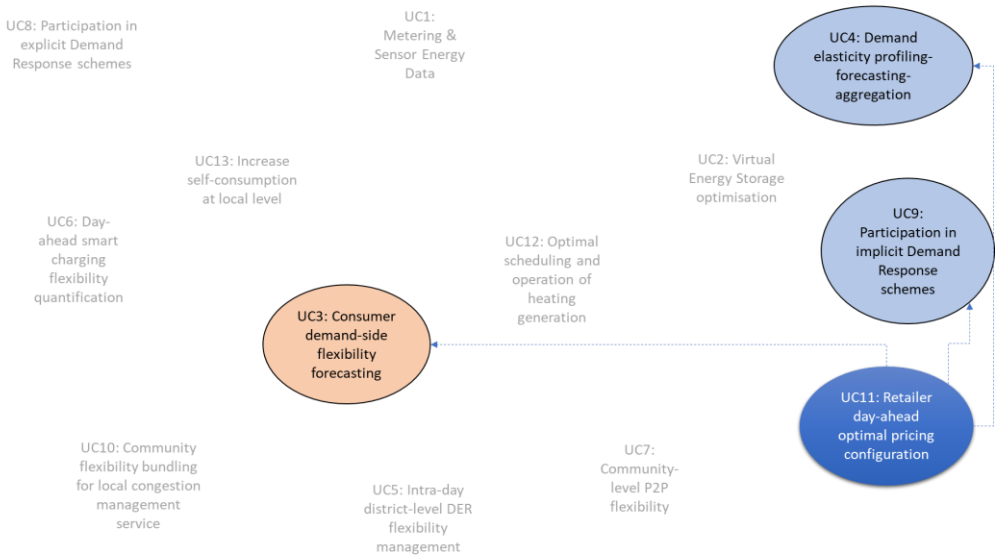


Figure 3.11: UC11 interconnection with other UCs

3.13. UC12 Optimal scheduling and operation of heating generation for a cost-efficient district-level DER management

1 Description of the Use Case

1.1 Name of Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case
12	Area: Building, grid, central HP Domain: Distribution, DER, Consumer Premises Zone: Process, Market	Optimal scheduling and operation of heating generation for a cost-efficient district-level DER management

1.2 Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
01	12.04.2021	CIRCE	First proposal of use case	Draft
02	10.05.2021	CIRCE	Comments addressed	Draft

03	06.07.2021	CIRCE, RINA-C	Final proposal	Final

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	Provide adaptive scheduling oriented to an optimal operating scheme of district heating assets, with the objective of obtaining maximum savings and preserving the proper operating point during peak demand.
Objective(s)	1. Operate the system to maintain the heat production at the optimum level. 2. Coordinate activation schedule with optimal power consumption from DERs 3. Integrate the electric heating system as a controllable load for DR purposes.
Related business case(s)	BC2 "EC as ESCO offering energy management services" BC6 "Heating as a service provider" BC7 "Prosumer engagement in Implicit Demand Response "

1.4 Narrative of Use Case

Narrative of Use Case
Short description
The development and implementation of an optimal operating schedule for district heating equipment can provide an additional layer of cost-saving flexibility to the urban energy consumption structure by leveraging the predictive and data-flow capabilities of today's smart grids.
Complete description
Integrate and coordinate an optimal operation schedule for district heating systems, being able to coordinate various heat sources (both centralized and distributed) according to generation costs, all this by means of real time control of the assets. The control system will adapt to the changing conditions of the heat network based but not limited to the following measures: • Estimation of heating demand • Output temperature • Internal temperature setpoints • Ambient temperature prediction • Electricity market prices

1.5 General Remarks

General Remarks
A heat demand forecasting system will be developed to adapt heat generation according to climate drivers and selecting the most optimal generation system.

1.6 Further Information to the Use Case for Classification / Mapping

The following table presents further Information for the classification of this use case:

Classification Information
Relation to Other Use Cases
UC1, UC5, UC13
Level of Depth
Medium
Prioritization
High
Generic, Regional or National Relation
Regional

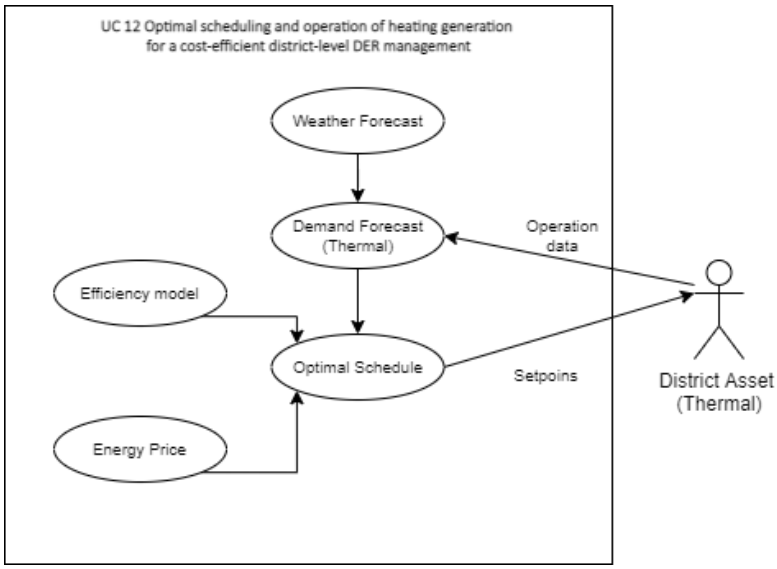
Viewpoint
Prosumer
Further Keywords for Classification
Flexibility estimation/forecasting, demand side management, demand response

2 Diagrams of Use Case

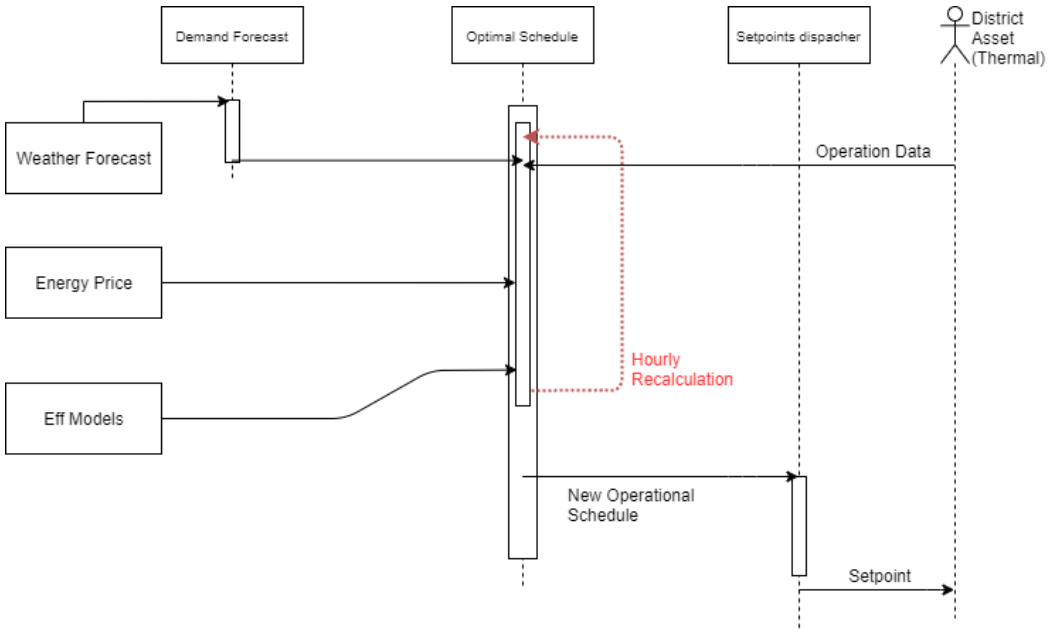
The diagram aims to illustrate the structure of the use case.

Diagram(s) of Use Case

[Use Case Diagram]



[Sequence diagram]



3 Technical Details

3.1 Actors

The following table presents the actors involved in this use case:

Actors			
Actor Name	Actor Type	Actor Description	Further information specific to this Use Case
Consumer	Stakeholder	End-user that consumes energy	
Heating schedule system	System	ACCEPT system responsible to define the schedule to specific assets	
Heating generation devices	Device	Required infrastructure	
BIML - Information/Communication Layer	System	ACCEPT system for enabling data monitoring	
BIML - Operation Layer	System	ACCEPT system responsible for the operation of the devices	

3.2 Triggering Event, Preconditions, Assumptions

The following table presents the triggering events, pre-conditions and assumptions of this use case:

Use Case Conditions			
Actor/System/Information/ Contract	Triggering Event	Pre-conditions	Assumption
Regular Operation	Hourly Schedule recalculation	Heating demand forecast, Fuel Cost, network data	

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

The following table presents the scenarios associated with this use case

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition
S01	Regular Operation	Heating schedule system	Hourly Schedule recalculation	Heating demand forecast, Fuel Cost, network data	Optimal operation schedule + Setpoints dispatchers activated

4.2 Steps per scenario

The following tables present the steps of each of the scenarios associated with this use case as well as the respective requirements:

Scenario Name:	S01- "Regular Operation"							
Step No.	Event	Name of Process/ Activity	Description of Process/ Activity	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirements, R-ID
St01	request	Network sensors	Get operational parameters of heating systems	Module to module	Energy community tools	Energy community tools	INF 1.1 Flows, temperatures	Data storage
St02	Request	Fuel cost	Get cost of fuel	Module to module	Energy community tools	Energy community tools	INF 1.2 Costs	Data storage
St03	calculation	Heating demand forecast	Determine the heating needs over a time horizon	internal	the module itself	Energy community tools	Heating load profile	Data storage
St04	request	Efficiency model for heat generator	Determine efficiency point based on flow and temperature	internal	the module itself	the module itself	Value of efficiency	Model storage
St05	calculation	Optimal Schedule calculator	Calculate de optimal operation point of all heating assets	internal	the module itself	Energy community tools	Schedule for next periods	Data storage
St06	output	Setpoints dispatcher	Send operation point	Module to Module	the module itself	Energy community tools	INF 1.3 Setpoints	Assets command integration

5 Information Exchanged

The following table presents the information exchanged in the context of this use case:

Information Exchanged			
Information exchanged (ID)	Name of information	Description of Information Exchanged	Requirements to information data
INF 1.1	Network sensor	Field data, related to heat generation system: output flow and temperature, input temperature.	
INF 1.2	Fuel Cost	cost of fuel for non-electric heating systems	
INF 1.3	Setpoints	Operation points for all heating systems	

6 Interconnection with other UCs

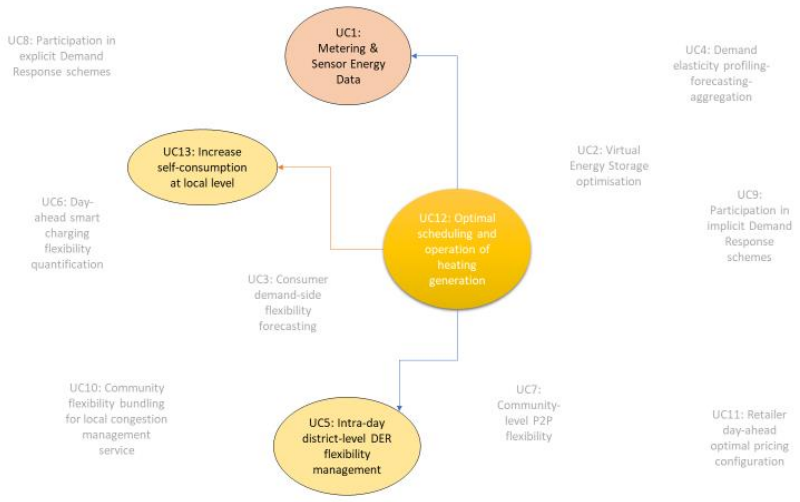


Figure 3.12: UC12 interconnection with other UCs

3.14. UC13 Increase self-consumption at community level

1 Description of the Use Case

1.1 Name of Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case
13	Area: Energy Community Domains: DER, Customer Premises Zones: Operation, Enterprise	Increase self-consumption at community level

1.2 Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
0.1	09/04/2021	Hypertech	Initial description (scope, objective, narrative, classification, actors)	Draft
0.2	21/05/2021	Hypertech	Business cases, Use Case Diagram, Sequence Diagram, Scenarios	Draft
0.25	26/05/2021	Hypertech	Second proposal of use case	Draft
0.3	06.07.2021	Hypertech, RINA-C	Final proposal of use case	Final

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The scope of this UC is to allow energy communities to maximize the use of their renewable resources. Related components are vertical tools for energy communities, demand flexibility management, district asset management
Objective(s)	1. Increase community self-consumption by aligning demand with local renewable generation 2. Reduce Renewable Energy Sources (RES) curtailment 3. Collective management of residential demand and district Distributed Energy Resources (DERs) to optimise collective self-consumption
Related business case(s)	BC2-ESCO offering energy management services BC3-ESCO facilitating P2P flexibility trading BC5-Optimised operation via P2P BC7-Prosumer engagement

1.4 Narrative of Use Case

Narrative of Use Case
Short description
The use case concentrates on the optimization of use of heating/cooling devices at district/community level, so that energy generated by renewable DERs is not wasted but utilised optimally to satisfy the user needs and reduce the amount of purchased energy from the grid. In addition, it stipulates the coordination of building and district energy resources to achieve the same objective, extended to cover the energy needs of the whole community, which is considered a single entity/actor.
Complete description
The intermittent nature or renewable generation means that supply is seldom matched to the demand by the users. This fact poses issues both for the prosumers or collective energy communities, through wasting free energy produced, as well as the grid, via introduction of imbalances in the network. In this use case we concentrate mainly on the establishment of a self-consumption framework, with the main objective being the increase of utilization of renewable energy to serve the prosumer and energy community needs. This corresponds directly to a reduction in purchase d energy from the grid, and consequently to the related energy bills. On a technical level, the efficient use of renewable resources can be achieved by three means. One is the storage of generated energy, allowing it to be utilized at a latter point in time, when it is needed. The second is the modification of the demand, to match more closely the supply. The third is though sharing of renewable resources within an energy community, allowing the smoothing out of potential peak differences. This UC will attempt to commonly optimize and coordinate the use of building heating/cooling devices, energy storage, and any district-wide resources, so that, by jointly taking into consideration all three means, we will be able to provide the best scheduling of operation of these devices to maximise self-consumption at the community and building level.

1.5 General Remarks

General Remarks
This UC has mostly the same requirements as UC2. The text is to large effect repeated in the two UCs. The UC on increasing self-consumption is driven by regulations and general financial situation in certain EU countries (e.g. Spain, Greece), where it appears to be the most efficient way to lower energy costs. To successfully implement this UC, certain technical requirements need to be satisfied, in terms of infrastructure, monitoring, communication and operation. More specifically, renewable resources connected to energy storage devices that can be monitored and modelled is highly important. Furthermore, communication and operation of building and district assets should be made at the same level and granularity

1.6 Further Information to the Use Case for Classification / Mapping

The following table presents further Information for the classification of this use case:

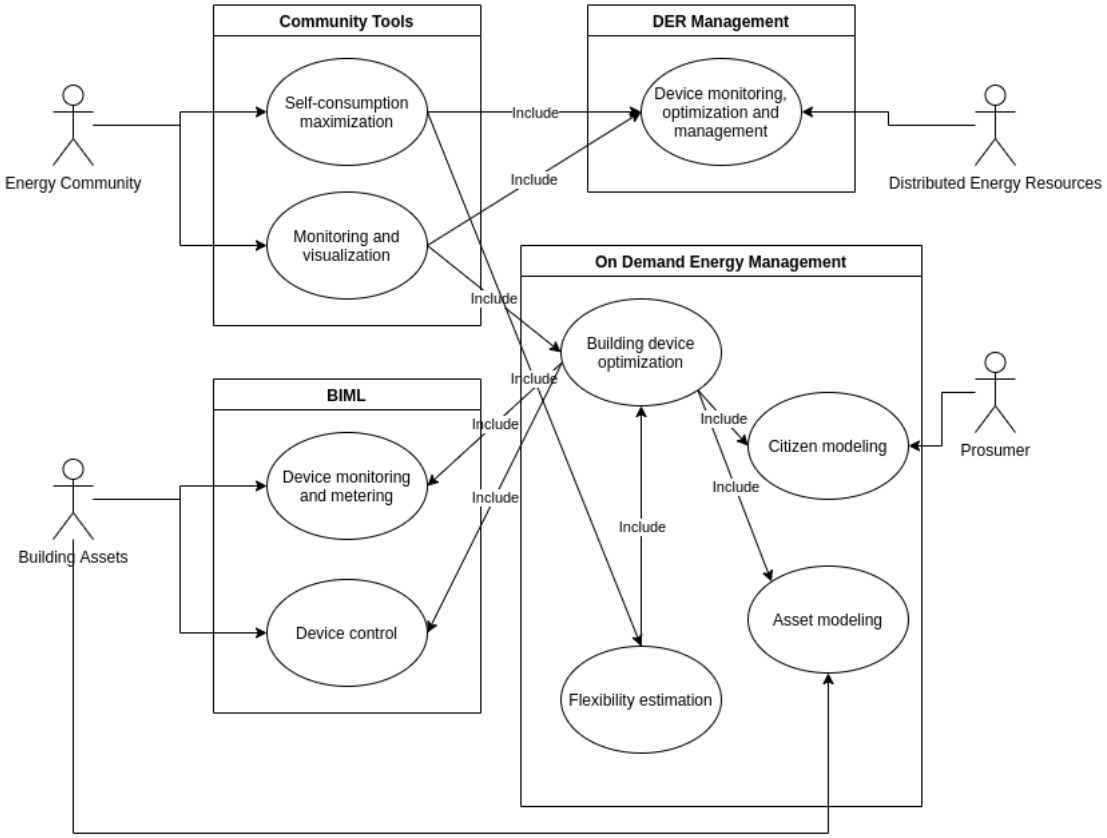
Classification Information
Relation to Other Use Cases
UC13 includes UC03 and UC05 (or UC06) (requires functionality from these UCs) UC13 generalizes UC02 (same functionality but bigger group of involved assets)
Level of Depth
Medium
Prioritization
High
Generic, Regional or National Relation
Regional
Viewpoint
Technical
Further Keywords for Classification
Cost-Optimization, Self-balancing, Self-consumption

2 Diagrams of Use Case

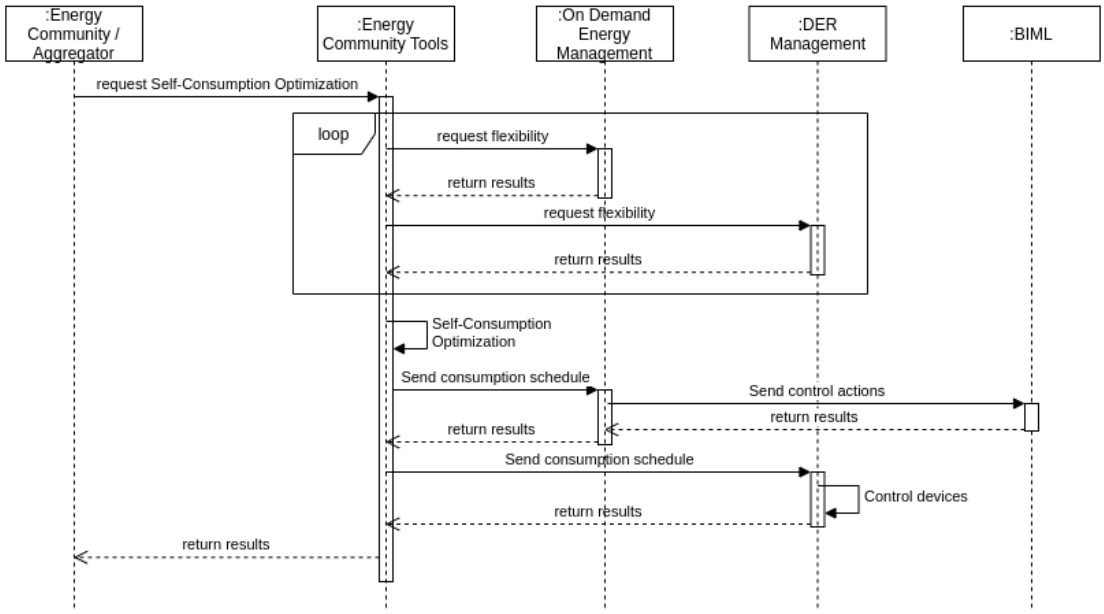
The diagram aims to illustrate the structure of the use case.

Diagram(s) of Use Case

[Use Case Diagram]



[Sequence Diagram]



3 Technical Details

3.1 Actors

The following table presents the actors involved in this use case:

Actors			
Actor Name	**Actor Type**	**Actor Description**	**Further information specific to this Use Case**
Energy Community	Stakeholder	Actor initiating and benefitting from the UC	The energy community comprises a portfolio of prosumers
Prosumer/Consumer	Stakeholder	Actor benefitting from the UC	
Distributed Energy Resources	Device	Required infrastructure	
Building assets	Device	Required infrastructure	
BIML - Information/Communication Layer	System	ACCEPT system for enabling building data monitoring and control	
On Demand Flexibility Management	System	ACCEPT collection of modules responsible for the management of building assets	
DER management	System	ACCEPT system responsible for the monitoring and control of district assets	
Energy community tools	System	ACCEPT system responsible for community level optimization	

3.2 Triggering Event, Preconditions, Assumptions

The following table presents the triggering events, pre-conditions and assumptions of this use case:

Use Case Conditions			
Actor/System/Information/ Contract	**Triggering Event**	**Pre-conditions**	**Assumption**
Energy Community	The energy community triggers the system to perform a day-ahead or intra-day optimization of certain assets.	Establishment of monitoring and communication infrastructure, establishment of Community tools and Uis, Characterization of resources	It is assumed that the stakeholder representing the energy community can initiate the optimization process either for the complete portfolio or for individual buildings

4 Step by Step Analysis of Use Case

4.1 Overview of Scenarios

The following table presents the scenarios associated with this use case

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition
S01	Self-Consumption maximization	Energy Community	The energy community triggers the system to perform a day-ahead or intra-day optimization of certain assets.	Establishment of monitoring and communication infrastructure, establishment of Community tools and UIs, Characterization of resources	Operation of district and building devices is performed based on the self-consumption maximization schedule

4.2 Steps per scenario

The following tables present the steps of each of the scenarios associated with this use case as well as the respective requirements:

Scenario Name:	Self-Consumption Maximization							
Step No.	Event	Name of Process/ Activity	Description of Process/ Activity	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirements, R-ID
St01	Request	Initiate optimization	User requests via the UI the optimal scheduling for the community	External	Energy Community	Energy Community Tools	INF 01 Request notification, INF 02 datetime, horizon, timestep	UI, infrastructure for monitoring and control in place. Software modules for optimization
St02	Request	Get flexibility forecast for building assets	Request the flexibility forecast for all building assets included	Module to Module	Energy Community Tools	On-Demand Flexibility Management	INF 01 Request notification, INF 03 building/asset ID, INF 02 datetime, horizon, timestep	Infrastructure for monitoring and control in place. Software modules for optimization
St03	Request	Get end user activity/comfort constraints	Request the information (comfort/occupancy/activity) of the occupants in order to define the required constraints for the energy optimization	Module to Module	On-Demand Flexibility Management	Citizen Digital Twin	INF 03 building/asset ID, INF 02 datetime, horizon, timestep	BIML, Citizen Digital Twin Module

St04	Request	Get Building/ Asset information	Request the thermal modelling and characteristics of the building zones and the relevant equipment	Module to Module	On-Demand Flexibility Management	Building Digital Twin	INF 03 building/asset ID, INF 02 datetime, horizon, timestep	BIML, Citizen Digital Twin Module
St05	Computation	Estimate flexibility	Run flexibility estimation algorithm based on retrieved constraints	Internal	On-Demand Flexibility Management	On-Demand Flexibility Management	-	Software modules for optimization
St06	Response	Return flexibility forecast	Return the flexibility forecast of devices to the energy community tool	Module to Module	On-Demand Flexibility Management	Energy Community Tools	INF 04 Timeseries of baseline and flexibility per asset	-
St07	Request	Get flexibility forecast for district assets	Request the flexibility forecast for all district assets included	Module to Module	Energy Community Tools	DER management	INF 01 Request notification, INF 03 district assets ID, INF 02 datetime, horizon, timestep	infrastructure for monitoring and control in place. Software modules for optimization
St08	Request	Get District Asset information	Request the thermal modelling and characteristics of the district assets	Internal	DER management	DER management	INF 03 District asset ID, INF 02 datetime, horizon, timestep	DER management
St09	Computation	Estimate flexibility	Run flexibility estimation algorithm based on retrieved constraints	Internal	DER management	DER management	-	Software modules for optimization
St10	Response	Return flexibility forecast	Return the flexibility forecast of devices to the energy community tool	Module to Module	DER management	Energy Community Tools	INF 04 Timeseries of baseline and flexibility (per asset)	-

St11	Consumption	Self-consumption optimization	Optimize the self-consumption of all community assets	Internal	Energy Community Tools	Energy Community Tools	INF 05 Timeseries of required consumption per asset	-
St12	Response	Present information	Present the optimal schedule to the requesting actor	External	Energy Community Tools	Energy Community		UI
St13	Request	Apply schedule	Request to follow the optimal schedule	External	Energy Community	Energy Community Tools	INF 01 Request notification, INF 05 Timeseries of required consumption	UI
St14	Request	Apply schedule for building assets	Request the optimal operation of all building assets included	Module to Module	Energy Community Tools	On-Demand Flexibility Management	INF 01 Request notification, INF 03 building/asset ID, INF 05 Timeseries of required consumption per asset	infrastructure for monitoring and control in place.
St15	Request	Apply schedule for building assets	Request the optimal operation of all building assets included	Module to Module	On-Demand Flexibility Management	BIML	INF 06 Timeseries of control actions to follow per device	infrastructure for monitoring and control in place.
St16	Response	Monitor event	Provide information of metered data	Module to Module	BIML	On-Demand Flexibility Management	INF 05 Timeseries of power consumption	-

St17	Response	Monitor event	Provide information of scheduled operation	Module to Module	On-Demand Flexibility Management	Energy Community tools	INF 05 Timeseries of power consumption, INF 07 comparison between scheduled and actual operation	-
St18	Request	Apply schedule for district assets	Request the optimal operation of all building assets included	Module to Module	Energy Community Tools	DER management	INF 01 Request notification, INF 03 building/asset ID, datetime, horizon, timestep, INF 06 Timeseries of control actions to follow per device	infrastructure for monitoring and control in place.
St19	Response	Monitor event	Provide information of scheduled operation	Module to Module	DER management	Energy Community tools	INF 05 Timeseries of power consumption, INF 07 comparison between scheduled operation	
St20	Response	Monitor Event	Visualize results of operation at community level	External	Energy Community tools	Energy Community	INF 05 Timeseries of power consumption, INF 07 comparison between scheduled operation	UI

5 Information Exchanged

The following table presents the information exchanged in the context of this use case:

Information Exchanged			
Information exchanged (ID)	Name of information	Description of Information Exchanged	Requirements to information data

INF 01	Request notification		
INF 02	Datetime, horizon and timestep	The information established the start time, duration and granularity for which the self-consumption optimization is requested	
INF 03	Building/Asset ID / District Asset ID	The information is required for the correct communication between the modules. The energy community may have the ability to select which assets (buildings or DERs) should be considered each time	
INF 04	Timeseries of baseline and flexibility	Set of timeseries showing the baseline consumption forecast and the available upwards and downwards flexibility	
INF 05	Timeseries of Power consumption	Information exchanged between the different modules and presenting the results of the self-consumption optimization. May be a timeseries of consumption per asset/ DER or aggregated one.	
INF 06	Timeseries of control actions	Control actions for each specific device/DER in order to follow the requested consumption schedule	
INF 07	Comparison between scheduled and actual operation	A timeseries object highlighting the requested vs actual consumption from assets/portfolio at each timestep	

6 Interconnection with other UCs

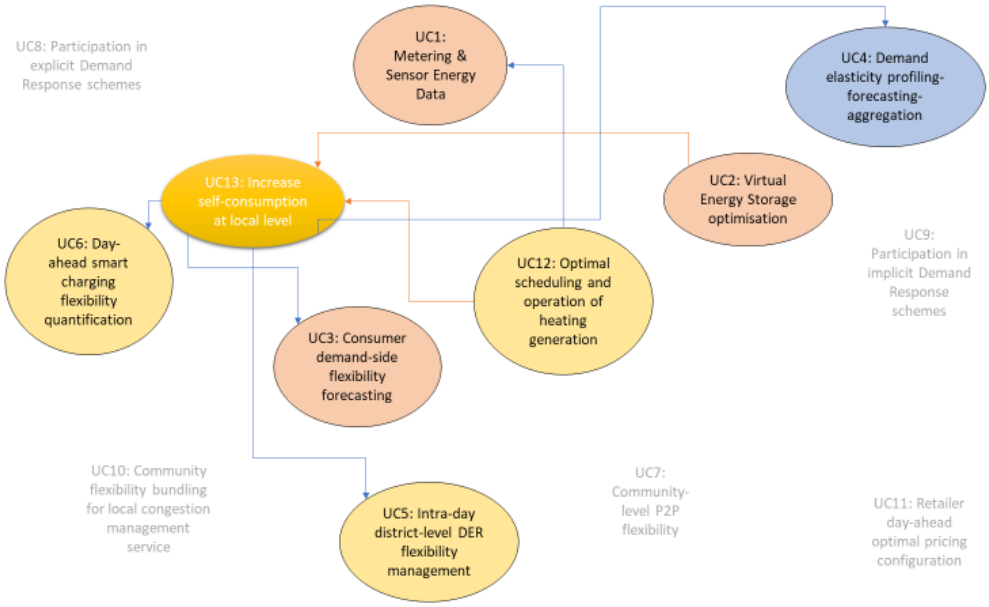


Figure 3.13: UC14 interconnection with other UCs

3.15. UC14 Active Citizen and LEC Engagement

1 Description of the Use Case

1.1 Name of Use Case

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case
14	Area: Energy Communities	Active Citizen and LEC Engagement

1.2 Version management

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status
01	04.04.2021	GECO	First proposal of use case	Draft
02	06.07.2021	GECO, RINA-C	Final proposal of use case	Final

1.3 Scope and Objectives of Use Case

Scope and Objectives of Use Case	
Scope	The main goals of this use case focus on promoting the engagement of the local community in the energy transition and raising customer's environmental and energy efficiency awareness.
Objective(s)	To challenge the unidirectional, top-down approach often taken when integrating renewable energy solutions and implement bi-directional communication between the local community and the operating manager/owner of the energy distribution network. Understanding the local energy community and the dynamics between the various stakeholders to suggest strategies for raising awareness, communication campaigns and behavioural change. This UC serves a specific purpose for T2.1 and should not be interpreted as a template for wider community engagement activities, particularly WP3.
Related business case(s)	All BCs

1.4 Narrative of Use Case

Narrative of Use Case
Short description

Rather than a traditional unidirectional top-down approach when implementing renewable energy solutions, active citizen and Local Energy Community (LEC) engagement aims to establish a meaningful two-way communication with members of the community and the operating manager/owner of energy distribution networks (e.g., DSO). Research into LECs through community mapping and analysis of needs, motivations and potential barriers is undertaken to implement effective engagement strategies to establish a long-term bottom-up and community-led discussion on the issues surrounding the active involvement of consumers/prosumers and LECs in the energy transition and the integration of large amount of RES in local areas.

Due to the unique characteristics of each community, the specific factors impacting active citizen and LEC engagement, including the stakeholders involved and/or affected, strategies for engagement cannot be predetermined. There will always be influencing factors that will be unknown before engagements start. Therefore, the complete description section below is based on a previous case study to illustrate the process utilised in this UC and given the complexities involved in engaging with communities it is not to be interpreted as a complete description of actions to be used in ACCEPT.

Complete description

Framing the narrative

The case study takes place in a mostly rural region of Europe with a large amount of distributed intermittent renewable electricity production. Due to low consumption levels, a lack of flexible demand and in some cases unsupportive national regulation, only a small proportion of the generated electricity is consumed locally. In recent years, given the mass deployment of RES technologies, the region recorded a significant surplus of generated electricity. This has resulted in much of this surplus electricity being redistributed to other parts of the country.

This has been a contributing factor for many local citizens and local businesses feeling like they have not directly benefitted from the high proportion of RES in their area. In fact, a growing perception has been that it has had a negative societal impact, particularly in terms of the cost of electricity to the end-user. Network charges are indeed some of the highest in the country (*e.g.* above 10 cent/kWh is a considerable gap especially when factoring other socioeconomic and sociodemographic factors including age, employment status, health *etc.*) due to significant investments in the low and high voltage grids. Workers in the local economy (*e.g*. agriculture, tourism, *etc.*), note that while electricity is generated locally, it is consumed in parts of the country where network fees are much lower. Simply put, members of the local community feel like the costs of renewable energy remain localised while the benefits are exported. This type of socio-political factor can have a significant impact on local/community engagement planning. Consequently, within the region there is a resistance to new RES projects, the energy transition in general, and criticism has been levelled at the local DSO.

In order to better manage intermittency and increase local consumption of locally produced electricity, the DSO tasked with engaging with the community is planning to upgrade its capacity (*e.g.* installing a Battery Energy Storage System (BESS) connected directly to its network just outside the area's main urban centre/municipality). This project is seen as an opportunity to also engage with local stakeholders on the issues arising from the integration of large amount of RES and the DSO's role in the energy system.

To actively engage citizens and the LEC, the needs, opportunities and abilities of relevant stakeholders within the community were assessed (see Needs Opportunities and Abilities model in section 2). This process has two main interrelated goals.

1. Actively incorporating the local socio-economic, regulatory and organisational context (*e.g*., human factor, key actors' legacy, incentives, drivers and barriers) in the design of the proposed activities; and

2. Bringing together stakeholders not traditionally perceived to be aligned to each other using a range of participatory and co-design methods that improve broad stakeholder participation in energy projects.

1.5 General Remarks

General Remarks

Specific remarks from Mytilineos:

The main constraints here for the Greek Pilot Site are generically expressed within several other UC and refer to simplification of knowledge transfer to enable trust and acceptance of users to testing the services provided within the project and actualize energy communities.

Specific remarks from AEM:

From our experience, users are usually not aware of the energy transition and the challenges this brings. Awareness shall be promoted through workshops and other dedicated communication channels. Also, in Switzerland, we have some (rural) users disappointed by the minimal advantage of having PVs. This is due to the fact that most of the locally produced solar

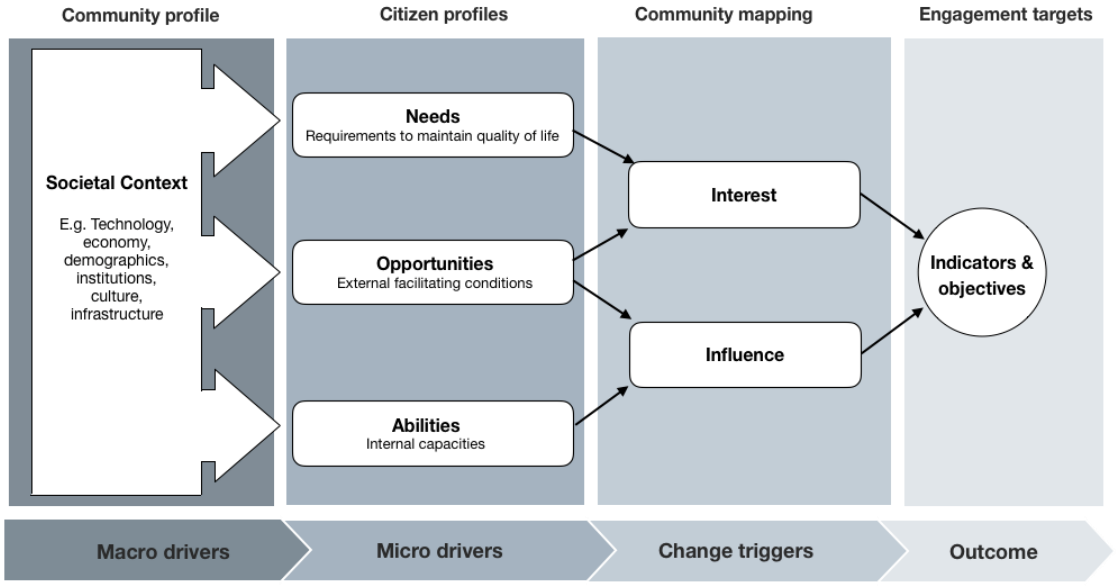
energy cannot be consumed by the household and has to be injected back to the grid, at a much lower price. From our direct experience, the creation of energy communities in combination with battery systems helps in increasing the quota of self-consumption greatly

1.6 Further Information to the Use Case for Classification / Mapping

The following table presents further Information for the classification of this use case:

Classification Information
Relation to Other Use Cases
All the other UCs, engagement is a cross-cutting activity across all the use cases
Level of Depth
High
Prioritization
High
Generic, Regional or National Relation
Generic
Viewpoint
Community
Further Keywords for Classification

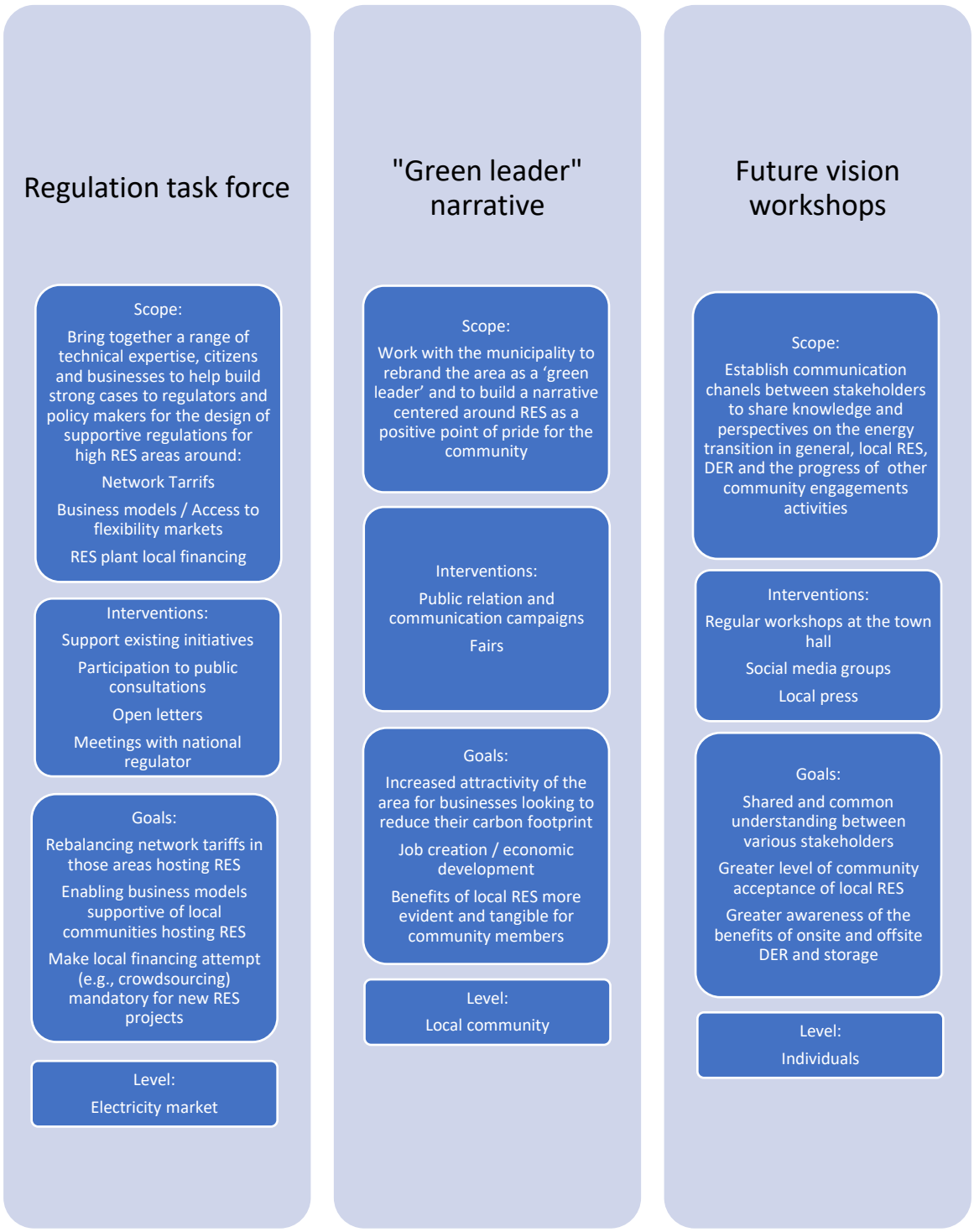
2 Diagram of Use Case



Describing the solution and implementation

Based on the information gathered from NOA assessment, various engagement strategies can be identified. The strategies identified in the case study referred to thus far are shown in the figure below[1].

[1] Note: these will change depending on the environmental, social, political and historical contexts that characterize any given energy project.



3 Technical Details

3.1 Actors

The actors relevant to ACCEPT are determined following an assessment at the local level with pilot site representatives. The following summarizes considerations for each of the key stakeholders in the local area resulting from the community stakeholder mapping and analysis work done in the previous case study:

Actor Name	Goal	Role

Operating manager/owner of energy distribution network (e.g. Local DSO)	In this example, the primary objective is to improve the DSO's corporate image and to diffuse emerging issues around network tariffs. Achieved through a greater understanding of the local community's perspective on the topic of RES and onsite or offsite distributed energy resources (DER) and exploring collaborative opportunities to provide greater benefit of local green generation to the local community.	As the local network operator and a non-market actor, the DSO needs to play the dual role of connector and facilitator. To this end, efforts will be made to strengthen relationships within the community, connect the community with relevant actors (e.g., at national level) and to continue looking for individuals who can serve as promoters of the project.
Local municipality	A goal of this long serving and popular mayor is to find and enable innovative ways for the local community and the municipality to benefit from the high amount of RES and DER in the area. Additionally, the mayor already foresees the potential of DER combined with storage to reduce electricity bills in municipal buildings which is currently hindered by regulation.	This very active mayor should serve as a "change agent" and "connector" for the community. His interest and knowledge of the topic provide a strong foundation for collaboration. Additionally, he shows a clear sense of pride in the leading role his region has taken in the green energy transition. Finally, as mayor, he is well connected within the community (and local media) and seems to carry a good deal of influence. As an elected representative, he will be helpful in encouraging greater participation and spread good will with relevant actors within and outside the community.
Prosumers (citizens and small business owners):	Prosumers quote financial incentives as their primary motivator, however there is clearly also a strong understanding of the broader societal benefits of RES and a sense of pride in their region and their own leadership role in the energy transition. Several private and business-owners are enthusiastic about sharing their experience as prosumers and to appear as trend setters. They also often show interest in acquiring new knowledge on how to create value and revenue streams from their existing assets via for instance distributed storage, home automation, or dynamic tariffs.	Prosumers could act as "Influencers" and "Ambassadors" in knowledge and experience sharing activities. As such they may be able to move community practices in preferred direction. Community members with an overall negative view of the energy transition may become more supportive as a result and consumers may be keen to act upon the learnings and experiences of other community members they can easily relate to (e.g., friends, neighbours).
Energy consumers (citizens and small business owners):	Energy consumers are currently facing relatively high network tariffs and Collaboration vs Contestation debates, usually characterised around ''NIMBY" attitudes towards additional visible wind turbines in their area. Having not visibly benefitted from the high share of renewable electricity in the area, it is important to show that their perspective and their lot will be considered going forward through inclusive and concrete engagements. It is also important to ensure consumers are aware of the opportunities arising from the energy transition and from DER (e.g., on their electricity bills) so they do not feel left-behind in the energy transition.	Experience and perspective sharing living in a high-RES area.
RES power plant developers	Several large-scale solar power plant developers are located in the area. Their international experience assessing, financing and developing RES power plant projects in other geographies will be very valuable in understanding how those areas have tackled issues of local acceptance and community participation.	Experience, best-practice and idea sharing, in particular related to community engagement and supportive regulation (e.g., minimum threshold for local funding).
RES power plant managers	The operator of the local power plant (not always the RES developer) operates within the local community and deals with the day-to-day operation of the plant. Good relationships with the local community is seen as important.	Establish programme of community engagement activities, open days, news bulletins in local media, *etc.*

Other actors (e.g., technology supplier, investors, scientific institutions)	While not always directly connected to the local community, these actors will play an important role in framing the community context (e.g., regulatory, economic, infrastructure, institutions, local "opinion formers") and in providing expert opinions.	This group will be viewed as expert consultants to be called upon for guidance, feedback, and advice

4. ACCEPT Business cases

4.1. Methodology for the definition of Business cases

One of the objectives of the ACCEPT Project is to test and validate several business cases and models. Considering the ACCEPT Use Cases (UCs) widely discussed in the previous chapter, in this section Business Cases (BCs) will be analyzed to the purpose of defining possible business scenarios that, along with use cases, drive the user requirement definition process.

Business scenarios aim to derive an understanding of the significant business needs, which can then be used to determine the important requirements and ensure solutions that meet the overall business needs. Business cases are intended as all the operations that the ACCEPT Pilot Sites intend and need to undertake to successfully reach their goals through the implementation of specific UCs. The BCs that have been identified are summarized in Table 4.1.

Table 4.1. Short description of ACCEPT Business Cases

Business Case		Short Description
BC1	Energy Community as Flexibility Aggregator	Energy Community as Flexibility Aggregator for Ancillary Service provision to System Operators and Balance Responsible Parties including network constraints management services, such as congestion management, and balancing services, such as frequency regulation.
BC2	Energy Community as an Energy Service Company (ESCO) offering energy management services	Energy Community as an Energy Service Company (ESCO) offering energy management services to community members, such as energy awareness and self-balancing on community level.
BC3	Energy Community as an Energy Service Company (ESCO) facilitating P2P flexibility trading	Energy Community as an Energy Service Company (ESCO) facilitating P2P flexibility trading (shadow administration).
BC4	Energy Community as a Retailer	Energy Community as a Retailer supplying the community members with energy models and potentially participate in the wholesale market the locally aggregated energy surplus.
BC5	Energy Community optimized operation via P2P flexibility trading	Energy Community optimized operation via P2P flexibility trading based on locally produced energy.
BC6	Heating-as-a-Service Provider	Heating-as-a-Service Provider models under schemes in which electric heating is utilized as a controllable load or alternatively through carrier coupling with DH networks leveraging the higher predictability of individual load behavior to offer heating under predefined contractual terms.
BC7	Prosumer engagement	Prosumer engagement in Implicit Demand Response for local energy profile optimization (Time-of-Use optimization).

All the above BCs will be tested within ACCEPT project, Table 4.2 shows the Pilot Sites associated to the BCs. Some of them will be tested to all the Pilot Site while some other will be tested in only one.

Table 4.2. Association between BCs and Pilot Sites

Business Case		Pilot Sites Involved
BC1	Energy Community as Flexibility Aggregator	LaSolar ESR
BC2	Energy Community as an Energy Service Company (ESCO) offering energy management services	LaSolar Mytilineos ESR AEM
BC3	Energy Community as an Energy Service Company (ESCO) facilitating P2P flexibility trading	Mytilineos
BC4	Energy Community as a Retailer	LaSolar Mytilineos ESR

		AEM
BC5	Energy Community optimized operation via P2P flexibility trading	LaSolar
BC6	Heating-as-a-Service Provider	AEM
BC7	Prosumer engagement	LaSolar ESR

Within the T2.1, the first step consisted in the analysis, for each business case, of five aspects that can be regarded as constituent elements of a business scenario which concern:

- Possible services to be offered
- Main actors involved in the BC, their roles, and responsibilities
- Main objectives that the service offering would allow to achieve
- Needed inputs to achieve the BC objectives (technological, economic, financial, policy, etc.)
- Expected benefits obtainable by the envisaged services

To study the aforementioned aspects, the methodology followed relies on a short questionnaire prepared for the Demo Site Responsible Partners with the purpose of gather information on the services they intend to offer, the main actors involved in the provisioning of the services, the input they need to achieve their objectives and the expected results and benefits in offering those services, both from an internal and an external perspective.
The analysis of the results contributes to the description of rational and scope of BCs for which reference was also made to the Universal Smart Energy Framework (USEF) developed by the USEF Foundation[2]. The framework provides a common standard to build smart energy products and services [30]. Considering the general purpose of ACCEPT, even more significant is the USEF White Paper "*Energy and Flexibility Services for Citizens Energy Communities*" [1], that extends the USEF Flexibility Value Chain [31] and defines the type of energy and flexibility services related to Citizens Energy Communities (CECs) and the economic value they can generate. Indeed, for the scope of this chapter, USEF [1] has been particularly relevant for describing the seven business cases identified in ACCEPT and for the characterization of the service offering related to each of them. The figure below illustrates the types of services that, according to USEF [1], Energy Communities could offer to their members.

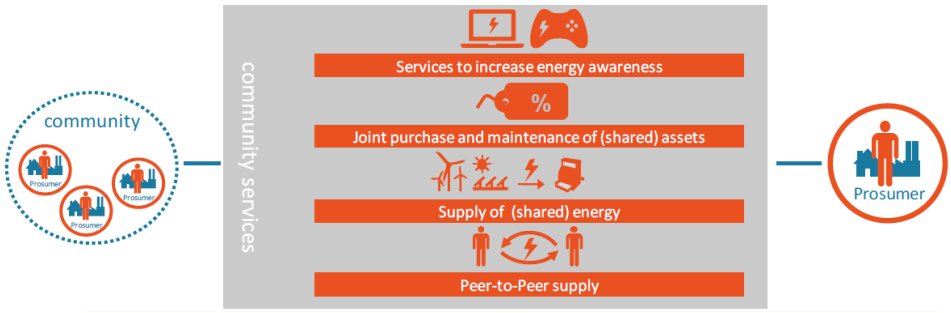


Figure 4.1. Four types of services that can be offered by a Citizens Energy Community (in the role of ESCo and/or Supplier) to the Prosumers within the community.
Source: USEF White Paper - Energy and Flexibility Services for Citizens Energy Communities. 2019 [1]

Chapter 2 of [1] is focused on the description of any of these four types of services. In addition, flexibility services for prosumers and flexibility services for Citizens Energy Communities are deeply described in chapter 3 and chapter 4, respectively. A final chapter summarizes all the energy and flexibility services that can be offered to the prosumers within a Citizen Energy Community. This is illustrated in Figure 4.2.

[2] "USEF Foundation is a non-profit partnership of seven organizations, active in all areas of the smart energy industry: ABB, Alliander, DNV GL, Essent, IBM, ICT Automation and Stedin". Source: USEF (2015)

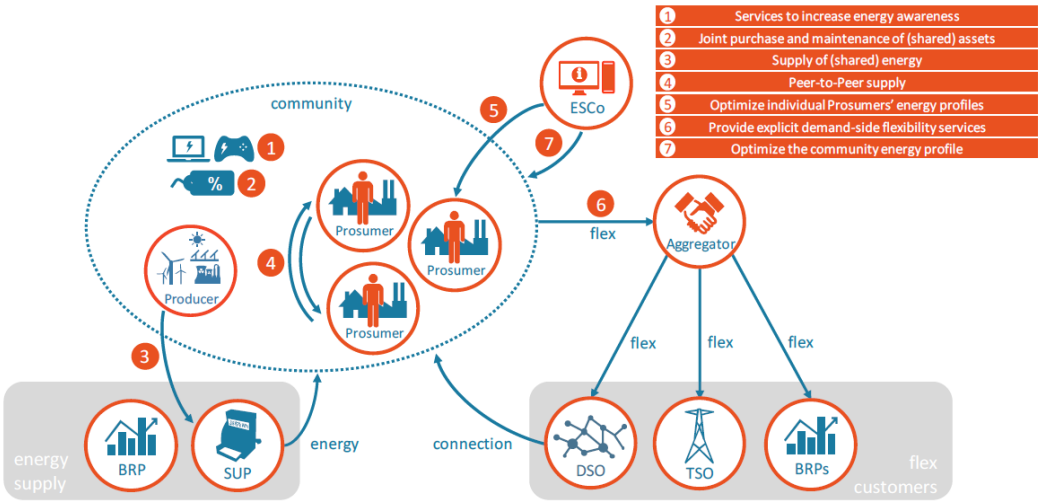


Figure 4.2. Illustration of all energy and flexibility services that can be offered to the Prosumers within a Citizen Energy Community.
Source: USEF White Paper - Energy and Flexibility Services for Citizens Energy Communities. 2019 [1]

Therefore, it has been made use of this reference mainly in the first step of the methodology here followed, especially for what concerns the general description of business cases, the identification of the services pertaining to each of them allowing also to have a first intuition of the value they can generate for end-users.

The second step consisted in the identification of obstacles and barriers to BCs implementation. In this respect, Demo Site Responsible Partners contributed by providing feedbacks in terms of relevance of a specific barrier and by proposing potential mitigation actions. Five main categories of obstacles and barriers have been identified (Regulatory and Legislative, Economic and Market, Technical, Social, Organizational). For each category, already some examples have been reported, to be detailed and specified by Demo Site Responsible Partners, as provided in the following table:

Table 4.3. Obstacles and barriers to BCs implementation

Category of obstacles	Short Description of obstacles
Regulatory and Legislative	Definition of energy community Interactions with citizens Interactions with DSO Unstable regulatory framework Legal constraints (e.g. consumer participation)
Economic and Market	High capital costs Absence of financial incentives Lacking efficient remuneration schemes No markets (remuneration) for provision of services to grid operators Absence of suitable business models
Technical	Limited available flexibility Obstacles around enabling technologies Obstacles around demand side response Grid issue Lack of ICT tools Cybersecurity and privacy aspects
Social	Lack of awareness and knowledge Negative perceptions Network and supply security Behavioral barriers
Organizational	Lack of support from expert organizations

The analysis of obstacles and barriers, in turn, allows to have an initial understanding of the degree of applicability of BCs to the ACCEPT Pilot Sites. This aspect has been investigated through an ad hoc questionnaire submitted to the four Demo Site Responsible Partners (see Annex III).

To summarize, in what follows each BC will be largely documented according to:

- its rational and scope
- the obstacles and barriers to its implementation
- its applicability to ACCEPT Pilot Sites

4.2. BC1: *Energy Community as Flexibility Aggregator*

Energy Community as Flexibility Aggregator for Ancillary Service provision to System Operators and Balance Responsible Parties including network constraints management services, such as congestion management, and balancing services, such as frequency regulation.

Pilot Responsible Partner Involved:

- *LaSolar*
- *ESR*

The energy community can assume the role of Aggregator to valorize the power flexibility of its assets on an accumulated basis through explicit demand response services [1] offered to different market parties such as DSOs, TSOs, BRPs, etc.

According to USEF [31], the flexibility-related services that could be offered are classified into the following categories:

1. Network constraints management services offered to system operators and utilized for system control and alleviation of voltage violations, minimization of thermal losses, grid congestion, reverse power, etc.
2. Wholesale services offered in day-ahead and intra-day markets to decrease sourcing costs of electricity.
3. Balancing services offered to the TSO and utilized for frequency regulation, e.g. Frequency Containment Reserve (FCR), Automatic/ Manual Frequency Restoration Reserve (mFRR/ aFRR), Replacement Reserve (RR), etc.
4. Adequacy services offered in capacity markets to the business parties that are responsible for security of supply based on the market design (e.g. TSO). The potential contribution of an energy community to security of supply increase could be realized via arrangement of long-term peak and non-peak generation capacity.

In this role, the energy community is responsible for the operation and management of a Virtual Power Plant comprising all available energy resources available to the community, including buildings, district DERs, etc.

The Figure below shows the ACCEPT Use Cases associated to BC1.

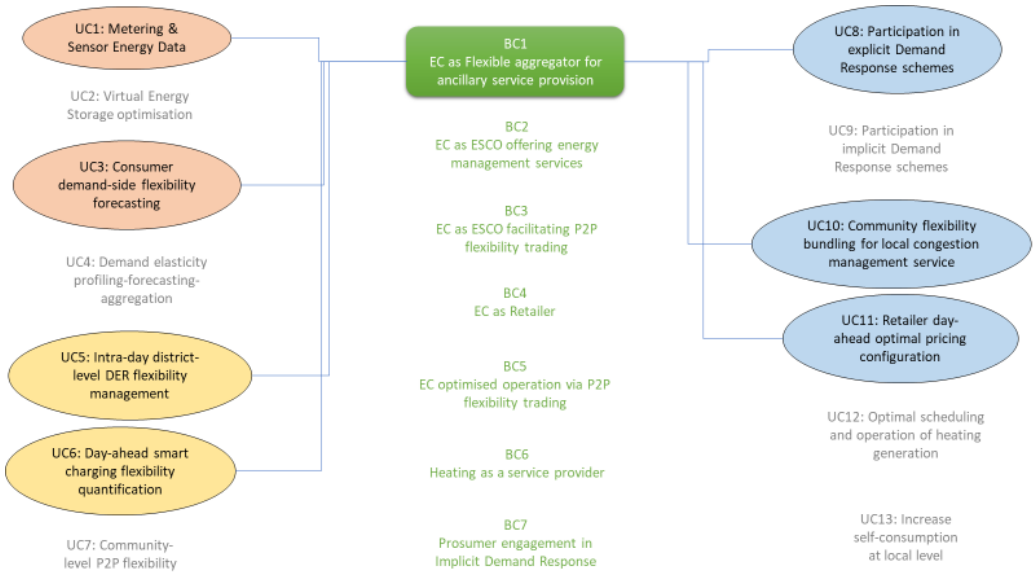


Figure 4.3. ACCEPT Use Cases associated to BC1

Within ACCEPT's Project, the service offering of BC1 could include Flexibility-related and Explicit Demand Response services that allow for the validation of green production and for making available green energy when it is needed, thus implying a reduction of network costs. These services, in association with the obtained flexibility from end-users, could be offered to DSO and TSO that qualify as potential target clients. In particular, the role of TSO and/or DSO would be to send the signals in order to start Demand Response actions and to cooperate with the Energy Community in flexible use of their assets. Other actors potentially involved in BC1 are the Pilot Manager, that establishes relationship with the end-users and gather flexibility from them, the Technical Manager that implements the necessary equipment to the local community and to the residential users so that the described energy services could be offered and, finally, the end-users that adjust their production and consumption, thus providing flexibility in exchange of a benefit. In particular, knowing the available flexibility would result into energy and economic savings for end-users. A potential action to achieve this objective consists in quantifying the amount of flexibility that could be achieved by testing the reactions from end-users after sending a signal from a "Virtual DSO".
By offering the envisaged services it would also be possible to familiarize end-users with Demand Response Schemes, therefore supporting green energy production and direct consumptions. To reach this aim, a constant communication between end-users and the Pilot and/or Technical manager would be necessary.
Technological, economic, legislative inputs would be required to offer the conceived services and to create value through them. For BC1 possible key resources are legal reforms that allow small consumers to participate in the market through aggregation, technological solutions suitable to manage and measure the amount of flexibility by the acquisition of data on the end-user's production/consumption decisions and changes in their energy profile, smart devices that control appliances, licenses. Table 4.4 summarizes the main elements that characterize BC1 illustrated so far.

Table 4.4. Potential key elements of BC1

Services	Actors and their roles	Objectives	Inputs
Flexibility-related and Explicit Demand Response services (ideally automated). Examples are: Validation of green production Availability of green energy when needed Network cost reductions	TSO/DSO: sends the signals to start DR actions. Pilot Manager: establishes relationship with the end-users. Gather flexibility from multiple end-users. Technical Manager: implements the necessary equipment to the local community and residential users End-user: provide flexibility in exchange of a benefit	Support Green energy production and direct consumption Learn the achievable amount of flexibility Familiarize end-users with DR Schemes	Legal reform to allow/facilitate small consumers enter the market Technological solutions capable to quantify the amount of flexibility Smart devices to manage appliances Licenses

The described services might bring important benefits to the Energy Community members: to the DSO for constraint management, to the TSO for constraint management and to maintain the system balance and, to the Prosumer, as the economic value of demand-side flexibility will partly flow back to the Prosumer as an incentive to shift load and/or generation in time.
To summarize, the main benefits of the services that could be offered within BC1 take the form of economic incentives to the DSO, TSO and end-users, they reflect in an increased degree of prosumer engagement in the energy system, in lower costs, in the opportunity to manage shared assets and, from a point of view external to the EC, the DSO and/or TSO would have the opportunity to gather information on the existing flexibility of dwellings.

Concerning obstacles and barriers to BC1 implementation, they have been analyzed according to the priority level to mitigate them for BC1 to be fully implemented, distinguishing between High, Medium and Low priority. Starting from the analysis of barriers identified as "High Priority", within the category *Regulatory and Legislative* the Interaction with DSO could constitute an obstacle in that the above-mentioned services of BC1 could be tested by means of a Virtual DSO and also because grid-based storage is taxable. The absence of already developed markets, the non-existence of a pricing system for local congestion and the fact that sustainable business models that favor both the citizens and the DSO are still not identified, represent the most relevant barriers of the *Economic and Market* category. Among the *Technical* barriers, removing obstacles around the enabling technologies and around Demand Side Response is a high priority. With reference to the former, the obstacles regard the communication between the solutions that will be developed in ACCEPT, the smart meters and the DSO. During the Project, a Virtual DSO could solve this issue in the testing phase. Relative to the obstacles around Demand Side Response, it is important to increase the level of automation and to understand to what extent the devices must be controlled for Demand Response to be efficient. Additionally, end-users might be skeptical in transferring the control to a software. Finally, the lack of awareness and knowledge is the *Social* barrier that present the highest level of priority. Indeed, citizens are still not fully aware of the energy transition and the challenges it entails for existing infrastructure and how disruptive it can be for business as usual. Consequently, it is crucial to invest time and resources so that citizens can deeply understand the value of such solutions and their new responsibilities.
Coming to those barriers regarded as "Medium Priority", they pertain to the *Technical* category relatively to Lack of ICT tools, in that there is the need of ICT tools that enable the communication of consumption, flexibility assets, and PV production between the Energy Community/Aggregator system and the DSO, and to Cybersecurity and privacy aspects (GDPR compliance). Within the *Economic and Market* category, capital costs represent an obstacle of medium importance since they are covered by the ACCEPT Project and in absence of which they would instead represent a more important barrier. Notice that, due to the energy-money exchange that BC1 envisages, an extra benefit for both prosumer and consumer will be obtained, but other sources of revenues should be envisaged for physical capital (infrastructures and technologies) to be maintained.

Grid issue (*Technical*), Negative perceptions and Network and supply security (*Social*), and Lack of support from expert organizations (*Organizational*) do not represent relevant barriers and, therefore, they have been identified as Low priority. Table 4.5 summarizes what discussed so far.

Table 4.5. Obstacles and barriers to BC1 implementation, by priority

Priority	Regulatory and Legislative	Economic and Market	Technical	Social	Organizational
High	Interaction with DSO	No markets (remuneration) for provision of services to grid operators Absence of suitable business models	Obstacles around enabling technologies Obstacles around demand side response	Lack of awareness and knowledge	
Medium		High capital costs	Lack of ICT tools Cybersecurity and privacy aspects		
Low			Grid Issue	Negative perceptions Network and supply security	Lack of support from expert organizations

In addition to what already illustrated, the barriers not included in Table 4.6 among those listed in Table 4.3 have a different degree of priority according to the Pilot Site in which BC1 will be tested. The Pilot Sites involved in BC1 are LaSolar and ESR.

Table 4.6. Pilot Site specific obstacle and barriers to BC1 implementation, by priority

Category of obstacles	Short Description of obstacles	LaSolar	ESR
Regulatory and Legislative	Definition of energy community	H	L
	Interactions with citizens	H	L
	Unstable regulatory framework	H	L
	Legal constraints (e.g. consumer participation)	H	L
Economic and Market	Absence of financial incentives	M	H
	Lacking efficient remuneration schemes	M	H
Technical	Limited available flexibility	H	M
Social	Behavioral barriers	M	H

As shown in the table above, differences arise in almost all the identified obstacles in the category *Regulatory and Legislative* which, contrary to the Dutch Pilot Site (ESR), they are a high priority barrier for the Spanish Pilot Site (LaSolar). In particular, a critical issue of the Spanish regulatory framework relates to the definition of energy communities because the Royal Decree Law 23/2020 of 23 June 2020 introduced the energy communities as entities, but these figures are not yet recognized. The interaction with citizens appears as crucial. Since one of the most important and challenging steps is to attract and engage the end users in the Project, an active communication with all the members of the community can mitigate this barrier. Other aspects that act as obstacles refer to the GDPR compliance and to the Demand Response mechanisms that, for small consumers, are not yet fully integrated within the regulatory framework (for further details on the Spanish regulatory framework refer also to Chapter 2). As can be seen from Table 4.6, a different level of priority is also assigned to the limited available flexibility, which belongs to the category of the *Technical* barriers. Given that incentives and remunerations depend heavily on the available flexibility and, consequently many small consumers are needed to be aggregated, and since aggregation

has started to be developed but it is not yet fully implemented, the limited available flexibility represents a High priority barrier for the Spanish Pilot Site.
Regarding *Economic and Market* barriers, the priority of absence of financial incentives and efficient remuneration schemes varies from high to medium. The main reason is that Demand Response actions depends largely on financial incentives to change consumption patterns and currently there are no existing compensation mechanisms for these actions. However, it is expected that the acceptance by Energy Community members to participate in the Project will not depend on these incentives as much as it might be for people outside the community. These differences on priorities translates into a different degree of applicability of BC1 in the two Pilot Sites.

Barriers' analysis and applicability of BC1 to LaSolar
From the analysis of obstacles and barriers it turns out that, according to the Spanish Pilot Site

- the 52% of the considered barriers are a high priority
- barriers perceived as a medium priority are the 29%
- the 19% of the barriers are considered a low priority

Figure 4.4 shows how many barriers (in percentage values) are High, Medium and Low priority to implement BC1 in LaSolar.

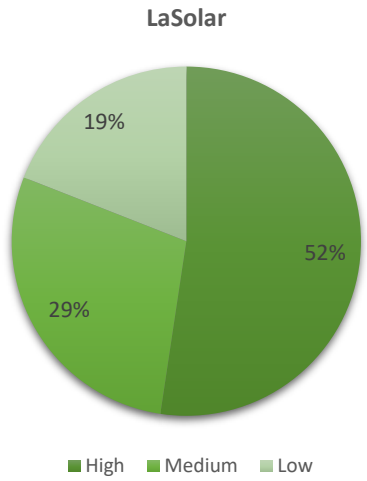


Figure 4.4. Levels of BC1 implementation barriers LaSolar

For what concerns the distribution of priorities among the five main categories of barriers here identified, Figure 4.5 how many obstacles fall in each them. It can be noticed that:

- the barriers in the *Regulatory and Legislative* category are all high priority
- in the *Economic and Market* category two are high priority (No markets for provision of services to grid operators and Absence of suitable business models) and three are medium priority (High capital costs, Absence of financial incentives, Lacking efficient remuneration schemes)
- *within the Technical* category three barriers are considered as high priority (Limited available flexibility, Obstacles around enabling technologies and Obstacles around demand side response), two are medium (Lack of ICT tools and Cybersecurity and privacy aspects), while Grid issue does not constitute an obstacle (Low priority)
- in the *Social* category all the barriers are Low priority, apart from Lack of awareness and knowledge (High) and Behavioral barriers (Medium)
- Organizational barriers are considered as Low priority in that they do not represent an obstacle

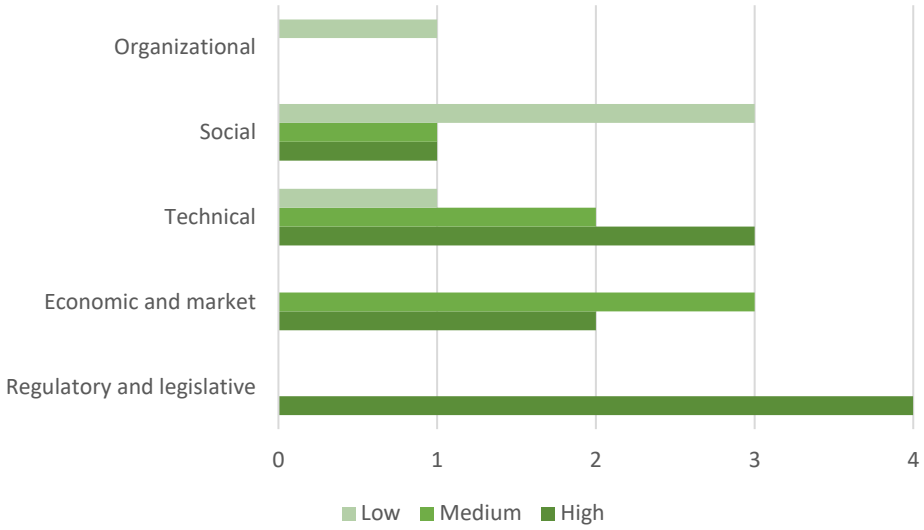


Figure 4.5. Number of obstacles for BC1 implementation in LaSolar

Barriers' analysis and applicability of BC1 to ESR

From the analysis of obstacles and barriers it emerges that, according to the Dutch Pilot Site

- the 43% of the considered barriers are a high priority
- barriers perceived as a medium priority are the 19%
- the 38% of the barriers are considered a low priority

Figure 4.6 shows how many barriers (in percentage values) are High, Medium and Low priority to implement BC1 in ESR.

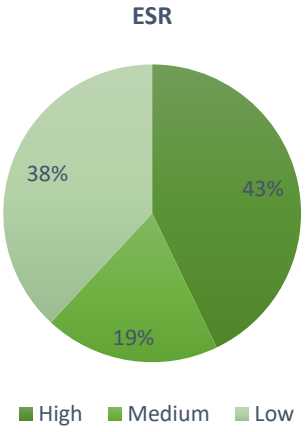


Figure 4.6. Levels of BC1 implementation barriers ESR

Regarding the distribution of priorities among the five main categories of barriers here identified, from Figure 4.7 it can be noticed that:

- all the barriers in the *Regulatory and Legislative* category are low priority, apart from the Interaction with DSO (high priority);
- in the *Economic and Market* category they are all high priority (Absence of financial incentives, Lacking efficient remuneration schemes, No markets for provision of services to grid operators and Absence of suitable business models) except for High capital costs (medium priority);

- *within the Technical* category two barriers are considered as high priority (Obstacles around enabling technologies and Obstacles around demand side response), three are medium (Limited available flexibility, Lack of ICT tools and Cybersecurity and privacy aspects), and two are low (Grid issue);
- in the *Social* category two barriers are high priority (Lack of awareness and knowledge and Behavioral barriers) and two are low (Negative perceptions and Network and supply security);
- *Organizational* barriers are considered as Low priority in that they do not represent an obstacle.

It is worth mentioning that, among the actors involved in this business case, the project partner Energie Samen Projectbureau is already active as aggregator at the FLEX-market and, therefore, it can provide expertise and project capacity to overcome the obstacles just discussed.

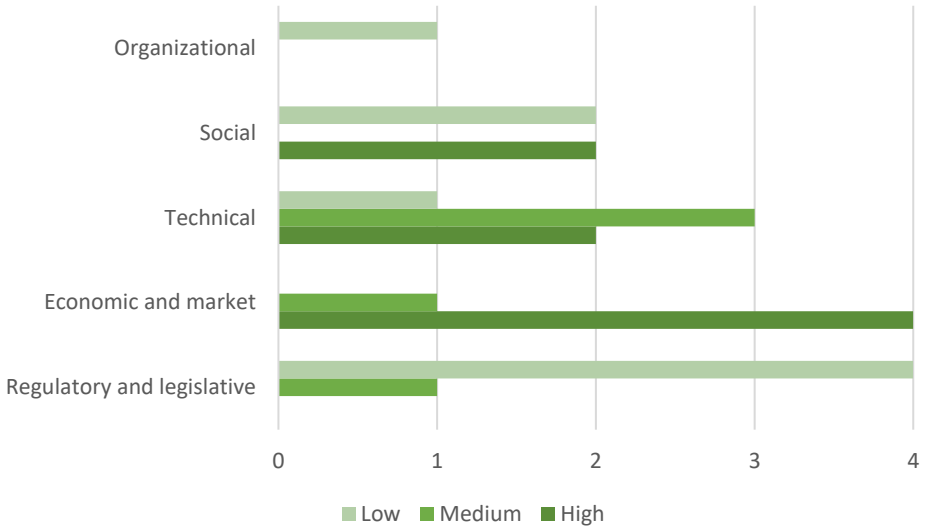


Figure 4.7. Number of obstacles for BC7 implementation in ESR

Comparing the two Pilot Sites and considering all the 21 barriers listed in Table 4.3 contemporaneously, it emerges that:

- the 52% of the considered barriers are a high priority for the Spanish Pilot Site against the 43% of the Dutch Pilot;
- low priority barriers represent the 38% of the total for the Dutch Pilot Site against the 19% for the Spanish Pilot;
- barriers perceived as a medium priority are the 29% for the Spanish Pilot Site and the 19% for the Dutch Pilot.

Given the higher number of low priorities barriers for the Dutch Pilot Site with respect to the Spanish one, and considering that the sum of High and Medium barriers represents the 81% for the Spanish Pilot Site and the 62% for the Dutch Pilot Site, from this analysis it turns out that BC1 seems to be easier to be implemented in the Netherlands than in Spain. In spite of that, BC1 is applicable in the Spanish Pilot Site and the several mitigation actions indicated by LaSolar, such as the use of a virtual DSO to overcome the interaction with DSO barrier or the investment in end-user education to mitigate social barriers, and which could be undertaken within ACCEPT Project, could potentially further increase the degree of applicability.

4.3. BC2: *Energy Community as an Energy Service Company (ESCO) offering energy management services*

Energy Community as an Energy Service Company (ESCO) offering energy management services to community members, such as energy awareness and self-balancing on community level.

Pilot Responsible Partner Involved:

- *LaSolar*
- *Mytilineos*
- *ESR*
- *AEM*

A community as an ESCO provides "energy awareness" services to the individual prosumers. This is the cornerstone concept of a CEC (Citizen Energy Community). The energy-related services that communities initially offer to their members are typically related to exploring the potential of DERs e.g. focusing on the joint purchase and maintenance of (shared) assets. It may be, though, that the first step is a simple focus on increasing energy awareness e.g. by providing energy diagnosis, energy consumption monitoring or by stimulating knowledge acquisition and exchange through dedicated workshops and training programs. Both improved energy awareness and social peer pressure help stimulate energy savings (thereby increasing energy efficiency). In the USEF role model it is typically the ESCo that offers such services to (individual) Prosumers. Hence, when a community offers such services to its members, it is interpreted as the community assuming the role of an ESCo. In terms of energy management services, the main objective is community-level self-management to optimize either intracommunity energy flows or energy/ancillary service offering to markets [1].

Figure 4.8 shows the ACCEPT Use Cases associated to BC2.

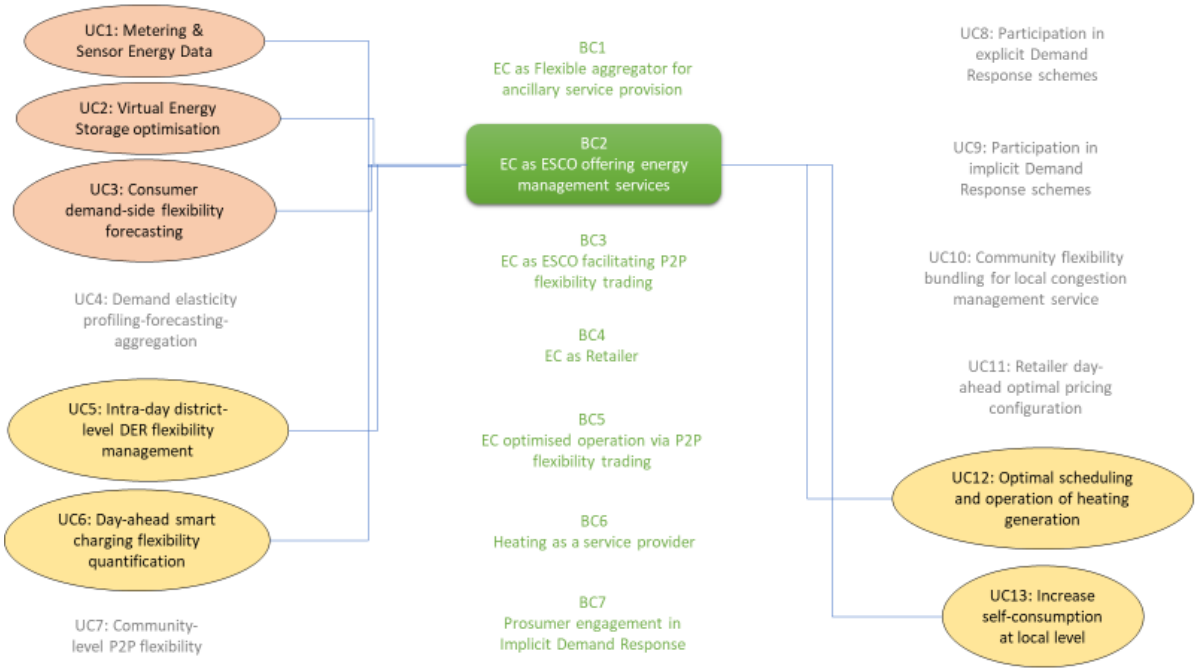


Figure 4.8. ACCEPT Use Cases associated to BC2

The service offering of BC2 could include energy services inherent to energy efficiency and reduction of costs, in association with energy supply. These energy services would ideally be automated, and based on the profiling of the selected users, thus preserving their comfort preferences. In case automated services could not be offered, an alternative would be represented by notification-based services to be offered directly to the individuals to guide the

behavioral changes of their energy patterns. Table 4.7 contains a rather exhaustive and detailed list of potential services that can characterize BC2 which are common to all the pilots.

Table 4.7. Potential services of BC2

Services
Energy community creation by means of an association (e.g. for shared assets and investments)
Energy awareness with real-time consumption/production monitoring
Benchmarking against EC consumption (e.g. top 5%) Alert system when consumption is abnormal
Analysis of consumption patterns and tailored advice on how to reduce consumption (e.g. freezer defrosting is necessary), also signaling of devices not working correctly or not correctly dimensioned/sized
Platform to allow users to interact with their flexibility (explicit DR)
Energy/cost forecasting in the next 24 hours by different scenarios (different flexibility setpoints)
Eventually billing and payment through the platform

To these services, other can be added on the basis of some specificities of the individual Pilot sites. It is the case of Mytilineos that is interested in offering automated or semi-automated services for the local football stadium of the community in order to manage the energy related to its lighting, and maintaining, at the same time, the comfort levels of the citizens it attracts. AEM is interested in supplying thermal energy (heating) as HaaS and in offering public parking spot rental with EV charging (for tenants), for which it would be necessary to involve the municipality that provides public facilities (e.g. public parking). ESR is, instead, mainly interested in the energy benchmarking and in particular:

1. Energy benchmarking community for heating (usage of gas and central heat pump)
2. Energy benchmarking community for electricity in the houses
3. Energy benchmarking community for electricity for mobility
4. Energy benchmarking fog generated electric energy
5. Energy benchmarking on the % of the generated energy that is consumed directly
6. Energy benchmarking individual household on the same subjects

Also for BC2 the project partner Energie Samen Projectbureau can play a significant role due to its expertise in this field. For this reason, the focus of ESR is more on benchmarking, with the expectation of becoming more and more active in this BC in the near future. The main actors involved in BC2 are building owners, which represent the decision makers in that they are the actors who opt for these services; tenants, required to accept the owner decision, they profit from the services; the ESCO and/or DSO that provides the services. To be implemented, BC2 requires technological inputs such as controlling software, analytics software, forecasting software, local weather forecasting, cloud storage, user-friendly webapp/app, interfaces with third parties (e.g. heat pumps), economic resources to be destinated for the installation of equipment and policy related inputs needed for ensuring to the community members the transparency and security of their data. By offering the envisaged services it would be possible to promote consumption of local renewable energy, to decrease energy peaks and grid stress flexibility management by the algorithm, to offer energy/cost transparency to citizens through an app that gather all real-time data and forecasts, and to educate users on their energy consumption and improvements. The implementation of BC2 might bring important benefits to the Energy Community members, in that it would allow for a reduction of energy consumption due to better usage of devices and energy bills for users, it would lead to an increase of local energy usage, it would improve energy and cost transparency and raise citizens awareness. In addition, dedicated energy services and business models related to energy trading would be created for the benefit of both the companies and the end users.

Table 4.8. Potential key elements of BC2

Actors and their roles	Objectives	Inputs	Benefits
Building owners: decision-makers that decide to participate in the EC and/or end-users that profit from services Tenants: end-users that profit from services DSO/ESCO: provide the services	Promote consumption of local renewable energy, ideally up to 90% of the produced energy that should be consumed by the EC. This could be done by an algorithm that manages the flexibilities, the district PV systems and the district battery Decrease energy peaks to decrease grid stress flexibility Offer energy/cost transparency to citizens done by an app that gather all real-time data and forecasts Educate users on their energy consumption and improvements potential done by an app that gather all real-time data and forecasts	Economic inputs regarding the equipment to be installed. Technological inputs affecting the rollout of the application used for automations and energy service provision in general. Policy related inputs ensuring to the community the overall transparency and security of their data.	Reduced energy consumption due to better usage of devices Increase of local energy usage (less grid stress) Decrease of energy bills for users Energy and cost transparency User-friendly monitoring Active and aware citizens

Table 4.9 gives an overview of the answers provided by the Pilot Sites on obstacles and barriers to BC2 implementation.

Table 4.9. Overview on Obstacles and Barriers to BC2 implementation, by Pilot and by Priority

Priority Level/ Pilot	Mytilineos	LaSolar	AEM	ESR
High Priority	1	3	4	10
Medium Priority	4	5	7	2
Low Priority	3	13	7	9

As shown by the table below, only for five of them there is a full agreement on the priority rating, that are:

- Lacking efficient remuneration schemes (Low)
- Cybersecurity and privacy aspects (Medium)
- Lack of awareness and knowledge (High)
- Network and supply security (Low)
- Lack of support from expert organizations (Low)

Apart from those seen just above, among Pilot sites answers on obstacles and barriers present a high variability, and for this reason the analysis of barriers, together with the discussion of the applicability of BC2, will be conducted separately for each Pilot Sites.

Table 4.10. Pilot Site specific obstacle and barriers to BC2 implementation, by priority

Category of obstacles	Short Description of obstacles	Mytilineos	LaSolar	AEM	ESR
Regulatory and Legislative	Definition of energy community	-	H	L	L
	Interactions with citizens	L	H	H	L
	Interactions with DSO	-	L	-	H
	Unstable regulatory framework	M	L	-	L

	Legal constraints (e.g. consumer participation)	M	M	-	L
Economic and Market	High capital costs	L	L-M	H	H
	Absence of financial incentives	L	L	M	H
	Lacking efficient remuneration schemes	-	L	L	L
	No markets (remuneration) for provision of services to grid operators	-	L	L	H
	Absence of suitable business models	-	L	H	H
Technical	Limited available flexibility	-	M	M	L
	Obstacles around enabling technologies	-	M	L	H
	Obstacles around demand side response	-	L	M	H
	Grid issue	-	L	L	H
	Lack of ICT tools	-	L	M	M
	Cybersecurity and privacy aspects	M	M	M	M
	Available Space	-	-	M	-
Social	Lack of awareness and knowledge	H	H	H	H
	Negative perceptions	M	L	L	L
	Network and supply security	-	L	L	L
	Behavioral barriers	-	M	M	H
Organizational	Lack of support from expert organizations	-	L	L	L

Barriers' analysis and applicability of BC2 to Mytilineos

The only barrier that Mytilineos identifies as high priority is the lack of awareness and knowledge (*Social* category), with respect to which a simplification of the transfer of knowledge should be made for a better involvement of end users and the minimization of drop-out rates. Due to the active communication between Mytilineos team, that also includes the Facility Management Team of the Greek Pilot Site, and the end users, interaction with citizens is labeled as low priority. The same priority is attached to capital costs and absence of financial incentives (*Economics and Market*) as well as the *Organizational* category. Most of the obstacles and barriers reported by Mytilineos fall in the medium priority rating. Specifically, within the category *Regulatory and Legislative* relevant barriers relates to GDPR issues (Legal constraints) and to the access to funding for energy communities (Unstable regulatory framework). Indeed, the lack of measures related to financial support is particularly evident in Energy Community related schemes in Greece and if this will not be an issue for test users, it could be later on with respect to the creation of business models and offering services to real end customers. Other medium priority barriers are those related to cybersecurity and privacy aspects (*Technical*) and negative perceptions (*Social*). From the analysis of obstacles and barriers to BC2 implementation, it is possible to make some considerations on the degree of applicability of this BC in the Greek pilot site. In particular, considering the barriers listed in Table 4.10, it emerges that only 8 out of 21 barriers (38%) are considered as relevant by Mytilineos, of which one is indicated as high priority (12, 5%), four are considered as medium priority (50%) and three are indicated as low priority (37, 5%), as shown by Figure 4.9.

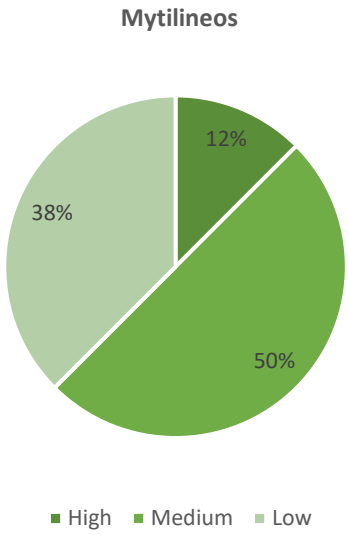


Figure 4.9. Levels of BC1 implementation barriers Mytilineos

Figure 4.10 illustrates the number of obstacles for BC2 implementation in Mytilineos, by category and by priority.

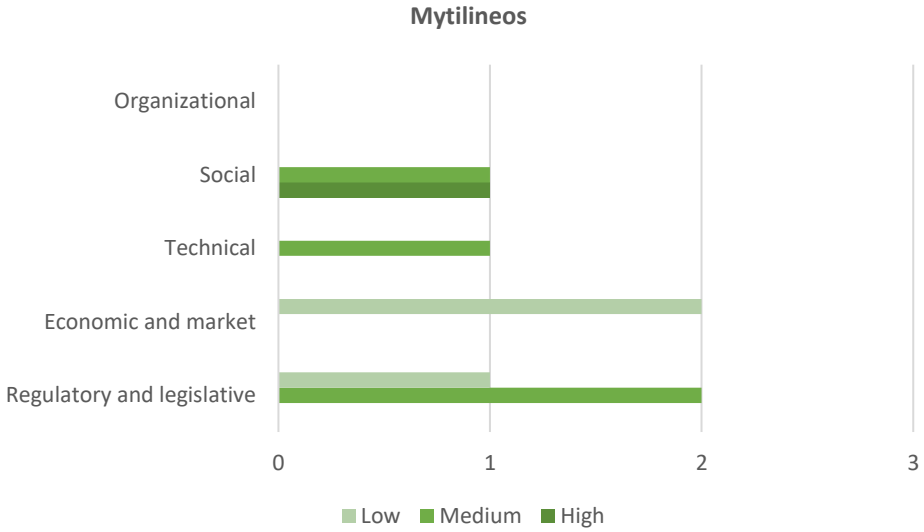


Figure 4.10 Number of obstacles for BC2 implementation in Mytilineos

In view of these considerations, BC2 can be assessed as a business case that presents a very good level of applicability in the Greek pilot site.

Barriers' analysis and applicability of BC2 to LaSolar

Within the category *Regulatory and Legislative*, as examined in BC1, definition of energy communities is still an issue in Spain where it represents a high priority barrier for LaSolar. The same priority is indicated for the interaction with citizens. In this BC there is no need to interact with the DSO or for a new regulatory framework and for this reason a low priority is indicated to these obstacles. Other aspects that act as obstacles of medium priority refer to the GDPR compliance. Regarding *Economic and Market* barriers, according to LaSolar, all the listed barriers are a low priority since ESCO market and business models already exist, installation costs are included in Project budget (Low-Medium barrier) and it is supposed that Implicit Demand Response would bring energy costs saving that, in

turn, would incentivize users. Among the *Technical* barriers, the rating ranges from low to medium priority. For what concerns obstacles around enabling technologies (Medium priority) the main problem is to calculate the savings according to a consumption baseline in order to establish compensatory mechanisms for ESCOs. Limited available flexibility is considered as an obstacle of medium importance because it would discourage end users in terms of financial reward from energy savings. The same priority is indicated for Cybersecurity and privacy aspects (GDPR compliance). As for BC1, lack of awareness and knowledge is the *Social* barrier that present the highest level of priority while behavioral barriers are considered important for the Spanish Pilot site, with a medium level of priority. From the analysis of obstacles and barriers it turns out that, according to the Spanish Pilot Site the 14% of the considered barriers are a high priority, barriers perceived as a medium priority are the 24%, the 62% of the barriers are considered a low priority (Figure 4.11).

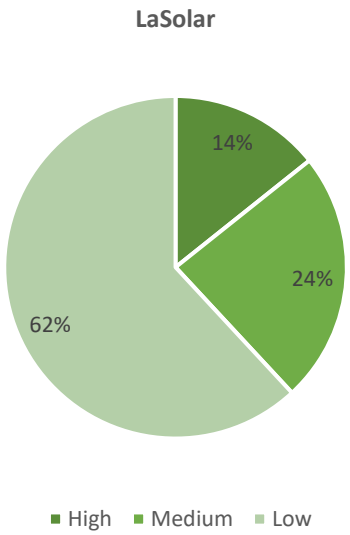


Figure 4.11. Levels of BC1 implementation barriers LaSolar

Figure 4.12 illustrates the number of obstacles for BC2 implementation in LaSolar, by category and by priority.

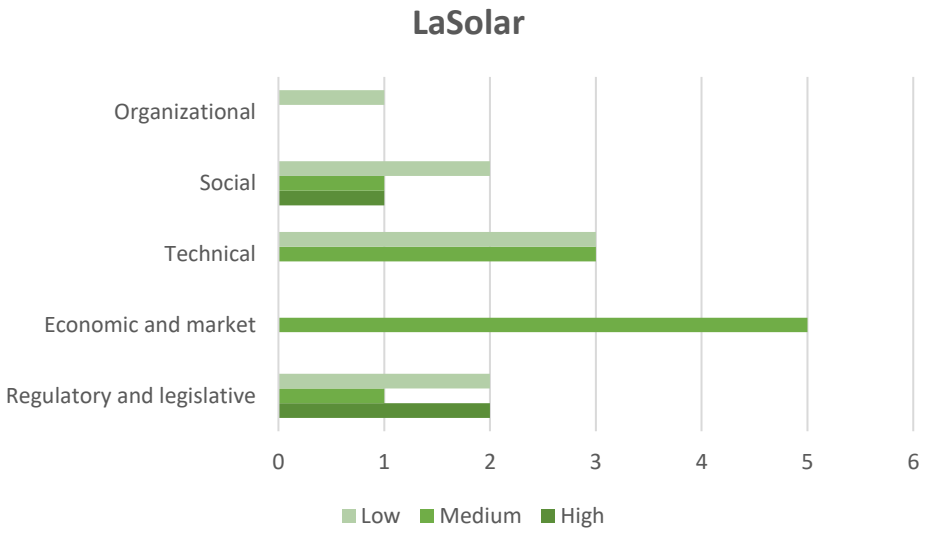


Figure 4.12. Number of obstacles for BC2 implementation in LaSolar

BC2 can be assessed as a business case that presents a good level of applicability in the Spanish pilot site.

Barriers' analysis and applicability of BC2 to ESR

Among the five main categories of barriers here identified, it can be noticed that all the barriers in the *Regulatory and Legislative* category are low priority, a part from the Interaction with DSO (high priority); in the *Economic and Market* category all are high priority (High capital costs, Absence of financial incentives, No markets for provision of services to grid operators and Absence of suitable business models) and one is low priority (Lacking efficient remuneration schemes); within the *Technical* category three barriers are considered as high priority (Obstacles around enabling technologies and Obstacles around demand side response, Grid issue), two are medium (Lack of ICT tools and Cybersecurity and privacy aspects), and one is low (Limited available flexibility); in the *Social* category two barriers are high priority (Lack of awareness and knowledge and Behavioral barriers) and two are low (Negative perceptions and Network and supply security); Organizational barriers are considered as Low priority in that they do not represent an obstacle. According to the Dutch Pilot Site the 43% of the considered barriers are a high priority, barriers perceived as a medium priority are the 9%, the 48% of the barriers are considered a low priority (Figure 4.13).

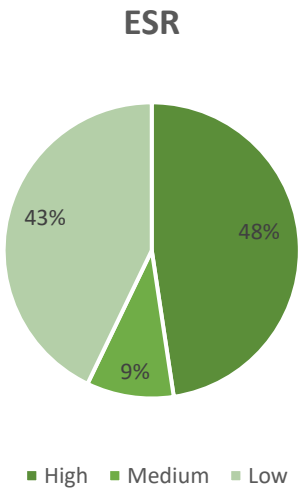


Figure 4.13. Levels of BC1 implementation barriers ESR

Figure 4.14 illustrates the number of obstacles for BC2 implementation in ESR, by category and by priority.

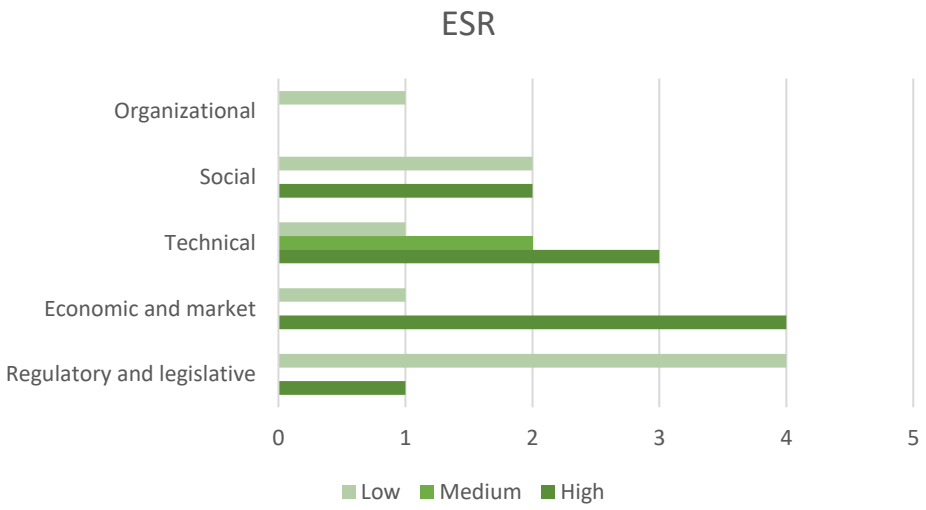


Figure 4.14. Number of obstacles for BC2 implementation in ESR

BC2 can be assessed as a business case that presents a good level of applicability in ESR.

Barriers' analysis and applicability of BC2 to AEM

AEM consider as relevant 17 out of 21 barriers of those listed in Table 4.3, plus one barrier that the Pilot site added to the list (18 barriers in total). Within the category *Regulatory and Legislative*, the interaction with DSO is not considered an obstacle in that AEM is the DSO, while the interaction with citizens represents the most important step to undergo (high priority). To mitigate the risk of low acceptance, AEM organized physical workshops and 1-1 meetings with consumers. In the future, priority will be in educating the users on the energy transition and the challenges this poses. All the other barriers in this category are labeled as a low priority. Within the *Economic and Market* category capital costs represent the only high priority barrier because ECs require batteries to increase rate of self-consumption and the battery is still very expensive and the costs cannot be transferred to the consumers. With reference to financial incentives (medium priority), in Switzerland incentives exist but, for new installations, high capital costs may arise also from auxiliary devices, such as pumps, pipings, etc. that are not covered by incentives. The absence of suitable business models is also indicated as a high priority since a sustainable business model that favors both the citizens and the DSO is still not identified. According to AEM, ideally the business model should be also able to cover the district battery costs, which are not covered by incentives. Citizen remuneration schemes can be developed after analyzing the energy consumption/production data and AEM did such an analysis already in the past (low priority). Among the *Technical* barriers, removing obstacles around the enabling technologies is the only barrier indicated as a low priority. AEM do not see any grid issue as an obstacle to BC2 implementation. All the other are medium priority to AEM, included a new barrier ***Available Space***. Solutions usually requires additional hardware, but in reality, it happens that that space is very limited (in the home cabinet there is usually not much space to install new devices) and that internet is often not available in the basements. These basics obstacles should be considered when developing new solutions. Moreover, space and power capacity for the installation of a district battery is also limited, especially in the urban residential areas. As for the majority of BCs here considered, lack of awareness and knowledge is the *Social* barrier that present the highest level of priority. Indeed, citizens are still not fully aware of the energy transition and the challenges it entails for existing infrastructure and how disruptive it can be for business as usual. Consequently, it is crucial to invest time and resources so that citizens can deeply understand the value of such solutions and their new responsibilities. Within the same category, behavioral barriers can be of medium priority and they can arise from the skepticism of end-users about solutions that control their devices. A constant and adequate information should avoid negative perceptions, and this is the reason why this is considered a low priority obstacle. To summarize the analysis of obstacles and barriers (Figure 4.15), according to the Swiss Pilot site:

- the 22% of the considered barriers are a high priority
- barriers perceived as a medium priority are the 39%
- the 39% of barriers are a low priority

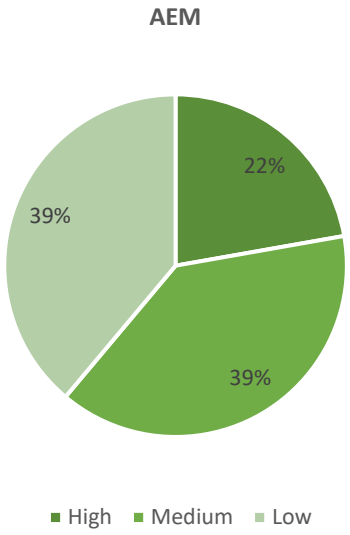


Figure 4.15. Levels of BC2 implementation barriers AEM

Figure 4.16 illustrates the number of obstacles for BC2 implementation in AEM, by category and by priority.

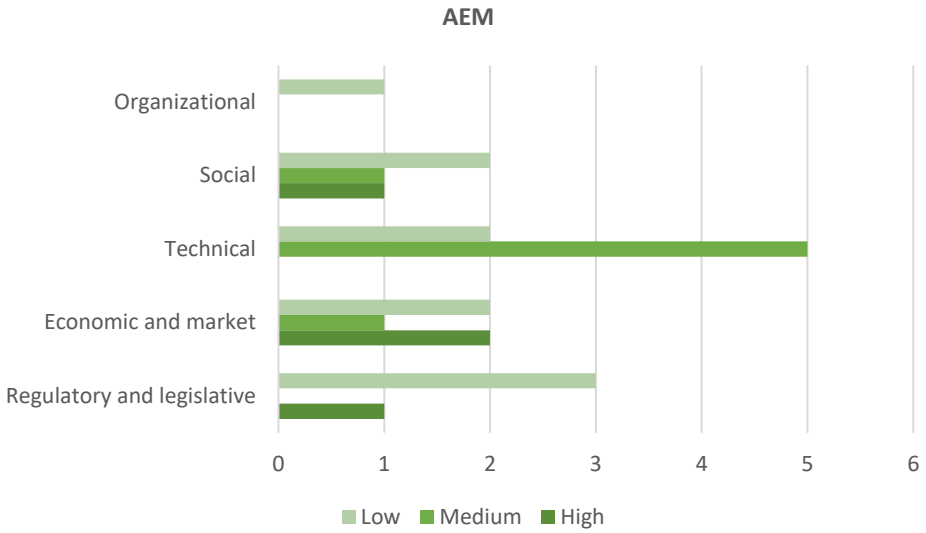


Figure 4.16. Number of obstacles for BC2 implementation in AEM

The sum of medium and low priority barriers represents, therefore, the 78% of the total and this led us to consider BC2 as a business cases that presents a very good level of applicability in AEM.

4.4. BC3: *Energy Community as an Energy Service Company (ESCO) facilitating P2P flexibility trading*

Energy Community as an Energy Service Company (ESCO) facilitating P2P flexibility trading (shadow administration).

Pilot Responsible Partner Involved:

- *Mytilineos*

The opportunity for managing community generation and supply lies in (the administrative) exchange of energy between Prosumers within the community. There is increasing demand for this approach, commonly referred to as Peer-to-Peer (P2P) supply. P2P supply clearly identifies the source of origin of the purchased energy and can therefore make Prosumers less dependent on the large-scale fossil generation units owned by Suppliers.
There are also P2P-intiatives that manage the additional administration of local generation and consumption, e.g. to stimulate the physical (real-time) use of local generation within the community itself. This is commonly referred to as shadow administration and is separate from the administration of the Supplier/Balance Responsible Party and so has no official role in the organization of the energy system. To stimulate the use of local generation, the shadow administration can be combined with the introduction of a (crypto) currency within the community. As Blockchain technology has characteristics that could fit with these developments (e.g. the distributed ledger), the technology is often used to facilitate (part of) the shadow administration. The (setup of the) administration is typically managed by the community itself in the role of an ESCo (USEF, 2019).

The Figure below shows the ACCEPT Use Cases associated to BC3.

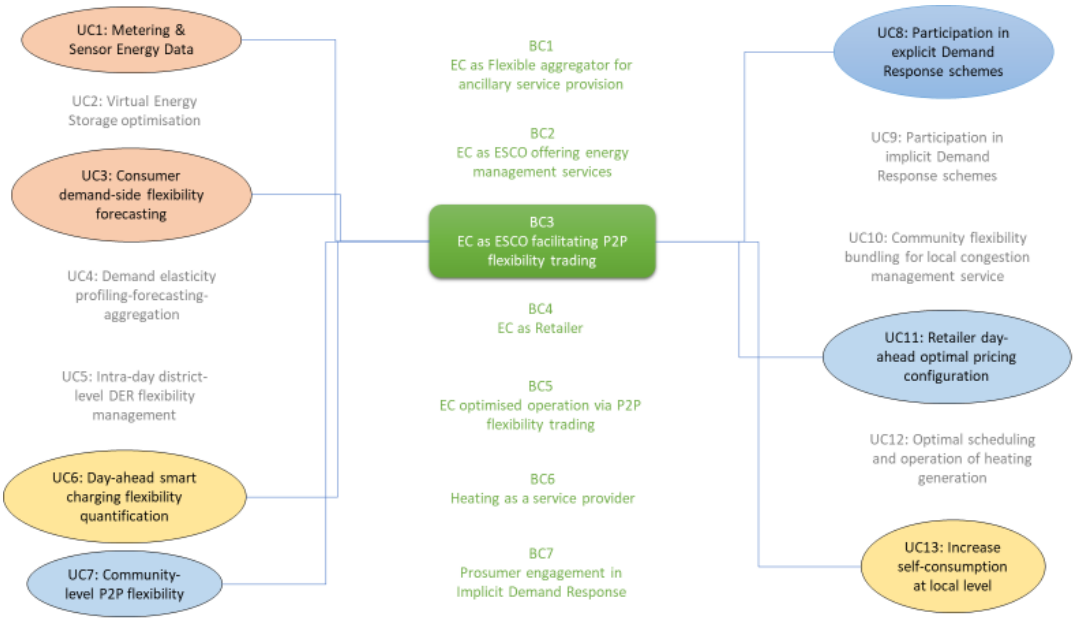


Figure 4.17. ACCEPT Use Cases associated to BC3

Within ACCEPT's Project, Aspra Spitia (Greece, Mytilineos) is the only Pilot Site in which BC3 will be tested and the services that could be offered include energy services and tools with reference to the energy availability and exchange capability among the members of the community.
Examples of services that could be provided are:

- Platform that enables exchange of energy savings: enabling trading locally and exchange in return for a new energy efficiency product that one may want to purchase.
  Services that give properly value of energy savings: valuing of energy efficiency via Blockchain, along with information and communication technologies and process automation.
- Services that help retain increased transparency: as Blockchain is a distributed ledger technology, data can be shared in a transparent manner on a secured and tamper proof platform.
- Services with increased security and customer trust: Blockchain is made secure through its cryptography processes which means that customers' energy saving data, information from financial institutions or data relating to any stakeholders in the energy efficiency market will be encrypted.

Citizens will play a crucial role in BC3, as they will be active players and testers of energy solutions and will provide inputs and feedback whenever needed. Other actors potentially involved in BC3 are the Pilot Manager, that supports the whole process and the Technical Manager that implements the necessary equipment to the local community and to the residential users so that the described energy services could be offered. In order for BC3 to be implemented, technological and policy related input would be needed. In particular, the former relates to inputs that influence the rollout of the application used for automation and the provision of energy services and the latter are required for ensuring to the community members the transparency and security of their data. BC3 would allow to rise the end user's acceptance and trust towards the related services and to familiarize them with energy trading. This, in turn would translate into benefits that, from an internal viewpoint, are inherent to the creation of dedicated energy trading services and business models that will favor both the company and end users and, from a perspective external to the community, would result into a better Energy Load Optimization, especially thanks to insights of the end-users. Table 4.11 summarizes the main elements that characterize BC3.

Table 4.11. Potential key elements of BC3

Services	Actors and their roles	Objectives	Inputs	Benefits
Platform that enables exchange of energy savings	Citizens: provide inputs and feedback whenever needed.	Raise of end customer's acceptance and	Technological inputs that influence the rollout of the	Company point of view: creation of dedicated energy

Services that give properly value of energy savings Services that help retain increased transparency Services with increased security and customer trust	Technical Manager: implements the necessary equipment to the local community and residential users. Pilot Site ~~(Mytilineos):~~ supports the process by obtaining insights and providing support whenever necessary.	trust towards related services. Familiarize end-users with energy trading.	application used for automation and the provision of energy services. Policy related inputs that ensure to the community members the transparency and security of their data.	trading services and business models that will benefit both the company and end users. External perspective: better Energy Load Optimization with insights from the end customers perspective.

Barriers' analysis and applicability of BC3 to Mytilineos

For what concerns obstacles and barriers to BC3 implementation, the only one that Mytilineos identifies as high priority is the lack of awareness and knowledge (*Social* category), with respect to which a simplification of the transfer of knowledge should be made for a better involvement of end users and the minimization of drop-out rates. Due to the active communication between Mytilineos team, that includes also the Facility Management Team of the Greek Pilot Site, and the end users, interaction with citizens is labeled as low priority and it is the only barrier indicated with this rating. No barrier belonging to *Economics and Market* and *Organizational* categories is perceived as relevant, while most of the obstacles and barriers reported by Mytilineos fall in the medium priority rating. Specifically, within the category *Regulatory and Legislative* relevant barriers relates to GDPR issues (Legal constraints) and to the access to funding for energy communities. Indeed, the lack of measures related to financial support is particularly evident in Energy Community related schemes in Greece and if this won't be an issue for test users, it could be later on, with respect to the creation of business models and offering services to real end customers. Other medium priority barriers are those related to cybersecurity and privacy aspects (*Technical*) and negative perceptions (*Social*). Table 4.12 summarizes the main points illustrated so far.

Table 4.12. Obstacles and barriers to BC3 implementation, by priority

Priority	Regulatory and Legislative	Technical	Social
High	\	\	Lack of awareness and knowledge
Medium	Legal constraints Unstable regulatory framework	Cybersecurity and privacy aspects	Negative perceptions
Low	Interactions with citizens	\	\

From the analysis of obstacles and barriers to BC3 implementation, it is possible to make some considerations on the degree of applicability of this BC in the Greek pilot site. In particular, considering the barriers listed in Table 4.3, it emerges that only 6 out of 21 barriers (29%) are considered as relevant by Mytilineos of which:

- One is indicated as high priority (16,67%)
- Four are considered as medium priority (67%)
- One is indicated as low priority (16,67%)

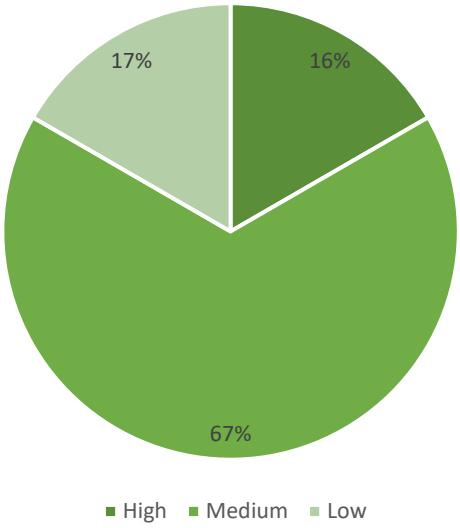


Figure 4.18. Levels of BC3 implementation barriers Mytilineos

Figure 4.19 illustrates the number of obstacles for BC3 implementation in Mytilineos, by category and by priority.

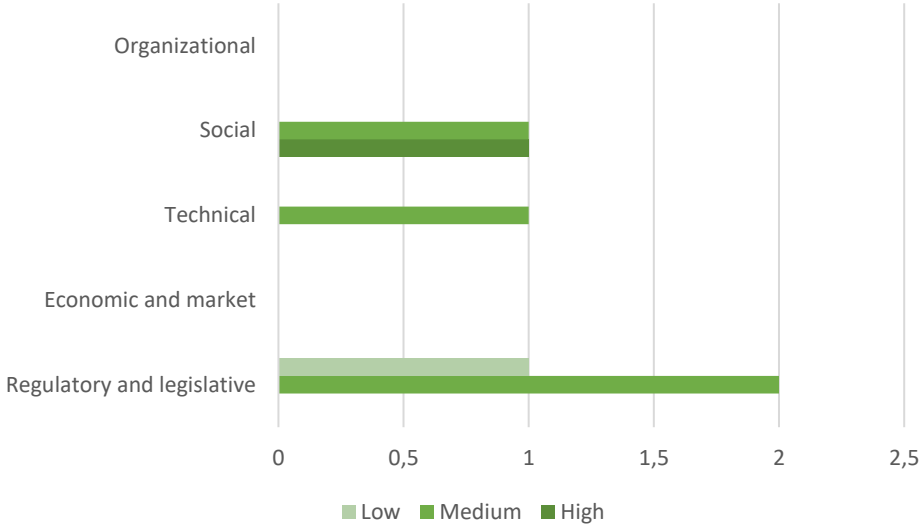


Figure 4.19. Number of obstacles for BC3 implementation in Mytilineos

In view of these considerations, BC3 can be assessed as a business case that presents a good level of applicability in the Greek pilot site.

4.5. BC4: *Energy Community as a Retailer*

Energy Community as a Retailer supplying the community members with energy models and potentially participate in the wholesale market the locally aggregated energy surplus.

Pilot Responsible Partner Involved:

- *LaSolar*
- *Mytilineos*
- *ESR*

- *AEM*

Energy retailing emerges for communities owning share renewable generation assets. The community supplies locally produced energy to its own members and substitute the third-party retailer. Beyond the intra-community energy/flexibility exchange, the aggregated expected surplus or deficit of energy can be managed centrally and valorized through bilateral contracts with third-party retailers or through direct participation in the wholesale market. In the first case, the community becomes an ESCO as described above. In the latter, it becomes a retailer and outsources the balancing responsibility to a centralized party.

The Figure below shows the ACCEPT Use Cases associated to BC4.

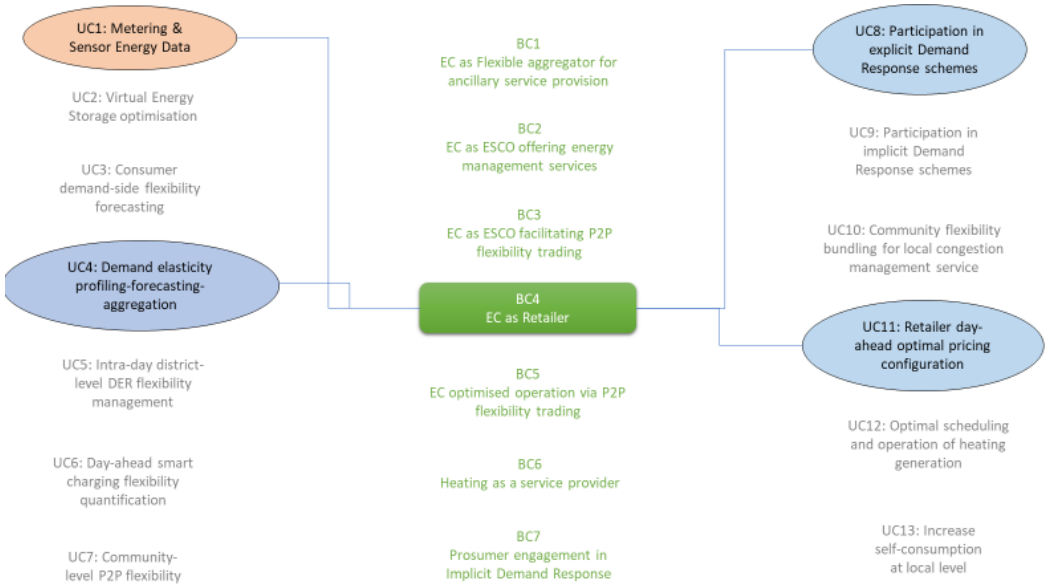


Figure 4.20. ACCEPT Use Cases associated to BC4

In addition to the services examined in BC2, BC4 could include Demand Response dedicated energy services that enable the community to participate actively in the wholesale market. In particular, the service offering can contemplate energy/flexibility market prices indications in real time through an app, advice, and planning on when to sell/buy electricity and flexibility in order to save money based on demand/production and market and earnings forecasts. The implementation of BC4 could permit to simplify the energy trading, to arise end-customer's acceptance and trust towards related services, to familiarize end-users with Demand Response Schemes, and to increase long term energy trading and economic forecasts. Actors, inputs and benefits of BC4 coincide with those of BC2.

Table 4.13. Potential key elements of BC4

Services	Actors and their roles	Objectives	Inputs	Benefits
Energy/flexibility market prices indication in real time within the app Advice and planning on when to sell/buy electricity and flexibility to save money based on demand/production	Building owners: decision-makers that decide to participate in the EC and/or end-users that profit from services Tenants: end-users that profit from services DSO/ESCO: provide the services	Simplification in energy trading. Raise end customer's acceptance and trust towards related services. Familiarize end users with	Economic inputs regarding the equipment to be installed. Technological inputs affecting the rollout of the application used for automations and energy service provision in general.	Reduced energy consumption due to better usage of devices Increase of local energy usage (less grid stress) Decrease of energy bills for users

and market forecasts Earning forecasting based on adopted strategy	Energy retailer: energy balancing role	Demand Response Schemes. Increase long term energy trading and economic forecasts.	Policy related inputs ensuring to the community the overall transparency and security of their data. Market information	Energy and cost transparency User-friendly monitoring Active and aware citizens

Table 4.14 gives an overview of the answers provided by the Pilot Sites on obstacles and barriers to BC4 implementation.

Table 4.14. Overview on Obstacles and Barriers to BC4 implementation, by Pilot and by Priority

Priority level/Pilot	Mytilineos	LaSolar	AEM	ESR
High Priority	1	6	4	10
Medium Priority	4	10	7	2
Low Priority	3	5	7	9

As for BC2, among Pilot sites answers on obstacles and barriers present a high variability, and only for four of them there is a full agreement on the priority rating, that are:

- Cybersecurity and privacy aspects (Medium)
- Lack of awareness and knowledge (High)
- Network and supply security (Low)
- Lack of support from expert organizations (Low)

For this reason, the analysis of barriers, together with the discussion of the applicability of BC4, will be conducted separately for each Pilot Sites.

Table 4.15. Pilot Site specific obstacle and barriers to BC4 implementation, by priority

Category of obstacles	Short Description of obstacles	Mytilineos	LaSolar	AEM	ESR
Regulatory and Legislative	Definition of energy community	-	H	L	L
	Interactions with citizens	L	H	H	L
	Interactions with DSO	-	M	-	H
	Unstable regulatory framework	M	H	-	L
	Legal constraints (e.g. consumer participation)	M	H	-	L
Economic and Market	High capital costs	L	L-M	H	H
	Absence of financial incentives	L	M	M	H
	Lacking efficient remuneration schemes	-	M	L	L
	No markets (remuneration) for provision of services to grid operators	-	H	L	H
	Absence of suitable business models	-	M	H	H
Technical	Limited available flexibility	-	M	M	L

	Obstacles around enabling technologies	-	M	L	H
	Obstacles around demand side response	-	M	M	H
	Grid issue	-	L	L	H
	Lack of ICT tools	-	M	M	M
	Cybersecurity and privacy aspects	M	M	M	M
	Available Space	-	-	M	-
Social	Lack of awareness and knowledge	H	H	H	H
	Negative perceptions	M	L	L	L
	Network and supply security	-	L	L	L
	Behavioral barriers	-	M	M	H
Organizational	Lack of support from expert organizations	-	L	L	L

The barriers analysis and the related considerations on the applicability of BC4 are the same as BC2 for all Pilot Sites, apart from LaSolar.

Barriers' analysis and applicability of BC4 to LaSolar

As for BC1, within the category *Regulatory and Legislative*, except for the interaction with DSO (indicated as medium priority), all the barriers are high priority for LaSolar. In this BC, future interactions with the DSO could be studied once analyzed the results of the demonstration activities and for this reason a medium priority is indicated to these obstacles. Other aspects that act as obstacles of medium priority refer to the GDPR compliance. Within the *Economic and Market* category, since P2P flexibility trading is not yet developed, the absence of markets acts as a high priority obstacle. Capital costs represent an obstacle of low-medium importance since they are covered by the ACCEPT Project (notice that in absence of ACCEPT they would instead represent a more important barrier). Medium priority is attached to the aspects related to financial incentives and remuneration schemes because Demand Response actions depends largely on financial incentives to change consumption patterns and currently there are no existing compensation mechanisms for these actions. However, it is expected that the acceptance by Energy Community members to participate in the Project will not depend on these incentives as much as it might be for people outside the community. All the *Technical* barriers are indicated as medium priority, except for grid issue (low priority). Limited available flexibility is considered as an obstacle of medium importance because it would discourage end users in terms of financial reward from energy savings. For what concerns obstacles around enabling technologies, here difficulties relate to the communication between ACCEPT solution and smart meters. Relative to the obstacles around Demand Side Response, it is important to increase the level of automation and to understand to what extent the devices must be controlled for Demand Response to be efficient. Additionally, end-users might be skeptical in transferring the control to a software. Relatively to Lack of ICT tools, there is the need of ICT tools that enable the communication of consumption, flexibility assets, and PV production between the Energy Community/Aggregator system and the DSO. Cybersecurity and privacy aspects relate to GDPR compliance.

For the same reasons examined in BC1, Lack of awareness and knowledge is the *Social* barrier that present the highest level of priority. Grid issue (*Technical*), Negative perceptions and Network and supply security (*Social*), and Lack of support from expert organizations (*Organizational*) do not represent relevant barriers and, therefore, they have been identified as Low priority.

From the analysis of obstacles and barriers it turns out that, according to the Spanish Pilot Site the 29% of the considered barriers are a high priority, barriers perceived as a medium priority are the 48%, the 24% of the barriers are considered a low priority (Figure 4.21).

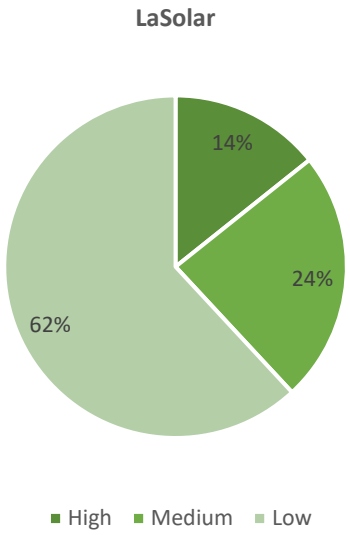


Figure 4.21. Levels of BC4 implementation barriers LaSolar

Figure 4.22 illustrates the number of obstacles for BC4 implementation in LaSolar, by category and by priority.

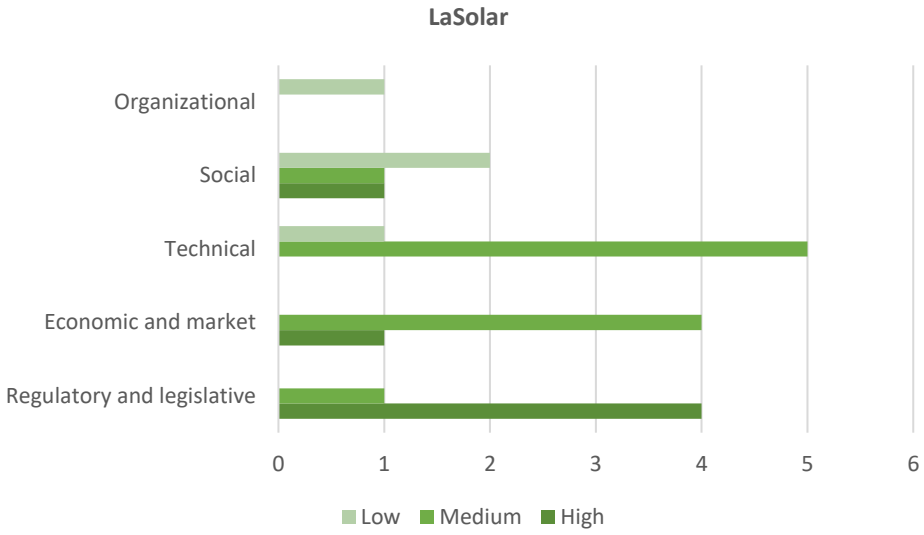


Figure 4.22. Number of obstacles for BC4 implementation in LaSolar

Low and medium priority represent the 71% of obstacles and barriers to BC4 implementation, that can be thus assessed as a business case that presents a good level of applicability in the Spanish pilot site.

4.6. BC5: *Energy Community optimized operation via P2P flexibility trading*

Energy Community optimized operation via P2P flexibility trading based on locally produced energy.

Pilot Responsible Partner Involved:

- *LaSolar*

Trading based on P2P models makes renewable energy more accessible, empowers consumers and allows them to make better use of their energy resources. P2P trading allows participants to support their local communities by enabling them to consume renewable power and earn more from their distributed generation, with or without

storage systems. At the same time consumers without renewable generation capacity can benefit directly from local renewable generation through P2P electricity trading.
In particular, P2P flexibility trading offers a new strategy for integrating prosumers into electricity markets, while providing transparency, autonomy and scalability. The extension of communications and automation to the individual consumer level opens the possibility for P2P platforms that enable prosumers to negotiate energy transactions directly with one another, and with upstream electricity market participants. P2P energy trading can also be used to help manage local demand constraints. In this particular case, the exchange of energy is managed directly by the energy community itself organizing a local P2P flexibility market. The proposed P2P market design allows the prosumers to negotiate local flexibility transactions with other prosumers, based on their individual preferences and energy requirements.

The Figure below shows the ACCEPT Use Cases associated to BC5.

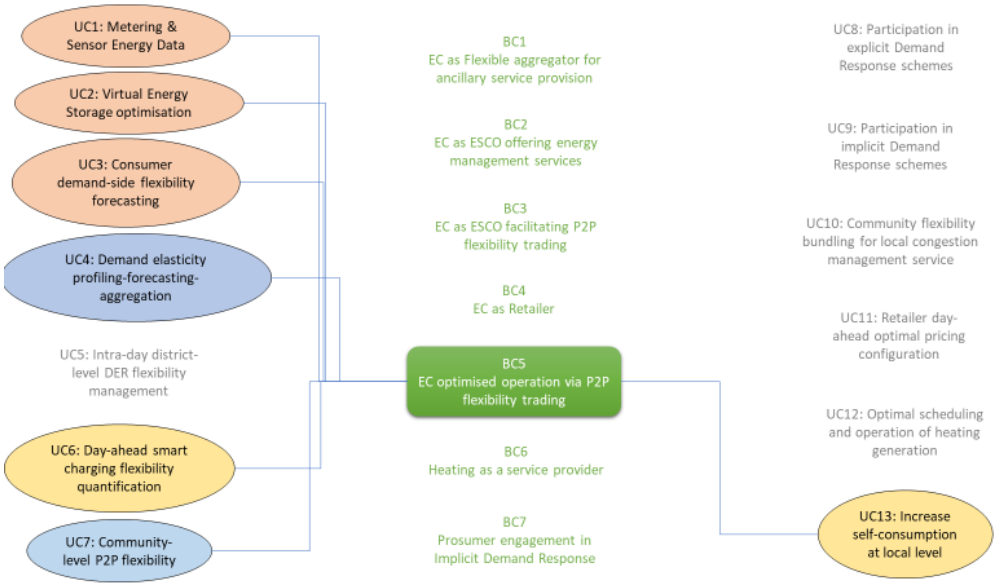


Figure 4.23. ACCEPT Use Cases associated to BC5

Within ACCEPT's Project, LaSolar (Spain) is the only Pilot Site in which BC5 will be tested and the envisaged services can be classified into i. Information services and ii. Demand Response services. Information services include monitoring and follow-up of production and consumption of prosumers and consumers and the real time monitoring and forecasting energy of energy exchanges among prosumers and/or consumers. Demand Response services include services relating to energy exchanges, market price and final money exchanges.
The main actors involved in BC5 are the Energy Community manager who takes care of the general configuration and daily management, the Technical manager that provide and install the necessary equipment and manage troubleshooting, and the end-users that provide and/or use the flexibility within the community. To be implemented, BC5 requires technological inputs that influence the rollout of the application used for automation and the provision of energy services, economic resources to be destinated for the installation of equipment and policy related inputs needed for ensuring to the community members the transparency and security of their data. BC5 would allow to rise the end user's acceptance and trust towards the related services and to familiarize them with energy trading. To reach these objectives it would be ideal to have easy-to-use and effective tools for community operator and users, along with a good support from PS leader and technical manager. The implementation of BC5 would represent a large step towards the realization of sustainable communities. Other benefits that could come from BC5 are the creation of dedicated energy trading services and business models that will favor both the company and end users and, from a perspective external to the community, a better Energy Load Optimization, especially thanks to insights of the end-users. Table 4.16 summarizes the main elements that characterize BC5.

Table 4.16. Potential key elements of BC5

Services	Actors and their roles	Objectives	Inputs	Benefits
Information services: - follow up of both production and consumptions of prosumers and consumers - monitoring in real time and forecasting energy exchanges among pro/consumers. Demand Response services: - service of energy exchanges, market price and final money exchanges	Energy Community manager: overall set up and daily run. Technical manager: to provide / set up equipment and troubleshooting. End-users: provide or use the flexibility within the community	Raise of end user's acceptance and trust towards related services. Familiarize end-users with Demand Response Schemes.	Technological inputs that influence the rollout of the application used for automation and the provision of energy services. Economic inputs to install equipment Policy related inputs ensuring to the community the overall transparency and security of their data	Energy Community point of view: creation of dedicated energy services/business models related to P2P exchange and demand response External perspective: better Energy Load Optimization Large step to real sustainable communities.

Barriers' analysis and applicability of BC5 to LaSolar

Concerning obstacles and barriers to BC5 implementation, LaSolar consider as relevant 19 out of 21 barriers (Table 4.3) associating to them different degrees of priority. Within the category Regulatory and Legislative, except for the interaction with DSO (indicated as medium priority), all the barriers are high priority. As already noted in BC1, a critical issue of the Spanish regulatory framework relates to the definition of energy communities because the Royal Decree Law 23/2020 of 23 June 2020 introduced the energy communities as entities, but these figures are not yet recognized (for further details on the Spanish regulatory framework refer also to section 2.2). In addition to the definition of ECs, the regulatory framework has not yet fully defined the P2P trading market. The interaction with citizens also appears as crucial. Since one of the most important and challenging steps is to attract and engage the end users in the Project, an active communication with all the members of the community can mitigate this barrier. Another aspect that acts as an obstacle refers to the GDPR compliance. Within the *Economic and Market* category, all barriers range from a Medium to High level of priority. Since P2P flexibility trading is not yet developed, the absence of markets and of suitable business models act as a high priority obstacle. Capital costs represent an obstacle of medium importance since they are covered by the ACCEPT Project (notice that in absence of ACCEPT they would instead represent a more important barrier). The same priority is attached to the aspects related to financial incentives and remuneration schemes because P2P flexibility trading is not yet developed. However, it is expected that these barriers can be mitigated thanks to the smooth interaction between community members. Among the *Technical* barriers, removing obstacles around the enabling technologies and around Demand Side Response is a high priority. Limited available flexibility is considered as an obstacle of medium importance because it would discourage end users in terms of financial reward from energy savings. The same priority is indicated for Lack of ICT tools, in that there is the need of ICT tools that enable the communication of consumption, flexibility assets, and PV production between members of the Energy Community, and to Cybersecurity and privacy aspects (GDPR compliance). As for BC1, lack of awareness and knowledge is the *Social* barrier that present the highest level of priority. Within the same category, behavioral barriers can be of medium priority and they can arise from the skepticism of end-users about solutions that control their devices. A constant and adequate information should avoid negative perceptions, and this is the reason why this is considered a low priority obstacle. Considering that there is no previous experience with P2P operations, the lack of support from experienced organizations is perceived as a medium priority obstacle although this problem can be overcome thanks to the past experience of the project partners.

Table 4.17. Obstacles and barriers to BC5 implementation

Category of obstacles	Short Description of obstacles	Priority
Regulatory and Legislative	Definition of energy community	H
	Interactions with citizens	H
	Interactions with DSO	M
	Unstable regulatory framework	H
	Legal constraints (e.g. consumer participation)	H
Economic and Market	High capital costs	M
	Absence of financial incentives	M
	Lacking efficient remuneration schemes	M
	No markets (remuneration) for provision of services to grid operators	H
	Absence of suitable business models	H
Technical	Limited available flexibility	M
	Obstacles around enabling technologies	H
	Obstacles around demand side response	H
	Lack of ICT tools	M
	Cybersecurity and privacy aspects	M
Social	Lack of awareness and knowledge	H
	Negative perceptions	L
	Behavioral barriers	M
Organizational	Lack of support from expert organizations	M

From the analysis of obstacles and barriers it turns out that, according to the Spanish Pilot Site

- the 47% of the considered barriers are a high priority
- barriers perceived as a medium priority are the 47%
- only 1 out of 19 of the barriers considered as relevant (5%) in a low priority

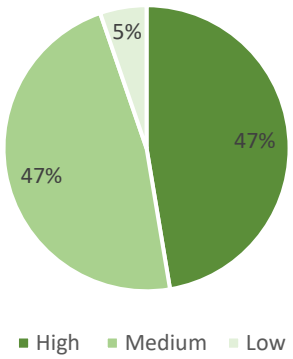


Figure 4.24 Levels of BC5 implementation barriers LaSolar

Figure 4.25 illustrates the number of obstacles for BC5 implementation in LaSolar, by category and by priority.

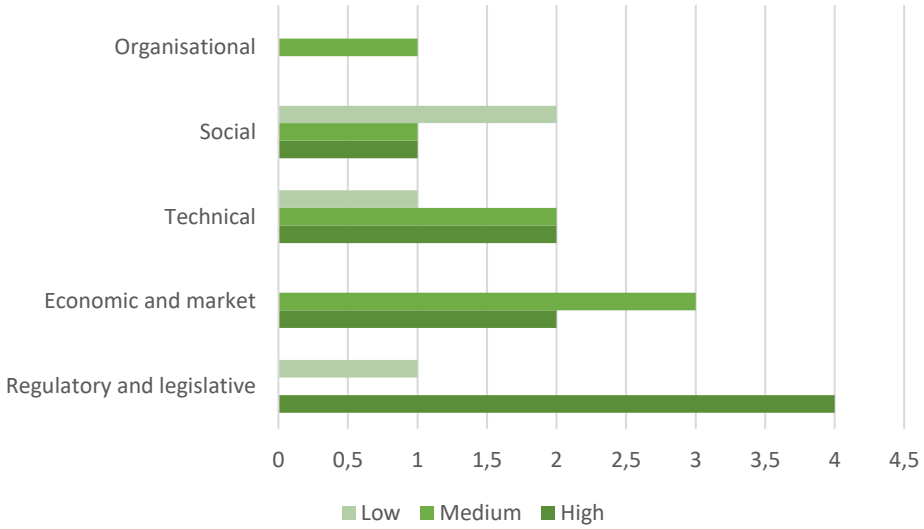


Figure 4.25. Number of obstacles for BC5 implementation in LaSolar

The sum of high and medium priority barriers represents, therefore, the 95% of the total and this led us to consider BC5 as a business case that presents a moderate level of applicability to LaSolar. However, the mitigation actions previously discussed can increase the level of applicability from moderate to good.

4.7. BC6: Energy Community as *Heating-as-a-Service Provider*

Heating-as-a-Service Provider models under schemes in which electric heating is utilized as a controllable load or alternatively through carrier coupling with DH networks leveraging the higher predictability of individual load behavior to offer heating under predefined contractual terms.

Pilot Responsible Partner Involved:

- *AEM*

An innovative ESCO service for energy communities is Heating-as-a-Service (HaaS). Heat as a Service is a new model for how businesses sell heating. Consumers who buy Heat as a Service choose how much to spend on the experience they want – feeling warm and comfortable when and where they want in their homes – instead of paying for kilowatt hours of energy. Once a service provider understands a consumer, the service provider can help them pick the best low carbon system for their situation, and help them prepare their home, so it is easy to install when they want to replace their existing.

The Figure 4.26 shows the ACCEPT Use Cases associated to BC6.

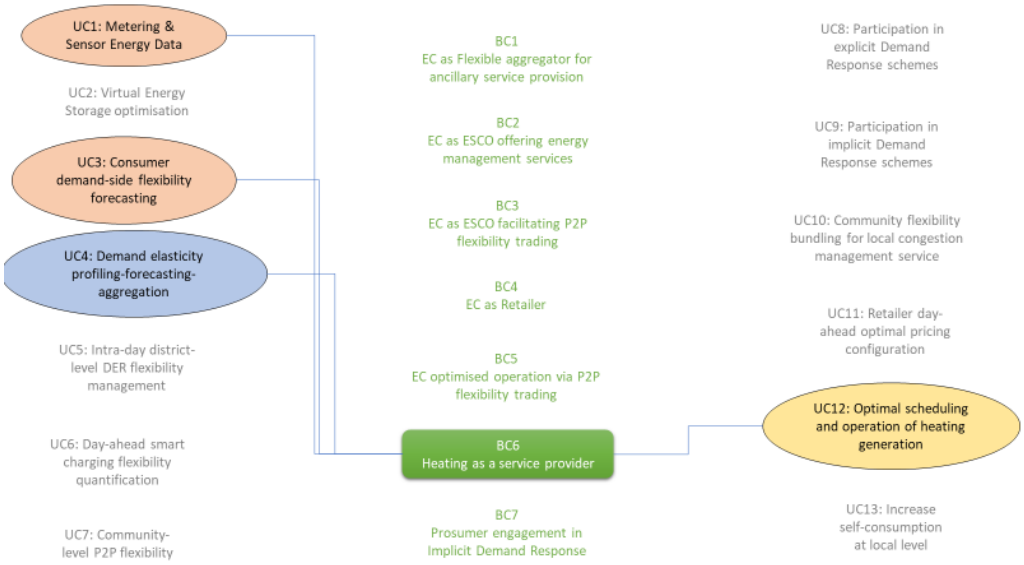


Figure 4.26. ACCEPT Use Cases associated to BC6

Within ACCEPT's Project, AEM (Switzerland) is the only Pilot Site in which BC6 will be tested and it indicates a variety of services that could be offered in the context of Heating as a Service business case. The service offering could include the heating provisioning as required to maintain a certain comfort level, optimization of the heating generation in order to reduce consumption and costs, monitoring and forecasting of consumption through an app that can also be used to pay bills, visualization of room temperature via sensors. In addition, in the long term the service offering could include other services in partnership with other ESCOs such as building insulation renovation, windows renovation, etc. The main actors involved in BC6 are building owners, which represent the decision makers in that they are the actors who opt for these services; tenants, required to accept the owner decision, they profit from the services; the ESCO that provides the services and buys electricity from DSO which, in turn, provides electricity. To be implemented, BC6 requires software's that optimize the consumption and operate the heating system, sensors for real-time data, local weather forecast, a user-friendly webapp. On the long term, partnership with ESCOs and other companies could be required as an input to put in place the last-mentioned services. BC6 would make it possible to achieve a multiplicity of objectives such as the substitution of old heating systems running on gasoil with newer renewable systems that could be partially covered by PV installations, thus allowing for a cost transfer from oil to electricity. BC would also free the consumers from managing the heating systems, optimize energy consumption by coupling the heating system with the PV, and ensure customer retention. This latter represents one of the main benefits that could come from BC6, together with the increase of local energy usage, the reduction of consumptions, energy and costs transparency, and the user exemption from maintenance duties. Table 4.18 recaps the main elements that characterize BC6.

Table 4.18. Potential key elements of BC6

Services	Actors and their roles	Objectives	Inputs	Benefits
Provide heating as required to maintain a certain comfort level Optimization of heating generation Consumption monitoring and forecasting Visualization of rooms temperature	Building owner: decision maker that opts for these services Tenants: required to accept the owner decision, profit from the services ESCO: provides the services, buys electricity from DSO	Substitute old heating systems running on gasoil with newer renewable systems, partially covered by PV installations (cost transfer from oil to electricity) Free the consumers from managing the heating systems (ESCO will pay for it and also manage it)	Software that optimizes the consumption and operates the heating system Sensors for real-time data Local weather forecast	Customer retention Optimized energy usage (less consumption) Local energy usage (e.g. PV) User released from maintenance duties

Bills/payment through the app Building insulation renovation, windows renovation, etc.	DSO: provide electricity	Optimize energy consumption by coupling the heating system with the PV Ensure customer retention	User-friendly webapp On the long-term partnership with ESCOs and companies	Energy and costs transparency

Barriers' analysis and applicability of BC6 to AEM

As far as obstacles and barriers to BC6 implementation are concerned, the analysis almost coincides with that of BC2. However, some differences have been indicated by AEM. With reference to *Regulatory and Legislative* barriers, all labeled as a low priority, it is worth mentioning that, for non-regulated services that cannot be offered by DSOs, a new company must be established to separate energy transport services (regulated) and HaaS (non-regulated). As for BC2, within the *Economic and Market* category the absence of suitable business models is also indicated as a medium priority but here this is due to the fact that changing existing gasoil heating systems to electric heating systems (e.g. heat pumps) transfers the earnings to the ESCO. Therefore, overcoming this obstacle may allow to build ECs that are economically sustainable.

Table 4.19 summarizes the indications on obstacles and barriers to BC6 provided by AEM.

Table 4.19. Obstacles and barriers to BC6 implementation

Category of obstacles	Short Description of obstacles	Priority
Regulatory and Legislative	Definition of energy community	L
	Interactions with citizens	H
	Unstable regulatory framework	L
	Legal constraints (e.g. consumer participation)	L
Economic and Market	High capital costs	H
	Absence of financial incentives	M
	Lacking efficient remuneration schemes	L
	No markets (remuneration) for provision of services to grid operators	L
	Absence of suitable business models	M
Technical	Limited available flexibility	M
	Obstacles around enabling technologies	L
	Obstacles around demand side response	M
	Lack of ICT tools	M
	Cybersecurity and privacy aspects	M
	Available Space	M
Social	Lack of awareness and knowledge	H
	Negative perceptions	L
	Behavioral barriers	M

To summarize the analysis of obstacles and barriers, according to the Swiss Pilot site:

- the 17% of the considered barriers are a high priority
- barriers perceived as a medium priority are the 44%
- the 39% of barriers are a low priority

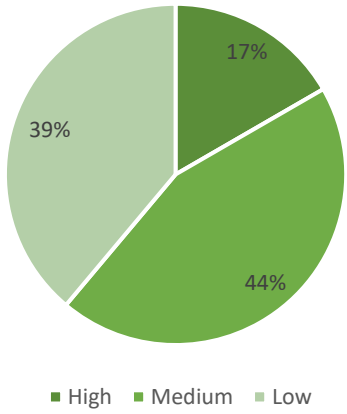


Figure 4.27. Levels of BC6 implementation barriers AEM

Figure 4.28 illustrates the number of obstacles for BC6 implementation in AEM, by category and by priority.

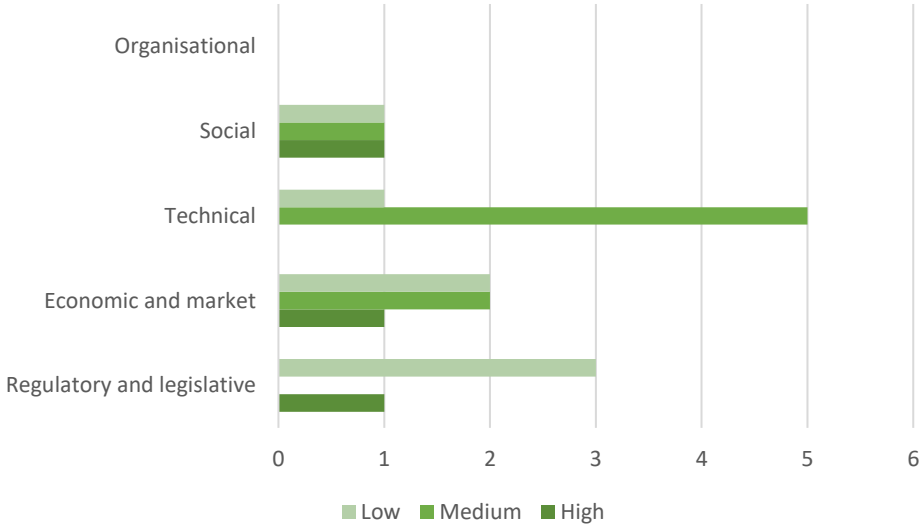


Figure 4.28. Number of obstacles for BC6 implementation in AEM

The sum of medium and low priority barriers represents, therefore, the 83% of the total and this lead us to consider BC6 as a business case that presents a very good level of applicability in AEM.

4.8. BC7: *Prosumer engagement*

Prosumer engagement in Implicit Demand Response for local energy profile optimisation (Time-of-Use optimisation).

Pilot Responsible Partner Involved:

- *LaSolar*
- *ESR*

By exposing the Prosumer to variable energy supply and/or network costs that are time-dependent (€/kWh) or depend on the maximum load (€/kW), Prosumers can be incentivized to shift their controllable load and/or generation in time, thereby unlocking the value of DSF. Typically, local optimization of controllable assets is offered as a service to the Prosumer by an ESCo. Optimization services include self-balancing services, kWmax control (control of the maximum load), Time-of-Use (ToU) optimization and emergency power supply.
ToU optimization: the variable price of grid supplied electricity and the feed-in tariff can also be time dependent. Variable price tariffs are referred to as Time-of-Use (ToU). Prosumers can reduce their energy bills by deploying demand-side flexibility i.e. allowing load to be from high-price intervals to low-price intervals or vice versa in case of generation shifting (USEF, [1]). Notice that this BC explicitly refers to ToU optimization. However, local optimization services for Prosumers also include self-balancing services, kWmax control (control of the maximum load) and optimization and emergency power supply, and that also dynamic (or flexible) tariff where the price of every hour relates to the real price on the day-ahead wholesale market may relate to this BC.

The Figure below shows the ACCEPT Use Cases associated to BC7.

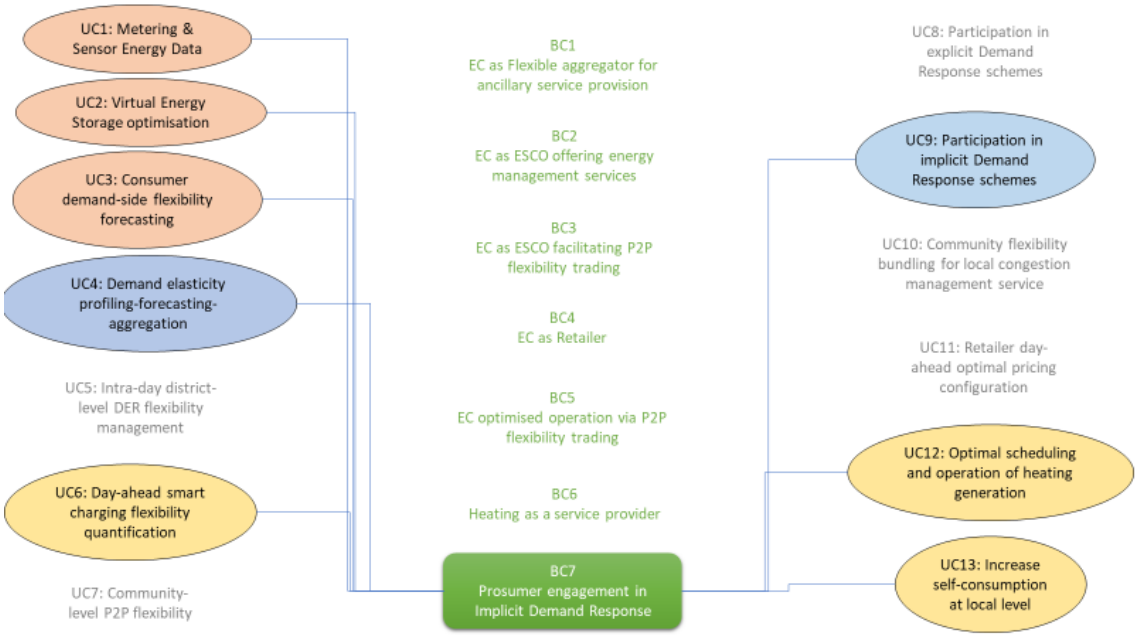


Figure 4.29. ACCEPT Use Cases associated to BC7

Within ACCEPT's Project, the service offering of BC7 could include Flexibility-related and Implicit Demand Response services that, associated with obtaining flexibility through demand shifting, would allow for the minimization of costs; energy related services for the optimization of energy consumption, ideally automated possibly through devices based on easy-to-read information and attractive user interfaces.
Actors potentially involved in BC7 are the Pilot Manager, that establishes relationship with the end-users and optimize energy consumption, the Technical Manager that implements the necessary equipment to the local community and to the residential users so that the described energy services could be offered and, finally, the end-users that, being aware of their power use behavior, are active player and tester of the solutions.

By offering the envisaged services it would be possible to obtain energy costs reduction thanks to the optimisation of the energy consumption, to raise end customer's acceptance and trust towards the services, to familiarize end-users with Demand Response Schemes, therefore supporting the use of green energy in the community.
Technological inputs would be required to offer the conceived services and, specifically it would be necessary to have solutions for the monitoring of consumption, that also manage appliances and measure the amount of savings, as well as smart devices that control appliances and effective tools that consumers can use in a simple way. Table 4.20 summarizes the main elements that characterize BC7 illustrated so far.

Table 4.20. Potential key elements of BC7

Services	Actors and their roles	Objectives	Inputs
Flexibility-related and Implicit DR services Energy related services: optimise energy consumption. Steering devices based on easy-to-read information and attractive user interface.	ESCO/Pilot Manager: Establish relationship with the end-users. Optimize energy consumption. Technical Manager: Implementation of necessary equipment to the local community and the premises of the residential users in order for the energy services to be offered. End-user: active player and tester of the solution.	Obtain energy costs reduction Raise end customer's acceptance and trust towards the services. Familiarize end users with Demand Response Schemes. More use of green power in the community	Technological solutions that monitor consumption, manage appliances and measures the amount of savings. Smart devices to control appliances. Good and simple tools for consumers

The described services might bring important benefits to the Energy Community members which take the form of savings in the electricity bill, increase in flexibility capacity and, from an external point of view, ESCOs would have the opportunity to have at disposal tools that allow to implement energy savings measurement.

Coming to obstacles and barriers to BC7 implementation, the only barrier identified as high priority is the Lack of awareness and knowledge (*Social*) while Cybersecurity and Privacy aspects (*Technical*) constitute a barrier of medium priority. To implement BC7 there is no need for a new regulatory framework and that is why unstable regulatory framework is of low priority. Within the *Economic and Market* category High capital costs and Lacking efficient remuneration schemes are indicated with same level of priority (low), as well as negative perception in the *Social* category.

Table 4.21. Obstacles and barriers to BC7 implementation, by priority

Priority	Regulatory and Legislative	Economic and Market	Technical	Social	Organizational
High	\	\	\	Lack of awareness and knowledge	\
Medium	\	\	Cybersecurity and privacy aspects	\	\
Low	Unstable regulatory framework	High capital costs Lacking efficient remuneration schemes	\	Negative perceptions	\

In addition to what already illustrated, the barriers not included in Table 4.22 among those listed in Table 4.3 have a different degree of priority according to the Pilot Site in which BC7 will be tested. The Pilot Sites involved in BC7 are LaSolar and ESR.

Table 4.22. Pilot Site specific obstacle and barriers to BC7 implementation, by priority

Category of obstacles	Short Description of obstacles	LaSolar	ESR
Regulatory and Legislative	Definition of energy communities	H	L
	Interactions with citizens	H	L
	Interactions with DSO	L	H
	Legal constraints (e.g. consumer participation)	M	L
Economic and Market	Absence of financial incentives	L	H
	No markets (remuneration) for provision of services to grid operators	L	H
	Absence of suitable business models	M	H
Technical	Limited available flexibility	M	L
	Obstacles around enabling technologies	L	H
	Obstacles around demand side response	M	H
	Grid issue	L	H
	Lack of ICT tools	L	M
Social	Behavioral barriers	M	H

As shown in the table above, differences arise in all the identified obstacles in the category *Regulatory and Legislative.* As examined in BC1, definition of energy communities is still an issue in Spain where, contrary to the Netherlands, this represents a high priority barrier for LaSolar. The same difference in priority arises for the interaction with citizens. Other aspects that act as obstacles of low-medium priority refer to the GDPR compliance. Regarding *Economic and Market* barriers, according to ESR all the barriers in this category have a high priority. For LaSolar, the only one with a medium priority is the absence of suitable business models, while the high capital costs and the absence of financial incentives are a low priority since installation costs are included in Project budget and it is supposed that Implicit Demand Response would bring energy costs saving that, in turn, would incentivize users. Among the *Technical* barriers, limited available flexibility and lack of ICT tools range from low to medium priority, while obstacles around demand side response varies from medium to high. More pronounced is the discrepancy that concerns obstacles around enabling technologies and grid issues, both labeled as low priority by LaSolar and high by ESR. Behavioral barriers are considered important for both Pilot sites, with a medium-high level of priority. These differences translate into a different degree of applicability of BC7 in the two Pilot Sites.

Barriers' analysis and applicability of BC7 to LaSolar

From the analysis of obstacles and barriers it turns out that, according to the Spanish Pilot Site

- the 14% of the considered barriers are a high priority
- barriers perceived as a medium priority are the 29%
- the 57% of the barriers are considered a low priority

Figure 4.30 shows how many barriers (in percentage values) are High, Medium and Low priority to implement BC7 in LaSolar.

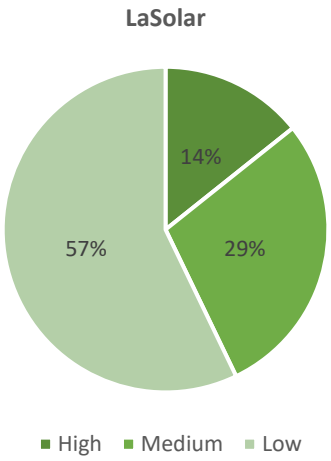


Figure 4.30. Levels of BC7 implementation barriers LaSolar

For what concerns the distribution of priorities among the five main categories of barriers here identified, Figure 4.31 shows how many obstacles fall in each of them. It can be noticed that:

- two barriers in the *Regulatory and Legislative* category are high priority (Definition of energy communities and interaction with citizens), one is a medium priority (legal constraints) and two are low (interaction with DSO and unstable regulatory framework);
- in the *Economic and Market* category all barriers are low priority, apart from the absence of suitable business models, which is medium priority;
- *within the Technical* category three barriers are considered as medium priority (Limited available flexibility, Cybersecurity and privacy aspects, and Obstacles around demand side response), and the remaining three are low (Obstacles around enabling technologies, Lack of ICT tools, Grid issue);
- in the *Social* category all the barriers are Low priority, apart from Lack of awareness and knowledge (High) and Behavioral barriers (Medium);
- Organizational barriers are considered as Low priority in that they do not represent an obstacle.

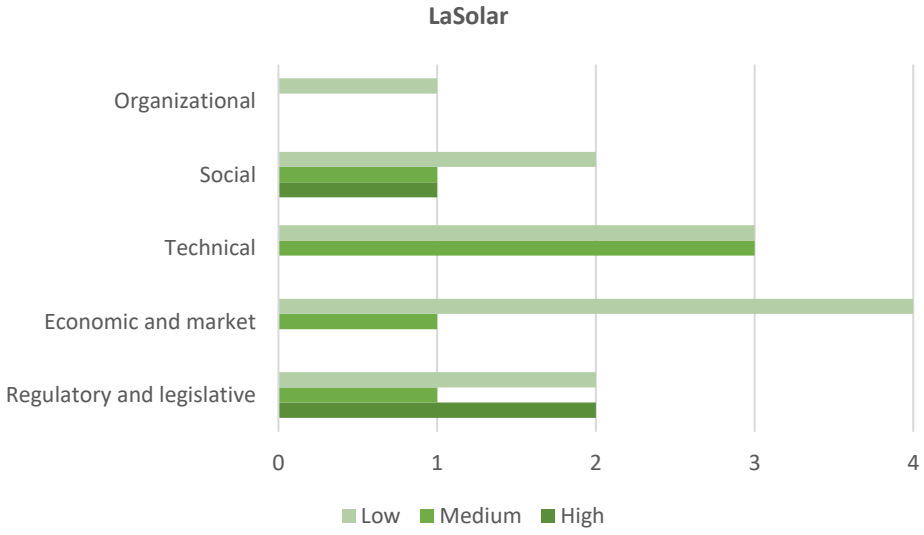


Figure 4.31. Number of obstacles for BC7 implementation in LaSolar

Barriers' analysis and applicability of BC7 to ESR

From the analysis of obstacles and barriers it emerges that, according to the Dutch Pilot Site:

- the 43% of the considered barriers are a high priority;
- barriers perceived as a medium priority are the 9%;
- the 48% of the barriers are considered a low priority.

Figure 4.32 shows how many barriers are High, Medium and Low priority to implement BC7 in ESR.

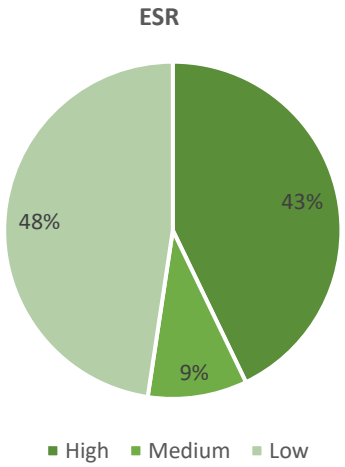


Figure 4.32. Levels of BC7 implementation barriers ESR

Regarding the distribution of priorities among the five main categories of barriers here identified, from Figure 4.33 it can be noticed that:

- all the barriers in the *Regulatory and Legislative* category are low priority, apart from the Interaction with DSO (high priority)
- in the *Economic and Market* category three are high priority (Absence of financial incentives, No markets for provision of services to grid operators and Absence of suitable business models) and two are low priority (High capital costs and Lacking efficient remuneration schemes)
- *within the Technical* category three barriers are considered as high priority (Obstacles around enabling technologies and Obstacles around demand side response, Grid issue), two are medium (Lack of ICT tools and Cybersecurity and privacy aspects), and one is low (Limited available flexibility)
- in the *Social* category two barriers are high priority (Lack of awareness and knowledge and Behavioral barriers) and two are low (Negative perceptions and Network and supply security)
- Organizational barriers are considered as Low priority in that they do not represent an obstacle

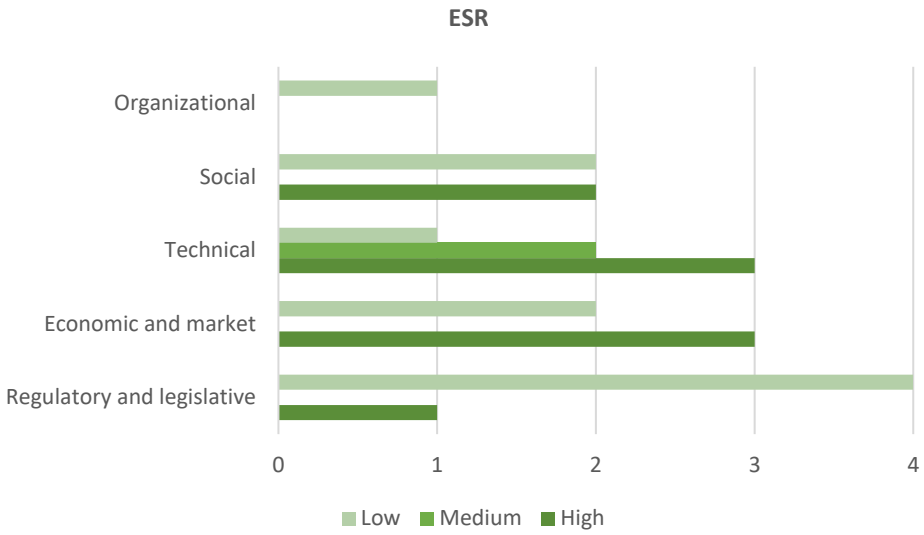


Figure 4.33. Number of obstacles for BC7 implementation in ESR

From a further analysis of the data presented above, it emerges that:

- the 14% of the considered barriers are a high priority for the Spanish Pilot Site against the 43% of the Dutch Pilot Site;
- low priority barriers dominate for the Spanish Pilot Site, 57% of the total, against the 48% for the Spanish Pilot Site;
- barriers perceived as a medium priority are the 29% for the Spanish Pilot Site and the 9% for the Dutch Pilot Sites.

5. ACCEPT Requirements

Having identified, defined and analysed the UCs and BCs of ACCEPT project, the next objective of this deliverable report lies in defining and analysing the end-user requirements. Through the requirement analysis it is possible to identify all necessary attributes, capabilities, characteristics, or qualities of a system that cover the needs of its users. To this end, each requirement describes measurable conditions the fulfilment of which is possible to be evaluated. The requirements have been divided in:

- **Users' requirements**: these have been collected through proper surveys to the end-users in order to collect feedback on how the ACCEPT solutions should be developed and understand feelings/concerns of the ACCEPT services;
- **Use cases requirements**: such requirements are strictly related to the technical solution and have been collected starting from Use Cases definition

It should be stressed that the definition and elaboration of a project's requirements is a **continuous process** as technical, economic and regulatory developments may alter / cancel previously defined requirements or add new requirements. Therefore, the list of requirements presented in the following sections depicts the initial perspectives of the ACCEPT consortium but will be subject to changes during the development of the project.

5.1. User Requirements

5.1.1. Methodology for the definition of users' requirements and survey preparation

In order to investigate users' requirement, RINA-C identified pilot specific end-users/stakeholders as they are directly involved in ACCEPT project thus activities of ACCEPT will have the greatest impact on them. Considering the scope purpose of the deliverable, and the overall ACCEPT objective, the analysis of users' requirements have been conducted divided the interested stakeholders in two main categories: B2B and B2C stakeholders, as business and customers end-users, respectively.

Table 5.1: B2B and B2C Role Stakeholders

B2B End-Users (energy sector)	B2C End-Users
• DSOs • Municipality • Energy Supplier • Pricing Operator • Aggregator • Energy Community • Building Occupant/Resident • Facility/Building Manager • Retailer	• Prosumer/Consumer involved in the energy communities

The two types of stakeholders have been divided following the above distinctions since the consumers and the business users' have different approach, interest and knowledge about technologies and solutions around demand response and energy community. In fact, while business stakeholders have in general a deeper view and understanding of these thematic, end-users should be approached via a very simple language since in general they do not have experience on this field. Moreover, to the business stakeholders it was possible to also ask questions around the business cases identified.

5.1.2. Methodology for the engagement of users

The two above-mentioned surveys aim to understand the users view, opinion or feeling and level of interest in implementation of ACCEPT innovative solutions (Use Cases) in the pilot, their requirements in terms of needs and/or

utility and level of acceptance inherent in the development of ACCEPT solutions as well as the presence of possible legislative, market, operational, functional barriers for the implementation of ACCEPT Use Cases.

The drafting of both of the surveys to business and customers stakeholders started with the analysis of the information of each Use Cases provided by its responsible partners (Chapter 3) and the translation of Use Cases into "ACCEPT services". The details of the services' description were approach in a different way for the B2C and B2B surveys. In fact, while for the B2C the services have been described in a very simple way aiming to explain to the end-users what the service does and the main results, focusing on the impact on their side, within the B2B survey more technical details could be included.
Then, for customers stakeholders (B2C survey) four surveys were prepared based on the specific services tested in the each ACCEPT pilot site (Table 5.2).

In B2B survey the attractiveness of ACCEPT developed business case (Chapter 4) was also investigated as well.

Table 5.2: ACCEPT Pilot Sites

Pilot		Partner Responsible
Aspra Spitia community	Viotia (Greece)	Mytilineos
Renewable Energy Cooperative Buildings	Murcia (Spain)	LaSolar - MIWenergia
Eva Lanxmeer Community	Culemborg (Netherlands)	ESB
Motta Massagno District	Lugano (Switzerland)	AEM

In order to involve **business and customers users** of ACCEPT pilot sites, the following steps have been carried out:

- First call with GECO, experts of consumer engagement, in order to discuss the key aspects of "**concept testing**" approach for distributing the customers survey to end-users in a comprehensive language have been organized;
- During **Living Lab** organized from GECO for WP3, RINA-C illustrated the intended methodology to share the survey (What, When, Where, Why, How) with the ACCEPT partners;
- After that RINA-C made specific **focus group discussions with pilot** responsible partners in order to show in detail a first draft of the survey to B2B and B2C surveys and to identify customers and business stakeholders (Respondent to the survey);
- In the meantime, GECO supported RINA-C in translate, according to "**concept testing**" approach, the UCs in a more user-friendly language for the final user;
- Then RINA-C uploaded the questions on the European Commission's official multilingual online survey management tool (**EUSurvey**) and sent the link and downloaded pdf version to every pilot responsible partner which contacted their end-users via dedicated workshops, phone call, interview etc..;
- Finally, the B2C surveys have been translated into the language of the pilot country (B2B remained in English, because it is more technical) to facilitate the understanding of "non-technical" users and each pilot has addressed the end-users in the way that suits them best (e.g. workshop, phone call, forward of the online link EUSurvey etc).

In drafting the questions of the surveys RINA-C also focused on the regulatory part and barriers, based on the work already done and described in Chapter 2.

The mentioned ACCEPT B2C and B2B surveys have been reported in Annex IV and Annex V.

5.1.3. Concept testing

Concept testing is a research method that involves asking consumers to assess a product or service prior to its introduction to the market. By asking target audience members to provide feedback on their initial reactions to the product or service concept (e.g. likes, dislikes), the product or service developer is better able to anticipate acceptance levels and make design adjustments where necessary. For the purposes of exploring the user requirements, this methodology was applied to the ACCEPT UCs, where each UC was classified as a service to be evaluated by end-users in the pilot communities.

Survey design

The concept testing survey was structured as follows. First, a text description of the service (i.e. ACCEPT UC) was provided. This service description was carefully 'translated' into layperson language to ensure the respondent was able to provide well informed feedback. Next, several Likert-scale and open-ended questions were asked to evaluate the appeal, usefulness, barriers, and willingness to adopt. This same set of questions was then repeated for each of use case services to be implemented in the pilot community. In addition to the service feedback, participants were asked about the appeal of the energy community concept, basic demographics, and interest in participating in future co-creation activities.

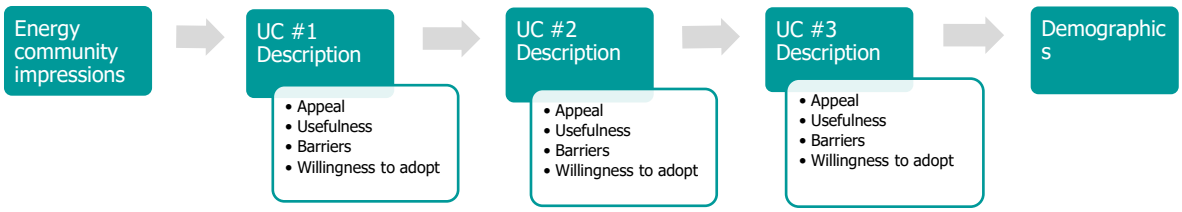


Figure 5.1: Example of the concept test survey structure

Participants

The concept testing sample included 115 B2C and 19 B2B respondents. Participants were recruited through ACCEPT pilot partner's contacts in their respective countries. As per GDPR and the ACCEPT ethical guidelines (see D1.5), informed consent was obtained from each respondent prior to their participation and all the following questions were proposed as "optional".

Table 5.3: Demographic characteristics of concept test participants

Results	B2C	B2B
Country	n.	n. (%)
Greece	38 (33%)	2 (11%)
Spain	35 (30%)	8 (42%)
Switzerland	23 (20%)	5 (26%)
Netherlands	19 (17%)	3 (16%)
Others	0	1 (5%)
Gender	n.	n. (%)
Male	64 (61%)	17 (89%)
Female	36 (34%)	2 (11%)

Prefer not to say	5 (5%)	0 (0%)
Age	\	\
<18	0 (0%)	0 (0%)
18-24	0 (0%)	0 (0%)
25-34	8 (8%)	3 (16%)
35-44	24 (23%)	7 (37%)
45-54	30 (29%)	6 (32%)
55-64	26 (25%)	3 (16%)
65+	15 (14%)	0 (0%)
Education level	\	\
Primary school	0 (0%)	0 (0%)
Secondary school	8 (7%)	0 (0%)
High school	15 (14%)	1 (5%)
Bachelor's degree	37 (34%)	8 (42%)
Master's degree	33 (31%)	9 (47%)
Other	5 (5%)	1 (5%)
Prefer not to say	10 (9%)	0 (0%)

Moreover, RINA-C has been able to achieve a mixed sample of actors' respondent, as shown in the following tables.

Results	B2C
Background	%
Prosumer/Consumer	53%
Facility/building manager	2%
Building Occupant/Resident	45%

Results	B2B
Background[3]	n. (%)
Energy Service Company (ESCo)	2 (11%)
Aggregator	3 (16%)
Energy community	3 (16%)

[3] Since some of the respondents identified themselves in more than one role, the total percentage is higher than 100%.

DSO	2 (11%)
Prosumers	2 (11%)
Facility manager	1 (5%)
Retailer	4 (21%)
Technology provider	1 (5%)
Energy utility	1 (5%)
Distributed generator provider	0 (0%)
Scientific community	2 (11%)
Municipality	5 (26%)

5.1.4. Results

Based on the answers to the above-mentioned surveys, an analysis was conducted with the specific objectives:

- to identify the pilot sites' end-users needs related to the operation of their community/district,
- to identify what the pilot sites' end-users expect from the activities within the ACCEPT project,
- to determine if the ACCEPT activities that will be conducted at individual pilot sites satisfy their needs and expectations,
- to investigate barriers and obstacles that may limit the success of the roll out of ACCEPT services.

The analysis was conducted in three phases: extraction of important information related to individual pilot sites, analysis of summary results and comparison between the four sites. The results are presented in the following chapters. In particular:

- a critical analysis of the feedback from **customer stakeholders** (B2C) of four ACCEPT pilot sites individually and a comparison of the four,
- a critical analysis of the feedback from **business stakeholders** (B2B) of four ACCEPT pilot sites.

5.1.4.1. B2C Results

First of all, demographic characteristics of concept test participants for each pilot have been analyzed and are shown in Figure 5.2. As already explained, per GDPR and the ACCEPT ethical guidelines (see D1.5), informed consent was obtained from each respondent prior to their participation and all the following questions were proposed as "optional".

For every selected parameter (background, gender, educational level, age) RINA-C has been able to achieve a mixed sample of actors' respondent. In particular, **background** categories reached have been mainly Prosumers/Consumers and Building occupant/Resident (in Eva Lanxmeer community (ESR) all the end-users are Prosumers/Consumers). We collected both **male and female** responses, with male preponderance in Mytilineos community and female in ESR community. Consumers' level of **education** has been highlighted as varied for all pilots and most limited to Bachelor's/Master's Degree for ESR.

Finally, the youngest range of **age** has been found in "25-34 years" while answer for every older range has been collected.

With reference to the demographic characteristics of the customer stakeholder respondents, no particular trends or correlations have been found between the profile of the respondent and the answers given to the survey. It is therefore believed that the feedback received does not depend on the profile of the person.

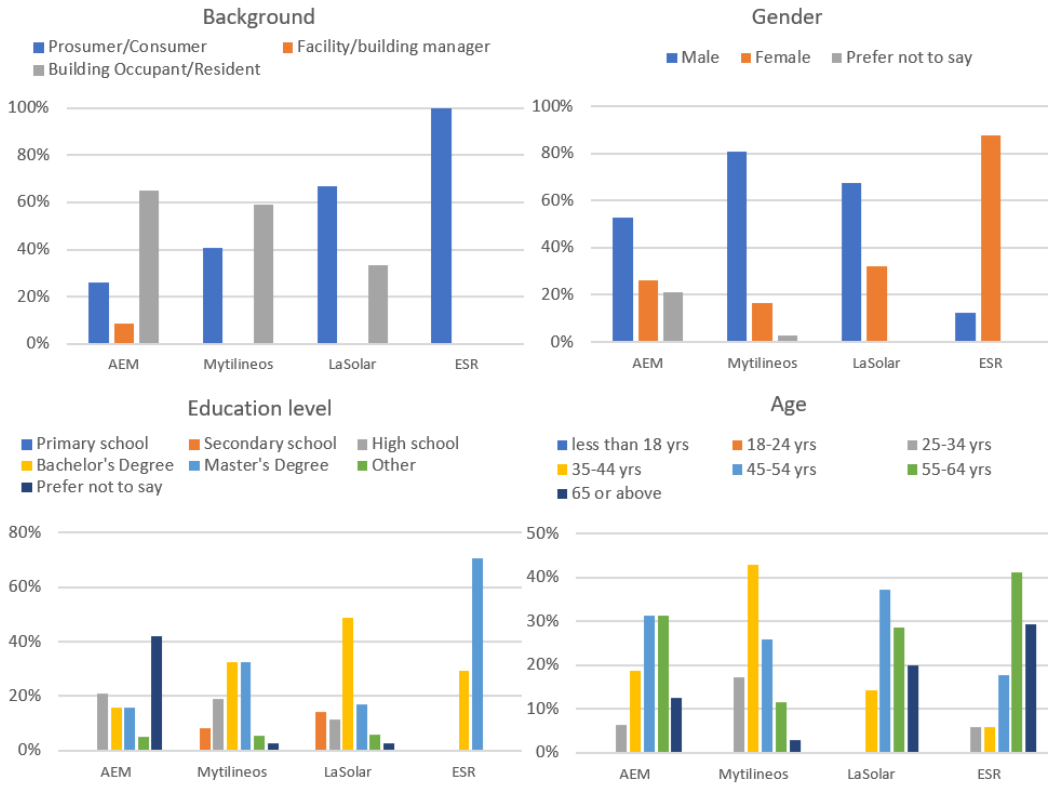


Figure 5.2: B2C Respondents Demographic Characteristics - Four pilot sites

Firstly, an analysis of general feedback on ACCEPT solutions has been performed and compared among the four pilots. Figures below show that ACCEPT project has been seen as *very appealing* especially to the customer stakeholders of the pilot sites located in Spain (**LaSolar**) and Greece (**Mytilineos**), mainly for social/environmental aspects such as empowering community members and the shift to renewable energies respectively. On the other hand, Swiss (**AEM**) and Dutch (**ESR**) end-users, have also expressed neutral opinions related to the concerns about the possible lack of community members collaboration and possibility of dispersion with time of interest for the services proposed.

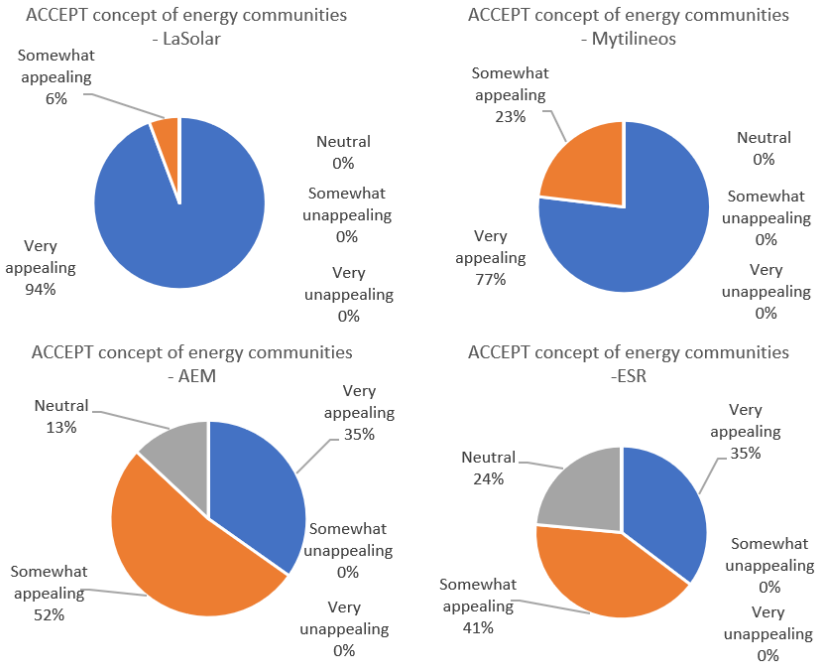


Figure 5.3: ACCEPT concept of energy community - Four pilot sites

An *active role* of engaging community end-users has been shown in Aspra Spitia (**Mytilineos**), followed by **LaSolar** community for which the *moderate/passive role* has been chosen only based on lack of time to follow the system and/or receive training on it.

Customers stakeholders of **ESR** community prefer to be moderately involved also because of the possibility of dispersion of the project with time and the little coherence with other initiatives taking place in the community.

Most of the Capriasca District (**AEM**) end-users on the other hand, prefer to be passively involved therefore not actively engaging with project activities as they consider the proposed services too intrusive, not very flexible and due to the compulsory presence of **external actors,** like the energy distributor, who care about the stability of the network.

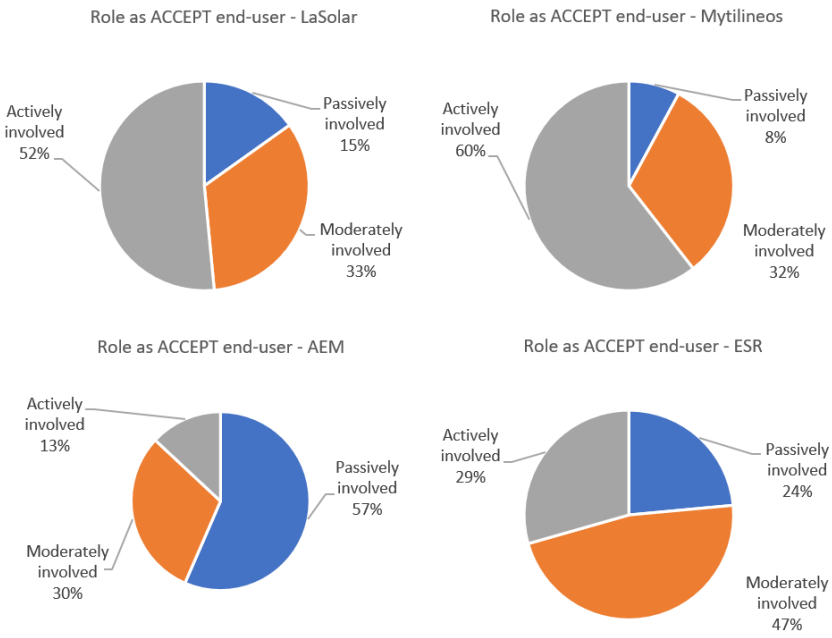


Figure 5.4: Role as ACCEPT end-users - Four pilot sites

Most of the barriers that may limit the success of the roll out of ACCEPT services have been identified as ***technical*** issues by all the customer stakeholders of the four pilot sites, mainly regarding the installation of too many devices and concerns about confidentiality and privacy of personal data.
Economic and ***social*** obstacles have been divided in almost all of the cases with the same percentage. Between the economic aspects prevails always the high cost of investment and subsequently the modification (increase) of the bills, while the concerns on the social aspects are mainly on the possible lack of user-friendly information and lack of customer decision-making power followed by the possible visibility of infrastructures (e.g. wind turbines, solar panels, etc.).
Finally, also ***regulatory/legislative*** aspect for the complexity of administrative procedures has always been stressed.

Figure 5.5: Barriers for services success - Four pilot sites

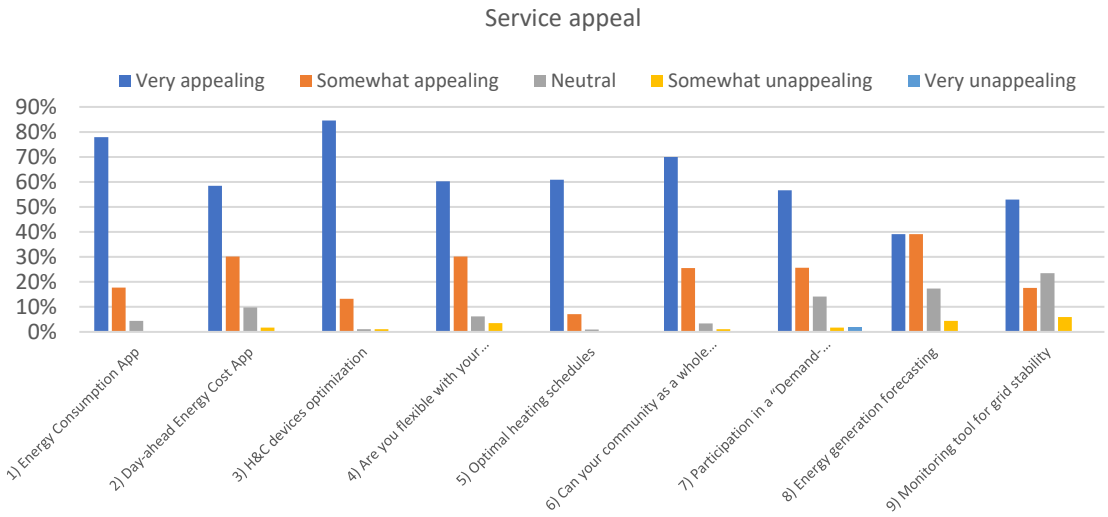


Figure 5.6: Service appeal - Four pilot sites

The figure above, shows the feedback of the four pilots on ACCEPT service attractiveness.
In particular, most of the Greek pilot community members customers stakeholders (**Mytilineos**) evaluated the proposed services as *very appealing,* especially for a better management in energy resources; some neutral responses have been due to the possible interference of services in personal choices, the lack of community collaboration and the required engagement time/extra action.
Most of the Spanish pilot community members customers stakeholders (**LaSolar**) evaluated the proposed services *appealing* especially for the innovative potential and increase of social awareness. Some concerns have been shown about the difficulties of adjust consumption and the importance of use the services in a cooperative/energy community with democratic participation.
Most of the Dutch pilot community members customers stakeholders (**ESR**) evaluated the proposed services *appealing* especially for providing insight/knowledge on energy management. Concerns have been raised on the training needed, the difficulties in adjusting daily activities and possible loss of interest on services with time.
Most of the Swiss pilot community members customers stakeholders (**AEM**) evaluated the proposed services *appealing* especially for the benefits of consumption transparency; some concerns have been highlighted for the requirement of an active role with specific skills and possible loss of interest on services with time as well as too many intrusive services.
Detailed single pilot site results can be found in the following sections.

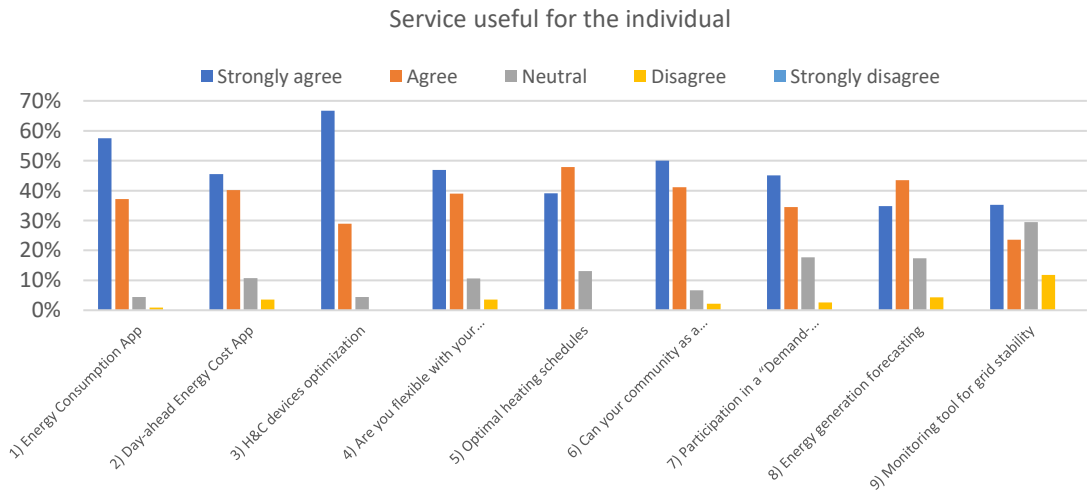


Figure 5.7: Service utility for the individual - Four pilot sites

The above figure shows the feedback of the four pilots regarding ACCEPT service utility for the individual.
Aspra Spitia (**Mytilineos**) community customers stakeholders *agree* on having personal **advantages** from the proposed services especially benefits such as an **understanding** energy profile and the possibility of highlight individual **weak points** of high energy consumption. Concerns have been stressed for the for **time needed** to monitor energy prod/cons and training.
LaSolar community customers stakeholders *strongly agree* on having personal **advantages** from the proposed services especially for the improvement of single energy consumption patterns or comfort and social **awareness**. Concerns have been indicated for **time needed**.
Capriasca district (**AEM**) community customers stakeholders *agree* on having personal **advantages** from the proposed services especially for increase the **update and social awareness** on energy management. Concerns have been highlighted for **uncertain economic benefit**.
Eva Lanxmeer (**ESR**) community customers stakeholders *agree* on having personal **advantages** from the proposed services especially for finding the **balance between generation and consumption** and adjust personal behaviors/habits. Customers' stakeholders **concerns** are mainly related to the need of **training** on energy specialized aspects.
Detailed single pilot site results can be found in the following sections.

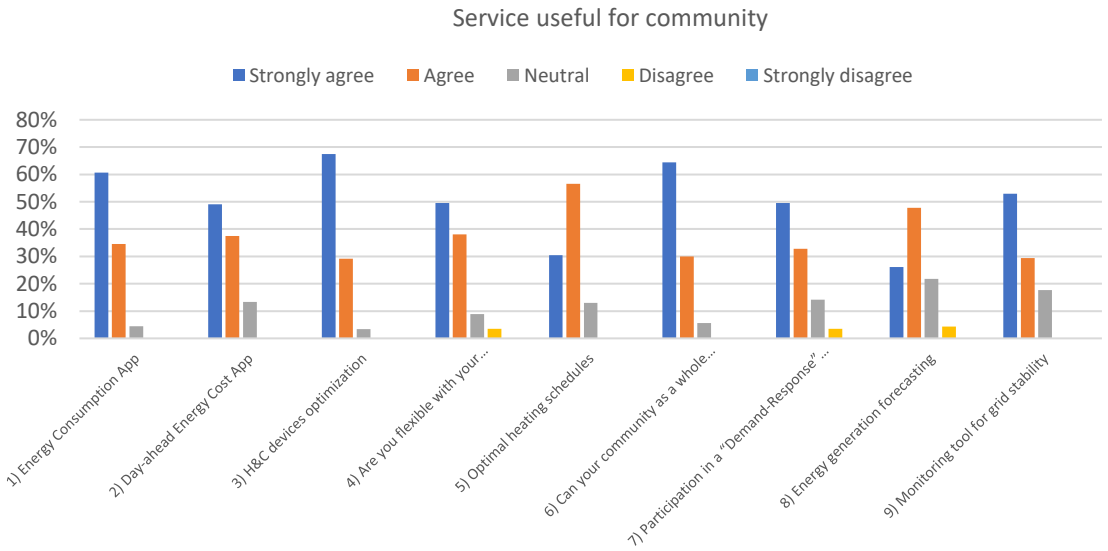


Figure 5.8: Service utility for the community - Four pilot sites

The above figure shows the feedback of the four pilots on ACCEPT service utility for the community as a whole.
LaSolar community customers stakeholders strongly *agree* on having community **advantages** from the proposed services especially benefits such as the promotion of **self-management** (independence from the grid in decision making) and the improvement of community members relations. Concerns have been stressed on the support needed from institutions and difficulties for older members in dealing with the innovative system.
ESR community customers stakeholders *agree* on having community **advantages** from the proposed services especially benefits like the increase of community awareness and consequent social moments of interactions. Concerns have been indicated for the time needed in actively follow the project and the needed training on specific energy topics.
Mytilineos community customers stakeholders *strongly agree* on having community **advantages** from the proposed services especially benefits like a **proper use** of energy, the possibility of services replicability and to gain an overall picture of community energy current situation. Concerns regards the service reliability and applicability in houses with energy losses for insulation.
AEM community customers stakeholders *agree* on having community **advantages** from the proposed services especially benefits such as a better knowledge on energy management and the consequent possible independence from network. Concerns have been expressed regarding the possible lack of collaboration between district members and the willingness of citizens in an active project participation.
Detailed single pilot site results can be found in the following sections.

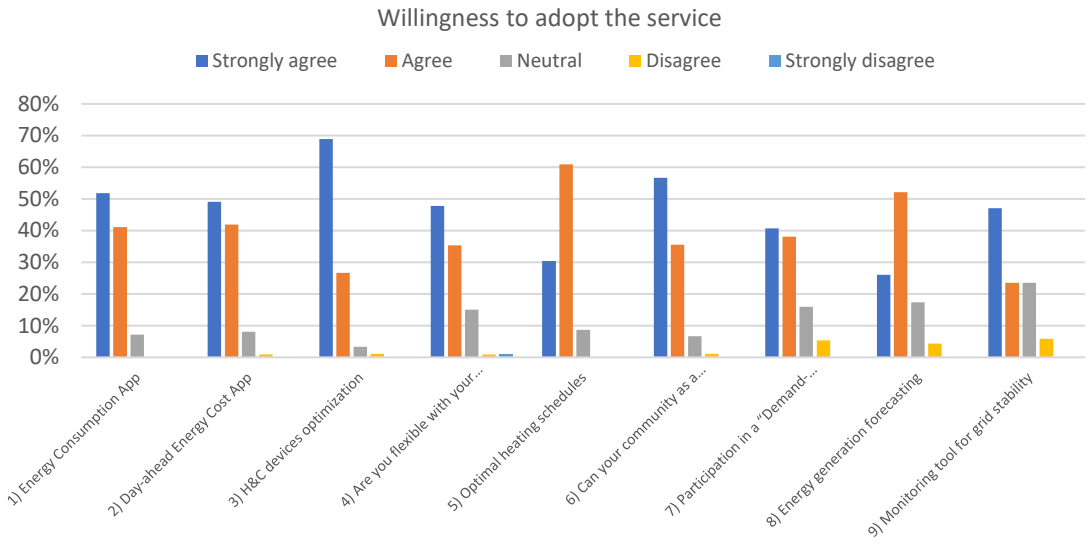


Figure 5.9: Willingness to adopt the service - Four pilot sites

The above figure shows the feedback of the four pilots regarding the willingness to adopt ACCEPT services.
Most of Aspra Spitia (**Mytilineos**) community members *strongly agree* on **adopting** ACCEPT services especially because they are identified as a necessary prerequisite for the system to work with concerns on the impossibility for the project to do otherwise.
LaSolar community members *agree* on **adopting** ACCEPT services especially for the logical need but also to respect their commitment in the project with the need for an operational and user-friendly **software** and results **concerned** for the costs, which should be commensurate with the expected results.
Eva Lanxmeer (**ESR**) community members *agree* on **adopting** ACCEPT services especially to hand over autonomy and to help the neighborhood even if some concerns have been stressed for privacy of personal data and the need for more insight.
Capriasca district (**AEM**) community members *agree* on **adopting** ACCEPT services especially for the utility to immediate check their consumption with concerns about confidentiality and **privacy** for personal data.

The following paragraphs describe in detail the analysis conducted on the results of the four pilot sites single customers surveys.

LaSolar feedbacks
The ACCEPT project has been indicated with *very positive* answers for the interest of LaSolar customers stakeholders in ACCEPT, guided from **social** individual aspects as the **empowerment** of each member of the community in having an active role in energy management as well as the **incorporation** of a great number of people in order to encourage collaboration and information exchange for a strengthening of the energy community at the local level. The idea is to have **independence** from the current energy monopoly of large business companies.
Environmental aspects have been also positively valued based on the idea of creating a more **sustainable**, responsible and supportive energy production and consumption, which can be applied to other communities for a contribution to a social cohesion.

Most of LaSolar community members would like to play an ***active role*** in their community so to be involved in multiple activities throughout the project (e.g. providing energy data, receiving information about piloting results, attending webinars, participating in focus groups) but there are some end-users who prefer to have a ***moderate*** *or* ***passive*** involvement during the project mainly because of lack of time to dedicate to it or because they don't live in the community year-round.
LaSolar customers stakeholders indicated mainly ***technical*** barriers that may limit the success of the roll out of ACCEPT services, especially regarding difficulties in installing specific technologies and installation of too many

devices/systems as well as concerns about data privacy but also ***economic*** obstacles related to possible high *investment* cost or modification of energy bill.

Social obstacles for services' success have been identified and include the lack of user-friendly information and loss of "customers decision-making power" once solutions are installed. Finally, complex ***administrative*** procedures in the community or regulations for neighborhood communities on prohibition of the installation of equipment (e.g.: cables, appliances, etc.) on facades, interior patios and other community spaces have also been stressed.

Other interference with the project could come from the influence of the large electricity sector on political decision-makers, creating an **unfair competition** from large electricity companies.

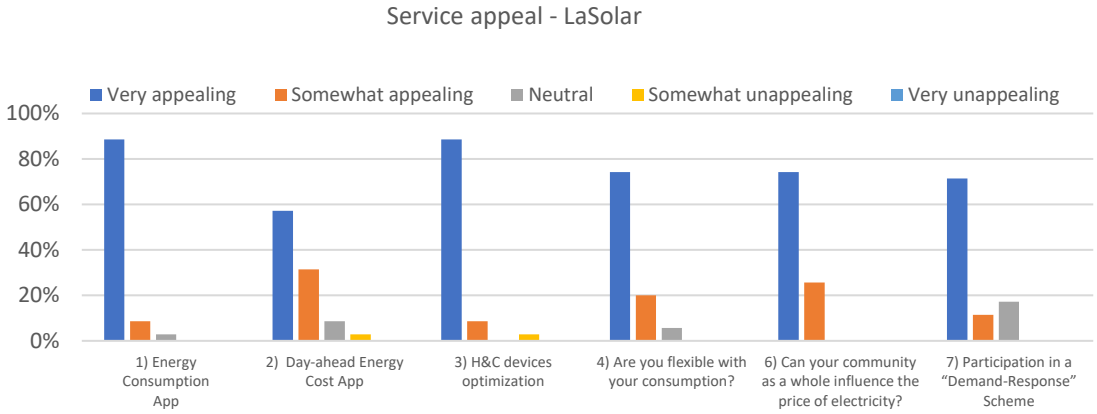


Figure 5.10: Services appeal - LaSolar customers stakeholders

The above figure shows that services proposed for application in LaSolar pilot site have been valued in a *very positive* way especially for the **innovative** potential of practical application of new technologies in the domestic environment and the visual/interpretative diagnostic information that they can offer to make daily decisions and favor savings.

Social benefits have been stressed mainly on the **possibility of awareness and understanding** of real data on your own energy production/consumption in order to investigate social behaviors and be able to prevent the demand or on the possible **active role of consumers** to control, improve and optimize the energy management and be part of the solution in critical moments. This can allow end-users to reduce **dependence** on the main grid, big energy multinationals or other external energy sources in favor to a more local self-generated clean energy consumption.

Savings, both **energy and economic**, have been valued as one of the gains, plus the possibility of visualizing then immediately in a visual/interpretative way.

General concerns have been described with regards to the difficulties of adjusting consumption or creating/modifying **habits**, especially if prices change frequently (daily) or people have fixed work schedules and/or shifts different every day – especially for the application of service 2). Moreover, the **already presence** of clean energy schedule in **three bands** has been underlined commenting service 3) as well as the importance of use services in a cooperative/energy community with **democratic** participation, with free sharing knowledge to reduce costs and avoid the use for private profit interests.

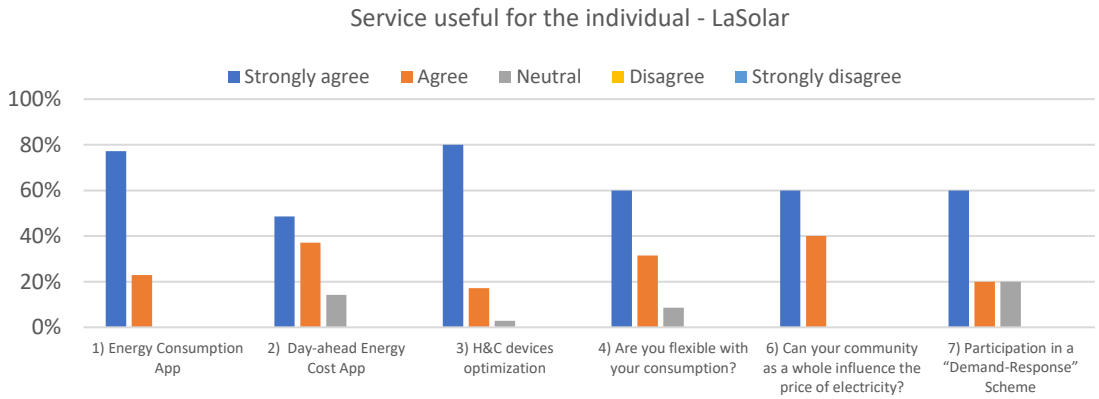


Figure 5.11: Services utility for individual members - LaSolar customers stakeholders

As showed in the above figure, LaSolar end-users valued the services proposed generally as *useful* for the individual community member the services proposed. In particular, personal **advantages** from the proposed services have been identified in the **improvement** of single energy consumption patterns or **comfort** at home, as well as the presence of an efficient system based on **accumulators** of hot/cold water.
Moreover, benefits such as the possibility of receiving **more information, knowledge and education** in the energy management and consequently on the amount of personal electricity bill as well as the decrease energy dependence to actors external to the community have been valued positively.
Personal concerns have been expressed on the **time needed** to devote to customers input actions especially from people with specific shift work or who don't live in the community year-round because it would be more difficult for them to learn about the services and adapt their daily behaviors especially for the optimal application of service 2).

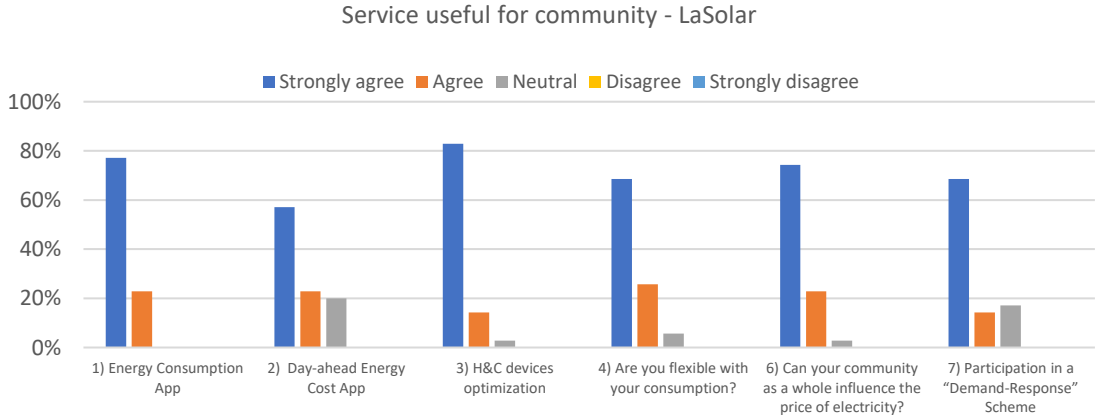


Figure 5.12: Services utility for community - LaSolar customers stakeholders

Community *advantages* related to the proposed services have been identified including the promotion of **self-management** of energy and consequently the independence in **decision making** from community's external actors and environmental/social awareness, as well as the increase/improvement of **relations among community** members. Moreover, a positive score has been given to the services for their **replicability** in other initiatives, which can allow for greater stability of service.
A general support needed from **institutional** actors has been underlined, as well as the difficulty for **older** community members in the use of equipment especially for the management of the application for an optimal use of service 2) and the training needed regarding for example service 7).

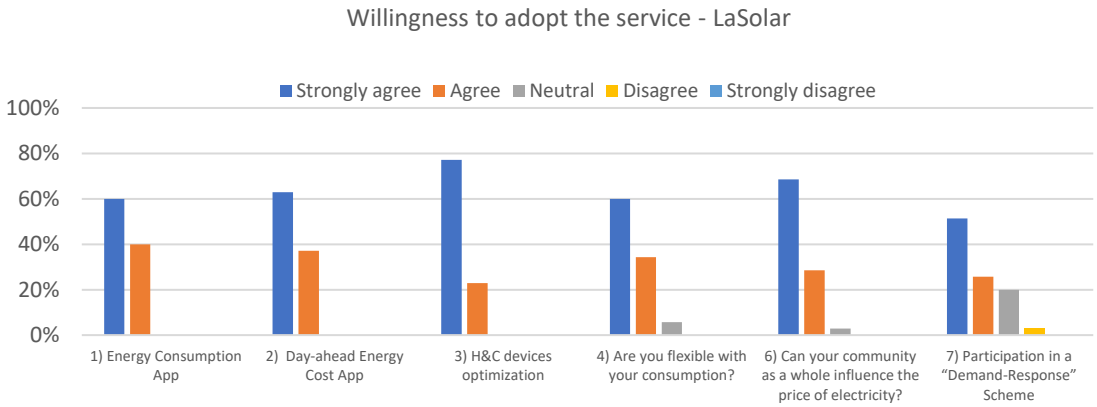


Figure 5.13: Willingness to adopt the services - LaSolar customers stakeholders

LaSolar community members are ***willing* to adopt** ACCEPT services (e.g. instrument installation such as sensors, automatic control of the home assets, availability to shift your consumptions based on price or grid request, use of tools/App) mainly for their **logical need** in order for the system to work but also to respect their **commitment** to the project and LaSolar community and to **help these initiatives** to become consolidated.
Customers only expressed the need for an operational and user-friendly **software** and results **concerned** for the costs, which should be commensurate with the expected results.

Mytilineos feedbacks

The ACCEPT project received *very positive* answers from the customers stakeholders of Aspra Spitia, guided from **environmental** aspects as the **shift to renewable energy** (even if some general concerns have been underlined on the warranty or reliability and autonomy of the renewable energy sources proposed), the optimization/reduction of energy resources consumption and contribution of the project to **more environmentally friendly producers,** even if demand is not covered by local production.
Moreover, the **rational use of energy** has been identified as a **social requirement** for the impact of human activities on the environment. Through ACCEPT, the energy background could give to each home/household an understanding of their actual energy needs and how to improve energy management.
Finally, the **consumer active involvement** has been identified as an important **social** benefit for help end-users to adapt to new technologies and familiarizing with them in everyday life.

Most of Aspra Spitia community members would like to play an ***active role*** in the community so to be involved in multiple activities throughout the project (e.g. providing energy data, receiving information about piloting results, attending webinars, participating in focus groups) but some end-users prefer to have a ***moderate*** *or* ***passive*** involvement on the project mainly for **lack of time** to dedicate to the **education and guidance** needed for the average consumer in order to avoid lack of information that can bring to an increase in consumption.

Aspra Spitia customers stakeholders indicated mainly ***technical*** barriers that may limit the success of the roll out of ACCEPT services, especially regarding data **management and privacy** as well as possible difficulties in installing specific technologies or concern on the allowance to the electricity supplier to automate control some settings (e.g. set-point (on-off), set-point boilers, HP, HVAC, etc.).
Economic obstacles for services success have been identified in the possible high investment cost or modification (increase) of energy bill.
Social barriers have also been identified, including as lack of user-friendly information and loss of "customers decision-making power" once solutions are installed. Finally, complex ***administrative*** procedures in the community or lack of cooperation and involvement of every community member have been also stressed.

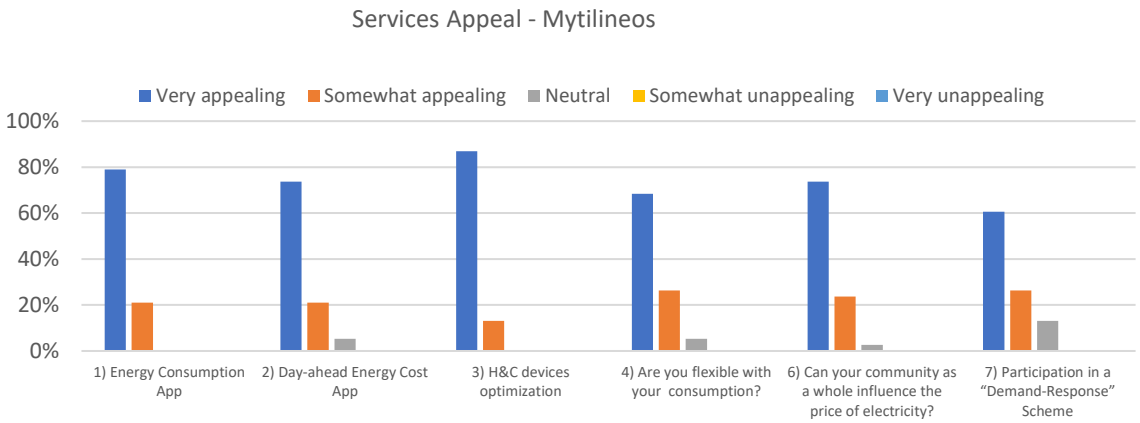


Figure 5.14: Services appeal - Mytilineos customers stakeholders

The above figure shows that services proposed for application in Aspra Spitia community have been valued in a *very positive* way especially for their **benefit in a better management of energy resources**, avoiding overconsumption, through real-time metering (immediate information) for awareness of the main energy consumption. It builds a culture of energy saving showing how behaviors and habits affect consumer profile and how they can be reduced.
It allows an **active participation** of end-users and it establishes **immediate cooperation with the provider**, helping him with a more stable supply and perhaps lower production costs so that the provider will be able to better predict a community's consumption through the knowledge of user behaviors.
Moreover, the implementation of services can reduce fixed energy **costs** (specially of energy-intensive household as washing machine) at the time when the price is most advantageous.

Nevertheless, specific concerns have been expressed regarding main aim of the application mentioned in service 2) which should be to reduce consumption (starting from peak hours) rather than using it when the price is most advantageous.
Moreover, end-users are **concerned** for the interference of services in **personal choices and the** required **engagement time**/extra action required to them as well as the **lack of community collaboration** that could bring to overconsumption for some when others are trying to improve the community footprint – especially for the service 6).
Technical aspects have been stressed regarding **safety issues** for automatic start-up of devices/appliances and the uncertainty that the appliances can respond **to the energy fluctuations** they are about to undergo for the optimal application of service 7).

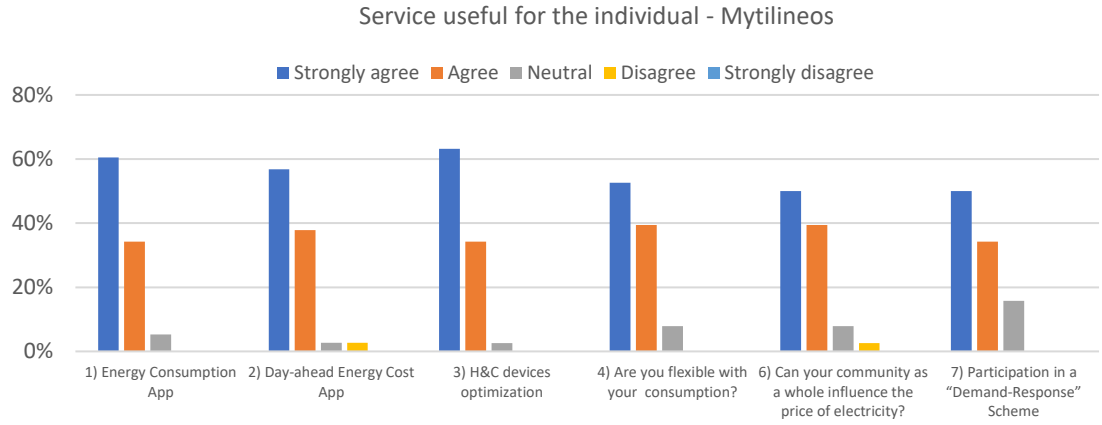


Figure 5.15: Services utility for individual members - Mytilineos customers stakeholders

As showed in the above figure, Aspra Spitia end-users valued *useful* in general for the individual community member the services proposed. In particular, personal **advantages** have been identified in the **understanding** of the

energy profile in order to control/reduce cost, save resources and have a complete picture of the operation of household appliances.
Moreover, the system could highlight **weak points of high energy consumption** at the **individual level** that need improvement and/or it could **feed the provider** with the necessary data to find the optimal operation, as long as it is done globally by all users.
Personal concerns have been expressed for the **needed time** to monitor the energy consumption/production - for an optimal application of service 2) - and be trained for a better insight/understanding of how the proposed services, their technologies and more in general the energy marked works for more specific services proposed i.e. 6) or 7).

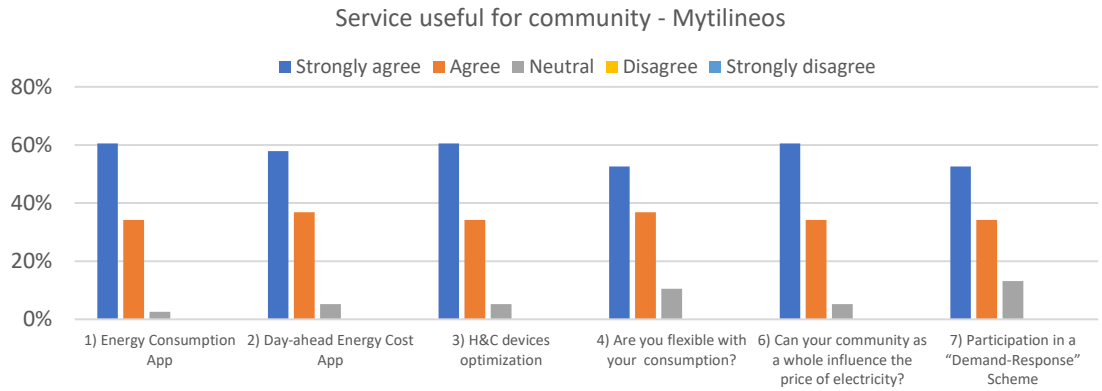


Figure 5.16: Services utility for community - Mytilineos customers stakeholders

Community *advantages* have been identified in the rationalization and **proper use** of energy, i.e. air conditioning because heating is more a common/constant demand, which can bring to a general community reduction of energy needs and highlight **weak points** of high energy consumption at the **collective level** that need improvement.
Moreover, a great opportunity of **replicability** has been indicated considering communities with fairly similar characteristics among consumers in order to increase the awareness and evolution on the community and present the opportunity to become a **model** community **towards sustainable** energy use at national and/or European level.
Finally, the services could help in understanding the **overall picture of community consumption** and could provide to the single individual the opportunity to compare its consumption with the community average; so the knowledge can bring significant reduction in usage at high price times and an economic saving.
Aspra Spitia customer stakeholders have been showed concerns - especially for service #3 - about the **service reliability** doubting that the service alone could not be able to meet the need considering that most community buildings have a lot of energy **losses due to insulation** and waterproofing or for the lack of positive community members engagement willingness/level for the optimal application of service #7.

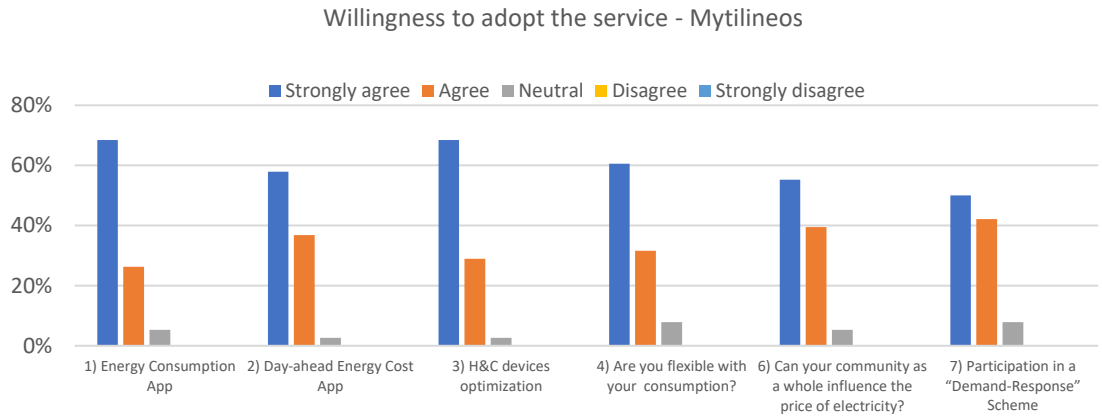


Figure 5.17: Willingness to adopt the services - Mytilineos customers stakeholders

As shown in the above figure, Aspra Spitia community members seem ***willing* to adopt** ACCEPT services (e.g. instrument installation such as sensors, automatic control of the home assets, availability to shift your consumptions based on price or grid request, use of tools/App) especially because they are seen as **prerequisites necessary** for the monitoring and development of the project as well as an implementation and record of the respective energy patterns so a first step towards the rational use of energy to monitoring the current situation. Customers also expressed the **impossibility** to practically implement the project **otherwise** so they consider it obligation to use the services.

AEM feedbacks

The ACCEPT project has been indicated with *positive answers* for the interest of Capriasca customers stakeholders in ACCEPT, guided from innovative **environmental** aspects as the consumption and promotion of **local renewable energy** (increase of solar self-consumption) and the consequent reduction of dependence on fossil fuels even if with some minor concerns about real applications of renewable energies (e.g. address the issue of "gray energies" to produce and transport materials).
Cost optimization for the reduction of energy bills has also been underlined as a project benefit.
"Neutral" responses have been driven by the possible **lack of community members collaboration**/honesty and the importance to have certified meters.

Most of Capriasca district members would like to play mainly a ***passive or moderate role*** in their community so to be involved in some planning and co-creation activities (e.g. attend presentations, participating in a focus group) or to not be actively engaging with any activities.

Capriasca customers stakeholders indicated mainly ***technical*** barriers that may limit the success of the roll out of ACCEPT services, especially regarding the installation of many devices/systems and the confidentiality and **privacy** data management as well as concerns about service reliability and the allowance to the electricity supplier to automate control some settings (e.g. set-point (on-off), set-point boilers, HP, HVAC, etc.).
Economic barriers for services' success have been seen related to possible high investment cost or modification of energy bill.
Social obstacles have been identified in a lack of user-friendly information and loss of "customers decision-making power" once solutions are installed. Finally, complex **administrative** procedures in the community or lack of cooperation and involvement of every community member have been made explicit.

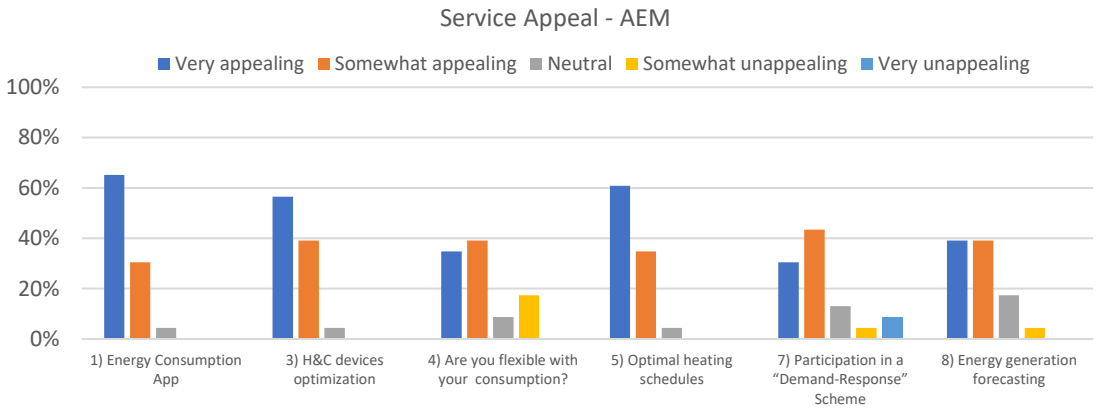


Figure 5.18: Services appeal - AEM customers stakeholders

The figure above, shows that services proposed for application in Capriasca District have been valued *positively* for the benefits of **consumption transparency** to consult, monitor and control specific energy data as well as the improvement in **energy efficiency**, i.e. reduce energy consumption, waste and optimize the use of appliances/equipment linked to personal behaviours/**habits**. This will bring to significant savings in energy and **economic** terms for reducing the energy bills and access advantageous tariff conditions.
General difficulties in accepting the services have been showed for the **required active role** in a field where specific skills can be required.
Moreover, specific concerns for have been stressed on privacy issues on service 4), the usual presence of external actors as the energy distributor on service 7) and doubts regarding the utility on service 8) because the power grid seems to be already stable.
Finally, the fear of **running out** of comfort temperature/hot water and that **with time interest in the system might wane** have been highlighted. Some district members found the system **too intrusive** and **not very flexible** considering the difficulty to change citizen behaviors/habits.

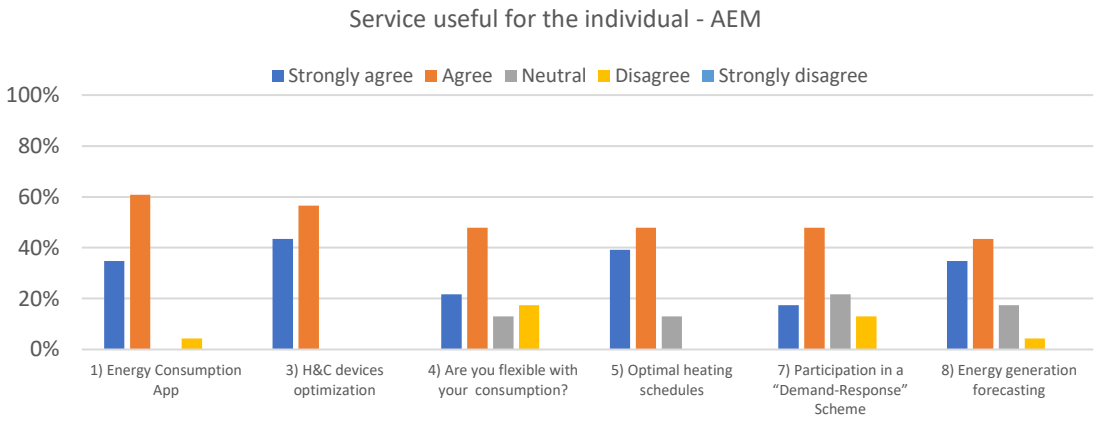


Figure 5.19: Services utility for individual members - AEM customers stakeholders

As showed in the above figure, mostly of Capriasca district customers stakeholders *agree*, even if not always strongly, on having personal **advantages** from the proposed services. In particular, the main benefit has been identified in been always **updated** and have an **awareness** of own consumption in order to act accordingly to have a consume/production optimization.
Concerns have been highlighted for the fear of "intrusion" in customers private habits - especially linked to service 4) - or on the actual **uncertainty** in have a **reduction** of energy **bill**, considering that some members already optimize energy consumption during the day applying service 7) and 8).

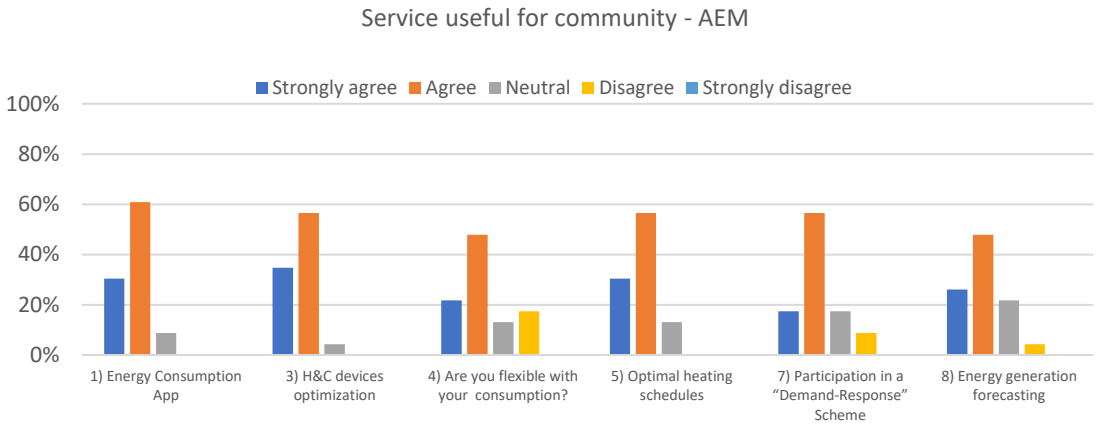


Figure 5.20: Services utility for community - AEM customers stakeholders

Community *advantages* have been identified in better **knowledge** of consumption for a general overview of community data, the **transparency** of energy data and the consequent **independence** on the network with possible advantageous tariff.
However, the need for **collaboration between district members** has been stressed as the reliability of the system also depends on whether each-end user acts accordingly to "improve" their consumption. Another necessary requirement especially linked to service 7) has been showed as the **willingness of citizens** in an active participation and the fact that some of them consider compulsory the presence of **external actors** who care about the stability of the network or the lack of a daily routine – service 4).

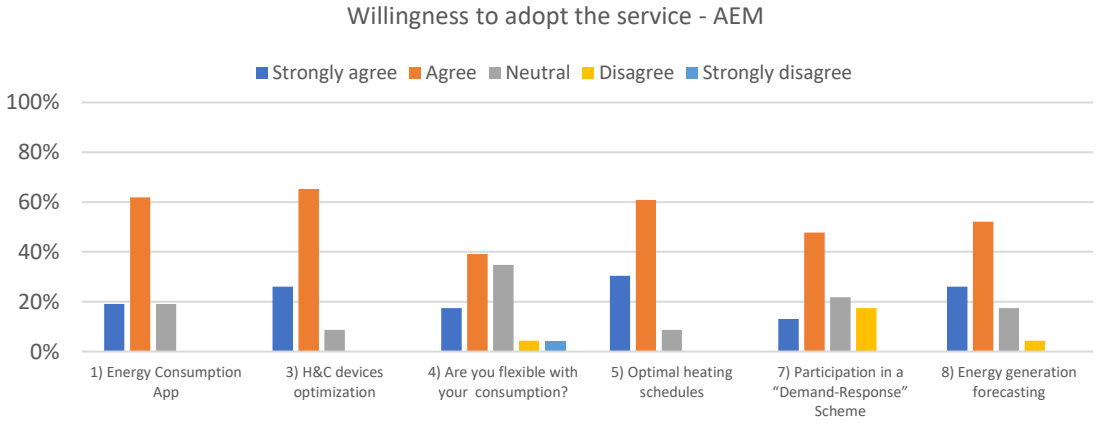


Figure 5.21: Willingness to adopt the services - AEM customers stakeholders

Capriasca district members have shown themselves ***willing* to adopt** ACCEPT services (e.g. instrument installation such as sensors, automatic control of the home assets, availability to shift your consumptions based on price or grid request, use of tools/App) especially to immediately check their own consumption and choose the best comfort and saving conditions, if it's feasible in the sense for appliances with timers.
General concerns regard confidentiality and **privacy** data issues as well as the importance of not reduce end-users **quality life** – especially for service 7) and the needed to understand what equipment and data records are going to be needed applying service 4).

ESR feedbacks

The ACCEPT project has been indicated with *positive* answers for the interest of Eva Lanxmeer customers stakeholders in ACCEPT, guided from innovative **social** aspects as the **curiosity** for some end-users who are already environmentally friendly to know how to use their devices (e.g.: solar cells, hybrid cars etc.) in a more efficient way and to know the most favorable time for the use of their electrical appliances (washing machine, dishwasher).
Economic and **environmental** aspects in energy saving on bills and increase sustainability have been also stressed.

Most of community members would like to play a ***moderately role*** in their community so to be involved in some planning and co-creation activities (e.g. attend presentations, participating in a focus group) especially because, even if they are concerned about the importance of **information** and **technical support**, on the other hand they showed a lack of time to immerse into the project, the possibility of dispersion and the little coherence with other initiatives in place.

Eva Lanxmeer customers stakeholders indicated mainly ***technical*** barriers that may limit the success of the roll out of ACCEPT services, especially regarding the installation of many devices/systems and the confidentiality and **privacy** data management as well as concerns on the possible difficulties in installing specific technologies.
Economic obstacles for services success have been seen related to possible high investment cost or modification of energy bill.
Social barriers have been identified for the lack of user-friendly information, the loss of "customers decision-making power" once solutions are installed and the possible visibility of infrastructures (e.g. wind turbines, solar panels, etc.).
Complex **administrative** procedures in the community have also been made stressed.
Finally, customers have shown a need to **optimize energy use;** in fact some of end-users generate more energy with solar panels than the consumed one that could be shared and used by neighbors but they are worried about the economic cost or hassle that this action could implicate.

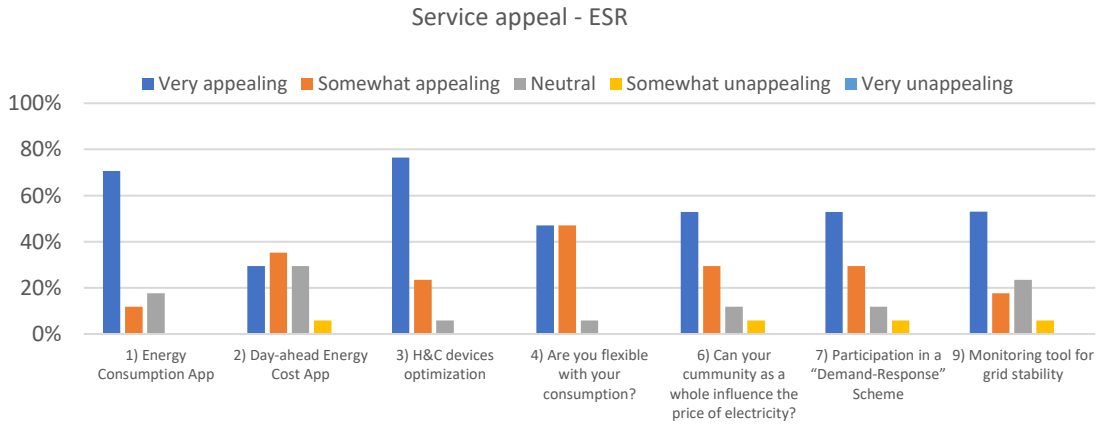


Figure 5.22: Services appeal - ESR customers stakeholders

The above figure shows that services proposed for application in Eva Lanxmeer community have been valued *positively*, especially for the benefits in providing an **insight** into consumption to make an optimal use of the energy supply and to check the operation of owned installations. The ultimate goal in term of **energy efficiency** has been seen as to live from the community generated energy as much as possible (reducing dependence on the main grid) and using the infrastructure collectively well with all the members.
ACCEPT project has been seen as a help in improving **together** innovative and **more sustainable** solutions at the neighborhood level, reduce costs and optimize comfort as well as help in grid overload prevention.

Customers stakeholders general **concerns** are related to: need of **training** on energy specialized aspects, fear for too much daily effort required from them and difficulties in adjust daily activities accordingly to energy optimized management and the preference, in some cases, that appliances should not be switched automatically, plus some of the ideas beyond the services proposed are **already in place.**
Specific concerns on service 2) have been stressed on the daily tracking timeline; some of end-users would prefer day/night as they are afraid to not be so price elastic. Doubts on the system flexibility have been stressed also for the application of service 6), while too much effort and/or problems seems to be expected for service 7).
Worries about the extent to what **third-party control** of individual consumption and how **privacy** data are collected centrally to set up the services have also been stressed – especially on service 9).
Finally, some members consider the services, i.e. the app, with the only function of raising awareness so with time **it may be used less and less**.

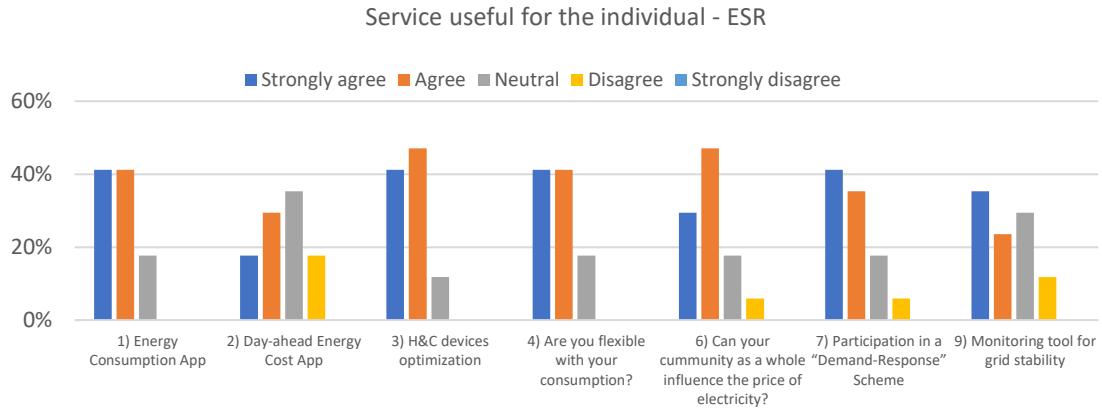


Figure 5.23: Services utility for individual members - ESR customers stakeholders

Most of Eva Lanxmeer community customers stakeholders agree on having *personal* ***advantages*** from the proposed services. In particular, benefits have been seen in finding the **balance between generation and consumption** and being able to eventually **adjust behaviors** as well as **curiosity** regarding how extent end-users consumption differs and bring financial benefits or a reduction of **dependency** from the grid.
Customers stakeholders **concerns** are mainly related to the need of **training** on energy specialized aspects especially for the application of service #2 and #9.

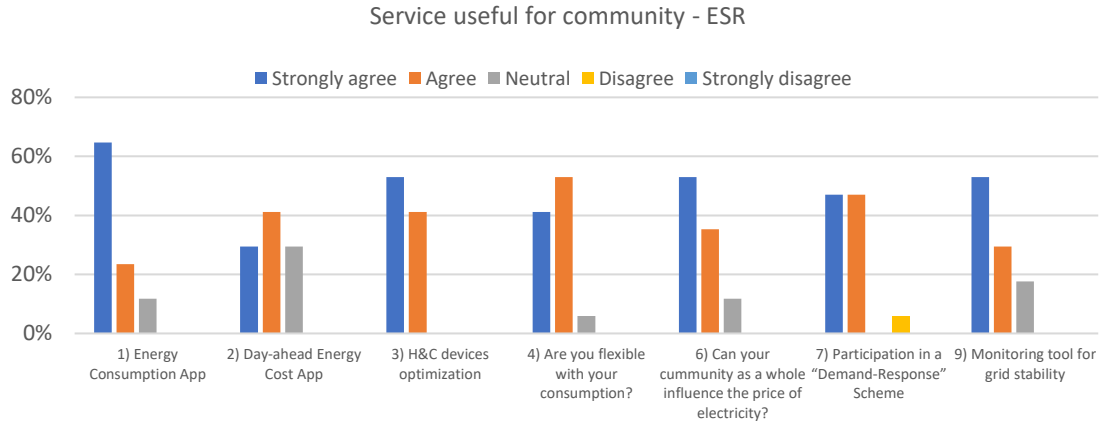


Figure 5.24: Services utility for community - ESR customers stakeholders

Community ***advantages*** have been identified in the increase of people **awareness**/insight into energy management in households with the possibility of explicit **moments of interactions** between members. This can bring to a more **sustainable neighborhood** and **avoid overloading** e-net.

Services have been seen useful also for having an **overview** of energy management in the entire district and visualize influence of individual installation on energy network load as well as for the district to have a **little dependence** on large suppliers.
Concerns are mainly related to the need of **training** on energy specialized aspects or possible need of a financial support to incentive the adoption of the proposed services – especially for the application of service #7.

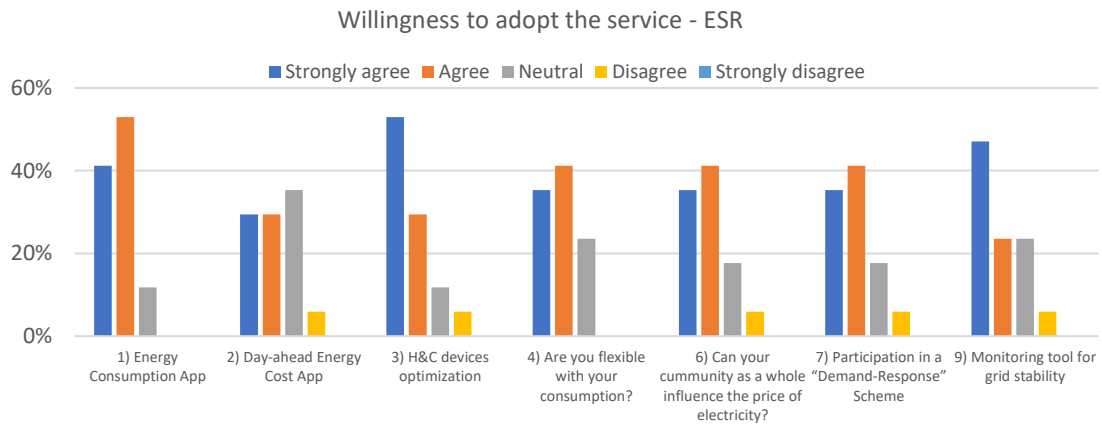


Figure 5.25: Willingness to adopt the services - ESR customers stakeholders

Most of Eva Lanxmeer community members have shown themselves ***willing to*** **adopt** ACCEPT services (e.g. instrument installation such as sensors, automatic control of the home assets, availability to shift your consumptions based on price or grid request, use of tools/App) especially to **hand over autonomy** and to **help the neighborhood** as a whole in a social way as long as it doesn't take too much effort.
Despite this, some members can be dissuaded from the hassle and **privacy sensitivity** of personal data or because they need more **insight** information regarding specialized issues or the overall project picture – especially for the application of service #2, #7 and #9.
Specific doubts on a lack of customers price sensitivity have been stressed for the service #3.

5.1.4.2. B2B Results

First of all, demographic characteristics of concept test participants have been analyzed and are shown in Figure 5.26. As already explained, per GDPR and the ACCEPT ethical guidelines (see D1.5), informed consent was obtained from each respondent prior to their participation and all the following questions were proposed as "optional".
For every selected parameter (background, gender, educational level, age) RINA-C has been able to achieve a mixed sample of actors' respondent. In particular, **background** categories reached have been mainly Municipality (26%) and Retailers (21%) followed by Aggregator (16%) and Energy community (16%). We collected both **male and female** responses, with male preponderance (89%). Business stakeholders' level of **education** has been highlighted as Bachelor's/Master's Degree (42%-47% respectively).
Finally, the youngest range of **age** has been found in "25-34 years" (16%) while answers have been collected also for "35-44" (37%), "45-54" (32%) and "55-64" (16%) ranges.

With reference to the demographic characteristics of the business stakeholder respondents, no particular trends or correlations have been found between the profile of the respondent and the answers given to the survey. It is therefore believed that the feedback received does not depend on the profile of the person.

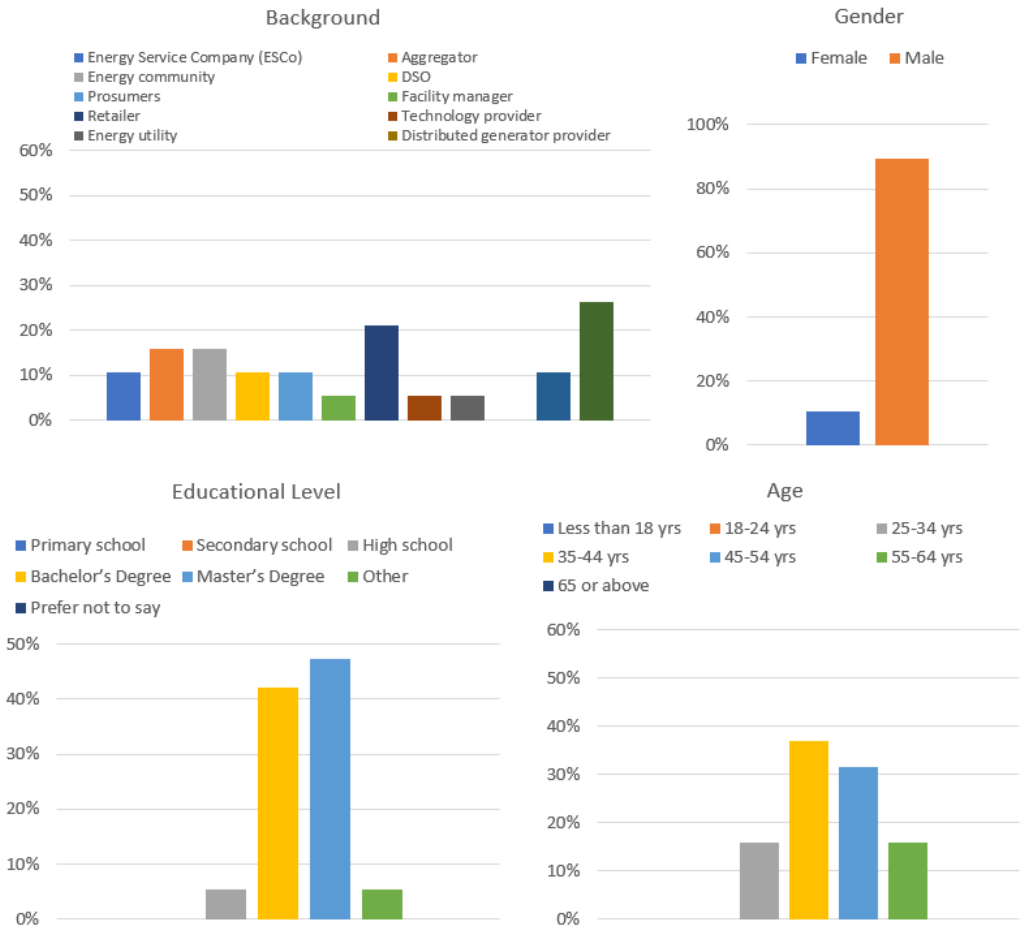


Figure 5.26: B2B Respondents Demographic Characteristics

Firstly, an analysis of general feedback on ACCEPT attractiveness has been performed. Figure below shows that ACCEPT project has been seen *very appealing* mainly for its **innovative opportunity** in the business relation with consumers and to find a "new energy system" more transparent, honest and democratic as well as for its **local** compound and the possibility to prevent heavier lines for electricity, to keep the E-network balanced (balance between demand and production).

Most of respondents did not expressed **concern** about the energy community concept if not from the **financial** side regarding the implementation of the project or the difficulty to **involve**/convince and coordinate neighbors as well as the importance for the DSO to find efficient solutions aim to not "disturb/bother" the users, especially in long terms.

Moreover, **main challenges** of the ACCEPT concept for its effective marketability have been stressed as people's resistance to change, the data management for privacy of members of community and the need to provide a clear guidance to the end-users in order to avoid trust issues and communicate with transparency and information. Another challenge has been identified for power to heat because the adaptation of the regulation strategy with an additional set of parameters (related to the price and volume of renewable energy locally available) could require serious additional software programming.

Regarding the **role** as stakeholders directly involved in ACCEPT project, business pilot sites stakeholders prefer to be involved in an active or moderate way, as showed in the figure below.

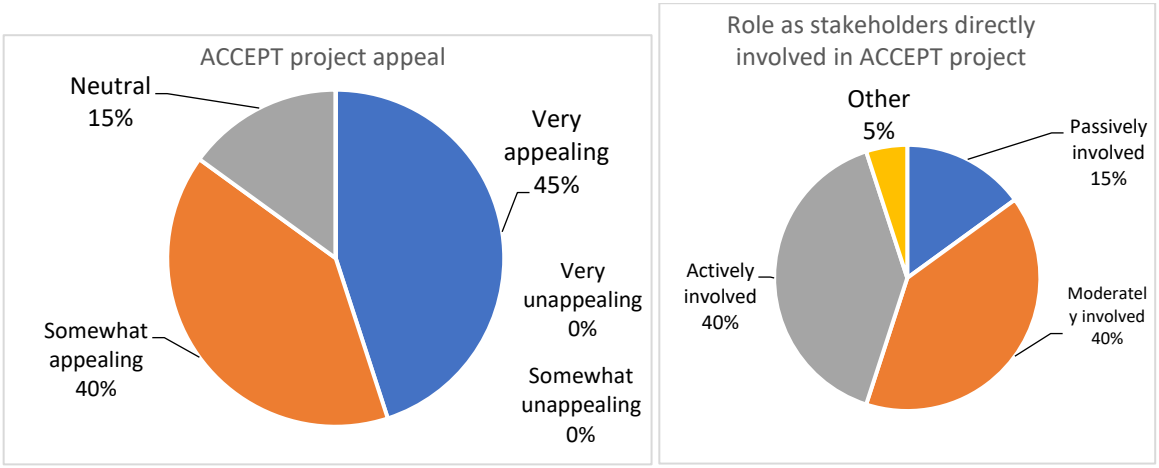


Figure 5.27: B2B ACCEPT appeal and role in the project

Most of the barriers that may limit the success of the roll out of ACCEPT services have been identified as ***technical*** issues, mainly on allowing your electricity supplier to automatic control some settings (e.g. set-point (on-off), set-point boilers, HP, HVAC, concerns about service reliability and difficulties in installing specific technologies.

Economic and ***social*** obstacles have acquired in almost all cases the same percentage. Among the economic aspects the high cost of investment prevailed and subsequently the modification (increase) of the bills but also due to the interests of large utilities that hinder and influence the legislation for its implementation in general, while the concerns on the social aspects are mainly on the possible lack of user-friendly information and lack of customer decision-making power followed from the possible visibility of infrastructures (e.g. wind turbines, solar panels, etc.). Finally, also ***regulatory/legislative*** aspect for the complexity of administrative procedures has always been stressed.

Specific barriers have been stressed due to the economic interests of large utilities that hinder and influence the legislation for its implementation in general or concerns about radiation of communication between devices, and the issue of liability of the financial risks involved in not delivering the performance offered to energy markets.

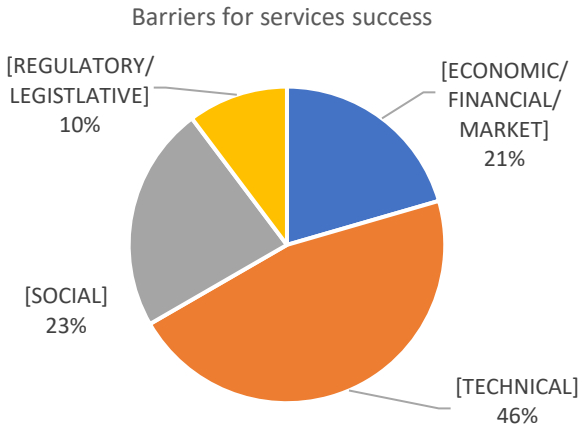
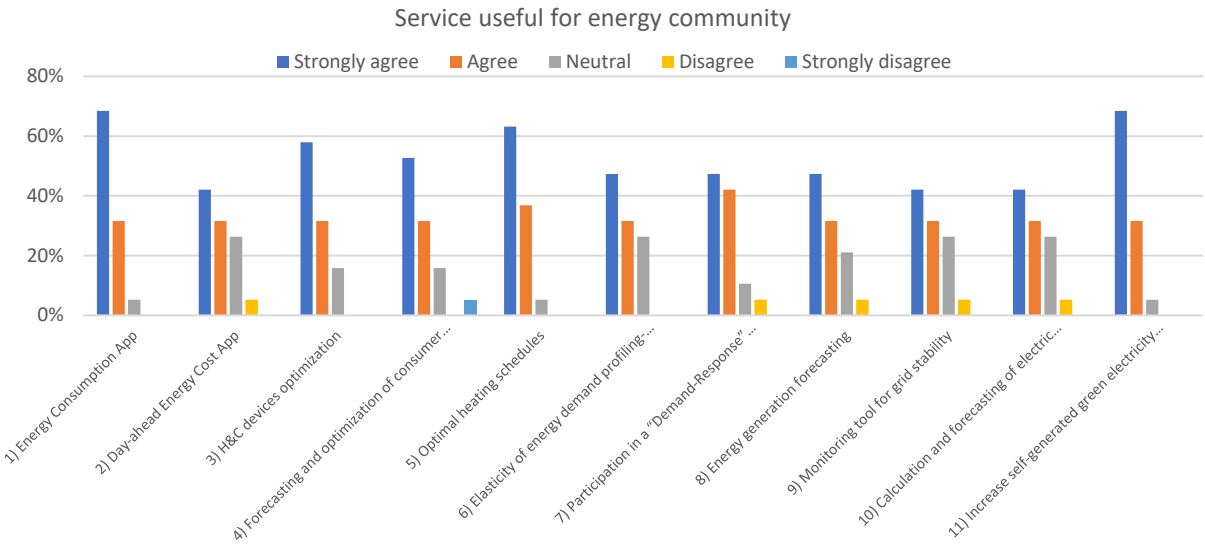


Figure 5.28: B2B Barriers for Services Success

Then, RINA-C asked business pilot sites stakeholders their opinion regarding the single service implemented in ACCEPT project. The results are presented in the below figure.



In general, most of business pilot sites stakeholders *agreed* with the implementation and utility of the services, mainly for the following reasons:

- **social awareness** improvement: insight to understand energy management, grid reliability, etc.
- **energy/system efficiency** improvement: reduction of transport/transmission losses and optimization of energy flows (supply and demand) through forecasting
- **economic advantages:** electricity price reductions through a cost friendly approach
- strong ideological ground that the whole (interconnected) energy system is better with robust **decentralized energy systems** with high level of balance between local production and consumption
- optimization of the energy purchases and possible applicability of the system also to sell the "flexibility" that the community can offer at energy markets (wholesale, grid balance, net congestion), if the community goals would change towards trading and speculation, especially for service #6
- applying service #10, car chargers helped "by the sun" could bring to the development of a business case of solar carport park
- balancing the grid avoids network problems and motivated the energy communities to balance their behaviors, especially for the application of service #9

General concerns have been indicated for the possible **loss of interest** with time in specific equipment, such as the app development in service #1 or the **willingness of the community** to actively participate and modify their habits. **Data privacy and security** have been also stressed as an important aspect to be taken into account. Moreover, has been highlighted the need for the maximization of self-consumption in an automatic way in order to not interfere too much with end-users private life as well as doubts about the actual significancy of the amount of energy and expenses "saved".

Finally, the following concerns have been stressed with reference to specific services:

- **barriers from the big utilities/companies,** which in some EU MS are the only actors that can carried out some of the actions implemented in service such as #6 and/or #7, not allowing small companies to enter cooperatives,
- service #4 has been especially seen as needed to reach the community goal of self-consumption, but it could not bring too much economic benefit to the consumers because of high governmental taxes on energy in the energy bill,
- the forecast planned for the implementation of service #8 has been seen as hard for small community with capacity of the generation system not big enough,
- some services i.e. #6, #8, #9 have been seen not for consumers but only business actors
- aggregating data as planned in service #6 could bring to the loss of data and less capability to steer separate users

About the main **technical criteria** considered as most **relevant for the actual feasibility and replicability of the ACCEPT services**, the following ones has been highlighted as the most important ones:

- *Technical criteria*: solutions should be safe and easy to use, with standardization as a key element for the deployment. Moreover, having enough storage capacity is essential
- *Environmental criteria*: the monitoring of energy consumption and production, the increase the consumption of self-generated green electricity (via renewable resources), strictly related to the technical criteria, CO_2 reduction and the minimization of the dependence of a single consumer
- *Market criteria*: legal barriers, the scale of the aggregated assets to make the business case feasible
- *Economic criteria*: economic interest of large utilities and cost savings for both energy community manager and for the end-users

Such criteria will be considered as requirements in ACCEPT services design and roll-up.

Regarding the **Business Cases,** 33% of the respondents agree that current business models are suitable for the set-up of an energy community. This because, from their point of view, the current technology solutions allow the deployment of energy community and renewable energies are well accepted. Moreover, current business models will allow that in addition to distributed electricity generation, the generation of employment and money is also distributed and with the possibility of accessing any professional and small business companies, not like now, in the hands of a few large companies. Main concerns about current business models are related to the contemporaneity of consumption / production is not taken into account for the distribution of costs / benefits and the fact that current business models do not provide sufficient information to the end-users making them less appealing for adoption. Most of the respondents have doubts since energy communities are in a developing process and obstacles that have to tackle into account are not known yet and the identification of business models that meet energy communities needs and are well accepted from the end-users could definitely make a huge step towards energy transition.

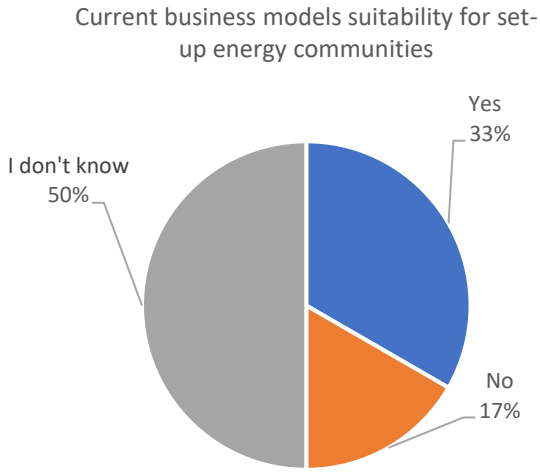


Figure 5.29: B2B Current Business Models Suitability

The Figure below, represents the attractiveness of each of the Business Case that will be analyzed within ACCEPT project, as described in Chapter 4.

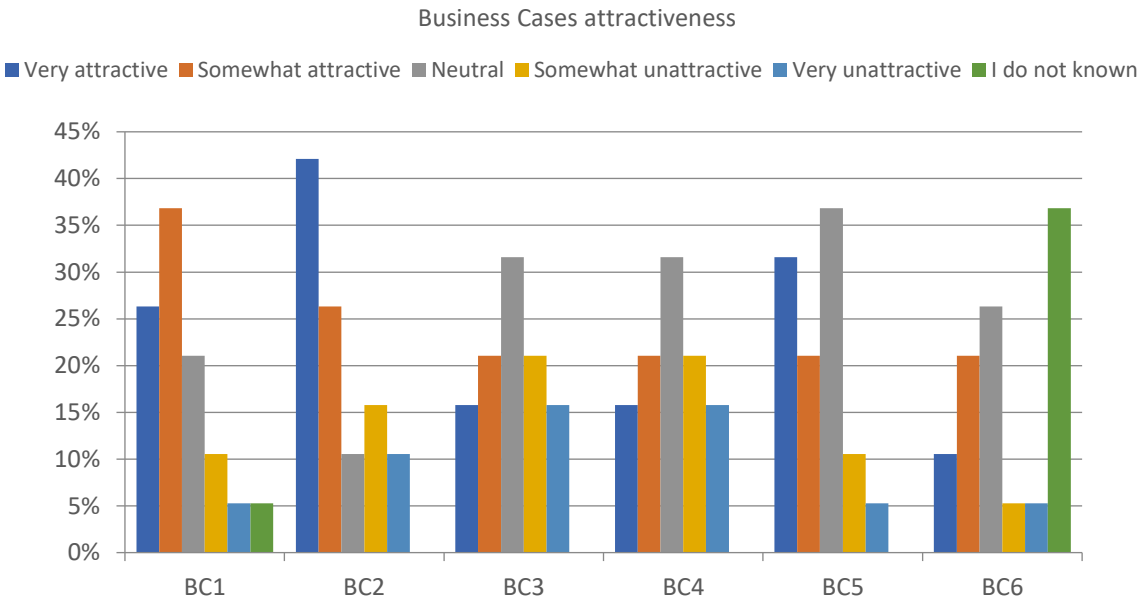


Figure 5.30: B2B Business Cases Attractiveness

In general, most of the business cases have been considered attractive or neutral even if for some of them concerns have been highlighted. The main comments/concerns for each of the BC has been summarized in the following table:

Table 5.4: B2B Business Cases Comments and Concerns

#	Comments	Concerns
BC1	• Necessary and essential step to achieve distributed electricity generation at reasonable prices • Reduction of Imbalances • Economic: reduction of investments and discounted rates for customers • Available flexibility has to be used for the community goal of increase self-consumption, that will provide most financial profit the community in the long run	• The aggregator can better service more energy communities (not just one) to have efficiency of scale • Might be difficult social and technical • Whether it's a unique user or a community the involved actors are end-users, so the TSO and DSO must be at their service and not the opposite • Avoid energy taxes by using locally produced energy real-time provides a bigger financial incentive than trading flexibility
BC2	• Necessary and essential step to achieve distributed electricity generation at reasonable prices • Local community level is the key • Added value services from a Utility Company • More attractive consumers participation	• Difficulties and lack of competence at least in the first phase • The aggregator can better service more energy communities (not just one) to have efficiency of scale • The cost savings of energy awareness and self-balancing are too limited to justify an ESCO
BC3	• Maximization of green energy generation self-consumption • Attractive at a community level, if the costs are less than the benefits	• The aggregator can better service more energy communities (not just one) to have efficiency of scale • More information needed • No feasibility at the moment because the money involved in flexibility trading between the households is too small and the energy required to operate the transactions in 'crypto currencies' make the costs of use unattractive

BC4	• Necessary and essential step to achieve distributed electricity generation at reasonable prices	• The aggregator can better service more energy communities (not just one) to have efficiency of scale • Too active role from the community required • Reduction of dependency to the Utility Company • Too many complications and not enough monetary savings especially at a small scale district, which usually use licensed electricity retailer
BC5	• Independence and possibilities to grow other energy communities • Attractive if doesn't require too much activity for the participants • Necessary and essential step to achieve distributed electricity generation at reasonable prices • Helps promote RES solutions and their value	• The aggregator can better service more energy communities (not just one) to have efficiency of scale • No feasibility at the moment because the money involved in flexibility trading between the households is too small
BC6	• Added Value for Utility Companies via new Services Provision • Flexibility for the customer and a new business model for companies	• End-users could always have the feeling to spend too much or that comfort is not proportioned to the expenses

5.2. Use Case Requirements

5.2.1. Methodology for the definition of use case requirements

Apart from the users' and stakeholders' requirements as defined in the previous sections, also the requirements related to the **technical objectives of the project and to the use cases** has been identified. Such requirements are necessary for the establishment of the different components of ACCEPT system architecture. Through the requirement analysis it is possible to identify all necessary attributes, capabilities, characteristics, or qualities of a system that covers the needs of its users. To this end, each requirement describes measurable conditions the fulfilment of which is possible to be evaluated.

An initial list of requirements has been identified for each of the Use Cases starting from the sub-sections presenting the scenario-steps of each use case in Chapter 3. Such list has been later refined, adding general requirements common to all the ACCEPT project objectives. All the requirements, both the general ones and Use case specific ones have been categorized by type of requirements (privacy & security, functional, non-functional, operational) and priority (high/medium/low).

The following sections present the detailed list of the ACCEPT requirements as defined in the first 6 months of the project. Section 5.2.2 presents general requirements which apply to all UCs while Sections 5.2.3 present requirements applying specifically to each of the 13 UCs of the project (no specific requirements have been identified for UC14 since it is not a technical use case).
It should be stressed that the definition and elaboration of a project's requirements is a continuous process as technical, economic and regulatory developments may alter / cancel previously defined requirements or add new requirements. Therefore, the list of requirements presented in the following sections depicts the initial perspectives of the ACCEPT consortium but will be subject to changes during the development of the project.

Furthermore, this continuous update of the project's requirements will be primarily driven through the active end-user and local stakeholder participation and involvement in the ACCEPT Living Labs (Task 3.1). Questionnaires and surveys have been already compiled and shared with end users and involved stakeholders (from consumers/ flexibility providers and DSOs to Aggregators, Building Managers, Regulators, Market Experts and overall local communities) to capture their view and requirements for the specific services that will be implemented in the four pilot sites (See Chapter 6.1). However, new Living Lab workshops will be organized in the next phase of the project

that could partially add/modify the current list of requirements. This could possibly be updated after the first pilot site ex-ante survey organized within Task 6.1.

Finally, as part of deliverable D2.3 and D2.4 ("ACCEPT system architecture description v1/v2"), the list of requirements will be updated based on the developed ACCEPT architecture and will be further elaborated by defining their rationale, acceptance criteria, dependencies and conflicts.

Regarding their type and nature, the requirements have been divided to:

~~a)~~ **functional** requirements, which constitute the fundamental requirements around the technical capabilities of the ACCEPT solutions
~~b)~~ **non-functional** requirements, which describe the general properties and qualities of the ACCEPT solutions
~~c)~~ **operational** requirements, which describe enabling conditions for the practical realization of the ACCEPT solutions
~~d)~~ **privacy & security**: who and under which conditions has access to the functionalities and data associated with the ACCEPT solutions

Regarding their **priority**, three different classes have been introduced:

a) High (H) priority, including requirements which are critical and necessary to achieve the goals of the project,
b) Medium (M) priority, including requirements which are necessary or very helpful to realize the application prototypes,
c) Low (L) priority, including requirements which are not of immediate relevance for the project, but their realization may provide additional features or benefits for applications or users.

5.2.2. General requirements

The list of general requirements helps setting the high-level objectives of the project and will help the development of all the ACCEPT solutions of the work to be developed in all the other tasks and work packages. This list contains general requirements that will guide the initial steps of the project related to: i) objectives that need to be taken into account in the design of all the technical solutions, ii) technical requirements common to all ACCEPT tools.

An overview of all general requirements is reported in the following table. Such list has been prepared by the whole consortium.

Type	Description	Priority (L/M/H)
Privacy & Security	Involved data exchanges should not be vulnerable / exposed to security hazards	H
	Data owners will ultimately decide for which purposes their data can be used	H
	The developed solutions will allow data anonymization where needed, by using anonymous labels or aggregation of personal data or pseudonymisation	H
	The developed solutions should conform to data protection schemes according to GPDR requirements and relevant national data protection legislation	H
	Customers should give their explicit, written, informed consent prior to any collection of their data	H
Non-functional	*The developed solutions:*	\
	- must be based on open standards	H
	- should be interoperable to ensure high replication potential	H

	- should be scalable in terms of computation and communication	H
	- should not endanger the security of supply and reliability of the underlying electricity grid	H
	- should be cost efficient, deploying the least-cost technological alternatives	M
	- should empower electricity consumers and foster decentralisation of the energy system (e.g. through micro-generation and community energy trading)	H
	- should be based on the principles of the energy market, fostering competition and market-based provision of services.	H
	- should conform to the current market and regulatory framework in the pilot countries and the EU in general.	H
	- should be adaptable to potential future changes in the EU market and regulatory framework.	M
	- should be non-intrusive	H
	Communication systems must be based on a specific, pre-defined set of protocols.	H
	A suitable support framework should be developed for the end users of the developed solutions	H
	The end users need to participate in decision making concerning the deployment, management and modification of the developed solutions	H
	The developed solutions should be able to handle different data formats	M
Functional	Periodic assessment of data quality should be performed to deal with various sources of erroneous data.	M
Operational	Sufficient data storage capacity should be available	H

5.2.1. Use Case specific requirements

The following tables presents the requirements associated with each of the identified Use Cases.

5.2.1.1. Use Case 1

UC1: Monitoring and Visualization of Metering & Sensor Energy Data in community buildings		
Type	**Description**	**Priority** L/M/H
Privacy & Security	Secure data exchange between sensors and IoT	H
	Secure data exchange between IoT and Cloud Applications	H
	Data storage compatible with GDPR, and anonymized where needed	H
Non-functional	Scalability, be able to easily include new participants (users, buildings, communities)	H
	Modularity, assemble IoT from off the shelf equipment	H
	Stability, stable operation at all times	H
	Security, in transmitting, receiving, storing data and user authentication/authorization	H
Functional	Models are calibrated and trained with historical data	H
	Models are updated with current data	H
	Store data locally in case of connection error	M
	Compatibility with off the shelf sensors	M
Operational	Sensors and meters have been installed properly	H
	Internet connection established	H

5.2.1.2. Use Case 2

UC2: Building self-consumption employing Virtual Thermal Energy Storage optimisation		
Type	**Description**	**Priority** L/M/H
Privacy & Security	Secure transmission of raw data	H
	Secure transmission of requests	H
Non-functional	Establishment of monitoring, control and communication infrastructure	H
	HVAC resources	H
	Software modules for modelling and consumption optimization	H
Functional	Model assets and citizen characteristics/ behaviour	H
	Optimize self-consumption at the building level	H
Operational	-	

5.2.1.3. Use Case 3

UC3: Consumer demand-side flexibility forecasting and optimisation taking into account comfort boundaries, activity patterns and possible requirements		
Type	**Description**	**Priority** L/M/H
Privacy & Security	Secure transmission of raw data	H
	Secure transmission of requests	H
Non-functional	Establishment of monitoring, control and communication infrastructure	H
	HVAC resources	L
	Software modules for modelling and consumption optimization	H
Functional	Model assets and citizen characteristics/ behaviour	H
	Compute and aggregate flexibility	H
Operational		

5.2.1.4. Use Case 4

UC4: Demand elasticity profiling-forecasting-aggregation and analysis in community level		
Type	**Description**	**Priority** L/M/H
Privacy & Security	-	
Non-functional	Comprehensible graphical visualisation of data provided to the supplier	M
	User friendly	H
Functional	Ability to receive monitoring data at any time	M
Operational	-	

5.2.2. Use Case 5

UC5: Intra-day district-level DER flexibility management for community self-balancing		
Type	**Description**	**Priority** L/M/H
Privacy & Security	-	
Non-functional	Markets requirements	H
Functional	Weather forecast	M
	Energy costs	H
	Real time data from Generation DERs	M
	Real time data from Storage	M
	Receive power values / time stamp	M
Operational	establishment of real-time metering, monitoring and control infrastructure in district assets	M

5.2.3. Use Case 6

UC6: Day-ahead smart charging flexibility quantification via EV usage pattern profiling and forecasting		
Type	**Description**	**Priority** L/M/H
Privacy & Security	Apply anonymization-pseudonymization	H
	Secure Wireless Communicarions	H
	Security measures concerning the citizen app	H
	Homomorphic Encryption on Collected Data	M
Non-functional	Use of OCPP for any applicable communication with the EV chargers.	M
Functional	real-time measurements of EV chargers	H
	historical data of EV charging/discharging	L
	Received favoured price signal	M
Operational	Communication infrastructure in place and operational	M

5.2.4. Use Case 7

UC7: Community-level P2P flexibility/ energy exchange based on locally produced renewable energy		
Type	**Description**	**Priority** L/M/H
Privacy & Security	Has established secure connection	H
	Immutability of transaction data	H
	Annonymization of users	H
Non-functional	Allows for high volume of trasnactions	M
	Allows for constant addition of new users/peers	H
	Continuous/uninterapted trading process	H
Functional	IoT system installed	H
	Production and consumption forecast	M

	P2P Platform achieves consensus over the exchanged information	H
	Peers are online	H
Operational	Ability to receive significant KPIs compatible with smart contracts	H
	Ability to receive significant forecast data and KPIs compatible with smart contracts if necessary	H
	Ability to communicate with Communicate Tools	H

5.2.5. Use Case 8

UC8: Participation in explicit Demand Response schemes		
Type	**Description**	**Priority** L/M/H
Privacy & Security	Apply anonymization-pseudonymization	H
	Secure Wireless Communicarions	H
	Security measures concerning the citizen app	H
Non-functional	Smart-contracts have been agreed	H
	User-oriented	M
Functional	Real-time monitoring	M
	Monitoring and control infrastructure is required in the buildings	H
Operational	Integration of the forecast, flexibility and decision-making tools	M
	Communication infrastructure in place and operational	H

5.2.6. Use Case 9

UC9: Participation in implicit Demand Response schemes		
Type	**Description**	**Priority** L/M/H
Privacy & Security	Apply anonymization-pseudonymization	H
	Secure Wireless Communicarions	H
	Security measures concerning the citizen app	H
Non-functional	User-oriented	M
Functional	Real-time metering, monitoring and control infrastructure is required in the buildings	M
	Energy consumption forecast	M
	Energy prices forecast	M
Operational	Communication infrastructure in place and operational	H
	integration of the forecast, flexibility and decision-making tools	H

5.2.7. Use Case 10

UC10: Community flexibility bundling for local congestion management service		
Type	**Description**	**Priority** L/M/H
Privacy & Security	-	
Non-functional	-	

Functional	real-time metering, monitoring and control infrastructure in the buildings assets, electric grid and central HP	M
Operational	Operation request flag	M
	flexibility value for assets	M

5.2.8. Use Case 11

UC11: Retailer day-ahead optimal pricing configuration for aggregated portfolio balancing		
Type	**Description**	**Priority** L/M/H
Privacy & Security	-	
Non-functional	Available feedback from market	H
	Available business scenario(s)/ strategies	H
Functional	Pre-processing at the management for data cleaning and normalization	H
	Pricing and profiling algorithms defined and implemented	H
	Continuous reporting of behavioural changes from customers	M
	Access to weather conditions data through API	M
	Robust Forecasting tool	H
Operational	Ability to receive monitoring data at any time	M

5.2.9. Use Case 12

UC12: Optimal scheduling and operation of heating generation for a cost-efficient district-level DER management		
Type	**Description**	**Priority** L/M/H
Privacy & Security	-	
Non-functional	-	
Functional	Heat demand forecasting system	M
	Weather forecast	H
	Energy costs	H
	Data storage	M
	Model of the storage	H
Operational	-	

5.2.10. Use Case 13

UC13: Increase self-consumption at local community level		
Type	**Description**	**Priority** L/M/H
Privacy & Security	Secure transmission of raw data	H
	Secure transmission of requests	H
Non-functional	Establishment of monitoring, control and communication infrastructure	H
	Renewable resources connected to energy storage devices	L
	Software modules for optimization	H

Functional	Model assets and citizen characteristics/ behaviour	H
	Compute and aggregate flexibility	H
	Optimize self-consumption at the community level	H
Operational	Communication and operation of building and district assets should be made at the same level and granularity	M

6. Conclusions

The results of activities summarized and reported in this deliverable, enable the planning and development of the activities of all the other WPs and tasks since such results will drive ACCEPT tools development and demonstration activities. In particular, business and citizen/user requirements for the ACCEPT framework were defined and analysed, driven by business scenarios and use-cases to allow communities, prosumers and other market actors to easily grasp the intention, functionality and use of the project results.

The main results achieved are hereby summarized for each of the main topics of the analysis.

Regulatory framework

Firstly, the current European and policy framework related to Energy Communities, and in particular the Renewable Energy Directive (RED II) and the Electricity Market Directive (EMDII), the has been analyzed together with their transposition at National level. All the countries represented by ACCEPT project partner have been evaluated through a dedicated survey. The aim was to identify regulatory instruments, the position of local government and the presence of non-technical aspects including legislative and regulatory barriers/restrictions and how to overcome these barriers/restrictions. At a general level, it should be noted that the transposition of EC directives into national legislation of Member States regarding energy communities is slow, and even more importantly heavily diversified.

From the investigation of the barriers towards promoting and developing energy communities the following aspects emerged:

- The existing **regulatory framework** seems complex, fragmented and not designed to promote energy community creation;
- Need for policies to **oblige major's DSO** to share information and solutions to new technical advances;
- Lack of **organizational & administrative** effort
- Access to **funding for customer**, especially for municipality and small companies
- Incentive programs/**financial incentives** are focused on the single "devices" and not on systems, making economically challenging to substitute old fossil heating systems with renewable ones.

ACCEPT Use Cases

To proper address ACCEPT objective, fourteen ACCEPT Use Cases have been identified and strategically designed and formulated. The Use Cases have been divided also in three main group bases on what they refer to: Building assets, Energy Communities or Distributed Energy Resources. For each Use Case, a responsible partner as well as a secondary one has been appointed based on partners' role in the project, expertise and knowledge. Each Use Case has been defined through a dedicated templated follow the standardised IEC 62559 methodology and includes the following sections: a) general description, scope and objectives, b) use case diagram and sequence diagram, c) technical details (actors, triggering events, preconditions and assumptions), d) scenarios and steps, e) exchanged information, f) interconnection with other Use Case. The detailed definition of the Use Cases is an important step for the future development of all the ACCEPT solutions as well as will drive demonstration activities. Moreover, an association between Use Cases and pilot sites where the UC will be deployment, tested and validated has been agreed between technical partners and pilot site responsibles, to evaluate specific remarks to be considered tailored to each pilot site.

ACCEPT Business Cases

Considering the ACCEPT Use Cases, seven different Business Cases have been analyzed to the purpose of defining possible business scenarios that, along with use cases, drive the user requirement definition process. Each of the Business Case have been associated to at least on Pilot Site where it will be tested, as well as an association between each BC and the UCs have been defined. For each of the Business Case, possible services to be offered, main actors involved and their role, main objective of each of the service, needed inputs to achieve BC objective and expected benefits have been identified with the support of pilot responsible.

Moreover, obstacles and barriers to BCs implementation, divided in five main groups (Regulatory and Legislative, Economic and Market, Technical, Social, Organizational), have been identified together with potential mitigation

actions. The analysis of obstacles and barriers, in turn, allowed to have an initial understanding of the degree of applicability of BCs to the ACCEPT Pilot Sites. The main results could be summarized in:

- *BC1*: the main benefits of the services that could be offered within BC1 take the form of economic incentives to the DSO, TSO and end-users. The main barriers for its applicability are related to both Regulatory and Legislative (interaction with DSO), Economic and market (absence of already developed markets), Technical (removing obstacles around enabling technologies and DMS) and Social (lack of awareness and knowledge). In general, its applicability is easier is Dutch Pilot Site respect to the Spanish one.
- *BC2*: its implementation might bring important benefits to the Energy Community members, in that it would allow for a reduction of energy consumption due to better usage of devices and energy bills for users, it would lead to an increase of local energy usage, it would improve energy and cost transparency and raise citizens awareness. The main barriers for its applicability are quite different among the four pilot sites however in all the pilots the BC have a very good level of applicability
- *BC3*: In order for BC3 to be implemented, technological and policy related input would be needed. In general, it allows to rise the end user's acceptance and trust towards the related services and to familiarize them with energy trading. BC3 presents a good level of applicability, with the lack of awareness and knowledge the main barrier.
- *BC4*: its implementation could permit to simplify the energy trading, to arise end-customer's acceptance and trust towards related services, to familiarize end-users with Demand Response Schemes, and to increase long term energy trading and economic forecasts. As for BC2, among Pilot sites answers on obstacles and barriers present a high variability, even if in all the cases it presents a good level of applicability
- *BC5*: its implementation would represent a large step towards the realization of sustainable communities. Benefits related to this BC are related to the creation of dedicated energy trading services and business models that will favor both the company and end users and, from a perspective external to the community, a better Energy Load Optimization, especially thanks to insights of the end-users. Concerning obstacles and barriers to BC5 implementation, LaSolar (the only pilot where this BC will be tested) consider as relevant 19 out of 21 barriers. In particular, since P2P flexibility trading is not yet developed, the absence of markets and of suitable business models act as a high priority obstacle. The sum of high and medium priority barriers represents, the 95% of the total and this led us to consider BC5 as a business case that presents a moderate level of applicability to LaSolar. However, the mitigation actions previously discussed can increase the level of applicability from moderate to good.
- *BC6*: the main benefits of this BC are related to ensure customer retention, together with the increase of local energy usage, the reduction of consumptions, energy and costs transparency, and the user exemption from maintenance duties. The BC presents a very good level of applicability in AEM, even if the absence of suitable business models has been highlighted as medium priority
- *BC7*: thanks to the possible services to be offered, it would be possible to bring important benefits to the Energy Community members which take the form of savings in the electricity bill, increase in flexibility capacity and, from an external point of view, ESCOs would have the opportunity to have at disposal tools that allow to implement energy savings measurement. The only barrier identified as high priority is the Lack of awareness and knowledge (Social) while Cybersecurity and Privacy aspects (Technical) constitute a barrier of medium priority. BC7 seems to be easier to be implemented in Spain than in the Netherlands which, however, is highly stimulated in implementing this BC and ESR shows a strong motivation to work on the barriers within the Project.

ACCEPT Requirements

Based on the Use Cases and Business Case, Users requirements (for both customers stakeholders and business stakeholders) and Use cases requirement have been collected. While users requirements have been collected through two dedicated surveys (B2B and B2C) to collect feedback on how the ACCEPT solutions should be developed and understand feelings/concerns of the ACCEPT services, Use Cases requirement are strictly related to the technical solution and have been collected starting from Use Cases definition, identifying for each of the four categorized considered (privacy & security, functional, non-functional, operational) their priority (high/medium/low).

From the two surveys distributed at pilot level, 115 answers were collected among the four pilot for the B2C and 19 for the B2B. The main results could be summarized in:

- ACCEPT project has been seen very appealing for both customer and business stakeholders mainly for social/environmental aspects and its innovative opportunity in the business relation with consumers and to find a "new energy system" more transparent, honest and democratic
- All customer stakeholders agree that the proposed services could provide both personal advantages as well as could provide benefit to the whole community, especially for promoting self-management and a better use of energy
- Mostly of business pilot sites stakeholders agreed with the implementation and utility of the services since they can increase social awareness, energy/system efficiency and providing economic advantages related to the reduction of the electricity price
- Mostly of the barriers that may limit the success of the roll out of ACCEPT services have been identified as ***technical*** issues in both B2C and B2B survey
- **Main challenges** of the ACCEPT concept for its effective marketability have been stressed as people's resistance to change, the data management for privacy of members of community and the need to provide a clear guidance to the end-users in order to avoid trust issues and communicate with transparency and information

The results of such deliverable represent a quality foundation for subsequent project activities. Above all, they will enable ACCEPT system architecture definition, Performance Measurement and Verification Methodology and related KPIs, development of ACCEPT ICT solutions, actual implementation of ACCEPT technical solutions and organizational activities, ACCEPT business models definition and evaluation.

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Annex I Regulatory Framework Survey Template

Description of national regulatory framework and online links	
At a country level, are you aligned with the above-mentioned laws?	.....
If no, please clarify why you are not aligned	.....
Is there any other national regulation related to these aspects that you refer to? *Please, answer "yes" or "no" providing details about it.*	.....
How do you think government policies have affected energy communities in your country, and your organization in particular?	.....
How do you think the government's energy policies might influence the energy communities in the future?	.....
Are there tools with which the government is incentivizing energy transition (e.g. EU Recovery Fund)?	.....
What do you think are the legislative, legal and market barriers facing energy communities in your country? How can they be mitigated?	.....
Is there existing legislation (or specific national/regional support programmes) in your country, designed to promote energy community creation, that has had a negative impact on your works? If so, how has it acted as a barrier?	.....
Which are the existent remuneration schemes, if any (e.g.: for surplus energy generated by prosumers)? *Please indicate the legislative or project/initiative reference*	.....

Annex II ACCEPT Use Cases Template

Use Case Title
1 Description of the Use Case

a. Name of Use Case

Use case identification: Including an ID, the SGAM Domains and Zones treated in the use case, and a name

Use Case Identification		
ID	Area / Domain(s)/ Zone(s)	Name of Use Case

b. Version management

Here, the history of updates of a given use case is included

Version Management				
Version No.	Date	Name of Author(s)	Changes	Approval Status

1.1 Scope and Objectives of Use Case

The scope describes what to what the use case is aiming to and its boundaries and obstacles. The objectives are presented as a list. A list including the related business cases is also included

Scope and Objectives of Use Case	
Scope	
Objective(s)	
Related business case(s)	

1.2 Narrative of Use Case

In this section, both a short and an extended description is included. The complete description should specify how, where, when and why. It is important to keep the descriptions simple, ensuring that they can be understood by non-experts.

Narrative of Use Case
Short description
Complete description

1.5 General Remarks

General Remarks
Is used for further comments which are not considered elsewhere. Any other important details related to the use case that does not fit anywhere else can be included here.

1.6 Further Information to the Use Case for Classification / Mapping

The following table presents further Information for the classification of this use case:

Classification Information
Relation to Other Use Cases
Relation such as include, extend, invoke or associate
Level of Depth
High level or individual
Prioritization
Mandatory or optional
Generic, Regional or National Relation
Given the reach of this project, a international nature may be also included
Viewpoint
Nature of the use case: Technical, political, business, test, etc
Further Keywords for Classification
A list of words related to the use case to ease later relations and identifications.

2 Diagrams of Use Case

The diagram aims to illustrate the structure of the use case.

For clarification, it is recommended to provide drawing(s) by hand, by a graphic or as UML graphics. The drawing should show interactions which identify the steps where possible.

UML use case diagrams, activity and sequence diagrams are usually used. Other diagrams can be included too.

Diagram(s) of Use Case
[Use Case Diagram] [Sequence Diagram]

3 Technical Details

3.1 Actors

In this section 3.1, actors which are involved in the use case are listed and described. These can for instance include people, systems, applications, databases, devices, etc. When necessary, actors can be sorted into groups. A name, a type, a short description and any necessary further information should be included,

The following table presents the actors involved in this use case:

Actors			
Actor Name	Actor Type	Actor Description	Further information specific to this Use Case

3.2 Triggering Event, Preconditions, Assumptions

The following table presents the triggering events, pre-conditions and assumptions of this use case:

Use Case Conditions			
Actor/System/Information/ Contract	Triggering Event	Pre-conditions	Assumption

4 Step by Step Analysis of Use Case

Template section 4 focuses on describing scenarios of the use case with a step-step analysis (sequence description). There should be a clear correlation between the narrative and these scenarios and steps.

4.1 Overview of Scenarios

The table provides an overview of the different scenarios of the use case like normal and alternative scenarios which are described in section 4.2 of the template.
In general, the writer of the use case starts with the normal sequence (success). In case precondition or post-condition does not provide the expected output (e.g. no success = failure), alternative scenarios have to be defined. A scenario describes a situation whose steps will be later defined. A short description, the responsible actor for the activation, the triggering event, preconditions and post-conditions must be included

The following table presents the scenarios associated with this use case

Scenario Conditions					
No.	Scenario Name	Primary Actor	Triggering Event	Pre-Condition	Post-Condition
S01					
S02					
S03					
S04					

4.2 Steps per scenario

For this scenario, all the steps performed shall be described going from start to end using simple verbs like – get, put, cancel, subscribe etc. Steps shall be numbered sequentially – 1, 2, 3 and so on. Further steps can be added to the table, if needed (number of steps are not limited).
Should the scenario require detailed descriptions of steps that are also used by other use cases, it should be considered creating a new "sub" use case, then referring to that "subroutine" in this scenario.
Steps make reference to the succession of events that takes place in a given Scenario. A description, the receiver and producer of the information, the information exchanged and any possible requirement should be included. The nature of the flow of information is determined in the Service field

The following tables present the steps of each of the scenarios associated with this use case as well as the respective requirements:

Scenario Name:	S01- "Title of scenario"							
Step No.	Event	Name of Process/ Activity	Description of Process/ Activity	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirements, R-ID

St01								
St02								
St03								

Scenario Name:	S02- "Title of scenario"							
Step No.	Event	Name of Process/ Activity	Description of Process/ Activity	Service	Information Producer (Actor)	Information Receiver (Actor)	Information Exchanged	Requirements, R-ID
St01								
St02								
St03								

Scenario Name:	S03- "Title of scenario"							
Step No.	*Event*	*Name of Process/ Activity*	*Description of Process/ Activity*	*Service*	*Information Producer (Actor)*	*Information Receiver (Actor)*	*Information Exchanged*	*Requirements, R-ID*
St01								
St02								
St03								

5 Information Exchanged

The following table presents the information exchanged in the context of this use case:

These information objects are corresponding to the "Name of Information" of the "Information Exchanged" column referenced in the scenario steps in template section 4 "Step by Step Analysis". If appropriate, further requirements to the information objects can be added.

Information Exchanged			
Information exchanged (ID)	Name of information	Description of Information Exchanged	Requirements to information data
Refers to an identifier used in the field "Information Exchanged" of Table 4.2.	Is a unique ID which identifies the selected information in the context of the use case.	Brief description, in case a reference to existing data models/information classes should be added. Using existing canonical data models is recommended.	Can be used to define requirements referring to the information and not to the step as in the step by step analysis (see template section 6 below): EXAMPLE: Data protection class corresponding to this information object.

Annex III Business Cases Survey Template

Business Cases ad hoc Questionnaire

BCX: *Short Description* Full description	
With respect to the BC in question, would you describe the kind of services you would like to offer?	.....
Who are the main actors involved in the business case, their roles and responsibilities?	.....
Which are the objectives you intend to achieve by offering the services envisaged within this business case? If possible, specify how do you intend to reach the objectives just described	.....
Which are the inputs do you need to achieve your objectives? (examples of inputs are technological, economic, and financial resources; policies and incentives; partnerships, business relations, etc.)	.....
What are the benefits that can be obtained by offering those services, both from the company point of view and from an external perspective?	.....
In order to collect information on what you believe are the main barriers (legislative / economic / market / financial / social / environmental) we ask you to fill in the *Obstacle and Barriers Table* where you can find a list of barriers, for each of which you can provide a quantitative assessment and open comments. Furthermore, we ask you to indicate other obstacles if they are not included in the list provided.	

Category of obstacles	Short Description of obstacles	Priority (H/M/L)	Qualitative Rating (open comments)
Regulatory and Legislative	Definition of energy community Interactions with citizens Interactions with DSO Unstable regulatory framework Legal constraints (e.g. consumer participation)		
Economic and Market	High capital costs Absence of financial incentives Lacking efficient remuneration schemes No markets (remuneration) for provision of services to grid operators Absence of suitable business models		
Technical	Limited available flexibility Obstacles around enabling technologies Obstacles around demand side response Grid issue Lack of ICT tools Cybersecurity and privacy aspects		
Social	Lack of awareness and knowledge Negative perceptions Network and supply security Behavioral barriers		
Organizational	Lack of support from expert organizations		

Annex IV B2C Survey Template

ACCEPT H2020 Project – Survey for customers stakeholders' requirements

[INTRODUCTION]

What is ACCEPT?
The aim of the EU-funded ACCEPT project is to develop a digital toolbox with which energy cooperatives can offer innovative digital services. In this way we can realize financial benefits for all involved.
The ACCEPT project is running at four pilot locations: Greece/the Netherlands/ Switzerland/Spain.

Your opinions matter
In this questionnaire, we would like to hear your initial opinions about the new energy saving services being developed and tested locally in your community by the ACCEPT project. This analysis will help the ACCEPT team to understand your perspective so we can make the services being developed as effective as possible for your community as possible. For example:

- Are the services interesting to you?
- How useful are they?
- Do they address a need?
- Are you concerned about the impact of any of the services?
- Can you anticipate any reason these services wouldn't work for your community?

This questionnaire will take approximately 10-15 minutes to complete and your feedback will go directly to the team working to develop these services.
Moreover, to learn more about ACCEPT project, check out the project's website: https://www.accept-project.eu/ .
ACCEPT – "Active communities & energy prosumers for the energy transition" funded by European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 957781.

Privacy policy
By completing and answering to this form, you agree that the data you provide can be used by the ACCEPT Project. The data is only used for the purpose and duration of the ACCEPT project. The data you provide will be used in compliance with the national privacy law and the GDPR, data protection principles in Regulation (EC) 2016/679 (more information can be found on the official website: https://gdpr.eu/). If you have any questions regarding the Privacy Policy, do not hesitate to contact us via email to alessandra.cuneo@rina.org.

[ENERGY COMMUNITY FEEDBACK]
To begin, we'd first like hear your opinions about the ACCEPT project.

Is the ACCEPT project appealing to you?

- Very appealing
- Somewhat appealing
- Neutral
- Somewhat unappealing
- Very unappealing

Why do you feel this is appealing/unappealing?
……

[GENERAL QUESTIONS]

Do you have any concern about the electricity net?

- Yes
- No

If yes, what are your concerns?

……

As an end-user, what role *would you like* to play in the community (single choice answer)?

- Passively involved - Not actively engaging with any activities
- Moderately involved – Involved in some planning and co-creation activities (e.g. attend presentations, participating in a focus group)
- Actively involved – Involved in multiple activities throughout the project (e.g. providing energy data, receiving information about piloting results, attending webinars, participating in focus groups)
- Other. Please specify

……

[SERVICES FEEDBACK]

We would like to ask for your opinion on some of the specific services being developed for your community.

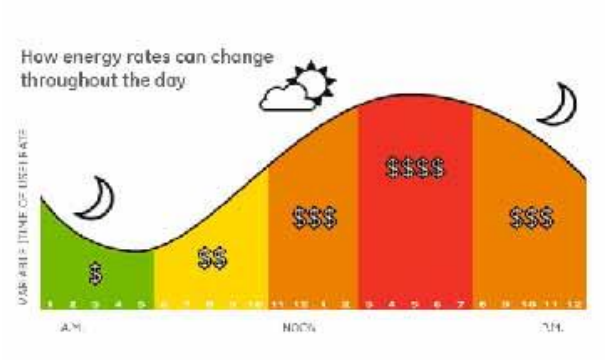
We will first provide you with a brief description of the service, then we will ask a few follow-up questions so we can better understand how you feel about this.

Your feedback will directly impact how the ACCEPT project team moves forward with the creation of these services.

Services that are going to be tested

1. **Energy Consumption App**
   - **The result**: Through an app, you can see your energy consumption profile and patterns visualized intuitively, so that you can make more informed decisions about your energy consumption
   - **What it does**: Uses sensors to monitor near real-time energy consumption data from community buildings and homes. This data will be displayed via efficient and meaningful visualizations designed to give end-users a deeper insight and understanding of their energy consumption
2. **App for Daily ahead Energy Cost**
   - **The result**: Provides you with a daily view of when energy prices will be best, so you can make more informed energy consumption decisions to help you save money
   - **What it does**: Through an app, you receive information about the energy day head prices
3. **Optimization of heating and cooling devices**
   - **The result:** This allows the community to use more local, self-generated green energy (i.e. produced via renewable resources). As a result, your community will reduce its dependence on the main grid. Additionally, the optimization of heating and cooling devices may help you lower your bills
   - **What it does**: This service will automatically utilize the most energy efficient settings so that traditionally heavy energy consumers – heating and cooling devices – can be optimized without sacrificing your comfort levels
4. **Are you flexible with your energy consumption?**
   - **The result:** By understanding when you, the energy consumer, might be more flexible in terms of energy consumption, the energy provider can better forecast and optimize energy distribution
   - **What it does:** Identifies building occupant's (e.g. residents, businesses) energy consumption behavior and preferences. For example, preferred comfort levels (e.g. room temperature), daily activity patterns (e.g. working from home, cooking, relaxing). As a result our energy provider can provide energy at a lower price at certain hours
5. **Optimal heating schedules**
   a) **The result:** This keeps your heat production at the optimal level, meaning you can maintain your comfort levels without compromising energy efficiency
   b) **What it does:** At the community level, identifies the optimal schedules for operating heating systems
6. **Can your community as a whole influence the price of electricity?**

- **The result**: Throughout the day, energy price vary based on the overall demand for energy. For example, in the evening, when most customers at home are cooking dinner and relaxing, energy prices will be higher. By better understanding your community's energy needs, it becomes easier for energy providers to purchase the optimal amount of energy from the energy market in total. This, in turn, allows energy providers to offer you 'dynamic pricing schemes' that reward customers with lower prices for not using energy at the costliest times of production
- **What it does**: Combines individual user behaviors profiles into one larger profile for the community as a whole. Having one aggregate community profile helps to identify the optimal amount of energy to be purchased from the energy market



7. **Participation in a "Demand-Response" Scheme**
   - **The result**: Participants of prosumers in demand response schedules help to take the strain off of the grid and ensure everyone can enjoy a stable energy supply without fear of interruption
   - **What it does:** Invites 'prosumers' (energy customers that also produce some of their own energy from, for example, solar PV panels) to participate in 'Demand response schemes'. These schemes provide an opportunity for prosumers to play a significant role in the operation of the electric grid by reducing or shifting their electricity usage during peak, high demand periods
8. **Energy generation forecasting**
   - The result: By predicting energy generation at the community level, more flexibility can be created, resulting in a more efficient and reliable energy network
   - What it does: Forecasts your community's renewable energy generation for the next hour or day ahead
9. **Monitoring tool for grid stability**
   a) **The result**: Provides the real-time status of the electrical network forecasts congestion events (black-outs, voltage problems, etc…) in order to prevent them or identify and evaluate the sections of the grid that could present congestion and act accordingly to avoid it.
   b) **What it does:** Provides a tool to monitor and control district level

The following questions were proposed for every service.

To what extent do you find this service appealing?

- Very appealing
- Somewhat appealing
- Neutral
- Somewhat unappealing
- Very unappealing

Why do you feel this idea is appealing/unappealing?

……

Do you find this service useful for you personally?

- Strongly agree
- Agree
- Neutral

- Disagree
- Strongly disagree

Why/why not? What need would it fill?

……..

Do you find this service useful for your community?

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

Why/why not? What need would it fill?

……..

Willingness to adopt this service (e.g. instrument installation such as sensors, automatic control of the home assets, availability to shift your consumptions based on price or grid request, use of tools/App)?

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

Why/why not?

……..

Do you have any concern about this service?

- Yes
- No

If yes, which kind of concern do you have?

……

[BARRIERS]

Next, we would like you to think about how these services might be implemented in in your community. From the list below, please select any barriers that you think may limit the success of the roll out of these services.

- Modification (increase) of energy bill [ECONOMIC/FINANCIAL/MARKET]
- High investment costs [ECONOMIC/FINANCIAL/MARKET]
- Installation of too many devices/systems [TECHNICAL]
- Difficulties in installing specific technologies
- Allowing your electricity supplier to automatic control some settings (e.g. set-point (on-off), set-point boilers, HP, HVAC [TECHNICAL]
- Complex administrative procedures in your community/region [REGULATORY/LEGISTLATIVE]
- Visible infrastructure and noise (e.g. visible wind turbines and solar panels) [SOCIAL]
- Loss of "customer decision-making power" once solutions are installed [SOCIAL]
- Lack of information/ Not receive clear (user – friendly) information about services [SOCIAL]
- Concerns about data privacy [TECHNICAL]
- Concerns about services reliability [TECHNICAL]
- Concerns about services safety [TECHNICAL]
- Something else (please specify: ……)
- I don't see any barriers

[PROFILING]

The following questions are **optional**.

Your age (optional):

- Less than 18 yrs
- 18-24 yrs

- 25-34 yrs
- 35-44 yrs
- 45-54 yrs
- 55-64 yrs
- 65 or above

Your gender (optional):

- Female
- Male
- Prefer not to say

Your income (optional):

- Below average
- Average Above average
- Prefer not to say

Your education level (optional):

- Primary school
- Secondary school
- High school
- Bachelor's Degree
- Master's Degree
- Other
- Prefer not to say

[PROFILING]

- If we missed something, please feel free to give us additional details on your opinion about the uptake of ACCEPT solutions.
  ……..
- Would you be interested in participating in future ACCEPT co-creation activities? For example, participating in surveys, interviews, focus groups, or information sessions?
  - Yes, I am interested
  - Not at this time
- If yes, please provide you contact details so we can add you to our contact list. (Your information will be managed in compliance with GDPR above-mentioned regulation)
  Name:_____
  Email address: _____

N.B.: in compliance with GDPR framework, please note that you can always unsubscribe from ACCEPT mailing list related to your interest/pilot

Annex V B2B Survey Template

ACCEPT H2020 Project – Survey for business stakeholders' requirements

This survey is proposed in the context of the project "ACCEPT – Active communities & energy prosumers for the energy transition" funded by European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 957781. **The EU-funded ACCEPT project intends to develop and deliver 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 Murcia, Spain; Aspra Spitia, Greece; Culemborg, Netherlands; and Massagno, Switzerland.

[SCOPE OF ACCEPT PROJECT]

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. 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. In particular, the Digital toolbox will facilitate the delivery of compound services that will materialise valorisation through value-stacking by energy communities in a manner that is desirable by citizens. 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 delivery of the ACCEPT solution as a Minimum Viable Product that has already passed preliminary market testing and financial viability checks.

[GLOSSARY]

Before starting, we would like to provide you some key definitions of terms used in the survey.

Prosumer	An end-user (residential, small and medium-sized enterprises, or industrial) that no longer only consumes energy, but also produces energy
Demand Response	A service which encourages businesses and consumers to reduce or shift their energy usage in peak periods, usually in response to price changes or incentive payments. Demand response measures enable participants to save on energy costs and reduce their carbon footprint
Flexibility	"Grid Flexibility" refers to the capability of a power system to maintain balance between generation and load during uncertainty, resulting in increased grid efficiency, resiliency and the integration of variable renewables into the grid
Peer-to-peer (P2P)	The P2P model creates an online marketplace where prosumers and consumers can trade electricity, without an intermediary, at their agreed price

[SCOPE OF THE SURVEY]

In this questionnaire, we would like to hear your initial opinions about the new energy saving services being developed and tested locally in your community by the ACCEPT project. This analysis will help the ACCEPT team to understand your perspective so we can make the services being developed as effective as possible for your community.

Through the questionnaire, we want for example to understand:

- Are the services interesting to you?
- How useful are they?
- Do they address a need?
- Are you concerned about the impact of any of the services?
- Can you anticipate any reason why these services wouldn't work for an energy community?

This questionnaire will take approximately 10-15 minutes to complete and your feedback will go directly to the team working to develop these services.

Privacy policy
By completing and answering this form, you agree that the data you provide can be used by the ACCEPT Project. The data is only used for the purpose and duration of the ACCEPT project. The data you provide will be used in compliance with the GDPR, data protection principles in Regulation (EC) 2016/679 (more information can be found on the official website: https://gdpr.eu/). If you have any questions regarding the Privacy Policy, do not hesitate to contact us via email to alessandra.cuneo@rina.org.
The privacy policy is available here:
ACCEPT_T2.1_survey_privacy_policy_eng.pdf

[RESPONDENT PROFILE]

Background

- Energy Service Company (ESCo)
- Aggregator
- Energy community
- DSO
- Prosumers
- Facility manager
- Retailer
- Technology provider
- Energy utility
- Distributed generator provider
- Scientific community
- Municipality
- Other? Please specify

Country

- Spain
- Switzerland
- Greece
- Netherlands
- Other? Please specify

Demographic descriptors

Your age (optional):

- Less than 18 yrs
- 18-24 yrs
- 25-34 yrs
- 35-44 yrs
- 45-54 yrs
- 55-64 yrs
- 65 or above
- Prefer not to say

Your gender (optional):

- Female
- Male
- Prefer not to say

Your education level (optional):

- Primary school
- Secondary school
- High school
- Bachelor's Degree
- Master's Degree
- Other
- Prefer not to say

[ENERGY COMMUNITY FEEDBACK]

To begin, we'd first like hear your opinions about the ACCEPT project and energy communities' concept as a whole

- How familiar are you with the concept of energy communities?
  - Very familiar
  - Somewhat familiar
  - Neutral
  - Somewhat unfamiliar
  - Very unfamiliar

- Do you want to know more on energy communities' concept?
  - Yes
  - No

If yes, the description from the B2C survey will appear.

- Do you have any concern about the energy community concept?
  - Yes
  - No

  If yes, what are your concerns?

  .....

- Is the ACCEPT project appealing to you?
  - Very appealing
  - Somewhat appealing
  - Neutral
  - Somewhat unappealing
  - Very unappealing

Why do you feel this is appealing/unappealing?

.....

- As stakeholders directly involved in ACCEPT project, what role would you like to play in your energy community?
  - Passively involved - Not actively engaging with any activities
  - Moderately involved – Involved in some planning and co-creation activities (e.g. attend presentations,
  - participating in a focus group)

- Actively involved – Involved in multiple activities throughout the project (e.g. providing energy data,
- receiving information about piloting results, attending webinars, participating in focus groups)
- Other

- What are in your opinion the main challenges of the ACCEPT concept for its effective marketability?

  .....

[SERVICES FEEDBACK]

Next, we would like to ask for your opinion on some of the specific services being developed for energy community.

We will first provide you with a brief description of the service, then we will ask a follow-up question so we can better understand what your feeling on that specific service is.

Your feedback will directly impact how the ACCEPT project team moves forward with the creation of these services.

1. **Monitoring energy consumption and production with sensors and visualization of performances in community buildings**: this service will evaluate the energy consumption profile and pattern of the users, visualize them through a dedicated App to give them a deeper insight and understanding of energy consumption

2. **Increase the consumption of self-generated green electricity (via renewable resources) and minimize the dependence of a single consumer and/or of the energy community on the grid**: this service will help the reduction of residential energy bills and facilitate the self-consumption of the community

3. **Forecasting and optimization of consumer demand flexibility**: this service identify building occupant's behaviour to understand when the energy consumer might be more flexible in terms of energy consumption, so the energy provider can better forecast and optimize energy distribution

4. **Elasticity of energy demand profiling-forecasting-aggregation**: this service profiles the energy demand of each users and aggregate them in a single having one aggregate community profile that help to purchase the optimal amount of energy from the energy market in total and to offer dynamic pricing schemes

5. **Day/hour ahead forecast of energy generation**: forecasting the energy generation help to reduce the use of reserves (i.e. generating capacity available to the system operator within a short interval of time to meet demand in case a generator goes down or there is another disruption to the supply) resulting in a more efficient and reliable energy network

6. **Calculation and forecasting of electric vehicles charging flexibility:** forecast the charging/discharging of EV of the consumer/prosumer (end-user that no longer only consumes energy, but also produces energy) could help in increasing the flexibility of the grid

7. **Participation of prosumers in Demand Response Schemes, based on Demand Response events requests from the Aggregator**: prosumers could play a significant role in the operation of the electric grid by reducing or shifting their electricity usage

8. **District-level monitoring and control tool for grid stability**: within this service a tool will evaluate the real-time status of the network and forecast congestion events (black-outs, voltage problems, etc…) in order to prevent them

9. **Energy price for the next day**: End-users receiving information about energy prices for the next day (through an app) in order for them to have a view of when, within the day, energy prices are more advantageous and make related consumption decisions

10. **Optimal scheduling and operation of heating systems**: thanks to this service it will be possible to maintain the heat production at the optimum level, maintaining appropriate comfort level without compromising the energy efficiency of the system

11. **Use of green energy (via renewable resources) at district/community level**: the set-points of the heating/cooling devices presented in the energy community will be optimized to reduce the amount of purchased energy from the grid

    The following questions were proposed for every service (from 1 to 11)

    Do you find this service useful for an energy community?
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

    Why/why not? What need would it fill?
    ……..

    Do you have any concern about this service?
    - Yes
    - No

    If yes, which kind of concern do you have?
    ……

- **Which technical criteria do you consider as most relevant for the actual feasibility and replicability of the above ACCEPT services?**

[BARRIERS]

We would like you to think about how these services might be implemented in an energy community. From the list below, please select any barriers that you think may limit the success of the roll out of these services (*select all that apply*).

- Absence of financial incentives [ECONOMIC/FINANCIAL/MARKET]
- Modification (increase) of energy bill [ECONOMIC/FINANCIAL/MARKET]
- High investment costs [ECONOMIC/FINANCIAL/MARKET]
- Installation of too many devices/systems [TECHNICAL]
- Difficulties in installing specific technologies [TECHNICAL]
- Allowing your electricity supplier or a designated third party to automatically control some settings (e.g. set-point (on-off), set-point boilers, Heat Pump, HVAC) [TECHNICAL]
- Unclear regulatory framework [REGULATORY/LEGISTLATIVE]
- Complex administrative procedures in your community/region [REGULATORY/LEGISTLATIVE]
- Visible infrastructure and noise (e.g. visible wind turbines and solar panels) [SOCIAL]
- Lack of support from local community members [SOCIAL]
- Loss of "customer decision-making power" once solutions are installed [SOCIAL]
- Lack of information/ Not receive clear (user – friendly) information about services [SOCIAL]
- Concerns about data privacy [TECHNICAL]
- Concerns about services reliability [TECHNICAL]
- Concerns about services safety [TECHNICAL]
- Something else (please specify: ……)

- I don't see any barriers

[BUSINESS MODELS]

Do you think current business models are suitable for set-up energy communities?

- Yes
- No
- I do not known

Why?

……

Which of the following business case do you think is attractive?

- **Energy Community as Flexibility Aggregator**: The energy community can assume the role of Aggregator to valorise the power flexibility of its assets on an accumulated basis through demand response services (i.e. Network constraints management services, balancing services, frequency regulation..) offered to different market parties such as DSOs, TSOs, etc.

The following questions were proposed for every business case

- Very attractive
- Somewhat attractive
- Neutral
- Somewhat unattractive
- Very unattractive
- I do not known

Why do you feel this idea is attractive/unattractive?

……

- **Energy Community as an Energy Service Company (ESCO)**: the energy community could assume the role of an ESCO offering energy management services to community members, such as energy awareness and self-balancing on community level.
- **Energy Community as an Energy Service Company (ESCO) facilitating peer-to-peer flexibility trading**: the energy community has the opportunity to manage directly local generation and consumption, e.g. to stimulate the physical (real-time) use of local generation within the community itself, via the exchange of energy between the prosumers of the community also via the introduction of a (crypto) currency within the community.
- **Energy Community as a Retailer**: the community supplies locally produced energy to its own members and substitute the third-party retailer, potentially participate in the wholesale market with the locally aggregated energy surplus.
- **Energy Community optimized operation via peer-to-peer (P2P) flexibility trading based on locally produced energy**: P2P trading allows participants to support their local communities by enabling them to consume renewable power and earn more from their distributed generation. The exchange of energy is managed directly by the energy community itself organizing a local P2P flexibility market. The proposed P2P market design allows the prosumers to negotiate local flexibility transactions with other prosumers, based on their individual preferences and energy requirements
- **Heating-as-a-Service Provider:** it is an innovative business model for how business sell heating. Consumers who buy Heat as a Service choose how much to spend on the experience they want – feeling warm and comfortable when and where they want in their homes – instead of paying for kilowatt hours of energy
- **Prosumer engagement in Implicit Demand Response for local energy profile optimization**: By exposing the Prosumer to variable energy supply and/or network costs that are time-dependent (€/kWh) or depend on the maximum load (€/kW), Prosumers can be incentivized to shift their controllable load and/or generation in time

[CONCLUSION]

- If we missed something, please feel free to give us additional details on your opinion about the uptake of ACCEPT solutions.
  ……..
- Would you be interested in participating in future ACCEPT co-creation activities? For example, participating in surveys, interviews, focus groups, or information sessions?
  - Yes, I am interested
  - Not at this time
- If yes, please provide you contact details so we can add you to our contact list. (Your information will be managed in compliance with GDPR above-mentioned regulation)
  Name:_____
  Organisation/company:_____
  Email address: _____

N.B.: in compliance with GDPR framework, please note that you can always unsubscribe from the ACCEPT mailing list related to your interest/pilot.