European Commission

bridge

Annual Report 2022

Energy Market Design and Flexibility

WG Regulation

May - 2023

AUTHORS

Helena Gerard (VITO/EnergyVille)

José Pablo Chaves Avila (Comillas Pontifical Univerity)

Karine Laffont-Eloire (DOWEL Innovation)

Katerina Drivakou (UBITECH ENERGY)

SUPPORT FROM THE BRIDGE SECRETARIAT

John Karakitsios, *ICCS-NTUA*, BRIDGE Secretariat

Adeola Adeoti*, CLERENS,* BRIDGE Secretariat

Martin Bracken, *CLERENS*, BRIDGE Secretariat

Niclette Kampata, *ZABALA*, BRIDGE Secretariat

Marcos Jareño, *ZABALA*, BRIDGE Secretariat

Agnieszka Gierej, *ZABALA*, BRIDGE Secretariat

BRIDGE WG/TF CHAIRMANSHIP

Chair: Helena Gerard (VITO/EnergyVille)

ACKNOWLEDGEMENTS

The editors would like to acknowledge the valuable inputs from BRIDGE projects consortia who participated in the 4 actions tackled in 2022, all contributing to this BRIDGE Regulatory WG 2022 Report.

EUROPEAN COMMISSION

Directorate-General for Energy
Directorate B – Just Transition, Consumers, Energy Efficiency and Innovation
Unit B5 – Innovation, Research, Digitalisation, Competitiveness

Contact: Mark van Stiphout (DG ENER)

E-mail: Mark.VAN-STIPHOUT@ec.europa.eu

European Commission

B-1049 Brussels

Annual Report 2022

Regulation Working Group

May 2023

LEGAL NOTICE

BOOK	ISBN 978-92-68-05729-2	doi: 10.2833/766254	MJ-09-23-565-EN-C
PDF	ISBN 978-92-68-05728-5	doi: 10.2833/040137	MJ-09-23-565-EN-N

Luxembourg: Publications Office of the European Union, 2023

Manuscript completed in May 2022

First edition

INDEX

1. Introduction

1.1 Introduction Bridge Regulatory WG

The BRIDGE Regulatory working group was established at the origin of the BRIDGE initiative with the objective of fostering knowledge sharing among H2020 projects affected or addressing by different regulatory aspects in the Energy domain.

The Regulatory WG, as the entire BRIDGE initiative, structures its activities on a yearly basis. In the last years, different topics have been addressed, resulting in most cases on specific reports that can be shared not only within the BRIDGE community, but with a larger audience.

The BRIDGE Regulatory working group is currently composed of 63 projects. It is a live group where projects are joining and leaving as results of the natural evolution of the projects. This "staff rotation" facilitates a dynamic environment for the introduction of new topics of interest. The BRIDGE Regulatory working group will continuously look for synergies with other BRIDGE working groups, and working groups outside BRIDGE (ISGAN, ETIP SNET,…). The BRIDGE Regulatory working group will define the most important regulatory challenges to be addressed, propose best practices from the BRIDGE projects and formulate recommendations for policy makers. In addition, thematic knowledge sharing sessions are organized to present best practices from projects that are close to final.

1.2 Introduction to the main challenges to be addressed

The topic of energy markets and flexibility is on the rise. Several (regulatory) initiatives are facilitating the steps to be taken to realize the sustainability goals for 2030 and 2050 (REPower EU, Framework Guideline Demand Response, Digitalisation of Energy Action Plan, Reform EU Electricity Market Design, …). Moreover, the consumer is more than ever at the centre of the public debate. The impact of the energy crisis on the end consumers, the rise of electric mobility and the uptake of energy sharing and related community aspects all illustrate the central role of consumers when designing a robust regulatory framework and market design for the future.

Following challenges are addressed by the working group in 2022:

- **Market access**: The increase of RES leads to new and adapted services for TSOs and DSOs. The provision of services will come mainly from decentralized resources. In order to guarantee an equal level playing field for new technologies, consumers, flexibility service providers and actors in general, innovation and regulatory changes are needed improve market access. Today, market access for consumer flexibility is still hindered and the value of flexibility via implicit (tariffs) or explicit flexibility mechanisms is still limited. Elements that need further elaboration to address the topic of market access are: the design of flexibility products and services, aggregation models, baseline-methodologies, tariff design, market processes (prequalification), submetering and settlement.
- **Collective flexibility**: Energy communities are developing in multiple countries. Energy Communities provide both services to the community and services to the grid. The specifications (including processes) Grid services might need adaptations to support the participation of energy communities. In particular the question arises how to assess the correct value provided by energy communities to the grid. Elements that need further elaboration are the redesign of grid services, the relation between the energy community and the grid operator, the financing models for a community, including a correct value assessment for the (potential) services provided.
- **Market coordination and integration**: Past years, several new services, markets and market platforms for energy and flexibility are developed. However, there is not one integrated markets and the fragmentation of products, services, markets, processes is not necessarily capturing possible synergies of a more and better interconnected system. The main complexity for further integration is the fact that there are many

dimensions where more coordination and integration could be beneficial. Axes of integration that should be further examined are: 1) integration across multiple services, 2) integration across multiple voltage levels, 3) integration between planning and operation, 4) integration between implicit and explicit flexibility mechanisms and 5) coordination between TSOs, DSOs and other market actors.

- **Sector coupling/sector integration**: Recently, increased attention is given to the possible synergies between different energy carriers at wholesale level and different services across different sectors (e.g. mobility). The extension from the overall regulatory/market framework towards new energy carriers and new sectors results in potential synergies for both consumers, market actors and the overall system. However, in order to maximize these synergies, several barriers need to be removed.

The work in the BRIDGE Regulatory working group is also contributing to main policy initiatives ongoing. In particular, the output of this report might provide insights for the ongoing development of the **Network Code for Demand Side Flexibility** and the implementation of the **reform of the EU Electricity Market Design**.

1.3 Overview Action Plan 2022

In 2022, the work of the BRIDGE Regulatory working group is focused on 4 main objectives, translated into 4 actions:

1. **Action 1:** Improve **market access** for consumers to value their flexibility *[Continuation of Action 5 (2021)]*

2. **Action 2:** Examine options for service provision by **energy communities** *[Continuation of Action 2 (2021)]*

3. **Action 3:** Facilitate flexibility market **coordination** and **integration** *[Continuation of Action 4 (2021)]*

4. **Action 4:** Support the potential synergies coming from **increased sector coupling/sector integration/system integration** *[New action]*

The following sections present the results achieved during 2022.

2. Action 1 – Improve consumers' market access to value their flexibility

2.1 Introduction of the Action

Consumers market access is a cornerstone for the development of the European electricity markets. Demand-side flexibility is in particular a relevant topic to unlock the value of demand-side resources. The topic is one of the priorities on the European regulatory landscape with the development of the Network Code on Demand Response, as specified in the Framework Guidelines developed by ACER, Agency for Cooperation of Energy Regulators [1].

Electricity demand response can be the ability to modify electricity consumption patterns in response to price signals or commands. There are two main types of demand response: implicit and explicit.

Implicit demand response occurs when consumers modify their electricity consumption patterns in response to price signals or other signals that indicate the cost or availability of electricity or related system services. For example, consumers might reduce their electricity consumption during peak hours when electricity prices are higher or increase their consumption during off-peak hours when prices are lower. Implicit demand response is mainly affected by tariff designs.

Explicit demand response, on the other hand, involves consumers actively participating in demand response programs designed to incentivise and facilitate changes in electricity consumption patterns. These programs may offer financial incentives or other benefits to consumers who reduce their electricity consumption during high demand, shift their consumption to off-peak hours or provide system services. Explicit demand response programs are typically more structured and coordinated, involving different buyers (single or multiple, depending on the market designs), including TSO, DSOs, BRPs, suppliers, etc. as buyers and other third-party entities (e.g. aggregators) that work with consumers to identify opportunities for providing flexibility, including system services. Implicit demand response, by contrast, is more decentralised and can be harder to predict or control, since it relies on individual consumers making their own decisions based on market signals. Aggregators can also provide automation services to implicit demand response optimising electricity demand.

For explicit demand response, the following key elements are necessary, which are explained in detail in the rest of the section:

1. Definition of flexibility in general terms, but in particular in this report we focus on system services, products, and related market design to acquire system services
2. Rules for aggregation to meet specified requirements and manage a portfolio of resources;
3. Baselining and submetering to determine the flexibility delivered;
4. Tariff design to efficiently allocate the cost of delivering electricity to end-users.

Both implicit and explicit demand response play an important role in helping to manage electricity demand and ensure the reliability and stability of the electricity system.

To identify Bridge projects' best practices, this action received information from several projects participating in the Bridge Regulation WG. The action counted with the input from 16 projects. These projects are **BeFlexible**, **eNeuron**, **EUniversal**, **FEVER**, **GIFT**, **iFLEX**, **InterConnect**, **OMEGA-X**, **OneNet**, **PLATONE**, **ReEmpowered**, **REACT**, **SENDER**, **SENERGY NETS**, **SERENE**, **SUSTENANCE**.

Methodology adopted in Action 1

Action 1 aims to investigate the experience of Horizon 2020 and Horizon Europe projects concerning the practices to improve consumers' market access to value their flexibility; hence, Action 1 activities are based on analysing the information provided by the working group contributors and public deliverables. The steps of the methodology adopted in Action 1 are shown in Figure 1.

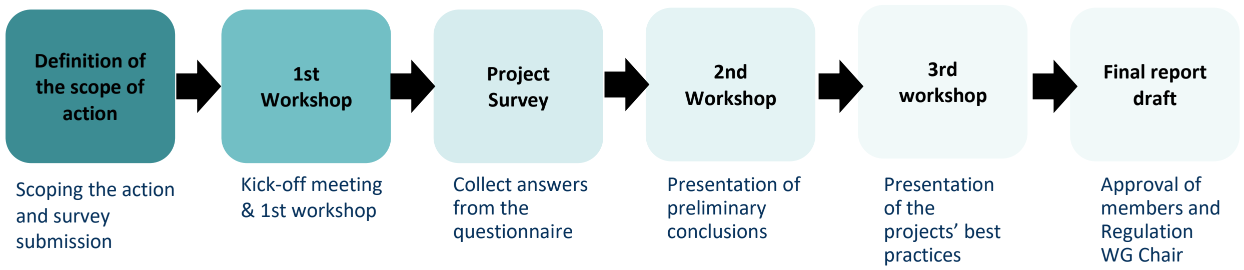


Figure 1. Steps of the methodology adopted in Action 1

As a first step, the relevant projects are selected among all the Horizon 2020 and Horizon Europe projects to identify the ones addressing the topics in the action's scope. The second step concerns the definition of a questionnaire to collect the relevant information. The questionnaire deals with four main topics: system service provision and acquisition mechanisms, rules for aggregation, baselining methodologies and submetering, and tariff design. The questionnaire focuses on relevant information regarding the design elements of the demonstrated solutions, the barriers encountered, and the lessons learnt and recommendations resulting from the project activities best practices. The third step concerns the administration of the questionnaires to the project representatives. The fourth step concerns analysing the received information to identify the peculiar aspects and the differences and similarities among the flexibility mechanisms adopted. The preliminary results were presented in an online meeting to the project representatives to collect their feedback. The fifth step of the methodology concerned the presentation and the discussion of the best practices in an online workshop with project representatives. The last step of the methodology addresses the formalisation of recommendations and lessons learnt based on projects' experience.

2.2 Best practices

The project review described in this chapter points out the state of the art of the European demonstration activities regarding explicit and implicit mechanisms for acquiring system services and the related implications in the practices to improve consumers' market access to value their flexibility. This section introduces the definitions adopted; then, several project examples describe the key aspects of reviewed topics.

2.2.1 Explicit demand response

Services and markets

System Operators (i.e., SOs, Transmission and Distributions system operators – TSOs and DSOs, respectively) are responsible for operating their networks efficiently, securely and reliably. This task requires SOs to procure services and products and establish the necessary rules. The support to system operation based on procurement or rules shall be objective, transparent, non-discriminatory, and developed in coordination with other relevant market participants [2], [3].

The needs for system operations can be described in terms of system services depending on the peculiarities that characterise the different possible needs [2], [4]. System services are defined as an action to mitigate a technical scarcity that otherwise would undermine network operation [5]. Products are defined as the tradable entity acquired by the SOs from the system service providers [5]. Products differ in terms of attributes and values. In general, product definition follows two extreme approaches: products are system service-specific products, or products are service-agnostic. In this document, the services and products are defined according to definitions in [2], [5], [6] and [7]. A wide range of mechanisms (e.g., auction-based markets, bilateral contracts, Peer-to-Peer (P2P) flexibility trading, dynamic network tariffs, flexible access and connection agreements, cost-based mechanisms, and obligation) can be used to acquire flexibility from resources owned by other power system players (e.g., distributed generators, prosumers, customers, aggregators). In this review, the flexibility mechanisms are classified according to the definition in [8], [9]. Moreover, the system services acquisition mechanisms entail several steps - market phases (e.g., prequalification, plan & forecast, procurement, activation, monitoring, measurement, and settlement) [10], [11].

Among the reviewed projects, **EUniversal**, **OneNet,** and **InterConnect** show the most significant experience in demonstrating acquisition mechanisms for systems services.

The **EUniversal** project develops a universal market interface for the DSO use of flexibility. The EUniversal demonstrators deal with local markets focusing on DSO acquisition of system services for local congestion management and voltage control [12]. Auction mechanisms are developed at the DSO level for procuring active and reactive power products considering time frames that span from years-ahead to day-ahead and intraday. The mechanisms demonstrated by the **EUniversal** demonstrators are continuous trading and discrete auction call markets with a pay-as-bid pricing mechanism.

The **OneNet** project focuses on TSO-DSO-Consumer coordination to define a common market design for Europe involving demonstrators of 4 clusters concerning 15 countries. **OneNet** demonstrates the acquisition of system services for frequency control, congestion management and voltage control at transmission and distribution levels [10]. **OneNet** focuses on coordinating local and central markets by demonstrating alternative market designs (i.e. common vs multi-level). **OneNet** demonstrators materialise discrete auction markets for active power products intending to formalise and harmonise the steps that form the acquisition mechanisms. Procurement timing spans from month-ahead to near-real-time, market platforms deploying pay-as-bid and pay-as-clear pricing mechanisms are developed, and both capacity and energy products are considered in the demonstration activities.

InterConnect brings efficient energy management allowing the digitalisation of homes, buildings and electric grids through Internet of Things (IoT), digital technologies (Artificial Intelligence, Blockchain, Cloud and Big Data), and open standards to guarantee interoperability, privacy, and cybersecurity [13]. **InterConnect** demonstrates technical aspects of system service acquisition mechanisms considering auction-based mechanisms for frequency control, and flexible access and connection agreements, bilateral contracts, and cost-based mechanisms for congestion management and voltage control at the distribution system level. Moreover, system adequacy is demonstrated, through flexible access and connection agreements, appliances are operated to balance the households' energy consumption, grid stability is ensured by the power limit calculation service connected to the knowledge engine.

Aggregation

As defined by the European Union, the aggregator is either a physical or legal person which combines multiple loads or generation assets belonging to multiple prosumers and can sell, purchase or auction those resources to multiple other actors interested in them [3, p. 20]. Balancing Responsible Parties (BRP), DSOs and TSOs are some of the already existing actors that might be interested in the services provided by the aggregators.

Besides simply providing demand response, the value proposition of the aggregators having the role of Flexibility Service Provider (FSP) lies in maximising the value stacking and minimising service-provision uncertainty [14]. In other words, the aggregator must provide the best return for the customers while supplying a reliable service to SOs by eliminating the uncertainty on the system service provision at the individual network customer level.

How the aggregator and the BRP coordinate among themselves is one of the key aspects of the implementation aggregators' figure; Table 2.1 shows six possible frameworks to deploy their relationships.

Table 2.1. Possible relationships between the aggregator and the BRP [14].

Relationship	Definition
Integrated	The aggregator and the supplier act as a single market party, and there is a single BRP for both.
Broker	The aggregator sells its demand response capability to the BRP, but the aggregator is not responsible for the imbalances generated by the resources.
Uncorrected	There is no relationship between the supplier and the aggregator, and there is no special BRP for the aggregator.
Central settlement	A central agent coordinates and corrects energy imbalances of the BRPs of the supplier and the aggregator. In addition, a compensation for the open supply position is also settled by this central agent.
Corrected	The aggregator has its own BRP, and the supplier's compensation is made through modifying the consumption profile. The consumption profile is corrected/modified so that the supplier can bill the same energy volume as if no activation has occurred (in other words the corrected consumption profile is the baseline). Then, in general, the aggregator compensates the consumer for the energy that has been billed, but not consumed.
Contractual	There are two BRPs, one for the aggregator and another for the supplier, and there is an ex-post correction between the BRPs.

InterConnect and **PLATONE** are the projects that are in the most advanced stage regarding aggregators deployment. On the one hand, **InterConnect** focuses on the development and demonstration to integrate buildings in the electricity sector [15]. On the other hand, **PLATONE** intends to increase the observability of less predictable loads while exploiting their demand response potential [16].

Baselining and submetering

The baseline refers to the value or profile assumed as a reference for a certain system service activation; the baseline serves as a reference for verifying service provision. For big resources, the baseline is obtained from the individual schedules; however, for small resources (e.g. households demand side response), which do not have an individual schedule, the baseline is critical to determine the service delivered. Several methodologies exist for baseline definition [17], [18]. Some aim to estimate the user's profile if the activation had not taken place. Examples are the *High X of Y* (and variations), *rolling average*, *regression* and *machine learning* models. Others are simpler counterfactuals, such as *meter before/meter after* and the *capacity limitation* (e.g. max. power allowed during the activation period). Alternatively, flexibility providers may be required to *self-declare* a baseline.

The **EUniversal**, **InterConnect** projects showcase mature baseline implementations and recommendations. The **EUniversal** project adopts a self-declared baseline, in which the baseline represents a forecast or plan of power consumption and/or production for a given portfolio during specified time intervals without activation of flexibility. The **InterConnect** project is demonstrating the self-declared method along with several others, including the High X of Y, the rolling average and regression methods.

The **InterConnect** project considers both a case in which the baseline is calculated by the Home Energy Management System (HEMS) and is submitted to the aggregator and DSO (a self-declared baseline), and a case when no baseline is submitted and the DSO considers the rolling average method to compute the baseline for single customers. The **EUniversal** project is addressing challenges such as the need for harmonising baseline methods and their suitability to local markets for system services. The **EUniversal** project indicates the importance of sharing best practices, procedures and principles among Member States. Moreover, **EUniversal** also indicates that the choice of baseline methods for local system services markets should also consider aspects such as local characteristics, product and asset type, data availability and timing of baseline submission.

Submeters could be used for each of the baselining methods mentioned. The usage of submetering may depend on the deployment and functionalities of smart meters and the needs for specific products and services.

From the participating projects **eNeuron** and **InterConnect** are mature to provide detailed recommendations on the submetering topic. **eNeuron** focuses on optimising the design and operation of local energy communities based on multi-carrier energy systems. In **eNeuron,** submetering is used for congestion management to monitor loads in the Energy Hub sites, forecast loads in those sites, and predict load constraints. Based on this, the power available on an EV Charger is limited in certain moments to shave power peaks. The objective is to minimise the energy obtained from the public network. To do that, **eNeuron** monitors and forecasts loads, to manage loads to match the available energy within the energy hub.

In addition, submetering is used **eNeuron** in to monitor voltage on high loads (EV chargers) and generation assets. The objective is to balance production, fast loading and batteries to avoid fast voltage drops. The objective is to prepare energy hubs for massive EVs adoption, as simultaneous charging has a large potential for voltage drops.

eNeuron is addressing some of the technical requirements for submetering. The **eNeuron** project considers measures described in Data Protection and Actions to prevent the risk of manipulation, but not limited to it. In the **eNeuron** project, data is protected, encrypted, and every single access to data must be logged in an auditable tool to protect users' privacy. Regarding interoperability, the **eNeuron** project works on creating the means to interconnect the tools with the assets/buildings' IT networks and user terminals and with the third-party systems and interfaces. To avoid the risk of manipulations, systems must be authenticated and authorised to transmit data to other systems, and the data transmitted must be encrypted.

InterConnect focuses on interoperable solutions connecting smart homes, buildings and grids with the electricity sector. For congestion management and voltage control, submetering is used for metering at the grid connection point (Power, Voltage, and Frequency) in the German, Belgian and Greek demonstrators. In the Portuguese demonstrator, submetering is used to calculate the baseline, increase LV grid observability and raise consumer awareness. For balancing services, submetering is used in the absence of digital smart meters and, in some cases, to isolate the consumption data of the controlled asset. Some of the technical requirements considered include telemetry needs assessed to determine fitness for service providers, which vary by demonstrator: from 5 seconds (Germany), 1 minute (Belgium and Portugal), and 5 minutes (Greece). Some of the barriers encountered include: the system and security requirements for German BSI (Federal Office for Information Security) certified SMGW (Smart Meter Gateway) infrastructure is very high. The BMWK (Federal Ministry for Economic Affairs and Climate Action) is working on a more practical solution. In countries lacking DSO smart-meters, it was necessary to install meters in the fuse box of the houses to provide services. Finally, the interoperability between devices and the need to create the necessary adaptations and connectors is challenging.

2.2.2 Implicit mechanisms

Tariff design

Tariff design is the process of allocating the cost of delivering electricity to end-users. In this document, we assume integral tariffs, meaning that costs to be recovered by tariffs can include generation costs, ancillary services costs, network costs, retail costs, policy costs, etc. A methodology to allocate costs to users consists of [19]:

- **Cost identification**: the payment that has to be recovered under each cost segment (generation, network, retail, ancillary services, etc.) is calculated.
- **Cost driver definition and tariff principles**: the main trigger of each cost segment is defined, and tariff principles applied (e.g., equity considerations), e.g., generation costs are driven by the weighted prices from

different wholesale markets (long-term, day-ahead, intraday), network costs are mainly driven by network peak usage. Part of the sunk network costs can be allocated following equity principles.
- **Cost allocation to charges**: depending on the cost drivers, costs can be allocated to energy charges (€/kWh), capacity charges (€/kW of measured or subscribed capacity), or fixed charges (€/customer). Charges can also differ by voltage level, location, or other metrics; and according to temporal granularity, i.e., hourly, time-block, monthly or annually differentiated.

Only the **EUniversal** project has developed a report focusing on tariff design. In this case, only grid tariffs are developed and compared, i.e., retail, generation, ancillary services, and policy costs are out of scope.

In the **EUniversal** project, a methodology for dynamic distribution grid tariffs to cope with network congestions is developed and applied to a German use case. A qualitative assessment of the main aspects defining grid tariff designs is performed based on different tariff design dimensions: distribution of grid costs, spatial variability, consumer variability, time variability, tariff driver, symmetry, dynamic element, billing trigger and granularity. This results in 5 tariff designs which are quantitatively compared based on their impact on grid operators (relieving grid congestions, re-dispatch need and cost recovery) and on the end-consumer (invoice impact depending on the installed appliances, i.e., PV panels, heat pumps). The 5 network tariff designs are [20]:

1. Static grid tariff: capacity-based tariff where the network congestion risk is identified ex-ante based on historical data analysis. Based on a combined seasonal and time-of-day analysis of the cumulative load profiles within the grid, five different tariff periods are defined and used as temporal (time-of-day and seasonal) differentiation elements in the design of this static grid tariff.
2. Event-based binary grid tariff: capacity-based tariff where the congestion risk is determined day-ahead. One tariff is applied for the entire day with a distinction between a low and high tariff depending on the anticipated grid state.
3. Event-based gradual grid tariff: capacity-based tariff where the congestion risk is determined day-ahead. One tariff is applied for the entire day with a distinction according to 5 rates depending on the anticipated grid state.
4. Dynamic binary grid tariff: volumetric tariff where the congestion risk is determined day-ahead. An hourly differentiation is applied with a distinction between a low and high tariff depending on the anticipated grid state.
5. Dynamic gradual grid tariff: volumetric tariff where the congestion risk is determined day-ahead. An hourly differentiation is applied with a distinction according to 5 rates depending on the anticipated grid state.

2.3 Conclusions

Intending to improve consumers' market access, this report reviews the Europen project experience dealing with the demonstration of system service provision and their acquisition mechanisms. The Horizon 2020 and Horizon Europe project initiatives are analysed considering as key elements the acquisition mechanism, the rules for aggregating the resources, the methodologies for baselining and submetering, and the tariff design.

2.3.1 Services and markets

The majority of the reviewed projects deal with demonstrations of systems service provision and the corresponding market-based acquisition (12 out of 16). Nevertheless, the remaining projects also focus on specific aspects related to the process of systems service provision. Figure 2 shows how the reviewed projects differ in terms of systems services of interest and the demonstrated systems service acquisition mechanism.

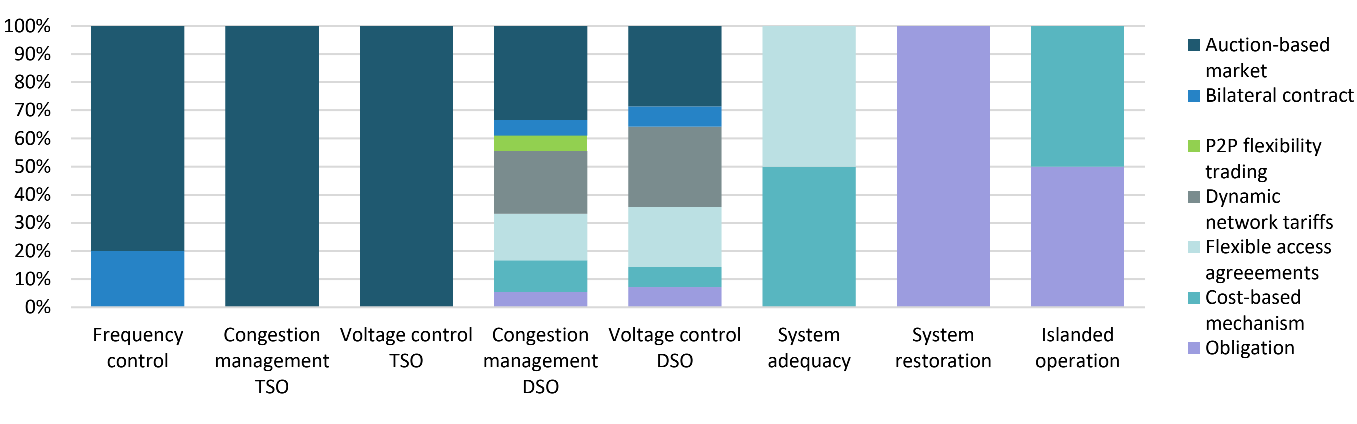


Figure 2. Overview of the acquisition mechanisms per system services demonstrated in reviewed projects.

Project experience led to identifying a set of barriers for the system service provision by network customers and market-based acquisition that highlight the perceived regulatory gaps. One of the main barriers is the **heterogeneity of regulation** in the EU Member States regarding acquisition mechanisms allowance, this barrier prevents solutions replicability. Moreover, regulation lacks **clear definitions of roles and responsibilities** for the actors involved. In fact, the emergence of new actors (e.g., service providers, aggregators, energy communities) and new roles for the existing actors (e.g., TSO, DSO, MO) require defining clear boundaries for the corresponding roles and responsibilities to avoid conflicts, inefficiencies and promote investments. Similarly, considering the complexity and the multiplicity of actors involved, the reviewed projects highlight the need to define the **acquisition mechanisms procedures** for the system service provision from network customers. With this regard, the project experience points out the need for regulation to study tighter cooperation among the actors for **enhanced information sharing** to enable the business models related to system service provision. Moreveor, regulation lacks in **harmonising entry market requirements** (e.g., bid granularity, metering certifications, aggregation rules, interoperability of the equipment); in some cases, the existing requirements are perceived as excessive and require to be revised to reduce the barriers to entering the system service markets. The main barriers to customer participation regard the **lack of consolidated practices and channels for customer engagement** due to the novelty of the activity, **harmonisation and transparency regarding system services and acquisition mechanisms** that reduce awareness. The reviewed project experience highlights the need for regulatory **attention to customers protection** to increase engagement and allow access to the customers' data necessary for enabling the system service provision mechanisms.

2.3.2 Aggregation

Among the reviewed projects, only 2 of them had already developed a solution for the aggregators. Furthermore, for most of the reviewed projects, the aggregation solutions are addressed as part of the demonstration (8) and/or as part of the simulation (3). However, it is worth noting that developing and demonstrating aggregators solutions is not the main goal for the majority of the reviewed projects.

From the two projects that had already developed a solution, **PLATONE** indicates that an uncorrected model is adopted. In the **InterConnect** project, four coordination methods were used: uncorrected (FCR in most countries and aFRR in France), corrected (long-term solution envisioned for aFRR in Belgium), contractual (only as an alternative in the absence of another mechanism for aFRR) and other (only simulation). Figure 3 presents the overview of the reviewed projects regarding the coordination between the aggregator and BRP.

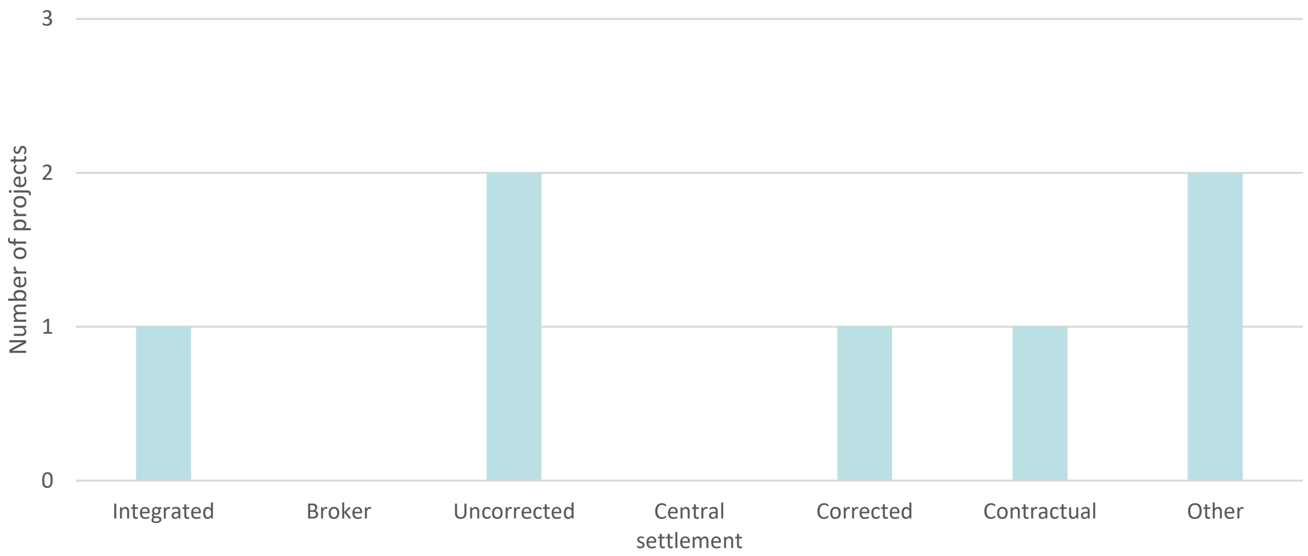


Figure 3: Types of coordination between the aggregator and the BRP, as described in Table 2.1.

Among the project surveyed, many of them intended to maximise the value stacking (**FEVER**), minimise the service provision uncertainty (**iFlex**), or both of them (**InterConnect**, **SENERGY NETS**, and **PLATONE**). The projects **SERENE**, **SENERGY NETS,** and **SUSTENANCE** also used these actors to provide other system services to the grid.

The **InterConnect** project found various barriers to the implementation of aggregators. First, the project considers the absence of clear definitions regarding baseline and metering requirements. Second, customer-centric designs require smart meters and a dedicated infrastructure to process the data and settle the market. Finally, in some countries, too many legal arrangements are required between the customer, DSO, FSP, and Home Energy Management System.

In the **PLATONE** project, the accuracy in evaluating the availability is found to be an issue, as the SO must be sure about the volumes acquired for solving the grid issues. Moreover, the FSP should remunerate or penalise the aggregated customers based on the services actually provided. Last, in the **GIFT** project, the main barrier is the absence of clear rules for aggregation.

2.3.3 Baselining and submetering

From the 16 projects analysed, 12 indicated that baselining is an applicable topic to the project. The development phase for baseline methods varies among the 12 projects. Most of them are in development (6), while some are already developed (4), and two do not have definitions yet. All 12 projects mention that the baselining topic is part of demonstration activities and not only simulations or conceptually addressed.

The projects analysed are implementing a wide range of baseline methods. The most common methods are the self-declared baseline and the meter before/after, both tested in 5 projects. Regression methods and High X of Y come after, being tested in 4 and 3 projects, respectively. Rolling average and Machine Learning techniques are being tested in 2 projects each. Figure 4 illustrates the baseline methods being tested in the 12 projects.

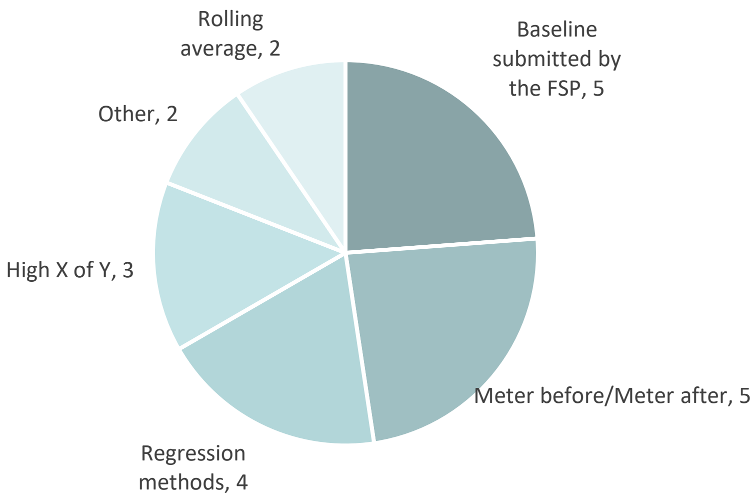


Figure 4: Baseline methods being demonstrated by the reviewed projects.

Projects faced challenges on the baseline choice and provide recommendations based on project findings. One topic raised by the projects is the distinction between a portfolio- or asset-based baseline. The **EUniversal**, **FEVER** and **InterConnect** all advocate for a portfolio approach. The **FEVER** project recommends a portfolio baseline for small (e.g. residential) consumers. Also, simplicity for baseline calculation is highlighted by the **REACT** and **PLATONE** projects.

Several projects commented on the data challenges involved in the baseline calculation. On the one hand, compliance with data privacy regulation may impose more challenges to baseline methods that require data other than metered data (e.g. regression or machine learning). On the other hand, some methods may require a large set of previous data, which might be unavailable. This is the case for the **REACT** project; for instance, in some cases, they did not have a big enough data sample to perform machine learning training for their baseline.

The projects also provided views on the need for transparency and harmonisation of baseline methods. The **InterConnect** project identified in their activities that the rolling average implementation in Belgium balancing market is not so transparent and may prevent the combination with self-declared baselines. The **EUniversal** project reflected on the harmonisation, mentioning that even if baseline methodologies are not harmonised in Europe, there might be best practices, procedures, and principles to be shared among Member States. These guiding principles already exist for baselining in frequency services and state that baseline methodologies should be accurate, simple, integer and effective. For baselines used in local flexibility markets, the **EUniversal** project also indicates the need to consider local characteristics, product and asset types, data availability, and timing of baseline submission.

Considering submetering, from the 16 projects which provided answers to the questionnaire, more than 13 address the topic of submetering. Of those 13 projects, 9 include the submetering in their demonstration activities, and 4 were considering it when the survey was sent.

The service where submetering is used the most is congestion management (in 6 projects), followed by voltage control (4 projects), and only two projects are using submetering for balancing services (frequency containment reserve- FCR, automatic frequency restoration reserves- aFRR and manual frequency restoration reserves- mFRR).

The projects were asked about the usage of submetering for the different market phases, for congestion management and voltage control. Most of the projects answered that submetering is used for plan and forecasts and monitoring. **GIFT** is the project which declared that submetering is used for the congestion management and voltage control settlement process. **eNeuron** also uses for settlement for congestion management. **InterConnect** is the only project that uses submetering for FCR and aFRR for all market phases.

Finally, only four projects (**eNEuron**, **FEVER**, **GIFT** and **InterConnect**) shared some views regarding the technical requirements of submetering and data protection considerations. **FEVER**, **GIFT** and **InterConnect** are considering general requirements of submetering regarding data access and installation procedures (**GIFT**) and the technical requirements assessed to determine fitness for service provision (**InterConnect**). The accuracy of the metering is considered in **InterConnect**. Time granularity is being addressed in **FEVER**, GIFT (minute level) and **InterConnect** (every 5 seconds, 1 minute or 5 minutes, depending on the system service). Cybersecurity of submetering is addressed in **eNeuron**. Interoperability considerations between the consumer and external agents are considered in **eNEuron**, **GIFT** and **InterConnect**. Finally, actions to prevent the risk of manipulations are addressed in **eNeuron**.

2.3.4 Tariff design

Of the 16 projects which provided answers to the questionnaire, only 4 projects (**EUniversal**, **iFlex**, **InterConnect**, and **ReEmpowered**) aim to develop a methodology for tariff design. **EUniversal** has already developed the methodology focusing only on grid tariff design, while it is under development for the rest of the projects.

The different grid tariff designs in the **EUniversal** project indicate that, overall, all selected tariff designs achieve good results. For the rest of the projects, tariff design is under development, and conclusions cannot be extracted. **iFlex** investigates flexible tariffs as an incentive mechanism, **InterConnect** project proposes dynamic tariffs based on 4 price levels to incentivize customers to change their consumption behaviour when renewable generation is high, and **ReEmpowered** develops a methodology for tariff design aiming to support business models of the smart microgrids, so that similar approaches can be adopted in other rural and remote areas.

EUniversal and **Interconnect** projects mentioned the lack of sufficient granular metering equipment at the household level as the major barrier to the deployment of dynamic network tariff designs. Specifically, the **InterConnect** pilot project in Greece cannot apply dynamic pricing until the national DSO finishes the smart meter roll-out, although regulation is being aligned.

2.4 Recommendations

This section resumes the main recommendations that result from the surveyed projects. Most of the analysed projects are still ongoing; therefore, recommendations are based on the available findings considering the actual maturity level. The recommendations in this section cover the design of system services acquisition mechanisms, aggregation rules, baselining methodologies, submetering, and tariff design.

The reviewed projects show a comfortable level of maturity in terms of systems service provision experimentation. However, **real-world deployments still require efforts in research and demonstration activities to define clear roles, responsibilities, requirements, and procedures**. Considering system service provision and related acquisition mechanisms, the reviewed project experience highlights that **harmonising approaches** are more promising than standardisation approaches to enable scalability of the proposed solutions, ease the market entry barriers, and foster value stacking for customers' participation. Harmonising approaches allow the necessary degree of freedom to comply with specificity by granting a satisfactory level of interoperability of procedures across markets.

Overall, the reviewed projects highlight that outclassing the identified challenges and barriers **calls for regulatory experimentation** to design channels for customers' participation in system service provision, encourage investments for energy transition, design business models, and compare on a level playing field system services from third-parties and traditional grid expansion.

Regarding the aggregation rules, the main recommendations are on **setting clear roles and responsibilities related to the aggregation of third-party resources** and on **harmonising and automatizing the procedures to access the markets** (i.e., administrative requirements and technical prequalification). Moreover, a central settlement method (i.e., a central agent that coordinates and corrects energy imbalances of the BRP of the supplier and the aggregator) might lead to high coordination costs, so the **adoption of a corrected settlement method** (i.e., the aggregator has its own BRP and the supplier's compensation that is made through the modification of the consumption profile) is an alternative solution to solve this problem on the long-term.

Furthermore, it is crucial to **improve the methodologies for evaluating the available resources** at each point of delivery. This evaluation might need different methodologies than the ones used by the aggregators to estimate the available aggregated resources. Nevertheless, the reviewed projects are not able to provide any solution yet and further investigation is required.

The baselining of distributed energy resources is necessary to implement distributed procurement mechanisms for system services. This topic is being explored and demonstrated by the majority of EU projects analysed, attesting the importance of the topic. The analysis shows **no one-size-fits-all baseline method**, as several methods are being tested and evaluated. One main concern is the **data availability** for the baseline calculation, as some methods require large sets of past data and others require data other than electricity metered data, which could entail barriers for the acquisition due to **data privacy regulations**. Projects also express their concerns over **transparency and harmonisation of baseline methods**. Overall, the preferred methods are based on **simplicity to implement and understand, as well as aggregated baselines, but there is a concern on aggregated baselines for the corrected settlement method**. Harmonizing baseline methods may not be strictly necessary, but best practices and **guidelines for baselining are desirable**.

Submetering is a tool that can contribute to facilitate the market access to small resources allowing to measure and **monitor the performance of the resources in isolation from the rest of the load**. Its use is being explored in different European projects for frequency and non-frequency system services for different market phases: prequalification, plan and forecast, monitoring, activation and settlement. The specific application depends on demonstration services, the presence of smart meters, and the type of resources, among other factors. **Submetering must fulfil technical requirements** which are being addressed by projects: **accuracy** of measures, specific **time granularity** that depends on the service provided, **cybersecurity**, **data protection**, **interoperability** requirements between consumers and external agents and actions to **prevent manipulations**. At present, there is still a **need for regulatory clarification on the specific functions** that submetering can perform, as well as the **requirements it must meet**.

Regarding the lessons learnt, all considered tariff designs succeeded in alleviating network congestion but differed in their ease of adaptability for consumers and in cost recovery estimation for grid operators. In addition, the **effectiveness** of certain tariff components **is tied to the design choices made in other tariff dimensions**. For example, if a tariff contains a capacity trigger (€/kW) to maximize cost reflectivity, the performance of this choice is influenced by the temporal granularity of the capacity measurements (quarter-hourly, hourly, or monthly).

The main recommendations are that **static implementation of grid constraints** in the distribution tariff entails a **lack of a direct and dynamic link to** the anticipated **day-to-day grid congestion**. Another improvement could be **increased locational granularity** in the network tariff design. However, other principles, such as **transparency** and **simplicity** could be impacted. In a manual control environment, such as **in the early stages of smart meter roll-out**, where supporting technologies are not yet widely available, an **event-based tariff design** may be the most practical option for residential consumers. This design involves notifying grid users a day in advance of potential network congestions, allowing them to adjust their energy usage accordingly. While other tariff designs may be more sophisticated in theory, the limitations of a manual control environment make the event-based design the most feasible option for implementation. Once **automated control equipment is available**, **hourly dynamic and energy-based tariffs**, coinciding with the dynamic price contracts of energy, **are recommended** to increase cost-reflectivity and efficient customer response.

Moreover, the involvement and **participation of local communities** are widely regarded as **crucial** to the **successful implementation of innovative tariff designs**. By engaging with local communities, utilities and regulatory bodies can better understand consumers' specific needs and preferences and tailor tariff designs to meet those needs.

This approach increases the likelihood of consumer acceptance and participation in new tariff structures, fostering a sense of collective responsibility towards managing energy consumption and reducing grid congestion.

2.5 Next steps

The analysed experience from EU project demonstrations allows identifying several priorities regarding the practices to improve consumers' market access to value their flexibility.

Regulations that enable system service acquisition mechanisms should be studied to enhance homogeneity across Member States. This would help to ensure that network customers across the EU are able to participate in the flexibility market on equal terms and benefit from the same opportunities. However, peculiar network customer needs shall be considered in the harmonization process to preserve local specificities where needed.

Secondly, regulations should define clear roles and responsibilities for the various actors involved in the system service provision to avoid distortions, conflicts, and inefficiencies. This would enhance transparency and increase customer participation, enabling consumers to fully engage with the flexibility market.

Furthermore, regulatory experimentation should be used to study the impact of different initiatives from a societal perspective. This approach would enable regulators to evaluate the effectiveness of different strategies for improving consumers' access to the flexibility market, and identify best practices that can be applied more broadly.

Efforts are needed to define good practices for designing the coordination of market phases, from prequalification to settlement. This will require a detailed understanding of the different stages of the market and their overlaps and potential synergies. By identifying best practices for market coordination, regulators can help to ensure that the market operates efficiently and effectively, delivering value to network customers.

Moreover, regulation should promote platforms for harmonizing procedures, transparent information sharing, and cooperation among actors to maximize the exploitation of available resources. By encouraging collaboration and sharing of information, regulators can help to facilitate the development of more efficient and effective markets.

Research and demonstration efforts are required to quantitatively analyse different baseline methods in different system service procurement contexts (i.e., different products, markets, and providers). By providing quantitative analysis, regulators can identify the most effective baseline methods for different contexts, and ensure that the market is designed to deliver maximum value to all stakeholders.

While research and demonstration activities have shown promising results, further work is needed to fill existing modelling gaps and gain the necessary empirical experience for the real-world implementation of demonstrated solutions. This will enable stakeholders to test and validate the performance of these systems under realistic conditions and identify any areas for improvement. Additionally, such large-scale demonstrators will provide an opportunity to evaluate the scalability and replicability of these solutions across different regions and markets.

By focusing on these priorities, regulators can help to ensure that the future market operates efficiently and effectively, improve consumers' market access, deliver value to consumers and the grid, empowering consumers to participate in the transition to a more sustainable energy system.

2.6 References

[1] ACER, Agency for Cooperation of Energy Regulators, 'Framework Guideline on Demand Response'. 2022. [Online]. Available:

https://acer.europa.eu/sites/default/files/documents/Official_documents/Acts_of_the_Agency/Framework_Guidelines/Framework%20Guidelines/FG_DemandResponse.pdf

[2] OneNet H2020 project, 'OneNet Deliverable 2.2 - A set of standardised products for system services in the TSO-DSO-consumer value chain', 2021.

[3] European Union, *Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (Text with EEA relevance.)*, vol. OJ L. 2019. Accessed: Dec. 26, 2020. [Online]. Available: http://data.europa.eu/eli/dir/2019/944/oj/eng

[4] EUniversal Project, 'EUniversal Deliverable 1.2: Observatory of research and demonstration initiatives on future electricity grids and markets'.

[5] OneNet Project, 'OneNet Deliverable 2.1: Review on markets and platforms in related activities'.

[6] EUniversal H2020 project, 'EUniversal Deliverable D2.1 - Grid flexibility services definition'. [Online]. Available: https://euniversal.eu/

[7] INTERRFACE H2020 project, 'INTERRFACE Deliverable 3.1 - Definition of new/changing requirements for services', INTERRFACE H2020 project, 2020.

[8] EUniversal H2020 project, 'EUniversal Deliverable: D5.1 - Identification of relevant market mechanisms for the procurement of flexibility needs and grid services', EUniversal H2020 project, 2021. Accessed: Mar. 04, 2021. [Online]. Available: https://euniversal.eu/wp-content/uploads/2021/02/EUniversal_D5.1.pdf

[9] European Commission. Directorate General for Energy., *bridge Annual report 2021: regulation working group.* LU: Publications Office, 2023. Accessed: Mar. 02, 2023. [Online]. Available: https://data.europa.eu/doi/10.2833/47621

[10] OneNet H2020 project, 'OneNet Deliverable 3.1 - Overview of market designs for the procurement of system services by DSOs and TSOs', OneNet H2020 Project, 2021. [Online]. Available: https://onenet-project.eu/wp-content/uploads/2021/08/D31-Overview-of-market-designs-for-the-procurement-of-system-services-by-DSOs-and-TSOs-1.pdf

[11] INTERRFACE H2020 project, 'INTERRFACE Deliverable 5.5 - Single Flexibility Platform Demonstration Description and Results', Jul. 2022.

[12] Janka Vanschoenwinkel *et al.*, 'EUniversal Deliverable D2.2 - Business Use Cases to unlock flexibility service provision', EUniversal H2020 project consortium, 2021. [Online]. Available: https://euniversal.eu/wp-content/uploads/2021/05/EUniversal_D2.2.pdf

[13] WP1 Pilot Partners, 'InterConnect D1.2 - Mapping between use cases and large-scale pilots', 2021. Accessed: Mar. 03, 2023. [Online]. Available: https://interconnectproject.eu/wp-content/uploads/2021/02/D1.2-Mapping-between-use-cases-and-large-scale-pilots_DraftVersion.pdf

[14] H. de Heer and M. van der Laan, 'Workstream on aggregator implementation models', USEF Energy, Sep. 2017. [Online]. Available: https://www.usef.energy/app/uploads/2017/09/Recommended-practices-for-DR-market-design-2.pdf

[15] 'About - Interconnect Project', *Interconnect*. https://interconnectproject.eu/about/ (accessed Mar. 03, 2023).

[16] 'Platone - Our Project', *Platone - Platform for Operation of distribution Networks*. https://www.platone-h2020.eu//Project/Our_Project (accessed Mar. 03, 2023).

[17] Energy Networks Association - DNV GL Ltd., ‘Baseline Methodology Assessment’, Dec. 2020. Accessed: Nov. 29, 2022. [Online]. Available: https://www.energynetworks.org/industry-hub/resource-library/open-networks-2020-ws1a-p7-baselining-assessment-report.pdf

[18] O. Valentini, N. Andreadou, P. Bertoldi, A. Lucas, I. Saviuc, and E. Kotsakis, ‘Demand Response Impact Evaluation: A Review of Methods for Estimating the Customer Baseline Load’, *Energies*, vol. 15, no. 14, Art. no. 14, Jan. 2022, doi: 10.3390/en15145259.

[19] N. Morell Dameto, J. P. Chaves-Ávila, and T. Gómez San Román, ‘Revisiting Electricity Network Tariffs in a Context of Decarbonization, Digitalization, and Decentralization’, *Energies*, vol. 13, no. 12, Art. no. 12, Jan. 2020, doi: 10.3390/en13123111.

[20] Gonçalo de Almeida Terça, Annelies Delnooz, Anibal Sanjab, Kris Kessels, and Md Umar Hashmi, ‘EUniversal Deliverable 5.2: Methodology for dynamic distribution grid tariffs’, EUniversal H2020 project. Accessed: Mar. 09, 2023. [Online]. Available: https://euniversal.eu/wp-content/uploads/2022/08/EUniversal_D5.2_Methodology-for-dynamic-distribution-grid-tariffs-.pdf

3. Action 2 - Service Provision by Energy Communities

3.1 Introduction

Energy Communities are a new market actor created by the Clean Energy Package for All Europeans, adopted in 2019, with the aim of organising collective and citizen-driven energy actions that help pave the way for a clean energy transition, while moving citizens to the fore and increasing public acceptance of renewable energy projects. Two Directives from the Clean Energy Package are of relevance: the Internal Electricity Market Directive, which introduces Citizen Energy Communities (CEC), and the Renewable Energy Directive, which defines Renewable Energy Communities (REC). Although REC and CEC are both Energy Communities, with the same 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), the activities they are allowed to carry out are not the same, as detailed in Table 2

Table 2: Definition of Renewable Energy Communities and Citizen Energy Communities

Type of EC	Renewable energy community (REC)	Citizen energy community (CEC)
Directive	Renewable Energy Directive (Article 22) 'REDII'	Electricity Market Directive (Article 16) 'EMDII'
Transposition	Deadline 30/06/21	Deadline 31/12/20
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	
Energy carriers	Electricity and more (biogas, heat)	Electricity
Allowed activities	**Generation, consumption, storage and sales of renewable energy, incl. through PPA** *Access to energy markets (directly or through aggregation) should be non-discriminatory*	**Generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles or provide other energy services to its members & shareholders** *Access to electricity markets (directly or through aggregation) should be non-discriminatory*
Membership / control	Open and voluntary participation, autonomous, effective control Citizens, local authorities and SMEs *(for private: should not be the primary commercial activity)*	Open and voluntary participation, effective control Citizens, local authorities and small and micro enterprises
Geographic limitation	Shareholders or members must be located in the proximity of the RE projects that are owned & developed by the REC	No geographic limitation, MS can choose to allow cross-border CEC

Both types of Energy Communities are recognised the right to access energy markets (directly or through aggregation) in a non-discriminatory way according to the EU Directives. However, the main determinants of the feasibility of RECs and CECs (and the possibility to access markets) are the national legislations in the EU Member States, which are closely related to the way the Renewable Electricity Directive and the Internal Electricity Market Directive have been transposed. The feasibility and viability of energy communities are also impacted by uncertainties and challenges in legal and administrative procedures, the maturity of the energy markets, the network codes, tariff schemes and grid fees, to name but a few.

Based on the outcomes of BRIDGE activities 2021-2022, the 2022 Work Plan of the Regulatory WG identified that Action 2 should investigate what are the possible grid services energy communities could deliver to support the future needs of the grid (both transmission and distribution). The objective of Action 2 is therefore to examine the options for service provision by energy communities.

Methodology adopted in Action 2

The different steps followed by Action 2 are illustrated in Figure 5.

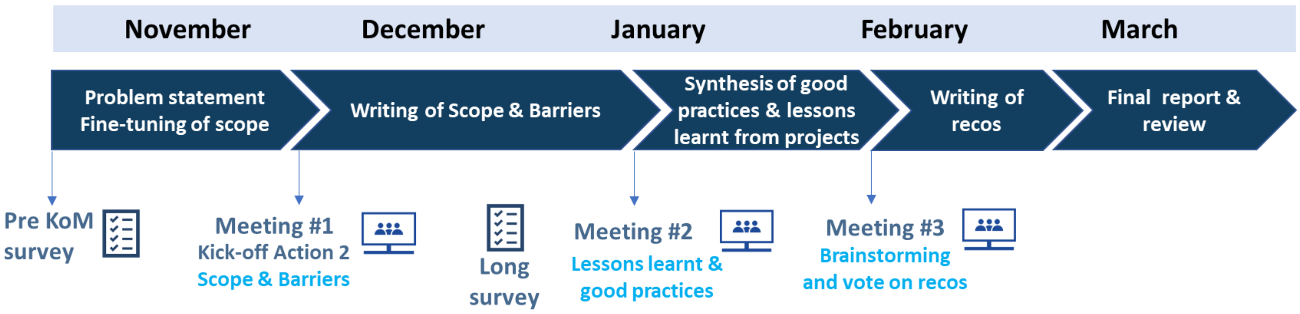


Figure 5: Steps of the methodology adopted in Action 2

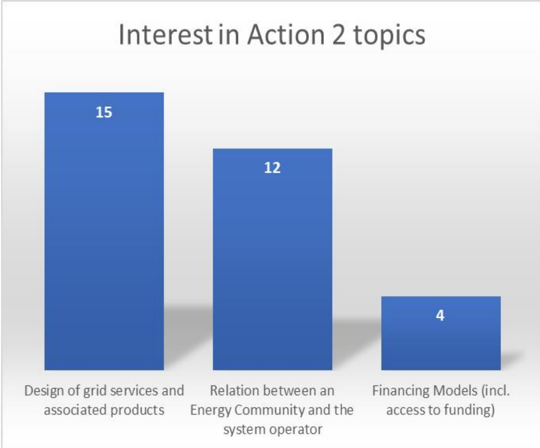
A brief questionnaire was first created and circulated to Action 2 contributors to collect their feedback concerning the scope of Action 2 and topics to be investigated. The results were presented in the kick-off meeting of Action 2 early Feburary, during which the projects also had to collectively identify the main barriers to the provision of grid services by energy communities during an interactive session using an online board. The results of these collective work where then aggregated, and project representatives where asked to check the resulting list of barriers, and rate them in a survey. This survey also collected their inputs on lessons learnt and good practices from their project: the results of this survey were presented during the second meeting, in which projects were also invited to pitch. The final meeting was dedicated to the elaboration of recommendations, once again during an interactive session using an online board. Recommendations were provided by participants, and a final vote allowed to select the most consensual ones.

Overall 30 projects participated in Action 2, either through participation to interactive sessions, or through surveys: MAESHA, INSULAE, INTERCONNECT, PLATONE, SERENE, SUSTENANCE, OMEGA-X, VPP4ISLANDS, CREATORS, TwinERGY, eNEURON, IElectrix, EUniversal, LocalRES, ReDREAM, DATA CELLAR, FEVER, ebalanceplus, E-LAND, BE FLEXIBLE, EV4EU, InterConnect, NESOI, TIGON, REEFLEX, BD4OPEM, ROBINSON, GIFT, READY4DC, SENERGY NETS. Some of these projects are focussing on renewable or citizens energy communities and are involving communities as part of their pilots. Other projects are focussing on flexibility services and market design: in that case energy communities are considered as a potentiel provider of flexibility, but are not always treated in a specific way.

3.2 Scope

Topics in scope include:

- Design of grid services and associated products
- Relation between Energy Community and the system operator
- Financing Models



Projects participating in the Action were first asked to identify the topics that were the most relevant to their projects among the 3 above topics. 22 projects answered. The topic related to financing models was the one triggering the less interest. One respondent suggested to add the topic of "Regulations and policies across Member States for the implementation of Energy Communities".

During the 1st meeting of Action 2, participating projects provided inputs on those 4 topics through an interactive session.

3.2.1 Type of grid services and products that could be offered by Energy Communities

Grid services and products have been reviewed by several BRIDGE projects (CoordiNet – see Figure 6, EUniversal[1] for instance).

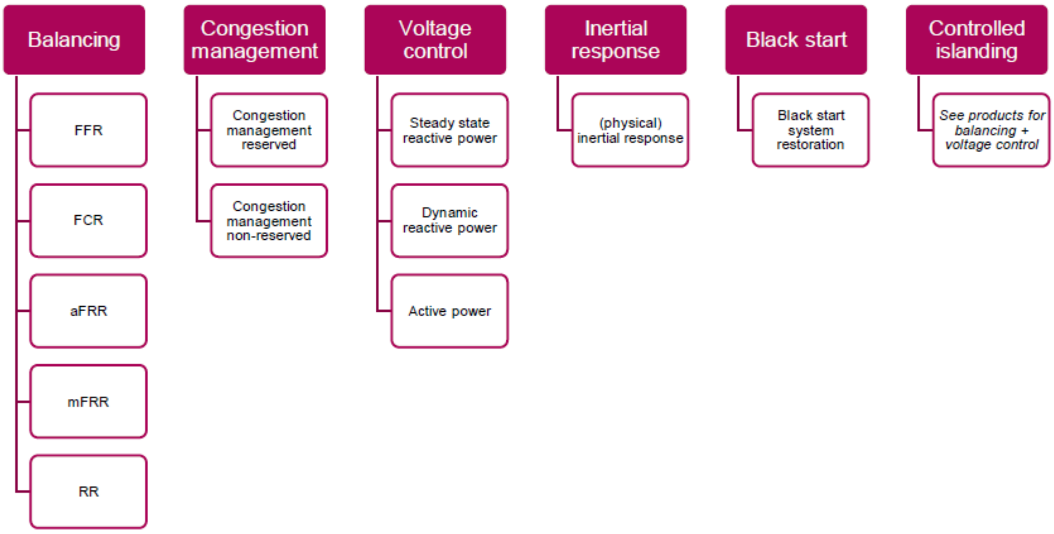


Figure 6: Grid services and products as defined by Coordinet

Most of the projects participating in Action 2 aim at providing **congestion management** (e.g. CREATORS, SERENE, OMEGA-X, SUSTENANCE, LocalRES, eNEURON, TIGON, REEFLEX, GIFT, DATA CELLAR), **voltage control** (e.g. eNEURON, REEFLEX, GIFT, DATA CELLAR), **grid balancing** (e.g. DATA CELLAR), and in a few cases only, **controlled islanding** (e.g. SUSTENANCE).

[1] see https://euniversal.eu/wp-content/uploads/2021/02/EUniversal__D2.1.pdf for a recent definition of grid flexibility services.

While some projects focus on improving the local grid stability for the energy community itself (e.g. LocalRES), others aim at defining market mechanisms to provide grid services to DSOs (e.g. FEVER). Other projects, such as DATA CELLAR, contribute to these grid services indirectly, by focussing on the creation of Data Space, the development of services or applications such as Digital Twin.

3.2.2 Relation between an Energy Community and the system operator

Energy Communities can interact with system operators in different ways:

Firstly, for the creation and operation of the EC, where DSOs usually play a key role (although this varies from one Member State to the other). Projects highlighted that DSOs can be facilitators (e.g. in the Netherlands and Belgium) or bottlenecks (e.g. difficult access to smart meter data, issue related to the very lengthy legalisation of PV plants in Spain), depending on the country.

Secondly for the provision of grid services to DSOs or TSOs, in which case the relationship is more of a contractual nature, through market mechanisms. OMEGA-X is currently working on a detailed description of the use cases showing the relationship between the involved stakeholders and in particular the DSO.

3.2.3 Financing Models (incl. access to funding)

As previously mentioned, this topic is the one deemed as the least relevant by participating projects, hence the few inputs.

CREATORS explained that in Spain there is a good funding opportunity from the Government for Energy Communities projects called CE-Implementa[2]. This instrument is funding the deployment of energy communities (renewable energy, energy efficiency, storage, mobility, demand management).

In SERENE, the investment for the community battery of Aardenhuis demo is partly financed by feed-in income / virtual power plant energy trading.

3.2.4 Regulations for implementation of Energy Communities at country level

Although not initially listed in Action 2 topics, this topic generated a lot of inputs. All projects have performed or will perform a regulatory analysis to identify regulatory barriers related to their topic. Several projects also highlighted that it would be useful to centrally store all projects' deliverables on regulatory topics.

With regard to the implementation of national regulations for Energy Communities (both RECs and CECs), the following input was provided:

- Some Member States are still behind schedule to transpose Article 22 of the Renewable Energy Directive (Directive (EU) 2018/2001) and/or Article 16 of the Electricity Market Directive (Directive (EU) 2019/944).
- In several countries the transposition law is just a copy-paste from the Directives: technical regulations and "rules of the game" still have to be defined and rolled out e.g. on how to set up communities and operate them – this means that national regulations are likely to evolve along the course of a project.
- Once the transposition is done, the clarity and 'ambition' of the transposing laws also vary a lot across Member States (e.g. geographic scope, maximum power for the community, approaches to define sharing coefficients, ability to sell surplus energy to the grid or share energy through peer-to-peer trading).

2 https://www.idae.es/ayudas-y-financiacion/comunidades-energeticas/programa-de-incentivos-proyectos-piloto-singulares-de

- The level of support provided to energy communities (incentives, subsidies) and their economic viability is also highly country dependent.

3.3 Barriers

Most projects that are setting up Energy Communities stressed that, although national regulations defining CECs and RECs are now in place, there is still a long way to go for Energy Communities to become a ‘real’ market actor and that a level playing field remains to be created.

The barriers to the provision of (grid) services by energy communities were first identified collectively during the kick-off meeting of Action 2, using an interactive online board. All the inputs where then clustered to retain a list of less than 15 barriers. While some barriers are of regulatory nature, others are financial, technical or social. Participating projects where then asked to rate each barrier within this list: 22 projects responded, which led to the identification of the 5 top barriers, as illustrated in Figure 7.

REGULATION	Processes (incl. technical regulations) for REC & CEC are not fully defined in national regulations yet.	1
	The CEC and REC concept as defined in EU regulation still has to be fully implemented in many MS	2
	Complex interactions with DSOs due to the lack of clear processes or standards	
	Smart Meter roll-out and their functionalities vary in countries	
	No overarching regulations for cross-sector projects (electricity/heat/mobility)	
	Grid services cannot for now be traded directly by the REC to the system operators as network codes are not adequate	
VALUE CHAIN/ MARKET	Flexibility markets are not mature enough or hardly accessible for Energy Communities	3
	The participation of aggregators is not yet fully allowed in all EU countries	4
FINANCIAL	Lack of clarity on how financial benefits from providing services should be split among the members of the community	
	High relative cost of equipment for demand response	
TECHNICAL	Technologies necessary for communities to provide services (such as actuators or other solutions needed to aggregate capacity) are most of the time not installed	
	Lack of common interoperability & data management processes/ standards, dataspaces, platforms and interfaces for data exchanges between stakeholders	5
SOCIAL	Difficulties for customers to accept the installation of many monitoring assets unless there is a clear chance of economic savings	
	Low social acceptability of technology (RES, smart meters, heat pumps), with consumers focussing on security of delivery, comfort, stable energy prices	

Figure 7: Barriers identified in Action 2. Top 5 barriers are the numbered ones

3.4 Lessons Learned and Good Practices

20 projects communicated lessons learned and good practices from their projects in relation to the barriers previously identified[3]. TwinERGY and e-Balance Plus presented their results and good practices in more detail during the 2nd meeting of Action 2.

The above projects involve demonstrations in 1 to 4 different countries, leading to a rather good coverage in terms of EU countries, as illustrated in Figure 8. Tow demonstrations in India and one in Turkey are also to be noted.

Figure 8: Countries where demonstrations from participating projects are located.

The numbers indicate the total numbers of demonstrations identified in each country during the survey

Respondents were also asked to identify 1 to 5 barriers for each of their demonstrations (see synthesis in Figure 9). This confirms the top barriers previously identified but also shows that encountered barriers vary substantially from one country to the other, and from one demonstration (use case) to the other.

[3] 10 other projects, which had participated in the Kick-off meeting of Action 2, did not answer the survey, most likely because they preferred to focus on another action of the Working Group.

Country name	Austria	Belgium	Croatia	Denmark	Finland	France	Germany	Greece	Hungary	Italy	Netherlands	Norway	Poland	Portugal	Romania	Spain
Number of demonstrations/ pilots	2	1	3	3	1	2	4	2	1	6	2	2	4	3	1	7
REGULATORY: Complex interactions with DSOs due to the lack of clear processes or standards	Yellow		Dark red	Red		Yellow	Yellow			Yellow	Red	Yellow	Red	Red	Yellow	Dark red
REGULATORY: The CEC and REC concept as defined in EU regulation still has to be fully implemented in many MS			Dark red	Yellow	Yellow					Yellow		Yellow	Dark red	Yellow	Yellow	Red
REGULATORY: Processes (incl. technical regulations) for REC & CEC are not fully defined in national regulations yet	Yellow		Dark red	Dark red	Yellow	Red	Yellow		Yellow	Yellow	Red	Yellow	Dark red	Yellow	Yellow	Dark red
REGULATORY: Smart Meter roll-out and their functionalities vary in countries		Yellow	Yellow				Yellow	Yellow						Yellow	Yellow	
REGULATORY: No overarching regulations for cross-sector projects			Red	Red						Yellow	Red	Red	Dark red	Yellow	Yellow	Yellow
REGULATORY: Grid services cannot for now be traded directly by the REC to the system operators	Yellow	Yellow	Yellow	Dark red			Yellow			Red	Red	Yellow	Dark red	Red	Yellow	Dark red
MARKET: Flexibility markets are not mature enough or hardly accessible for Energy Communities	Yellow	Yellow	Yellow	Yellow		Red	Yellow	Yellow		Red		Yellow		Dark red	Yellow	Dark red
MARKET: The participation of aggregators and demand are not yet fully allowed in all EU countries. Other limitations are still present in some countries.	Yellow		Yellow	Dark red		Red	Yellow	Yellow		Dark red	Red	Yellow	Red		Yellow	Red
FINANCIAL: Unclear how financial benefits from providing services should be split among the members of the community			Yellow				Yellow						Yellow	Yellow		Red
FINANCIAL: High relative cost of equipment for demand response					Yellow	Yellow				Yellow						Yellow
TECHNICAL: Technologies necessary for communities to provide services (such as actuators or other solutions needed to aggregate capacity) are most of the time not installed					Yellow		Yellow			Yellow		Yellow				Yellow
TECHNICAL: Lack of common interoperability & data management processes/ standards, dataspaces, platforms and interfaces for data exchanges between stakeholders		Yellow					Yellow	Dark red		Yellow		Yellow		Red		Yellow
SOCIAL: Difficulties for customers to accept the installation of many monitoring assets unless there is a clear chance of economic savings		Yellow		Yellow		Yellow	Yellow	Yellow		Red						Red
SOCIAL: Low social acceptability of technology (RES, smart meters, heat pumps), with consumers focussing on security of delivery, comfort, stable energy prices					Yellow					Yellow				Yellow		Yellow

Yellow: main barrier for 1 demo or for less than half of the demos in that country
Red: main barrier for more than half but less than 2/3 of the demos
Dark red: main barrier for more than 2/3 of the demos

Figure 9: Main barriers faced by the demonstrations, depending on the countries where they are located.

All lessons learned and good practices collected in the online survey are presented in a synthetic way below.

For the top 5 barriers:

The CEC and REC concept as defined in EU regulation still has to be fully implemented in many MS

Processes (incl. technical regulations) for REC & CEC are not fully defined in national regulations yet

Lessons learned from projects	Good practices
• It is key to stay up-to-date with latest regulatory information at national level (and even anticipate) • In some demonstrations 'old' regulations were used instead of new regulations transposing CECs & RECs (e.g. Royal Decree 244/2019 on CSC in Spain) • Institutional training was needed	• Have partners in the consortium that have expertise in the set-up of energy communities and in regulation • Carry out a regulatory compliance check of Use Cases early on in the project • Participate in working groups dealing with the implementation at regional and national levels and make proposals for improvements • Providing a best-practice data base helping to formulate the implementation rules • Communicate with the ministry in charge of the implementation of regulations related to Energy communities • Request regulatory sandbox if relevant

Flexibility markets are not mature enough or hardly accessible for Energy Communities

The participation of aggregators is limited

Lessons learned from projects	Good practices
• In several countries it is not possible for EC to sell grid services, markets are not ready and/ or aggregators are not allowed • Lab validation of algorithms instead of real market validation • The scope of some demos had to be adjusted	• Point out shortcomings to regulators (e.g. min bid size) and propose a new market design, including new market rules at EU level • Support/ accelerate the development of local flexibility markets • Partner with local aggregators (where allowed)

Lack of common interoperability & data management processes/ standards, dataspaces, platforms and interfaces for data exchanges between stakeholders

Lessons learned from projects	Good practices
• Data sharing agreements are crucial • A common architecture / data management platform should be used	• Define a common architecture early on in the project, drawing on results from past projects • Cooperate across EU projects on establishing industrial standards, with a uniformed ontology • Coordinate with DSO and research organizations • Establish clear data governance with data owners and users

For the other barriers:

Grid services cannot, for now, be traded directly by the REC/CEC to the system operators as network codes are not adequate	
Lessons learned from projects	**Good practices**
• As of today grid services can be provided within the community (e.g. grid stability, prevention of black out) but not traded	• Request regulatory sandbox if relevant • Provide policy recommendations on how to change the network code to enable RECs and CECs to provide services • Update roles and responsibilities of DSOs to enable them to use flexibility

Complex interactions with DSOs due to the lack of clear processes or standards, limiting the real-time access to relevant energy data and making some services impractical	
Lessons learned from projects	**Good practices**
• Clear processes for the integration of Energy Communities (and the role of the DSO) are lacking in several countries. This may lead to lengthy legalisation/ authorisation procedures by the DSO, or to the limitation of services that can be provided (due to sharing coefficients) • Issues with regulatory ownership of battery storage assets	• Communicate early on with the DSO and get its support • Develop a common approach for the use of flexibility by DSOs • Ask for regulatory sandbox where needed… or adjust demo content to align with regulation (but strive to maintain the same impact) • Install new meters if needed to collect data

Smart Meter roll-out and their functionalities vary in countries	
Lessons learned from projects	**Good practices**
• Several projects had to install new smart meters and a gateway to collect data	• Select grids that have Smart Meters already installed • Install additional meters (and gateway) only if those installed are not enough, or if access to data is complex

Unclear how financial benefits from providing services should be split among the members of the community	
Lessons learned from projects	**Good practices**
• Several projects have developed innovative business models (e.g. Energy Community as a Service) and/ or have modelled benefits for the different sectors • The chosen legal figure is key for the split of financial benefits	• Provide alternative, non-financial benefits • Implement innovative business models → *Link to BM WG*

High relative cost of equipment for demand response

Lessons learned from projects	Good practices
• The financial case for industrial DR is more viable than for residential • For residential applications, the investment is usually paid by EU or national funding • Costs have further increased because of inflation	• Select an ESCO approach for industrial DR • Make sure the financial case is viable

Technologies necessary for communities to provide services are most of the time not installed

Lessons learned from projects	Good practices
• We tend to overestimate the equipment / technologies already available in the demos • Additional devices that can communicate with the smart meter and control the flexible asset are most of time needed	• Define (realistic) digitalisation requirements for legacy equipment early on in the project (at proposal stage).

Difficulties for customers to accept the installation of many monitoring assets unless there is a clear chance of economic savings

Lessons learned from projects	Good practices
• Applications need to have simple interfaces • Communication at demo sites is key • Payment of equipment by the project (and not by the customer) makes it easier to accept • Financial incentives (and high energy prices) help too	• Focus on education • Design applications for special population groups • Use a systemic co-creation, co-development and co-participation approach along the value chain • Develop a clear engagement strategy at demo sites, emphasise non-financial benefits → *link to citizens engagement WG*

Low social acceptability of technology (RES, smart meters, heat pumps), with consumers focussing on security of delivery, comfort, stable energy prices

Lessons learned from projects	Good practices
• Communication at demo sites was implemented by most projects. Some projects also carried out community education, participation in joint activities of interest groups across the country • Industrial/big consumers are easier to convince • For residential: depends on energy culture	• Develop a clear engagement strategy, with community education. • Lead by example: get support from the municipality/ mayor, or local heroes • Special lectures for vulnerable population groups

3.5 Recommendations

Recommendations to address the main barriers, which build upon lessons learned and good practices from the participating projects, were defined during a final interactive workshop.

Some of these recommendations are directly related to Energy Communities while others relate to grid flexibility services & markets:

Energy Communities

- **Raise awareness of national regulators**: Projects should be encouraged to invite regulators from Member States to national project events, and to participate in their regular events to expose and discuss the challenges related to regulation
- **Request Member States to properly define in national regulations the legal figure of RECs and CECs**, their capacities, their obligations, rights and duties (including for data related aspects), and the respective roles of market participants and relevant actors (including DSOs) so as to clearly set the rules and create a level-playing field
- **Launch supporting actions looking into enabling framework & tools for Energy Communities**, with the aim of producing handbooks on how to set up communities and provide services (taking into account lessons learnt and good practices from EU projects) as well as providing detailed advice to national governments on how to improve technical regulations & processes

Grid services & flexibility markets:

- **Streamline the set-up of regulatory sandboxes** to develop, test, compare and assess the effectiveness of innovative local flexibility markets concepts so as to reassure stakeholders
- **Design technology-neutral flexibility products and markets** (with clear roles and responsibilities) that consider the participation of all types of flexibility providers, including Energy Communities, and ensure a level playing field for all participants. Attention should also be paid to price signals and flexibility activation, to make sure they are coherent and that they enable the design of compensation mechanisms
- **Enable independent aggregators to bid into all markets** without any pre-determined arrangements with suppliers/BRPs

Overall, these recommendations are in line with the

- the new framework guidelines from ACER on demand response which was published in December 2022 (and will lead to the drafting of new binding EU rules by ENTSO-E and the EU DSO Entity),
- the proposal for a regulation to improve the EU's electricity market design.

4. Action 3 – Facilitate flexibility market coordination and integration

The action will continue in 2023 and no intermediate results are yet presented.

5. Action 4 – Support the potential synergies coming from increased sector coupling/sector integration/system integration

5.1 Introduction of the Action

To contribute to the achievement of the Paris Agreement 2°C, and potentially 1.5°C, objectives the EU needs a new energy paradigm. Sector coupling and Sector integration, binding together power and end-use sectors to integrate the rising share of variable renewable energy in the energy system, offer a new framework for this purpose[4]. Sector coupling or integrating the sectors to build a decarbonized and hybrid EU energy system is not a goal per se but important means to achieve the EU climate objectives and the EU Green Deal's vision for a carbon-neutral EU economy by 2050.

To identify the existing barriers, this action received information from several projects participating in the BRIDGE Regulation WG. The action counted with the input from 11 projects. These projects are **BeFlexible**, **EUniversal**, **FEVER**, **SENDER**, **TwinERGY**, **InterConnect**, **OMEGA-X**, **FEDECOM**, **GIFT**, **ReEmpowered**, **SENERGY NETS**.

Methodology adopted in Action 4

Action 4 aims to investigate the experience of Horizon 2020 and Horizon Europe projects concerning the identification of existing barriers and problem statement; hence, Action 4 activities are based on analysing the information collected from the working group contributors and the discussions in the organized workshops. The steps of the methodology adopted in Action 4 are shown in Figure 1.

Figure 10: Steps of the methodology adopted in Action 4

As a first step, a brief questionnaire was created and circulated to Action 4 contributors to collect their feedback concerning the existing barriers in cross-sector and cross-coupling integration structured upon 4 building blogs: service provision by e-mobility, integration with heat, sector integration at the household level and offshore wind integration. The second step concerned analysing the received information to identify the barriers that hinder the integration of the different sectors. The preliminary results were presented in an online meeting to the project representatives to collect their feedback. The third step concerned the discussion of the best practices in an online workshop with project representatives, however most of the projects contributing in this action that carried out research focusing on cross-sector integrtation were not mature enough to provide concrete feedback on best practices. Thus, Action 4 work focused on the problem statement and in the fourth step a workshop was organised

[4] OLCZAK, Maria, PIEBALGS, Andris, Sector coupling: the new EU climate and energy paradigm?, Policy Briefs, 2018/17, Florence School of Regulation, Energy, Gas - https://hdl.handle.net/1814/59294

to discuss the conclusions that could be drawn. The last step of the methodology addresses the formalisation of these conclusions and their official reporting.

5.2 Problem statement

5.2.1 Service provision by e-mobility

All the reviewed projects contributing to Action 4 deal with the service provision by e-mobility. Figure 2 shows the number of projects indicating specific barriers as relevant to their demo activities.

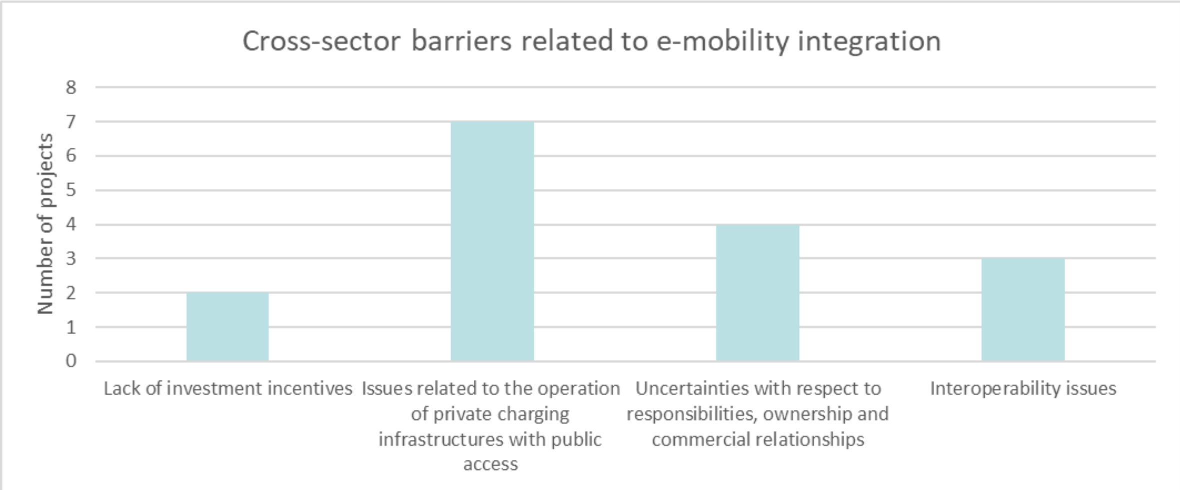


Figure 11: Overview of the barriers related to service provision by e-mobility in the reviewed projects.

One of the main barriers are the issues related to the **operation of private charging infrastructures with public access** and the role of charging stations owners/operators. Moreover, regulation lacks **clear definitions of responsibilities, ownership and commercial relationships** for the actors involved, while the **lack of interoperability of EVs and chargers with the other smart devices and smart homes** that results in insufficient measurement and data exchange was also highlighted. Only 2 out of 11 projects (GIFT, RE-EMPOWERED) reported the lack of investement incentives as a barrier. Other barriers that were reported are the missing regulatory basis for the provision of system services by the EVs, the **lack of incentives for charging operators to participate in business models** in the field of flexibility, as well as the **lack of definition of the aggregator in the national regulatory frameworks** for energy and the limited access of aggregators to markets (e.g. only in the balancing market).The reviewed project experience highlights the need to establish semantic interoperability also applying to EVs, to define the different roles and relationships and aggregator's role within the regulatory framweworks, as well as to develop attractive business models for charging infrastructure operators in the field of flexibility.

5.2.2 Integration with heat

The majority of the reviewed projects deal with demonstrations of heat integration (9 out of 11). Figure 3 presents the overview of projects' feedback on barriers hindering the heat integration.

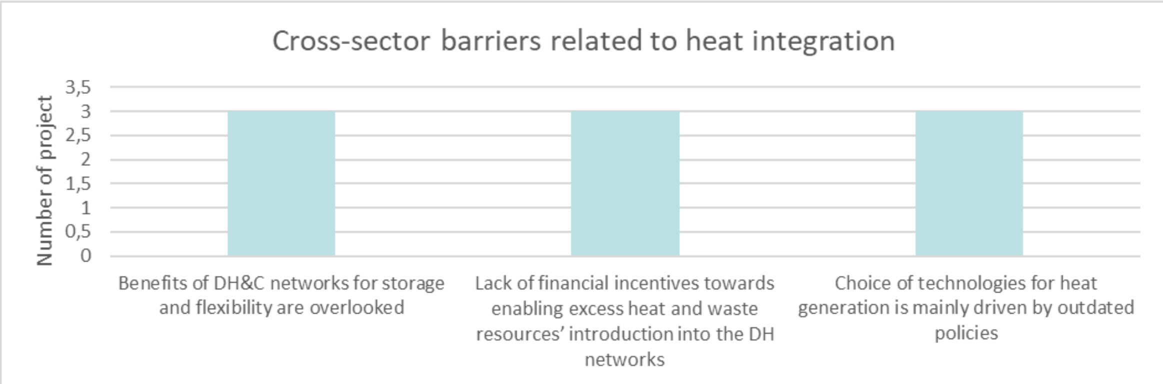


Figure 12: Overview of the barriers related to heat integration in the reviewed projects.

The **BeFlexible** project stated that the provision of system services by using heat pumps is limited since **aggregation in some countries is still a barrier** but necessary for this technology, while the **InterConnect** project raised the lack of **interoperability of heating devices**, such as heat pumps, as an issue highlighting that these devices need to be interoperable for communication with other smart devices and smart homes/smart building management systems.

The **SENERGY NETS** project reported various barriers to the integration of heat with other sectors, based on the partners experience in previous projects. These barriers include the **lack of compatibility/coordination of incentive schemes** between the different energy sectors (e.g., some RES support schemes in the heat sector may limit the flexibility provision to the electricity sector), the **lack of coordination between network operators** (between DSOs and TSOs and between operators of different energy carriers) and the **insufficient coordination between the markets or service procurement mechanisms** in the different energy sectors. Moreover, the heterogeneous situations in the heat sector from one country to the other, and even from one area (city or systems) to the other. It should be noted that, heat systems are inherently local and contrary to the electricity and gas systems, there is no unbundling in the heat networks and most often no “organized market”. In the **RE-EMPOWERED** project, the lack of adequate skills and limited participation by citizens is found to be an issue.

5.2.3 Sector integration at the household level

The majority of the reviewed projects deal with demonstrations of sector integration at the household level (9 out of 11). Figure 4 presents the overview of projects' feedback on barriers hindering the sector integration at the household level.

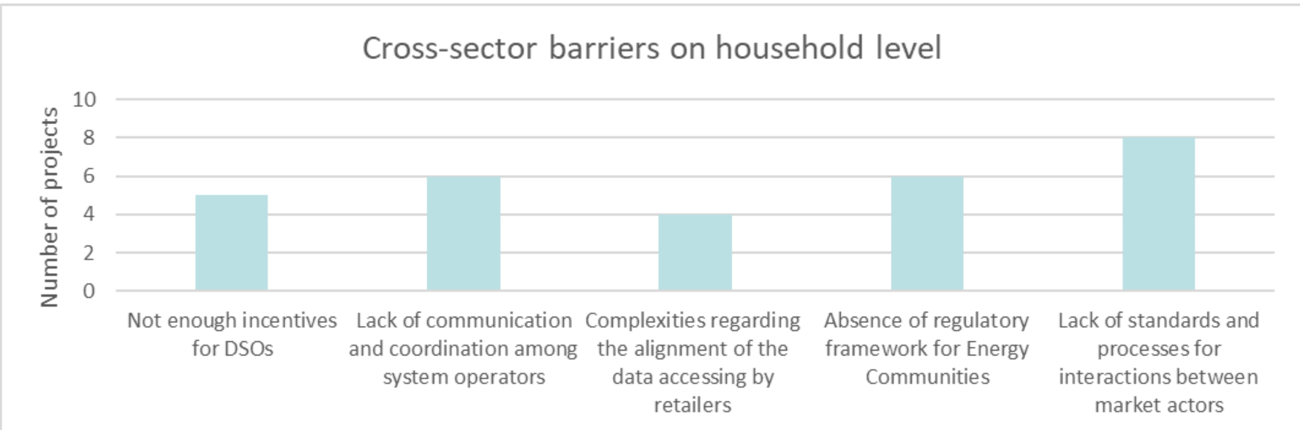


Figure 13: Overview of the barriers related to sector integration at the household level in the reviewed projects.

Most of the projects indicate as a barrier the **lack of standards and processes for interactions between market actors**, while the lack of communication and **coordination among system operators** and the **absence of regulatory**

framework for Energy Communities are also raised from several (6 out of 11) projects as barriers. The lack of sufficient incentives for the DSOs was reported as a barrier from 5 projects, while the complexities regarding the alignment of accessing the data by retailers is perceived as a barrier from 4 projects.

The **SENDER** project reported as a barrier the **lack of incentives for providing flexibility to DSOs** (no flexible grid tariffs implemented). Moreover, it raised the issue of ensuring the interest for an active project participation in case costs for infrastructure must be carried by households, as well as the information/knowledge sharing concerning sector coupling/sector integration at household level and the possibilities to provide flexibility. Moreover, the project highlighted that in case no aggregator is involved, **high efforts for administration of single households** are required.

The **RE-EMPOWERED** project reported the barrier of lack of standards/best practices for DSM for heating systems at the household level. Finally, the **TWINERGY** project reported as a barrier the lack of adoption of HEMS and smart appliances, as well as the lack of knowledge and skills, as an important social factor relevant to the technological barrier.

5.2.4 Offshore wind integration

No project contributing to Action 4 carried out demonstrations related to offshore wind integration.

5.3 Conclusions

This section resumes the main conclusions that resulted from the Action 4 activities. Most of the reviewed projects are still ongoing or just started; therefore, conclusions are more of a high-level nature and aim to create the basis for further analysis in the upcoming Regulation WG actions. Therefore, no specific recommendations are formulated.

Data management, data exchanges and appropriate platforms and mechanisms are key issues. In the same way, interoperability is really important in cross-sector integration across all aspects studied within Action 4. There is insufficient coordination between DSOs, TSOs and operators of different carriers, while market designs and regulations are most often still developed in silos for the different energy sectors. There is a need for a cross-sectoral approach for grid tariffs, energy taxes and renewable support schemes to better reflect the evolution of the energy systems and markets. The high initial costs for procurement and installation of necessary infrastructure for heating systems and household-level equipment hinder the cross-sector integration especially when the infrastructure costs must be carried by the households. There is difficulty for gas, heat and electricity networks operators to discuss with each other because of the different "culture" of the different networks although common roles and functions apply in their operations at some extent. There is a need to establish a common language. Overall, the **need for a cross-sector approach in the development of regulation** is the main conclusion of the Action 4 discussions.

6. Recommendations

Several recommendations are formulated for the individual actions (see before). In addition, following key messages were formulated across the different actions:

- Importance of finding **a balance between EU harmonisation and local solutions** (e.g. prequalification, local market design, products for local congestion management,…)
- Need for further elaboration of **roles and responsibilities** of new (regulated and non-regulated) actors and activities, for example in the context of energy communities or data spaces
- Main **barriers for flexibility** provision are related to the **low voltage level** (minimum bid size, prequalification, baselining, settlement,…)
- Importance of **Regulatory Sandboxes** is acknowledged and might even increase in the coming years.
- Need for more '**modelling power**' to assess the impact of a **wide roll-out of local solutions** on the overall (European) system.
- Novel regulatory initiatives and market design proposals should **onboard consumer centricity during the development** in contrast to assess consumer engagement strategies in a second phase.

7. References

ACER, Agency for Cooperation of Energy Regulators, ‘Framework Guideline on Demand Response’. 2022. [Online]. Available: https://acer.europa.eu/sites/default/files/documents/Official_documents/Acts_of_the_Agency/Framework_Guidelines/Framework%20Guidelines/FG_DemandResponse.pdf

[2] OneNet H2020 project, ‘OneNet Deliverable 2.2 - A set of standardised products for system services in the TSO-DSO-consumer value chain’, 2021.

[3] European Union, *Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (Text with EEA relevance.)*, vol. OJ L. 2019. Accessed: Dec. 26, 2020. [Online]. Available: http://data.europa.eu/eli/dir/2019/944/oj/eng

[4] EUniversal Project, ‘EUniversal Deliverable 1.2: Observatory of research and demonstration initiatives on future electricity grids and markets’.

[5] OneNet Project, ‘OneNet Deliverable 2.1: Review on markets and platforms in related activities’.

[6] EUniversal H2020 project, ‘EUniversal Deliverable D2.1 - Grid flexibility services definition’. [Online]. Available: https://euniversal.eu/

[7] INTERRFACE H2020 project, ‘INTERRFACE Deliverable 3.1 - Definition of new/changing requirements for services’, INTERRFACE H2020 project, 2020.

[8] EUniversal H2020 project, ‘EUniversal Deliverable: D5.1 - Identification of relevant market mechanisms for the procurement of flexibility needs and grid services’, EUniversal H2020 project, 2021. Accessed: Mar. 04, 2021. [Online]. Available: https://euniversal.eu/wp-content/uploads/2021/02/EUniversal_D5.1.pdf

[9] European Commission. Directorate General for Energy., *bridge Annual report 2021: regulation working group.* LU: Publications Office, 2023. Accessed: Mar. 02, 2023. [Online]. Available: https://data.europa.eu/doi/10.2833/47621

[10] OneNet H2020 project, ‘OneNet Deliverable 3.1 - Overview of market designs for the procurement of system services by DSOs and TSOs’, OneNet H2020 Project, 2021. [Online]. Available: https://onenet-project.eu/wp-content/uploads/2021/08/D31-Overview-of-market-designs-for-the-procurement-of-system-services-by-DSOs-and-TSOs-1.pdf

[11] INTERRFACE H2020 project, ‘INTERRFACE Deliverable 5.5 - Single Flexibility Platform Demonstration Description and Results’, Jul. 2022.

[12] Janka Vanschoenwinkel *et al.*, ‘EUniversal Deliverable D2.2 - Business Use Cases to unlock flexibility service provision’, EUniversal H2020 project consortium, 2021. [Online]. Available: https://euniversal.eu/wp-content/uploads/2021/05/EUniversal_D2.2.pdf

[13] WP1 Pilot Partners, ‘InterConnect D1.2 - Mapping between use cases and large-scale pilots’, 2021. Accessed: Mar. 03, 2023. [Online]. Available: https://interconnectproject.eu/wp-content/uploads/2021/02/D1.2-Mapping-between-use-cases-and-large-scale-pilots_DraftVersion.pdf

[14] H. de Heer and M. van der Laan, ‘Workstream on aggregator implementation models’, USEF Energy, Sep. 2017. [Online]. Available: https://www.usef.energy/app/uploads/2017/09/Recommended-practices-for-DR-market-design-2.pdf

[15] ‘About - Interconnect Project’, *Interconnect*. https://interconnectproject.eu/about/ (accessed Mar. 03, 2023).

[16] ‘Platone - Our Project’, *Platone - Platform for Operation of distribution Networks*. https://www.platone-h2020.eu//Project/Our_Project (accessed Mar. 03, 2023).

[17] Energy Networks Association - DNV GL Ltd., ‘Baseline Methodology Assessment’, Dec. 2020. Accessed: Nov. 29, 2022. [Online]. Available: https://www.energynetworks.org/industry-hub/resource-library/open-networks-2020-ws1a-p7-baselining-assessment-report.pdf

[18] O. Valentini, N. Andreadou, P. Bertoldi, A. Lucas, I. Saviuc, and E. Kotsakis, ‘Demand Response Impact Evaluation: A Review of Methods for Estimating the Customer Baseline Load’, *Energies*, vol. 15, no. 14, Art. no. 14, Jan. 2022, doi: 10.3390/en15145259.

[19] N. Morell Dameto, J. P. Chaves-Ávila, and T. Gómez San Román, ‘Revisiting Electricity Network Tariffs in a Context of Decarbonization, Digitalization, and Decentralization’, *Energies*, vol. 13, no. 12, Art. no. 12, Jan. 2020, doi: 10.3390/en13123111.

[20] Gonçalo de Almeida Terça, Annelies Delnooz, Anibal Sanjab, Kris Kessels, and Md Umar Hashmi, ‘EUniversal Deliverable 5.2: Methodology for dynamic distribution grid tariffs’, EUniversal H2020 project. Accessed: Mar. 09, 2023. [Online]. Available: https://euniversal.eu/wp-content/uploads/2022/08/EUniversal_D5.2_Methodology-for-dynamic-distribution-grid-tariffs-.pdf

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://europa.eu/european-union/contact_en

On the phone or by email

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

– by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

– at the following standard number: +32 22999696, or

– by email via: https://europa.eu/european-union/contact_en

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: https://europa.eu/european-union/index_en

EU publications

You can download or order free and priced EU publications from: https://op.europa.eu/en/publications. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://europa.eu/european-union/contact_en).

EU law and related documents

For access to legal information from the EU, including all EU law since 1952 in all the official language versions, go to EUR-Lex at: http://eur-lex.europa.eu

Open data from the EU

The EU Open Data Portal (http://data.europa.eu/euodp/en) provides access to datasets from the EU. Data can be downloaded and reused for free, for both commercial and non-commercial purposes.

MJ-09-23-565-EN-N

ISBN 978-92-68-05728-5

Publications Office
of the European Union