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Regulation Working Group

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BRIDGE

Regulation Working Group
Annual Activity Report 2024-2025

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TABLE OF CONTENTS

Sommario

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

CEC	Citizen energy community
CEP	Clean Energy Package
CSC	Collective self-consumption
DR	Demand Response
DER	Distributed Energy Resources
DSO	Distribution System Operator
EC	European Commission
EMD	Electricity Market Design
ESO	Energy Sharing Organiser
EV	Electric Vehicle
GA	General Assembly
LEC	Local Energy Community
LFM	Local Flexibility Market
LV	Low Voltage
MV	Medium Voltage
MS	Member State
NRA	National Regulatory Authority
OSS	One-Stop-Shop
P2P	peer-to-peer
PED	Positive Energy District
PV	Photovoltaics
REC	Renewable energy community
RED	Renewable energy Directive
RES	Renewable energy source
SME	Small and medium enterprise
SO	System Operator
TSO	Transmission System Operator
WG	Working Group

1. INTRODUCTION

1.1 Introduction to the BRIDGE Regulation WG

The BRIDGE Regulation Working Group (WG) was established from the beginning of the BRIDGE initiative to foster knowledge sharing among projects funded by Horizon 2020 and Horizon Europe programmes, which address different regulatory aspects in the field of energy.

The Regulation 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 in specific reports that can be shared not only within the BRIDGE community, but with a larger audience.

The Regulation WG is a live group where projects join and leave as they evolve. This "staff rotation" facilitates a dynamic environment for the introduction of new topics of interest. The WG continuously looks for synergies with other BRIDGE working groups, and with those outside BRIDGE (ISGAN, ETIP SNET, …). The WG defines the most important regulatory challenges to be addressed, proposes best practices from the BRIDGE projects and formulates recommendations for policy makers. In addition, thematic knowledge sharing sessions are organised to present best practices from projects that are close to their end date.

1.2 Introduction to the Main Challenges to be Addressed

The topic of energy markets and flexibility is intensifying. Several (regulatory) initiatives, such as the Digitalisation of Energy Action Plan (2022), the Reform of the EU Electricity Market Design (2024), the upcoming European Grids Package (set for release in 2025) and the future regulation on Energy Sharing (2026) are driving efforts to meet the sustainability goals for 2030 and 2050[1]. Moreover, consumers are increasingly central to the public debate. The impact of the energy crisis on 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 for the future.

The following challenges were addressed by the WG in 2024:

1. **Market access:** Today's market access for consumer flexibility is hindered and the value of flexibility via implicit or explicit flexibility mechanisms is still limited. The WG explores the elements that need to be addressed and would need further elaborations, such as the regulatory barriers that hinder the valorisation of flexibility for individual consumers
2. **Peer-to-peer and energy sharing:** Given the impact of the energy crisis and transition on individual consumers, it is worth investigating the role of the peer-to-peer and energy sharing in the overall market design. The WG has focused on the regulatory barriers and the enablers for the uptake of energy sharing as well as energy communities.
3. **Flexibility market coordination and integration**: The development and implementation of flexibility mechanisms across the European Union involve various best practices and barriers that need to be addressed. Understanding these elements is crucial for advancing the integration of local flexibility markets with existing market structures. By identifying successful strategies and challenges faced by different projects, the WG has developed recommendations to foster energy and flexibility market coordination and integration.
4. **Sector coupling/sector integration**: Recently, increased attention has been 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

[1] COM(2022) 552 final, 18/10/2022, Communication from the Commission to the European Parliament, the Council, the European Economic And Social Committee and the Committee of the Regions, *Digitalising the energy system - EU action plan*.

new sectors is leading to potential synergies for consumers, market actors and the overall system. To maximise these synergies, it is important to address some key regulatory barriers.

5. **Market coordination and integration:** Supporting system operators in preparing the grid for 2030 is crucial. Several new services, markets and platforms for energy and flexibility have been developed in recent years. However, innovations are needed to advance processes/tools of network planning and network operations.

1.3 Overview of Action Plan 2024

In 2024, the BRIDGE Regulation WG focused on five main objectives, each of which was operationalised through a dedicated action. These actions were designed to address key regulatory challenges and priorities identified by the WG, ensuring a structured and goal-oriented approach throughout the year. (Table 1):

Table 1 Regulation WG's Action Plan 2024

Action n.	Action title	Note
Action 1	Improve **market access** for consumers to value their flexibility	*Continuation of Action 1 (2023)*
Action 2	**Peer-to-peer and energy sharing**	*Continuation of Action 2 (2023)*
Action 3	Energy and flexibility market coordination and integration	*Continuation of Action 3 (2022)*
Action 4	Support the potential synergies coming from **increased sector coupling/sector integration/system integration**	*Continuation of Action 4 (2023)*
Action 5	Support the **system operators to prepare the grid for 2030**	*Continuation of Action 5 (2023)*

The following sections present the results achieved during 2024.

1.4 Regulation WG Projects

In 2024, the BRIDGE Regulation WG includes a total of 68 ongoing projects engaged in cross-cutting activities. These projects are considered part of the WG network insofar as they are registered to the mailing list, participate in the monthly meetings, and/or receive communication and updates pertaining to the WG (listed in Figure 1.1**Errore. L'origine riferimento non è stata trovata.** for reference). For details on which projects actively participated in specific WG actions, please refer to the individual chapters of each action in the following sections.

Figure 1.1: List of projects in the Regulation WG

2. ACTION 1 – IMPROVE CONSUMERS' MARKET ACCESS TO VALUE THEIR FLEXIBILITY

Action leader: Anna Pizzamiglio (Lisbon Council), **EDDIE Project**.

2.1 Introduction of the Action

The transition to a more consumer-driven, flexible energy market requires overcoming significant regulatory barriers that prevent individuals from fully engaging in and benefiting from flexibility mechanisms. As the energy system evolves, consumers are becoming increasingly able to manage and optimise their energy usage through digital tools, such as smart appliances and energy management systems. This shift presents both challenges and opportunities for regulatory frameworks, which need to adapt to enable broader participation in flexibility markets.

While there are various mechanisms in place to enable consumers to access flexibility markets, such as aggregation rules, tariff designs, and smart appliances, these were often developed independently. As a result, their combined potential to enhance system efficiency and facilitate consumer participation has been limited. Therefore, a more integrated approach is required to address existing gaps and harmonise regulatory frameworks, ensuring that all consumers have equal access to the benefits of flexibility.

Action 1 focused on identifying and addressing the regulatory barriers to consumer participation in flexibility markets. A workshop/webinar held in March 2025 brought together projects from across the BRIDGE initiative, with the goal of identifying best practices, exploring the impact of various regulatory frameworks, and developing actionable recommendations to improve market access.

2.2 Methodology Adopted in Action 1

To investigate how regulatory barriers affect consumer access to flexibility markets, Action 1 followed a three-step methodology:

Figure 1: Steps of the methodology adopted in Action 1

1. Scoping Survey

A detailed questionnaire was circulated among Regulation WG projects to capture their experiences on consumer flexibility. The survey explored the role of flexibility in each project, regulatory and non-regulatory barriers across different market actors (e.g., DSOs, aggregators, consumers), the importance of digitalisation, and existing solutions. It also included questions on regional differences in engagement practices and successful case studies. The survey received inputs from over ten BRIDGE projects, offering a broad and diverse evidence base.

2. Preliminary Synthesis and Workshop Design

Survey responses were analysed to identify recurring challenges and innovative approaches. These findings were then used to shape the agenda for a workshop, convened in March 2025 with the aim of facilitating peer learning, surfacing further insights, and co-developing actionable recommendations. To support structured discussion, a PESTLE framework (Political, Economic, Social, Technological, Legal, Environmental) was adopted. This approach enabled a systemic exploration of the different types of barriers and enablers that influence consumer flexibility participation.

3. Collaborative Workshop

The collaborative workshop focused on the survey results and allowed participants to delve deeper into the key findings from the survey and share insights from their projects.

2.3 Results from the Collaborative Workshop

Political Barriers

One of the most prominent discussions centred on the implementation gap between European Union-level policies and national regulatory frameworks. While EU directives, such as the Clean Energy Package, set the foundation for flexibility markets, participants emphasised the slow pace of implementation at the Member State level. The workshop revealed that although the regulatory framework for consumer flexibility is in place at the EU level, its application varies significantly across Member States. Participants highlighted that local regulatory environments are often a hindrance, with some Member States still grappling with the fundamental concept of consumer flexibility.

Economic Barriers

Participants also highlighted market entry barriers caused by lack of economic incentives for consumers and businesses. The discussion revealed that the absence of clear financial incentives and dynamic pricing mechanisms significantly impacts the willingness of consumers to participate in flexibility markets. Moreover, infrastructure limitations and the high costs of implementing new technologies were cited as key challenges in expanding participation in flexibility solutions. Participants agreed that innovative market design and pricing mechanisms could unlock economic opportunities and enhance engagement.

Social Barriers

The social aspect of the discussion was particularly impactful. Participants recognised that consumer trust remains one of the most significant barriers to widespread participation in flexibility markets. The reluctance of consumers to engage, particularly in markets requiring data sharing and dynamic pricing, was emphasised. The lack of awareness and understanding of how flexibility can benefit individual consumers were identified as key factors driving this hesitance. The workshop participants also acknowledged the importance of collaborative efforts with consumer engagement groups to improve education, build trust, and ensure that the transition to flexible energy systems is inclusive.

Technological Barriers

On the technological front, the workshop highlighted the critical role of data access and interoperability in enabling the success of flexibility markets. A recurring theme was the lack of standardisation and the challenges posed by legacy infrastructure. While technological solutions like smart meters and digital platforms are essential for empowering consumers, participants pointed out that these tools are often not yet fully integrated across different sectors or regions. The workshop also discussed the need for a robust data space to ensure seamless data exchange between market participants, which could alleviate many of the technological barriers currently faced.

Legal Barriers

Participants agreed that data privacy regulations, such as the General Data Protection Regulation (GDPR), are a double-edged sword. While they ensure the protection of consumer data, they also pose significant challenges for data sharing and access necessary for flexibility market participation. Several workshop participants shared experiences of navigating complex consent procedures, especially when engaging with residential consumers. The need for clearer regulations that balance privacy protection with flexibility market needs was identified as a crucial area for improvement.

Environmental Barriers

The environmental discussions focused on the potential for flexibility technologies to reduce carbon emissions. Many participants agreed that consumer flexibility could play a central role in achieving energy system decarbonisation goals. However, some participants raised concerns about the environmental impact of the digital tools that enable these systems, particularly in terms of the energy consumed by servers and cooling technologies. The workshop suggested that a life cycle analysis of these digital tools could be beneficial in evaluating their overall environmental impact.

2.4 Key Takeaways

The workshop's discussions and overall work on Action 1 led to several key conclusions that will inform future actions within the BRIDGE initiative:

- Fragmentation at the Member State level remains one of the most significant barriers to the success of consumer flexibility markets. The slow pace of regulatory implementation and varying national policies are impeding progress.
- Social factors, particularly consumer trust, are crucial for unlocking the potential of flexibility markets. Ongoing collaboration with the Working Group on Consumer Engagement will be essential to address these barriers.
- Technological barriers, especially those related to data access and interoperability, must be addressed to create a seamless, integrated system that allows for broader participation in flexibility markets.
- Financial incentives and dynamic pricing mechanisms need to be aligned with market structures to ensure that consumers and market actors are incentivised to participate.

These insights will serve as a foundation for further collaboration across BRIDGE projects and the development of practical recommendations aimed at improving access to and participation in flexibility markets. Next steps include conducting a more in-depth exploration of EU-level policies and exploring ways to build consumer trust through better data access, user-friendly platforms, and clear regulatory frameworks.

3. ACTION 2 - PEER-TO-PEER AND ENERGY SHARING

Action leader: Karine Laffont-Eloire (DOWEL Innovation), **LocalRES Project**.

3.1 Introduction of the Action

In the BRIDGE activity year 2022-2023, Action 2 initially focused on energy communities and how they could provide grid services.

The 2023-2024 Work Plan of the Regulation WG then asked Action 2 to investigate the role of peer-to-peer (P2P) and energy sharing in the overall market design, investigating barriers and their potential to facilitate energy community adoption. Action 2 thus centred on energy sharing and peer to peer trading, while also expanding its focus to include energy communities and their capabilities in conducting energy sharing or P2P trading. This scope was continued in the 2024-2025 Workplan.

3.1.1 Regulatory background

'Energy sharing' allows citizens to share self-generated electricity with their neighbourhood (or even beyond) on a contractual basis. As of Q1 2025, among all 27 EU member states, only a few of them have fully implemented functional energy sharing frameworks.

Energy communities are a new market actor created by the Clean Energy for all Europeans Package, adopted in 2019, with the aim of organising collective and citizen-driven energy actions that help pave the way for a clean energy transition. The activities they are allowed to carry out include joint generation and consumption of renewable energy – in other words they can take part in energy sharing.

Energy sharing	Peer-to-peer trading	Energy communities
Defined by Directive (EU) 2024/1711	Defined in Directive (EU) 2018/2001	Defined in Directive (EU) 2018/2001 (REC) and Directive (EU) 2019/944 (CEC)
means the **self-consumption by active customers of renewable energy** either: generated or stored offsite or on sites between them by a facility they own, lease or rent in whole or in part; or the right to which has been transferred to them by another active customer for a price or free of charge	the sale of renewable energy between market participants by means of a **contract with pre-determined conditions governing the automated execution and settlement of the transaction**, either directly between market participants or indirectly through a certified third-party market participant, such as an aggregator	Different definitions for RECs and CECs, but both shall 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 include joint generation and consumption of renewable energy.
An activity	A contract	An organisational concept

Figure 3.1: Energy sharing regulatory framework

The regulatory landscape related to energy sharing has been recently enriched by a proposal from the European Commission to improve the EU Electricity Market Design (EMD) and amend the relevant regulations and directives[2]. The proposal was politically agreed upon at the end of 2023 and was formally adopted in June 2024[3]. It is of specific interest for the BRIDGE projects that have activities related to energy sharing, P2P trading and energy communities. The proposal indeed operationalises energy sharing by establishing relevant roles, rights and responsibilities and expanding the right to wider categories of active customers.

Energy sharing can take multiple forms (Figure 3.2), and only some of these forms may be allowed depending on the Member State.

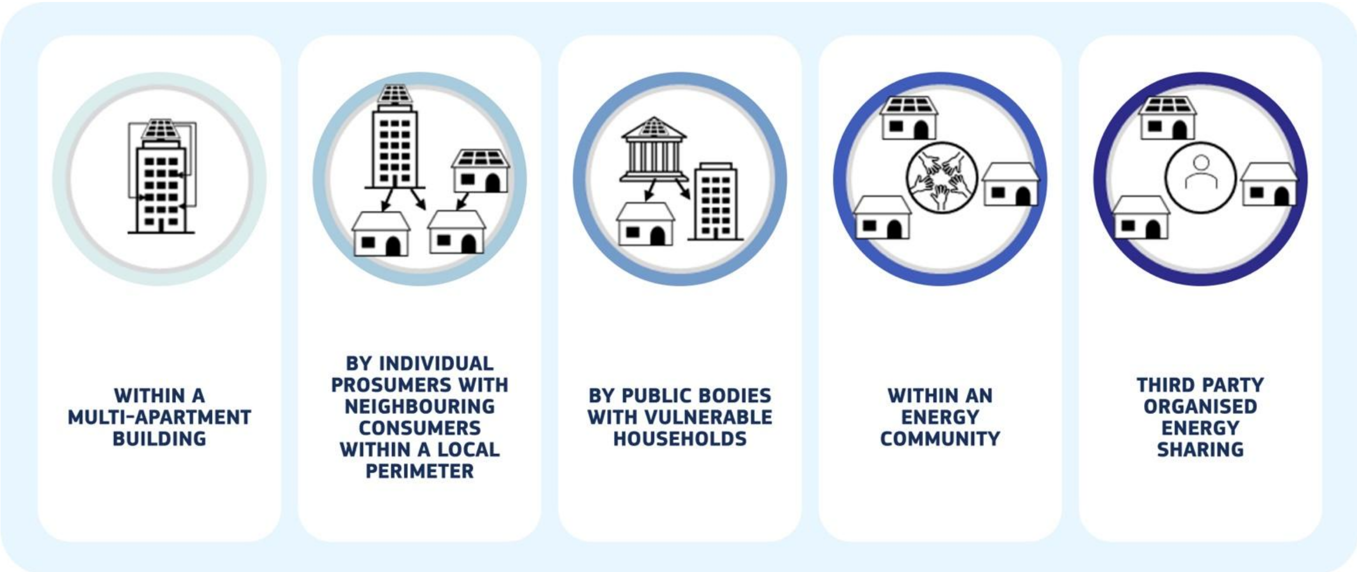

Figure 3.2: The multiple forms that energy sharing can take

3.1.2 Methodology Adopted in Action 2

Last year, Action 2 endeavoured to get a better understanding of the barriers EU-funded projects under the BRIDGE umbrella are facing when developing innovative solutions for energy sharing (including through P2P). Lessons learnt from their real-life demonstrations with active consumers or energy communities were also gathered in order to derive good practices and recommendations. The activities carried out since September 2024 have built upon this work, with the ambitious objective of delivering a **standalone report on energy sharing**[4]. This report includes an overview of national regulatory frameworks for energy sharing in Europe, as well as a set of policy recommendations, each supported by a proposal of corresponding actions.

The different steps undertaken in the implementation of Action 2 are illustrated in Figure 3.3 providing a visual overview of the methodology adopted and the sequence of activities carried out throughout the process.

[2] COM(2023) 148 final, 2023/0077 (COD), Proposal for a Regulation of the European Parliament and of the Council amending Regulations (EU) 2019/943 and (EU) 2019/942 as well as Directives (EU) 2018/2001 and (EU) 2019/944 to improve the Union's electricity market design.

[3] DIRECTIVE (EU) 2024/1711 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 June 2024 amending Directives (EU) 2018/2001 and (EU) 2019/944 as regards improving the Union's electricity market design.

[4] European Commission: European Climate, Infrastructure and Environment Executive Agency, Directorate-General for Energy, Fina, B., Laffont-Eloire, K., Monsberger, C. et al., Report on energy sharing, Laffont-Eloire, K.(editor), Publications Office of the European Union, 2025, https://data.europa.eu/doi/10.2926/8653694

Figure 3.3: Steps of the methodology adopted in Action 2

Three online meetings were organised between September and December 2024, all with a mix of presentations and interactive discussions (using an online board). The first meeting welcomed the new projects participating in the Action and presented the results of the work done from January to June 2024 (identification of barriers, draft recommendations). During that meeting, the objectives and timeline of the activities to be carried out until March 2025 were also explained, and instructions were given to the projects on how to contribute to the report on energy sharing. Projects then had to contribute to the regulatory overview by providing detailed inputs for the countries in which they had a demonstration site, using a common template (Excel spreadsheet) hosted on BRIDGE sharepoint. To avoid duplication of effort, each project was assigned the description of 2 to 3 Member States. The second meeting was dedicated to sharing lessons learnt and identifying remaining barriers. The final meeting focused on the recommendations in order to check that what had been proposed in summer 2024 was still valid and to fine-tune some of them.

After the third meeting, contributing projects were regularly reminded to provide inputs to the regulatory overview, and additional projects covering the topics of energy sharing and/or energy communities were also contacted in view of adding new Member States to the regulatory overview. As a result, a total of 14 countries were covered. Participating projects were also asked to provide short project descriptions, with insights about their lessons learnt in relation to energy sharing. Action 2 chair then aggregated all inputs into a single document, whose structure had been previously agreed with DG ENER, to make sure that the provided information would be easily exploitable.

In parallel, after discussion with DG ENER, activities were launched together with the Citizens and Consumers Engagement WG to develop a survey focusing on consumer rights in energy-sharing schemes. The survey was circulated to projects involved in the Regulation WG in February, and inputs from 9 projects were collected early March. Results were then analysed and presented to DG ENER.

3.1.3 Participating Projects in the Action 2

Overall 15 projects participated in Action 2 this year, either through participation to interactive sessions, or through the collaborative documents shared on BRIDGE sharepoint: **ACCEPT**, **COMMUNITAS**, **Data Cellar**, **Dedalus**, **Energetic**, **EU-DREAM**, **FEDECOM**, **LocalRES**, **ODEON**, **OPENTUNITY**, **PARMENIDES**, **PEDvolution**, **POCITYF**, **SENDER**, **U2DEMO**.

Projects **OMEGA-X**, **ECHO**, **BeFlexible**, **RESCHOOL** also answered the survey on consumer rights.

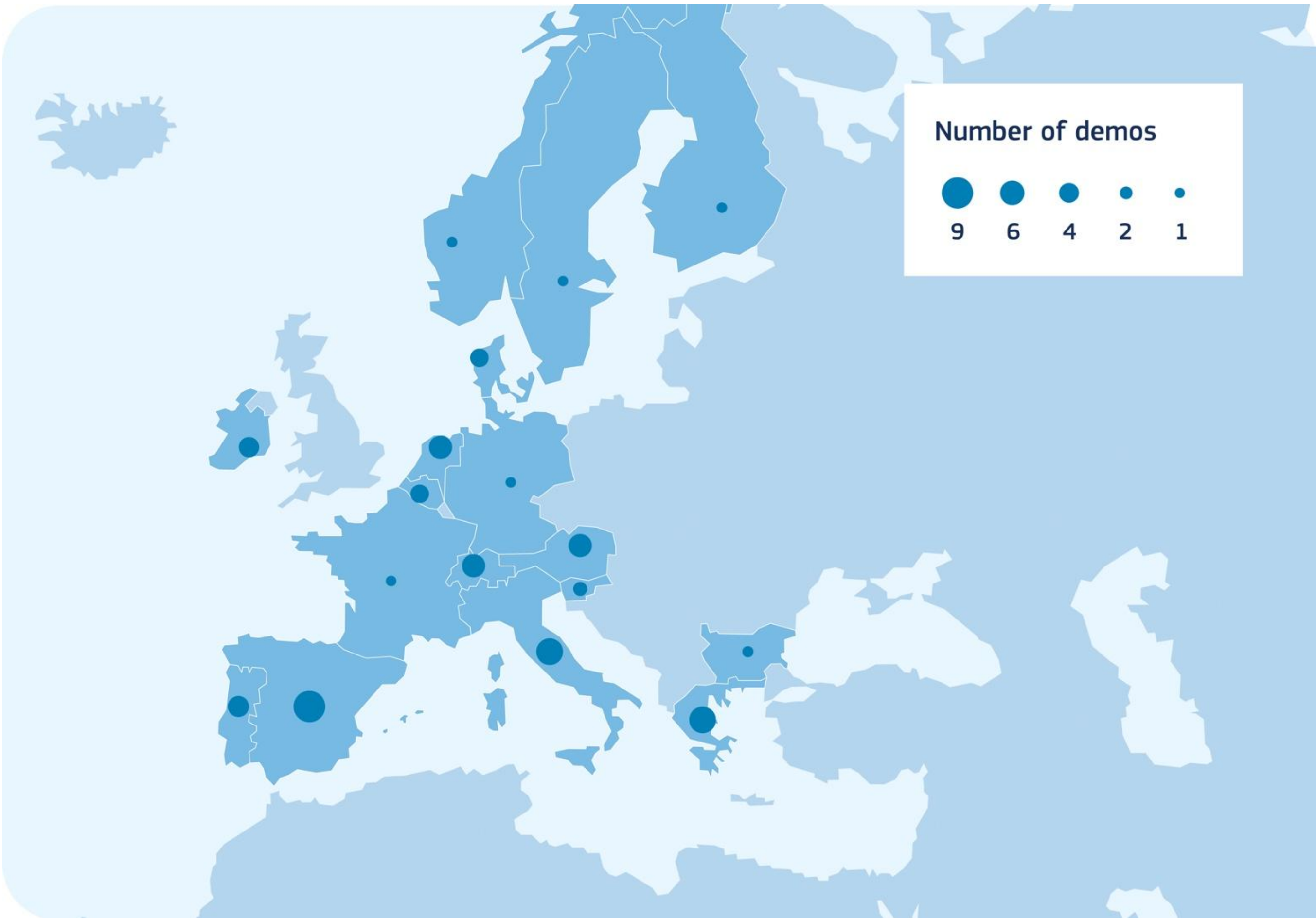

Figure 3.4: Location of the demonstrations of the projects participating in Action 2 since September 2024

Most projects are focusing on energy sharing or P2P trading schemes. In parallel, several other projects concentrate on the development of renewable or citizen energy communities, actively engaging community members as part of their pilots implementations. Some of the projects have a focus on broader topics such as flexibility services or data management, which nonetheless incorporate energy communities or energy sharing models as relevant use cases within their overall frameworks.

3.2 Barriers

The barriers to the implementation of energy sharing and P2P trading were identified in a survey run early in 2024. All the inputs were then organised into a list of about 20 barriers (see Figure 3.5, with the top five as rated by the projects). While some barriers are of regulatory nature, others are financial, technical or social.

The regulatory framework was deemed overly complex by some participating projects. The legislative texts adopted at Member State level to transpose the EU directives were considered too restrictive and not fully aligned with the EU definitions. Additionally, energy sharing and P2P trading focus on electricity, thereby creating silos and missing the opportunity to unlock the potential of sector coupling.

Category	Barrier	Rank
REGULATION	Unclear **definition of energy sharing at EU level** (unclear distinction with supply and P2P trading)	3
	Lack of **national regulatory framework for P2P trading** in most of MS	2
	National regulatory constraints for energy sharing, with territorial discrepancies	
	Great diversity between the different Member States for Energy communities	
	Lack of clearly defined roles and responsabilities, e.g. for DSOs, which can be bottleneck	4
VALUE CHAIN/ MARKET	**Lack of market framework for energy sharing and P2P trading in some MS** (incl. rules for imbalance settlement, pricing), and lack of harmonization between countries	1
	Fow or missing 3rd parties offering marketplace and services for P2P trading	
	Delays in grid connection and to get permits for RES installations	
	Complex and long administrative process with DSO to register new energy communities of energy sharing participants	
FINANCIAL	**Limited or delayed incentives** (incl. Loans or favourable taxation) **and funding** (grants) for citizen-lead RES projects which have a high initial investment (and high connection fees)	
	High cost of implementing smart energy solutions (e.g. metering devices) to make homes smarter	
	Limited economic benefit / no business model (e.g. P2P trading provides very small financial gain, high transaction cost in some MS)	
	Lack of trust from financial actors (banks) which results in difficult access to finance, as energy communities are complex to understand from legal point of view	
TECHNICAL	**Complex access to data and lack of interoperability** (Difficulties in obtaining data from DSOs and from communities, issues with data sharing, lack of interoperability with existing devices/ smart systems, data integration to different energy market communication environments)	5
	Cybersecurity risk increased by the exchange of data and the multiplication of new tools developed by 3rd parties	
	Lack of technical infrastructure or smart meters. Once set up, frequent maintenance is needed	
	Risks of grid congestion or imbalances in the balance groups (e.g. multiple suppliers)	
SOCIAL	**Lack of trust & privacy concerns:** Difficulties in convincing citizens to share their data	
	Digital barrier: slow or no change in behavior after installing smart devices, inadequate usability of applications	
	Lack of awareness, energy literacy and understanding about the role of prosumers or the opportunity to participate in energy communities	
	Limited knowledge about funding sources and incentives and reluctance to invest	
	Lack of inclusion for vulnerable consumers groups (the elderly, low-income groups facing energy poverty, digital poverty)	
	Lack of motivation: the economic benefit remains the priority of citizens in general	

Figure 3.5: Barriers identified in Action 2. The Top 5 barriers are numbered according to their relevance

Since the elaboration of this list of barriers, the regulatory landscape has evolved at EU level, with energy sharing being now defined thanks to Directive 2024/1711, **which alleviates one of the barriers identified early in 2024 by the participating projects** (see barrier numbered as "3" in Figure 3.5). However, as Member States have until June 2026 to transpose the article about energy sharing, it is unlikely that the national regulatory frameworks will be simplified in the short term, and the list of other barriers can therefore be considered as still valid.

Most of these barriers were encountered by several of the participating projects. Once again, sharing **lessons learnt** proves invaluable in addressing these challenges more effectively: insights from projects can be found in the **standalone report on energy sharing** published by Action 2**.**

3.3 Results from the detailed regulatory overview

In conclusion, 14 European countries (12 Member States) were covered in the regulatory overview, thanks to a collective effort to which most Action 2 projects contributed. **Detailed country factsheets can be found in the standalone report on energy sharing** – only a very short synthesis is provided here. In that report, several projects also provided detailed insights, information and lessons learnt on their demonstrations, sharing good practices to benefit the wider community and enhance collaboration.

Based on the inputs provided by projects, the 'maturity' of the regulatory frameworks related to energy sharing was assessed in all the Member States covered.

Four levels of maturity are proposed to evaluate the status of regulatory frameworks for energy sharing across different contexts:

- **Level 0 – Absence of a regulatory framework:** no regulatory provisions are currently in place to enable or govern energy sharing activities;
- **Level 1 – Partial framework:** A limited regulatory structure exists, for example, allowing energy sharing only within a single building or across a private grid. Alternatively, the regulatory framework may still be under development or undergoing preliminary consultations.
- **Level 2 – Functional but constrained framework:** A regulatory framework is in place and operational, yet it presents certain limitations. These may include the use of static allocation coefficients only, the absence of a formally defined role such as the Energy Sharing Organiser, or the persistence of market or administrative barriers that hinder effective implementation.
- **Level 3 – Fully functional regulatory framework:** A comprehensive and mature regulatory environment is established, enabling energy sharing to take place in a practical, flexible, and market-integrated manner, with clearly defined roles, rules, and mechanisms.

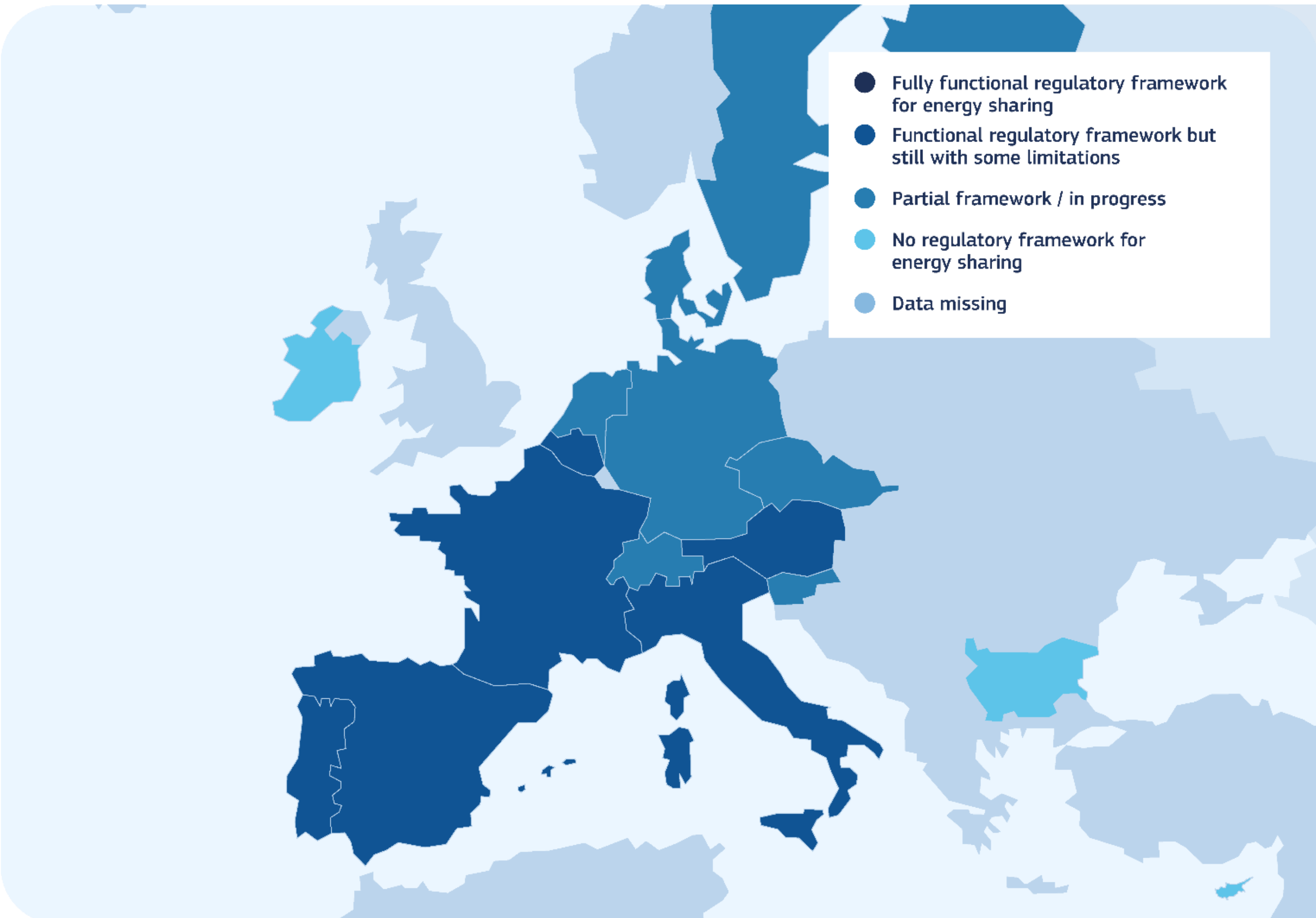

Figure 3.6: Maturity of the national regulatory frameworks for energy sharing

Countries where regulation is rather advanced include Portugal, France, Spain, Italy and Austria. However, the regulatory frameworks in those countries still have some limitations. For example, in Austria only energy communities can share energy, in Spain the energy sharing organiser does not exist yet and the process to register an energy-sharing arrangement may take time. In several cases, fully dynamic energy sharing coefficients are not possible yet.

Regulatory frameworks are being developed in Central and Northern Europe (e.g. Germany, Czechia, Sweden, the Netherlands, Denmark) but are not completely functional for now.

3.4 Recommendations

Recommendations to address the main barriers, drawing on lessons learnt and good practices from the participating projects, were identified and prioritised during two interactive workshops organised in spring 2024. Eight key recommendations were finally selected in summer 2024, and each one was then broken down into a set of recommended actions. These actions were drawn up collectively with help from several experts from BRIDGE projects.

Some of these recommendations target EU policy makers and regulators, while others target national regulators or local stakeholders. They are presented by order of priority in the Table 2 below.

Tabela 2 List of recommendation in order of priority

Priority	Recommendation	*EU level*	*MS level*
1	Create implementing guidelines for MSs for energy sharing: clear definition, responsibilities of the different market players, and how it can be done (including through P2P trading), making sure that national regulations on energy sharing include necessary provisions on inclusiveness and consumer protection	✓	✓
2	Set up national and EU working groups bringing together regulatory bodies, DSO, suppliers, representative bodies for energy sharing participants (to be created if necessary), and EU projects, to share lessons learnt and good practices (incl. on sharing coefficients)	✓	✓
3	Simplify legal registration process for communities, e.g. with a digital registration system	✓	✓
4	Allow for the creation of local energy markets to enable trading between communities		✓
5	If not already done, deploy intelligent metering system and harmonised communication standards		✓
6	Support DSOs so they can enable energy sharing, incl. data sharing with market actors	✓	✓
7	Implement a systemic and cross-sectoral approach, to avoid silos between electricity, heat, DH&C, gas and mobility	✓	✓
8	Define a clear framework at EU level for data governance in the energy sector (data access, ownership, privacy, cybersecurity), with guidelines for MS on how to implement at national level, to build trust and enable new business models for energy sharing *(link to Action on Data Spaces)*	✓	✓

These recommendations include establishing guidelines to support Member States in transposing the new Article 15 on the "right to energy sharing" (see Priority 1 in the above table). The full recommendations, broken down into actions, are provided at the end of the standalone report on energy sharing.

3.5 Conclusions

The continued engagement of EU funded projects in Action 2 enabled to carry out a review of existing national regulatory frameworks in more than 15 countries. Overall, the reports provided by BRIDGE projects demonstrate a positive move towards the establishment of supportive regulation of energy sharing throughout Europe. The sharing of good practices is critical at this stage, to ensure that regulation truly supports energy sharing initiatives and also implements a level playing field for those citizen-led schemes.

The contributions of the BRIDGE projects involved in Action 2 were also instrumental in developing the standalone report on energy sharing. In the coming year, this report will be enriched with new findings (e.g. for countries not covered yet), and specific topics (such as consumer rights and protection) will be explored in more details. It is indeed essential to make sure that national regulations on energy sharing include necessary provisions on inclusiveness and consumer protection.

4. ACTION 3 – FACILITATE ENERGY AND FLEXIBILITY MARKET COORDINATION AND INTEGRATION

Action leaders: José Pablo Chaves Avila (Comillas Pontifical University), **BeFlexible Project**; Matteo Troncia (Comillas Pontifical University), **BeFlexible Project**; Eliana Ormeño Mejía (Comillas Pontifical University), **BeFlexible Project**; Alberto Vannoni (RSE), **SENERGY NETS Project**.

4.1 Introduction of the Action

The transition to a sustainable energy system requires reducing fossil fuel dependence and enhancing the efficiency of the electricity sector. However, integrating variable renewable sources (e.g., solar, wind) and electrifying key sectors (e.g., mobility, heating) pose significant challenges to grid capacity and system balancing. At the same time, digital advancements enable consumers to take a more active role in managing their energy usage.

These changes also bring new opportunities for system operation, such as exploiting the existing intrinsic flexibility of power systems. Therefore, leveraging flexibility from distributed energy resources represents an alternative to traditional grid reinforcements. Well-designed flexibility acquisition mechanisms, such as network tariffs, flexible connection agreements, and local flexibility markets can unlock this flexibility. Nevertheless, they were initially designed as independent acquisition mechanisms, limiting their combined potential to improve system efficiency and cost effectiveness.

4.1.1 Methodology adopted in Action 3

Action 3 of the BRIDGE Regulation Working Group aims to analyse the best practices and the barriers to developing and implementing energy and flexibility markets across the European Union countries. This process involves collecting insights and experiences from different EU-funded projects, using information provided for the working group contributors and public deliverables. The objective consists of formalising recommendations to foster the coordination and integration of energy and flexibility markets. By evaluating these projects, Action 3 seeks to identify synergies, inefficiencies, and propose strategies for enhancing the design and coordination of flexibility acquisition mechanisms.

Figure 4.1 shows the general steps considered for Action 3:

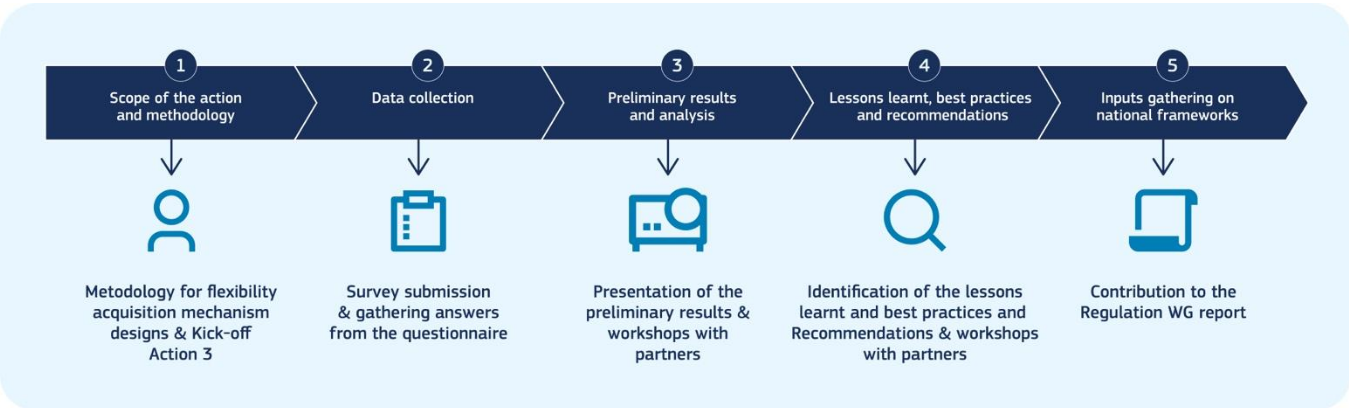

Figure 4.1: Steps of the methodology adopted in Action 3

1. **Scope of the action and methodology:** Projects were selected to identify those aligned with the scope of Action 3. Additionally, the methodology was designed to analyse several mechanisms for acquiring DSO services (network tariffs, flexible connection agreements and local flexibility markets). This is explained in more detail in [1], as part of the activities of BeFlexible project.
2. **Data collection**: A two-stage survey was conducted to assess flexibility acquisition mechanisms, as shown in Figure 4.2. Questionnaires were sent in two steps to gather information regarding the design of

mechanisms for acquiring flexibility, implemented in the countries where the projects apply, as well as those currently under design and/or under testing in the projects' pilots. The focus was on the mechanisms for acquiring DSO services for congestion management and voltage control.

Figure 4.2: Surveys in Action 3

3. **Preliminary results and analysis:** The collected data was analysed to extract initial insights. Several discussion sessions were conducted to gain a deeper understanding of the acquisition mechanisms applied in the different countries and evaluated projects. The results are shown in section 4.3.
4. **Lessons learnt, best practices and recommendations**: This phase synthesised findings from surveys and workshops with partners to address lessons learnt, best practices and areas for improvement (section 4.3). Additionally, recommendations were formulated based on partner contributions to guide the integration of acquisition mechanisms for flexibility services, avoiding mistakes and starting with sound decisions (section 4.4).
5. **Final report:** The insights and recommendations derived from the previous steps were compiled into this report.

The final results of this process, presented below, were discussed with the members of the WG during an interactive workshop, held on 22/01/2025.

4.1.2 Participating Projects in the Action 3

Action 3 builds upon the information and insights provided by several projects actively participating in the WG. These contributions, which are illustrated in Figure 4.3: Projects participated in the Action 3Figure 4.3 serve as the foundation for the analysis conducted within the framework of this activity.

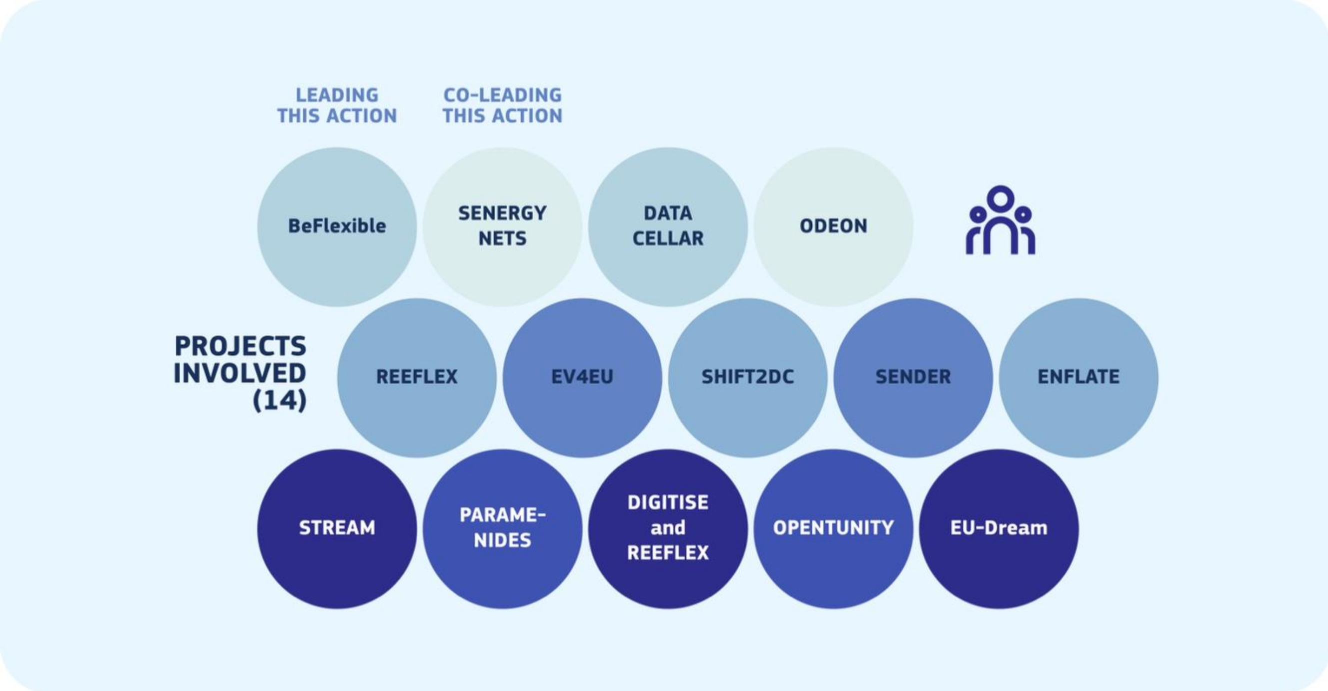

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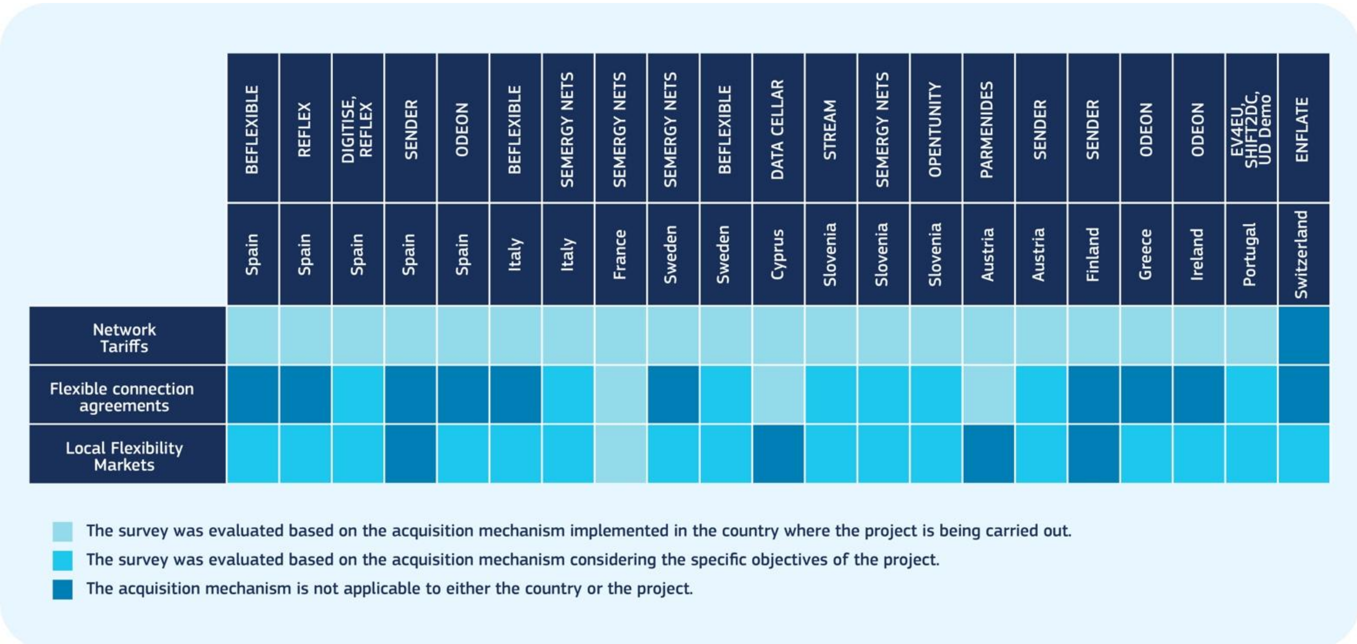
Figure 4.3: Projects participated in the Action 3

Errore. L'origine riferimento non è stata trovata. shows the projects and countries that have been assessed at d ifferent stages of the survey. The evaluated projects are present in Spain, Italy, France, Sweden, Cyprus, Slovenia, Austria, Finland, Greece, Ireland, Portugal, and Switzerland.

Tabela 3 Scope of the survey evaluation on partners' contributions.



4.2 Background and scope: Flexibility acquisition mechanism designs

Flexibility in power systems refers to the ability to use available resources to address uncertainty and variability in generation and demand in order to maintain system balance, ensure operational limits and react to price signals [2], [3]. Consequently, providing flexibility to the power system can be understood as *"the modification of generation injection and/or consumption patterns in reaction to an external signal (price signal or activation) in order to provide a service within the energy system"* [4].

As shown in Figure 4.4 [5], DSO needs can be traditionally driven based on network reinforcement or expansion to meet increasing flows (demand or generation), but these investments can lead to economic and technical inefficiencies (e.g., an oversized infrastructure in valley hours), and face regulatory or environmental constraints. As an alternative, flexibility can be exploited from existing resources to provide system services (congestion management and/or voltage control) by integrating appropriate economic signals that trigger grid upgrades only when strictly necessary. This flexibility can be acquired through two main approaches: employing own grid flexible resources (e.g., network reconfiguration, capacity banks, or electronic devices) [6], or by means of third-party flexible resources (e.g., distributed generation, demand-side response, and storage systems).

These flexible resources, inherently capable of adjusting their energy patterns, offer an opportunity to locally address grid problems by shifting or modifying their network usage. The procurement of such flexibility can be facilitated through acquisition mechanisms, categorised as implicit or explicit. Implicit mechanisms, like network tariffs, incorporate economic signals to incentivise efficient grid usage without explicit service commitments. Explicit mechanisms, such as flexible connection agreements, market-based procurement (local flexibility markets), or rules-based approaches, establish contractual or market-driven obligations for flexibility provision.

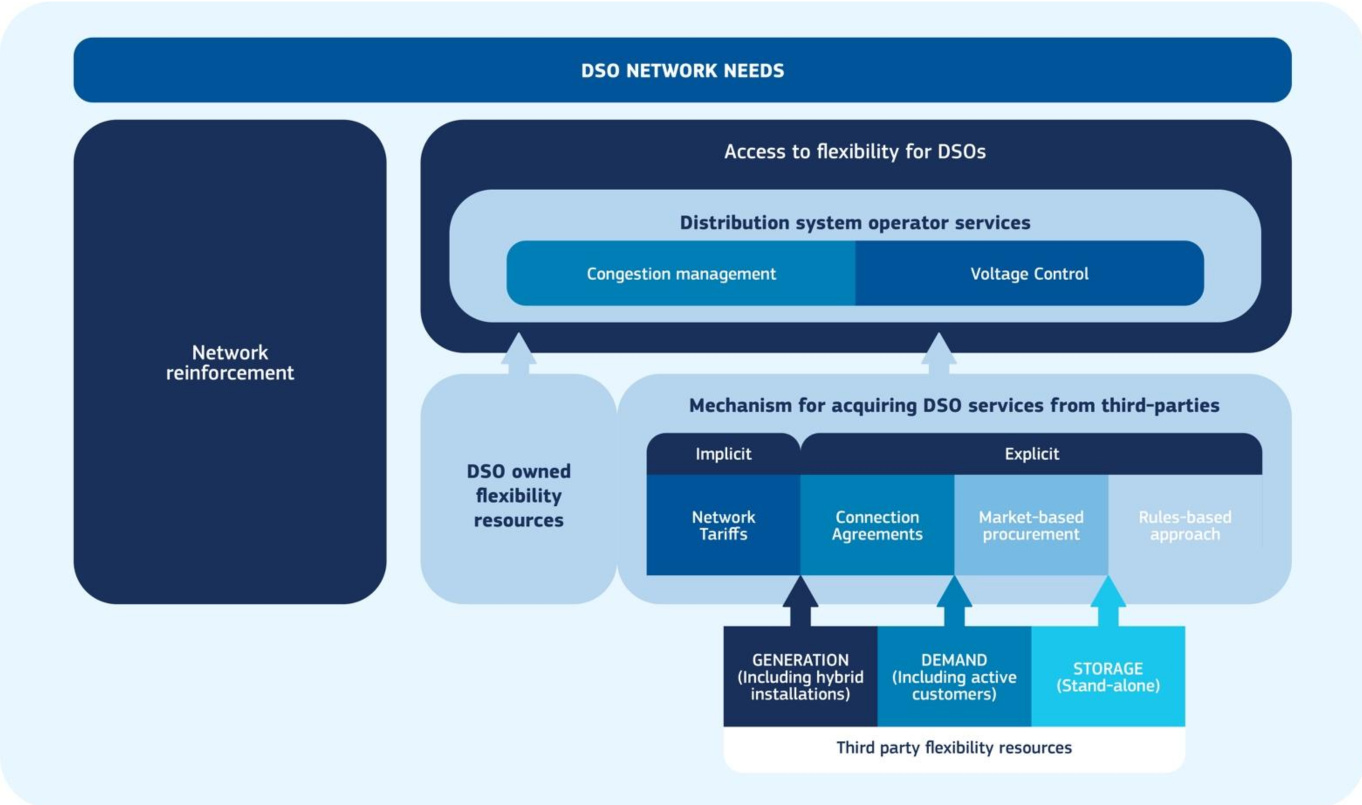


Figure 4.4: Mechanisms for DSOs to address network needs

The following section presents the results of the analyses conducted on network tariffs, flexible connection agreements, and local flexibility markets. Rule-based mechanisms were not considered, as they are highly specific to each country's conditions and beyond the scope of this action.

4.3 Lessons learnt and best practices

This section describes the mechanisms for acquiring DSO services through network tariffs, flexible connection agreements and local flexibility markets identified in the first stage of Action 3 methodology based on the work proposed in [1], [5]. Additionally, it defines the design dimensions and options established for these acquisition mechanisms and summarises the most relevant feedback received from the partners contribution in the data collection step regarding the lessons learnt and best practices. The design dimensions can be understood as variables that collectively represent the characteristics and functionalities of each acquisition mechanism, and the options refer to the potential implementation values for a particular dimension. The design dimensions are established according to their impact on increasing the economic efficiency of the other mechanisms as result of their joint implementation.

4.3.1 Network tariffs

Network tariffs are structured pricing mechanisms that recover network costs, including infrastructure investment, operation, and maintenance while charging customers for grid usage. Network tariffs could also be employed to send economic signals to customers to reduce current and future network costs [7]. Therefore, well-designed network tariffs can influence customer behaviours, leading to lower operational costs, and mitigating current or expected grid congestion.

For network tariffs, 8 design dimensions are identified, as shown in Figure 4.5. These design dimensions and options may not apply simultaneously, but they define the characteristics of the network tariff mechanism specific to each analysed jurisdiction. Further details on tariff design alternatives are presented in [1], [5]. Below is a brief overview of these design dimensions and options:

- **Cost Allocation methods:** It represents how recognised costs must be recovered and assigned to customers. Network tariffs can be designed considering the current network costs divided by the total consumption *(Average Costs)*, or considering the current network costs and forecast of costs of the future network investments to encourage customers to reduce their network usage and avoid expected future costs, plus residual costs necessary to cover remaining costs *(Long-term Incremental + Residual Costs).*
- **Charging variable:** It determines how costs are allocated to customers. It can be a fixed value assigned per customer (*Fixed*), established as a power-based (kW) charge (*Capacity charge*), or set based on energy (kWh) consumption (*Energy charge*). For the Capacity charge, there are three possibilities: based on the maximum peak demand *(Used Capacity (measured))* and it is determined ex-post; or according to a predetermined value in the connection contract *(Capacity (contracted))*; or dependent on the installation physical availability *(Capacity (physical))*. Lastly, fixed charges can be associated with customer size, wealth, or other variables, but not with energy nor capacity.
- **Locational granularity:** It can be understood as how a location is partitioned to allocate network charges. It can be applied uniformly across an entire country *(System-wide) or* can be distinguished by differentiated areas *(Zonal)* or based on connection points *(Nodal).*
- **Temporal granularity of charges:** It can be understood as how time is partitioned for allocating network charges, resulting from generation and demand profile changes and their impact on the network. It can be uniform throughout the year *(Yearly)*; vary between seasons in the year considering specific months *(Seasonal (Monthly))*; or it can be divided into time blocks *(Blocks (Daily))*, such as hours within a day or across seasons, etc.; or it can be ranged by hours *(Hourly)*.
- **Price setting periodicity:** It measures how often network charges are re-calculated. This periodicity can be set once a year *(Year ahead (static))*; or based on the forecast network usage for the next day *(Day(s) ahead (Dynamic))*; or after network usage has occurred *(Ex-post)*.
- **Temporal granularity of measurements:** It refers to the subdivision of time for data collection using appropriate equipment, such as smart meters. Lower granularity provides highly detailed data. It can be based on one measure in the year *(Yearly)*, every month *(Monthly)*, by blocks *(Blocks (Daily))*, every hour *(Hourly),* or every 15 minutes *(Quarter hourly).*

- **Customer differentiation:** It refers to the possibility of tailoring network tariffs based on specific technologies or equipment that customers may employ (specific tariffs according to technologies *(Generation, Storage, EVs, etc.))*. Alternatively, customer differentiation could be based on voltage levels or specific grid areas *(By Voltage levels or network areas).*
- **Symmetry of charges (Energy or capacity components):** It states if network charges can be symmetric for energy withdrawals and injections, i.e., the same charge but with the opposite sign *(Same network and injection charges)*, or if energy withdrawals and injections have different network charges *(Different network and injection charges)*.

Additionally, Figure 4.5 presents the results obtained from the surveys for the acquisition mechanism of network tariffs. The responses are based exclusively on its implementation in each country, according to the information provided by ongoing projects in these jurisdictions. Among the 20 responses received for this acquisition mechanism, the survey was evaluated based on the design dimensions and options specific in each country.

Figure 4.5 represents the presence (blue-coloured) or absence (left blank) of specific options within the design dimensions of the network tariff schemes analysed. It comparatively illustrates a high degree of heterogeneity in the adoption of network tariff designs across these countries. However, certain commonalities can be observed among some of them. Some network tariff structures are system-wide, based on average costs, and include capacity charges (mainly contracted capacity) along with energy charges; the charges are recalculated a year ahead and incorporate time-granular measurements at 15-minute intervals.

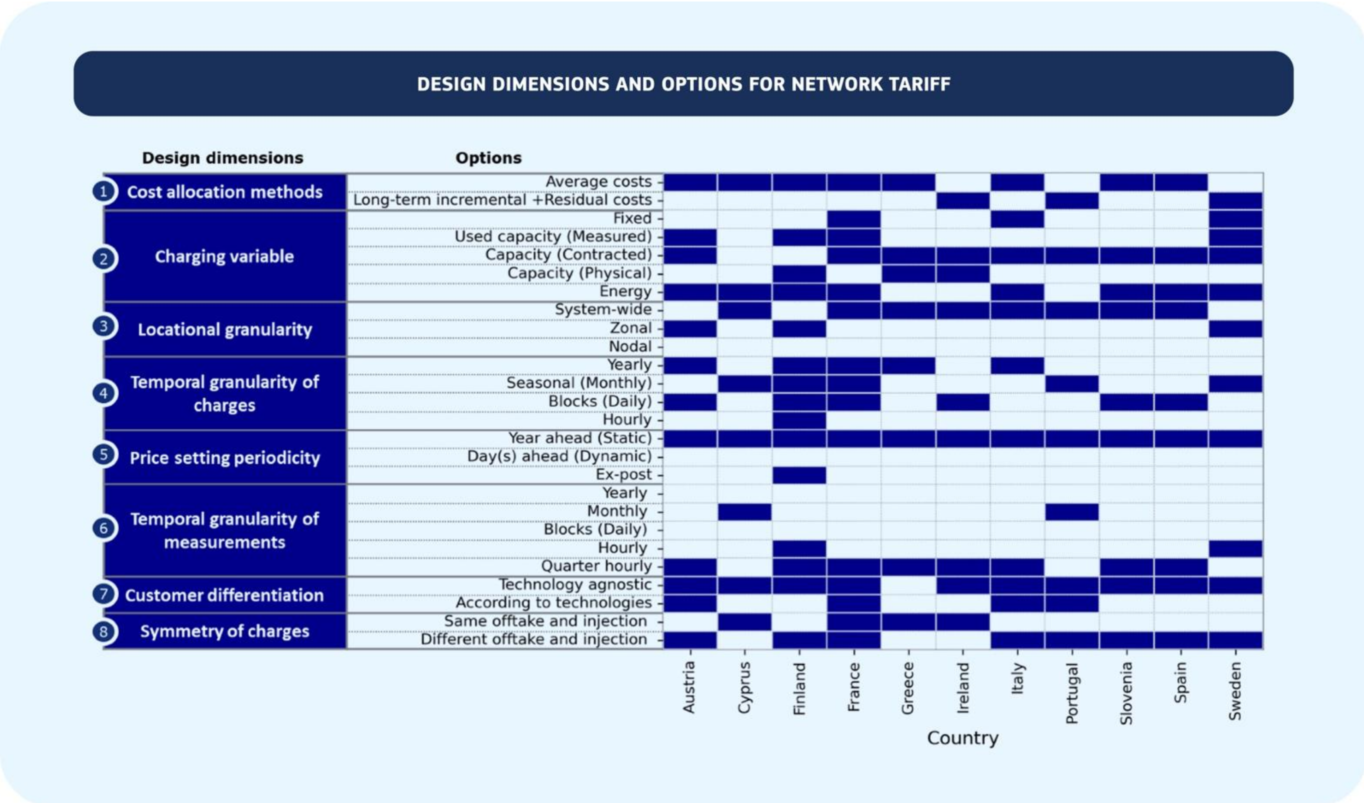


Figure 4.5: Design dimensions and options for network tariffs

Some specific insights from partners are also provided below:

- **Cost allocation methods.** The BeFlexible project considers that long-term incremental tariffs could be more cost-reflective, particularly when a large number of flexible resources can respond effectively to economic signals. However, REEFLEX considers that long-term incremental + residual costs may hinder electrification. REEFLEX highlights that flexibility provisions to system operators seem to be a more appropriate way to reduce network investments without discouraging electrification.
- **Network tariffs & local markets interactions.** REEFLEX states that network tariffs should encourage

consumption during renewable production hours but not at the cost of infinite grid expansion. Therefore, a balance should be found. In this regard, local flexibility markets may help. Similarly, BeFlexible supports promoting consumption during low-prices/higher renewable energy hours but in consideration of the costs of grid constraints. This is particularly relevant in tariff designs with low spatial granularity that could create challenges in areas with high renewable resource availability.

- **Locational granularity.** REEFLEX indicated that zonal/nodal locational granularity may discriminate consumers by physical location. However, the DATACELLAR and DIGITISE projects considered that nodal granularities should be the answer for the correct deployment of resources because they consider high-RES saturated nodes. The STREAM project proposed that based on the situation in the grid, differently sized zones can be established in the "problematic" zones.
- **Temporal granularity.** REEFLEX considers that renewable energy is highly variable from one hour to the next, thus hourly network tariff charges facilitate the integration of renewables into the system. The temporal granularity of measurements should be the same as the imbalance settlement period (currently, in most EU countries, it's hourly or quarter-hourly).
- **Customer differentiation.** REEFLEX and BeFlexible stated that network tariffs should be technology agnostic, and customer differentiation can be made by voltage level or network areas. However, in the initial stage, more favourable network tariffs may be applied to flexible customers giving services to system operators to manage grid congestion and encourage investments in this type of resource. EU-DREAM specified that in Brussels, reductions in network tariffs are temporarily provided to energy communities as there is a belief that these can reduce the impact on the grid.
- **Customer response.** SENERGY NETS and BeFlexible agree that network tariff designs could encourage customers to optimise their network usage by adjusting their consumption to reduce network stress, especially during peak demand periods, enabling them to save money. PARMENIDES considered that a high degree of automation (e.g., energy management systems) is important to leverage the full potential of network tariffs. Furthermore, the STREAM project emphasises that better communication with the public plays an important role in avoiding misconceptions and reducing resistance, mainly at the first stages of any new network tariff implementation.

Considering the previous discussions, the lessons learnt and best practices for network tariffs can be summarised as follows:

a) Network tariff designs vary across the EU countries considered in this analysis.

b) None of the projects explore new tariff designs to encourage flexibility or their interaction with other complementary mechanisms (flexible connection, local flexibility markets).

c) Network tariff designs with more time granular charges can encourage customers to shift their usage to off-peak periods and can help to integrate more renewables in the system as its production is highly variable from one hour to the next.

d) Digitalisation and new technology, such as smart metering, enable precise consumption tracking and better demand response to price signals.

e) Most tariffs are technology-agnostic. However, in early stages, dedicated tariffs could be offered to flexible customers to encourage investments in new business models (e.g., energy communities, aggregators).

f) Clearer communication on network tariff design processes with the public is essential for better acceptance.

4.3.2 Flexible connection agreements

The increasing congestion risks and costs in power systems are challenging the traditional guarantee of firm grid access for contracted capacities. In response, some EU countries are considering alternative (flexible or non-firm) connection agreements to boost flexibility [8]. These agreements allow new customers to connect while awaiting network reinforcements, potentially limiting energy withdrawals and injections in time or capacity, particularly in areas with limited network hosting capacity [9]. Although system operators can no longer guarantee full capacity access at all times, these agreements offer a cost-effective solution by allowing curtailments to manage congestion and balance supply and demand.

For flexible connection agreements, 12 design dimensions are identified, as shown in Figure 4.6. These design dimensions and options may not apply simultaneously, but they define the characteristics of the flexible connection agreement mechanism. For further information, refer to [1], [5]. Below is a brief overview of these design dimensions and options:

- **Duration of flexible connection:** It can be temporary *(Temporary)*, for example, waiting until network reinforcement is the most efficient solution. Or it can be permanent *(Permanent)* flexible connection agreements when network expansion is not possible at all, or it is extremely costly.
- **Curtailment notification:** It indicates how much in advance customers receive the notification for the curtailment. It can be one day before *(Day-ahead)*, hours before on the same day *(intra-day)*, or in time intervals less than a fraction of an hour *(real-time)*. In some cases, notifications may also be made after the activation due to immediate response to unforeseen events *(ex-post)*.
- **Connection costs:** It can be defined as the amount of cost that should be recovered, and it is assigned to new customers or those who want to increase their current capacity. It can be established if network reinforcement is required for accommodating the increment due to the upgraded capacity *(Deep connection costs)* or if new customers can connect without added charges *(Shallow connection cost)*.
- **Benefit for allowing flexible connection:** Flexible connections allow DSOs to avoid network expansion when it is not possible or unfeasible *(Avoid reinforcement)*. Alternatively, network upgrades can be deferred *(Defer reinforcement)* when this solution has a lower cost compared to network expansion, for example, until enough customers are connected to share the associated cost. Also, flexible connections can serve as a means for connection-seekers to connect to the grid while reinforcement is being carried out due to the long-time frames required for committed grid expansions (Preliminary connection).
- **Network connection criteria:** It encompasses the grid requirements that determine access to non-firm connections. The grid's capacity *(Capacity limitation)* might be restricted during a specific timeframe. Alternatively, network access can be limited according to tension levels *(Voltage level limitation)*. Also, according to specific measures, such as N or N-1 criteria *(Security criteria),* or short-circuit power rating *(Short-circuit power rate).*
- **Reason for activation of the energy curtailment due to flexible connection:** It is not limited to specific events, and it can occur for various reasons. While the operation of electricity grids already includes those customers, who might be disconnected due to outages *(Emergency)*, flexible connections allow expanding the employment of injection/withdrawal reductions, such as in the case of network maintenance *(Maintenance)*. Congestion-based reduction of grid access capacity can be triggered due to variations in electrical flows *(Congestion)*.
- **Pre-definition of curtailment:** It identifies the potential hours of curtailment. If congestion occurs due to electrical flow variations, flexible hosting capacity might be assigned as peak/off-peak capacity *(peak/off-peak).* The flexible connection could be bound to the seasonality of resource availability, which can be for days or periods *(Seasonality (Days or periods)).*
- **Principle for network access:** It considers the methodology to assign curtailment to non-firm customers. All customers connected can be curtailed equally *(Pro-rata)*, with the same percentage of available energy or the same amount of capacity. Also, the last customer to connect is the first to be curtailed *(Last-on-first-out (LIFO))*. Otherwise, curtailment is assigned according to an auction scheme *(Auction)*. Lastly, when customer with the highest participation in the congestion is curtailed first *(Level of congestion created)*.
- **Compensation payments for energy curtailment:** The amount of compensation payment can be arranged as a flat price in the connection agreement *(Fixed).* Furthermore, if curtailable connections participate in the local flexibility market (LFM) as a price taker, the compensation payment is deduced from the LFM price *(Set by the LFM).* Also, both SO and customers are expected to prefer a variable payment amount to

account for future changes in SPOT and flexibility prices *(Local Market-indexed).* If the customer does not participate in the LFM, coupling the compensation value to LFM prices could represent an interesting solution. In certain regions, access to flexible connections may be granted with the requirement of curtailment, if necessary, without an assigned payment *(None).*

- **Possibility to sell the expected curtailed energy:** For upstream congestion, customers could sell their electricity to others in the same feeder. This could be enabled via the introduction of LFM *(Local Markets).* Another approach is allowing participation in the negotiation process *(Bilateral Contracts)*.
- **Limit to maximum curtailment:** It offers customers certainty through various options: setting a maximum duration *(Duration (hours))* for curtailment in hours per year: imposing a maximum capacity curtailed *(Capacity Limitation),* either full disconnection or partial with a minimum agreed capacity, ensuring firm grid capacity; limiting maximum energy curtailed *(energy limitation)* annually (MWh or % of available energy); introducing a maximum economic *(Monetary limitation)* value of curtailed energy (€ or % of potential earnings).
- **Eligible customers:** It means that, depending on the state of network congestion, flexible connections might be offered to customers of different technologies. It can cover generation, including hybrid facilities *(Generation), and* consumption *(demand)* including active customers. In addition, storage systems (Storage) that operate as standalone are also included.

Figure 4.6 presents the survey results regarding the acquisition mechanism through flexible connection agreements. Among the 21 responses, 9 evaluated the survey based on design dimensions and options relevant to their specific projects, while 3 focused on each country where this mechanism is implemented. The remaining 9 indicated that this mechanism does not apply to their country or project, as shown in Table 4.

Additionally, Figure 4.6 shows a comparative analysis of flexible connection agreement design dimensions and options across various EU jurisdictions. In the case of multiple answers for the same country, the heatmap visualises the frequency with which different options are adopted across the projects for this country, highlighting key trends, and divergences in design among the projects. The figure illustrates a significant variation in how flexible connection agreements are structured. To showcase some particularities, most temporary agreements reflect a strategic requirement of flexibility to optimise grid utilisation in the short term. Real-time and intra-day curtailment notifications are widely adopted. The ability to sell curtailed energy remains limited, with only a few cases allowing bilateral contracts or market participation.

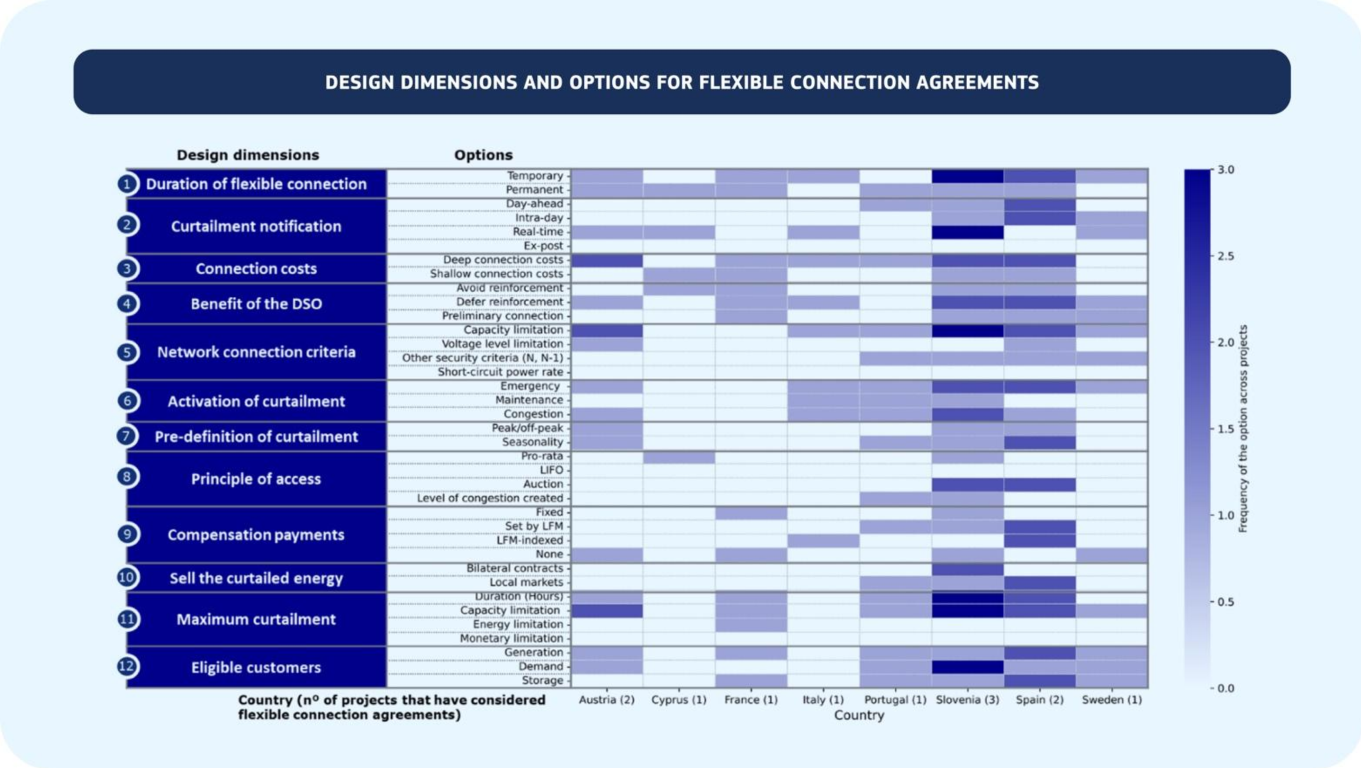


Figure 4.6: Design dimensions and options for flexible connection agreements

Some specific insights from partners are also provided below:

- **Implementation of flexible connection agreement.** In the second phase of the surveys, EU-DREAM pointed out that Flanders removed flexible access agreements (AmFT) in 2022 due to misalignment with EU regulations but will be reintroduced under new technical rules by 2025. DSOs can set up specific connection rules depending on the local conditions on the grid. Both assets that can control the consumption and/or production of electricity are allowed to have flexible connection agreements. In Wallonia, DSO Ores is launching a product on non-fixed connection agreements for new connections at MV. The regulation does not explicitly allow nor forbid this, so the DSO is still in discussion with the regulator.
- **Network connection criteria and sale of curtailed energy.** The REEFLEX project suggested that flexible connection agreements should be market-based. This consists in holding a local flexibility market auction in the local zone before granting the flexible connection. In that auction, the customers that are already connected can offer their flexibility (increase generation/lower consumption or lower generation/increase consumption) to the new customers or can offer increased capacity to those who request connection in the specific schedule where there might be congestion caused by this new connection. Additionally, when non-permanent flexible connection agreements are granted, local services procurement should be evaluated periodically to assess if there are flexibility resources available that could convert the flexible connection into firm capacity.
- **Duration of flexible connection.** REEFLEX considered that flexible connections should be temporarily in line with Regulation EU 2019/943[5]. However, flexible connections should be periodically reassessed as new flexible resources may emerge to solve network problems employing a local flexibility market, potentially transitioning into a firm connection.

Considering the previous discussions, the lessons learnt and best practices for flexible connection agreements can be summarised as follows:

a) Flexible connection agreements are not a common practice in EU countries. However, in countries like France

[5] REGULATION (EU) 2019/943 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 June 2019 on the internal market for electricity (recast).

and Austria, they are well established.

b) Flexible connection agreements can address long connection waiting lists.

c) Flexible connection agreements should be periodically reviewed to assess the actual hosting capacity of the grid. This reassessment helps determine whether non-firm connections (which have conditional access) can be upgraded to firm connections (which have guaranteed access).

d) Like the other mechanisms, flexible connections entail costs. The total cost of non-firm connections needs to be considered to ensure that the services with the lowest overall cost are dispatched first (grid expansion, grid reinforcement, local flexibility markets or flexible connections).

4.3.3 Local Flexibility Markets

LFMs for DSO services are market-based mechanisms designed to enhance grid flexibility by integrating local distributed energy resources (DERs) to address specific network challenges to avoid or defer grid investments and reinforcements. These markets enable service providers to offer flexibility products, with buyers and sellers engaging in processes such as prequalification, contracting, activation, and settlement [10], [11]. LFMs should operate through long- and short-term timeframes, ensuring cost effectiveness, market liquidity, and minimal distortions. Depending on the framework, they may be managed by system operators or neutral third parties such as market operators [12], offering a structured approach to procuring flexibility for local grid management.

For local flexibility markets, 10 design dimensions are identified, as shown in Figure 4.7. These design dimensions and options may not apply simultaneously, but they define the characteristics of the local flexibility markets. Further details on local market designs can be found in [1], [5]. Below is a brief overview of these design dimensions and options:

- **Flexibility need – grid level:** It refers to the specific voltage level on the electricity grid where local flexibility services are required. Therefore, in generation and transmission *(High Voltage),* there is a demand for flexibility services to manage voltage and high-power flows. Also, flexibility needs could be associated with sub-transmission or distribution substation levels *(Medium Voltage)*, where flexibility services may be required to maintain voltage and solve congestion. Likewise, flexibility services can also be necessary for distribution networks serving end users *(Low Voltage)*.

- **Negotiation timeframe (Gate Opening and Closure for participation):** Market participants can plan and submit their flexibility offers during this window. At the gate opening, the requirement objectives are released to service providers. The gate closure marks the end of the negotiation period, where the clearing process is conducted to match flexibility needs with resource offers that satisfy all technical constraints. It can occur over an extended period, typically weeks to years in advance *(Long-term (Weeks-ahead to years-ahead))*. Alternatively, it can occur on a much shorter time scale primarily for addressing immediate grid operational requirements, as hours before real-time *(short-term (day-ahead, intraday)),* or from one hour to seconds *(Real-time (1 Hour to seconds)).*

- **Contract length:** It defines the duration for which a service contract is established with a commitment from the flexible resources to remain available. This period can be one year *(Yearly)*, occur monthly *(Monthly)*, seven-day periods *(Weekly)*, cover a single day *(Daily)*, or even real-time availability with short-term notice *(Hourly).*

- **Temporal bid granularity:** It corresponds to the temporal resolution, or the smallest time interval, at which flexibility needs change, and service providers must be capable of responding uninterruptedly. It can vary from greater than an hour *(>1 hour)* providing bids in hourly or longer time-blocks, one-hour intervals *(1 hour)*, 30-minute intervals *(30 min),* or 15-minute intervals *(15 min)*.

- **Response Time (Activation):** It corresponds to the time required for a ramping operation after an activation command, whether it involves an increase (ramp-up) or a decrease (ramp-down) in power or energy. Resources can be categorised based on their activation speed, including those with slower responses exceeding one hour *(> 1 hour),* those with moderate responses ranging from 30 minutes to one hour *(30 min – 1 hour)*, those responding within 15 to 30 minutes *(15 min – 30 min)*, and those with nearly instantaneous responses *(<15 min).*

- **Transactional Object:** It refers to the commodity that can be involved in transactions associated with providing system services through flexible resources. The object can represent a commitment for the resources to be available to provide its flexibility for a predetermined duration in the form of standby capacity *(Capacity (Availability))*. This implementation option emphasises the object's capability to remain in reserve and be prepared for deployment if required. Likewise, this commodity can encompass the active utilisation of flexible resources to respond in real-time *(Energy (Activation))*, comprising the injection or absorption of energy.
- **Power:** It corresponds to the specific type of power required to address network problems according to the component congested. Typically, when congestion issues arise in power lines or transformers, active power *(Active Power)* is required. This is because it directly influences the ability to meet the real-time demand of consumers and serves as the primary focus of power generation. Additionally, when issues in buses appear, such as overvoltage or undervoltage, reactive power *(Reactive Power)* may be required as it helps manage voltage fluctuations and supports the operation of reactive elements connected to the grid.
- **Direction:** It distinguishes the orientation in which flexible resources are required. When additional power is needed, it can be provided by increasing generation or reducing consumption (Upwards). Conversely, when a reduction of excess power in the network is necessary, it can be achieved by decreasing generation or increasing consumption (downwards).
- **Symmetry Requirements (For upwards and downwards):** It addresses the need for uniformity in products and services. Symmetric *(Symmetric products)* are characterised by a high degree of balance, offering solutions that equally apply to both upwards and downwards flexibility needs. In contrast, Asymmetric *(Asymmetric products)* are tailored to address specific requirements that may differ between upwards and downwards scenarios.
- **Source (Flexibility assets):** It corresponds to the specific flexibility assets employed to deliver the system services. This can encompass a range of assets, including power generation sources *(Generation (Including hybrid installations))*, renewable energy installations, and hybrid power plants, capable of adjusting their output to meet grid requirements. Additionally, it can involve using demand-side management techniques and active customer participation *(Demand (Including active customers))*. Furthermore, it can consider standalone energy storage systems *(Storage (stand-alone))* such as batteries, which can store excess energy during periods of surplus and release it when needed.

Figure 4.7 presents the survey results regarding the acquisition mechanism for local flexibility markets. Among the 16 evaluated, the survey was based on the design dimensions and options relevant to their specific project, while 1 focused on its country (SENERGY NETS, France). The remaining 4 did not evaluate this mechanism, as shown in Table 4.

Figure 4.7 shows a comparative analysis of local flexibility markets design dimensions and options across various EU jurisdictions. In the case of multiple answers for the same country, the heatmap illustrates the frequency of adoption for different design choices across the projects for this country, identifying key trends and similarities among the projects. The figure illustrates a preference for short-term and long-term over real-time negotiations timeframes, active power transactions are more common than reactive power, and regarding flexibility sources, demand-side participation is the most frequently adopted, closely followed by generation and storage.

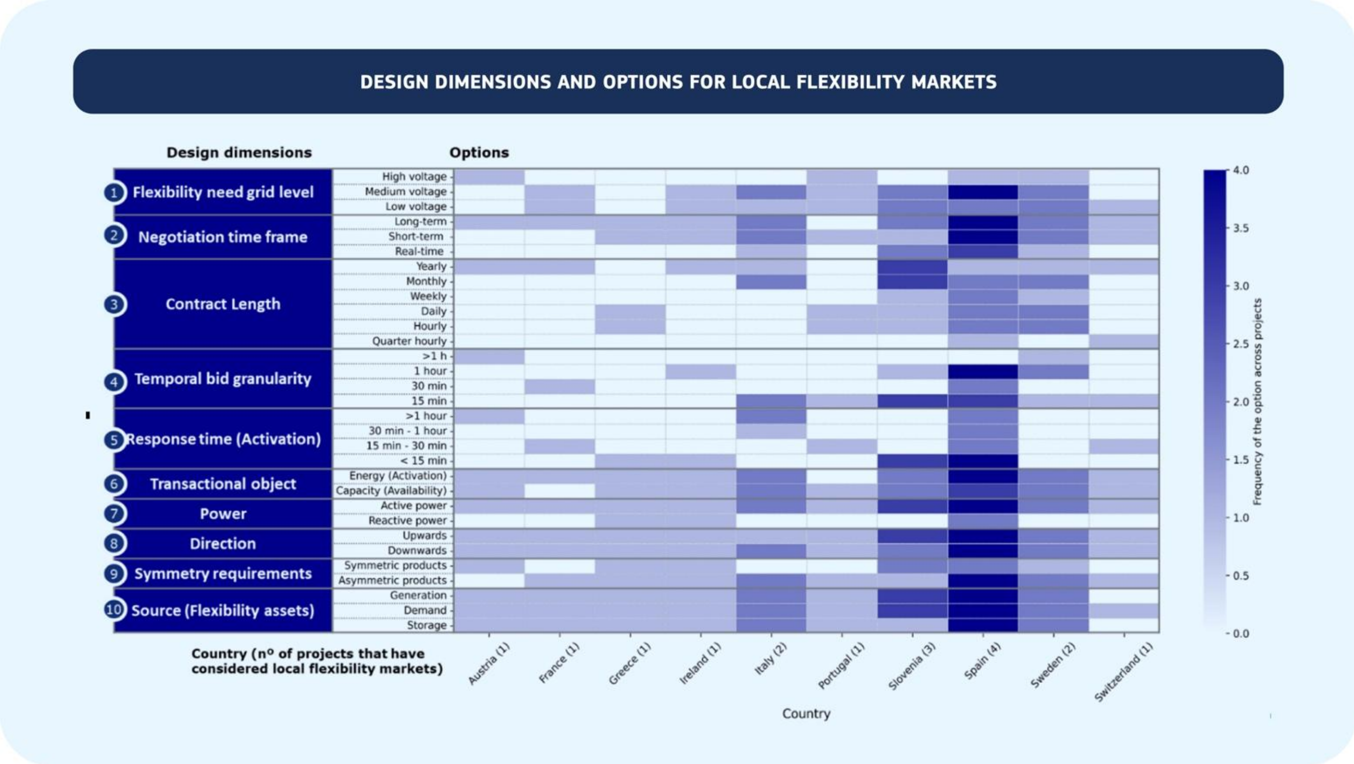


Figure 4.7: Design dimensions and options for local flexibility markets

Some specific insights from partners are also provided below:

- **Negotiation timeframe.** REEFLEX considers long-term markets for DSO's foreseen grid needs and short-term and real-time (up to 15 minutes) markets for DSO's unforeseen grid needs or activation. Real-time LFM results should be communicated to TSOs at least 1 hour ahead of real time (or 15 minutes) to ensure system balance. Similarly, SENERGY NETS states that the availability of flexibility capacity is contracted between grid operators and service providers some weeks or months ahead, and, depending on the implemented mechanism, the energy activated can be traded on devoted markets on the day ahead or intraday. Also, ENFLATE indicates that all assets that want to participate have to sign a long-term contract for reservation offering all their flexibility, and there are day-ahead and intraday auctions for utilisation.
- **Grid data.** STREAM states that establishing an LFM is a complex process that requires coordination among all stakeholders. However, even with strong cooperation, delays and misunderstandings can still arise. A key challenge is the availability of an accurate and updated grid topology, which DSOs usually have on paper but not necessarily in practice, and which may be outdated or incomplete. Additionally, while a three-phase grid model would be ideal, confidentiality reasons have made even a one-phase model difficult to provide. Nevertheless, BeFlexible suggests alternative approaches to integrating service providers' grid impacts into LFMs, such as using sensitivity factors.
- **Roles and responsibilities.** DATACELLAR, DIGITISE and BeFlexible stated that establishing the roles, attributes, and obligations of aggregators is important for enabling small consumers to participate in flexibility markets. Without clear regulations, their integration may face barriers, limiting their full potential. REEFLEX considers that the local market operator should be a neutral third party, with no commercial interest in these markets (neither the buyer of flexibility nor the seller), and with accredited experience in existing electricity markets operation.

Considering the previous discussions, the lessons learnt and best practices for local flexibility markets can be summarised as follows:

a) Some countries already have LFMs in place (e.g. France), while the rest are exploring tailored designs for specific project objectives, with several pilots testing customised solutions (e.g. long- and short-term markets).

b) There is a trend towards long-term and short-term markets over real-time markets. Long-term markets are for availability (capacity), while short-term markets (day ahead and intraday) focus on activation (energy).

c) LFMs mainly trade active power products (upwards or downwards) obtained from diverse resource types (generation, demand, or storage).

d) LFMs could rely on aggregators to pool small-scale resources, making it easier for smaller participants to enter the market and ensure that minimum volume thresholds are met.

e) Setting out clear roles and responsibilities for aggregators, DSOs and local market operators is key to avoid market distortion and ensure transparency and competitiveness.

4.3.4 Interplay and coordination of acquisition mechanisms

Despite the benefits of acquisition mechanisms such as network tariffs, flexible connection agreements, and local flexibility markets, standalone designs would overlook the potential synergies or conflicts that may arise when they interact within the **same jurisdiction.** The methodology employed in **this action can serve as a starting point for identifying the interplay and coordination of these acquisition mechanisms**, residing in the design dimensions and options that characterize each acquisition mechanism and their expected impact on economic efficiency resulting from their joint operation, for the optimal allocation of resources that maximise the overall welfare.

To better illustrate this interplay, it is useful to consider the case of network tariffs with a lack of locational or temporal granularity charges. Thus, they cannot accurately reflect network costs and could fail to encourage customer-efficient behaviours. In those cases, LFMs could leverage local flexibility by employing distributed resources to reduce local problems and operational costs or by indefinitely deferring network upgrade investments. However, overlapping signals from these mechanisms may lead to inefficiencies, such as double rewarding or charging the same resources, potentially encouraging gaming behaviours or creating an uneven playing field. In the case of flexible connection agreements, if they coexist with LFMs without proper coordination, misalignments in economic signals could arise. For example, if a flexible connection is curtailed (and receives compensation payments) due to congestion and simultaneously participates in an LFM offering flexibility services, it may face double compensation, which can distort the signals sent and desired customer responses.

To maximise economic efficiency and avoid these conflicts, **proper coordination of network tariffs, flexible connection agreements and local flexibility markets is essential.** This requires aligning their design dimensions and options **to prevent uncoordinated signals and ensure that each mechanism complements rather than competes with the others.**

4.4 Recommendations

This section provides recommendations that can be inferred from the projects' results for each of the mechanisms that foster flexibility from users connected to DSO networks.

4.4.1 Network tariffs

As indicated in section 4.3.1, the network tariff designs vary across EU countries, reflecting different network structures, regulatory frameworks, and policy priorities. Due to this diversity, there is a need to **formalise updated EU-wide network tariff design guidelines and to establish common or consistent principles that also account for country-specific grid requirements and customers' capabilities.** The objective is to balance cost reflectivity, efficiency, and fairness and to support the procurement of flexibility and reduce the need for unnecessary infrastructure reinforcement or expansion.

In this sense, it is important to consider that **efficient network tariff designs could incorporate temporal and locational pricing signals** to enhance economic efficiency and encourage optimal network usage**.** Additionally**,** these **charges should be periodically updated to reflect changes in consumption patterns and renewable energy availability.** Targeted **incentives can encourage customers to shift grid usage to periods of low network stress.**

Furthermore, to accomplish a successful implementation of network tariff designs, it is critical to **promote them through public campaigns highlighting their benefits for consumers and the grid**, using clear and transparent communication strategies that reduce resistance and achieve greater acceptance.

4.4.2 Flexible connection agreements

Section 4.3.2 states that flexible connection agreements are uncommon across EU countries and depend on local DSOs. Therefore, to implement flexibility in grid management **standardised and consistent procedures for flexible connection agreements should be established.** These procedures must reflect the characteristics of grids, while ensuring neutrality and cost effectiveness in managing new customer connections.

Furthermore, a **stronger cooperation between system operators (DSOs and TSOs) and customers is needed to address inefficiencies in grid connection management**. This includes resolving interoperability challenges, such as misaligned technical standards or communication protocols, and ensuring that **investments in network infrastructure or flexibility solutions are well coordinated and cost-effective.**

Another key aspect is that **when temporary flexible connections are set up, the overall network condition and local services procurement through LFM should be evaluated periodically**. This could include **assessing the availability of flexibility resources** (e.g., liquidity for LFM) **to potentially upgrade flexible connections to firm capacity.**

Additionally, some proposals suggest using a market-based approach for flexible connection agreements. This means that before granting a new flexible connection, a flexibility auction is held in the local area. In this auction, customers who are already connected to the grid can offer their flexibility to help accommodate the new connection or an increase in customers' contracted capacity.

4.4.3 Local Flexibility Markets

According to the results obtained in section 4.3.3, **stronger cooperation between DSOs, TSOs, market operators and aggregators is needed to enhance the effectiveness of local flexibility markets.** This collaboration helps identify and address inefficiencies, such as misaligned prequalification mechanisms, poor coordination in flexibility procurement, and barriers to seamlessly integrating flexibility services into grid operations.

Another critical factor to consider is incorporating **cost-efficient price signals, based on cost-causality principles, which are essential for LFMs to ensure fair and efficient procurement of flexibility services.** Well-structured pricing for availability and activation prevents market manipulation, such as artificial congestion creation or inflated bidding.

To minimise entry barriers and promote wider participation, registration processes in LFMs should be simple, aligning with the Network Code for Demand Response's stance on streamlined prequalification mechanisms. For example, digital platforms can facilitate customer registration, making it easier for new participants to engage in LFMs while ensuring compliance with regulatory requirements.

Finally, **to avoid market distortion and ensure transparency and competitiveness in LFM, regulation should set out clear roles and responsibilities for aggregators, DSOs and local market operators**.

4.5 Conclusions and Final Remarks

Network tariffs, flexible connection agreements, and local flexibility markets can be designed to encourage the procurement of flexibility from third-party resources by DSOs. **Breaking down these acquisition mechanisms** into their constitutive components allows **potential synergies, conflicts, or inefficiencies to be identified**, providing valuable **insights to guide the effective design of the coexisting mechanisms.** In this chapter, the design dimensions and options of these mechanisms are identified, considering several projects within the BRIDGE initiative benefiting from the active collaboration of partners.

Despite their coexistence in practice, network tariffs, flexible connection agreements, and local flexibility markets are often developed independently, with limited consideration of their interactions, potential synergies, or conflicts. This gap highlights the need for a more integrated approach in their design to fully leverage their combined capabilities in addressing system service requirements.

Network tariffs lacking locational and temporal granularities cannot accurately reflect network costs and can fail to incentivise customer-efficient behaviours. In such cases, **local flexibility markets and flexible connection agreements can complement network tariffs**, leveraging the flexibility from distributed resources to address local network problems, reducing operational costs, or mitigating future investment requirements in specific areas.

Complementing network tariffs with flexible connection agreements and local flexibility markets can effectively address network challenges by **reducing waiting times for new customers to connect.** In this way, these mechanisms alleviate the problem of lack of connection capacity, especially for the integration of renewable generation. Providing the DSO with tools to reduce the amount of energy exchanged by customers, when necessary, could bring economic, technical, and environmental benefits by increasing the integration of zero-emission energy production.

Examining the interaction between **local flexibility markets and flexible connection agreements** could uncover potential inefficiencies. **In certain cases, flexible connection agreements can reduce liquidity in LFMs by limiting the participation of potential providers.** This can occur when pre-defined curtailment conditions restrict market engagement, when flexible connection holders have reduced financial incentives to offer flexibility, or when system operators prioritise direct agreements over market-based procurement. Such impacts may lead to lower competition, higher flexibility costs, and less efficient outcomes.

Uncoordinated **mechanism designs may send inefficient economic signals to customers** for their network usage **leading to distortions and non-efficient economic behaviours.** Additionally, preferential access to information, inaccurate mechanism designs, or the ability to influence market conditions could result in market power issues or an uneven playing field. These considerations highlight the **need for coordinated acquisition mechanism designs to prevent inefficiencies or unintended consequences**.

Future research should continue exploring the interactions among the mechanisms and provide methodologies to quantify trade-offs between them in incentivising flexibility from DERs.

5. ACTION 4 – SUPPORT THE POTENTIAL SYNERGIES FROM INCREASED SECTOR COUPLING/SECTOR INTEGRATION/SYSTEM INTEGRATION

Action leaders: David Verez (ARCbcn), **HYSTORE Project**; Diana Moneta (RSE), **FLOW Project**; Laia Guitart (E.DSO), **Interconnect Project**.

5.1 Introduction to action 4

5.1.1 Topic, goals and next steps

Traditionally, the EU energy system has been divided into different segments, with different infrastructures for electricity, oil or natural gas, being developed and operated in isolation from each other. Over the years, this division resulted in the development of unidirectional connections between specific infrastructures and particular end-use sectors, with linear energy flows (see Figure 5.1). However, the electrification of end uses brings different sectors into connection with each other. In this context, the model based on unidirectional flows of energy becomes technically and economically inefficient in delivering a decarbonised energy system.

Evidence shows that the coordinated operation of the different energy systems and infrastructures will reduce the costs of the energy transition by enabling a more effective use of existing assets (see Figure 5.1). In addition, managing the different energy flows as one system increases the chances to adapt to the intermittency and variability of renewable energy sources (RES) that could affect the balance between supply and demand that is required to maintain stability and reliability of the grid.

In the EU, the integration of different energy systems is seen as the foundation for the energy system of the future. In this context, the European Commission has fuelled multiple initiatives that aim to link the different sectors and infrastructure to boost renewables and reduce carbon emissions. A clear example is the Energy Sector Integration Strategy that was published on July 8, 2020 in which it was proposed to adopt a holistic view of the energy system rather than a perspective based on single segments.[6] Today, while some notable advancements have been implemented across the EU, several gaps remain.

[6] COM(2020) 299 final, 08/07/2020 - Powering a climate-neutral economy: An EU Strategy for Energy System Integration

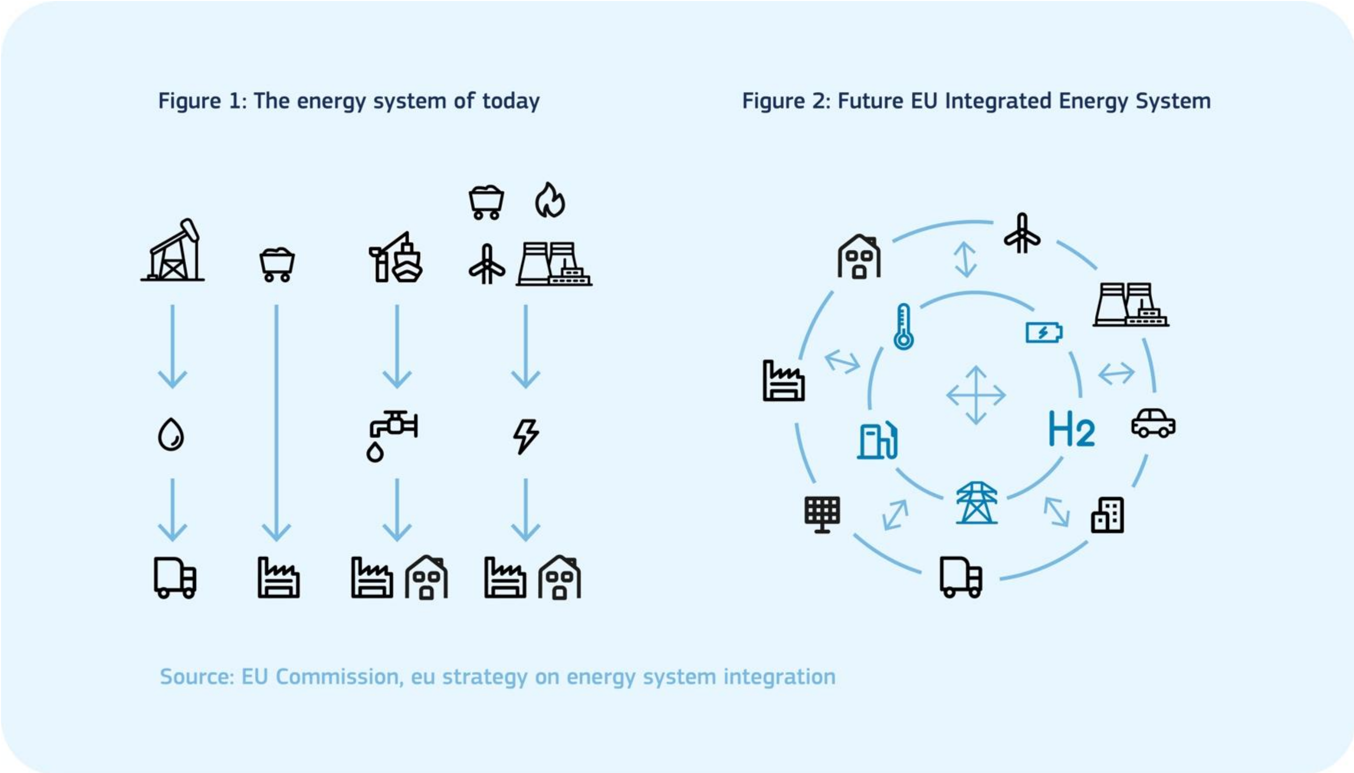


Figure 5.1: Comparison between the current linear and segmented EU energy system and the envisioned integrated energy system of the future. Source: European Commission, EU Strategy for Energy System Integration (2020)

This section presents the Executive Summary of the Action 4 standalone report. Action 4 aims to bring together EU-funded projects focused on sector coupling to identify key barriers, best practices, and recommendations encountered during the implementation of innovative solutions in pilot projects. The main objective is to provide a clear overview of regulatory challenges that hinder innovation and the integration of the EU energy system. This analysis aims to feed the publication of the EU Competitiveness Compass, which highlights the need to enhance competitiveness and to ensure sustainable prosperity. In this report, we present the Executive Summary of the Action 4 standalone report. We frame the topic, goals, and next steps, and provide a synthesis of the main barriers, best practices, and high-level recommendations, together with a comparative view of survey results for 2023–2024 and 2024–2025 (Figure 5.2). The detailed methodology, case studies, and the complete policy roadmap are available in the standalone report.

5.1.2 Joint leadership and standalone report

In the framework of BRIDGE's mission to build on the efforts within various Horizon 2020 and Horizon Europe projects, fostering discussions on the real challenges encountered in demonstration initiatives, Action 4 explores sector coupling from a broad perspective. Sector coupling encompasses various elements, including buildings and energy storage, and can be analysed through the lenses of:

- Regulatory challenges
- Business models
- Grid implications.

Although there is no universally accepted definition of sector coupling, for the purposes of this report, it is understood as follows:

Sector coupling involves the increased integration of energy end-use and supply sectors with one another to improve the efficiency and flexibility of the energy system as well as its reliability and adequacy.

In this context, the main goal of Action 4 is to provide insights into sector coupling by discussing the regulatory perspective in different end-use and supply sectors. In particular, specific focus is placed on:

- Service provision by EVs
- Sector integration with heat
- Integration at household level.

Between 2024 and 2025, Action 4 benefits from joint leadership, bringing together diverse backgrounds and technologies. This report builds on the findings of last year's edition, which identified key barriers to sector coupling based on input from participating projects. The output and findings of 2025 can be found in the standalone report published by Action 4[7].

5.2 Executive summary of the standalone report

The successful transition to a climate-neutral European energy system requires a fundamental redesign of its operational and regulatory principles. Sector coupling and system integration are essential pillars of this transformation, as they unlock synergies across electricity, heating, mobility, and gas systems. Action 4 of the BRIDGE initiative addresses this challenge by consolidating practical evidence from more than thirty EU-funded projects, identifying persistent barriers, and formulating strategic recommendations to accelerate the deployment of integrated energy systems.

Between 2023 and 2025, projects reported a progressive shift from technical challenges towards structural and institutional barriers. Initial obstacles, such as data interoperability and privacy, are being progressively addressed through standardisation efforts and enhanced governance mechanisms. However, systemic challenges remain. Fragmented network regulations, complex and inconsistent permitting procedures, and the absence of harmonised market mechanisms, continue to constrain cross-sector implementation.

The evidence collected through Action 4 reveals consistent patterns. In the case of e-mobility, inadequate coordination among stakeholders and outdated network codes continue to hinder the effective deployment of vehicle-to-grid services. In the heating sector, regulatory fragmentation and the lack of appropriate market incentives prevent the scaling-up of thermal flexibility solutions. At the household level, decentralised systems suffer from inconsistent legal frameworks and limited support for prosumer market participation. In the case of emerging energy vectors, such as hydrogen or electrothermal systems, legal uncertainty and complex permitting procedures are the most critical barriers.

Despite these challenges, the report identifies a wide range of best practices and regulatory innovations with strong potential for replication. These include the adoption of open interoperability protocols, the creation of regulatory sandboxes, and the implementation of joint planning frameworks between distribution system operators, aggregators, and local authorities. Pilot projects have successfully tested innovative remuneration schemes for flexibility, new cross-sector business models, and user-centric digital tools that enhance consumer engagement and system efficiency.

Building on this analysis, the report provides a policy roadmap structured around six strategic axes: **alignment of regulatory frameworks, fiscal reform for multi-energy systems, expansion of cross-sector flexibility markets, improved governance for local implementation, harmonisation of permitting procedures, and institutionalised stakeholder dialogue**. Each axis includes targeted actions designed to unlock investment and operational synergies across the EU energy landscape.

[7] European Commission: European Climate, Infrastructure and Environment Executive Agency, Directorate-General for Energy, Verez, D., Moneta, D. and Guitart, L., Supporting potential synergies from increased sector coupling, sector integration and system integration, Publications Office of the European Union, 2025, https://data.europa.eu/doi/10.2926/5883029

Figure 5.2 summarises the evolution of reported barriers from the 2024 and 2025 Action 4 surveys. It clearly illustrates a general reduction in data-related challenges, such as interoperability and privacy, while highlighting the increasing prominence of regulatory fragmentation, permitting procedures, and stakeholder coordination as systemic bottlenecks. These trends reflect the growing maturity of pilot projects and the urgent need to address institutional constraints through coherent policy action.

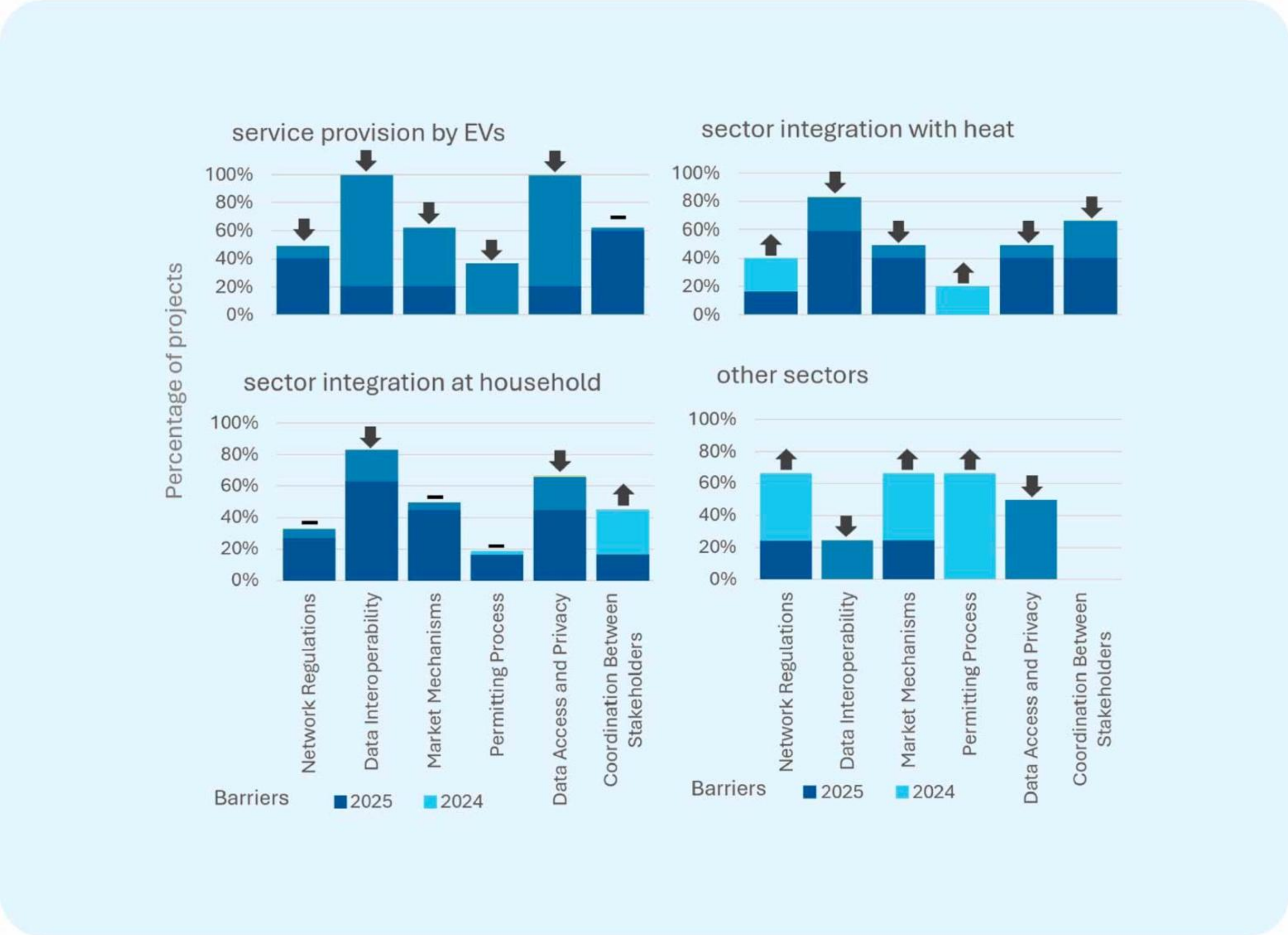


Figure 5.2: Comparative analysis of the survey results for sector-specific barriers reported by projects in the 2023-2024 and 2024-2025 reports

Action 4 contributes directly to the EU Competitiveness Compass by clarifying the regulatory and systemic adjustments required to scale innovation and reinforce Europe's industrial and energy leadership. The findings presented serve as a foundation for coordinated policymaking across Member States, supporting the implementation of the European Green Deal and the development of integrated infrastructures aligned with climate neutrality targets.

6. ACTION 5 – SUPPORT THE SYSTEM OPERATORS TO PREPARE THE GRID FOR 2030

Action leader: Santiago Gallego (i-DE, Grupo Iberdrola), **BeFlexible Project**.

6.1 Introduction of the Action

The Regulation Working Group proposed this Action 5 in the context of the need to adapt electricity grids to an increasing electrification of the economy, where users will have a more active role in the future system. To help with this task, this action seeks to enhance network planning and operations to help operators prepare for 2030, even more so, considering the renewed interest from policymakers and regulators in electricity networks (European Action Plan on Grids, new provisions of the Market Design reform,…)[8]. Considering that there are more than 2 600 system operators (SO) across Europe with a wide spectrum of company sizes and disparities in national concentrations, it is essential that they can manage more flexibility systems with the help of innovative tools, which in some cases are being tested in European-funded projects. Action 5 focuses on identifying innovations to improve processes and tools, with key areas including integrating flexibility, balancing investments with flexibility, managing congestion, and developing remuneration mechanisms for system operators

The following methodology has been followed and will be further implemented in the coming months, leading to the presentation of a unified and comprehensive outcome of the action.

6.2 Methodology Adopted in Action 5

The action started in 2023 with a questionnaire that was sent to the participating BRIDGE projects. The questionnaire focused on the applicability and complementarity of different flexibility mechanisms (market-based, cost-based, rule-based, flexible connection agreements, dynamic tariffs) and the trade-off between investment and the use of flexibility.
In 2024, the workshop "Applicability of different flexibility mechanisms for DSOs and their trade-off with investments", was held in cooperation with ISGAN WG6. This workshop was part of the '2023.01 Active System Management by Distribution System Operators – Online workshop series', comprising three workshops. During the workshop the participants discussed each of the factors more in detail (i.e., the type of DSO need or service that is considered). The results of a poll were presented showing which flexibility mechanisms are considered most suitable for solving congestion and voltage issues in DSO grids. The flexibility mechanisms were ranked from 1 to 5, with different colours indicating the first and last choices (corresponding to the most to least suited) made by respondents.

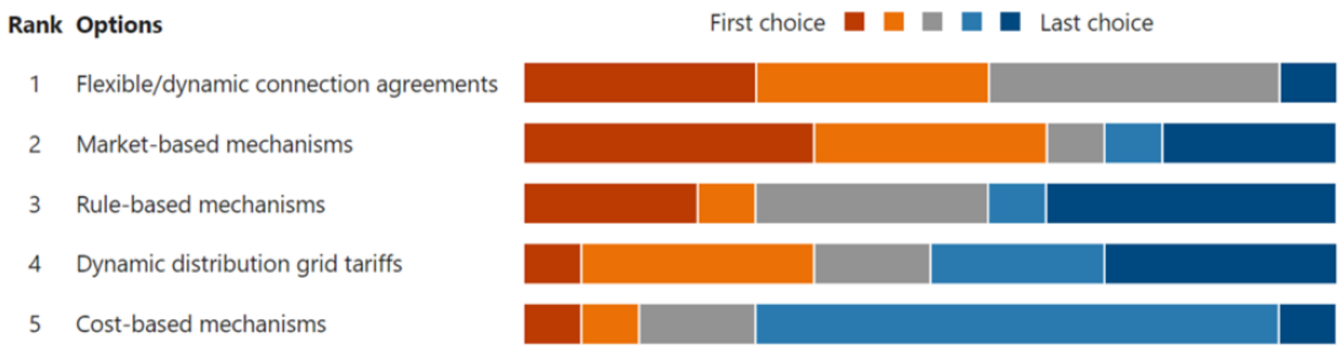


Figure 6.1: Poll answers on which flexibility mechanisms are most suited to solve congestion in DSO grids

[8] COM(2023) 757 final, 28/11/2023, Grids, the missing link - An EU Action Plan for Grids.

(input from workshop 3)

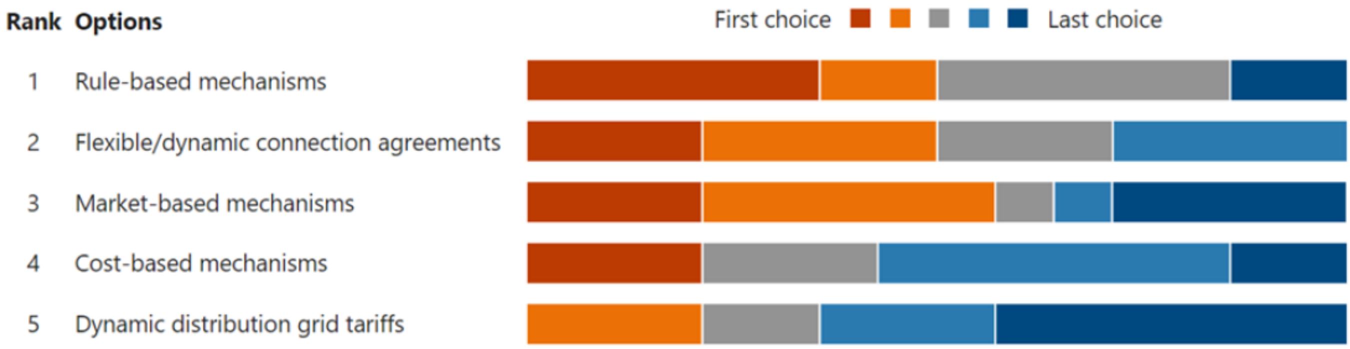


Figure 6.2: Poll answers on which flexibility mechanisms are most suited to solve voltage issues in DSO grids (input from workshop 3)

Another topic discussed during the third workshop was that the existing designs of flexibility mechanisms present some limitations, as they are traditionally conceived to operate as independent solutions without considering their potential for integration and complementarity. This standalone approach overlooks the synergies and conflicts that may arise when different mechanisms coexist and interact. For instance, network tariffs can provide long-term signals for infrastructure investment, while market-based solutions can address short-term operational needs. Similarly, dynamic connection agreements can provide immediate SO services that can be later managed through (local) market transactions, fostering cooperation between short-term and long-term flexibility solutions. On the other hand, designing these mechanisms, without considering their interactions, can lead to conflicts such as overlapping signals to consumers, which may lead to distorted consumer behaviours. Thus, each mechanism should be designed to signal an independent cost segment separated from another mechanism.

There were 5 main takeaways from the workshop:

- DSOs should carefully select flexibility mechanisms (market-based, dynamic connection agreements, tariffs, rule-based) tailored to needs and efficiency – customised to the voltage levels.
- The combination of multiple flexibility mechanisms is essential, with more than 2/3 favouring growth in market-based options.
- Market-based flexibility proves effective for short- and long-term solutions, with long-term solutions especially relevant for DSOs in deferring grid investments.
- There is no standardised methodology to make a trade-off between grid investment and by DSOs – a challenge that is being actively discussed in many countries.
- Anticipatory investments are crucial, especially for enabling use cases like untapped RES potential and e-mobility growth. Future scenario robustness is key.

It is important to take into account that the output of this action shows some synergies with that of Action 3.

6.3 Action 5 - Next steps

A new survey was circulated to participating projects on the December 3, 2024 with a deadline on January 10, 2025, with the following questions:

- What do you think is the biggest challenge SOs face when designing their network in the next five years?
- Which of the mentioned SO solutions does your project contribute to?
- Regarding the ones you have marked, indicate the degree of maturity.
- Which measures used by SOs do you think need to be adopted more quickly?
- Describe in one or two sentences how your project can help SOs improve the planning and operation of

their network.

The targeted projects are**: BEFLEXIBLE, DATA CELLAR, EFORT, ELECTRON, ENERGETIC, FLEXCHESS, HEDGE-IoT, ODEON, OMEGA-X, OPENTUNITY, R2D2, SENERGY NETS, STREAM, TWINEU, ENFLATE, PARMENIDES, REEFLEX, DRIVE2X, FEDECOM.**

The responses were received and analysed, and a meeting was held with the participating projects discussing the survey results, also focusing on barriers and draft recommendations. As this is an ongoing activity, the results of the analysis and the insights from the discussions with the projects involved will be presented in next year's annual activity report. Finally, Action 5 will seek to organize a joint workshop together with ETIP SNET.

7. KNOWLEDGE SHARING

Action leaders: The cross-working group action is currently being managed at a high level by the WG chairmanship and secretariat

The secretariat and WG chair organised four knowledge sharing sessions which focused on barriers faced by projects, innovative solutions adopted and, in the end, provided recommendations for other projects facing the same issues.

In the first part of the year, all ongoing and completed BRIDGE WG Regulation projects have been contacted to gauge their interest in participating in knowledge-sharing initiatives. Potential topics of interest have been collected from these engagements. After following up post-September plenary for further insights, a plan for knowledge-sharing meetings was drafted and then shared in December during the plenary meeting. It included five knowledge sharing sessions on the topics which were derived from clustering proposals submitted by the projects, and they include:

1. **Market Design in Energy Sharing, P2P and Energy Community Models** (17 January 2025, 12:00-13:00 CET)
2. **Regulatory Frameworks for Flexibility in Energy Systems – TSO/DSO Coordination** (31 January 2025, 12:00-13:00 CET)
3. **Acceptance of AI and Consumer Perspective** (14 February 2025, 12:00-13:00 CET)
4. **Cross-Sector and Multi-Energy Integration** (28 February 2025, 12:00-13:00 CET)
5. **Cybersecurity and Digital Transformation in Energy Regulation** (14 March 2025, 12:00-13:00 CET)

After having presented this topic list and the chosen dates, the secretariat shared another survey for projects to sign up for the different sessions. All sessions were scheduled successfully except the one on AI as not many BRIDGE projects are tackling the topic, resulting in scarcity of material to be discussed. Each meeting lasted one hour and was divided into three parts for a structured discussion concerning: (i) Barriers encountered; (ii) Innovative solutions implemented; (iii) Best practices and recommendations. The third session concerning Acceptance of AI and consumer perspective was cancelled due to limited interest of projects.

The table below contains the list of sessions that were effectively carried out together with projects presenting for each session:

Table 4 Scope of the survey evaluation on partners' contributions

Session number	Date	Topic	Projects presenting
1	17 January 2025	Market Design in Energy Sharing, P2P and Energy Community Models	• PARMENIDES • Hedge IoT • STUNNED
2	31 January 2025	Regulatory Frameworks for Flexibility in Energy Systems – TSO/DSO Coordination	• SENERGY NETS • BeFlexible • AIR4NRG
3	28 February	Cross-Sector and Multi-Energy Integration	• SENERGY NETS • U2Demo • EV4EU
4	14 March	Cybersecurity and Digital Transformation in Energy Regulation	• AHEAD • R2D2 • TwinEU

8. CONCLUSIONS

The 2024–2025 BRIDGE Regulation Working Group Annual Report consolidates the group's insights from a wide range of EU-funded innovation projects into actionable regulatory guidance. Each section of this report reflects a major area of inquiry undertaken by the WG, and collectively they point towards a shared conclusion: regulation must evolve in step with innovation to enable a resilient, inclusive, and decarbonised energy system.

The report focused on the regulatory mapping and assessment of Clean Energy Package (CEP) implementation across Member States. A key takeaway is that while the CEP has introduced important concepts—such as active consumers (who can engage in energy sharing), citizen energy communities, and demand-side flexibility—its national-level implementation remains highly heterogeneous. The WG observed significant divergences in how key provisions are defined, enforced, and monitored. This inconsistency impedes innovation and creates legal uncertainty for market participants. A harmonised and enforceable regulatory framework is therefore essential to unlock the full potential of flexibility and community participation across Europe.

Then the barriers demand-side flexibility (DSF) were examined and the state of readiness of national frameworks to support it. The analysis revealed that many BRIDGE projects continue to face barriers related to baseline methodologies, market entry thresholds, and the neutrality of system operators. Although flexibility is widely acknowledged as a critical resource for system balancing and congestion management, the regulatory tools to access it remain limited or unclear. The WG concludes that achieving scalable DSF integration requires regulatory convergence around baseline design, performance monitoring, and the neutral facilitation of markets by DSOs and TSOs.

Another key element dealt with the integration of energy communities and active consumers into energy markets. Findings show that despite growing policy support, communities still face practical obstacles in accessing markets, grid services, and fair remuneration. These challenges are compounded by inconsistent definitions and fragmented governance at national level. The WG highlights the need for regulatory frameworks that enable energy communities and energy-sharing schemes to deliver value both to their members and to the system as a whole. This includes clear market access rights, supportive data infrastructure, and streamlined licensing and compliance procedures.

Interoperability and digitalisation are becoming a key enabler for integration of distributed resources, data governance, and the digital platforms underpin flexibility services. BRIDGE projects revealed that technical capability often exceeds regulatory readiness, with gaps in interoperability standards, cybersecurity protocols, and roles for data access. The WG concludes that European regulation must more explicitly support interoperable digital infrastructures, ensuring secure and transparent data flows that empower consumers, aggregators, and system operators.

The need for DSO-TSO coordination and the operationalisation of flexibility at different voltage levels in a coordinated manner continues to be a key challenge. The WG recommends that coordination requirements be proportionate to the size, location, and timing of flexibility activations, avoiding unnecessary administrative burdens while maintaining system security.

Regulatory sandboxes for experimentation can become a relevant tool for more structured and accessible frameworks across Member States. Some regulatory uncertainties could be mitigated through sandbox schemes that allow temporary deviations from standard rules in a controlled environment. These schemes should include transparent evaluation criteria, stakeholder engagement, and the ability to scale lessons learnt into national frameworks.

Finally, cross-cutting issues and recommendations have been identified, including the importance of stakeholder engagement, regulatory clarity, consumer protection, and the development of shared metrics to evaluate the performance of flexibility and energy sharing mechanisms. The WG stressed the need for continuous dialogue among regulators, innovators, and citizens, as well as the creation of adaptable regulatory tools that can evolve alongside technological and social change.

In summary, this annual report underscores that while significant strides have been made, realising the EU's decarbonisation and decentralisation trends will require ongoing regulatory adaptation. The BRIDGE Regulation Working Group remains committed to fostering alignment between policy design and practical innovation by translating project-based evidence into policy-relevant insights. As Europe moves into the critical implementation phase of its energy transition, the WG's collaborative and iterative approach to regulation will continue to serve as a foundation for building a fairer, smarter, and more sustainable energy future.

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