Platone

PLATFORM FOR OPERATION
OF DISTRIBUTION NETWORKS

Platone

PLATform for Operation of distribution NEtworks

D1.3 v1.0

Overview of regulatory aspects that impact the solutions tested in the demos in European countries

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Abstract

The objective of this deliverable is to provide an overview of regulatory aspects and their impacts on the solutions tested in the demonstrators in European countries based on questionnaires and scientific research. This deliverable assesses regulatory areas such as flexibility, customers, energy storage and electric vehicles, aggregation, DSO revenue regulation, cybersecurity, and data protection, blockchain and smart contracts as well as energy communities. It was found that there is either a lack of regulation in many areas on European level and national level that need to be explored to be able to tackle the problems of the present and keep up with the emerging technologies in the future or that the regulation differs greatly among the countries. A nonuniform implementation of EU legal framework may not only be problematic for the commercialisation of products that are developed in H2020 projects but the differences in the organisation and operation of the various national markets impedes the introduction of managerial or process innovation at the European level.

Keyword list

Distributed system operators, consumer, legislation, clean energy package, blockchain, smart contracts, distribution management, energy management, demand response, energy storage, cybersecurity, data management, data protection, energy communities, DSO revenue regulation, network tariffs, innovation, obstacles, regulatory framework, harmonization

Executive Summary

"Innovation for the customers, innovation for the grid" is the vision of project Platone - Platform for Operation of distribution Networks. Within the H2020 programme "A single, smart European electricity grid", Platone addresses the topic "Flexibility and retail market options for the distribution grid". Modern power grids are moving away from centralised, infrastructure-heavy transmission system operators (TSOs) towards distribution system operators (DSOs) that are flexible and more capable of managing diverse renewable energy sources. DSOs require new ways of managing the increased number of producers, end users and more volatile power distribution systems of the future. Platone is using blockchain technology to build the Platone Open Framework to meet the needs of modern DSO power systems, including data management. The Platone Open Framework aims to create an open, flexible and secure system that enables distribution grid flexibility/congestion management mechanisms, through innovative energy market models involving all the possible actors at many levels (DSOs, TSOs, customers, aggregators). It is an open source framework based on blockchain technology that enables a secure and shared data management system, allows standard and flexible integration of external solutions (e.g. legacy solutions), and is open to integration of external services through standardized open application program interfaces (APIs). It is built with existing regulations in mind and will allow small power producers to be easily certified so that they can sell excess energy back to the grid. The Platone Open Framework will also incorporate an open-market system to link with traditional TSOs. The Platone Open Framework will be tested in three European demos and within the Canadian Distributed Energy Management Initiative (DEMI).

This deliverable is part of the Work Package 1: "DSO operation strategies and harmonization" and provides an overview of regulatory aspects and their impacts on the solutions tested in the demonstrators based on questionnaires and scientific research. The report encompass analysis of areas such as flexibility, customers connected to the grid, energy storage and electric vehicles, aggregation, DSO revenue regulation, cybersecurity, and data protection, blockchain and smart contracts as well as energy communities, which are relevant for Platone. The following key takeaways were found: there are no flexibility markets in most European countries and that flexibility services for distribution system operators such as congestion management are not defined in the European legislation. Harnessing flexibility in the power system will be a key enabler to meeting Europe's long-term decarbonisation goals. An efficient operation of the grid could be guaranteed through the procurement of flexibility services.

Regarding the customers that are connected to the DSO network, it was found that the European legislation explicitly allows the member states to extend and adapt the definition of prosumers, which poses challenges and opportunities to the Platone project: On the one hand it will be difficult to replicate a single product and on the other hand it is an opportunity to implement and adapt the project to different frameworks and use the best practices to improve the service of the platform. DSOs are not allowed to own storage in nearly all countries analysed. Furthermore, based on the answers from the questionnaires to the different DSOs, it was found that V1G and V2G are not allowed neither. The limited progress in the debate especially concerning storage might indicate that the discussion is not conclusive.

Energy storage has a key role in the energy transition towards a carbon-neutral economy because the energy system relies increasingly on renewable energy sources. Exceptions allowing for DSOs to own storage could be an option in the future to bridge the gap of a current lack of Business Use Cases that hampers investment. Since the deployment of energy storage is excluded from most legislation, it is found to be difficult to include it in the network planning which will lead to a further delay of storage usage.

Aggregation services are not available in all analysis countries. The European Commission defines aggregation in the Directive 2019/944 [1], however there is again the lack of transposition into the national legislation. The role and responsibilities with respect to the other market parties are not defined yet.

Energy communities exist already in the framework of EU national legislations but the implementation of the concept of energy communities can result in strongly different concepts. There is a lack of (harmonized) legislation in the demo countries because the RED II Directive [2] still needs to be transposed into national legislation. This poses major challenges to the Platone project since it inhibits the scalability and replicability in other European countries. The transposition of the EU directives may lead to diverse structures at the national level.

With regards to tariffs the revenue from them, this report suggests that they be linked with the costs incurred by DSOs in a more dynamic manner. The Greek demo develops a method of calculating the network tariffs in a cost-reflective, transparent, and understandable way, which is implementable and limited in complexity while providing incentive for efficient network use. In such a case, the co-existence of all these objectives with the necessity of revenue adequacy for DSO and the effect tariffs have on the actual demand patterns needs to be modelled and investigated.

Regarding cybersecurity, data management and data protection, the relevant directives are currently under revision at European level and will only be implemented after the project is finished, making it complicated to predict the impact on the project. Meanwhile existing regulatory frameworks in the analysed countries differ a lot, so it might be advisable to harmonize the rules for key areas. Deeper harmonisation of the rules especially regarding data security will benefit the scalability and replicability of the project. Due to lack of regulation or great divergence it is currently not possible to implement in other countries.

Smart contracts are not defined in the legislation of the analysed countries. When it comes to the legality of smart contracts, some of the issues that arise are: the formal and signing requirements, the immutability of smart contracts, audits/quality assurance and the legal status, effect and enforceability of smart contracts in general. Another fundamental issue at hand is that there is not a single, uniform blockchain implementation.

Generally, a clear lack of legislation was found in various areas which inhibits the progress and eventual replicability of the project in the different countries.

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1 Introduction

The project “PLATform for Operation of distribution Networks – Platone” aims to develop an architecture for testing and implementing a data acquisition system based on a two-layer Blockchain approach: an “Access Layer” to connect customers to the Distribution System Operator (DSO) and a “Service Layer” to link customers and DSO to the Flexibility Market environment (Market Place, Aggregators, …). The two layers are linked by a Shared Customer Database, containing all the data certified by Blockchain and made available to all the relevant stakeholders of the two layers. This Platone Open Framework architecture allows a greater stakeholder involvement and enables an efficient and smart network management. The tools used for this purpose will be based on platforms able to receive data from different sources, such as weather forecasting systems or distributed smart devices spread all over the urban area. These platforms, by talking to each other and exchanging data, will allow collecting and elaborating information useful for DSOs, transmission system operators (TSOs), Market, customers and aggregators. In particular, the DSOs will invest in a standard, open, non-discriminatory, blockchain-based, economic dispute settlement infrastructure, to give to both the customers and to the aggregator the possibility to more easily become flexibility market players. This solution will allow the DSO to acquire a new role as a market enabler for end users and a smarter observer of the distribution network. By defining this innovative two-layer architecture, Platone strongly contributes to aims to removing technical and economic barriers to the achievement of a carbon-free society by 2050 [3], creating the ecosystem for new market mechanisms for a rapid roll out among DSOs and for a large involvement of customers in the active management of grids and in the flexibility markets. The Platone platform will be tested in three European demos (Greece, Germany and Italy) and within the Distributed Energy Management Initiative (DEMI) in Canada. The Platone consortium aims to go for a commercial exploitation of the results after the project is finished. Within the H2020 programme “A single, smart European electricity grid” Platone addresses the topic “Flexibility and retail market options for the distribution grid”.

Considering the innovation that Platone proposes, a significant gap is expected between this vision and the legislative frame of the EU and the different member states. The energy transition foresees a greater role than ever before for the DSOs who will be the enabler of new solutions and the direct link to the emancipated consumers. While this is somewhat foreseen in European legislation, member states are still adapting their legislation. This report aims to give an overview of the state of play across Europe, to understand how the Platone innovation may be impacted by the regulatory framework.

Different regulatory frameworks can have a direct and indirect impacts on research and innovation and the link is complex and sometimes difficult to demonstrate because different forms of regulation do not have the same impact on the innovation process. For the development of the Platone project it is important to understand the potential impact of the regulation in place on the innovation process. This deliverable provides an overview and insights into blind spots that should be tackled by the various governments and the European Union as a whole and kept in mind in the further development of the Platone solutions.

1.1 Task 1.2

The Task 1.2 is about demo harmonisation, coordination, and the assessment of the fitness of the current regulation. It aims at connecting the three demonstrators of the project and continuously harmonising their activities and comparing their activities with the state of play in the regulatory framework at national and EU level. The task is divided into two subtasks, of which the first, T1.2.1, deals with the harmonisation among the three demonstrators through periodic demo roundtables. The aim of this deliverable is to report on the work carried out in the framework of the second subtask, T1.2.2, which analyses the current regulatory situation and monitors developments to identify potential obstacles to innovations relevant to the project. To this end a preliminary scoping exercise of relevant policy areas was carried out based on the initial work reported in D6.8 [4] and D6.9 [5] of the project and discussion with the demo developers. A questionnaire was developed [see Annex A and Annex B] to gather information about the regulatory state of play in the identified areas. This questionnaire was distributed firstly among the three DSOs leading the project demonstrators and then among E.DSO members, who count a variety of European electricity DSOs. The outcome of the questionnaires was analysed to identify gaps between the Platone vision and the current regulatory fitness in the demo countries as well as in other countries.

1.2 Objectives of the Work Reported in this Deliverable

The objective of the work reported in this deliverable is to provide an overview of regulatory aspects and their impacts on the solutions tested in the demonstrators in European countries based on the received answers in the questionnaires and scientific research. This deliverable will assess regulatory elements that will be relevant throughout the conduct of the project and its demonstrators. It will provide a general overview of the regulatory framework in areas relevant to the project and allow for the identification of regulatory recommendations to support the scalability and replicability of the Platone solutions. It aims to give a better overview of the current regulatory fitness and with the aim of drawing comprehensive conclusions, not only at EU level and in the demo countries, but also in 5 other countries namely, Austria, Czech Republic, Lithuania, Portugal, Spain and Ukraine, thanks to the contributions from E.DSO members.

The analysis of the deliverable as well as the answered questionnaires will in a next step be used as an input for the scalability, replicability and cost benefit analysis and for the standardization and interoperability WP7.

1.3 Outline of the Deliverable

The document is structured as follows: Chapter 1 provides a general introduction and explanation of the topic. In Chapter 2 the methodology that was applied while conducting the research is explained and a mapping is included that shows the relation between Use Cases and the thematic areas discussed in this report. Chapter 3 provides a description of the three demonstrators of Platone and the key obstacles to the innovation process identified by the demonstrators. Chapter 4 to chapter 11 deal with the regulatory situation of the topics identified as crucial to the demonstrators: flexibility, customers connected to the DSO network, energy storage end electric vehicles, aggregation, local energy communities, DSO revenue regulation, cybersecurity, data management, data protection, blockchain strategy and smart contracts. The European regulatory framework as well as the legislation of nine European countries are analysed. Chapter 12 concludes with the recommendations based on the analysis of the previous chapters.

1.4 How to Read this Document

In this report, the latest European and National legislations are presented thoroughly, and there is no need for the reader to have previous specific prior knowledge on the subject. The focus is on the laws that concern Platone, and where necessary, definitions are given for specific terms. The current legislation, and previous decisions have been officially published and readers can find these online.

The report takes its base in the Deliverables 6.8 “Report on the analysis of the regulatory and legislative framework” (M6) [4] and Deliverable 6.9. “Report on solutions and recommendations for the roll-out of the designed solutions” (M12) [5].

While this document informs about the regulation that the Platone solution touches, readers may find a detailed description of this solution, ‘The Platone Open Framework’, in the D2.1 “PlatOne Platform requirements and reference architecture (v1)” (M12) [6]. It should be noted that this deliverable will be updated after the first demo run (M30) but that the general concept of the solution is not expected to be subject to change.

Regarding the definitions of the different consumer types who may interact with the Platone Open Framework, this report is informed by Work Package 8, and namely the work that will reported into D8.9 “Communication and Dissemination Plan (v2)” (M27) which is being prepared in parallel.

The present deliverable will furthermore constitute the base for the scalability and replicability analysis which is to be developed within T7.1 and T7.2.

2 Methodology

To follow up on the development of the regulatory situation in the different demo countries as well as their impact as potential obstacles to innovation, the first step was to set the scope of the analysis. As Platone is very ambitious in its innovation it was decided to keep a rather wide scope to create the best possible basis for the later scalability and replicability analysis to be performed as part of the project Work Package 7.

2.1 Scope

The preliminary analysis of relevant topics was executed based on the outcomes of Work Package 6 and namely the two deliverables 6.8 [4] and 6.9 [5], as well as the concrete and available demo plans and the challenges that the project aims to tackle:

1. Unlock flexibility to address local congestion and voltage stability;
2. Improve grid operation through advanced network observability;
3. Improve customers engagement and facilitate their fair participation in the market;
4. Support cooperation with the TSO;
5. Ensure reliable and secure power supplies in the context of increasing DER penetration.

The final list includes eight thematic areas whose regulatory framework has central implication for the Platone solutions is as follows:

- Flexibility
- Customers connected to the DSO network
- Energy Storage and EVs
- Aggregation
- Energy communities
- DSO revenue regulation
- Blockchain and smart contracts in the energy sector
- Data management, protection, and cybersecurity

Of these eight thematic areas, flexibility appears to be somewhat more general with the possibility to umbrella most of the other topics. It should therefore be mentioned that this thematic area focusses primarily on the legal base for flexibility services and markets.

As a next step, the relevance of European legislation within the eight thematic areas was mapped against the demo activities. This allowed for further specification of relevant aspects and to identify the relevant issues to be investigated further with a detailed questionnaire. The table below shows which of the eight topics the demos through their use cases:

		Italy		Greece					Germany			
Regulatory aspects		UC1 Voltage Control	UC2 Congestion Management	UC1 Functions of the State Estimation tool given conventional measurements	UC2 PMU data integration into SE tool	UC3 Distribution Network limit violation mitigation	UC4 Frequency support by the distribution network	UC5 PMU integration and Data Visualization for Flexibility Services	UC1 Islanding	UC2 Flexibility Provision	UC3 Bulk Energy Supply	UC4 Bulk Energy Export
1 Flexibility services	**1.1. Flexibility services characteristics**	X	X			X	X		X	X	X	X
	1.2 Organisation of flexibility provision framework	X	X			X	X		X	X	X	X
2 Customers connected to DSO network	**2.1 Consumer prosumer**	X	X			X	X		X	X	X	X
	2.2 Tariffs					X	X					
3 Energy storage and EVs	**3.1 DSO ownership of storage units**								X	X	X	X
	3.2 Functionalities allowed	X	X						X	X	X	X
4 Aggregation	**4.1 Are aggregation services available in your country?**	X	X			X	X					
	4.2 What kind of customers can join aggregation services in your country?	X	X			X	X					
	4.3 Can residential consumers contract aggregators independently?	X	X			X	X					
	4.4 Could the aggregator be operating all the consumption of a consumer?					X	X					
	4.5 On what basis/features can the					X	X					

	aggregator be operating all the consumption of a consumer in your country?											
	4.6 What are the technical specifications for aggregators in your country?	X	X			X	X					
5 Local Energy Communities	**5.1 Jurisdictional aspects**								X	X	X	X
	5.2 Technical requirements								X	X	X	X
	5.3 CECS								X	X	X	X
	5.4 CEC requirements								X	X	X	X
	5.5 REC/CEC and DSO cooperation								X	X	X	X
6 DSO revenue regulation	**6.1 What are the regulations regarding DSO investment innovation?**	X	X									
	6.2 Do revenues reflect CAPEX?	X	X									
	6.3 Do revenues reflect OPEX?											
7 Blockchain and Smart Contracts in the energy sector	**7.1 Is there a national strategy for regulating the application of blockchain technology?**	X	X									
	7.2 Is there a national strategy for regulating the application of blockchain technology specific to the energy sector?	X	X									
8 Data Management,	**8.1 Who owns energy data?**							X				

protection, and cybersecurity	**8.2 Who collects energy data in your country?**							X				
	8.3 Who stores energy data?							X				
	8.7 Do you foresee a Data Access Policy for the energy data you manage?	X	X					X				
	8.8 How do you protect the access to the energy data?							X				
	8.9 Do you apply any mechanism for ensuring data privacy and data integrity and avoiding data tempering							X				
	11.2 Which approach is used for connection charge (shallow deep, mixed)?					X	X					
	11.3 is RES curtailment allowed?	X	X			X	X					

Table 1: Use Case Mapping: Use Cases vs. thematic areas analysed

The second column of the table demonstrates the link between the mapping and the development of the questionnaire to gather information to understand the state of play in the three demo countries.

The questionnaire includes a few generic questions to understand the inherent conditions related to the respondent DSO and its context, before diving into the eight themes. These questions were especially thought for being able to compare the results in the demo countries with the answers from other DSOs. To this end the questionnaire was sent to E.DSO members representing a variety of DSOs in terms of sizes and innovation level providing additional perspective to the analysis. The countries analysed in addition to the three demo countries are: Austria, Czech Republic, Lithuania, Portugal, Spain, and Ukraine.

In most cases the questions are of a quantitative kind and answers are supported by arguments based on the current legislation. In a few cases the respondents have been asked their opinion and the answers are therefore based on certain subjectivity. These answers are marked by pale turquoise titled boxes in the thematic chapters below.

The analysis of the questionnaires builds on the results from the previous deliverables, namely D6.8 and D6.9, and updates the information where necessary and widens the scope beyond the demo countries. Several calls with the Platone partners were organised to deepen the discussion on the different topics to understand the impact of the regulatory situation to the innovative solution of the respective demonstrator.

The report is structured according to the identified eight thematic areas with separate chapters dedicated to the analysis of the state of play in each of the thematic areas. The analysis and structure of the eight thematic chapters are based on the following steps, which represent the methodology of this report:

- Definition of the topic
- Context within the Platone project
- Outline of the legislative framework at European level
- Outline of the legislative framework in the demonstration countries as well as six additional European countries
- Analysis of the regulatory fitness of the legislation with reference to the needs of the Platone project.
- Conclusions and recommendations

Due to the close relation between the eight thematic areas some overlap concerning the relevant legislation is found. The order of the thematic chapters therefore begins with Flexibility whose regulatory analysis the following chapters are based on.

To define the limits of each topic a literature review has been performed to complement the mapping shown in Table 1 and to ensure that the findings of this report remain relevant. Basing the analysis on this review and the information gathered from the questionnaires, the development and current regulatory situation in the different countries will be analysed to highlight potential obstacles and gaps and conclude with recommendations for policymakers.

2.2 Limitations

Two central points must be considered: on the one hand the project was planned based on the European and national legislations that were in place in 2018. On the other hand, important EU Directives that are crucial to the implementation of the project, have not been transposed into the national legislation in the different Member states yet or are currently discussed on a European level.

It must be noted and underlined that the research for this Deliverable was conducted between April and June. If there were any updates of the legal framework after that in the different countries, this information is not considered in the analysis.

It should be noted that the document will not discuss the technical potential of the innovation mentioned in this report, but only relate to them from a regulatory point of view. Due to its scope, it will remain focused on the obstacles to innovation from a DSO point of view, as DSOs are the subject of the implementation of the Platone solutions.

3 Description of the three Demonstrations of Platone

This chapter summarises the three demonstration sites of Platone deployed in Italy, Greece, and Germany. The three “demos” are testing different Use Cases (UCs) and represent different boundary conditions as described in D1.1. [7].

A common solution, the Platone Open Framework, based on block chain technology is being developed at project level. It consists of several components which altogether help DSOs address the five challenges identified by the project and described in Chapter 2.1. The components may be implemented altogether or independently. Of the Platone demos the Italian demo will implement all components of the solutions, while both Greece and Germany will test and use specific parts of according to their specific needs.

The demonstrations sites are summarized below:

- *A field trial in Rome, Italy, which will demonstrate the complete structure of the Platone Open Framework*

  The aim of the Italian demo is to define a fully functional system that enables distributed resources connected to the medium and low voltage grid to provide services in different flexibility market models which include all the stakeholders (TSO, DSO, aggregators and end-users). The grid is completely underground because the field trial area has a high artistic value. The electricity users in the area are very heterogeneous and consist of: (a) headquarters of important companies and institutions, (b) a shopping centre, (c) about 4,000 users connected in low voltage, (d) about 30 prosumers that use rooftop photovoltaic power plant, (e) about three big companies with a relevant Electric Vehicles fleet for testing V2G energy services.

- A field trial in Mesogeia, Greece, with specific focus on customer flexibility with indirect methods such as tariffs.

  The aim of the Greek demo is to demonstrate the ability of DERs to provide ancillary services to the system, participate in the Day-Ahead (DA) and Balancing markets and contribute to the secure operation of the distribution network. The pilot site is located in the area of Mesogeia at the south-eastern part of Attica, near Athens and is considered as ideal for demonstration purposes since: a) it combines parts of mainland and interconnected islands, which gives an interesting mixture of locations, systems and infrastructure to be studied; b) provides a mix of rural, urban and suburban areas; c) consists of a customer mix including households, small, medium and large industries; d) has high RES penetration of various types and e) is close to the capital.

- *A field trial in Twistringen, Germany, which will focus on the flexibility implementation in relation with a local energy community.*

  The German demo site will focus on a low voltage network in a rural area with a high penetration of DER. It is these regions where a high potential for DER meets a low residential and commercial load where some of the challenges of the energy transition surface first. This demonstration focusses on the supervision between local balancing mechanisms and centralized grid operation. Furthermore, the flexibility arrangement between the local network and the higher-level networks will be addressed. An effective informational and temporal uncoupling of low and medium voltage networks is another goal which will be treated by handling energy supply and export in bulk packages instead of a real-time exchange.

4 Flexibility Services Regulation and the organisation of flexibility provision framework

The chapter is organized as follows: firstly, flexibility and flexibility services are defined. Secondly, the importance of flexibility for the Platone project is explained. In a third step the European and national legislation of nine European countries is explained to understand if the current regulatory framework fulfils the requirements to scale the project and replicate it as a product in the different European countries. In the final analysis, eventual shortcomings are brought forward.

The chapter recognises the importance of TSO-DSO coordination within this topic, but in coherence with the demonstration plans it does not enter into the discussion of how these actors should cooperate with regards to the procurement of flexibility.

4.1 Definition of Flexibility

The increasing share of renewables in the changing energy system poses challenges such as frequency variation, voltage drops and swells or outages etc. The DSOs can compensate the imbalances caused by the distributed variable generation through flexibility services [8].

Following the definition of Eurelectric [9] subsequently shared by all four European DSO associations (CEDEC, E.DSO, EURELECTRIC, GEODE), flexibility is the modification of generation and injection patterns of electricity into the system reacting to an external signal such as network tariffs or activation to maintain a stable grid operation. Flexibility can be characterised through various parameters, for example duration, response time, location etc. [10] [11]. Flexibility offers the possibility to the DSOs to improve their grid capacity management, to balance eventual congestion, to provide voltage control, to mitigate power quality problems and can be a cost-effective solution for network reinforcement [8] [11]. In addition to that, flexibility services enhance the cost effectiveness of the system and improves the remuneration of the provided services [4].

4.2 Flexibility in the context of the Platone project

Flexibility is a key topic for Platone, as the project sets out to create synergies between flexibility markets and DSO technical operations. This takes place through the development of the Platone Open Framework which is a multilayer platform that integrates the customer in the network operation by allowing them direct participation in the flexibility markets. The project addresses the growing needs of DSOs to have real-time insight into the operation of their networks while unlocking new flexibility sources and allowing them to participate in a fair and open way.

The key goals of the project is firstly, to unlock flexibility to address local congestion and voltage stability; secondly, to improve grid operation through an advanced observability approach; thirdly, to improve customers' engagement and facilitate their fair participation in the market and finally, to ensure reliable and secure power supplies in the context of increasing DER penetration.

The demonstrations in the three countries work on flexibility measures and electricity grid services provided by storage of electricity, power-to-x, demand response, and variable generation enabling additional decarbonisation [7]. Furthermore, they involve smart grid technologies for optimal observability and tools for a higher automation and control of the grid and distributed energy sources, for increased resilience of the electricity grid and for increased system security, and test market mechanisms to mitigate short-term and long-term congestions or other problems in the network [7].The Italian demonstration specifically is testing the implementation of a "local flexibility market" where the DSO places its own request for flexibility on the market where also the consumers are connected through an aggregator.

4.3 European Union: Regulatory and legislative framework

The Clean Energy for all Europeans package (CEP), published in 2019, is the central energy policy framework to accelerate the energy transition and to achieve the EU Paris Agreement commitments. The CEP includes eight legislative acts, covering [12]:

- Energy performance in buildings, Directive 2018/844 [13]

- Renewable energy, Directive 2018/2001 [2]
- Energy efficiency, Directive 2018/2002 [14]
- Governance of the Energy Union and Climate Action, Regulation 2018/1999 [15]
- The common rules for the internal market for electricity, Directive 2019/944 [1]
- The internal market for electricity, Regulation 2019/943 [16]
- Risk-preparedness in the electricity sector, Regulation 2019/941 [17]
- The establishment a European Union Agency for the Cooperation of Energy Regulators, Regulation 2019/942 [18]

In addition to the CEP the 3rd Energy Package also prepares the new and enhanced role of the DSO with new tasks. Flexibility services are regulated by Directive 2019/944 [1] and Regulation 2019/943 [16]. The latter foresees the use of demand-side flexibility to guarantee a cost-efficient, secure, and reliable network planning and operation, and notes that the TSO and DSO must coordinate and exchange all the necessary data and information to this end [16].

Regarding the particular role of the DSO, Article 31 (5,6) of Directive 2019/944 [1], notes that DSOs shall act as neutral market facilitator when procuring the products and services necessary for the efficient, reliable, and secure operation of the distribution system while cooperating with the TSOs and all relevant market participants. The relevance of the flexibility in the distribution grid operation is further specified in Article 31(7) which stipulates that the DSOs shall procure the non-frequency ancillary services needed for their system, and that this shall be done in accordance with transparent, non-discriminatory, and market-based procedures.

Lastly, Article 32 (1) of the same Directive [1] indicates that Member States shall provide the necessary regulatory framework that allows and provides incentives for DSOs to procure flexibility services from providers of distributed generation, demand response or energy storage, such as congestion management to improve efficiencies in the operation and development of the distribution system. Article 32 (3) defines that DSOs shall develop specifications for the flexibility services procured and, where appropriate, standardised market products for such services at least at national level, in collaboration with the National Regulatory Authority and all other relevant market operators.

4.4 Italy: Regulatory and legislative framework

As of June 2021, DSOs are not allowed to procure flexibility services in Italy. Even though the Italian National Regulatory Authority (ARERA) commissioned Terna (Italian TSO) to plan pilot projects aimed at evaluating and expanding the role of DSOs as neutral market facilitators in the consultation document 322/2019/R/eel [19], no specific rules are defined yet. The Directive 2019/944 was not transposed yet into Italian law and a consultation is supposed to be published before the summer break of 2021.[1]

To increase the number of resources participating in the Ancillary Service Market and to increase the pool of ancillary services providers, Terna and the Italian National Regulator (ARERA) have since 2017 launched several initiatives to open the market to new kinds of participants and resources. This has led to more than 1,3 GW of demand side response (DSR), storage or small RES plants qualified to Ancillary Service Market as of 2020 in the form of “UVAM” (Mixed Enabled Virtual Units) [20].

Concerning data exchange between TSO, DSO and Significant Grid Users (SGU) some rules are indicated in the ARERA consultation document 361/2020/R/eel [21].

In Italy, Terna, is reimbursed for procuring flexibility services with a specific mechanism (an uplift on the electricity bill to reimburse the flexibility cost). As only Terna is involved in the reimbursement mechanism it does not affect the Italian demo. Flexibility products are not standardized in Italy because DSOs are not allowed to purchase such services but there is a framework for TSO/DSO cooperation foreseen for flexibility procurement and data exchange.

Which criteria/criterion should define the flexibility services suitable for DSO control area?
According to the Italian demonstrator, aggregation of the distributed energy resources for the relevant node (such as secondary substations, feeders, primary substations) should be used as criterion for

[1] June 2021 still no update has been published.

congestion management for the DSO control area and localization of DERs available for the service regarding voltage control.

4.5 Greece: Regulatory and legislative framework

According to the present regulatory framework the DSO in Greece is not allowed to procure flexibility services.

The Greek solution developed within the project employs flexible loads through network tariffs and the innovative approach that the Greek demonstrator proposes (variable (per-hour) the use of network tariffs in the Day Ahead context and even with locational variation), cannot be applied and tested in a real-life environment since network tariffs are regulated by the National Regulatory Authority of Greece.

Hence, the consequence of the above is that the innovative approach the Greek demo develops will be tested in a simulated environment, even if actual historical data as well as real network data are going to be used.

A memorandum of understanding has been signed between the DSO (HEDNO) and TSO (IPTO) of Greece, which includes the cooperation in the following:

- Planning and Development of Transmission and Distribution Systems
- System Restoration
- Congestion Management
- Real Time Data Exchange

4.6 Germany: Regulatory and legislative framework

As of June 2021, there is no legislative framework that regulates flexibility markets in Germany. Article 14 of the Renewable Energy Industry Act (Energienwirtschaftsgesetz" – EnWG)) [22] regulates the tasks of electricity DSOs and is adapted to the requirements set in Electricity Directive 2019/944 [1]. This regulatory framework enables TSOs and DSOs to procure system services. According to the §12h EnWG [23] "TSOs with control area responsibility and operators of electricity distribution networks are obliged to procure the following system services for their respective network that are not frequency-bound in a transparent, non-discriminatory and market-based process:

1. Voltage regulation services,
2. Inertia of the local network stability,
3. Short circuit current
4. Dynamic reactive power backup,
5. Black start capability, and,
6. Island operability.

These ancillary services may only be procured insofar as they are necessary for safe, reliable, and efficient network operation. Electricity DSO may only procure these ancillary services if they need them in their own network or if the ancillary services are procured in agreement with the operators of transmission networks with control area responsibility" [23].

In Germany the following definitions regarding voltage control are in place:

- The general requirements for voltage regulation are set in the VDE-AR-N 4105 which applies to generators connected to LV-networks/Erzeugungsanlagen NS-Netz) and describes fixed characteristic curve reactive power ready for voltage support[2].
- Additional requirements are defined in VDE 4100 (Anschluss von Kundenanlagen an das NS-Netz und Betrieb) in the technical guidelines for grid connection, which are defined by the DSO and are individual from DSO to DSO.

[2] cos Φ (P)

- There are no technical guidelines describing technical requirements for DSOs, however in case of Feed-In Management (§ 14 of the Renewable Energy Act – EEG) [22] a regulation for assets is described in § 9 of the Renewable Energy Act (EEG) [24].

Which criteria/criterion should define the flexibility services suitable for DSO control area?
The most relevant flexibility services for the German Demo are congestion management, voltage control and black start capability. Currently there are no regulations for flexibility to be procured on flexibility markets. However, in the operational environment of grid operation some general technical requirements for the connection of generator and loads to the grid are described:

4.7 Other European countries: Regulatory and legislative framework

The table below gives and overview of the situation in the countries studied in addition to the three demo countries. Further specification of national particularities are provided afterwards.

Question	Austria	Czech Republic	Lithuania	Portugal	Spain	Ukraine
Is the DSO allowed to procure flexibility services in your country?	No	Yes	no	No	No	No
Are the flexibility product standardized in your country?	No	No	No	No	No	No
Are bilateral agreements included to the flexibility market? (e.g., DER owner & DSO)	No	No	No	No	No	No

Table 2: Flexibility products, services, and markets in other European countries

4.7.1 Austria

As of June 2021, it is not possible for DSOs to procure flexibility services in Austria. The requirements for flexibility services in Austria are activation time, the direction, and the type of unit. The regulatory framework regarding flexibility services is different for the TSOs and are organised at a national level for the balancing market. Here it is important to underline that balancing as a service lies within the responsibility of the TSOs and markets for procurement of services regarding balances already exist to some extent.

There are bilateral agreements included to the flexibility market but the TSOs and DSOs do not cooperate. Generally, there is a framework foreseen for TSO/DSO cooperation for balancing, network planning, operation, and data exchange.

4.7.2 Czech Republic

In Czech Republic there is recently new regulation in place detailing requirement for non-frequency services for DSOs.

The flexibility services differ for DSOs and TSOs; DSOs procure non-frequency services with local impact and the most relevant type of service is the voltage control which concerns mostly reactive power. The flexibility products are standardized and concern voltage control, management of reactive power

flows, black start, and islanding. There are bilateral agreements included in the flexibility market and TSOs and DSOs cooperate to organise the flexibility market. The cooperation framework includes flexibility procurement and data exchange.

The flexibility market is not integrated into the existing processes of the EU electricity market and DSOs do not cooperate with each other. The Czech regulatory framework defines cross-border flexibility as well as flexibility services across countries. There is a set of guidelines (secondary regulations) defined by TSO/DSO working groups providing rules for procurement of flexibility/ data exchange/market prequalification etc. The operators are reimbursed by the NRA when they need to use flexibility.

Which criteria/criterion should define the flexibility services suitable for DSO control area?
The most relevant service for the DSO is voltage control and the requirements for flexibility services are activation time, direction, availability ratio, technical response time, the location of the measuring process and the number of instances/per year.

4.7.3 Lithuania

As of June 2021, DSOs are not allowed to procure flexibility services in Lithuania. According to the response, the most relevant flexibility services for the DSO would be voltage control and congestion solving [Annex B.3]. Flexibility products are not standardized in Lithuania. Even though TSOs and DSOs do not cooperate to organize the flexibility market there is a cooperation framework foreseen in the areas of network planning, operation and data exchange.

Which criteria/criterion should define the flexibility services suitable for DSO control area?
The criteria that define the flexibility services suitable for DSO control area for voltage control and congestion management are the size of unit and location in the network [Annex B.3].

4.7.4 Portugal

As of June 2021, DSOs are not allowed to procure flexibility services in Portugal and flexibility products are not standardized neither in the legislation. The TSOs and DSOs do not cooperate to organize the flexibility market but there is a cooperation framework foreseen for network planning, operation, and data exchange.

4.7.5 Spain

As of June 2021, it is not possible for DSOs in Spain to procure flexibility services, but there are pilot demonstrations going.

In Spain, the flexibility services differ between DSOs and TSOs because the TSO is allowed to procure flexibility services related to balancing and the DSO services are not in place. The solutions for flexibility services are clustered at a national, regional, and local level throughout the definition of different types of flexibility solutions according to grid necessities.

The flexibility services are not standardized but according to the DSO they should be standardized, however include enough diversity to reach all solutions. Furthermore, the DSO argues that there should be bilateral agreement included to the flexibility market. DSOs and TSOs normally do not cooperate however through the participation in the CoordiNet H2020 project, a possible cooperation is being assessed on a legislative level. A general regulatory framework is lacking. DSOs are cooperating with each other in demonstration H2020 projects such as CoordiNet and OneNet and in working groups to enable solutions such as the Futured Flexibility Working Group. Cross border- flexibility is only defined for the balancing services of the TSOs. Operators are not reimbursed by the NRA when they need to use flexibility since they work under pilot projects which have a separate allocated budget.

Which criteria/criterion should define the flexibility services suitable for DSO control area?

Regarding the requirements for flexibility services, for activation time there are no services established but should exist as a requirement. Long activation times between 30 and 60 minutes are considered useful. Requirements concerning direction and Bid size -MW are not applicable in Spain as there are no services established'. The type of unit is considered as not necessary unless it refers to generation, demand and storage. The availability ratio, technical response time and location of the measuring process are not applicable but considered eligible. The number of instances/days per year is considered not necessary as they are free to bid when possible. The general approach of the DSO is that the requirements should be set up in a way that they enable as many resources as possible to participate [Annex B.5]

4.7.6 Ukraine

As of June 2021, it is not possible for DSOs in Ukraine to procure flexibility services.

4.8 Analysis

In view of the changes to the electricity system produced by the energy transition, the importance and responsibilities of the DSO will increase. This happens as an increasing number of DERs require connection at DSO level as well as new actors announce their arrival in the energy sector, such as active consumers. The CEP foresees this extended role DSOs will have both as a market facilitator and as an innovation driver in support for the energy transition. In the light hereof the CEP allow DSOs to increase the use of flexibility to ensure system stability and, consequently a costly expansion of the grid may be necessary. As seen in the previous sub-chapters the EU legislation provides clear grounds for DSOs to become flexibility procurers and to actively use flexibility as a tool in their operations. It is noted as well that harnessing flexibility in the power system will be a key enabler to meeting Europe's long-term decarbonisation goals. [25].

As seen in 4.3, Directive 2019/944 [1] and Regulation 2019/943 [16] passes the ball to the Member states for the implementation of a regulatory framework that allows distribution system operators to procure flexibility. However, the following sub-chapters clearly shows that in the majority of the concerned countries, the Directive has not been implemented yet. Exceptions to this are the Czech Republic and Germany. Other voices in the debate such as Prettico [26], suggest that "policy actions should mostly focus on monitoring the implementation of the innovative provisions of the Directive 2019/944 [1], with minor adjustments so that processes across different countries can be compared and best practices for implementation can be identified [26]".

There is a clear lack of legislation which could inhibit the progress and eventual replicability of the project in the different countries. An efficient operation of the grid could be guaranteed through the procurement of flexibility services. Therefore, the implementation in the national legislation must take into due consideration the enhanced responsibility of the DSOs, and enable their use of flexibility for the continuous stable and reliable distribution of electricity.

Secondly, at EU level the legislation defines that DSOs should cooperate with TSOs and all relevant market operators, however it is not defined who is relevant. It must be underlined that because of emerging technologies the number of relevant operators will change and increase in the future and that the national implementation of the legislative framework needs to be adapted to this reality.

Thirdly, the flexibility services relevant to distribution system operators such as congestion management are not defined in the European legislation. This leads to the concern that a myriad of such definitions may be developed with no promise of harmonisation between different countries and regions. While the Platone Market Platform does not care about the definition of the services, its relevance and efficiency will be greater if a common definition is found which may as well allow for the creation of markets with multiple DSOs, to the benefit of the market liquidity.

Finally, due to the absence of markets and defined services, no historic and actual data are available that could serve as a basis for an improvement of the regulatory framework. This implies that the current projects start from zero and that good cooperation and communication will be necessary between projects and among countries to develop an efficient system that reacts to the rapidly changing needs of the energy transition.

5 Customers connected to DSO network

This chapter is dedicated to the customers connected to the DSO network and the framework that guides their interaction with the DSOs. It will focus on the prosumers as these represent one of the more complex interactions with potential for bi-directional power flow, making them active on both demand and supply side. The economic relation between the consumers and the DSOs is represented by tariffs which will also be discussed in this chapter.

The chapter is organized as follows: firstly, prosumers are defined. Secondly, the importance of prosumers and tariffs for the Platone project is explained. In a third step the European and national legislation of nine European countries is explained to understand if the current regulatory framework fulfils the requirements to scale the project and replicate it as a product in the different European countries. In the final analysis, eventual shortcomings will be brought forward.

5.1 Definition of Prosumers

In the Platone project an identification of the users of the Platone Open Solution has been performed within the task 1.5 “Harmonization with customers and partners needs and expectations” and further developed by work package 8 “Dissemination and Exploitation”. The user identification includes a few customer groups which can be understood from the first line in the figure below:

Figure 1: Customers and Stakeholder of the Platone project

A new updated definition that will be based on other projects and the BRIDGE initiative will be available in D8.9 “Communication and Dissemination Plan (v2)” (M27: November 2021). In this future Deliverable a technical and social description of the types, which needs the input from the project’s engagement process[3] will be provided.

The consumer types identified by Platone distinguish between residential and commercial consumers and whether the consumer is active on both the demand and supply side. In Platone the consumers active on both demand and supply side are named ‘prostomers’ to express that these in additional to producing energy may also be able to store it.

> The European Parliament defines 'Prosumers' as consumers who both produce and consume electricity. On the one hand, prosumers 'self-consume' some of the electricity they produce and on the other hand they sell the excess to the grid. In case their production does not meet their demand, they also buy power from the grid. Examples of prosumers include residential prosumers, community/cooperative energy, commercial prosumers, and public prosumers. [27].

[3] delayed due to Covid crisis

The above definition provides further detail and with the recognition of the consumers' potential ability to defer consumption by use of storage technologies, this definition will be the base of the following analysis.

5.2 Prosumers in context of the Platone project

Consumers are at the core of the Platone innovation, and their active participation is key for reaching the full potential of the proposed Platone Open Framework. Consumers will be able to participate actively in the electricity market via the Platone Market Platform and DSOs may manage the relations with those who are their customers through the Shared Customer Database (SCD). Consumers therefore play a role in all three demos, however in different forms.

The SCD will be implemented in all three Platone demos, while the Market Platform will be implemented and tested in the Italian demo. In the framework of the task 1.5 "Harmonization with customers and partners needs and expectations" the demos have all done extensive work to inform potentially interested users and engage consumers in their activities.

5.3 European Union: Regulatory and legislative framework

At European level three different forms of prosumers are distinguished, namely individual and collective self- consumption and energy communities. The Electricity Market Directive 2019/944 [1] and the RED II 2018/2001 [2] define self-consumption and individual self-consumers and are already prevalent concepts in the different member states. According to Directives [2] [1], final consumers are entitled to consume and store electricity they have produced within their premises and to sell this electricity. In contrast to active consumers that can be involved in activities beyond energy generation such as the participation in flexibility or energy efficiency schemes, renewable self-consumers are limited to producing electricity from renewable sources [28].

Active customers and renewable self-consumers are in the legislation defined as follows:

> Directive 2019/944 Article 2 (6) [1]: 'Active customer' means a final customer, or a group of jointly acting final customers, who consumes, or stores electricity generated within their premises located within confined boundaries or, where allowed by a Member State, within other premises, or sell self-generated electricity or participates in flexibility or energy efficiency schemes, provided that these activities do not constitute their primary commercial or professional activity;
>
> Directive 2018/2001 Article 2 (14) [2]: 'renewables self-consumer' means a final customer operating within its premises located within confined boundaries or, where permitted by a Member State, within other premises, who generates renewable electricity for its own consumption, and who may store or sell self-generated renewable electricity, provided that, for a non-household renewables self-consumer, those activities do not constitute its primary commercial or professional activity;
>
> Directive (EU) 2018/2001 Article 2 (15) [2]: 'jointly acting renewables self-consumers' means a group of at least two jointly acting renewables self-consumers who are in the same building or multi-apartment block.

While individual self-consumption is possible in most member states, collective self-consumption is an emerging concept. In some member states legal frameworks for collective self-consumption are being developed. The specifics of the models vary, and different solutions were chosen to ensure compatibility with the principles set by the Third Package and national law emerging from it.

5.4 Italy: Regulatory and legislative framework

In Italy consumers/prosumers are incentivized and enabled to provide flexibility: Incentives can be given to cover the costs of monitoring systems for guaranteed availability and for the service provided. Incentives are calibrated on the capacity and the energy offered. In the pilot projects as stated in 300/17/R/eel Regulation [29] issued by Arera, the Italian Regulatory Authority for Energy, the minimum size of the resource is 1 MW (The possibility of reducing the minimum capacity to 200 kW is under discussion).

The technical requirements for consumers/prosumers to be able to participate in the flexibility market are time-response, availability, additional equipment at customer/network interface and additional systems like customer EMS: these indications are based on pilot projects as stated in 300/17/R/eel Regulation [29]. Consumers/prosumers get an active role in the process of providing flexibility and the main barriers are the equipment costs needed to enable the customers in low voltage, the knowledge of the flexibility service market and, the trust in the new market.

The tariff methodology, designed by the Regulatory Authority, does not provide incentives for consumers to provide flexibility.

The questionnaire assessed the topic "flexible loads through network tariffs" and what type of network tariffs are allowed in the different countries. This table summarises the network tariff structure in Italy:

Tariff Driver	Feature
Energy (Eur/kWh)	Flat[4]
	Fixed[5]
Capacity (Eur/kW)	Fixed
Type	Household vs industrial vs commercial

Table 3: Tariff drivers in the Italian demo

5.5 Greece: Regulatory and legislative framework

In Greece consumers/prosumers are not enabled or incentivised to provide flexibility. Consumers do not get an active role in the flexibility market. No mechanism exists yet. It is expected that this will change with the complete implementation of the Target Model. Another barrier is the limited rollout of smart metering.

The questionnaire assessed the topic "flexible loads through network tariffs" and what type of network tariffs are allowed in the different countries. This table summarises the network tariff structure in Greece:

Tariff Driver	Feature
Energy (Eur/kWh)	Fixed
	ToU[6]
Capacity (Eur/kW)	Fixed
	Time of Use
Location	Urban vs rural
Type	Household vs industrial vs commercial

Table 4: Tariff drivers in the Greek demo

The tariff methodology in Greece gives incentives for consumers to transfer consumption during off-peak hours, by not applying network tariffs in these moments. In the current legal framework, there is no base for flexibility provision, this action therefore represents an indirect incentive not a direct provision of flexibility. The tariffs are defined and calculated by the National Regulatory Authority (NRA).

[4] The time variation of prices is exclusively due to changes in spot prices.
[5] Fixed-priced offers provide a fixed price of the energy component for a defined period, regardless of changes in the market price.
[6] Time-of-use pricing: ToU network tariffs charge different pre-defined prices at pre-defined times of the day or year

5.6 Germany: Regulatory and legislative framework

In Germany consumers/prosumers are enabled and incentivised to provide flexibility: residential consumers/prosumers can take part in direct marketing by contracting their plants, for example PV or wind, to direct marketers, i.e. flexibility aggregators, which then trade aggregated flexibilities on energy exchanges and/or spot markets. Bigger single consumers/prosumers can demand prequalification by TSOs and take part in the Control Power Market or interruptible loads market. Private customers can receive a reduced grid charge for heating power in case they allow the DSO to curtail consumption in case of high loads in the network. The minimum power for Frequency Containment Reserve (FCR) is 1 MW, for Frequency Restoration Reserve with automatic activation (aFRR) and with manual activation (mFRR) 5 MW. The minimum power for interruptible load is 5 MW. Single residential consumers/prosumers don't market their flexibility on their own but by contracting direct marketers who aggregate flexibility from different sources. What production/demand single consumers must provide to take part in such offers depends on the conditions of the direct marketer.

Residential consumers/prosumers need a suitable metering device for their plant and must meet technical conditions of the aggregator/direct retailer.

As main barriers the following was identified: Residential consumers/prosumers must contract a direct retailer to participate in the flexibility (energy) market. They may also have to decide whether they want to receive a compensation via the EEG or go into direct marketing. The regulator describes the framework, roles, and rules for determination of network tariffs and decides whether the tariffs are justified. The grid operator calculates and sets the tariffs.

The questionnaire assessed the topic "flexible loads through network tariffs" and what type of network tariffs are allowed in the different countries. This table summarises the network tariff structure in Germany:

Tariff Driver	**Feature**
Energy (Eur/kWh)	Flat
	Fixed
	ToU
	Dynamic (real-time)
	Seasonal
	Event-driven
	Other:
Capacity (Eur/kW)	Flat (SLP – yes, customers with measured and recorded capacity consumption – no)
	Fixed
	Variable
	***Time of Use
Reactive power (Eur/kvarh)	
Location	Regional
Type	Household vs industrial vs commercial

Table 5: Tariff drivers in the German demo

5.7 Other countries: Regulatory and legislative framework

The table below gives and overview of the situation in the countries studied in addition to the three demo countries. Further specification of national particularities is provided afterwards.

	Austria	Czech Republic	Lithuania	Portugal	Spain	Ukraine
Are consumers/	No	Yes	No	No	No	No

prosumers enabled to provide flexibility?						
Do consumers/ prosumers get incentives to provide flexibility services?	No	No	No	No	No	No
What are barriers for consumers /prosumers to participate in flexibility market?	There is no flexibility market in Austria yet. It is only in discussion in the sector. So far we offer only interruptible load tariffs as flexibility.	The development of the non-frequency market is at its early stage- relevant market mechanisms still need to be established (e.g. Market platform)	There is no market, no product, no legal basis	NA	Lack of regulation, Incentives not defined	The lack of relevant legislation and absence of flexibility market

Table 6: Tariff drivers in other European countries

5.7.1 Austria

In Austria, consumers/prosumers are not enabled or incentivized to provide flexibility and have therefore no active role in the process. The main barrier is that there is no flexibility market in Austria yet. It is only in discussion in the sector. So far, the Austrian DSO offers only interruptible load tariffs as flexibility.

The following network tariffs are allowed in Austria:

Tariff Driver	Feature
Energy (Eur/kWh)	Flat
	Fixed
	Seasonal
Capacity (Eur/kW)	Flat
	Fixed

Table 7: Tariff drivers in Austria

In Austria the DSO together with the NRA design the tariffs, however these do not incentivize consumers to provide flexibility.

5.7.2 Czech Republic

In the Czech Republic, consumers/prosumers are enabled but not incentivized to provide flexibility. Regarding the minimum size of production/demand response that consumers/prosumers must provide, there is no minimum requirements set – it depends on the policy of the relevant aggregator (it must be noted that the flexibility market is developing at present so the rules/requirements might change). The

technical requirements for consumers/prosumers to be able to participate in the flexibility market are time response and availability. Consumers do not get an active role in the process of providing flexibility. The main barrier is that the development of the non-frequency market is at its early stage – relevant market mechanisms still need to be established (e.g., market platform). Tariffs are designed by the Regulatory Authority.

5.7.3 Lithuania

In Lithuania, consumers/prosumers are not enabled or incentivised to provide flexibility and customers have no active role in the process. The main barriers are the lack of a market, the lack of a product and the lack of a legal basis. The network tariffs allowed in Lithuania are:

Tariff Driver	Feature
Energy (Eur/kWh)	Fixed
Capacity (Eur/kW)	Only for commercial customers

Table 8: Tariff drivers in Lithuania

The NRA designs the tariffs, and the tariff methodology does not provide incentives for consumers to provide flexibility.

5.7.4 Portugal

In Portugal, consumers/prosumers are not enabled or incentivised to provide flexibility. The network tariffs allowed in Portugal are the following:

Tariff Driver	Feature
Energy (Eur/kWh)	Fixed
	ToU
	Seasonal
Capacity (Eur/kW)	Fixed
	Time of Use
Type	Household vs industrial vs commercial

Table 9: Tariff drivers in Portugal

The tariffs are designed by the NRA and the tariff methodology does not provide incentives for consumers to provide flexibility.

5.7.5 Spain

In Spain consumers/prosumers are not enabled or incentivised to provide flexibility. The minimum size of production/demand response that consumers/prosumers have to provide to be able to participate in the flexibility market are not defined yet, but it should be related to the product and/or the voltage level. Consumers/prosumers do not get an active role in the process of providing flexibility due to a lack of regulation.

Tariff Driver	Feature
Energy (Eur/kWh)	Flat
	The Spanish Regulator has proposed a new mechanism for network tariffs with six (three for domestic) different periods (static ToU tariffs) and prescriptions for charging points for EV.

	This new structure is yet to be fully implemented in the next months.
Capacity (Eur/kW)	Flat
Type	Household vs industrial vs commercial

Table 10: Tariff drivers in Spain

The tariff methodology tariff methodology in Spain does not provide incentives for consumers to provide flexibility. The authority in charge is the Spanish National Regulatory Authority "Comisión Nacional de los Mercados y la Competencia (CNMC)" who defines the tariffs.

5.7.6 Ukraine

In Ukraine consumers/prosumers are not enabled or incentivised to provide flexibility and do not have an active role in the process. The main barriers for consumers to participate in the flexibility market is the lack of regulation in the area and the absence of a flexibility market. Regarding network tariffs, they are regulated by the Ukrainian NRA and differ for the different DSOs. The reactive power (Eur/kVarh) is applicable for legal entities. There is a special methodology of calculation of reactive power, in accordance with which the difference between consumed and imported reactive power is determined. The type of network tariffs can be distinguished between household and commercial. The tariff methodology does not provide incentives for consumers to provide flexibility.

5.8 Analysis

The energy system is changing rapidly, and new types and roles of customers will emerge. It will be a challenge to adapt the regulatory framework of the different EU member states because various definitions already exist. The analysis of the regulatory framework of the countries shows, that the legislation differs greatly among member states. The European legislation explicitly allows the member states to extend and adapt the definition of prosumers, which poses challenges and opportunities to the Platone project: on the one hand it will be difficult to replicate the project as whole in a standardized way, since the regulatory framework regarding prosumers will differ in the various countries. On the other hand, it is an opportunity to implement and adapt the project to different frameworks and use the best practices to improve the service of the platform.

In addition to the great differences between the legislative frameworks among the countries studied, a key barrier is the lack of a flexibility market. This leads to the conclusion, that the transposition of the Directives 2008/2001 [2] and 2019/944 [1] are crucial to achieve significant progress in the energy transition and to ensure the central role of the consumers.

Without the clear definition of flexibility services and developments of markets as well as the permission for the DSOs to make use of these, DSOs are left with Tariffs as the main tool to incentivise consumer participation.

As the tables above have shown, the network tariffs and their structure differ greatly between the countries. This will have an impact on the scalability and replicability of some of the recommendations of the Greek demo, that is, to link the revenue from tariffs with the costs incurred by DSOs in a more dynamic manner. The Greek demo approach is aligned to E.DSO's recent guidelines on the topic [30] where network tariffs are recommended to be cost reflective, incentives for efficient network use, transparent and understandable, implementable, and limited in complexity. In such a case, the co-existence of all these objectives with the necessity of revenue adequacy for the DSO and the effect tariffs have on the actual demand patterns needs to be modelled and investigated.

6 Energy storage and Electric Vehicles

This chapter tackles energy storage as well as Electric Vehicles (EVs), both technologies which can tap RES when available but postpone the actual consumption. This is positive not only for the uptake of RES in the electricity consumption mix but can as well contribute positively to grid congestion management.

The chapter is organized as follows: first, energy storage and EVs are defined. Secondly, the importance of these topics for the Platone project is explained. In a third step the European and national legislation of the demo countries are described before directing the attention to the other European countries encompassed by this analysis. This contributes to understanding if the current regulatory framework fulfils the requirements to scale the project and replicate it as a product in the different European countries. In the final analysis, eventual shortcomings will be brought forward.

6.1 Definition Energy Storage and Electric Vehicles

As such, energy storage plays a key role in the energy transition towards a carbon-neutral economy because the energy system is relying increasingly on renewable energy sources [28]. Energy storage (hydrogen and batteries) can be used to stabilise fluctuations in demand and supply by allowing excess electricity to be stored in large quantities. [31]

According to the Electricity Market Design Directive 2019/944 [1]:

> Energy storage means, in the electricity system, deferring the final use of electricity to a moment later than when it was generated, or the conversion of electrical energy into a form of energy which can be stored, the storing of such energy, and the subsequent reconversion of such energy into electrical energy or use as another energy carrier.

Meanwhile, the increasing number of electric vehicles affects the electricity system changing the consumption patterns and congestions at the same time as vast amounts of new renewable and distributed energy resources are to be incorporated into the grids. [32]

EVs are a central part of the European Commission Strategy to decrease CO_2 emissions, and the policy related to battery-powered vehicles is mainly focused on technological optimisation and market development. Future challenges that were identified include reliability and durability of batteries and super-capacitors, reducing battery weight and volume, safety, cost reduction, improved hybrid electric powertrains, charging infrastructure and plug-in solutions [33]. When it comes to provision of services from EV charging a distinction is made between V1G, which represents a unidirectional flow between the vehicle and the grid, and the V2G which is bi-directional flow.

> EVs differ from combustible vehicles, in that they emit no tailpipe CO_2 and other pollutants such as NOx, NMHC and PM at the point of use. EVs provide quiet and smooth operation and consequently create less noise and vibration [33].

The analysis of this chapter is based on these definitions.

6.2 Energy Storage and Electric Vehicles in the context of Platone

Both energy storage and EVs are flexibility measures which will be used in the Platone demonstrations. In the framework of the German demonstration, the goal is to utilize the energy storage to minimize the exchange between the local network and the supplying medium voltage feeder. In the Italian demo, one of the activities is the installation and the management of the battery energy storage at the end-users' premises as well as private EVs that will be used potentially for flexibility.

6.3 European Union: Regulatory and legislative framework

In 2013 the European Commission recognized in the working paper "The future role and challenges of Energy Storage" the lack of business cases for energy storage and recommended that legislators should create clear provisions for the development of storage services [34]. In 2017, the Commission discussed policy approaches that address the barriers in the context with the new electricity market design in the

white paper “Energy storage - the role of electricity” [35]. In the paper four principles regarding the market development for energy storage were defined, namely:

- storage helps secure the energy supply and decarbonisation of the system,
- it should be allowed for storage to participate fully in the electricity markets,
- storage should participate and be rewarded equally for flexibility services,
- a cost-efficient use of decentralised storage should be enabled through a regulatory framework [36].

As can be seen, the potential of storage is fully recognised both in the above mentioned paper and as well in the CEP. However, the barriers to harvesting this potential are many and widely discussed. Some studies list the large diversity and interaction of storage technologies and applications and the resulting multitude of barriers and corresponding policies for the area as an obstacle for the technology to fulfil its potential [37].

The Electricity Market Design Directive 2019/944 defines energy storage and sets new guidelines for it, including provisions about ownership of energy storage facilities by customers and DSOs and the role of TSOs.

Key Articles of Directive 2019/944 [1] are:

> Article 15, which defines that the final customer is entitled to act as an active customer and allowed to own energy storage facility. Storage owners have the right to a grid connection within a reasonable time after the request. This is provided usually by the DSO.
> Article 36 which defines that DSOs are not allowed to own, develop, manage, or operate energy storage facilities with exemption when they are fully integrated network components, and the regulatory authority has granted its approval.

Regarding the prohibition of TSO and DSO ownership of storage mentioned above, a few exceptions exists. They comprise fully integrated network components or a regulatory process certifying the lack of market interest at reasonable cost and length and the necessity of the storage system or services for the network. The article includes a phase out of system operator activities in 18 months in the case of sufficient market interest, with possible compensation.

When it comes to Electric Vehicles Article 33 of Directive 2019/944 [1] is crucial as it defines the rules for the integration of electromobility into the electricity network:

According to Article 33 [1] Member States must provide the necessary regulatory framework to facilitate the connection of publicly accessible and private recharging points to the distribution network and ensure that DSOs cooperate on a non-discriminatory basis with any undertaking that owns, develops, operates or manages recharging points for electric vehicles, including with regard to connection to the grid. However, DSOs are not allowed to own, develop, manage, or operate recharging points for electric vehicles, except for their own use. Member states may diverge from this rule under specific conditions.

Market rules set out in the Electricity Market Design Directive [1] aim at creating favourable conditions for electric vehicles. They aim to facilitate the effective deployment of publicly accessible and private charging points for EVs and to ensure the efficient integration of vehicle charging into the system. This includes also the participation of EVs into demand response by enabling smart charging.

During the preparation of this report, the European Commission presented a proposal to transform the EU economy to Union’s climate goals. The measures in the proposal namely aim at accelerating the reduction of greenhouse gas emission also from the transport sector. The proposal includes measures to bring down emissions from new cars with 100% by 2035, meaning that all new cars from 2035 will be required to be zero-emission vehicles. To ensure a smooth transition from diesel cars, the proposal asks member states to expand their charging capacity in line with zero-emission car sales, specifically they are asked to install charging and fueling points at every 60 km on major highways [38].

Whether owning storage facilities or EVs, the Electricity Market Design Directive provides that Consumers should be able to consume, to store and to sell self-generated electricity to the market and to participate in all electricity markets by providing flexibility to the system, for instance through energy storage, such as storage using electric vehicles [1].

6.4 Italy: Regulatory and legislative framework

In Italy energy storage was defined in the Regulatory decision as the following:

> "A storage system is a set of devices able to absorb and release electric energy, foreseen to work continuously in parallel to the grid or able to modify the energy exchange with the electricity grid. The storage system may or may not be integrated with a generating plant. Systems that enter into function only in emergency conditions like during a black out are not considered to be a storage system." [39].

According to the Legislative Decree 93/2011 [40] TSOs and DSOs may develop and operate battery storage facilities however, DSOs must submit a proposal providing a cost-benefit analysis to the regulator that justifies such investments if it is to be recovered through tariffs. Only if the cost benefit analysis (CBA) is evaluated positively by the regulators, can the DSO use a storage. In addition to that, as mentioned in the previous chapter, DSOs are not allowed to procure local flexibility services. ARERA issued a consultation [41] on the extension of the exemption on transmission and distribution grid charges to complex configurations such as the combination of consumption and storage. According to ARERA all electricity drawn from the grid and intended to power the storage systems for subsequent re-injection in the network and / or the auxiliary generation services should be treated as negative electricity input for determining tariffs. This would apply also to cases such as aggregated assets or vehicle-to-grid.

The main barriers in Italy regarding storage as identified in the EC study are:

- The absence of adequate long term price signals that differ from the capacity market is a main barrier to the development of storage facilities. Services provided by the storage are still treated singularly and independently from each other, with no integration among them. As such, the regulatory framework is still lacking, or insufficiently attractive, to fully maximize value from storage technologies.
- The net billing scheme 'scambio sul posto' is still active and does not consider storage. Thus it disincentives behind-the-meter storage, within and outside of the scheme.
- While pilot projects are ongoing to allow the participation of (aggregated) storage in ancillary service markets, there is a need for a consistent and comprehensive opening of these markets for (aggregated) storage and loads.
- Further information is needed on ancillary services to develop a storage business plan based not only on the energy market [37].

6.5 Greece: Regulatory and legislative framework

According to EU Directive 2019/944 [1], the DSO is only allowed to own energy storage components if these are fully integrated in the grid and only after the Regulatory Authority has issued an approval. This EU directive has not yet been fully applied into law in Greece, so currently there is no regulatory framework regarding the ownership of energy storage by the DSO. In 2019, the National Regulatory Authority issued a public consultation for the formulation of a new regulatory framework for the installation. This concerns operation and pricing of storage stations in electricity transmission and distribution networks including the relationship between electricity markets and storage, viability of investments on storage, mechanisms for remuneration, energy storage participation in the electricity markets, licensing and permitting for behind-the-meter storage, possible differentiation between small-scale and large-scale storage and other barriers (Annex A.3).

In Greece hybrid stations in the NIIs (Non-Interconnected Islands) and pump-hydroelectric stations in the interconnected system operate under the provisions of Laws 3468/2006 [42], 3851/2010 [43] and 4414/2016 [44]. Moreover, batteries can be deployed as part of large hybrid stations in the medium voltage level and as of January 2018, Law 4513/2018 [45] for energy communities provides for the usage of energy storage for self-consumption purposes, for self-producers using net-metering infrastructure. It is expected that, by the end of 2021, the new regulatory framework for energy storage will be announced.

6.6 Germany: Regulatory and legislative framework

As of May/June 2021 there is no common definition of energy storage and electricity storage in the regulatory framework in Germany. There are legal differences as to whether the electricity originates from a self-generating or self-supply system or is sourced from the public grid, and whether the stored electricity is fed into the public grid or consumed directly in the site. Due to the unbundling between network operation and the other actors according to the Energy Industry Act (EnWG) [46], the operation of a storage facility for the distribution network operator is only possible for a few services (all of them non- commercial).

DERs in Germany are obliged to participate in voltage control by providing reactive power in relation to the voltage in the network or active power infeed of the DER. A static control mechanism is applied. The technical details are described in the Technical Guideline of the BDEW Federal Association of Energy and Water Management (BDEW Bundesverband der Energie- und Wasserwirtschaft). However, it is the DSOs themselves who define the specific technical values to be applied in their grids (P-curve, Q(U)-curve individually. The legal base is described in §19 EnWG [24] together with §11 EnWG [47].

The regulatory gap concerning the application of EEG 2014 dispositions when renewable electricity is stored, for example regulation in § 60 (3) EEG 2014 [48] cannot be applied directly because the electricity was not obtained from the public grid.

Other key barriers for storage in Germany identified in the study of the Commission [37] are:

- In the further development of the electricity market, balancing deviations will be more heavily punished, resulting in suppliers taking liability for their customers. Storage can then be part of the corporate strategy to avoid such deviations.
- Network tariff exemption does not remove the obligation for storage facilities to pay some other regulatory charges not directly related to TSO activities. There is legal uncertainty as to whether the exemption from the network charges also applies to the concession fee and the levies that are charged. This concerns the CHP surcharge, the §19 [49] surcharge and the offshore liability charge.
- Delivery to a sister company in a corporation is not considered as self-supply

6.7 Other countries: Regulatory and legislative framework

The table below gives and overview of the situation in the countries studied in addition to the three demo countries. Further specification of national particularities is provided afterwards.

Question	Austria	Czech Republic	Lithuania	Portugal	Spain	Ukraine
Is the DSO allowed to own storage?	No, in the future for ancillary services	Not for commercial use batteries necessary for grid operation allowed	No	No	Only to ensure the safe and reliable operation of the Distribution network	Currently no legislation adopted to regulate the usage of electricity storage by the DSO
V1G (smart charging) allowed?	No	No	No	No	No	No
V2G (Vehicle to Grid) allowed?	No	No	No	No	No	No

Table 11: Energy storage and EV services used by DSOs

6.7.1 Austria

Austria seems to be the only Member State that considers storage from a holistic point of view, considering all impacts and potential risks related to manufacturing, storage, transport, installation, and operation. There is no common definition of energy storage in the Austrian regulatory framework. The unbundling provisions of the recast Electricity Directive still need to be transposed into national law, (battery) storages shall in this regard be acknowledged as grid integrated assets for (non-frequency ancillary services) system operation.

6.7.2 Czech Republic

DSOs are not allowed to own storage plants but can operate them as of June 2021. An example for a cooperation, is the 4 MW project between CEZ (DSO) and CEPS (Czech TSO) in Tusimice, which is partially operated by CEPS, but only during the testing regime. Changes in the ancillary services provision are not addressing the topic of storage: stand-alone batteries still cannot provide ancillary services, only in connection with spinning reserves. Stand-alone batteries can be connected to the grid (only in testing mode), but cannot supply electricity to the grid, hence their use in hybrid installations is limited, except at the same site. There is no common definition of energy storage in the regulatory framework, and it was removed from the Energy Act amendment draft.

6.7.3 Lithuania

In 2000 the law on electricity unbundling was introduced but it does not refer to storage, requiring unbundling only regarding generation, transmission, distribution, and supply. Energy storage is not defined in the Law on Electricity or any other legislation in Lithuania. Except for pumped hydro in FRRm (Manual Frequency Restoration Reserve), there is no participation of storage for the provision of ancillary services allowed.

6.7.4 Portugal

Energy storage is not defined in the primary national regulatory framework, only in the renewables self-consumption and energy community's framework. The requirements for permitting autonomous storage units are not yet defined, and there is no expected date on legislation.

6.7.5 Spain

There are no unbundling requirements for TSOs/DSOs owning storage since regulation does not address the topic (except for pumped hydro on islands). The lack of a definition for (independent) aggregators increases the uncertainty for storage and impedes its participation in energy and ancillary service markets.

Prototypes and pilot projects face the same requirements as large-scale projects while having a more limited project duration. Demonstration equipment has trouble to meet conventional permitting requirements due to the lack of standards for a developing technology. Pilot and demonstration projects deserve specific and streamlined permitting processes which would accelerate and reduce the costs of the development cycle.

6.7.6 Ukraine

Currently there is no legislation adopted to regulate the usage of electricity storage by the DSO.

6.8 Analysis

As shown above, the regulation does not provide for DSOs to own storage. Furthermore, V1G and V2G are not allowed either. This means that to harvest the potential of these technologies other actors will have to come forward, in the case of V1G and V2G policy initiative is required, while storage may be deployed by other market players.

However, a first conclusion regarding the role of energy storage and DSOs is, that the same questions and topics that were discussed in the Commission study from 2013 [34] remains unanswered today in 2021. This shows that little progress was made at European level and leads to the assumption that even

though DSOs are not allowed to own storage and will not be allowed so in the future, the discussion is not conclusive.

This deliverable aligns itself with the conclusion of the paper “Study on energy storage – contribution to the security of the electricity supply in Europe” [36] which underlines, that unclear regulatory frameworks hinder the deployment of storage and create uncertainty for investors as well. Although, energy storage has a key role in the energy transition towards a carbon-neutral economy in which the energy system is relying increasingly on renewable energy sources, the business use case for energy storage currently remains absent. In the EU legislation a door is open for the DSO to own storage in the case where there is no ground for a market-based solution. Exceptions are as well reflected in the responses mentioning the permission for DSO to own storage, however, in most cases it concerns non-commercial purposes.

While several of the studied countries have not yet transposed the relevant directives, it is doubtful that they will be able to offer sufficient incentives for DSOs to kick-off a roll out of storage. This is due to the provisions in the EU regulation which limits the possibility for DSOS to own storage to cases where the market does not provide for a positive business case, and only until the market-based solutions are possible. In this case the storage must be phased out within 18 months. This time limit makes storage a dubious investment choice for DSOs, who are not guaranteed reimbursement for their efforts.

In countries where storage is further excluded from the legislations, it is difficult for the DSOs to include it in the network planning regardless of the ownership. This is likely to lead to further delays of storage usage.

Meanwhile, the roll-out EVs is more successful, this may be due to motorised vehicles already being an integrated part of the economy, and that the EVs are a direct replacement of these. The EVs as well benefit from clear language from the legislators, with the European Commission clearly stating that the sale of diesel cars should end by 2035. One month after the presentation[7], it is however, too early to evaluate on the effect of the proposed direction.

In the meantime, integration of smart EV charging infrastructure into the DSOs’ network and, where regulation allows this, direct involvement of the DSOs in the management of the infrastructure as an extension of the regulated role, may facilitate the acceleration of the roll out of EVs and charging infrastructure. This would enable cost-efficient local load management, help the deployment of charging spots, guarantee open access and support standardisation. Namely the standardisation will be important for ensuring the development of a consumer-centric system, where no technical barriers limit the consumer choice.

In the case of both storage and EVs harvesting their full potential is as well affected by the missing market for flexibility and permission for DSOs to procure flexibility services.

[7] Presentation made on 14 July 2021 [38]

7 Aggregation

This chapter is dedicated to aggregation which is defined below, while chapter 7.2 outlines the relation of the topic to the project demo activities. This will be followed by a summary of the findings of the regarding the state of play first at EU level, then in the three demo countries and the additional six analysed countries. Finally, chapter 7.8 will summarise the analysis of the topic.

7.1 Definition of Aggregators and Aggregation

Aggregators are foreseen to play an important role as enablers for decentralised market actors like consumers, prosumers, active customers, and energy communities. Aggregation is a business model that combines the flexibility of smaller users and allow them to participate in the markets. The aggregator can take the role of the intermediary between decentralised actors and the market and can help small actors like renewable self-consumers, active customers, or small businesses to participate in the electricity market [50]. Aggregation is still a concept in the process of development.

> The Directive 2019/944 [1] defines aggregation as a function performed by a natural or legal person who combines multiple customer loads or generated electricity for sale, purchase, or auction in any electricity market. It defines 'independent aggregator' as a market participant engaged in aggregation who is not affiliated to the customer's supplier. 'Demand response' is understood as the change of electricity load by final customers from their normal or current consumption patterns in response to market signals. This includes responses to time-variable electricity prices or incentive payments, or responses to the acceptance of the final customer's bid to sell demand reduction or increase at a price in an organised market.

The analysis of this chapter is based on this definition.

7.2 Aggregation in context of Platone

The blockchain-based infrastructure of Platone offers Aggregators the opportunity to become flexibility market players and to exchange with customers in an easy way. The Platone framework aims to create a fully replicable and scalable system that enables distribution grid flexibility/congestion management mechanisms through Peer 2 Peer (P2P) market models involving all the possible actors including Aggregators. Aggregators will be active players in the Market Platform of Platone, exchanging data with DSOs and customers. The Greek demonstrator employs the aggregator as an intermediate between DERs and the DSO and the Italian demonstrator creates a platform for the aggregator.

7.3 European Union: Regulatory framework and legislation

The Energy Efficiency Directive 2012/27/EU [51] was an important step forward for demand side response (DSR) in Europe as the term aggregator was introduced here for the first time. The Electricity Balancing Guideline (2017/2195) [52] allows for the aggregation of demand facilities, energy storage facilities and power generating facilities in a scheduling area to offer balancing services [52].

Article 13 and 17 of Directive 2019/941 [17] concerns aggregation contracts and demand response through aggregation and stipulates:

- Member States shall ensure that all customers are free to enter a contract with an aggregator without the consent of the final customer's electricity provider.
- Market participants engaged in aggregation shall ensure that customers are fully informed on the terms and conditions of the contract. If they request it, customers can access their data free of charge at least once every billing period.
- Customers shall not be subject to discriminatory technical and administrative requirements from their supplier based on whether they have a contract with a market participant engaged in aggregation.
- Member States shall allow and foster participation of DSR through aggregation, in a non-discriminatory manner in all electricity markets.
- Aggregators are responsible for the imbalances they cause to the electricity system and members states can ask undertakings to pay compensation to market participants directly affected by DSR activation, without creating a barrier for market entry.

According to Regulation 2019/943 [16] market participation of consumers and small businesses shall be enabled by aggregation of generation from multiple generation facilities or load from multiple demand facilities to provide joint offers on the electricity market and be jointly operated in the electricity system, subject to compliance with EU treaty rules on competition.

Regarding a framework for local settlement of generation, energy communities and self-consumption the Renewable Energy Directive (RED II) [2] stipulates the following:

- According to Article 21 of Directive 2018/2001 [2], renewable self-consumers, individually or through aggregators, are entitled to generate renewable energy, including for their own consumption, store and sell their excess production of renewable electricity. This includes power purchase agreements, electricity suppliers and peer-to-peer trading arrangements.
- According to Article 22 of Directive 2018/2001 [2] the benefits of renewable energy communities are the following: They are entitled to generate, consume, store and sell renewable energy, including through power purchase agreements; to arrange sharing of renewable energy within the community that is produced by the production units owned by the community; to access all suitable energy markets directly or through aggregation in a non-discriminatory manner. It also states that Member States shall provide an enabling framework to promote and facilitate the development of renewable energy communities.

7.4 Italy: Regulatory framework and legislation

Aggregation services are available in Italy. Aggregation is allowed only in the pilot projects stated by 300/17/R/eel [29] of the Italian Regulatory Authority for Energy. In these initiatives, the aggregator can involve all type of DERs. Three projects are managed by TERNA the Italian Transmission System Operator. The project about Mixed Aggregated Virtual Units (UVAM) influences the Italian Demo because the technical requirements defined by TERNA for qualifying UVAM are used as a reference [29].

Residential consumers are allowed to contract aggregators independently. In Italy, the aggregator can operate all the consumption of a consumer because the aggregator can also be the energy provider. The Aggregator cannot replace the consumer but support the consumers in low voltage to take part in the flexibility market. The technical specifications for aggregators are still not defined because it is currently in the first stages of the development.

In the consultation 322/2019/R/eel [19] ARERA defines that Terna must review the definition of ancillary services necessary for correct execution of the dispatching activity and related needs, as well as the modalities with which the necessary resources are provided and remunerated. This shall be done guaranteeing full technology neutrality and without barriers to the use of all available resources (including renewable sources, storage systems, distributed generation in general and consumption units) which are economically convenient. Furthermore, the consultations makes notion of the importance to take into account the existence of new figures, such as the so-called "aggregators" of resources widespread, for the provision of ancillary services.

One of the main regulatory gaps with respect to the aggregator in the context of the local flexibility market, is the complete lack of regulation defining roles and responsibilities of DSOs, BRPs, and BSPs.

7.5 Greece: Regulatory framework and legislation

The Energy Efficiency Directive 2012/27/EU [51] which introduces the term “Aggregator” was integrated in the Greek legislation with Law 4342 of [53] November 2015 It is worth mentioning that currently in Greece aggregators are only representing RES producers and high-efficiency CHP.

Aggregation services are available in Greece: Owners of RES and Combined Cycle power plants can join aggregation services, to participate in the market. It should be noted that a) wind farms of 3MW or higher and b) other RES and CHP of 500kW or higher are obliged to participate in the energy markets. Consumers will also be enabled to join, following the full implementation of the Balancing Market as it is defined by the Target model[8]. An aggregator will represent the consumer as a Balancing Service

[8] The legal framework for the Target Model derives from EU’s Third Energy Package Namely Directive 2019/944 [3] and Regulation 2019/943 [17].

Provider (BSP) or Balancing Responsible Party (BRP) in the Balancing Market which is planned to be fully implemented by the fourth trimester of 2021. Residential consumers cannot contract aggregators independently and aggregators cannot be operating all the consumption of a consumer. The technical specifications of load aggregation are not defined yet.

7.6 Germany: Regulatory framework and legislation

Aggregation services are available in Germany. Direct market actors' aggregate flexibility from different sources, sometimes in the so-called virtual power plants. Private customers as well as industry and commercial customer can join aggregation services. Residential consumers can contract aggregators independently, however, not every aggregator may offer their services in each region of the country. The aggregator may replace the consumer in the sense that the aggregator may be responsible for operation of assets owned by the customer and be active on markets on their behalf.

7.7 Other countries: Regulatory framework and legislation

The table below gives and overview of the situation in the countries studied in addition to the three demo countries. Further specification of national particularities is provided afterwards.

	Austria	Czech Republic	Lithuania	Portugal	Spain	Ukraine
Are aggregation services available?	Yes	Yes	Yes	No	No	No
Can residential consumers contract aggregators independently?	Yes	NA	Yes	NA	No	No
Could the aggregator be operating all the consumption of a consumer?	Yes	NA	Yes	NA	No	No

Table 12: Use of aggregation in other European countries

In Austria customers with storage can join aggregation. The aggregator does not replace the consumer but acts as balance group responsible. In Czech Republic the legislation is currently under preparation and the role of the aggregator is therefore not defined yet - aggregation is used for wholesale only, market with grid related services is not established (relevant legislation is not in place). In Lithuania commercial and industrial consumers can join aggregation. In Spain the role of aggregator is already recognised in the Spanish legislation, but the implementation of rules for the aggregation of consumption and generation of consumers, producers or storage facilities are yet to be implemented.

7.8 Analysis

This chapter shows that aggregation and the role of the aggregator is still a relatively new concept, in the process of development in the studied countries. It is therefore not surprising that aggregation services are not available in all the countries studied. This comes as no surprise seeing the limited development of markets for flexibility where the aggregators could serve a purpose in the studies countries.

While the EC provides a definition of aggregation in Directive 2019/944 [1], there is again a lack of transposition into the national legislation. The role and responsibilities with respect to the other market parties are not defined yet. The Italian Electricity regulation has included aggregation of DERs since

2017. However, the absence of a local flexibility market where aggregation also participates remains the main regulatory gap regarding aggregation in Italy.

In Greece, the term “Aggregator” has already been introduced, but its role in the Greek energy market is still limited to representing RES producers and high efficiency CHP units. It is expected that the role of aggregators will be further expanded to include consumers-prosumers or energy communities’ representation.

8 Energy Communities

This chapter is dedicated to Energy Communities which will be defined below in general terms, while chapter 8.2 will outline the relevance of the topic related to the project activities. This will be followed by a summary of the findings regarding the state of play first at EU level and then in the three demo countries and the additional six analysed countries. Finally, chapter 8.8 will summarise the analysis of the topic.

8.1 Definition Energy Communities

The central attributes of "Energy communities" can be explained as the organisation of collective energy actions based on open, democratic participation and governance and the provision of benefits for the members or the local community [47]. They are crucial actors in the energy transition at the citizen and at the local level because they foster greater citizen participation and acceptance of RES projects as well as encouraging local investments and engagement of vulnerable customers [48].

The analysis of this chapter is based on the definition above.

8.2 Energy Communities in the context of Platone

In the Platone project, the German demonstration will focus on the interaction with energy communities: The German demo is situated in a rural area denominated by a low residential and commercial consumption and a high penetration of distributed energy resources. The strategic aim of the German demonstrator is to develop and test innovative strategies for the integration of future energy communities into DSO grid operation strategies to increase hosting capacities of distribution grids and make them more efficient. In the demonstration a testing environment will be set up and local customers and RES will be integrated in a local EMS enabling the community to maximize local consumption, provide flexibility on external request and apply new strategies of energy supply based on a package-based energy delivery and export approach [7].

8.3 European Union: Regulatory and legislative framework

In the Clean Energy Package two sub-categories are linked to the energy communities, namely Citizen Energy Communities (CECs) that are included in the revised Internal Electricity Market Directive 2019/944 [1] and Renewable Energy Communities (RECs) that are included in the revised Renewable Energy Directive 2018/2001 [2].

To give an overview, the table below categorizes the main similarities and differences of the two definitions:

	Citizens Energy Communities (CEC)	**Renewable Energy Communities (REC)**
Legal basis	Internal Market for Electricity Directive	Renewable Energy Directive
Legal form	Any	Any
Purpose	Social, economic, and environmental benefits for members/shareholders or the local area in which it operates	Social, economic, and environmental benefits for members/shareholders or the local area in which it operates
Ownership	Natural persons, Local authorities, including municipalities, or small enterprises and microenterprises	Natural persons, Local authorities (*including municipalities, or small enterprises and microenterprises*), provided that for private undertakings their participation does not constitute their primary commercial or professional activity.
Autonomy	Large energy companies cannot exercise any decision-making power	Explicitly mentioned
Activities	Generation, distribution (depending on the Member State decision), supply, consumption, sharing, aggregation and storage of electricity	Generation, distribution, consumption, storage, sale, aggregation, supply and sharing of renewable energy

	Energy-efficiency services, EV charging services, other energy-related services (commercial)	Energy-related services (*commercial*)
Geographical limitations	No geographical limitation	To be located in the proximity of projects owned and developed by the community
Technologies	Technology neutral	Limited to renewable energy technologies

Table 13: Differences between CEC and REC

The key differences between REC and CEC are identified in the table above: CECs can operate across the electricity sector and do not have a technology-specific focus, while RECs engage specifically on renewable energy. Furthermore, RECs are rooted within a local context (close to RES), while no such requirements explicitly exist for CECs. In governance terms, RECs also represent a subset of CECs because RECs generally are stricter in terms of eligibility, requirements for effective control at local level, and democratic governance. When looking at permitted activities, CECs are enabled, if their Member State decide so, to own, operate and manage an electricity distribution network [54]. RECs on the other hand are entitled to produce, consume, store, and sell renewable energy, including through renewables power purchase agreements, to share renewable energy within the community, and to access all suitable markets [55].

The outline above aims primarily at giving an overview on the legislative framework and differences on a European level.

8.4 Italy: Regulatory and legislative framework

In Italy, D. Lgs.162/2020 [56] experimentally transposed EU legislation for the REC and Collective self-consumption. According to this law, RES can be included in the REC only if they are installed under the same secondary substation. According to the legislation, customers must be connected to the same MV/LV transformer and/or located in the same building. Citizen Energy Communities on the other hand are not yet defined in the legislation. The framework on REC/CEC and DSO cooperation includes the procedure to identify the customers and producers connected to the same secondary substation. Furthermore, the REC can be aggregated according to the pilot project stated by the 300/17/R/eel [29] regulation of the Italian Regulatory Authority for Energy.

8.5 Greece: Regulatory and legislative framework

In 2018 the Greek government introduced a definition of Energy Communities, as urban partnerships with the aim of strengthening the sharing economy and innovation in the energy sector, in Law N4513/2018 [57]. The transposition of RED II [2] with a definition of RECs into the Greek legislation is expected in 2021 but as of June 2021 there is no concrete information available yet. According to the current provisions in Greece, RES should be located within the prefecture where the Energy community is incorporated however the communities are not based exclusively on renewable energy sources [58].

There are no specific technical requirements that regulate Energy Communities. The criterion of locality translates into the obligation of at least 50% plus one of the members to relate to the place where the registered office is located. The relationship is proven by the individuals-members owning property within the prefecture where the Energy Community is based, and, in a similar way, by the legal entities-members being registered in the prefecture where the Energy Community is based [58].

Financial incentives include an exemption from bidding procedures for projects up to 6 MW for wind farms and 1 MW for photovoltaics (PV). There is also an exemption from the obligation to pay the annual fee for the right to hold a power generation license, and a reduced guaranteed payment of 50% for participation in the auction-based subsidy scheme. However, there is geographical limitation regarding the members of the Energy Community.

Energy Communities can perform various activities in the energy sector. There is an absolute requirement for them to perform at least one of the activities listed below:

- Production, storage, self-consumption, or supply of electrical energy or thermal (heating or cooling) energy by RES, CHP or hybrid power plants based within the prefecture of the energy community,
- Management of biomass, biogas, bio-waste as primary resource for production of electrical or thermal energy,
- Supply of energy products, appliances, and installations for the Energy Community's members, aiming at improving the energy efficiency and reducing the energy consumption and the use of conventional fuels,
- Supply of electro-mobility for Energy Community's members,
- Distribution of electrical energy within the prefecture where the Energy Community is based,
- Supply of electrical energy or natural gas to end-customers who are located within the prefecture where the Energy Community is based,
- Production, distribution and supply of heating or cooling within the prefecture where the Energy Community is based,
- Demand response and representation services for customers/producers in the Energy Market,
- Development of the grid, management of infrastructure of alternative fuels or management of sustainable transportation services within the prefecture where the Energy Community is based,
- Installation and operation of desalination plants using RES within the prefecture where the Energy Community is based,
- Energy services

Energy Communities have the right to operate distribution grids. In the area of distribution, the law does not offer any specific incentive to Energy Communities, other than the right to perform distribution, production, and supply of electrical and/or thermal energy (bundling of activities) within the prefecture that the Energy Community is based. There are no provisions in the Law about the ownership of distribution grids.

Furthermore, the following points are central elements of the law [58]:

- Locality as a necessary condition for the creation of synergies and partnerships for the implementation of energy projects to respond to local needs, utilising local renewable sources, with the aim of disseminating benefits to energy communities' members and generating added value for the greater local communities.
- Insularity, in which special arrangements and privileges are introduced for the case of very small islands with population below 3100 people, to address issues such as the high cost per kWh as well as the environmental, economic and social issues raised by the use of conventional forms of potential production.
- The activation and enhancement of technological tools such as energy offsetting and virtual energy offsetting, in particular, to shield vulnerable consumers.
- Financial incentives and support measures which mainly concern the development of renewables power plants, to exploit domestic potential with the involvement of local communities as defined in national energy targets.

8.6 Germany: Regulatory and legislative framework

The German government defined citizen' energy communities in the Energy Act (EEG) [46] as at least ten natural persons who are members eligible to vote, in which at least 51 per cent of the voting rights are held by natural persons with a permanent residency in the administrative district of the project location of an energy community.

As mentioned in chapter 8.3, the definitions and concepts of energy communities vary considerably among the Member States and the definition in Germany does not correspond fully to one or the other definition that are explained above.

8.7 Other countries: Regulatory and legislative framework

In December 2019, the Bridge H2020 Task Force for Energy Communities found that legal frameworks for energy communities existed in Germany, the Netherlands, France, Belgium (Wallonia), Greece, Portugal, Luxembourg, Slovenia, and Ireland. However, they also found that the countries did not fully comply with the CEP provisions because the legislative framework was developed before the publication

of CEP [59]. The JRC analysed in their report “Energy Communities: an overview of energy and social innovation” the developments in Denmark, Sweden, and the UK regarding energy communities, and found that national legislations do not necessarily offer the same ownership rights and legal recognition granted by the Clean Energy Package to Energy Communities [58].

The table shows the situations in the other analysed countries. Further specification of national particularities is provided afterwards.

Question	Austria	Czech Republic	Lithuania	Portugal	Spain	Ukraine
Definition RECs in country’s legislation?	No	No	No	Yes	Yes	No
Definition CECs in country’s legislation?	No	No	No	No	No	No

Table 14: Legal base for Energy Communities in other European countries

The table shows that only in Spain and Portugal RECs have been defined as legal entities. The Spanish Government passed Royal Decree-law 23/2020 of 23 June [60] approving energy related and other measures to revitalise the economy and partially transposes several EU Directives into the Spanish legal system. Measures are implemented to foster new business models through the regulation of new ways to form part of the electricity system which were previously lacking sufficient governance such as RECs. RECs have been added as a party to the electricity system to foster greater participation by local citizens and entities in community-based renewable energy projects [61].

In Portugal, the Decree Law No. 162/2019 establishes the legal scheme of renewable energy communities whereas until that moment only individual self-consumption was allowed. The Decree Law also allows participants in renewable energy projects to constitute legal entities for production, consumption, sharing, storage, and sale of renewable energy [62]. The Decree-Law stepped into force on January 1st, 2020, for self-consumption and RECs with smart meters and installed at the same voltage level, and in 2021 for other self-consumption activities.

8.8 Analysis

According to the study of the JRC [58], the rise of community projects in new areas such as energy supply and electro-mobility can foster new business models if their roles are gradually expanding into the provision of multiple energy services. The energy communities can as such create great value and facilitate the active role of consumers in the energy transition.

They can as well offer local flexibility services and energy allocation decreases costs locally but increase system costs. Therefore, if collective self-consumption rises, regulators should consider redesigning network tariffs in a way that avoids negative impacts on the overall cost base [58]. This will however require strong cooperation between the energy communities and the system operators [54].

As the research in this chapter shows, energy communities exist already in the framework of EU and national legislations. But as shown above, there is a lack of (harmonized) legislation in the demo countries because the RED II Directive [2] still needs to be transposed into national legislation. The transposition of the EU directives may lead to diverse structures at the national level, and the uncertainty may constitute a challenge for selling the Platone solution to energy communities.

The uncertainties concern especially the division of responsibilities between system operators and energy communities, and the adequate network tariff to be applied to energy communities [54]. As seen in 8.3, the energy communities are enabled to perform various tasks such as supply generation, and distribution within their community. This overlaps with the role of the DSO, which is to distribute, and runs counter to principle of unbundling created to protect the consumer. Should energy communities act as distributors within the DSO network, it would be important for the network stability that they adhere

to the same principles of keeping the flow secure and reliable as the DSOs. The alternative would make the DSO responsible for a zone which is had no command or visibility over.

According to the Council of European Energy Regulators, CEER, energy communities should not become a vehicle to circumvent existing market principles, such as unbundling, consumer rights or the cost sharing principles applied to energy grids. The regulatory framework should be such that they do not face undue barriers nor create undue distortions in existing markets [63].

With regards to tariffs the uncertainty concern striking a balance between the energy communities use of the network and the benefits they bring to the network. As such they should be differentiated from collective self-consumption, as energy communities are able to provide additional services to the grid by injecting or withdrawing electricity. To avoid distortion of the competition wide exemption of tariffs should be avoided to ensure that tariffs apply equally to consumer whether or not part of an energy community [54].

Especially the German demonstrator works on innovative solution for energy communities, a key takeaway is that energy communities and DSOs should cooperate since the goal is not to build parallel grids or legislative frameworks but to invest in RES. As energy communities are still in the early stages of development, it is essential not to over-regulate the field and not to disrupt the current development at national level. It might be a benefit if energy communities are enabled to provide flexibility services to DSOs via open markets or bilateral agreements, the later can be facilitated by the Platone Market Platform.

9 DSO revenue regulation

This chapter is dedicated to DSO revenue regulation. The central concepts for the discussion namely CAPEX, OPEX, and TOTEX, will be described in the following, before presenting the relevance of the topic's link to the project Platone activities.

9.1 Definition

Revenue regulation is specific to the DSO, given their special status as operators of critical societal infrastructure. It is important to study the possibilities for the DSOs to invest in their own network to understand their potential regarding the innovation of the network.

CAPEX: "Capital expenditure, or CAPEX, is financing used by companies to secure physical assets or upgrade current assets. CAPEX generally takes two forms; maintenance expenditure, in which a company purchases assets that extend the useful life of existing assets, and expansion expenditure, in which a company purchases new assets to grow the business." [64]

OPEX: "The other term widely used in cash flow, operating expenditure or OPEX, consists of the recurring costs of a product, system or company. It can also include employee costs and facility expenses such as rent." [64]

TOTEX: "The TOTEX (Capital Expenditure + Operational Expenditure) approach looks at the total cost of expenditure, over the long-term operating life of an asset. Put simply, an opportunity may appear relatively expensive in terms of CAPEX, but under the TOTEX approach, appear to present tangible economic benefits with attractive payback period. Investing a dollar more during CAPEX may deliver tenfold benefits during the plant life." [65]

9.2 DSO Revenue regulation in the context of Platone

The question of the DSO revenue regulation does not directly affect the Platone demo activities. However, the implementation of the Platone Open Framework and other interoperable flexibility solutions and measures are impacted by these regulations. One of the main revenue streams for the DSOs tariff has been discussed in the previous chapter 5.

9.3 European Union: Regulatory framework and legislation

The basic framework for distribution tariffs is set in the Third Energy Package, while other specific pieces of EU legislation in this area exist, particularly addressing energy efficiency and renewable energy developments.

According to Article 59 (1) of the Electricity Directive 2019/944 [1], NRAs are responsible for approving, and fixing, based on transparent criteria, the distribution tariffs, and their methodologies. Article 18 of the Electricity Regulation 2019/943 [16] defines that the tariffs for the access to distribution networks shall be cost-reflective, transparent, considering the need for network security and flexibility and reflect efficient actual costs incurred and that tariffs are applied in a non-discriminatory manner.

There should be no positive or negative discrimination against storage, aggregation and no desensitization to self-generation, self-consumption, and DSR participation. Tariffs applied to producers and consumers shall provide locational signals, and consider the amount of network losses, congestion caused and investment costs of infrastructures.

Member States may implement time differentiated network tariffs. Where smart metering systems have been deployed, time differentiated network tariffs shall be considered by NRAs when fixing or approving transmission and distribution tariffs or their methodologies. Where appropriate, methodologies may be introduced, reflecting the use of the network, in a transparent, cost efficient and foreseeable way for the consumer. Tariff methodologies shall provide incentives for the cost-efficient operation, e.g., the procurement of services. Performance targets may be introduced by NRAs to develop further energy efficiency, flexibility, and the development of smart grids.

9.4 Italy

Regulations concerning DSO investments in innovation are issued by ARERA, the National Regulatory Authority for Energy. Resolution 639/2018/R/com is the key legislation for DSOs remuneration [66]. In view of the opening of the dispatching market, ARERA had also issued the 300/2017/R/eel Resolution [29] for pilot projects on dispatching services. The main elements for determining the revenue cap are OPEX (updated with price-cap), return on net RAB, additional return for incentives and depreciation [67]. The revenues of innovations are performed by increasing the CAPEX / RAB of the company, for the part of the costs related to investments. There is no tool or sandbox set up to secure DSO investments.

9.5 Greece

The main elements for determining allowed revenue are OPEX (non-controllable and controllable costs), Depreciation, RAB (Assets and approved investment plans, working capital) and the WACC. The allowed revenue for electricity distribution is currently calculated by relying on the principles underpinning the electricity transmission revenue methodology, adapted to single-year regulatory periods and applied broadly as cost-plus on both OPEX and CAPEX. Funded Projects in Research and Innovation (FPRI) are defined to advance knowledge-transfer in matters of design, construction, operation and maintenance of the grid, with the long-term goal of increasing the profitability of OPEX and CAPEX. In terms of funding, FPRIs are included in the budget of the DSO, according to the percentage that is agreed upon by the NRA. For a FPRI to gain approval by the NRA, the following criteria must be met:

a) Degree of innovation,

b) Advanced development in the design of infrastructure,

c) Promotion of DERs,

d) Promotion of Energy Saving and Energy Management.

Projects of major importance that HEDNO delivers contribute to the facilitation of an increase in DER penetration and smart grid implementation. According to the new NRA's decision, these investments will be included in the Special Regulatory Asset Base (RAB) and will receive premium WACC, if they are executed on time. The methodology for revenue calculation [68] [69] is as follows, the allowed revenue for year *i* of the regulatory period:

$$AR_i = O_i + U_i + D_i + R_i + X_i - Y_i$$[9]

Required revenue for year *i* of the regulatory period:

$$RR_i = AR_i \pm P1_i \pm P2_i \pm P3_i \pm P4_i \pm P5_i \pm INF_I \pm EFF_i \pm LIF_i \pm QIF_i$$

The RR is based on the AR_i (allowed revenue for year I of the regulatory period, as listed above in the text), adjusted by several parameters related with the settlement amounts due to:

1) under-recovery or over-recovery of the RR of the reference year ($P1_i$),

[9] O_i : the annual estimated reasonable controlled operating expenditure of year i

U_i : the annual estimated uncontrolled operating expenditure of year i

D_i : the annual depreciation of the Operator's assets included in the Regulatory Asset Base (RAB)

R_i : the allowed return on capital investment, excluding the investments on Major Importance Projects. R_i is calculated by multiplying the estimated value of the RAB for year i and the real, pre-tax, rate of return percentage.

X_i : the allowed return on capital investment on Major Importance Projects

Y_i: the estimated revenue from of non-regulated activities of year i, if the regulated and non-regulated activities have not been separated with distinct cost centres

2) depreciation or WACC deviation due to over-investment or under-investment ($P2_i$),

3) Non- controllable OPEX deviation ($P3_i$),

4) deviation between the estimated and real revenues of the reference year coming from other regulated and non-regulated services provided by the operator and subsidies (providing that the expenses of these activities are not unbundled in the accounts and have been included in the estimation of the Operator's Allowed Revenue) ($P4_i$),

5) redefinition of the reasonable return based on the tax index change ($P5_i$),

6) deviations between estimated and real inflation (INF_I),

7) incentives on Controlled OPEX (EFF_i),

8) incentives for power losses reduction (LIF_i) and

9) charges due to deviations from the expected Energy and Service quality (QIF_i).

Several of these parameters can have positive or negative sign. The output from the incentives mechanism for power losses reduction will not be included in the 1st new Regulatory Period (2021-2024), but in the one after that.

A revenue cap in Greece provides incentives to innovation because the budget of FPRIs is a percentage of the revenue of the DSO, thus the revenue cap is an incentive. The same is valid for DER development since DER development is a criterion for the approval of FPRIs by the NRA.

9.6 Germany

The main elements for determining the revenue cap are non-controllable and controllable costs, TOTEX efficiency benchmark, efficiency bonus, general inflation and sectoral productivity factor, quality element, volatile costs.

Investments in new assets after the base year led to an adjustment of the CAPEX. The revenue caps for network operators are set for a five-year regulatory period. Each cap is composed of the permanently non-controllable costs, temporarily non-controllable costs, controllable costs (applying a distribution factor for reducing inefficiencies), a possible efficiency bonus, general inflation relative to the base year and a general sectoral productivity factor, a CAPEX in period top-up to take account of the cost of capital for investments after the base year, quality element, and volatile costs. The difference between the allowed revenue and the development of actual volumes over the year is entered into a regulatory account. From the third regulatory period (2018 for gas and 2019 for electricity) there is an annual subtraction of the capital cost for the DSOs. This subtraction takes account of the fall in capital expenditure for the asset base (total costs of depreciation, the return on equity and the corporate tax, each of which is imputed, plus the costs of borrowing) over the duration of the regulatory period. The CAPEX subtraction is also deducted from the cost pool. The remaining controllable costs data and the structural data are then taken for the efficiency benchmarking model. There are currently no further plans to fundamentally change the incentive-based regulatory regime in Germany. Various changes were made to the regime in 2016. Currently there are plans to introduce more incentives for supporting the grid extension related to the energy transition and for supporting the decrease of grid bottlenecks and the related costs of operating with these grid bottlenecks [67].

9.7 Other countries

The table shows the situations in the other analysed countries. Further specification of national particularities is provided afterwards.

Question	Austria	Czech Republic	Lithuania	Portugal	Spain	Ukraine
What are the regulations regarding DSO investment innovation?	Part of the tariff covers the innovation cost. It must be approved by the NRA.		Legal framework is under preparation		The Royal Decree Law 23/2020 includes regulatory sandboxes in which pilot research and innovation projects can be developed. The rules for the development of such sandboxes have to be implemented.	There is no specific regulation regarding investments in innovation. Each year the NRA approves investment programs for each DSO. Investment programs may include any innovation that is subject to regulatory approval.
Do revenues reflect CAPEX?	Yes, the innovation portion in the tariff covers CAPEX and OPEX	Yes, all CAPEX investment are concerned (including innovation)	Yes	Yes, the HV and MV allowed revenue model established a specific regulatory rate of return on the company's net Regulated Asset Base. In general, the way the regulator sets allowed revenues takes into account the company's asset base.	Yes, in Business-as-usual revenues do reflect CAPEX investment in infrastructure, but talking about investments in innovation specifically, not details are available.	Yes
Do revenues reflect OPEX	Yes, the innovation portion in the tariff covers CAPEX and OPEX	Yes, three years rolling average of actual cost.	Yes	Yes, the regulator, prior to the beginning of a new regulatory period, sets the allowed operating costs that the company has the right to recover through network tariffs.	Yes, in Business-as-usual revenues do reflect CAPEX investment in infrastructure, but talking about investments in innovation specifically, not details are available.	Yes

Table 15: DSO revenue regulation in other countries

9.7.1 Austria

The main elements for determining the revenue cap are efficiency scores and general productivity offset, network price index and expansion factors, efficiency dependent WACC.

The TOTEX inflation-adjusted budget constraint with general and individual productivity offsets was replaced by a similar procedure to OPEX and an introduction of an efficiency-adjusted WACC for the cost of capital. The OPEX which is determined for the base year of a regulatory period is adjusted via a network price index (consisting of a consumer price index and a wage index), a general productivity offset (0.95%) and an individual efficiency factor annually. [67]

9.7.2 Czech Republic

The main elements for determining the revenue cap are the allowed costs, the allowed depreciation, RAB and WACC. The allowable income levels are calculated as the sum of economically based costs consisting of CAPEX (cost of depreciation (using straight line method) and ROI), OPEX (repair and maintenance, administrative cost, wages, etc.), taxes and technical losses. [67]

9.7.3 Lithuania

The main elements for determining the revenue cap are TOTEX, RAB, WACC, technical losses. The allowable income levels are calculated as the sum of economically based costs consisting of CAPEX (cost of depreciation (using straight line method) and ROI), OPEX (repair and maintenance, administrative cost, wages, etc.), taxes and technical losses. The regulated price caps are adjusted each year following the change of the inflation rate (OPEX), new investments, depreciation and change of WACC (CAPEX), the electricity price (technical losses) and the ROI adjustment from previous periods. Investment projects are based on technical justification, financial justification and economic justification, e.g. CBA and impact on regulated prices [67].

9.7.4 Spain

The main elements for the revenue cap are investment values, OPEX values, other regulated tasks reference values, RAB, rate of return, regulatory lifetime of assets, number of clients and incentives. In addition, they have incentives/penalties that can result in increased or decreased revenues, depending on their performance. DSOs receive an allowance for O&M (OPEX) included into a term named ‘COMGES’, which comprises OPEX and a small part of investments not included in the electricity assets that have reference values. It is updated within the regulatory period with a factor that establishes a proportion between this term and the investments in electric assets that have reference values. An efficiency factor also adjusts COMGES, to reflect the company’s capacity to manage ‘COMGES’ costs.

DSOs receive the following revenues to perform other regulated tasks:

(1) metering,

(2) helping clients contract electricity, revenues to support invoicing and to reduce non-payments by clients,

(3) responding to telephone calls from clients,

(4) grid planning and

(5) revenues to cover overhead costs.

At the electricity DSO level, again Spain is one of the countries which has implemented several additional incentives such as investment control incentive, a financial prudence incentive, an assets lifetime extension incentive and innovation support [67].

9.7.5 Portugal

The main elements for the revenue cap are non-controllable and controllable costs, RAB, WACC, efficiency benchmark, inflation, incentives and general economic interest costs.

The “cost bases” considered in the price-cap and revenue-cap methodologies result from critical analysis of the companies’ operating costs (net of additional income), controllable and non-controllable

costs and investment costs. Recently, ERSE has defined a new, output-based incentive, which aims to lead the DSO to deliver to consumers value-added services enabled by smart grids. The amount of this incentive is based on the sharing, between the DSO and consumers, of the benefits generated by such services. To access it, the DSO must demonstrate that it provides a package of "key smart-grid services" [67].

9.7.6 Ukraine

There is no specific regulation governing the issues of investments in innovation. Each year the NRA approves investment program for each DSO. Investment programs may include any innovation that is subject to regulators' approval, however the revenue cap as is does not provide incentive for innovation. Likewise, there is no example of sandboxes promoting DSO investments into innovation.

9.8 Analysis

The questionnaires showed that none of the nine countries analysed have revenue caps which provides incentives for DER development. One of the respondents added the concern that a side effect of the revenue caps may be that investments are not deployed sufficiently and thereby limits the DER development (Annex B.6). In Ukraine incentives for DER development are provided by a special green tariff for RES generation facilities.

Of the countries included in this analysis, only Portugal has a specific regulation regarding investments: ERSE has set a specific smart grid investment incentives, which rewards the company with an additional rate of return on projects that prove to deliver certain smart grid outputs. In addition, there is a new incentive which is given to the DSO for each connection point that benefits from new and smart services (such as remote operations or new consumption data being provided).

The decision to select OPEX over CAPEX (or vice versa) as a way of recognising technology spending should be based on a better understanding of the role of capital expenditure. Many DSOs are limited in the amount of capital expenditure they are able to access. As capital investment is limited, organisations usually want to direct their investment towards revenue-generating activities. OPEX is considered to be better suited for organisations anticipating rapid growth or changes in technology requirements [64].

Due to the energy transition, NRAs must deal with new tasks such as the integration of renewable energies e.g., wind, solar and biogas, the installation of smart grids and meters, and the necessary investments in new lines, and new technology. Here, the right adjustments and the implementation of incentives are needed to prepare the networks for their new and/or changed tasks. In the light hereof it should be note that no tools/sandboxes that allow DSOs to invest in innovations exist in the countries analysed.

The approach of the Greek demo which pays specific attention to tariffs, is in line with E.DSO's recently published tariffs guideline [30]. These guidelines recommend network tariffs to be cost reflective, transparent, implementable, and limited in complexity as well as to incentivise efficient network use. In this light, it is suggested that the co-existence of all these objectives with the necessity of revenue adequacy for DSO and the effect tariffs have on the actual demand patterns be modelled and investigated.

10 Cybersecurity, Data Management and Data Protection

This chapter is dedicated to key aspects linked to the digitalisation of the grid, namely, cybersecurity, data management, and data protection. The definitions of these will be presented in chapter 10.1 while their connection with the project activities will be presented in chapter 10.2, before presenting the state of play first at EU level, then in three demo countries and in the other studied countries. An analysis of the findings will be provided in chapter 10.8.

10.1 Cybersecurity, Data Management and Data Protection definitions

The European Programme for Critical Infrastructure Protection (EPCIP) established in 2006 [70] and the European Critical Infrastructure (ECI) Directive adopted in 2008 [71] single out the energy and transport sectors on the cybersecurity agenda. The more recent EU Security Union Strategy for 2020-2025 [72] and the recently adopted Counter-Terrorism Agenda [73] further stress the importance of ensuring the resilience of critical infrastructure in the face of physical and digital risks.

As both the 2019 evaluation of the ECI Directive Search for available translations of the preceding and the impact assessment supporting this proposal have found, existing European and national measures do not sufficiently ensure that operators are able to confront the increasingly complex operational challenges that they face today. The Council and the Parliament called therefore the Commission to revise the current approach to critical infrastructure protection [74].

The Third Energy Package states that consumers shall have at their disposal their consumption data and member states shall define a format for the data and a procedure for suppliers and consumers to have access to the data. Directive 2012/27/EU [14] establishes the importance of customers, or third parties acting on behalf of customers. Data protection in the EU is mainly governed by the General Data Protection Regulation (GDPR) [75]. The blockchain based platform of Platone will allow the DSOs to perform a data aggregation process that does not violate the privacy and security of the customers.

10.2 Cybersecurity, Data Management and Data Protection in the context of the Platone project

Cybersecurity is particularly crucial for Platone as the core of the project's innovation aims at strongly connecting the physical and digital infrastructures. As part of the Platone Open Framework, the project will develop a concept of data management with multiple benefits such as improved grid operation, facilitation of fair participation of customers to the market and the efficient cooperation between DSOs and TSOs, among others. Data regulations will as well play an important role regarding the in the interactions with consumers. This is particularly relevant for the activities in the German and Italian demonstrators which will both test the Platone Open Framework component the Shared Customer Database.

10.3 European Union: Regulatory framework and legislation

10.3.1 Cybersecurity

As announced in the "Communication on Shaping Europe's Digital Future" in February 2020, the European Commission is working on a European cybersecurity strategy, including the establishment of a joint Cybersecurity Unit, a Review of the Security of Network and Information Systems (NIS) Directive and giving a push to the single market for cybersecurity [76].

In December 2020, the European Commission and the High Representative of the Union for Foreign Affairs and Security Policy presented a new EU Cybersecurity Strategy that covers essential services including energy grids, which aims to prevent the impacts of potential cyberattacks and to ensure international security and stability in cyberspace [77]. The strategy includes a proposal for a Directive on the resilience of critical entities:

Noteworthy provisions of the Directive 2016/1148 include:

- Member States will be obligated to, among other things, have a strategy for ensuring the resilience of critical entities, carry out a national risk assessment and, on this basis, identify critical entities.

- Critical entities will be required to carry out risk assessments of their own, take appropriate technical and organisational measures to boost resilience, and report disruptive incidents to national authorities.
- Critical entities providing services to or in at least one-third of Member States will be subject to specific oversight, including advisory missions organised by the Commission.
- The Commission will offer different forms of support to Member States and critical entities, a Union-level risk overview, best practices, methodologies, cross-border training activities and exercises to test the resilience of critical entities.
- Regular cross-border cooperation regarding the implementation of the directive will be facilitated through an expert group, the Critical Entities Resilience Group [78].

The Commission emphasizes the importance to prevent any possible "disruptions such as, for instance, large-scale power outages, may serve to erode security and public safety, prompting uncertainty and undermining confidence in critical entities, as well as in the authorities responsible for their oversight and for keeping the population safe and secure" [78].

Furthermore, the Commission has adopted a proposal for a revised Directive on Security of Network and Information Systems (NIS 2 Directive) to address the deficiencies of the previous NIS Directive (Directive 2016/1148) [79], to adapt it to the current needs and make it future proof because critical infrastructures run the risk of also being potential terrorist targets, therefore this proposal contributes to the objectives of the recently adopted EU Agenda on Counter-Terrorism.

The Directive [80], in particular:

> (a) lays down obligations for the Member States to adopt a national cybersecurity strategy, designate competent national authorities, single points of contact and CSIRTs;
>
> (b) provides that Member States shall lay down cybersecurity risk management and reporting obligations for entities referred to as essential entities in Annex I and important.
>
> (c) provides that Member States shall lay down obligations on cybersecurity information sharing. [80]

Once the proposal is agreed on between the institutions it will be adopted, and Member States will have to transpose the NIS2 Directive within 18 months. To ensure alignment between the two instruments, all critical entities identified under the critical entities' resilience directive would be subject to cyber resilience obligations under NIS2 [80].

Furthermore, in the Clean Energy Package provisions for the adoption of future technical rules for electricity such as a Network Code on Cyber Security are included. With the Regulation 2019/881 [81], the mandate is confirmed to achieve a high common level of cybersecurity across the Union in improving cybersecurity.

The final target of all the legislative proposals is to monitor and operate the grid effectively and efficiently, while considering the cybersecurity risks resulting from the use of new technologies and from the adaptation of old technologies to a new digitalized and complex environment.

10.3.2 Data Management

The EU will create a single market for data where data can flow within the EU and across sectors, for the benefit of all; European rules, in particular privacy and data protection, as well as competition law, are fully respected; the rules for access and use of data are fair, practical, and clear [51].

Currently, there are two main approaches for the management of smart metering data. Whilst some Member States seem to have opted for a centralized data hub, others prefer a more decentralized system where data activities are split amongst a greater number of players acting as metering responsible parties. In our understanding, a central data hub is likely to deliver benefits of increased competition by lowering transaction costs for commercial parties whose business model heavily relies on access to metering data. On the other hand, a decentralized data infrastructure provides benefits in terms of data protection and sovereignty of the customer, cascading effects, and cybersecurity as well as lower barriers for integration with respect for other commodities [82].

According to Article 23 and 24 of the Directive EU 2019/944 [1]:

- Member States shall ensure that all eligible parties have non-discriminatory access to data under clear and equal terms, in compliance with the relevant data protection legislation.
- When smart meters are implemented and DSOs are involved in data management, the compliance program shall include specific measures to exclude discriminatory access to data from eligible parties.
- If the DSO in not unbundled, Member States shall take all necessary measures to ensure that the vertically integrated undertaking does not have privileged access to data for the conduct of its supply activity.

No common specific data management model is recommended at EU level, and each Member State, independently of the adopted data management model, must authorize, certify or, where applicable, supervise the parties responsible for data management.

10.3.3 Data Protection

The GDPR Regulation (EU) 2016/679 [75] regulates the protection of natural persons concerning the processing of personal data and the free movement of such data. The regulation is an essential step to strengthen individuals' fundamental rights in the digital age and facilitate business by clarifying rules for companies and public bodies in the digital single market. The law aims at harmonizing the fragmented national legislative provisions regarding data protection. In addition to that, the European Commission drafted a proposal for a regulation for ePrivacy rules for all electronic communications including amongst others the following points [83]:

- Stronger rules: all people and businesses in the EU will enjoy the same level of protection of their electronic communications through this directly applicable regulation. Businesses will also benefit from one single set of rules across the EU.
- Communications content and metadata: privacy is guaranteed for communications content and metadata. Metadata — data that describes other data, such as author, date created and location — has a high privacy component and should be anonymized or deleted if users did not give their consent, unless the data is needed for billing.
- More effective enforcement: the enforcement of the confidentiality rules in the Regulation will be the responsibility of data protection authorities, already in charge of the rules under the GDPR.

Furthermore, Regulation 2018/1807 [84] aims at improving the mobility of non-personal data across borders in the single market, ensuring that the powers of competent authorities to request and receive access to data for regulatory purposes remain unaffected and to make it easier for professional users of data storage or other processing services to switch service providers and to port data, while not creating an excessive burden on service providers or distorting the market.

10.4 Italy: Regulatory framework and legislation

	Type of Data	**Responsible person/entity**
Who owns energy data?	Personal data Measurements from smart meter	Customer
	Grid data Measurements from sensors on the grid	DSO
	Market data	Energy trader
Who collects energy data?	Personal data Grid data Measurements from smart meter Measurements from the sensors on the grid	DSO
	Market	Energy trader
Who stores energy data?	Personal data Grid data Measurements from smart meter	DSO

	Measurements from the sensors on the grid	
	Market	Energy trader
Who purchases energy data?		Data cannot be sold in Italy

Table 16: Energy data regulation Italy

The relevance of data differs for the DSO according to the objective; the most useful for the grid observability are sensors data and for the energy balance the smart meter data. If a market participant wants to access the data - regardless of whether it is an aggregator, ESCO or energy trader - the customers' permission is needed.

The DSO working on the Italian demo foresees a data access policy for the energy data where only the DSO's authorized personnel have access to the data and where third-party data access requests are subject to evaluation by the DSO. Energy Data are confidential data, the DSO needs to guarantee a high data protection standard. Mechanism to ensure data privacy and data integrity and avoiding data tampering are applied, the energy data are moved to a specific PLC or VPN channel and the access is managed through a procedure that allows the access only to authorized personnel.

In 2019 the Italian government adopted the Law Decree n.105 of September 21st [85]. The Decree has brought along significant innovations in relation to the creation of a perimeter of national cyber security and aims to ensure a high level of security of the networks, information systems and IT services of public administrations, as well as of national, public and private entities and operators, through the establishment of a national cyber security perimeter and the provision of measures suitable for guaranteeing the necessary safety standards aimed at minimizing risks while allowing the widest use of the most advanced tools offered by information and communication technologies [86].

Data protection in Italy is regulated through Legislative Decree no. 101 of 10 August 2018 [87], which formally transferred provisions of the EU GDPR - General Data Protection Regulation [75] into the Italian regulatory framework and entered into force on 19 September 2018.

10.5 Greece: Regulatory framework and legislation

	Type of Data	**Responsible person/entity**
Who owns energy data?	Incoming – Outgoing active and reactive energy Voltage and current Power quality events and, more specifically, under-voltage, over-voltage, over-current, power-down, power-up Events of potential attempt for tampering the meter such as tampering/removal of the meter cover, terminals cover removal, strong DC magnetic field influence Status of the load switches	Customer and DSO (HEDNO)
Who collects energy data?		DSO (HEDNO)
Who stores energy data?		DSO (HEDNO)
Who purchases energy data?	Energy consumption (for billing, calculation of network losses) Energy Production (for billing, settlement)	Please find the explanation below

Table 17: Energy data regulation Greece

In Greece, the data offered by the DSO are not traded, but the DSO makes them available to energy providers, so that they can bill their customers. Each energy provider is entitled to access the data of their clients and not of all users in general. The routing processes that are used to exchange data for energy consumption and production are ERP type systems and the stakeholders involved are the DSO, TSO, and energy provider. If a market participant such as the energy provider wants to access the data, it is possible if the market participant is at the same time the supplier of the customer. If not, the data is accessible only with the written consent of the customer.

The Greek Use Cases are impacted by Law 4342/2015 that defines the role of the DSO regarding data management rules and metering [88].

All data that the DSO handles are protected through the ISO 27001 for data privacy and all personal data according to the GDPR according to EU directive that has been incorporated in the Greek legislation. The Greek demo applies these mechanisms for ensuring data privacy and data integrity.

10.6 Germany: Regulatory framework and legislation

	Type of Data	**Responsible person/entity**
Who owns energy data?	Personal data	DSO
Who collects energy data?	Grid data	DSO
Who stores energy data?	Market data Measurements from smart meter Measurements from sensors on the grid	DSO or commissioned service providers

Table 18: Energy data regulation Germany

In Germany energy data are used by the DSO, energy suppliers and sales. To exchange data the energy supplier and seller need the power of attorney, then data can be exchanged digitally. If an aggregator wants to access the data, this is only possible through a request to the DSO. The relevance of data for the DSO differ, for example sensors data and smart meter data are considered the most useful for grid observability and energy balance. Generally, aggregators, ESCO and the energy traders can access the data.

The German Demo adheres to the GDPR [75] and the Federal Data Protection [89]. Furthermore, the company has in place additional group policies for data protection called “Group Policy - People Guideline PG04 - Data Protection and Company Policy 054 – Privacy”.

10.7 Other countries: Regulatory framework and legislation

In the following table the data handling of the different countries is summarized. There was no data available for Portugal in this chapter:

	Austria	Czech Republic	Lithuania	Spain	Ukraine
Who owns energy data?	Customer consumption data are owned by the customer and grid data (system operation) by the DSO	The metering data are owned by the DSO	All energy meter data are owned by the DSO	Consumption data are owned by the, DSO and the Customer; Monitoring data are owned by the DSO/TSO	Meter data are owned by DSO, TSO, Metering Service Providers: Load curve data are owned by DSO, TSO, Metering Service Providers Event log of metering devices are owned by DSO, TSO, Metering Service Providers Real-time data of grid parameters are owned by DSO, TSO, Metering Service Providers Quality parameters if such recorded by the device are owned by DSO, TSO, Metering Service Providers
Who collects energy data?	Customer data and grid data are collected by the DSO	The metering data are collected by the DSOs and TSOs; The customer data are collected by the Czech electricity and gas market operator	All energy meter data are collected by the DSO	Consumption data are collected by the DSO; Monitoring data are collected by DSO/TSO	Meter data are collected by DSO, TSO, Metering Service Providers: Load curve data are collected by DSO, TSO, Metering Service Providers Event log of metering devices are collected by DSO, TSO, Metering Service Providers Real-time data of grid parameters are collected by DSO, TSO, Metering Service Providers Quality parameters if such recorded by the device are collected by DSO, TSO, Metering Service Providers
Who stores energy data?	Customer data and grid data are stored by the DSO	/		Consumption data are stored by DSO and suppliers; Monitoring data are stored by DSO/TSO	Meter data are collected by DSO, TSO, Metering Service Providers: Load curve data are stored by DSO, TSO, Metering Service Providers

					Event log of metering devices are stored by DSO, TSO, Metering Service Providers Real-time data of grid parameters are stored by DSO, TSO, Metering Service Providers Quality parameters if such recorded by the device are stored by DSO, TSO, Metering Service Providers
Who purchases energy data?	Energy data cannot be sold or purchased	/	/	/	/

Table 19: Energy data regulation other countries

10.7.1 Austria

In Austria, all data are equally relevant to the DSO: the routing process that is used to exchange consumption data of customers goes through the DSO, the relevant supplier, the aggregator, and the balance coordinator. The stakeholders involved are therefore the DSO, the supplier, the balance coordinator and clearing and settlement. If a market participant wants to access the data it is feasible, however the procedure depends on the market participant: customers are always allowed to access their data. Suppliers and aggregators need to get the approval of the customer. In the case of the DSO that replied to the questionnaire to the questionnaire a Data Access Policy is foreseen to manage the energy data. For the customer and consumption, a locked system in the data centre exists with no connection to the outside. For personal data the GDPR rules are applied to ensure data privacy and data integrity and to avoid data tampering.

10.7.2 Lithuania

In Lithuania, all data are equally important to the DSO that participated in the questionnaire; if a market participant for example the supplier wants to access the datahub the consent of the customer is needed. Customer information as well as consumption and generation data are protected according to GDPR. No extra mechanism is applied for ensuring data privacy and data integrity and avoiding data tampering.

10.7.3 Spain

For the Spanish DSO that participated in the questionnaire some data are more relevant and useful than others, for example monitoring data are necessary for Grid Operation, aggregated consumption data for forecasting and the calculation of energy losses and non-energy data for regular DSO activities. The data exchange in Spain is organized according to the following rooting processes: for the monitoring data there is a real time exchange where DSOs and TSOs are the main stakeholders involved. Consumption data are exchanged periodically by the suppliers for billing purposes. If a market participant wants to access the data, this is feasible for the aggregator and supplier if the information is provided by DERs. The DER own their own data. The Spanish DSO foresees a data access policy for the energy data they manage that complies with the national and European regulations. The Policy is continually adapted to new legal requirements and practices. Consumption and monitoring data are protected through a RBAC Role Based Access Control. Personal and critical information has special treatment. To ensure data privacy and avoid data tampering mechanisms are applied: for consumption data encryption and authentication and for monitoring data IPSEC tunnels and owned FO.

10.7.4 Ukraine

For the Ukrainian DSO that participated in the questionnaire some data are more relevant than others; for example, regarding the load curve: The market operates in the “hourly” paradigm, and it is the profile data from the meters that are used to determine the purchase volumes of electricity by the hour of the day. According to the meter data 90% of clients’ consumption is calculated. Based on the real-time data of grid parameters the correct operation of metering units is monitored. Event log of metering devices data are required to control interventions in the meter operation (magnet, opening of the terminal cover and housing, etc.) The rooting processes that are used to exchange data differ regarding the type of data: Load curve information and meter data are transferred in the form of text files and the main stakeholders involved are DSOs, TSOs and providers of revenue metering services. The generalized load graph for DSOs is transferred by TSOs in XML structure. If a market participant such as electricity suppliers and metering service providers want to access the data, the written consent of the client is necessary. The Ukrainian DSO that participated in the questionnaire work with a specific Data Access Policy to manage the energy data. Generally, DSOs cannot transfer personal data of clients without their consent. This applies to both household and legal entities. DSOs can provide generalized data, for example, for an industry as a whole or for a geographic region. The access to energy data is protected for different types of data such as the load curve, meter data, real time data of grid parameters or event log of metering devices: In all cases the data collection and processing system is isolated from the external network, access to the Database management system is limited at the network, physical and organizational levels (isolated networks, modern firewalls (NGFW), etc. are used).

10.8 Analysis

Cybersecurity contains all the safeguards and measures adopted to defend information systems and their users against unauthorized access, attack and damage and to ensure the confidentiality, integrity and availability of data. In the energy sector cybersecurity is of crucial significance as Information Technology (IT) and Operational Technology (OT) systems are connected through cyberspace delivering/transmitting data and executing controls to energy systems. As mentioned above, the need to ensure appropriate cybersecurity for operators, market participants and consumers is very important because the more devices are getting digitally connected to the power system, the more they expose such a very critical infrastructure to the risk of cyberattacks. The European Commission is taking important steps by updating the NIS Directive, which results in the NIS2 Directive as well as introducing a Directive for critical entities: The EU Cybersecurity Strategy is important because it covers essential services such as energy grids to prevent impacts of potential cyberattacks and to ensure international security and stability in cyberspace

Since the NIS2 Directive and the Directive on Resilience of Critical Entities will only be implemented after the project is already finished it is not possible to foresee the impact on the project. The regulatory framework in the various states differ a lot, so it might be advisable to harmonize the rules for key areas such as data security when transposing the directives.

Regarding customer data protection it is of great value to the project that the GDPR provides for common rules across Europe with regards to safeguarding and protection of private data. This way, in all the studied countries a consent from the consumer is needed before their data can be shared with third parties. Thus, the governance of the consumer over her/his own data is applicable in all countries and is to be kept in mind always in the iterations of the Platone Open Framework.

11 Blockchain and Smart contracts in the energy sector

This final chapter is dedicated to blockchain and smart contracts, which will be defined in the following. In chapter 11.2 the implication of the topic in Platone is indicated, followed by an analysis of the state of play first at EU level and then in the three demo countries, followed by an overview of the six other analysed countries. Finally, chapter 11.8 will sum up and analyse the findings.

11.1 Definition Blockchain and Smart contracts

A smart contract in the blockchain context, generally means computer code that is stored on a blockchain and that can be accessed by one or more parties. These programmes are often self-executing and make use of blockchain properties like tamper-resistance and, decentralised processing, and the like. Smart legal contracts, which are smart contracts on a blockchain that represent - or that would like to represent - a legal contract, along with the issues they involve need to be distinguished from Smart contracts with legal implications, which are artefacts/constructs based on smart technology that clearly have legal implications [90].

11.2 Blockchain and Smart contract in the context of Platone

The use of blockchain technology plays a fundamental role in the Platone Open Framework, where block chain is used to certify data. It is therefore necessary to conduct an analysis of what impact the use of blockchain has on the energy domain, in legal and regulatory terms. In particular, the context of interest of the Platone project is on the use of the blockchain as a legal "registry" and the smart contracts as legal “contracts”, both at European level and in the three different demo countries (Italy, Germany and Greece).

11.3 European Union: Regulatory and legislative framework

The European Commission strongly supports blockchain on the policy, legal and regulatory and funding fronts and is working on several different initiatives to bring together and enhance Europe’s leading role in blockchain technology. To this end the European Blockchain Partnership was launched to develop a common EU strategy for blockchain and the European Blockchain Observatory, which pools expertise to identify and monitor activities across Europe. Another important development is the European Blockchain Services Infrastructure, EBSI, which is the world's first cross-border blockchain initiative in the field of public administration [91].

The European Blockchain Partnership is planning a pan-European regulatory sandbox in cooperation with the European Commission for use cases in the European Blockchain Services Infrastructure, and outside of EBSI, including for data portability, B2B data spaces, smart contracts and digital identity (Self-Sovereign Identity) in the health, environment, mobility, energy and other key sectors. The sandbox is expected to become operational in 2021/22 [92].

Among others these are key aspects of the EC Blockchain Strategy that will have an impact on the solutions of Platone:

- Building a pan-European public services blockchain infrastructure as a central pillar with the aim to include at a later stage the interoperability with private sector platforms. This vision is being realised through the European Blockchain Partnership and the output is the EBSI, which will come into production in 2021.
- Promoting legal certainty for areas pertaining to blockchain-based applications such as smart contracts that protects consumers and provides legal certainty for businesses. The EC strongly supports a pan-European framework and hopes to avoid legal and regulatory fragmentation. A proposal for a Regulation on Markets in Crypto-assets (European Commission, 2020) was published creating a pan-European regulatory sandbox for innovative blockchain solutions.
- Promoting blockchain for sustainability: The EU recognises the potential of, and supports the use of blockchain technology in, fostering sustainable economic development, addressing climate change, and supporting the European Green New Deal.
- Supporting interoperability and standards: The EC believes strongly in the importance of standards in promoting blockchain technology [92].

11.4 Italy: Regulatory and legislative framework

Blockchain technology is crucial for the Platone Italian Demo and Italy is among the first countries in Europe that has regulated two instruments of the future: blockchain and smart contract in Article 8 of Law n. 12 of 11 February 2019 [93]:

According to Art. 8 [93] about technologies based on distributed ledgers and smart contracts:

> 1. They define themselves as technologies based on distributed register technologies and computer protocols which use a shared, distributed, replicable ledger, simultaneously accessible, architecturally decentralized on a cryptographic basis, such as to allow registration, validation, updating and archiving of data both in clear text and further protected by cryptography verifiable by each participant, not alterable and not editable.
>
> 2. A "smart contract" is defined as a programme for a computer that operates on technologies based on distributed registers and whose execution automatically binds two or more parts based on predefined effects. The smart contracts meet the written form requirement after computer identification of the interested parties, through a process having the requirements set by The Agency for Digital Italy with guidelines to be adopted within ninety days of the date of entry into force of the law conversion of this decree.

The Italian Ministry of Economic Development published a "Proposal for an Italian strategy on Blockchain-based technologies" [94]. The document aims to identify possible developments, obstacles, and economic fallout from the introduction of these solutions. In the document, a paragraph dedicated to the Energy sector, indicates how the Blockchain can be instrumental in facilitating the local consumption of energy produced by DERs and the participation of prosumers in the markets for services provided to the grid. It should be noted that Italy does not recognize smart contracts as legal contracts. The main issues that were identified by the Italian demo in this regard are so far the legal value, enforceability, data privacy, energy consumption and time of elaboration of the smart contracts.

11.5 Greece: Regulatory and legislative framework

In all Use Cases of the Greek demo, Blockchain technology is used mainly for data (measurements, customer data) certification, for security and integrity with the implementation of the Blockchain Access Platform (BAP). Blockchain Access Platform (BAP) is part of the Blockchain Access Layer of the Platone Framework [5].

In Greece no general and no specific national strategy for regulating the application of blockchain technology in the energy sector exists. Smart contracts are not recognized as legal contracts and sandboxes to check blockchain technology do not exist. The main barriers in the current regulatory framework that could hinder the application of the blockchain technology identified by the Greek demo are territoriality, liability, enforceability, data privacy and the total lack of regulation.

11.6 Germany: Regulatory and legislative framework

There is a national blockchain strategy in Germany focusing on the further implementation and research of Blockchain technologies. According to the German government the focus of the Blockchain strategy is on [95]

1. Ensuring stability and stimulating innovation in the financial sector,
2. Advancing innovation by providing funding for projects and living laboratories,
3. Facilitating investment by putting reliable investment conditions in place,
4. Harnessing digital technology to improve administrative services,
5. Disseminating information: knowledge, networking and collaboration.

There are certain examples where Blockchain is used in the energy sector, but there is not a specific overall strategy implemented yet. A focus is the energy sector such as the aim to set up a cross-technology pilot laboratory for energy: The next step in implementing blockchain technology in the energy industry is to test specific applications under real conditions. In connection with existing funding measures and projects, the German Federal government is beginning to set up a cross-technology pilot

laboratory for the energy sector. Together with actors from the energy industry, society, and authorities - using selected use cases - systemic efficiency gains are to be examined and technology impact assessments carried out. A particular attention should be paid to any negative effects, e.g., in energy efficiency, to be able to make a holistic assessment. Synergies with other, new technologies such as artificial intelligence or big data in this New Technology Lab are being examined, among other things, their economic, societal, regulatory, and social impacts and challenges [96].

11.7 Other countries: Regulatory and legislative framework

In the following table the regulatory base for smart contracts and blockchain in the different countries is summarized. There was no data available for Portugal and The Czech Republic for this chapter:

Question	Austria	Czech Republic	Lithuania	Portugal	Spain	Ukraine
Is there a national strategy for regulating the application of blockchain technology (for the energy sector)?	No	N/A	No	No	No	No
Does the regulatory framework country recognize smart contracts as legal contracts?	No	N/A	Yes	N/A	No	No
Are there any sandboxes in your country to check blockchain technology?	No	N/A	No	N/A	No	No

Table 20: Legal base for block chain and smart contracts in other countries

According to the questionnaire, the Austrian DSO identifies the legal value, territoriality, liability, and enforceability as the key barriers in the current regulatory framework that could hinder the application of the blockchain technology. According to the Spanish DSO the key barrier in the current regulatory framework that could hinder the application of the blockchain technology is the legal value of it. The Ukrainian DSO identifies the legal value, liability, and enforceability as the key barriers in the current regulatory framework that could hinder the application of the blockchain technology.

In Lithuania smart contracts are only recognized as legal contracts if there is a hybrid generation at one connection point.

11.8 Analysis

Smart contracts are not defined in the legislation of the studied countries. When it comes to the legality of smart contracts, here are some of the issues that arise such as the formal and signing requirements, the immutability of smart contracts, audits/quality assurance and the legal status, effect and enforceability of smart contracts generally. Various issues have been identified: First, issues of cost, speed, scalability and ultimately, the long-term security of blockchains. Second, the environmental and climatic costs due to a massive growth in computing power needs. Third, issues of interoperability and a general fluidity and harmonization across a range software (and hardware) has long plagued digital network design and scalability, and the same fate confronts blockchains. The blockchain attributes of decentralization, disintermediation and distribution are all powerful ideals which ought, at least in theory, to undermine monopolies and discourage monopolistic interests. A final fundamental issue is that there is not a single, uniform blockchain [97].

The main issues that were identified by the Italian demo in relation with the Platone project are so far the legal value, enforceability, data privacy, energy consumption and time of elaboration of the smart contracts.

12 Main findings and Conclusions

In this chapter the main findings of this report will be presented regarding the eight thematic areas discussed and the different regulatory frameworks in the three demo countries and the studied countries. Platone's targets and vision aim not only at facilitating the energy goals of the Clean Energy Package but to combine various areas and produce innovative solutions in currently developing the use of areas such as blockchain or the energy storage. However, there is a huge gap between the legislative framework of the EU and different member states and the solution proposed by Platone in support for the DSOs role to facilitate the energy transition and a level playing field for energy services.

This gap is somewhat expected considering the innovativeness of the Platone solution. Nevertheless, the challenges that Platone addresses regarding the system operation are based on the extended role foreseen for the DSOs in the view of the energy transition. This extended role is to a wide extent covered by the CEP, whose directives the Member States are bound to transpose. Therefore, updates to national legislation are foreseen for the near future. Seeing the recent fit for 55 package [38], which was published towards the end of this work, it may not be enough to adapt the already existing electric regulatory framework to new legislation of the Clean Energy Package, considering the ambitious goals and measures set out. It will be crucial to monitor these developments.

Different regulatory frameworks can have a direct and indirect impact on research and innovation and the link is complex and sometimes difficult to demonstrate because various forms of regulation do not have the same impact on the innovation process in different contexts. In general, the report finds that the past years have seen extensive updates to regulation, and more is on the way, to prepare the energy sector for the transition to a digital and carbon neutral system. However, the many laws and updates might risk putting national legislators under pressure and consequently reduce the quality of the transposition into national laws.

Furthermore, as Member States have discretionary room regarding the forms and methods to achieving the goals set in a directive, the implementation of a Directive is likely to vary from one Member State to the other. This is different to EU regulations which are directly applicable as is. Hence, whether the provisions were specified in a Directive or Regulation has an impact on their applicability as well as in the form in which they are implemented. Of the eight laws that constitutes the CEP three of them are Regulations and concern the electricity market rules, the governance of the energy union while more central provisions impacting Platone results are written in Directives such as the Electricity Directive and the Electricity Market Design Directive.

With specific regard to the eight themes which has been analysed, especially the gaps in the area of **flexibility** stand as a barrier to harvesting the full potential of the active participation of **customers**, aggregators and Energy communities into the electricity market. The lack of definition of flexibility services and products for DSOs maintains the relation between the DSOs and the aforementioned stakeholders in a unidirectional exchange. In this case the provision for providing ancillary services as well from the part of storage and EV exist, but as long as such services are not defined and markets for their trading don't exist it remains an unlocked potential. Without the proper existence of flexibility markets and the role of the **aggregator** is limited to wholesale.

When it comes to **storage**, the missing flexibility markets stands again as a barrier limiting the potential of the business case for storage. The lack of a business case allows in principle the DSOs to own and operate storage for a time limited to when the business case is possible. The uncertainties regarding the reward of such investment appears to be a barrier for DSOs to kick-start this deployment. The attention must therefore be turned either towards other actors or extensive sandboxes and guarantees should be set for system operators to push the roll out of this technology. The case for EVs is slightly different, as the EVs can bring value to their owners even without the existence of a flexibility market. In the light of the Commission's ambition to have zero emissions from new cars from 2035, a rise in EV purchase can be expected with a consequent rise in connection requests. The active participation of the EV owners through demand response, can help the DSO to operate the grid in a stable and reliable way. Should this not be possible through a service market by the time the penetration of EVs take off, DSO may consider applying dynamic tariffs.

Regarding **energy communities**, the report finds that the division of responsibilities between DSOs and communities needs to be clear. Should the Energy Communities be permitted to operate networks and

distribute electricity with the same responsibilities as the DSOs, these might take interest in solutions such as the Platone DSO Technical Platform for their operations.

As per the **DSO revenue regulation**, the energy transition will require great investment into the DSO grid to integrate the new technologies, connect EV charging infrastructure and storage, roll out smart meters where they are not already present and enhance the observability of the grid for better planning. The Platone Open Framework is a solution that can help DSOs but cannot defer all other investments. To keep up with the technological innovation on the demand and supply sides as well as safeguarding the infrastructure which, with digitalisation also becomes more vulnerable to cyber-attacks, the investment need will be significant in the coming years. Thus some amendments to DSO revenue regulation may be necessary to enable the DSOs to keep their grids up with these trends. A preliminary recommendation is to link the revenue from tariffs to the costs incurred by the DSOs in a more dynamic manner to not hamper grid investments further.

Cyber security is yet another area where new legislation has been advertised. With the digitalisation of energy sector, the importance of **data protection** and **data management** has become inevitable. The impact of the GDPR has made the issue and rules concerning data privacy well known. However, it would seem that general best practices for implementation are still being verified.

In the area of **blockchain** and **smart contracts** there is a clear lack of regulation, also at European level, which needs to be explored to keep up with the emerging technologies. It is however noted that, with regards to data, the GDPR provides harmonised guidelines which will an advantage for the scalability of the solution. Even if the regulation is still young, the demos show great respect for its purpose and discussion in the Italian demo has already taken place as to how the privacy of the customers can be ensured even within the companies themselves.

The objective of the work reported in this deliverable is to provide an overview of regulatory aspects and their impacts on the solutions tested in the demonstrators in European countries based on the received answers in the questionnaires and scientific research. All partners of the Platone project work hard to explore innovative areas and provide solutions. The barriers encountered can be considered as a point of reference in the legislative process of the present and the future.

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16 List of Abbreviations

Abbreviation	Term
aFRR	Automatic Frequency Restoration Reserve
ARERA	Autorità di Regolazione per Energia Reti e Ambiente (Italian Regulatory Authority)
BDEW	Bundesverband der Energie- und Wasserwirtschaft
BSIG	Gesetz über das Bundesamt für Sicherheit in der Informationstechnik, German Act to strengthen the security of Federal Information Technology
BRP	Balance Responsible Party
BSP	Balance Service Provider
CAPEX	Capital expenditures
CEC	Citizen Energy Community
CEP	Clean Energy Package
CEPS	Czech TSO
CHP	Combined Heat and Power
CNMC	Comisión Nacional de los Mercados y la Competencia
CSIRT	Computer Security Incident Response Team
DCC	Demand Connection Code
DER	Distributed Energy Resource
DSO	Distribution System Operator
DSR	Demand Side Response
EBP	European Blockchain Partnership
EC	European Commission
EV	Electric Vehicles
EEG	German Renewable Energy Act
ENTSO-E	European Network of Transmission System Operators for Electricity
EnWG	Energiewirtschaftsgesetz, German Energy Industry Act
ERP	Enterprise Resource Planning
EU	European Union
FCR	Frequency Containment Reserve
FRRm	Manual Frequency Restoration Reserve
GDPR	General Data Protection Regulation
ICT	Information and Communication Technology
IPTO	Independent Power Transmission Operator (Greek TSO)
LEC	Local Energy Community
mFRR	Manual Frequency Restoration Reserve
MS	Member State
NIS	Network and Information Systems
NMHC	Non-methane hydrocarbons
NOx	Nitrogen Oxides
NRA	National Regulatory Authority
OPEX	Operating expenditures
PM	Particulate matter
POD	Point of Delivery
RAB	Regulatory Asset Base
REC	Renewable Energy Communities
RED	Renewable Energy Directive
RES	Renewable Energy Source
ROI	Return on Investment
RR	Replacement Reserve
SGU	Significant Grid User
SO	System Operator
TOTEX	Total Expenditure (Capital Expenditure + Operational expenditure)

TSO	Transmission System Operator
UC	Use Case
UVAM	Unità Virtuali Abilitate Miste, Mixed Enabled Virtual Units
V1G	Vehicle to grid (unidirectional)
V2G	Vehicle to grid (bidirectional)
WACC	Weighted average cost of capital

Annex A Questionnaires Demonstrator countries

A.1 Questionnaire introduction

Platone questionnaire on regulations concerning DSOs

Dear interviewee,

Thank you for participating in our questionnaire on regulations concerning DSOs. The survey will be used as an input to the deliverable 1.3 of the Platone project, titled: 'Overview of regulatory aspects that impact the solutions tested in the demos in European countries.

Platone is a H2020 project that engages 12 partners from Belgium, Germany, Greece, and Italy and aims to define new approaches to increase the observability of Distributed Energy Resources (DER) while exploiting their flexibility. The main outcome of the project will be advanced management platforms to unlock grid flexibility and to realize an open and non-discriminatory market, linking users, aggregators, and system operators.

The aim of this questionnaire is to assess the regulatory elements that are relevant to the Platone project from the DSO perspective. The results will be useful in forming regulatory recommendations to support the implementation of innovative solutions identified and developed in the project. The feedback will be used for deliverable "D1.3: Overview of regulatory aspects that impact the solutions tested in the demos in European countries".

Collected information will be treated anonymously and will be used for the deliverable only. The personal data provided (your mail) will be used strictly for the purposes connected to the necessities regarding the development of the aforementioned report, that is sending information and queries for clarification.

Best regards,

Platone team

February 2021

The project PLATform for Operation of distribution NEtworks (Platone) receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 864300.

A.2 Italy

Which country do you operate in?

Italy

Added questions:

How many DSOs are operating in your country?

128

What is the volume of lines your DSO is operating? (in Km)

31.153

Your DSO belong to which following category:

- Less than 100 000 connected customers ☐
- Between 100 000 and 1 million connected customers ☐
- More than 1 million connected customers ■

For electricity distribution, what share, in percentage, your DSO represents in your country in terms of…

- Volume of lines: Click or tap here to enter text.
- Connection points: Approximately 5% of the connection points present in Italy (In Italy there are more than 36 million connection points)
- Customers: Click or tap here to enter text.

1. Flexibility services

Flexibility services include "up regulation" that provides additional power as needed to maintain system balance, and "down regulation" that reduces the power generation in the system. Both up and down regulation can also be supplied by controllable loads.

1.1 Energy flexibility and demand response

1.1.1. Can a DSO procure flexibility services in your country? If yes, please specify which ones.

No.

1.1.2. What are the most relevant flexibility service(s) serve(s) for your DSO?

- Voltage Control: Yes ☐ No ☐
- Congestion solving: Yes ☐ No ☐
- Other? (please add)

1.1.3. Following this table, what are the requirements for flexibility services in your country?

Table 1
Different DER and their technical characteristics.

	DER	Flexibility direction	Flexibility characteristic (power vs energy)	Availability ratio	Predictability	Technical response time	Grid[a]	Ref.
Electrical Consumption	Lighting loads (W)	Unidirectional (downward)	New LED systems: energy types older lightings: power types	$0.2 < a_r < 0.5$ during peak hours	Good	Second	DS	[38–40]
	Dispatchable, residential loads (washing machines, dishwasher)	Unidirectional (downward)	Power type $5\ s < t_r < 5$ min	$a_r < 0.1$ low *max power ratios* t_r due to max off time	High	Second	DS	[39,40]
	Electrical heating/ Cooling (continuous loads)	Unidirectional (downward)	Power type $t_r \approx 15$ min	$0.4 < a_r < 1$	High	Second	DS	[40,41]
Bi-directional	Electrochemical Energy Storage (EES) (kW-MW)	Bidirectional	Power & Energy types $4\ s < t_r < 10$ h	$a_r \approx 1$	Perfect	Second to Minute	DS or TS	[42,43]
	Electric Vehicle (kW)	Unidirectional or Bidirectional	Power & Energy types 30 min $< t_r < 6$ h	$0.5 < a_r < 0.9$	High	Second	DS	[44,45]
Generation	PV Unit	Unidirectional (Upward)	Curtailable	$0.25 < a_r < 0.4$	Good a few hours ahead	Minute	DS	[46]
	Micro-CHP unit (kW)	Unidirectional (production mode)	Energy type	$a_r \approx 1$	Perfect	Rather slow (5%/min)	DS	[37]

[a] Where DS stands for distribution grid and TS for transmission grid.

- Activation Time Yes ☐ No ☐
- Click or tap here to enter text.
- Direction Yes ☐ No ☐
- Click or tap here to enter text.
- Bid size – MW Yes ☐ No ☐
- Click or tap here to enter text.
- Type of unit Yes ☐ No ☐
- Click or tap here to enter text.
- Availability ratio Yes ☐ No ☐
- Click or tap here to enter text.
- Technical response time Yes ☐ No ☐
- Click or tap here to enter text.
- Location of the measuring process Yes ☐ No ☐
- Click or tap here to enter text.
- Number of instances/days per year Yes ☐ No ☐
- Click or tap here to enter text.
- Other? Please provide additional inputs, explanation or figures in the frames following the requirements proposed.

1.1.4. Are the flexibility services the same for DSOs and TSOs in your country?

Yes ☐ No ☐

1.1.4.1. If no, please highlight the differences in terms of requirements, following those proposed in the question 1.1.3.

1.1.5. Is/are there solution(s) for flexibility services to be clustered in your country?

- At national level: Yes ☐ No ■ Not aware ☐
- At regional level: Yes ☐ No ■ Not aware ☐
- At local level: Yes ☐ No ■ Not aware ☐

1.1.5.1. If yes, how can it/they be clustered?

Click or tap here to enter text.

1.1.6. Which criteria/criterion should define the flexibility services suitable for DSO control area?

Flexibility service	Suggested criteria
Congestion	Aggregation of the DERs for relevant node (as secondary substations, feeders, primary substations)
Voltage	Localization of DERs available for the service

1.2 Organization of flexibility provision framework

1.2.1. Are the flexibility products standardized in your country?

■

Yes ☐ No

1.2.1.1. If yes, which ones:

Click or tap here to enter text.

1.2.2. Are bilateral agreements included to the flexibility market in your country? (E.g.: DER owner & DSO)

Yes ☐ No ■

1.2.3. Do TSOs and DSOs cooperate to organize the flexibility market in your country?

Yes ☐ No ■

1.2.4. Is there foreseen a framework in your country for TSO/DSO cooperation on

- Balancing: Yes ☐ No ■
- Network planning: Yes ☐ No ■
- Operation: Yes ☐ No ■
- Flexibility procurement: Yes ■ No ☐
- Data exchange: Yes ■ No ☐
- Other? (please add)

Click or tap here to enter text.

1.2.5. Is the flexibility market integrated into the existing processes of EU electricity markets?

Yes ☐ No ☐

1.2.6. Do DSOs cooperate among each other to organize the flexibility market in your country?

Yes ☐ No ■

1.2.6.1. If yes, please provide example(s):

Click or tap here to enter text.

1.2.7. Is cross-border flexibility defined in your national legislation?

Yes ☐ No ☐

1.2.8. Are flexibility services across countries regulated in your country legislation?

Yes ☐ No ☐

1.2.9. Is there a certain flexibility market type defined in your country legislation?

Yes ☐ No ■

1.2.9.1. If yes, please specify.

Click or tap here to enter text.

1.2.10. Are operators reimbursed by the NRA when need to use flexibility?

Yes ■ No ☐

1.2.11. If no, who is covering the financial costs for flexibility services procured by DSOs in your country?

Click or tap here to enter text.

2. Customers connected to DSO network

2.1 Consumer – prosumer

2.1.1. Are consumers/prosumers enabled to provide flexibility in your country?

Yes ■ No ☐

2.1.2. Do consumers/prosumers get incentives to provide flexibility services in your country?

Yes ■ No □

2.1.2.1. If yes, please specify:

Incentives can be given to cover the costs of monitoring systems for guaranteed availability and for the service provided. Incentives are calibrated on the capacity and the energy offered.

2.1.3. What is the minimum size of production/demand response that consumers/prosumers have to provide to be able to participate in the flexibility market in your country?

In the pilot projects as stated in 300/17/R/eel Regulation issued by Arera, Italian Regulatory Authority for Energy, the minimum size of the resource is 1 MW. (It is under discussion the possibility of reducing the minimum capacity to 200 kW)

2.1.4. What are the technical requirements for consumers/prosumers to be able to participate in flexibility market in your country?

- Time-response Yes ■ No □
- Availability Yes ■ No □
- Additional equipment at customer/network border Yes ■ No □
- Additional apparatus for observability Yes □ No ■
  - Billing or settlement of services Yes □ No □
  - Others (please add)

All the answers are based on pilot projects as stated in 300/17/R/eel Regulation issued by Arera, Italian Regulatory Authority for Energy.

- Additional system (like customer EMS) Yes ■ No □
- Capability to follow a setpoint or capability to respect a max (min) limit at Pod (customer/network border) Yes □ No ■
- Others? (please add)

Click or tap here to enter text.

2.1.5. Do consumers/prosumers get an active role in the process of providing flexibility?

Yes ■ No □

2.1.6. What are barriers for consumers/prosumers to participate in flexibility market in your country?

Main barriers are the equipment costs needed to enable the customers in low voltage, the knowledge of the flexibility service and market, the trust in the new market.

2.2 Flexible loads through network tariffs

2.2.1. What type of network tariffs are allowed in your country? (Mark the correct ones)

Click or tap here to enter text.

TARIFF DRIVER	Feature	
Energy (Eur/kWh)	Flat*	□
	Fixed**	□

	ToU***	☐
	Dynamic (real-time)	☐
	Seasonal	☐
	Event-driven	☐
	Other:	
Capacity (Eur/kW)	Flat	☐
	Fixed	☐
	Variable	☐
	Time of Use	☐
	Other:	☐
Reactive power (Eur/kvarh)		
Location	Urban vs rural	☐
	Regional	☐
Type	Household vs industrial vs commercial	☐

**the time variation of prices is exclusively due to changes in spot prices.*

*** Fixed-priced offers provide a fixed price of the energy component for a defined period of time, regardless of changes in the market price.*

**** Time-of-use pricing: ToU network tariffs charge different pre-defined prices at pre-defined times of the day or year*

2.2.2. Does the tariff methodology in your country provide incentives for consumers to provide flexibility?

Yes ☐ No ■

2.2.3. Who designs the tariffs (is it the regulatory authority)?

Yes, the Regulatory Authority design the tariffs.

Energy storage and EVs

3.1. In which cases are DSOs allowed to own energy storage in your country?

DSOs are allowed to own energy storage only when the cost benefit analysis, requested by the Regulatory Authority, gives a positive outcome.

3.2. For which functionalities are DSOs allowed to use storage in your country?

DSOs are allowed to use storage to guarantee the grid security.

3.3. What services are EVs allowed to sell to DSOs in your country?

- Storage Yes ☐ No ■ Not aware ☐
- Demand response Yes ☐ No ■ Not aware ☐
- Other (please add):

3.4. Is V1G (smart charging) promoted in your country?

Yes ■ No ☐

3.5. Is V2G (Vehicle-to-grid) charging allowed in your country?

Yes ☐ No ■

3.5.1. Is it promoted?

Yes ☐ No ☐ Not aware ■

3. Aggregation

4.1. Are aggregation services available in your country?

Yes ■ No ☐

4.2. What kind of customers can join aggregation services in your country?

The Aggregation is allowed only in the pilot projects stated by 300/17/R/eel of the Italian Regulatory Authority for Energy. In these initiatives, the aggregator can involve all type of DERs.

4.3. Can residential consumers contract aggregators independently in your country?

Yes ■ No ☐

4.4. Could the aggregator be operating all the consumption of a consumer in your country?

Yes ■ No ☐

4.5. On what basis/features can the aggregator replace the consumer?

No, the Aggregator cannot replace the consumer. The Aggregator can just support the consumers in Low Voltage to take part into flexibility market.

4.6. What are the technical specifications for aggregators in your country?

This topic is under definition because it is currently in the first stages of the mechanisms.

4. Local Energy Communities

5.1. Are Renewable Energy Communities (REC) defined in your country legislation?

Yes ■ No ☐

5.1.1. If yes, what geographic scope can REC assume regarding proximity to RES?

In Italy, D.Lgs.162/2020 experimentally transposed EU legislation for the REC and Collective self-consumption. According to this law, RES can enter in the REC only if they are installed under the same secondary substation.

5.2. Does technical requirement(s) regulate REC in your country legislation? If yes which one(s):

- Customers must be connected to the same MV/LV transformer: Yes ■ No ☐
- Customers must be located in the same building: Yes ■ No ☐
- Other:

5.3. Is Citizen Energy Community (CEC) defined in your country legislation? **No**

5.3.1. If yes, are there any geographical limitations for the dimensions of CECs defined?

Yes ☐ No ☐

5.3.2. If yes, please provide the limit:

Click or tap here to enter text.

5.4. Does technical requirement(s) regulate(s) CEC in your country legislation?

Yes ☐ No ■

5.4.1. If yes which one(s):

- Customers must be connected to the same MV/LV transformer: Yes ☐ No ☐
- Customers must be located in the same building: Yes ☐ No ☐
- Other:

Click or tap here to enter text.

5.5. Is there a framework in your country on REC/CEC and DSO cooperation?

Yes ■ No ☐

5.5.1. If yes, what does it include?

The procedure to identify the customers and producers connect to the same Secondary Substation

5.5.2. Are RECs and CECs allowed to provide flexibility services in your country?

Yes ■ No ☐

The REC can be aggregated according to the pilot project stated by 300/17/R/eel regulation of the Italian Regulatory Authority for Energy.

5.6. Which further classes of energy communities are worth to be considered in your network?

- Collective generation and trading of electricity Yes ☐ No ■
- Generation-Consumption Communities Yes ☐ No ■
- Collective residential & industrial self-consumption Yes ■ No ☐
- Energy positive districts Yes ■ No ☐
- Energy islands Yes ☐ No ■
- Municipal utilities Yes ☐ No ■
- Financial aggregation and investment Yes ☐ No ■
- Cooperative Financing of Energy Efficiency Yes ☐ No ■
- Collective service providers Yes ☐ No ■
- Digital supply and demand response systems Yes ☐ No ■
- If other, please provide them: ■ ☐

Click or tap here to enter text.

5. DSO revenue regulation

6.1. What are the regulations in your country regarding DSO investments in innovation?

Regulations issued by ARERA, National Regulatory Authority for Energy, regulate DSO investments in Innovation. 639/2018/R/com Resolution is the key legislation for DSOs remuneration. In view of the opening of the dispatching market, ARERA had also issued the 300/2017/R/eel Resolution for pilot projects on dispatching services.

6.2. Do revenues reflect CAPEX?

Yes ■ No ☐

Please explain your answer:

Yes, revenues of innovations are performed by increasing of CAPEX / RAB of the company, for the part of the costs related to investments

6.3. Do revenues reflect OPEX?

Yes ☐ No ■

Please explain your answer:

No increasing of revenues on OPEX are foreseen for innovation activities, only CAPEX are admitted for revenues.

6.4. Does revenue cap in your country provide incentives to innovation?

Yes ☐ No ☐

Please explain your answer:

Click or tap here to enter text.

6.5. Does revenue cap in your country provide incentives to DER development?

Yes ☐ No ☐

Please explain your answer:

Click or tap here to enter text.

6.6. Are there any tools / sandboxes that allow DSO to invest in innovations in your country?

Yes ☐ No ☐

6.6.1. If yes, which one(s):

In view of the opening of the dispatching market, ARERA had issued the 300/2017/R/eel Resolution for pilot projects on dispatching services. There is no tool or sandbox set up to secure DSO investments.

6. Blockchain and Smart contracts in the energy sector

7.1. Is there a national strategy for regulating the application of blockchain technology?

Yes ■ No ☐

7.2.1. Is there a national strategy for regulating the application of blockchain technology specific for the energy sector?

Yes ■ No ☐

If yes, could you please describe it:

The Italian Ministry of Economic Development, with the contribution of experts in the field, has drawn up the document "Proposals for an Italian strategy on Blockchain-based technologies". The document aims to identify possible developments, obstacles and economic fallout from the introduction of these solutions. In the document, a paragraph dedicated to the Energy sector, indicates how the Blockchain can be instrumental in facilitating the local consumption of energy produced by DERs and the participation of prosumers in the markets for services provided to the grid.

7.3. Does your country recognize smart contracts as legal contracts?

Yes ☐ No ■

7.3.1. If yes, please specify How?

Click or tap here to enter text.

7.4. Are there any sandboxes in your country to check blockchain technology?

Yes ☐ No ☐

7.5. Which are, in your opinion, barriers in the current regulatory framework that could hinder the application of the blockchain technology?

- Legal value Yes ■ No ☐

- Territoriality Yes ☐ No ■
- Liability Yes ☐ No ■
- Enforceability Yes ■ No ☐
- Data privacy Yes ■ No ☐
- Energy consumption Yes ■ No ☐
- Time of elaboration Yes ■ No ☐
- Others:

Click or tap here to enter text.

7. Data management, protection, and cybersecurity

8.1. Who owns energy data in your country?

Type of data	Data owner
Personal data	Customer
Grid data	DSO
Market data	Energy Trader
Measurements from smart meter	Customer
Measurements from the sensors on the grid	DSO

8.2. Who collects energy data in your country?

Type of data	Data collector
Personal data	DSO
Grid Data	DSO
Market	Energy Trader
Measurements from smart meter	DSO
Measurements from the sensors on the grid	DSO

8.3. Who stores energy data in your country?

Type of data	Data storage-provider
Personal data	DSO
Grid Data	DSO
Market	Energy Trader
Measurements from smart meter	DSO
Measurements from the sensors on the grid	DSO

8.4 Who purchases each energy data and for which purpose(s)?

At present, data cannot be sold in Italy

Type of data	Uses	Purchaser

8.5 Are some data more relevant for DSOs than other?

Yes ■ No □

8.5.1. If yes, please specify which one(s) and organise the from the most useful to the less useful:

	Type of data	Usefulness (please explain why)
1.	Sensors data	For the grid observability
2.	Smart meter data	For the energy balance
3.		
4.		
5.		
6.		

8.5. What rooting process(es) is/are used to exchange data in your country

	Type of data	Rooting process(es)*	Stakeholders involved
1.			
2.			
3.			
4.			
5.			
6.			

Click or tap here to enter text.

8.6. If a market participant wants to access the data, is that feasible in your country? how?

	Market participant	Feasible (Yes/No + please explain why/how)
1.	Aggregator	Yes, it must have the customer's mandate of representation
2.	ESCO	Yes, it must have the customer's mandate of representation
3.	Energy trader	Yes, it must have the customer's mandate of representation
4.		
5.		
6.		

Questions for the specific DSO

8.7 Do you foresee a Data Access Policy for the energy data you manage?

Yes ■ No □

8.7.1. If not sensitive, could you please provide the main points structuring this policy please?

Click or tap here to enter text.

8.8 How do you protect the access to the energy data?

	Type of data	Protection (please explain how and why)
1.	Energy Data	Only the DSO's authorized personnel can access to the data, so everyone that would to access to data have to done a request to the DSO that evaluates the possibility. Energy Data are confidential data so the DSO has to manage them carefully.
2.		
3.		
4.		
5.		
6.		

8.9 Do you apply any mechanism for ensuring data privacy and data integrity and avoiding data tampering?

Yes ■ No □

8.9.1. If yes, what mechanisms?

	Type of data	Mechanism (please explain how)
1.	Energy Data	The data travel on dedicated channel (as PLC o VPN) and the access is carefully managed with a procedure that allows the access only to the authorized personnel.
2.		
3.		
4.		
5.		
6.		

A.3 Greece

Which country do you operate in?

Greece

Added questions:

How many DSOs are operating in your country?

1

What is the volume of lines your DSO is operating? (in Km)

240 186

Your DSO belong to which following category:

- Less than 100 000 connected customers ☐
- Between 100 000 and 1 million connected customers ☐
- More than 1 million connected customers ■

For electricity distribution, what share, in percentage, your DSO represents in your country in terms of…

- Volume of lines: 100%
- Connection points: 100%
- Customers: 100%

1. Flexibility services

Flexibility services include "up regulation" that provides additional power as needed to maintain system balance, and "down regulation" that reduces the power generation in the system. Both up and down regulation can also be supplied by controllable loads.

1.1 Energy flexibility and demand response

1.1.1. Can a DSO procure flexibility services in your country? If yes, please specify which ones.

No, the DSO is not allowed to procure flexibility services.

1.1.2. What are the most relevant flexibility service(s) for your DSO?

- Voltage Control: Yes ☐ No ☐ Not applicable
- Congestion solving: Yes ☐ No ☐ Not applicable
- Other: Applicable for Non-Interconnected Grid (Islands), both relevant

Click or tap here to enter text.

1.1.3. Following this table, what are the requirements for flexibility services in your country?

Table 1
Different DER and their technical characteristics.

	DER	Flexibility direction	Flexibility characteristic (power vs energy)	Availability ratio	Predictability	Technical response time	Grid[4]	Ref.
Electrical Consumption	Lighting loads (W)	Unidirectional (downward)	New LED systems: energy types older lightings: power types	$0.2 < a_r < 0.5$ during peak hours	Good	Second	DS	[38–40]
	Dispatchable, residential loads (washing machines, dishwasher)	Unidirectional (downward)	Power type $5\ s < t_r < 5$ min	$a_r < 0.1$ low *max power ratios* t_r due to max off time	High	Second	DS	[39,40]
	Electrical heating/ Cooling (continuous loads)	Unidirectional (downward)	Power type $t_r \approx 15$ min	$0.4 < a_r < 1$	High	Second	DS	[40,41]
Bi-directional	Electrochemical Energy Storage (EES) (kW-MW)	Bidirectional	Power & Energy types $4\ s < t_r < 10$ h	$a_r \approx 1$	Perfect	Second to Minute	DS or TS	[42,43]
	Electric Vehicle (kW)	Unidirectional or Bidirectional	Power & Energy types 30 min $< t_r < 6$ h	$0.5 < a_r < 0.9$	High	Second	DS	[44,45]
Generation	PV Unit	Unidirectional (Upward)	Curtailable	$0.25 < a_r < 0.4$	Good a few hours ahead	Minute	DS	[46]
	Micro-CHP unit (kW)	Unidirectional (production mode)	Energy type	$a_r \approx 1$	Perfect	Rather slow (5%/min)	DS	[37]

[4] Where DS stands for distribution grid and TS for transmission grid.

- Activation Time Yes No ☐

-
- Direction Yes ☐ No ☐
-
- Bid size – MW Yes ☐ No ☐
- Click or tap here to enter text.
- Type of unit Yes ☐ No ☐
- Click or tap here to enter text.
- Availability ratio Yes ☐ No ☐
-
- Technical response time Yes ☐ No ☐
-
- Location of the measuring process Yes ☐ No ☐
- Click or tap here to enter text.
- Number of instances/days per year Yes ☐ No ☐
- Click or tap here to enter text.
- Other? Please provide additional inputs, explanation or figures in the frames following the requirements proposed.

*No regulatory framework for DSO at the moment

1.1.4. Are the flexibility services the same for DSOs and TSOs in your country?

Yes ☐ No ■

1.1.4.1. If no, please highlight the differences in terms of requirements, following those proposed in the question 1.1.3.

The DSO is not allowed to procure flexibility services, so the question is not applicable

1.1.5. Is/are there solution(s) for flexibility services to be clustered in your country?

- At national level: Yes ☐ No ☐ Not aware ☐
- At regional level: Yes ☐ No ☐ Not aware ☐
- At local level: Yes ☐ No ☐ Not aware ☐

1.1.5.1. If yes, how can it/they be clustered?

Not applicable

1.1.6. Which criteria/criterion should define the flexibility services suitable for DSO control area?

Flexibility service	Suggested criteria
Not applicable	

1.2 Organization of flexibility provision framework

1.2.1. Are the flexibility products standardized in your country?

Yes ☐ No ■

1.2.1.1. If yes, which ones:

Click or tap here to enter text.

1.2.2. Are bilateral agreements included to the flexibility market in your country? (E.g.: DER owner & DSO)

Yes ☐ No ■

1.2.3. Do TSOs and DSOs cooperate to organize the flexibility market in your country?

Yes ☐ No ■

1.2.4. Is there foreseen a framework in your country for TSO/DSO cooperation on

- Balancing: Yes ☐ No ☐
- Network planning: Yes ■ No ☐
- Operation: Yes ■ No ☐
- Flexibility procurement: Yes ☐ No ☐
- Data exchange: Yes ■ No ☐
- Other: Pilot Demonstrations

A memorandum of understanding has been signed between DSO (HEDNO) and TSO (IPTO) of Greece, which includes the cooperation in the abovementioned fields.

1.2.5. Is the flexibility market integrated into the existing processes of EU electricity markets?

Yes ☐ No ■

1.2.6. Do DSOs cooperate among each other to organize the flexibility market in your country?

Yes ☐ No ☐ Not applicable, as there is only one DSO (HEDNO).

1.2.6.1. If yes, please provide example(s):

Click or tap here to enter text.

1.2.7. Is cross-border flexibility defined in your national legislation?

Yes ☐ No ■

1.2.8. Are flexibility services across countries regulated in your country legislation?

Yes ☐ No ☐ Not applicable

1.2.9. Is there a certain flexibility market type defined in your country legislation?

Yes ☐ No ■

1.2.9.1. If yes, please specify.

Click or tap here to enter text.

1.2.10. Are operators reimbursed by the NRA when need to use flexibility?

Yes ☐ No ☐ Not applicable

1.2.11. If no, who is covering the financial costs for flexibility services procured by DSOs in your country?

Not applicable

2. Customers connected to DSO network

2.1 Consumer – prosumer

2.1.1. Are consumers/prosumers enabled to provide flexibility in your country?

Yes ☐ No ■

2.1.2. Do consumers/prosumers get incentives to provide flexibility services in your country?

Yes ☐ No ■

2.1.2.1. If yes, please specify:

Click or tap here to enter text.

2.1.3. What is the minimum size of production/demand response that consumers/prosumers have to provide to be able to participate in the flexibility market in your country?

Not applicable

2.1.4. What are the technical requirements for consumers/prosumers to be able to participate in flexibility market in your country?

- Time-response Yes ☐ No ☐
- Availability Yes ☐ No ☐
- Additional equipment at customer/network border Yes ☐ No ☐
- Additional apparatus for observability Yes ☐ No ☐
  - Billing or settlement of services Yes ☐ No ☐
  - Others (please add)

Click or tap here to enter text.

- Additional system (like customer EMS) Yes ☐ No ☐
- Capability to follow a setpoint or capability to respect a max (min) limit at Pod (customer/network border) Yes ☐ No ☐
- Others? (please add)

Click or tap here to enter text.

2.1.5. Do consumers/prosumers get an active role in the process of providing flexibility?

Yes ☐ No ■

2.1.6. What are barriers for consumers/prosumers to participate in flexibility market in your country?

No mechanism exists yet. It is expected that this will change with the complete implementation of the Target Model. Another barrier is the limited rollout of smart metering.

2.2 Flexible loads through network tariffs

2.2.1. What type of network tariffs are allowed in your country? (Mark the correct ones)

TARIFF DRIVER	**Feature**	
Energy (Eur/kWh)	Flat*	☐
	Fixed**	X
	ToU***	X
	Dynamic (real-time)	☐
	Seasonal	☐
	Event-driven	☐
	Other:	

Capacity (Eur/kW)	Flat	☐
	Fixed	X
	Variable	☐
	Time of Use	X
	Other:	☐
Reactive power (Eur/kvarh)		
Location	Urban vs rural	X
	Regional	☐
Type	Household vs industrial vs commercial	X
	the time variation of prices is exclusively due to changes in spot prices.* * Fixed-priced offers provide a fixed price of the energy component for a defined period of time, regardless of changes in the market price.* **** Time-of-use pricing: ToU network tariffs charge different pre-defined prices at pre-defined times of the day or year*	

2.2.2. Does the tariff methodology in your country provide incentives for consumers to provide flexibility?

Yes ☒ No ☐

Consumption during off-peak hours is encouraged, by not applying Network Tariffs. (Indirect incentive, not provision of flexibility).

2.2.3. Who designs the tariffs (is it the regulatory authority)?

The tariffs are defined and calculated by the National Regulatory Authority (NRA).

3. Energy storage and EVs

3.1. In which cases are DSOs allowed to own energy storage in your country?

According to EU directive 2019/944, DSOs are only allowed to own energy storage components if these are fully integrated in the grid and only after the Regulatory Authority has issued an approval. This EU directive has not yet been fully applied into law in Greece, so for the time being no legal framework exists for the ownership of energy storage by the DSO in Greece.

3.2. For which functionalities are DSOs allowed to use storage in your country?

As explained in 3.1, the legal framework for energy storage ownership in Greece is not available yet.

3.3. What services are EVs allowed to sell to DSOs in your country?

- Storage Yes ☐ No ☐ Not aware ☐
- Demand response Yes ☐ No ☐ Not aware ☐
- Other (please add):

None

3.4. Is V1G (smart charging) promoted in your country?

Yes ☐ No ■

3.5. Is V2G (Vehicle-to-grid) charging allowed in your country?

Yes ☐ No ■

3.5.1. Is it promoted?

Yes ■ No ☐ Not aware ☐

4. Aggregation

4.1. Are aggregation services available in your country?

Yes ■ No ☐

4.2. What kind of customers can join aggregation services in your country?

Owners of RES and Combined Cycle power plants can join aggregation services, in order to participate in the market. Consumers will also be enabled to join, following the full implementation of the Target Model. The rollout is planned for the fourth trimester of 2021.

4.3. Can residential consumers contract aggregators independently in your country?

Yes ☐ No ■

4.4. Could the aggregator be operating all the consumption of a consumer in your country?

Yes ☐ No ■

4.5. On what basis/features can the aggregator replace the consumer?

An aggregator can represent the consumer as a Balancing Service Provider (BSP).

4.6. What are the technical specifications for aggregators in your country?

Aggregators can participate in the energy markets representing owners of RES and CHP. It should be noted that a) wind farms of 3MW or higher and b) other RES and CHP of 500kW or higher are obliged to participate in the energy markets. The technical specifications of load aggregation are not defined yet.

5. Local Energy Communities

5.1. Are Renewable Energy Communities (REC) defined in your country legislation?

Yes ■ No ☐

5.1.1. If yes, what geographic scope can REC assume regarding proximity to RES?

RES should be located within the prefecture where the Energy community is incorporated. However, they are defined as Energy Communities (ECs) and not REC, as their scope is not exclusively energy from Renewable Sources.

5.2. Does technical requirement(s) regulate REC in your country legislation? If yes which one(s):

- Customers must be connected to the same MV/LV transformer: Yes ☐ No ☐
- Customers must be located in the same building: Yes ☐ No ☐

There are no specific technical requirements that regulate ECs. However, there is a geographical limitation regarding the members of the EC. At least 50% +1 of the members should be related to the area, where the EC is registered to. More specifically, the aforementioned relationship is proven by the individuals-members owning property within the prefecture where the EC is based, and, in a similar way, by the legal entities-members being registered in the prefecture where the EC is based. ECs can perform various activities in the energy sector. There is an absolute requirement for them to perform at least one of the activities listed below:

- Production, storage, self-consumption or supply of electrical energy or thermal (heating or cooling) energy by RES, CHP or hybrid power plants based within the prefecture of the EC,

- Management of biomass, biogas, bio-waste as primary resource for production of electrical or thermal energy,
- Supply of energy products, appliances, and installations for the EC's members, aiming at improving the energy efficiency and reducing the energy consumption and the use of conventional fuels,
- Supply of electro-mobility for EC's members,
- Distribution of electrical energy within the prefecture where the EC is based,
- Supply of electrical energy or natural gas to end-customers who are within the prefecture where the EC is based,
- Production, distribution and supply of heating or cooling within the prefecture where the EC is based,
- Demand response and representation services for customers/producers in the Energy Market,
- Development of the grid, management of infrastructure of alternative fuels or management of sustainable transportation services within the prefecture where the EC is based,
- Installation and operation of desalination plants using RES within the prefecture where the EC is based,
- Energy services.

5.3. Is Citizen Energy Community (CEC) defined in your country legislation? No

5.3.1. If yes, are there any geographical limitations for the dimensions of CECs defined?

Yes ☐ No ☐ See 5.5.1

5.3.2. If yes, please provide the limit:

5.4. Does technical requirement(s) regulate(s) CEC in your country legislation?

Yes ☐ No ☐ See 5.5.1

5.4.1. If yes which one(s):

- Customers must be connected to the same MV/LV transformer: Yes ☐ No ☐
- Customers must be located in the same building: Yes ☐ No ☐
- Other:

5.5. Is there a framework in your country on REC/CEC and DSO cooperation?

Yes ☐ No ☐ See 5.5.1

5.5.1. If yes, what does it include?

ECs have the right to operate distribution grids. In the area of distribution, the law does not offer any specific incentive to ECs, other than the right to perform distribution, production and supply of electrical and/or thermal energy (bundling of activities) within the prefecture that the EC is based. There are no provisions in the Law about the ownership of distribution grids.

There is no differentiation between RECs and CECs in Greece. In essence, they are defined solely as Energy Communities (ECs). See 5.1 and 5.2 for more details of the related legal framework.

5.5.2. Are RECs and CECs allowed to provide flexibility services in your country?

Yes ☐ No ■

Click or tap here to enter text.

5.6. Which further classes of energy communities are worth to be considered in your network?

- Collective generation and trading of electricity	Yes		No	
- Generation-Consumption Communities	Yes		No	
- Collective residential & industrial self-consumption	Yes	■	No	
- Energy positive districts	Yes		No	
- Energy islands	Yes		No	
- Municipal utilities	Yes	■	No	
- Financial aggregation and investment	Yes	■	No	
- Cooperative Financing of Energy Efficiency	Yes		No	
- Collective service providers	Yes		No	
- Digital supply and demand response systems	Yes		No	
- If other, please provide them:		■		

Click or tap here to enter text.

6. DSO revenue regulation

6.1. What are the regulations in your country regarding DSO investments in innovation?

Funded Projects in Research and Innovation (FPRI) are defined in order to advance knowledge-transfer in matters of design, construction, operation and maintenance of the grid, with the long-term goal of increasing the profitability of OPEX and CAPEX.

In terms of funding, FPRIs are included in the budget of the DSO, according to the percentage that is agreed upon by the NRA. For a FPRI to gain approval by the NRA, the following criteria must be met:

a) Degree of innovation

b) Advanced development in the design of infrastructure

c) Promotion of DERs

d) Promotion of Energy Saving and Energy Management

Projects of Major Importance that HEDNO delivers, contribute in the facilitation of increase in DER penetration and smart grid implementation. According to the new NRA's decision, these investments will be included in the Special Regulatory Asset Base (RAB) and will receive premium WACC, as long as they are executed on time.

6.2. Do revenues reflect CAPEX?

Yes ■ No

Please explain your answer:

The methodology for revenue calculation (NRA's decision n. 1431_22/10/2020, Government Gazette n. 4740B / 26/10/2020) is as follows:

Allowed revenue for year i of the regulatory period:

$$AR_i = O_i + U_i + D_i + R_i + X_i - Y_i$$

O_i : the annual estimated reasonable controlled operating expenditure of year i

U_i : the annual estimated uncontrolled operating expenditure of year i

D_i : the annual depreciation of the Operator's assets included in the Regulatory Asset Base (RAB)

R_i : the allowed return on capital investment, excluding the investments on Major Importance Projects. R_i is calculated by multiplying the estimated value of the RAB for year i and the real, pre-tax, rate of return percentage.

X_i : the allowed return on capital investment on Major Importance Projects

Y_i: the estimated revenue from of non-regulated activities of year i, if the regulated and non-regulated activities have not been separated with distinct cost centers

Required revenue for year i of the regulatory period:

$$RR_i = AR_i \pm P1_i \pm P2_i \pm P3_i \pm P4_i \pm P5_i \pm INF_I \pm EFF_i \pm LIF_i \pm QIF_i$$

The RR is based on the AR adjusted by several parameters related with the settlement amounts due to:

1) under-recovery or over-recovery ot the RR of the reference year,

2) depreciation or WACC deviation due to over-investment or under-investment,

3) Non- controllable OPEX deviation,

4) deviation between the estimated and real revenues of the reference year coming from other regulated and non-regulated services provided by the operator and subsidies (providing that the expenses of these activities are not unbundled in the accounts and have been included in the estimation of the Operator's Allowed Revenue),

5) redefinition of the reasonable return based on the tax index change,

6) deviations between estimated and real inflation (INFi),

7) incentives on Controlled OPEX (EFFi),

8) incentives for power losses reduction (LIFi) and

9) charges due to deviations from the expected Energy and Service quality (QIFi).

Several of these parameters can have positive or negative sign. The output from the incentives mechanism for power losses reduction will not be included in the 1st new Regulatory Period (2021-2024), but in the one after that.

6.3. Do revenues reflect OPEX?

Yes ■ No □

Please explain your answer:

See 6.2

6.4. Does revenue cap in your country provide incentives to innovation?

Yes ■ No □

Please explain your answer:

The budget of FPRIs, as mentioned above, is a percentage of the revenue of the DSO, thus revenue cap is an incentive

6.5.Does revenue cap in your country provide incentives to DER development?

Yes ■ No □

Please explain your answer:

Yes, since DER development is a criterion for the approval of FPRIs by the NRA

6.6. Are there any tools / sandboxes / that allow DSO to invest in innovations in your country?

Yes □ No ■

6.6.1. If yes, which one(s):

7. Blockchain and Smart contracts in the energy sector

7.1. Is there a national strategy for regulating the application of blockchain technology?

Yes □ No ■

7.2.1. Is there a national strategy for regulating the application of blockchain technology specific for the energy sector?

Yes ☐ No ■

If yes, could you please describe it:

Click or tap here to enter text.

7.3. Does your country recognize smart contracts as legal contracts?

Yes ☐ No ■

7.3.1. If yes, please specify How?

Click or tap here to enter text.

7.4. Are there any sandboxes in your country to check blockchain technology?

Yes ☐ No ■

7.5. Which are, in your opinion, barriers in the current regulatory framework that could hinder the application of the blockchain technology?

- Legal value Yes ■ No ☐
- Territoriality Yes ■ No ☐
- Liability Yes ■ No ☐
- Enforceability Yes ■ No ☐
- Data privacy Yes ■ No ☐
- Energy consumption Yes ☐ No ☐
- Time of elaboration Yes ☐ No ☐
- Others: Lack of Regulation in total

8. Data management, protection, and cybersecurity

8.1. Who owns energy data in your country?

Type of data	Data owner
Incoming – Outgoing active and reactive energy	Customer
Voltage and current	
Direction of energy flow	
Power quality events and, more specifically, under-voltage, over-voltage, over-current, power-down, power-up	
Events of potential attempt for tampering the meter such as tampering/removal of the meter cover, terminals cover removal, strong DC magnetic field influence	
Status of the load switch	
Active tariff zone	

8.2. Who collects energy data in your country?

Type of data	Data collector
Same as in 8.1	DSO (HEDNO)

8.3. Who stores energy data in your country?

Type of data	Data storage-provider
Same as in 8.1	DSO (HEDNO)

8.4 Who purchase each energy data and for which purpose(s)?

Data offered by the DSO are not traded, but the DSO makes them available to energy providers, so that they can bill their customers. Each energy provider is entitled to access the data of their clients and not of all users in general.

Type of data	Uses	Purchaser
Energy Consumption	Billing, calculation of network losses	-
Energy Production	Billing, settlement	-

8.5 Are some data more relevant for DSOs than other?

Yes ☐ No ■

8.5.1. If yes, please specify which one(s) and organise the from the most useful to the less useful:

	Type of data	Usefulness (please explain why)
1.		
2.		
3.		
4.		
5.		
6.		

8.5. What rooting process(es) is/are used to exchange data in your country

	Type of data	Rooting process(es)*	Stakeholders involved
1.	Energy consumption	ERP type systems	DSO, TSO and Energy providers
2.	Energy production	ERP type systems	
3.			
4.			
5.			
6.			

Click or tap here to enter text.

8.6. If a market participant wants to access the data, is that feasible in your country? how?

	Market participant	Feasible (Yes/No + please explain why/how)
1.	Energy provider	Yes, if the market participant is at the same time the supplier of the customer. If not, the data is accessible only with the written consent of the customer.
2.		
3.		
4.		
5.		
6.		

Questions for the specific DSO

8.7 Do you foresee a Data Access Policy for the energy data you manage?

Yes ☐ No ☐

8.7.1. If not sensitive, could you please provide the main points structuring this policy please?

Click or tap here to enter text.

8.8 How do you protect the access to the energy data?

	Type of data	Protection (please explain how and why)
1.	All data that the DSO handles	ISO 27001 for data privacy
2.	All DSO data that include personal data	GDPR according to EU directive that has been incorporated in the legislation
3.		
4.		
5.		
6.		

8.9 Do you apply any mechanism for ensuring data privacy and data integrity and avoiding data tampering?

Yes ■ No ☐

8.9.1. If yes, what mechanisms?

See above, 8.8

	Type of data	Mechanism (please explain how)
1.		
2.		
3.		
4.		
5.		

A.4 Germany

Which country do you represent?

Germany

1. **Flexibility services**

1.1 Energy flexibility and demand response

Can DSO procure flexibility services in your country? If yes, please specify which ones.

No, there is no marked based approach implemented so far. As far as they can by interpreted as flexibility, following mechanisms are implemented: heat-tariffs, enabling the DSO to interrupt consumption of flexible heaters (heat pumps & night storage heaters).

Are DERs (distributed energy resources) allowed to participate in voltage control in your country?

Yes, they are.

Are the flexibility services the same for DSOs and TSOs in your country?

No, they are not. DSOs cannot procure flexibility services. See above

What are requirements for flexibility services in your country?

Flexibility services or products procured by TSOs have to meet certain prequalification conditions, such has requiring a minimum installed power or being able to provide electrical energy with a certain gradient. For more info see https://www.regelleistung.net/ext/static/prequalification?lang=en

How can flexibility services be clustered in your country?

For TSO flexibility there are two main services / products: Control power and interruptible load

How should flexibility services that are suitable for DSO control area be defined?

Flexibility assets, either single plants or an aggregation, should be able to adjust their operating point in response to an external trigger. Furthermore, the asset needs to have a metering device allowing to measure the current power input into or output from the grid. Ideally, the asset owner provides own generation forecasts for a defined schedule.

1.2 Organization of flexibility provision framework

Are the flexibility products standardized in your country?

There is a regulatory framework for certain flexibility products procured by TSOs. See above.

Is the flexibility market integrated in your country?

No

Is there foreseen framework in your country on TSO/DSO cooperation on balancing, network planning, operation, flexibility procurement, data exchange?

There are certain regulatory frameworks for different grid operation and planning processes. These can be European frameworks such as GLDPM or SO GL for Data exchange, or national frameworks such as the Erneuerbare-Energien-Gesetz (EEG) or the Energiewirtschaftsgesetz (EnWG). EEG and EnWG cover different aspects, for example the changes in Redispatch: From October 2021 onwards, German DSOs having to carry out preventive Redispatch in their grids including plants with an installed power equal or greater than 100 kW.

Do TSO and DSO cooperate for organizing flexibility market in your country?

Only in research projects such as SINTEG.

Do DSOs cooperate among each other for organizing flexibility market in your country?

Only in research project such as SINTEG.

Is cross-border flexibility defined in your country legislation?

TSOs can procure reserve power plants and control power from other countries.

Is there certain flexibility market type defined in your country legislation? If yes, please specify.

No, there is not.

Who is responsible for flexibility market in your country? (e.g. operator, third party)

Energy spot markets like the EEX are operated by third parties.

Who is funding the financial compensation for flexibility services procured by DSO in your country?

Only for SINTEG research project the regulator allows a funding via grid charges.

2. Customers connected to DSO network

2.1 Consumer – prosumer

Are consumers/prosumers enabled to provide flexibility in your country?

Yes

Do consumers/prosumers get incentives to provide flexibility services in your country? If yes, please specify.

Yes, residential consumers/prosumers can take part in direct marketing by contracting their plants, for example PV or wind, to direct marketers, i.e. flexibility aggregators, which then trade aggregated flexibilities on energy exchanges and/or spot markets. Bigger single consumers/prosumers can demand prequalification by TSOs and take part in the Control Power Market or interruptible loads market. Private customers can receive a reduced grid charge for heating power in case they allow the DSO to curtail consumption in case of high loads in the network.

What is the minimum size of production/demand response that consumers/prosumers have to provide to be able to participate in flexibility market in your country?

Minimum power for Frequency Containment Reserve (FCR) is 1 MW, for Frequency Restoration Reserve with automatic activation (aFRR) and with manual activation (mFRR) 5 MW. Minimum power for interruptible load is 5 MW. Single residential consumers/prosumers don't market their flexibility on their own but by contracting direct marketers who aggregate flexibility from different sources. What production/demand single consumers have to provide to take part in such offers depends on the conditions of the direct marketer.

What are technical requirements for consumers/prosumers to be able to participate in flexibility market in your country?

Residential consumers/prosumers need a suitable metering device for their plant and have to meet technical conditions of the aggregator / direct marketeer. Prequalification conditions for power plants can be found here: https://www.regelleistung.net/ext/static/prequalification?lang=en

What are barriers for consumers/prosumers to participate in flexibility market in your country?

Residential consumers/prosumers have to contract a direct marketeer in order to participate in the flexibility (energy) market. They may also have to decide whether they want to receive a compensation via the EEG or go into direct marketing.

2.2 Flexible loads through network tariffs

What type of network tariffs are allowed in your country? (Mark the correct ones)

Click or tap here to enter text.

TARIFF DRIVER	Feature	N
Energy (Eur/kWh)	Flat*	yes
	Fixed**	yes
	ToU***	yes
	Dynamic (real-time)	Yes (not

		practised)
	Seasonal	Yes (not practised
	Event-driven	Yes (not practised
	Other:	
Capacity (Eur/kW)	Flat (SLP – yes, customers with measured and recorded capacity consumption – no)	Yes/no
	Fixed	yes
	Variable	Yes (not practised
	***Time of Use	yes
	Other:	Yes (not practised
Reactive power (Eur/kvarh)		
Location	City vs rural	No
	Regional	Yes
Type	Household vs industrial vs commercial	Yes

Does tariff methodology in your country provide incentives for consumers to provide flexibility?

Yes

Who designs the tariffs (Is it the regulatory authority)?

The regulator describes the framework, roles and rules for determination of network tariffs and decides whether the tariffs are justified. The grid operator calculates and sets the tariffs.

3. **Energy storage and EVs**

In what cases are DSOs allowed to own energy storage in your country?

DSO in general are not allowed to own storages to be used for economical reasons.

For which functionalities DSOs are allowed to use storage in your country?

See comments above.

What services Electric Vehicles are allowed to sell to DSOs in your country? (e.g. storage, demand response)

Except for pilot projects or in research projects Electrical Vehicles only consume energy when they charge their batteries. There are no services they currently can sell.

Is V1G (smart charging) charging promoted in your country?

There are research projects focusing on V1G, but this is not an established technology yet.

Is V2G (Vehicle-to-grid) charging allowed / promoted in your country?

There are research projects focusing on V2G, but this is not an established technology yet.

4. **Aggregation**

Are aggregation services available in your country?

Yes, direct marketers aggregate flexibility from different sources. Sometimes in so-called Virtual power plants.

What kind of customers can join aggregation services in your country?

Private customer, industry, commercial

Can residential consumer contract aggregator independently in your country?

In theory, yes. However, not every aggregator may offer their services in each region of the country.

Can aggregator replace the consumer in your country?

The aggregator may be responsible for operation of assets owned by customer and be active on markets on their behalf.

What are technical specifications for aggregators in your country?

-

5. **Local Energy Communities**

Is Renewable Energy Community (REC) defined in your country legislation?

No

Is Citizen Energy Community (CEC) defined in your country legislation?

No

Is there framework in your country on REC/CEC and DSO cooperation?

No

Are RECs and CECs allowed to provide flexibility services in your country?

There is no regulation focusing on that issue. Households in general are allowed.

6. **DSO revenue regulation**

What are regulations in your country regarding DSO investments in innovation?

Do revenues reflect CAPEX?

Click or tap here to enter text.

Do revenues reflect OPEX?

Click or tap here to enter text.

Does revenue cap in your country provides incentives to innovation?

Click or tap here to enter text.

Does revenue cap in your country provides incentives to DER development?

Click or tap here to enter text.

Is there any tools / sandboxes / that allow DSO to invest in innovations in your country?

Click or tap here to enter text.

7. **Blockchain and Smart contracts in the energy sector**

Is there a national strategy for regulating the application of blockchain technology? And a specific strategy in the energy sector?

There is a national blockchain strategy in Germany focusing on the further implementation and research of Blockchain technologies. There are certain examples where Blockchain is used in the energy sector, but there is not a specific overall strategy. For the German strategy on Blockchain see here: https://www.bundesfinanzministerium.de/Content/EN/Pressemitteilungen/2019/2019-18-09-joint-release-with-bmwi.html

Does your country recognize smart contracts as legal contracts? How?

No

Is there any sandboxes in your country to check blockchain technology?

Not known

Which are, in your opinion, barriers that could obstacle the application of the blockchain technology with the current regulatory framework? (e.g. legal value, territoriality, liability, enforceability, data privacy)

Click or tap here to enter text.

8. **Data management, protection and cybersecurity**

Who owns energy data in your country?

DSO

Who collects energy data in your country?

DSO

Who store energy data in your country?

DSO or commissioned service providers

Who use energy data in your country?

DSO, Energy Supplier, Sales

How can data be exchanged (through which routes) in your country?

Energy Supplier and Sales need power of attorney. Data are exchanged digital.

If Aggregator wants to access the data how can it do it your country?

Aggregators are only allowed to access own data via request addressed to DSO.

Annex B Questionnaires other countries

B.1 Austria

Which country do you operate in?

Austria

Added questions:

How many DSOs are operating in your country?

135

What is the volume of lines your DSO is operating? (in Km)

1406 km 110 kV. 52785 km 20 kV and 400 V

Your DSO belong to which following category:

- Less than 100 000 connected customers ☐
- Between 100 000 and 1 million connected customers X
- More than 1 million connected customers ☐

For electricity distribution, what share, in percentage, your DSO represents in your country in terms of…

- Volume of lines: 20%
- Connection points: 20%
- Customers: 20%

1. Flexibility services

Flexibility services include "up regulation" that provides additional power as needed to maintain system balance, and "down regulation" that reduces the power generation in the system. Both up and down regulation can also be supplied by controllable loads.

1.1 Energy flexibility and demand response

1.1.1. Can a DSO procure flexibility services in your country? If yes, please specify which ones.

No

1.1.2. What are the most relevant flexibility service(s) serve(s) for your DSO?

- Voltage Control: Yes ☐ No ☐
- Congestion solving: Yes ☐ No ☐
- Other? (please add)

Click or tap here to enter text.

1.1.3. Following this table, what are the requirements for flexibility services in your country?

Table 1
Different DER and their technical characteristics.

	DER	Flexibility direction	Flexibility characteristic (power vs energy)	Availability ratio	Predictability	Technical response time	Grid[a]	Ref.
Electrical Consumption	Lighting loads (W)	Unidirectional (downward)	New LED systems: energy types older lightings: power types	$0.2 < a_r < 0.5$ during peak hours	Good	Second	DS	[38–40]
	Dispatchable, residential loads (washing machines, dishwasher)	Unidirectional (downward)	Power type 5 s $< t_r <$ 5 min	$a_r < 0.1$ low *max power ratios* t_r due to max off time	High	Second	DS	[39,40]
	Electrical heating/ Cooling (continuous loads)	Unidirectional (downward)	Power type $t_r \approx$ 15 min	$0.4 < a_r < 1$	High	Second	DS	[40,41]
Bi-directional	Electrochemical Energy Storage (EES) (kW-MW)	Bidirectional	Power & Energy types 4 s $< t_r <$ 10 h	$a_r \approx 1$	Perfect	Second to Minute	DS or TS	[42,43]
	Electric Vehicle (kW)	Unidirectional or Bidirectional	Power & Energy types 30 min $< t_r <$ 6 h	$0.5 < a_r < 0.9$	High	Second	DS	[44,45]
Generation	PV Unit	Unidirectional (Upward)	Curtailable	$0.25 < a_r < 0.4$	Good a few hours ahead	Minute	DS	[46]
	Micro-CHP unit (kW)	Unidirectional (production mode)	Energy type	$a_r \approx 1$	Perfect	Rather slow (5%/min)	DS	[37]

[a] Where DS stands for distribution grid and TS for transmission grid.

- Activation Time Yes X No ☐
- Click or tap here to enter text.
- Direction Yes X No ☐
- Click or tap here to enter text.
- Bid size – MW Yes ☐ No ☐
- Click or tap here to enter text.
- Type of unit Yes ☒ No ☐
- Flexibility is only interruptible load
- Availability ratio Yes ☐ No ☒
- Click or tap here to enter text.
- Technical response time Yes ☐ No ☒
- Click or tap here to enter text.
- Location of the measuring process Yes ☐ No ☒
- Click or tap here to enter text.
- Number of instances/days per year Yes ☐ No ☒
- Click or tap here to enter text.
- Other? Please provide additional inputs, explanation or figures in the frames following the requirements proposed.

Click or tap here to enter text.

1.1.4. Are the flexibility services the same for DSOs and TSOs in your country?

Yes ☐ No ☒

1.1.4.1. If no, please highlight the differences in terms of requirements, following those proposed in the question 1.1.3.

Click or tap here to enter text.

1.1.5. Is/are there solution(s) for flexibility services to be clustered in your country?

- At national level: Yes ☒ No ☐ Not aware ☐
- At regional level: Yes ☐ No ☒ Not aware ☐
- At local level: Yes ☐ No ☒ Not aware ☐

1.1.5.1. If yes, how can it/they be clustered?

For the balancing market of the TSO

1.1.6. Which criteria/criterion should define the flexibility services suitable for DSO control area?

Flexibility service	Suggested criteria

1.2 Organization of flexibility provision framework

1.2.1. Are the flexibility products standardized in your country?

Yes [ ] No [X]

1.2.1.1. If yes, which ones:

Click or tap here to enter text.

1.2.2. Are bilateral agreements included to the flexibility market in your country? (E.g.: DER owner & DSO)

Yes [X] No [ ]

1.2.3.Do TSOs and DSOs cooperate to organize the flexibility market in your country?

Yes [ ] No [X]

1.2.4. Is there foreseen a framework in your country for TSO/DSO cooperation on

- Balancing: Yes [X] No [ ]
- Network planning: Yes [X] No [ ]
- Operation: Yes [X] No [ ]
- Flexibility procurement: Yes [ ] No [X]
- Data exchange: Yes [X] No [ ]
- Other? (please add)

Click or tap here to enter text.

1.2.5. Is the flexibility market integrated into the existing processes of EU electricity markets?

Yes [ ] No [ ]

1.2.6. Do DSOs cooperate among each other to organize the flexibility market in your country?

Yes [ ] No [X]

1.2.6.1. If yes, please provide example(s):

Click or tap here to enter text.

1.2.7. Is cross-border flexibility defined in your national legislation?

Yes [ ] No [X]

1.2.8. Are flexibility services across countries regulated in your country legislation?

Yes [ ] No [X]

1.2.9. Is there a certain flexibility market type defined in your country legislation?

Yes ☐ No ☒

1.2.9.1. If yes, please specify.

Click or tap here to enter text.

1.2.10. Are operators reimbursed by the NRA when need to use flexibility?

Yes ☐ No ☒

1.2.11. If no, who is covering the financial costs for flexibility services procured by DSOs in your country?

The costs of the flexibility service is within the network tariff.

2. Customers connected to DSO network

2.1 Consumer – prosumer

2.1.1. Are consumers/prosumers enabled to provide flexibility in your country?

Yes ☐ No ☒

2.1.2. Do consumers/prosumers get incentives to provide flexibility services in your country?

Yes ☐ No ☒

2.1.2.1. If yes, please specify:

Click or tap here to enter text.

2.1.3. What is the minimum size of production/demand response that consumers/prosumers have to provide to be able to participate in the flexibility market in your country?

Click or tap here to enter text.

2.1.4. What are the technical requirements for consumers/prosumers to be able to participate in flexibility market in your country?

- Time-response Yes ☒ No ☐
- Availability Yes ☒ No ☐
- Additional equipment at customer/network border Yes ☐ No ☐
- Additional apparatus for observability Yes ☐ No ☐
  - Billing or settlement of services Yes ☐ No ☐
  - Others (please add)

Click or tap here to enter text.

- Additional system (like customer EMS) Yes ☐ No ☐
- Capability to follow a setpoint or capability to respect a max (min) limit at Pod (customer/network border) Yes ☒ No ☐
- Others? (please add)

Click or tap here to enter text.

2.1.5. Do consumers/prosumers get an active role in the process of providing flexibility?

Yes ☐ No ☒

2.1.6. What are barriers for consumers/prosumers to participate in flexibility market in your country?

There is no flexibility market in Austria yet. It is only in discussion in the sector. So far we offer only interruptible load tariffs as flexibility.

2.2 Flexible loads through network tariffs

2.2.1. What type of network tariffs are allowed in your country? (Mark the correct ones)

Click or tap here to enter text.

TARIFF DRIVER	Feature	
Energy (Eur/kWh)	Flat*	X
	Fixed**	X
	ToU***	☐
	Dynamic (real-time)	☐
	Seasonal	X
	Event-driven	☐
	Other:	
Capacity (Eur/kW)	Flat	X
	Fixed	X
	Variable	☐
	Time of Use	☐
	Other:	☐
Reactive power (Eur/kvarh)		
Location	Urban vs rural	☐
	Regional	☐
Type	Household vs industrial vs commercial	☐
	the time variation of prices is exclusively due to changes in spot prices.* * Fixed-priced offers provide a fixed price of the energy component for a defined period of time, regardless of changes in the market price.* **** Time-of-use pricing: ToU network tariffs charge different pre-defined prices at pre-defined times of the day or year*	

2.2.2. Does the tariff methodology in your country provide incentives for consumers to provide flexibility?

Yes ☐ No ☒

2.2.3. Who designs the tariffs (is it the regulatory authority)?

The DSO together with the NRA.

3. Energy storage and EVs

3.1. In which cases are DSOs allowed to own energy storage in your country?

None.

3.2. For which functionalities are DSOs allowed to use storage in your country?

In the future: non-frequency ancilliary services

3.3. What services are EVs allowed to sell to DSOs in your country?

- Storage Yes ☐ No ☒ Not aware ☐
- Demand response Yes ☐ No ☒ Not aware ☐
- Other (please add):

Click or tap here to enter text.

3.4. Is V1G (smart charging) promoted in your country?

Yes ☐ No ☒

3.5. Is V2G (Vehicle-to-grid) charging allowed in your country?

Yes ☐ No ☒

3.5.1. Is it promoted?

Yes ☐ No ☒ Not aware ☐

4. Aggregation

4.1. Are aggregation services available in your country?

Yes ☒ No ☐

4.2. What kind of customers can join aggregation services in your country?

Customers with storage

4.3. Can residential consumers contract aggregators independently in your country?

Yes ☒ No ☐

4.4. Could the aggregator be operating all the consumption of a consumer in your country?

Yes ☒ No ☐

4.5. On what basis/features can the aggregator replace the consumer?

The aggregator does not replace the consumer. It acts only as balance group responsible.

4.6. What are the technical specifications for aggregators in your country?

Click or tap here to enter text.

5. Local Energy Communities

5.1. Are Renewable Energy Communities (REC) defined in your country legislation?

Yes ☐ No ☒ there will be definitions for REC in the future laws.

5.1.1. If yes, what geographic scope can REC assume regarding proximity to RES?

Click or tap here to enter text.

5.2. Does technical requirement(s) regulate REC in your country legislation? If yes which one(s):

- Customers must be connected to the same MV/LV transformer: Yes ☒ No ☐
- Customers must be located in the same building: Yes ☐ No ☒
- Other:

Click or tap here to enter text.

5.3. Is Citizen Energy Community (CEC) defined in your country legislation?

5.3.1. If yes, are there any geographical limitations for the dimensions of CECs defined?

Yes ☐ No ☒ will be in the future laws.

5.3.2. If yes, please provide the limit:

Click or tap here to enter text.

5.4. Does technical requirement(s) regulate(s) CEC in your country legislation?

Yes ☐ No ☐

5.4.1. If yes which one(s):

- Customers must be connected to the same MV/LV transformer: Yes ☐ No ☐
- Customers must be located in the same building: Yes ☐ No ☐
- Other:

Click or tap here to enter text.

5.5. Is there a framework in your country on REC/CEC and DSO cooperation?

Yes ☐ No ☒

5.5.1. If yes, what does it includes?

Click or tap here to enter text.

5.5.2. Are RECs and CECs allowed to provide flexibility services in your country?

Yes ☐ No ☒

Click or tap here to enter text.

5.6. Which further classes of energy communities are worth to be considered in your network?

- Collective generation and trading of electricity Yes ☐ No ☐
- Generation-Consumption Communities Yes ☐ No ☐
- Collective residential & industrial self-consumption Yes ☐ No ☐
- Energy positive districts Yes ☐ No ☐
- Energy islands Yes ☐ No ☐
- Municipal utilities Yes ☐ No ☐
- Financial aggregation and investment Yes ☐ No ☐
- Cooperative Financing of Energy Efficiency Yes ☐ No ☐
- Collective service providers Yes ☐ No ☐
- Digital supply and demand response systems Yes ☐ No ☐
- If other, please provide them: ☐ ☐

Click or tap here to enter text.

6. DSO revenue regulation

6.1. What are the regulations in your country regarding DSO investments in innovation?

Part of the tariff covers the innovation costs. The innovations put on the bill have to be confirmed by the NRA.

6.2. Do revenues reflect CAPEX?

Yes ☒ No ☐

Please explain your answer:

The innovation portion in the tariff covers CAPEX and OPEX

6.3. Do revenues reflect OPEX?

Yes [X] No [ ]

Please explain your answer:

The innovation portion in the tariff covers CAPEX and OPEX

6.4. Does revenue cap in your country provide incentives to innovation?

Yes [ ] No [X]

Please explain your answer:

Click or tap here to enter text.

6.5.Does revenue cap in your country provide incentives to DER development?

Yes [ ] No [X]

Please explain your answer:

Click or tap here to enter text.

6.6. Are there any tools / sandboxes / that allow DSO to invest in innovations in your country?

Yes [ ] No [X]

6.6.1. If yes, which one(s):

Click or tap here to enter text.

7. Blockchain and Smart contracts in the energy sector

7.1. Is there a national strategy for regulating the application of blockchain technology?

Yes [ ] No [X]

7.2.1. Is there a national strategy for regulating the application of blockchain technology specific for the energy sector?

Yes [ ] No [X]

If yes, could you please describe it:

Click or tap here to enter text.

7.3. Does your country recognize smart contracts as legal contracts?

Yes [ ] No [X]

7.3.1. If yes, please specify How?

Click or tap here to enter text.

7.4. Are there any sandboxes in your country to check blockchain technology?

Yes [ ] No [X]

7.5. Which are, in your opinion, barriers in the current regulatory framework that could hinder the application of the blockchain technology?

- Legal value Yes [X] No [ ]
- Territoriality Yes [X] No [ ]
- Liability Yes [X] No [ ]
- Enforceability Yes [X] No [ ]
- Data privacy Yes [ ] No [ ]

- Energy consumption Yes No
- Time of elaboration Yes No
- Others:

Click or tap here to enter text.

8. Data management, protection, and cybersecurity

8.1. Who owns energy data in your country?

Type of data	Data owner
Customer data (consumption)	Customer
Grid data (system operation)	DSO

8.2. Who collects energy data in your country?

Type of data	Data collector
Customer data (consumption)	DSO
Grid data (system operation)	DSO

8.3. Who stores energy data in your country?

Type of data	Data storage-provider
Customer data (consumption)	DSO
Grid data (system operation)	DSO

8.4 Who purchase each energy data and for which purpose(s)?

Energy data are not allowed to be sold or purchased.

Type of data	Uses	Purchaser

8.5 Are some data more relevant for DSOs than other?

Yes ☐ No ☒

8.5.1. If yes, please specify which one(s) and organise the from the most useful to the less useful:

	Type of data	Usefulness (please explain why)
1.		
2.		
3.		
4.		
5.		
6.		

8.5. What rooting process(es) is/are used to exchange data in your country

	Type of data	Rooting process(es)*	Stakeholders involved
1.	Consumption data	DSO; relevant supplier; aggregator; balance coordinator	DSO, supplier, balance coordinator, clearing&settlement

Click or tap here to enter text.

8.6. If a market participant wants to access the data, is that feasible in your country? how?

	Market participant	Feasible (Yes/No + please explain why/how)
1.	Customer	Yes, the customer is always allowed to get his/her data.
2.	Supplier	Has to get permittance from the customer
3.	Aggregator	Has to get permittance from the customer

Questions for the specific DSO

8.7 Do you foresee a Data Access Policy for the energy data you manage?

Yes [X] No [ ]

8.7.1. If not sensitive, could you please provide the main points structuring this policy please?

Only the customer can access its data.

8.8 How do you protect the access to the energy data?

	Type of data	Protection (please explain how and why)
1.	Customer core	Locked system in the data center with no connection to ourside
2.	Customer consumption	Locked system in the data center with no connection to ourside

8.9 Do you apply any mechanism for ensuring data privacy and data integrity and avoiding data tampering?

Yes [X] No [ ]

8.9.1. If yes, what mechanisms?

	Type of data	Mechanism (please explain how)
1.	Personal data	According to the GDPR

B.2 Czech Republic

Which country do you operate in?

Czech Republic

Added questions:

How many DSOs are operating in your country?

3

What is the volume of lines your DSO is operating? (in Km)

Click or tap here to enter text.

Your DSO belong to which following category:

- Less than 100 000 connected customers ☐
- Between 100 000 and 1 million connected customers ☐
- More than 1 million connected customers ☐

For electricity distribution, what share, in percentage, your DSO represents in your country in terms of…

- Volume of lines: Click or tap here to enter text.
- Connection points: Click or tap here to enter text.
- Customers: Click or tap here to enter text.

1. Flexibility services

Flexibility services include "up regulation" that provides additional power as needed to maintain system balance, and "down regulation" that reduces the power generation in the system. Both up and down regulation can also be supplied by controllable loads.

1.1 Energy flexibility and demand response

1.1.1. Can a DSO procure flexibility services in your country? If yes, please specify which ones.

Yes, there is recently new regulation in place detailing requirement for non-frequency services for DSOs

1.1.2. What are the most relevant flexibility service(s) serve(s) for your DSO?

- Voltage Control: Yes ☐ No ☐
- Congestion solving: Yes ☐ No ☐
- Other? (please add)

Click or tap here to enter text.

1.1.3. Following this table, what are the requirements for flexibility services in your country?

Table 1
Different DER and their technical characteristics.

	DER	Flexibility direction	Flexibility characteristic (power vs energy)	Availability ratio	Predictability	Technical response time	Grid[a]	Ref.
Electrical Consumption	Lighting loads (W)	Unidirectional (downward)	New LED systems: energy types older lightings: power types	$0.2 < a_r < 0.5$ during peak hours	Good	Second	DS	[38–40]
	Dispatchable, residential loads (washing machines, dishwasher)	Unidirectional (downward)	Power type $5\ s < t_r < 5$ min	$a_r < 0.1$ low *max power ratios* t_r due to max off time	High	Second	DS	[39,40]
	Electrical heating/ Cooling (continuous loads)	Unidirectional (downward)	Power type $t_r \approx 15$ min	$0.4 < a_r < 1$	High	Second	DS	[40,41]
Bi-directional	Electrochemical Energy Storage (EES) (kW-MW)	Bidirectional	Power & Energy types $4\ s < t_r < 10$ h	$a_r \approx 1$	Perfect	Second to Minute	DS or TS	[42,43]
	Electric Vehicle (kW)	Unidirectional or Bidirectional	Power & Energy types 30 min $< t_r < 6$ h	$0.5 < a_r < 0.9$	High	Second	DS	[44,45]
Generation	PV Unit	Unidirectional (Upward)	Curtailable	$0.25 < a_r < 0.4$	Good a few hours ahead	Minute	DS	[46]
	Micro-CHP unit (kW)	Unidirectional (production mode)	Energy type	$a_r \approx 1$	Perfect	Rather slow (5%/min)	DS	[37]

[a] Where DS stands for distribution grid and TS for transmission grid.

- Activation Time Yes No ☐

- Click or tap here to enter text.
- Direction Yes ☐ No ☐
- Click or tap here to enter text.
- Bid size – MW Yes ☐ No ☐
- Click or tap here to enter text.
- Type of unit Yes ☐ No ☐
- Click or tap here to enter text.
- Availability ratio Yes ☐ No ☐
- Click or tap here to enter text.
- Technical response time Yes ☐ No ☐
- Click or tap here to enter text.
- Location of the measuring process Yes ☐ No ☐
- Click or tap here to enter text.
- Number of instances/days per year Yes ☐ No ☐
- Click or tap here to enter text.
- Other? Please provide additional inputs, explanation or figures in the frames following the requirements proposed.

Click or tap here to enter text.

1.1.4. Are the flexibility services the same for DSOs and TSOs in your country?

Yes ☐ No ☐

1.1.4.1. If no, please highlight the differences in terms of requirements, following those proposed in the question 1.1.3.

DSOs procure non frequency services with local impact. The most relevant type of service is the voltage control (it goes mostly for reactive power).

1.1.5. Is/are there solution(s) for flexibility services to be clustered in your country?

- At national level: Yes ☐ No ☐ Not aware ☐
- At regional level: Yes ☐ No ☐ Not aware ☐
- At local level: Yes ☐ No ☐ Not aware ☐

1.1.5.1. If yes, how can it/they be clustered?

The major division is between balancing services (country-wide) and non-frequency provided locally.

1.1.6. Which criteria/criterion should define the flexibility services suitable for DSO control area?

Flexibility service	Suggested criteria

1.2 Organization of flexibility provision framework

1.2.1. Are the flexibility products standardized in your country?

Yes ☐ No ☐

1.2.1.1. If yes, which ones:

Voltage control, management of reactive power flows, black start, islanding

1.2.2. Are bilateral agreements included to the flexibility market in your country? (E.g.: DER owner & DSO)

Yes ☐ No ☐

1.2.3. Do TSOs and DSOs cooperate to organize the flexibility market in your country?

Yes ☐ No ☐

1.2.4. Is there foreseen a framework in your country for TSO/DSO cooperation on

- Balancing: Yes ☐ No ☐
- Network planning: Yes ☐ No ☐
- Operation: Yes ☐ No ☐
- Flexibility procurement: Yes ☐ No ☐
- Data exchange: Yes ☐ No ☐
- Other? (please add)

Click or tap here to enter text.

1.2.5. Is the flexibility market integrated into the existing processes of EU electricity markets?

Yes ☐ No ☐

1.2.6. Do DSOs cooperate among each other to organize the flexibility market in your country?

Yes ☐ No ☐

1.2.6.1. If yes, please provide example(s):

Click or tap here to enter text.

1.2.7. Is cross-border flexibility defined in your national legislation?

Yes ☐ No ☐

1.2.8. Are flexibility services across countries regulated in your country legislation?

Yes ☐ No ☐

1.2.9. Is there a certain flexibility market type defined in your country legislation?

Yes ☐ No ☐

1.2.9.1. If yes, please specify.

There are set of guidelines (secondary regulation) defined by TSO/DSO working groups providing rules for procurement of flexibility/ data exchange/market prequalification etc.

1.2.10. Are operators reimbursed by the NRA when need to use flexibility?

Yes ☐ No ☐

1.2.11. If no, who is covering the financial costs for flexibility services procured by DSOs in your country?

Click or tap here to enter text.

2. Customers connected to DSO network

2.1 Consumer – prosumer

2.1.1. Are consumers/prosumers enabled to provide flexibility in your country?

Yes ☐ No ☐

2.1.2. Do consumers/prosumers get incentives to provide flexibility services in your country?

Yes ☐ No ☐

2.1.2.1. If yes, please specify:

Click or tap here to enter text.

2.1.3. What is the minimum size of production/demand response that consumers/prosumers have to provide to be able to participate in the flexibility market in your country?

There isn't minimum requirements set – it depends on policy of relevant aggregator (please not that flexibility market is developing at present so the rules/requirements might change)

2.1.4. What are the technical requirements for consumers/prosumers to be able to participate in flexibility market in your country?

- Time-response Yes ☐ No ☐
- Availability Yes ☐ No ☐
- Additional equipment at customer/network border Yes ☐ No ☐
- Additional apparatus for observability Yes ☐ No ☐
  - Billing or settlement of services Yes ☐ No ☐
  - Others (please add)

Click or tap here to enter text.

- Additional system (like customer EMS) Yes ☐ No ☐
- Capability to follow a setpoint or capability to respect a max (min) limit at Pod (customer/network border) Yes ☐ No ☐
- Others? (please add)

Click or tap here to enter text.

2.1.5. Do consumers/prosumers get an active role in the process of providing flexibility?

Yes ☐ No ☐

2.1.6. What are barriers for consumers/prosumers to participate in flexibility market in your country?

The development of the non-frequency market is at its early stage – relevant market mechanisms still needs to be established (e.g. market platform) .

2.2 Flexible loads through network tariffs

2.2.1. What type of network tariffs are allowed in your country? (Mark the correct ones)

Click or tap here to enter text.

TARIFF DRIVER	Feature	
Energy (Eur/kWh)	Flat*	☐
	Fixed**	☐

	ToU***	☐
	Dynamic (real-time)	☐
	Seasonal	☐
	Event-driven	☐
	Other:	
Capacity (Eur/kW)	Flat	☐
	Fixed	☐
	Variable	☐
	Time of Use	☐
	Other:	☐
Reactive power (Eur/kvarh)		
Location	Urban vs rural	☐
	Regional	☐
Type	Household vs industrial vs commercial	☐

**the time variation of prices is exclusively due to changes in spot prices.*

*** Fixed-priced offers provide a fixed price of the energy component for a defined period of time, regardless of changes in the market price.*

**** Time-of-use pricing: ToU network tariffs charge different pre-defined prices at pre-defined times of the day or year*

2.2.2. Does the tariff methodology in your country provide incentives for consumers to provide flexibility?

Yes ☐ No ☐

2.2.3. Who designs the tariffs (is it the regulatory authority)?

Regulatory authority

3. Energy storage and EVs

3.1. In which cases are DSOs allowed to own energy storage in your country?

DSO is not allowed to own energy storage for commercial use (batteries necessary for grid operation allowed)

4. Aggregation

4.1. Are aggregation services available in your country?

Yes ☐ No ☐

4.2. What kind of customers can join aggregation services in your country?

At present relevant legislation is prepared and the role of aggregator is not defined yet – aggregation is used for wholesale only, market with grid related services is not established (relevant legislation is not in place).

5. Local Energy Communities

5.1. Are Renewable Energy Communities (REC) defined in your country legislation?

Yes ☐ No ☐

6. DSO revenue regulation

6.1. What are the regulations in your country regarding DSO investments in innovation?

Click or tap here to enter text.

6.2. Do revenues reflect CAPEX?

Yes ☐ No ☐

Please explain your answer:

Generally speaking all CAPEX investment are concerned (including innovation).

6.3. Do revenues reflect OPEX?

Yes ☐ No ☐

Please explain your answer:

Three years rolling average of actual cost.

6.4. Does revenue cap in your country provide incentives to innovation?

Yes ☐ No ☐

Please explain your answer:

Click or tap here to enter text.

6.5.Does revenue cap in your country provide incentives to DER development?

Yes ☐ No ☐

Please explain your answer:

Click or tap here to enter text.

6.6. Are there any tools / sandboxes / that allow DSO to invest in innovations in your country?

Yes ☐ No ☐

6.6.1. If yes, which one(s):

Click or tap here to enter text.

8. Data management, protection, and cybersecurity

8.1. Who owns energy data in your country?

Type of data	Data owner
Metering data only	ČEZdistribuce

8.2. Who collects energy data in your country?

Type of data	Data collector
Metering data only	DSOs, TSO
Customer data	Czech electricity and gas market operator,

B.3 Lithuania

Which country do you operate in?

Lithuania

Added questions:

How many DSOs are operating in your country?

6

What is the volume of lines your DSO is operating? (in Km)

125 000 km Electricity and 9 000 km gas

Your DSO belong to which following category:

- Less than 100 000 connected customers ☐
- Between 100 000 and 1 million connected customers ☐
- More than 1 million connected customers ■

For electricity distribution, what share, in percentage, your DSO represents in your country in terms of…

- Volume of lines: 99,9
- Connection points: 1,8 M
- Customers: 1,6

1. Flexibility services

Flexibility services include "up regulation" that provides additional power as needed to maintain system balance, and "down regulation" that reduces the power generation in the system. Both up and down regulation can also be supplied by controllable loads.

1.1 Energy flexibility and demand response

1.1.1. Can a DSO procure flexibility services in your country? If yes, please specify which ones.

No

1.1.2. What are the most relevant flexibility service(s) serve(s) for your DSO?

- Voltage Control: Yes ■ No ☐
- Congestion solving: Yes ■ No ☐
- Other? (please add)

Click or tap here to enter text.

1.1.3. Following this table, what are the requirements for flexibility services in your country?

Table 1
Different DER and their technical characteristics.

	DER	Flexibility direction	Flexibility characteristic (power vs energy)	Availability ratio	Predictability	Technical response time	Grid[a]	Ref.
Electrical Consumption	Lighting loads (W)	Unidirectional (downward)	New LED systems: energy types older lightings: power types	$0.2 < a_r < 0.5$ during peak hours	Good	Second	DS	[38–40]
	Dispatchable, residential loads (washing machines, dishwasher)	Unidirectional (downward)	Power type $5\ s < t_r < 5$ min	$a_r < 0.1$ low *max power ratios* t_r due to max off time	High	Second	DS	[39,40]
	Electrical heating/ Cooling (continuous loads)	Unidirectional (downward)	Power type $t_r \approx 15$ min	$0.4 < a_r < 1$	High	Second	DS	[40,41]
Bi-directional	Electrochemical Energy Storage (EES) (kW-MW)	Bidirectional	Power & Energy types $4\ s < t_r < 10$ h	$a_r \approx 1$	Perfect	Second to Minute	DS or TS	[42,43]
	Electric Vehicle (kW)	Unidirectional or Bidirectional	Power & Energy types 30 min $< t_r < 6$ h	$0.5 < a_r < 0.9$	High	Second	DS	[44,45]
Generation	PV Unit	Unidirectional (Upward)	Curtailable	$0.25 < a_r < 0.4$	Good a few hours ahead	Minute	DS	[46]
	Micro-CHP unit (kW)	Unidirectional (production mode)	Energy type	$a_r \approx 1$	Perfect	Rather slow (5%/min)	DS	[37]

[a] Where DS stands for distribution grid and TS for transmission grid.

- Activation Time Yes No ☐

- Click or tap here to enter text.
- Direction Yes ☐ No ☐
- Click or tap here to enter text.
- Bid size – MW Yes ☐ No ☐
- Click or tap here to enter text.
- Type of unit Yes ☐ No ☐
- Click or tap here to enter text.
- Availability ratio Yes ☐ No ☐
- Click or tap here to enter text.
- Technical response time Yes ☐ No ☐
- Click or tap here to enter text.
- Location of the measuring process Yes ☐ No ☐
- Click or tap here to enter text.
- Number of instances/days per year Yes ☐ No ☐
- Click or tap here to enter text.
- Other? Please provide additional inputs, explanation or figures in the frames following the requirements proposed.

Click or tap here to enter text.

1.1.4. Are the flexibility services the same for DSOs and TSOs in your country?

Yes ☐ No ☐

1.1.4.1. If no, please highlight the differences in terms of requirements, following those proposed in the question 1.1.3.

Click or tap here to enter text.

1.1.5. Is/are there solution(s) for flexibility services to be clustered in your country?

- At national level: Yes ☐ No ■ Not aware ☐
- At regional level: Yes ☐ No ■ Not aware ☐
- At local level: Yes ☐ No ■ Not aware ☐

1.1.5.1. If yes, how can it/they be clustered?

Click or tap here to enter text.

1.1.6. Which criteria/criterion should define the flexibility services suitable for DSO control area?

Flexibility service	Suggested criteria
Voltage control	Size of unit and location in the network
Congestion management	Size of unit and location in the network

1.2 Organization of flexibility provision framework

1.2.1. Are the flexibility products standardized in your country?

Yes ☐ No ■

1.2.1.1. If yes, which ones:

Click or tap here to enter text.

1.2.2. Are bilateral agreements included to the flexibility market in your country? (E.g.: DER owner & DSO)

Yes ☐ No ■

1.2.3.Do TSOs and DSOs cooperate to organize the flexibility market in your country?

Yes ☐ No ■

1.2.4. Is there foreseen a framework in your country for TSO/DSO cooperation on

- Balancing: Yes ☐ No ■
- Network planning: Yes ■ No ☐
- Operation: Yes ■ No ☐
- Flexibility procurement: Yes ☐ No ■
- Data exchange: Yes ■ No ☐
- Other? (please add)

Click or tap here to enter text.

1.2.5. Is the flexibility market integrated into the existing processes of EU electricity markets?

Yes ☐ No ■

1.2.6. Do DSOs cooperate among each other to organize the flexibility market in your country?

Yes ☐ No ■

1.2.6.1. If yes, please provide example(s):

Click or tap here to enter text.

1.2.7. Is cross-border flexibility defined in your national legislation?

Yes ☐ No ■

1.2.8. Are flexibility services across countries regulated in your country legislation?

Yes ☐ No ■

1.2.9. Is there a certain flexibility market type defined in your country legislation?

Yes ☐ No ■

1.2.9.1. If yes, please specify.

Click or tap here to enter text.

1.2.10. Are operators reimbursed by the NRA when need to use flexibility?

Yes ☐ No ■

1.2.11. If no, who is covering the financial costs for flexibility services procured by DSOs in your country?

There is no flexibility service in Lithuania at DSO level. The legal framework is currently being developed

2. Customers connected to DSO network

2.1 Consumer – prosumer

2.1.1. Are consumers/prosumers enabled to provide flexibility in your country?

Yes ☐ No ■

2.1.2. Do consumers/prosumers get incentives to provide flexibility services in your country?

Yes ☐ No ■

2.1.2.1. If yes, please specify:

Click or tap here to enter text.

2.1.3. What is the minimum size of production/demand response that consumers/prosumers have to provide to be able to participate in the flexibility market in your country?

Click or tap here to enter text.

2.1.4. What are the technical requirements for consumers/prosumers to be able to participate in flexibility market in your country?

- Time-response Yes ☐ No ☐
- Availability Yes ☐ No ☐
- Additional equipment at customer/network border Yes ☐ No ☐
- Additional apparatus for observability Yes ☐ No ☐
    - Billing or settlement of services Yes ☐ No ☐
    - Others (please add)

Click or tap here to enter text.

- Additional system (like customer EMS) Yes ☐ No ☐
- Capability to follow a setpoint or capability to respect a max (min) limit at Pod (customer/network border) Yes ☐ No ☐
- Others? (please add)

Click or tap here to enter text.

2.1.5. Do consumers/prosumers get an active role in the process of providing flexibility?

Yes ☐ No ■

2.1.6. What are barriers for consumers/prosumers to participate in flexibility market in your country?

There is no market, no product, no legal basis

2.2 Flexible loads through network tariffs

2.2.1. What type of network tariffs are allowed in your country? (Mark the correct ones)

Click or tap here to enter text.

TARIFF DRIVER	**Feature**	
Energy (Eur/kWh)	Flat*	☐
	Fixed**	X
	ToU***	☐
	Dynamic (real-time)	☐

	Seasonal	☐
	Event-driven	☐
	Other:	
Capacity (Eur/kW)	Flat	☐
	Fixed	☐
	Variable	☐
	Time of Use	☐
	Other: Only for commercial customers	X
Reactive power (Eur/kvarh)		
Location	Urban vs rural	☐
	Regional	☐
Type	Household vs industrial vs commercial	☐
	the time variation of prices is exclusively due to changes in spot prices.* * Fixed-priced offers provide a fixed price of the energy component for a defined period of time, regardless of changes in the market price.* **** Time-of-use pricing: ToU network tariffs charge different pre-defined prices at pre-defined times of the day or year*	

2.2.2. Does the tariff methodology in your country provide incentives for consumers to provide flexibility?

Yes ☐ No ■

2.2.3. Who designs the tariffs (is it the regulatory authority)?

NRA

3. Energy storage and EVs

3.1. In which cases are DSOs allowed to own energy storage in your country?

Not allowed

3.2. For which functionalities are DSOs allowed to use storage in your country?

If its integrated into the network

3.3. What services are EVs allowed to sell to DSOs in your country?

- Storage Yes ☐ No ■ Not aware ☐
- Demand response Yes ☐ No ■ Not aware ☐

- Other (please add):

Click or tap here to enter text.

3.4. Is V1G (smart charging) promoted in your country?

Yes ☐ No ■

3.5. Is V2G (Vehicle-to-grid) charging allowed in your country?

Yes ☐ No ■

3.5.1. Is it promoted?

Yes ☐ No ■ Not aware ☐

4. Aggregation

4.1. Are aggregation services available in your country?

Yes ■ No ☐

4.2. What kind of customers can join aggregation services in your country?

Commercial and industrial, there is only a pilot project with TSO

4.3. Can residential consumers contract aggregators independently in your country?

Yes ■ No ☐

4.4. Could the aggregator be operating all the consumption of a consumer in your country?

Yes ■ No ☐

4.5. On what basis/features can the aggregator replace the consumer?

Click or tap here to enter text.

4.6. What are the technical specifications for aggregators in your country?

Click or tap here to enter text.

5. Local Energy Communities

5.1. Are Renewable Energy Communities (REC) defined in your country legislation?

Yes ☐ No ■

5.1.1. If yes, what geographic scope can REC assume regarding proximity to RES?

Click or tap here to enter text.

5.2. Does technical requirement(s) regulate REC in your country legislation? If yes which one(s):

- Customers must be connected to the same MV/LV transformer: Yes ☐ No ☐
- Customers must be located in the same building: Yes ☐ No ☐
- Other:

Click or tap here to enter text.

5.3. Is Citizen Energy Community (CEC) defined in your country legislation?

5.3.1. If yes, are there any geographical limitations for the dimensions of CECs defined?

Yes ☐ No ☐

5.3.2. If yes, please provide the limit:

Click or tap here to enter text.

5.4. Does technical requirement(s) regulate(s) CEC in your country legislation?

Yes ☐ No ☐

5.4.1. If yes which one(s):

- Customers must be connected to the same MV/LV transformer: Yes ☐ No ☐
- Customers must be located in the same building: Yes ☐ No ☐
- Other:

Click or tap here to enter text.

5.5. Is there a framework in your country on REC/CEC and DSO cooperation?

Yes ☐ No ☐

5.5.1. If yes, what does it includes?

Click or tap here to enter text.

5.5.2. Are RECs and CECs allowed to provide flexibility services in your country?

Yes ☐ No ☐

Click or tap here to enter text.

5.6. Which further classes of energy communities are worth to be considered in your network?

- Collective generation and trading of electricity Yes ☐ No ☐
- Generation-Consumption Communities Yes ☐ No ☐
- Collective residential & industrial self-consumption Yes ☐ No ☐
- Energy positive districts Yes ☐ No ☐
- Energy islands Yes ☐ No ☐
- Municipal utilities Yes ☐ No ☐
- Financial aggregation and investment Yes ☐ No ☐
- Cooperative Financing of Energy Efficiency Yes ☐ No ☐
- Collective service providers Yes ☐ No ☐
- Digital supply and demand response systems Yes ☐ No ☐
- If other, please provide them:

Click or tap here to enter text.

6. DSO revenue regulation

6.1. What are the regulations in your country regarding DSO investments in innovation?

Now only from own money, But legal framework is under preparation

6.2. Do revenues reflect CAPEX?

Yes ☐ No ☐

Please explain your answer:

Click or tap here to enter text.

6.3. Do revenues reflect OPEX?

Yes ☐ No ☐

Please explain your answer:

Click or tap here to enter text.

6.4. Does revenue cap in your country provide incentives to innovation?

Yes ☐ No ☐

Please explain your answer:

Click or tap here to enter text.

6.5.Does revenue cap in your country provide incentives to DER development?

Yes ☐ No ■

Please explain your answer:

Click or tap here to enter text.

6.6. Are there any tools / sandboxes / that allow DSO to invest in innovations in your country?

Yes ■ No ☐

6.6.1. If yes, which one(s):

DSO has onw sandbox, NRA sandbox is under preparation phase

7. Blockchain and Smart contracts in the energy sector

7.1. Is there a national strategy for regulating the application of blockchain technology?

Yes ☐ No ■

7.2.1. Is there a national strategy for regulating the application of blockchain technology specific for the energy sector?

Yes ☐ No ■

If yes, could you please describe it:

Click or tap here to enter text.

7.3. Does your country recognize smart contracts as legal contracts?

Yes ■ No ☐

7.3.1. If yes, please specify How?

Connect hybrid generation at one connection point

7.4. Are there any sandboxes in your country to check blockchain technology?

Yes ☐ No ■

7.5. Which are, in your opinion, barriers in the current regulatory framework that could hinder the application of the blockchain technology?

- Legal value Yes ☐ No ☐
- Territoriality Yes ☐ No ☐
- Liability Yes ☐ No ☐
- Enforceability Yes ☐ No ☐
- Data privacy Yes ☐ No ☐
- Energy consumption Yes ☐ No ☐
- Time of elaboration Yes ☐ No ☐
- Others:

Click or tap here to enter text.

8. Data management, protection, and cybersecurity

8.1. Who owns energy data in your country?

Type of data	Data owner
All energy meters data	DSO

8.2. Who collects energy data in your country?

Type of data	Data collector
All energy meters data	DSO

8.3. Who stores energy data in your country?

Type of data	Data storage-provider

8.4 Who purchase each energy data and for which purpose(s)?

There is no purchase of energy data

Type of data	Uses	Purchaser

8.5 Are some data more relevant for DSOs than other?

Yes ☐ No ■

8.5.1. If yes, please specify which one(s) and organise the from the most useful to the less useful:

	Type of data	Usefulness (please explain why)
1.		
2.		
3.		
4.		
5.		
6.		

8.5. What rooting process(es) is/are used to exchange data in your country

	Type of data	Rooting process(es)*	Stakeholders involved
1.			
2.			
3.			
4.			
5.			
6.			

Click or tap here to enter text.

8.6. If a market participant wants to access the data, is that feasible in your country? how?

	Market participant	Feasible (Yes/No + please explain why/how)
1.	*e.g. Aggregator*	
2.	Supplier	Yes via Dathub with the consent of the customers

3.		
4.		
5.		
6.		

Questions for the specific DSO

8.7 Do you foresee a Data Access Policy for the energy data you manage?

Yes ■ No □

8.7.1. If not sensitive, could you please provide the main points structuring this policy please?

Click or tap here to enter text.

8.8 How do you protect the access to the energy data?

	Type of data	Protection (please explain how and why)
1.	Customer information	GDBR rules
2.	Consumption/generation data	GDBR rules
3.		
4.		
5.		
6.		

8.9 Do you apply any mechanism for ensuring data privacy and data integrity and avoiding data tampering?

Yes □ No ■

B.4 Portugal

Which country do you operate in?

Portugal

E-mail address (optional: will be used to ask further explanation of answer if needed)

Click or tap here to enter text.

Added questions:

How many DSOs are operating in your country?

13

What is the volume of lines your DSO is operating? (in Km)

228 thousand km

Your DSO belong to which following category:

- Less than 100 000 connected customers ☐
- Between 100 000 and 1 million connected customers ☐
- More than 1 million connected customers ☐

For electricity distribution, what share, in percentage, your DSO represents in your country in terms of…

- Volume of lines: Click or tap here to enter text.
- Connection points: Click or tap here to enter text.
- Customers: Click or tap here to enter text.

There are only 10 really small DSO in Continental Portugal, so E-Redes represents the large majority of lines, connection points and customers.

1. **Flexibility services**

Flexibility services include "up regulation" that provides additional power as needed to maintain system balance, and "down regulation" that reduces the power generation in the system. Both up and down regulation can also be supplied by controllable loads.

1.1 Energy flexibility and demand response

1.1.1. Can a DSO procure flexibility services in your country? If yes, please specify which ones.

No

1.1.2. What are the most relevant flexibility service(s) serve(s) for your DSO?

- Voltage Control: Yes ☐ No ☐
- Congestion solving: Yes ☐ No ☐
- Other? (please add)

Click or tap here to enter text.

1.1.3. Following this table, what are the requirements for flexibility services in your country?

Table 1
Different DER and their technical characteristics.

	DER	Flexibility direction	Flexibility characteristic (power vs energy)	Availability ratio	Predictability	Technical response time	Grid[a]	Ref.
Electrical Consumption	Lighting loads (W)	Unidirectional (downward)	New LED systems: energy types older lightings: power types	$0.2 < a_r < 0.5$ during peak hours	Good	Second	DS	[38–40]
	Dispatchable, residential loads (washing machines, dishwasher)	Unidirectional (downward)	Power type 5 s $< t_r <$ 5 min	$a_r < 0.1$ low *max power ratios* t_r due to max off time	High	Second	DS	[39,40]
	Electrical heating/ Cooling (continuous loads)	Unidirectional (downward)	Power type $t_r \approx$ 15 min	$0.4 < a_r < 1$	High	Second	DS	[40,41]
Bi-directional	Electrochemical Energy Storage (EES) (kW-MW)	Bidirectional	Power & Energy types 4 s $< t_r <$ 10 h	$a_r \approx 1$	Perfect	Second to Minute	DS or TS	[42,43]
	Electric Vehicle (kW)	Unidirectional or Bidirectional	Power & Energy types 30 min $< t_r <$ 6 h	$0.5 < a_r < 0.9$	High	Second	DS	[44,45]
Generation	PV Unit	Unidirectional (Upward)	Curtailable	$0.25 < a_r < 0.4$	Good a few hours ahead	Minute	DS	[46]
	Micro-CHP unit (kW)	Unidirectional (production mode)	Energy type	$a_r \approx 1$	Perfect	Rather slow (5%/min)	DS	[37]

[a] Where DS stands for distribution grid and TS for transmission grid.

- Activation Time Yes ☐ No ☐
- Click or tap here to enter text.
- Direction Yes ☐ No ☐
- Click or tap here to enter text.
- Bid size – MW Yes ☐ No ☐
- Click or tap here to enter text.
- Type of unit Yes ☐ No ☐
- Click or tap here to enter text.
- Availability ratio Yes ☐ No ☐
- Click or tap here to enter text.
- Technical response time Yes ☐ No ☐
- Click or tap here to enter text.
- Location of the measuring process Yes ☐ No ☐
- Click or tap here to enter text.
- Number of instances/days per year Yes ☐ No ☐
- Click or tap here to enter text.
- Other? Please provide additional inputs, explanation or figures in the frames following the requirements proposed.

Click or tap here to enter text.

1.1.4. Are the flexibility services the same for DSOs and TSOs in your country?

Yes ☐ No ☐

1.1.4.1. If no, please highlight the differences in terms of requirements, following those proposed in the question 1.1.3.

Click or tap here to enter text.

1.1.5. Is/are there solution(s) for flexibility services to be clustered in your country?

- At national level: Yes ☐ No ☐ Not aware ☐
- At regional level: Yes ☐ No ☐ Not aware ☐
- At local level: Yes ☐ No ☐ Not aware ☐

1.1.5.1. If yes, how can it/they be clustered?

Click or tap here to enter text.

1.1.6. Which criteria/criterion should define the flexibility services suitable for DSO control area?

Flexibility service	Suggested criteria

1.2 Organization of flexibility provision framework

1.2.1. Are the flexibility products standardized in your country?

Yes ☐ No ■

1.2.1.1. If yes, which ones:

Click or tap here to enter text.

1.2.2. Are bilateral agreements included to the flexibility market in your country? (E.g.: DER owner & DSO)

Yes ☐ No ■

1.2.3.Do TSOs and DSOs cooperate to organize the flexibility market in your country?

Yes ☐ No X

1.2.4. Is there foreseen a framework in your country for TSO/DSO cooperation on

- Balancing: Yes ☐ No ■
- Network planning: Yes ■ No ☐
- Operation: Yes ■ No ☐
- Flexibility procurement: Yes ☐ No ■
- Data exchange: Yes ■ No ☐
- Other? (please add)

Click or tap here to enter text.

1.2.5. Is the flexibility market integrated into the existing processes of EU electricity markets?

Yes ☐ No ☐

1.2.6. Do DSOs cooperate among each other to organize the flexibility market in your country?

Yes ☐ No ■

1.2.6.1. If yes, please provide example(s):

Click or tap here to enter text.

1.2.7. Is cross-border flexibility defined in your national legislation?

Yes ☐ No ■

1.2.8. Are flexibility services across countries regulated in your country legislation?

Yes ☐ No ■

1.2.9. Is there a certain flexibility market type defined in your country legislation?

Yes ☐ No ■

1.2.9.1. If yes, please specify.

Click or tap here to enter text.

1.2.10. Are operators reimbursed by the NRA when need to use flexibility?

Yes ☐ No ☐

1.2.11. If no, who is covering the financial costs for flexibility services procured by DSOs in your country?

Click or tap here to enter text.

2. Customers connected to DSO network

2.1 Consumer – prosumer

2.1.1. Are consumers/prosumers enabled to provide flexibility in your country?

Yes ☐ No ■

2.1.2. Do consumers/prosumers get incentives to provide flexibility services in your country?

Yes ☐ No ■

2.1.2.1. If yes, please specify:

Click or tap here to enter text.

2.1.3. What is the minimum size of production/demand response that consumers/prosumers have to provide to be able to participate in the flexibility market in your country?

Click or tap here to enter text.

2.1.4. What are the technical requirements for consumers/prosumers to be able to participate in flexibility market in your country?

- Time-response Yes ☐ No ☐
- Availability Yes ☐ No ☐
- Additional equipment at customer/network border Yes ☐ No ☐
- Additional apparatus for observability Yes ☐ No ☐
  - Billing or settlement of services Yes ☐ No ☐
  - Others (please add)

Click or tap here to enter text.

- Additional system (like customer EMS) Yes ☐ No ☐
- Capability to follow a setpoint or capability to respect a max (min) limit at Pod (customer/network border) Yes ☐ No ☐
- Others? (please add)

Click or tap here to enter text.

2.1.5. Do consumers/prosumers get an active role in the process of providing flexibility?

Yes ☐ No ☐

2.1.6. What are barriers for consumers/prosumers to participate in flexibility market in your country?

Click or tap here to enter text.

2.2 Flexible loads through network tariffs

2.2.1. What type of network tariffs are allowed in your country? (Mark the correct ones)

Click or tap here to enter text.

TARIFF DRIVER	Feature	
Energy (Eur/kWh)	Flat*	☐
	Fixed**	☒
	ToU***	☒
	Dynamic (real-time)	☐
	Seasonal	☒
	Event-driven	☐
	Other:	
Capacity (Eur/kW)	Flat	☐
	Fixed	☒
	Variable	☐
	Time of Use	☒
	Other:	☐
Reactive power (Eur/kvarh)		
Location	Urban vs rural	☐
	Regional	☐
Type	Household vs industrial vs commercial	☒
	the time variation of prices is exclusively due to changes in spot prices.* * Fixed-priced offers provide a fixed price of the energy component for a defined period of time, regardless of changes in the market price.* **** Time-of-use pricing: ToU network tariffs charge different pre-defined prices at pre-defined times of the day or year*	

2.2.2. Does the tariff methodology in your country provide incentives for consumers to provide flexibility?

Yes ☐ No ■

2.2.3. Who designs the tariffs (is it the regulatory authority)?

NRA

3. Energy storage and EVs

3.1. In which cases are DSOs allowed to own energy storage in your country?

To be defined

3.2. For which functionalities are DSOs allowed to use storage in your country?

To be defined

3.3. What services are EVs allowed to sell to DSOs in your country?

- Storage Yes ☐ No ■ Not aware ☐
- Demand response Yes ☐ No ■ Not aware ☐
- Other (please add):

Click or tap here to enter text.

3.4. Is V1G (smart charging) promoted in your country?

Yes ☐ No ☐

3.5. Is V2G (Vehicle-to-grid) charging allowed in your country?

Yes ☐ No ☐

3.5.1. Is it promoted?

Yes ☐ No ☐ Not aware ☐

4. Aggregation

4.1. Are aggregation services available in your country?

Yes ☐ No ■

4.2. What kind of customers can join aggregation services in your country?

Click or tap here to enter text.

4.3. Can residential consumers contract aggregators independently in your country?

Yes ☐ No ☐

4.4. Could the aggregator be operating all the consumption of a consumer in your country?

Yes ☐ No ☐

4.5. On what basis/features can the aggregator replace the consumer?

Click or tap here to enter text.

4.6. What are the technical specifications for aggregators in your country?

Click or tap here to enter text.

5. Local Energy Communities

5.1. Are Renewable Energy Communities (REC) defined in your country legislation?

Yes ■ No ☐

5.1.1. If yes, what geographic scope can REC assume regarding proximity to RES?

Same building or area of apartments/houses. Assessed case by case by the technical regulator (DGEG)

5.2. Does technical requirement(s) regulate REC in your country legislation? If yes which one(s:

- Customers must be connected to the same MV/LV transformer: Yes ■ No ☐
- Customers must be located in the same building: Yes ■ No ☐
- Other:

Assessed case by case by the technical regulator (DGEG)

5.3. Is Citizen Energy Community (CEC) defined in your country legislation? No

5.3.1. If yes, are there any geographical limitations for the dimensions of CECs defined?

Yes ☐ No ☐

5.3.2. If yes, please provide the limit:

Click or tap here to enter text.

5.4. Does technical requirement(s) regulate(s) CEC in your country legislation?

Yes ☐ No ☐

5.4.1. If yes which one(s):

- Customers must be connected to the same MV/LV transformer: Yes ☐ No ☐
- Customers must be located in the same building: Yes ☐ No ☐
- Other:

Click or tap here to enter text.

5.5. Is there a framework in your country on REC/CEC and DSO cooperation?

Yes ■ No ☐

5.5.1. If yes, what does it includes ?

Mostly related with metering and consumption information exchange

5.5.2. Are RECs and CECs allowed to provide flexibility services in your country?

Yes ☐ No ☐

Click or tap here to enter text.

5.6. Which further classes of energy communities are worth to be considered in your network?

- Collective generation and trading of electricity Yes ☐ No ☐
- Generation-Consumption Communities Yes ☐ No ☐
- Collective residential & industrial self-consumption Yes ☐ No ☐
- Energy positive districts Yes ☐ No ☐
- Energy islands Yes ☐ No ☐
- Municipal utilities Yes ☐ No ☐
- Financial aggregation and investment Yes ☐ No ☐
- Cooperative Financing of Energy Efficiency Yes ☐ No ☐
- Collective service providers Yes ☐ No ☐
- Digital supply and demand response systems Yes ☐ No ☐
- If other, please provide them:

Click or tap here to enter text.

6. DSO revenue regulation

6.1. What are the regulations in your country regarding DSO investments in innovation?

Click or tap here to enter text.

6.2. Do revenues reflect CAPEX?

Yes ■ No ☐

Please explain your answer:

The HV and MV allowed revenues model establishes a specific regulatory rate of return on the company's net Regulated Asset Base. In general, the way the regulator sets allowed revenues takes into account the company's asset base.

6.3. Do revenues reflect OPEX?

Yes ■ No ☐

Please explain your answer:

The regulator, prior to the beginning of a new regulatory period, sets the allowed operating costs that the company has the right to recover through network tariffs.

6.4. Does revenue cap in your country provide incentives to innovation?

Yes ■ No ☐

Please explain your answer:

ERSE sets a specific smart grid investment incentive, which can reward the company with an additional rate of return on project that are proved to deliver certain outputs. On the other hand, there is now a new incentive which is given to the DSO for each connection point that benefits from a series of new and smart services.

6.5.Does revenue cap in your country provide incentives to DER development?

Yes ■ No ☐

Please explain your answer:

There is no direct incentive related to DER. There are, however, the two incentives mentioned on question 6.4's answer: one of them for innovative projects and the other for consumption points that benefit from new and smart services (such as remote operations or new consumption data being provided).

6.6. Are there any tools / sandboxes / that allow DSO to invest in innovations in your country?

Yes ☐ No ■

6.6.1. If yes, which one(s):

Click or tap here to enter text.

7. Blockchain and Smart contracts in the energy sector

7.1. Is there a national strategy for regulating the application of blockchain technology?

Yes ☐ No ■

7.2.1. Is there a national strategy for regulating the application of blockchain technology specific for the energy sector?

Yes ☐ No ■

If yes, could you please describe it:

Click or tap here to enter text.

7.3. Does your country recognize smart contracts as legal contracts?

Yes ☐ No ☐

7.3.1. If yes, please specify How?

Click or tap here to enter text.

7.4. Are there any sandboxes in your country to check blockchain technology?

Yes ☐ No ☐

7.5. Which are, in your opinion, barriers in the current regulatory framework that could hinder the application of the blockchain technology?

- Legal value Yes ☐ No ☐
- Territoriality Yes ☐ No ☐
- Liability Yes ☐ No ☐
- Enforceability Yes ☐ No ☐
- Data privacy Yes ☐ No ☐
- Energy consumption Yes ☐ No ☐
- Time of elaboration Yes ☐ No ☐
- Others:

Click or tap here to enter text.

8. Data management, protection, and cybersecurity

8.1. Who owns energy data in your country?

Type of data	Data owner

8.2. Who collects energy data in your country?

Type of data	Data collector

8.3. Who stores energy data in your country?

Type of data	Data storage-provider

8.4 Who purchase each energy data and for which purpose(s)?

Click or tap here to enter text.

Type of data	Uses	Purchaser

8.5 Are some data more relevant for DSOs than other?

Yes ☐ No ☐

8.5.1. If yes, please specify which one(s) and organise the from the most useful to the less useful:

	Type of data	Usefulness (please explain why)
1.		
2.		
3.		
4.		
5.		
6.		

8.5. What rooting process(es) is/are used to exchange data in your country

	Type of data	Rooting process(es)*	Stakeholders involved

1.			
2.			
3.			
4.			
5.			
6.			

Click or tap here to enter text.

8.6. If a market participant wants to access the data, is that feasible in your country? how?

	Market participant	Feasible (Yes/No + please explain why/how)
1.	*e.g. Aggregator*	
2.		
3.		
4.		
5.		
6.		

Questions for the specific DSO

8.7 Do you foresee a Data Access Policy for the energy data you manage?

Yes ☐ No ☐

8.7.1. If not sensitive, could you please provide the main points structuring this policy please?

Click or tap here to enter text.

8.8 How do you protect the access to the energy data?

	Type of data	Protection (please explain how and why)
1.		
2.		
3.		
4.		
5.		
6.		

8.9 Do you apply any mechanism for ensuring data privacy and data integrity and avoiding data tampering?

Yes ☐ No ☐

8.9.1. If yes, what mechanisms?

	Type of data	Mechanism (please explain how)
1.		
2.		
3.		
4.		
5.		
6.		

B.5 Spain

Which country do you operate in?

Spain

Added questions:

How many DSOs are operating in your country?

354

What is the volume of lines your DSO is operating? (in Km)

270.480 Km

Your DSO belong to which following category:

- Less than 100 000 connected customers ☐
- Between 100 000 and 1 million connected customers ☐
- More than 1 million connected customers ■

For electricity distribution, what share, in percentage, your DSO represents in your country in terms of…

- Volume of lines: 38%
- Connection points: 40%
- Customers: 40%

1. Flexibility services

Flexibility services include "up regulation" that provides additional power as needed to maintain system balance, and "down regulation" that reduces the power generation in the system. Both up and down regulation can also be supplied by controllable loads.

1.1 Energy flexibility and demand response

1.1.1. Can a DSO procure flexibility services in your country? If yes, please specify which ones.

No, but there are some demonstration projects ongoing. I-DE participates in CoordiNet and OneNet

1.1.2. What are the most relevant flexibility service(s) serve(s) for your DSO?

- Voltage Control: Yes ☐ No ■
- Congestion solving: Yes ☐ No ■
- Other? (please add)

Controlled Islanding is a service tested, but not the most relevant.

1.1.3. Following this table, what are the requirements for flexibility services in your country?

Table 1
Different DER and their technical characteristics.

	DER	Flexibility direction	Flexibility characteristic (power vs energy)	Availability ratio	Predictability	Technical response time	Grid[a]	Ref.
Electrical Consumption	Lighting loads (W)	Unidirectional (downward)	New LED systems: energy types older lightings: power types	$0.2 < a_r < 0.5$ during peak hours	Good	Second	DS	[38–40]
	Dispatchable, residential loads (washing machines, dishwasher)	Unidirectional (downward)	Power type $5\ s < t_r < 5$ min	$a_r < 0.1$ low *max power ratios* t_r due to max off time	High	Second	DS	[39,40]
	Electrical heating/ Cooling (continuous loads)	Unidirectional (downward)	Power type $t_r \approx 15$ min	$0.4 < a_r < 1$	High	Second	DS	[40,41]
Bi-directional	Electrochemical Energy Storage (EES) (kW-MW)	Bidirectional	Power & Energy types $4\ s < t_r < 10$ h	$a_r \approx 1$	Perfect	Second to Minute	DS or TS	[42,43]
	Electric Vehicle (kW)	Unidirectional or Bidirectional	Power & Energy types 30 min $< t_r < 6$ h	$0.5 < a_r < 0.9$	High	Second	DS	[44,45]
Generation	PV Unit	Unidirectional (Upward)	Curtailable	$0.25 < a_r < 0.4$	Good a few hours ahead	Minute	DS	[46]
	Micro-CHP unit (kW)	Unidirectional (production mode)	Energy type	$a_r \approx 1$	Perfect	Rather slow (5%/min)	DS	[37]

[a] Where DS stands for distribution grid and TS for transmission grid.

- Activation Time Yes No ☐

Not applicable in Spain yet as there are not services established. This requirement should exist, but not very demanding. Long activation times (30-60 min) are also useful.

- Direction Yes ☐ No ☐

Not applicable in Spain yet as there are not services established. This requirement should exist.

- Bid size – MW Yes ☐ No ☐

Not applicable in Spain yet as there are not services established. This requirement should exist.

- Type of unit Yes ☐ No ☐

Not applicable in Spain yet as there are not services established. This requirement is not so necessary unless it refers to generation, demand and storage.

- Availability ratio Yes ☐ No ☐

Not applicable in Spain yet as there are not services established. This requirement should exist.

- Technical response time Yes ☐ No ☐

Not applicable in Spain yet as there are not services established. This requirement should exist.

- Location of the measuring process Yes ☐ No ☐

Not applicable in Spain yet as there are not services established. This requirement should exist.

- Number of instances/days per year Yes ☐ No ☐

Not applicable in Spain yet as there are not services established. This requirement is not so necessary as they are free to bid when possible.

- Other? Please provide additional inputs, explanation or figures in the frames following the requirements proposed.

Requirements should enable as many resources as possible.

1.1.4. Are the flexibility services the same for DSOs and TSOs in your country?

Yes ☐ No ■

1.1.4.1. If no, please highlight the differences in terms of requirements, following those proposed in the question 1.1.3.

TSO has flexibility services related to Balancing. DSO services are not in place. They should be less demanding.

1.1.5. Is/are there solution(s) for flexibility services to be clustered in your country?

- At national level: Yes ■ No ☐ Not aware ☐
- At regional level: Yes ■ No ☐ Not aware ☐
- At local level: Yes ■ No ☐ Not aware ☐

1.1.5.1. If yes, how can it/they be clustered?

Throughout the establishment of different type of flexibility solutions according to grid necessities.

1.1.6. Which criteria/criterion should define the flexibility services suitable for DSO control area?

Flexibility service	Suggested criteria
Congestion management	Need to operate without reaching the acceptable active power limits
Voltage Control	Need to operate without reaching the required voltage limits

Controlled Islanding	Need to maintain the security of supply in case of grid failure

1.2 Organization of flexibility provision framework

1.2.1. Are the flexibility products standardized in your country?

Yes ☐ No ■

1.2.1.1. If yes, which ones:

They should be standardized, but with enough diversity to reach all solutions.

1.2.2. Are bilateral agreements included to the flexibility market in your country? (E.g.: DER owner & DSO) They should be included

Yes ☐ No ■

1.2.3.Do TSOs and DSOs cooperate to organize the flexibility market in your country?

Yes ■ No ☐

Under the CoordiNet project.

1.2.4. Is there foreseen a framework in your country for TSO/DSO cooperation on

- Balancing: Yes ☐ No ☐
- Network planning: Yes ☐ No ☐
- Operation: Yes ☐ No ☐
- Flexibility procurement: Yes ☐ No ☐
- Data exchange: Yes ☐ No ☐
- Other ? (please add)

The TSO and two DSOs are participating in the CoordiNet project in which coordination is being assessed. But there is not a regulatory framework for the coordination.

1.2.5. Is the flexibility market integrated into the existing processes of EU electricity markets?

Yes ☐ No ■

1.2.6. Do DSOs cooperate among each other to organize the flexibility market in your country?

Yes ■ No ☐

1.2.6.1. If yes, please provide example(s):

Working together in demonstration projects (CoordiNet, Onenet) and in workgroups to enable these solutions (Futured Flexibility WG).

1.2.7. Is cross-border flexibility defined in your national legislation?

Yes ☐ No ■ Only for balancing services (TSOs)

1.2.8. Are flexibility services across countries regulated in your country legislation?

Yes ☐ No ■

1.2.9. Is there a certain flexibility market type defined in your country legislation?

Yes ☐ No ■

1.2.9.1. If yes, please specify.

REE is participating in European projects related to standard balancing products.

1.2.10. Are operators reimbursed by the NRA when need to use flexibility?

Yes ☐ No ■

1.2.11. If no, who is covering the financial costs for flexibility services procured by DSOs in your country?

Under pilot projects which have their own budget

2. Customers connected to DSO network

2.1 Consumer – prosumer

2.1.1. Are consumers/prosumers enabled to provide flexibility in your country?

Yes ☐ No ■

2.1.2. Do consumers/prosumers get incentives to provide flexibility services in your country?

Yes ☐ No ■

2.1.2.1. If yes, please specify:

Demand can participate in balancing products RR, aFRR and mFRR.

2.1.3. What is the minimum size of production/demand response that consumers/prosumers have to provide to be able to participate in the flexibility market in your country?

Not defined yet, but it should be related to the product and/or the voltage level.

2.1.4. What are the technical requirements for consumers/prosumers to be able to participate in flexibility market in your country?

- Time-response Yes ☐ No ☐
- Availability Yes ☐ No ☐
- Additional equipment at customer/network border Yes ☐ No ☐
- Additional apparatus for observability Yes ☐ No ☐
  - Billing or settlement of services Yes ☐ No ☐
  - Others (please add)

Not defined yet, but observability need to me considered.

- Additional system (like customer EMS) Yes ☐ No ☐
- Capability to follow a setpoint or capability to respect a max (min) limit at Pod (customer/network border) Yes ☐ No ☐
- Others? (please add)

Not defined yet, but it should be related to the product and/or the voltage level.

2.1.5. Do consumers/prosumers get an active role in the process of providing flexibility?

Yes ☐ No ☒

2.1.6. What are barriers for consumers/prosumers to participate in flexibility market in your country?

Lack of regulation. Incentives not defined.

2.2 Flexible loads through network tariffs

2.2.1. What type of network tariffs are allowed in your country? (Mark the correct ones)

Click or tap here to enter text.

TARIFF DRIVER	Feature	
Energy (Eur/kWh)	Flat*	☒
	Fixed**	☐
	ToU***	☐
	Dynamic (real-time)	☐
	Seasonal	☐
	Event-driven	☐
	Other: The Spanish Regulator has proposed a new mechanism for network tariffs with six (three for domestic) different periods (static ToU tariffs) and particular prescriptions for charging points for EV. This new structure is yet to be fully implemented in the next months.	
Capacity (Eur/kW)	Flat	☒
	Fixed	☐
	Variable	☐
	Time of Use	☐
	Other:	☐
Reactive power (Eur/kvarh)		
Location	Urban vs rural	☐
	Regional	☐
Type	Household vs industrial vs commercial	☒
	the time variation of prices is exclusively due to changes in spot prices.* * Fixed-priced offers provide a fixed price of the energy component for a defined period of time, regardless of changes in the market price.* **** Time-of-use pricing: ToU network tariffs charge different pre-defined prices at pre-defined times of the day or year*	

2.2.2. Does the tariff methodology in your country provide incentives for consumers to provide flexibility?

Yes ☐ No ☒

2.2.3. Who designs the tariffs (is it the regulatory authority)?

The Spanish National Regulatory Authority "Comisión Nacional de los Mercados y la Competencia (CNMC)".

3. Energy storage and EVs

3.1. In which cases are DSOs allowed to own energy storage in your country?

When used to ensure the safe and reliable operation of the distribution network.

3.2. For which functionalities are DSOs allowed to use storage in your country?

Ensure the safe and reliable operation of the distribution network and not used for the sale and purchase of energy

3.3. What services are EVs allowed to sell to DSOs in your country?

- Storage Yes ☐ No ■ Not aware ☐
- Demand response Yes ☐ No ■ Not aware ☐
- Other (please add):

Click or tap here to enter text.

3.4. Is V1G (smart charging) promoted in your country?

Yes ☐ No ■

3.5. Is V2G (Vehicle-to-grid) charging allowed in your country?

Yes ☐ No ■

3.5.1. Is it promoted?

Yes ☐ No ■ Not aware ☐

4. Aggregation

4.1. Are aggregation services available in your country?

Yes ☐ No ☒

4.2. What kind of customers can join aggregation services in your country?

The role of aggregator is already recognised in the Spanish legislation, but the implementation of rules for the aggregation of consumption and generation of consumers, producers or storage facilities are yet to be implemented.

4.3. Can residential consumers contract aggregators independently in your country?

Yes ☐ No ☒

4.4. Could the aggregator be operating all the consumption of a consumer in your country?

Yes ☐ No ☒

4.5. On what basis/features can the aggregator replace the consumer?

Aggregators will be able to provide aggregation services and are not related to the customer's supplier, understanding by aggregation that activity carried out by natural or legal persons that combine multiple consumptions or electricity generated from consumers, producers or storage facilities for sale or purchase in the electricity production market.

4.6. What are the technical specifications for aggregators in your country?

Such specifications are not yet implemented.

5. Local Energy Communities

5.1. Are Renewable Energy Communities (REC) defined in your country legislation?

Yes ☒ No ☐

5.1.1. If yes, what geographic scope can REC assume regarding proximity to RES?

The definition of REC in the Spanish legislation (Royal Decree-Law 23/2020) implies the proximity to the renewable energy projects that are owned or developed by these REC. The details for the geographic scope have yet to be detailed.

5.2. Does technical requirement(s) regulate REC in your country legislation? If yes which one(s0:

- Customers must be connected to the same MV/LV transformer: Yes ☐ No ☒
- Customers must be located in the same building: Yes ☐ No ☒
- Other: Not yet defined.

The geographical scope and point of connection are related to the concept of collective self-consumption, that is different to the concept of REC. In the case of collective self-consumption, the requirements to be met must be one of the above, or alternatively, they must be at a distance of less than 500m.

5.3. Is Citizen Energy Community (CEC) defined in your country legislation?

No.

5.3.1. If yes, are there any geographical limitations for the dimensions of CECs defined?

Yes ☐ No ☒

5.3.2. If yes, please provide the limit:

Click or tap here to enter text.

5.4. Does technical requirement(s) regulate(s) CEC in your country legislation?

Yes ☐ No ☒

5.4.1. If yes which one(s):

- Customers must be connected to the same MV/LV transformer: Yes ☐ No ☐
- Customers must be located in the same building: Yes ☐ No ☐
- Other:

Click or tap here to enter text.

5.5. Is there a framework in your country on REC/CEC and DSO cooperation?

Yes ☐ No ☒

5.5.1. If yes, what does it includes ?

Click or tap here to enter text.

5.5.2. Are RECs and CECs allowed to provide flexibility services in your country?

Yes ☐ No ☒

Click or tap here to enter text.

5.6. Which further classes of energy communities are worth to be considered in your network?

- Collective generation and trading of electricity Yes ☐ No ☒
- Generation-Consumption Communities Yes ☐ No ☒
- Collective residential & industrial self-consumption Yes ☒ No ☐
- Energy positive districts Yes ☐ No ☒
- Energy islands Yes ☐ No ☒
- Municipal utilities Yes ☐ No ☒

- Financial aggregation and investment Yes ☐ No ☒
- Cooperative Financing of Energy Efficiency Yes ☐ No ☒
- Collective service providers Yes ☐ No ☒
- Digital supply and demand response systems Yes ☐ No ☒
- If other, please provide them:

Click or tap here to enter text.

6. DSO revenue regulation

6.1. What are the regulations in your country regarding DSO investments in innovation?

The Spanish Royal Decree-Law 23/2020 includes regulatory sand boxes in which pilot research and innovation projects can be developed under its umbrella. The rules for the development of such sand boxes have to be implemented.

6.2. Do revenues reflect CAPEX?

Yes ☒ No ☐

Please explain your answer:

In business as usual, revenues do reflect CAPEX investment in infrastructures, but talking about investments in innovation specifically, we do not know yet the details.

6.3. Do revenues reflect OPEX?

Yes ☒ No ☐

Please explain your answer:

In business as usual, revenues do reflect OPEX for the distribution assets, but talking about innovation projects specifically, we do not know yet the details.

6.4. Does revenue cap in your country provide incentives to innovation?

Yes ☐ No ☒

Please explain your answer:

The aforementioned Royal Decree-Law 23/2020 do not provide details and new rules will have to be implemented.

6.5.Does revenue cap in your country provide incentives to DER development?

Yes ☐ No ☒

Please explain your answer:

Revenue cap could lead to the opposite scenario, where investments are not deployed in a sufficient quantity, limiting DER development.

6.6. Are there any tools / sandboxes / that allow DSO to invest in innovations in your country?

Yes ☐ No ☒

6.6.1. If yes, which one(s):

The main tools for innovation investment are the EU funds, and, to a lesser extent, national and regional funds.

7. Blockchain and Smart contracts in the energy sector

7.1. Is there a national strategy for regulating the application of blockchain technology?

Yes ☐ No x

7.2.1. Is there a national strategy for regulating the application of blockchain technology specific for the energy sector?

Yes [ ] No [x]

If yes, could you please describe it:

Click or tap here to enter text.

7.3. Does your country recognize smart contracts as legal contracts?

Yes [ ] No [x]

7.3.1. If yes, please specify How?

Click or tap here to enter text.

7.4. Are there any sandboxes in your country to check blockchain technology?

Yes [ ] No [x]

7.5. Which are, in your opinion, barriers in the current regulatory framework that could hinder the application of the blockchain technology?

- Legal value Yes [x] No [ ]
- Territoriality Yes [ ] No [x]
- Liability Yes [ ] No [x]
- Enforceability Yes [ ] No [x]
- Data privacy Yes [ ] No [x]
- Energy consumption Yes [ ] No [x]
- Time of elaboration Yes [ ] No [x]
- Others:

Click or tap here to enter text.

8. Data management, protection, and cybersecurity

8.1. Who owns energy data in your country?

Type of data	Data owner
Consumption	DSO&Customers
Monitoring	DSO/TSO

8.2. Who collects energy data in your country?

Type of data	Data collector
Consumption	DSO
Monitoring	DSO/TSO

8.3. Who stores energy data in your country?

Type of data	Data storage-provider
Consumption	DSOs & Suppliers
Monitoring	DSO/TSO

8.4 Who purchase each energy data and for which purpose(s)?

Energy data are not sold in Spain.

Type of data	Uses	Purchaser

8.5 Are some data more relevant for DSOs than other?

Yes ☒ No ☐

8.5.1. If yes, please specify which one(s) and organise the from the most useful to the less useful:

	Type of data	Usefulness (please explain why)

1.	Monitoring	Necessary for grid operation
2.	Aggregated consumption data	Forecasting, energy losses, etc.
3.	Non energy data	For regular DSO activities
4.		
5.		
6.		

8.5. What rooting process(es) is/are used to exchange data in your country

	Type of data	Rooting process(es)*	Stakeholders involved
1.	Monitoring	Real Time exchange data protocols	DSO, TSO
2.	Consumption data	Periodic data exchange for billing purposes	Suppliers
3.			
4.			
5.			
6.			

Click or tap here to enter text.

8.6. If a market participant wants to access the data, is that feasible in your country? how?

	Market participant	Feasible (Yes/No + please explain why/how)
1.	*Aggregator*	Information provided by DERs
2.	Supplier	Yes, as mentioned above.
3.	DERs	Yes, their own data
4.		
5.		
6.		

Questions for the specific DSO

8.7 Do you foresee a Data Access Policy for the energy data you manage?

Yes [X] No [ ]

8.7.1. If not sensitive, could you please provide the main points structuring this policy please?

We currently have a Data Access Policy that complies with the national and European regulations. The Policy is continually adapted to new legal requirements and practices.

8.8 How do you protect the access to the energy data?

	Type of data	Protection (please explain how and why)
1.	Consumption	RBAC Role Based Access Control. Personal and critical information has special treatment.
2.	Monitoring	RBAC Role Based Access Control. Personal and critical information has special treatment.
3.		
4.		
5.		
6.		

8.9 Do you apply any mechanism for ensuring data privacy and data integrity and avoiding data tampering?

Yes [x] No [ ]

8.9.1. If yes, what mechanisms?

	Type of data	Mechanism (please explain how)
1.	Consumption	Encryption and Authentication
2.	Monitoring	IPSEC tunnels and owned FO.
3.		
4.		
5.		
6.		

B.6 Ukraine

Which country do you operate in?

Ukraine

Added questions:

How many DSOs are operating in your country?

32

What is the volume of lines your DSO is operating? (in Km)

187 292.3

Your DSO belong to which following category:

- Less than 100 000 connected customers ☐
- Between 100 000 and 1 million connected customers ☐
- More than 1 million connected customers ■

For electricity distribution, what share, in percentage, your DSO represents in your country in terms of…

- Volume of lines: 23%
- Connection points: N/A
- Customers: 31%

1. Flexibility services

Flexibility services include "up regulation" that provides additional power as needed to maintain system balance, and "down regulation" that reduces the power generation in the system. Both up and down regulation can also be supplied by controllable loads.

1.1 Energy flexibility and demand response

1.1.1. Can a DSO procure flexibility services in your country? If yes, please specify which ones.

No

1.1.2. What are the most relevant flexibility service(s) serve(s) for your DSO?

- Voltage Control: Yes ■ No ☐
- Congestion solving: Yes ☐ No ■
- Other? (please add)

Click or tap here to enter text.

1.1.3. Following this table, what are the requirements for flexibility services in your country?

Table 1
Different DER and their technical characteristics.

	DER	Flexibility direction	Flexibility characteristic (power vs energy)	Availability ratio	Predictability	Technical response time	Grid[a]	Ref.
Electrical Consumption	Lighting loads (W)	Unidirectional (downward)	New LED systems: energy types older lightings: power types	$0.2 < a_r < 0.5$ during peak hours	Good	Second	DS	[38–40]
	Dispatchable, residential loads (washing machines, dishwasher)	Unidirectional (downward)	Power type $5\ s < t_r < 5$ min	$a_r < 0.1$ low *max power ratios* t_r due to max off time	High	Second	DS	[39,40]
	Electrical heating/ Cooling (continuous loads)	Unidirectional (downward)	Power type $t_r \approx 15$ min	$0.4 < a_r < 1$	High	Second	DS	[40,41]
Bi-directional	Electrochemical Energy Storage (EES) (kW-MW)	Bidirectional	Power & Energy types $4\ s < t_r < 10$ h	$a_r \approx 1$	Perfect	Second to Minute	DS or TS	[42,43]
	Electric Vehicle (kW)	Unidirectional or Bidirectional	Power & Energy types 30 min $< t_r < 6$ h	$0.5 < a_r < 0.9$	High	Second	DS	[44,45]
Generation	PV Unit	Unidirectional (Upward)	Curtailable	$0.25 < a_r < 0.4$	Good a few hours ahead	Minute	DS	[46]
	Micro-CHP unit (kW)	Unidirectional (production mode)	Energy type	$a_r \approx 1$	Perfect	Rather slow (5%/min)	DS	[37]

[a] Where DS stands for distribution grid and TS for transmission grid.

- Activation Time Yes No ☐

- Click or tap here to enter text.
- Direction Yes ☐ No ☐
- Click or tap here to enter text.
- Bid size – MW Yes ☐ No ☐
- Click or tap here to enter text.
- Type of unit Yes ☐ No ☐
- Click or tap here to enter text.
- Availability ratio Yes ☐ No ☐
- Click or tap here to enter text.
- Technical response time Yes ☐ No ☐
- Click or tap here to enter text.
- Location of the measuring process Yes ☐ No ☐
- Click or tap here to enter text.
- Number of instances/days per year Yes ☐ No ☐
- Click or tap here to enter text.
- Other? Please provide additional inputs, explanation or figures in the frames following the requirements proposed.

Requirements are not defined for flexibility services in Ukraine

1.1.4. Are the flexibility services the same for DSOs and TSOs in your country?

Yes ☐ No ■

1.1.4.1. If no, please highlight the differences in terms of requirements, following those proposed in the question 1.1.3.

At DSO level, flexibility services are not defined

1.1.5. Is/are there solution(s) for flexibility services to be clustered in your country?

- At national level: Yes ☐ No ■ Not aware ☐
- At regional level: Yes ☐ No ■ Not aware ☐
- At local level: Yes ☐ No ■ Not aware ☐

1.1.5.1. If yes, how can it/they be clustered?

-

1.1.6. Which criteria/criterion should define the flexibility services suitable for DSO control area?

Flexibility service	Suggested criteria

1.2 Organization of flexibility provision framework

1.2.1. Are the flexibility products standardized in your country?

Yes ☐ No ■

1.2.1.1. If yes, which ones:

-

1.2.2. Are bilateral agreements included to the flexibility market in your country? (E.g.: DER owner & DSO)

Yes ☐ No ■

1.2.3. Do TSOs and DSOs cooperate to organize the flexibility market in your country?

Yes ☐ No ■

1.2.4. Is there foreseen a framework in your country for TSO/DSO cooperation on

- Balancing: Yes ■ No ☐
- Network planning: Yes ■ No ☐
- Operation: Yes ■ No ☐
- Flexibility procurement: Yes ☐ No ■
- Data exchange: Yes ■ No ☐
- Other? (please add)

Click or tap here to enter text.

1.2.5. Is the flexibility market integrated into the existing processes of EU electricity markets?

Yes ☐ No ■

1.2.6. Do DSOs cooperate among each other to organize the flexibility market in your country?

Yes ☐ No ■

1.2.6.1. If yes, please provide example(s):

Click or tap here to enter text.

1.2.7. Is cross-border flexibility defined in your national legislation?

Yes ☐ No ■

1.2.8. Are flexibility services across countries regulated in your country legislation?

Yes ☐ No ■

1.2.9. Is there a certain flexibility market type defined in your country legislation?

Yes ☐ No ■

1.2.9.1. If yes, please specify.

Click or tap here to enter text.

1.2.10. Are operators reimbursed by the NRA when need to use flexibility?

Yes ☐ No ■

1.2.11. If no, who is covering the financial costs for flexibility services procured by DSOs in your country?

DSOs are not procured flexibility services in Ukraine

2. Customers connected to DSO network

2.1 Consumer – prosumer

2.1.1. Are consumers/prosumers enabled to provide flexibility in your country?

Yes ☐ No ■

2.1.2. Do consumers/prosumers get incentives to provide flexibility services in your country?

Yes ☐ No ■

2.1.2.1. If yes, please specify:

-

2.1.3. What is the minimum size of production/demand response that consumers/prosumers have to provide to be able to participate in the flexibility market in your country?

-

2.1.4. What are the technical requirements for consumers/prosumers to be able to participate in flexibility market in your country?

- Time-response Yes ☐ No ☐
- Availability Yes ☐ No ☐
- Additional equipment at customer/network border Yes ☐ No ☐
- Additional apparatus for observability Yes ☐ No ☐
    - Billing or settlement of services Yes ☐ No ☐
    - Others (please add)
- Additional system (like customer EMS) Yes ☐ No ☐
- Capability to follow a setpoint or capability to respect a max (min) limit at Pod (customer/network border) Yes ☐ No ☐
- Others? (please add)

Not relevant

2.1.5. Do consumers/prosumers get an active role in the process of providing flexibility?

Yes ☐ No ■

2.1.6. What are barriers for consumers/prosumers to participate in flexibility market in your country?

The lack of relevant legislation and actual absence of flexibility market.

2.2 Flexible loads through network tariffs

2.2.1. What type of network tariffs are allowed in your country? (Mark the correct ones)

Click or tap here to enter text.

TARIFF DRIVER	**Feature**	
Energy (Eur/kWh)	Flat*	☐
	Fixed**	☐
	ToU***	☐

	Dynamic (real-time)	☐
	Seasonal	☐
	Event-driven	☐
	Other: Distribution tariffs are regulated by NRA and are different for different DSOs.	
Capacity (Eur/kW)	Flat	☐
	Fixed	☐
	Variable	☐
	Time of Use	☐
	Other:	☐
Reactive power (Eur/kvarh)	Applicable for legal entities. There is a special methodology of calculation of reactive power, in accordance to which the difference between consumed and imported reactive power is determined.	
Location	Urban vs rural	☐
	Regional	☐
Type	Household vs industrial vs commercial	☐
	the time variation of prices is exclusively due to changes in spot prices.* * Fixed-priced offers provide a fixed price of the energy component for a defined period of time, regardless of changes in the market price.* **** Time-of-use pricing: ToU network tariffs charge different pre-defined prices at pre-defined times of the day or year*	

2.2.2. Does the tariff methodology in your country provide incentives for consumers to provide flexibility?

Yes ☐ No ■

2.2.3. Who designs the tariffs (is it the regulatory authority)?

Yes, the regulatory authority

3. Energy storage and EVs

3.1. In which cases are DSOs allowed to own energy storage in your country?

Currently, there is no legislation in Ukraine adopted to regulate the usage of electricity storage by the DSO.

3.2. For which functionalities are DSOs allowed to use storage in your country?

-

3.3. What services are EVs allowed to sell to DSOs in your country?

- Storage Yes ☐ No ■ Not aware ☐
- Demand response Yes ☐ No ■ Not aware ☐
- Other (please add):

Click or tap here to enter text.

3.4. Is V1G (smart charging) promoted in your country?

Yes ☐ No ■

3.5. Is V2G (Vehicle-to-grid) charging allowed in your country?

Yes ☐ No ■

3.5.1. Is it promoted?

Yes ☐ No ■ Not aware ☐

4. Aggregation

4.1. Are aggregation services available in your country?

Yes ☐ No ■

4.2. What kind of customers can join aggregation services in your country?

-

4.3. Can residential consumers contract aggregators independently in your country?

Yes ☐ No ■

4.4. Could the aggregator be operating all the consumption of a consumer in your country?

Yes ☐ No ■

4.5. On what basis/features can the aggregator replace the consumer?

-

4.6. What are the technical specifications for aggregators in your country?

N/A

5. Local Energy Communities

5.1. Are Renewable Energy Communities (REC) defined in your country legislation?

Yes ☐ No ■

5.1.1. If yes, what geographic scope can REC assume regarding proximity to RES?

-

5.2. Does technical requirement(s) regulate REC in your country legislation? If yes which one(s):

- Customers must be connected to the same MV/LV transformer: Yes ☐ No ■
- Customers must be located in the same building: Yes ☐ No ■
- Other:

Click or tap here to enter text.

5.3. Is Citizen Energy Community (CEC) defined in your country legislation?

Yes ☐ No ■

5.3.1. If yes, are there any geographical limitations for the dimensions of CECs defined?

Yes ☐ No ☐

5.3.2. If yes, please provide the limit:

Click or tap here to enter text.

5.4. Does technical requirement(s) regulate(s) CEC in your country legislation?

Yes ☐ No ■

5.4.1. If yes which one(s):

- Customers must be connected to the same MV/LV transformer: Yes ☐ No ☐
- Customers must be located in the same building: Yes ☐ No ☐
- Other:

Click or tap here to enter text.

5.5. Is there a framework in your country on REC/CEC and DSO cooperation?

Yes ☐ No ■

5.5.1. If yes, what does it includes?

Click or tap here to enter text.

5.5.2. Are RECs and CECs allowed to provide flexibility services in your country?

Yes ☐ No ☐

N/A

5.6. Which further classes of energy communities are worth to be considered in your network?

- Collective generation and trading of electricity Yes ■ No ☐
- Generation-Consumption Communities Yes ■ No ☐
- Collective residential & industrial self-consumption Yes ☐ No ■
- Energy positive districts Yes ■ No ☐
- Energy islands Yes ☐ No ■
- Municipal utilities Yes ■ No ☐
- Financial aggregation and investment Yes ☐ No ■
- Cooperative Financing of Energy Efficiency Yes ■ No ☐
- Collective service providers Yes ■ No ☐
- Digital supply and demand response systems Yes ■ No ☐
- If other, please provide them: ■ ☐

Click or tap here to enter text.

6. DSO revenue regulation

6.1. What are the regulations in your country regarding DSO investments in innovation?

There is no specific regulation governing the issues of investments in innovation. Each year the NRA approves investment program for each DSO. Investment programs may include any innovation that is subject to regulators' approval.

6.2. Do revenues reflect CAPEX?

Yes ■ No ☐

Please explain your answer:

Click or tap here to enter text.

6.3. Do revenues reflect OPEX?

Yes ■ No □

Please explain your answer:

Click or tap here to enter text.

6.4. Does revenue cap in your country provide incentives to innovation?

Yes □ No ■

Please explain your answer:

Click or tap here to enter text.

6.5. Does revenue cap in your country provide incentives to DER development?

Yes ■ No □

Please explain your answer:

Revenue caps of DSOs does not provide any incentives to DER development. Incentives for DER development are provided by a special «green tariff» for RES generation facilities. Additionally, DSO is obliged to connect in a non-discriminatory way the renewable energy sources if such connection is technically feasible.

6.6. Are there any tools / sandboxes / that allow DSO to invest in innovations in your country?

Yes □ No ■

6.6.1. If yes, which one(s):

Click or tap here to enter text.

7. Blockchain and Smart contracts in the energy sector

7.1. Is there a national strategy for regulating the application of blockchain technology?

Yes □ No ■

7.2.1. Is there a national strategy for regulating the application of blockchain technology specific for the energy sector?

Yes □ No ■

If yes, could you please describe it:

Click or tap here to enter text.

7.3. Does your country recognize smart contracts as legal contracts?

Yes □ No ■

7.3.1. If yes, please specify How?

Click or tap here to enter text.

7.4. Are there any sandboxes in your country to check blockchain technology?

Yes □ No ■

7.5. Which are, in your opinion, barriers in the current regulatory framework that could hinder the application of the blockchain technology?

- Legal value Yes ■ No □
- Territoriality Yes □ No ■
- Liability Yes ■ No □
- Enforceability Yes ■ No □
- Data privacy Yes □ No ■

- Energy consumption Yes No
- Time of elaboration Yes No
- Others:

Click or tap here to enter text.

8. Data management, protection, and cybersecurity

8.1. Who owns energy data in your country?

Type of data	Data owner
Meter data	DSO, TSO, Metering Service Providers
Load curve	DSO, TSO, Metering Service Providers
Event log of metering devices	DSO, TSO, Metering Service Providers
Real-time data of grid parameters	DSO, TSO, Metering Service Providers
Quality parameters if such recorded by the device	DSO, TSO, Metering Service Providers

8.2. Who collects energy data in your country?

Type of data	Data collector
Meter data	DSO, TSO, Metering Service Providers
Load curve	DSO, TSO, Metering Service Providers
Event log of metering devices	DSO, TSO, Metering Service Providers
Real-time data of grid parameters	DSO, TSO, Metering Service Providers
Quality parameters if such recorded by the device	DSO, TSO, Metering Service Providers

8.3. Who stores energy data in your country?

Type of data	Data storage-provider
Meter data	DSO, TSO, Metering Service Providers
Load curve	DSO, TSO, Metering Service Providers
Event log of metering devices	DSO, TSO, Metering Service Providers
Real-time data of grid parameters	DSO, TSO, Metering Service Providers

Quality parameters if such recorded by the device	DSO, TSO, Metering Service Providers

8.4 Who purchase each energy data and for which purpose(s)?

Information is not available

Type of data	Uses	Purchaser

8.5 Are some data more relevant for DSOs than other?

Yes ■ No □

8.5.1. If yes, please specify which one(s) and organise the from the most useful to the less useful:

	Type of data	Usefulness (please explain why)
1.	Load curve	The market operates in the “hourly” paradigm, and it is the profile data from the meters that are used to determine the purchase volumes of electricity by the hour of the day.
2.	Meter data	According to that data 90% of clients’ consumption is calculated.
3.	Real-time data of grid parameters	Based on this data, the correct operation of metering units is monitored.
4.	Event log of metering devices	Data required to control interventions in the meter operation (magnet, opening of the terminal cover and housing, shutdown, etc.)
5.	Quality parameters if such recorded by the device	This functionality is not widely used in metering devices.
6.		

8.5. What rooting process(es) is/are used to exchange data in your country

	Type of data	Rooting process(es)*	Stakeholders involved

1.	Load curve	Information transfer in the form of text files.	DSO, TSO, Providers of revenue metering services
2.	Meter data	Information transfer in the form of text files.	DSO, TSO, Providers of revenue metering services
3.	Generalized load graph for DSO	XML-structure	TSO
4.			
5.			
6.			

Click or tap here to enter text.

8.6. If a market participant wants to access the data, is that feasible in your country? how?

	Market participant	Feasible (Yes/No + please explain why/how)
1.	Electricity suppliers	Upon the written consent of the client.
2.	Metering Service Providers	Upon the written consent of the client.
3.		
4.		
5.		
6.		

Questions for the specific DSO

8.7 Do you foresee a Data Access Policy for the energy data you manage?

Yes ■ No ☐

8.7.1. If not sensitive, could you please provide the main points structuring this policy please?

DSOs cannot transfer personal data of the client without due consent. This applies to both household and legal entities. But we can provide generalized data, for example, for an industry as a whole or for a geographic region.

8.8 How do you protect the access to the energy data?

	Type of data	Protection (please explain how and why)
1.	Load curve	The data collection and processing system is isolated from the external network, access to the Database management system is limited at the network, physical and organizational levels (isolated networks, modern firewalls (NGFW), etc. are used).

2.	Meter data	The data collection and processing system is isolated from the external network, access to the Database management system is limited at the network, physical and organizational levels (isolated networks, modern firewalls (NGFW), etc. are used).
3.	Real-time data of grid parameters	The data collection and processing system is isolated from the external network, access to the Database management system is limited at the network, physical and organizational levels (isolated networks, modern firewalls (NGFW), etc. are used).
4.	Event log of metering devices	The data collection and processing system is isolated from the external network, access to the Database management system is limited at the network, physical and organizational levels (isolated networks, modern firewalls (NGFW), etc. are used).
5.		
6.		

8.9 Do you apply any mechanism for ensuring data privacy and data integrity and avoiding data tampering?

Yes ■ No □

8.9.1. If yes, what mechanisms?

	Type of data	Mechanism (please explain how)
1.	Load curve	Building balances according to buses, nodes. Control of balances at the acceptable level. Reading data from the database of metering devices directly. This refers to metering devices at the perimeter, technical metering at substations and legal entities.
2.	Meter data	Building balances according to buses, nodes. Control of balances at the acceptable level. Reading data from the database of metering devices directly. This refers to metering devices at the perimeter, technical metering at substations and legal entities.
3.		