FlexPlan

Advanced methodology and tools taking advantage of storage and FLEXibility in transmission and distribution grid PLANning

Lessons and recommendations on pan-European level regulation, policies and strategies

D6.3

Distribution Level	PU
Responsible Partner	RSE
Checked by WP leader	Andrei Morch (SINTEF Energi AS) – WP6 Leader Date: 2023-02-06
Approved by Project Coordinator	Gianluigi Migliavacca (RSE) Date: 2023-02-06

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 863819

Issue Record

Planned delivery date	31/01/2023
Actual date of delivery	06/02/2023
Status and version	FINAL

Version	Date	Author(s)	Notes
00	2022-12-12	Lattanzio Giorgia	Creation of the document
01	2023-01-31	Lattanzio Giorgia and Migliavacca Gianluigi	First draft
02	2023-02-06	Lattanzio Giorgia and Morch Andrei	Finalization of the document for public consultation

About FlexPlan

The FlexPlan project aims at establishing a new grid planning methodology considering the opportunity to introduce new storage and flexibility resources in electricity transmission and distribution grids as an alternative to building new grid elements. This is in line with the goals and principles of the new EC package *Clean Energy for all Europeans,* which emphasizes the potential usage of flexibility sources in the phases of grid planning and operation as alternative to grid expansion. In sight of this, FlexPlan creates a new innovative grid planning tool whose ambition is to go beyond the state of the art of planning methodologies, by including the following innovative features: integrated T&D planning, full inclusion of environmental analysis, probabilistic contingency methodologies replacing the N-1 criterion as well as optimal planning decision over several decades. However, FlexPlan is not limited to building a new tool but it also uses it to analyse six regional cases covering nearly the whole European continent, aimed at demonstrating the application of the tool on real scenarios as well as at casting a view on grid planning in Europe till 2050. In this way, the FlexPlan project tries to answer the question of which role flexibility could play and how its usage can contribute to reduce planning investments yet maintaining (at least) the current system security levels. The project ends up formulating guidelines for regulators and for the planning offices of TSOs and DSOs. The consortium includes three European TSOs, one of the most important European DSO group, several R&D companies and universities from 8 European Countries (among which the Italian RSE acting as project coordinator) and N-SIDE, the developer of the European market coupling platform EUPHEMIA.

Partners

Table of Contents

List of Abbreviations and Acronyms

Abbreviation/Acronym	Meaning
CBA	Cost Benefit Analysis
CfD	Contract for Difference
CM	Capacity Mechanisms
CRM	Capacity Remuneration Mechanisms
DER	Distribute Energy Resources
DR	Demand Response
DSO	Distribution System Operators
EFET	European Federation of Energy Trades
FC	FlexPlan Consortium
FCR	Frequency Containment Reserve
FES	Flexibility Energy Sources
FSP	Flexible Service Providers
GHG	Green House Gases
MS	Member States
NC CG	Network Code on Grid Connection
NDP	Network Development Plan
NRA	National Regulatory Authorities
OPF	Optimal Power Flow
PPAs	Power Purchase Agreements
RC	Regional Cases
RES	Renewable Energy Sources
RoE	Return on Equity
ROI	Return on Investments
RT	Real Time
SGU	Significant Grid Users
SO	System Operators
SRM	Strategic Reserve Mechanisms
T&D Networks	Transmission and Distribution Networks
ToU	Time of Use
TRL	Technology Readiness Level
TSO	Transmission System Operators
TYNDP	Ten Year Network Development Plan
WACC	Weighted Average Cost of Capital

Executive Summary

This deliverable represents the last step of the analysis of the present regulatory framework and concludes the analysis formulating guidelines and recommendations for a proper deployment of flexibility resources. The development of these recommendations is based on the importance of the role of flexibility resources, demonstrated by the FlexPlan tool, and possible regulatory barriers, identified in European and national regulations.

Starting from the work already performed during FlexPlan project and thanks to a further review of present regulations and studies, ten key factors have been selected to describe aspects which can strongly influence the deployment of flexibility resources. Each key factor is considered as a milestone to achieve a great exploitation of flexibility potential; however, they are strictly connected one to the others.

To achieve a substantial and appropriate level of system flexibility, it is necessary to develop a regulatory framework which incentivize investments in these assets. For this reason, **new incentivizing mechanisms** should be provided to private investors for the settling of new flexibility resources. System Operators (SOs) should participate in the definition of such incentives in order to create an efficient incentivizing framework which reflects the system needs, meaning that locational signals should be used to led investments in critical nodes of the networks. **Locational capacity markets** or long-term contracts, where the provision of flexibility services at a maximum price is compelled in exchange for a capacity remuneration evaluated on the basis of the local need for flexibility, represent a possibility.

The cooperation between Transmission and Distribution system operators is essential given the mutual influence. Planning activities should be carried out in a coordinated process considering the complexity of solving a unified optimization process and assuring data privacy. A simplified approach, called T&D decomposition, is proposed by FlexPlan which consider an exchange of data only at the boarder without the necessity of knowing every detail of the system.

Cost-Benefit Analysis must consider every advantageous brought by flexibility resources, benefit brought to system reliability, possible reduction of green-house-gases. Sensitivity analyses help in understanding the impact of new flexibility resources on environment with respect to the traditional resources.

Furthermore, a proper framework should also be created for **flexibility participation in real time markets**. A market reform is advised in order to assure to flexibility service providers a level-playing field where new flexibility resources are able to compete with traditional ones. In this context, the **role of aggregators** should be accurately defined and designed. Aggregators are entities that allow the participation of very small resources into real time markets reducing the risk exposure thanks to an internal compensation of the resources included in their portfolio.

Flexibility procurement could be managed by means of **market-based mechanisms or must-run dispatch**. Market-based mechanisms are always suggested in cases where a considerable amount of flexibility resources is available; however, when the amount of flexible capacity runs low, must-run dispatch could be the solution. SOs should be allowed to manage flexibility resources in real time markets

on behalf of third parties and, to avoid exercising market power, the profit should be destined to the flexibility owner.

Recently, **market reforms** have been published which aim at addressing the high energy prices. Anyway, quite often these reforms do not consider every possible role of flexibility resources. Even if flexibility resources are able to provide flexibility services and so substitute traditional technologies, arbitrage can be exploited from price oscillations, so in some cases they should be subject to price caps.

1 Introduction

The European energy sector is undergoing a major change from traditional centralized generation to a more inclusive system, relying on variable and less predictable electricity generation from renewable sources. With the objective of not losing stability and security of the electricity grid, this changeover requires resorting to services provided by flexible resources as way to ensure a degree of dispatchability comparable with the one ensured by conventional power plants. In this context, distributed energy resources (DER), such as distributed generators, storage, active consumers, local energy communities or aggregators can play an important role as well.

This progress requires new processes and regulations to assure that the system can dispose of an adequate size and location of the flexible resources as well as ensure an efficient, transparent and non-discriminatory exploitation for them. New System Operators (SO) coordination procedures, new modalities for the procurement of flexibility services, new mechanisms to provide incentives through locational signals and other regulatory provisions must be investigated to facilitate and properly complete this evolution. In recent years, the European Commission investigated and published new directives, for example Regulation EU 2019/943 [1] and Directive EU 2019/944 [2], and the forthcoming Guideline on Demand Response [3] to manage flexibility markets, guarantee resource adequacy at national and international level and valorise the role of flexibility as a support to grid planning in synergy with network investments. Several approaches have been proposed by CEER [3] and ENTSO-E [4] to exploit flexibility potential allowing transmission system operators (TSOs) and distribution system operators (DSOs) to access them. However, existing and new proposed regulations (such as [3]) are not yet sufficient, and a further development is necessary to overcome many existing barriers. Furthermore, a European framework is needed to create a level playing field for flexibility resources in the competition for services markets and reduce complexity for Flexibility Service Providers (FSP) which are active in more than one EU market while promoting a standardized market environment able to prevent gaming behaviours taking profit of distorted signals from non-harmonized national regulatory contexts.

On one hand, flexibility products can be used for short-term needs in the services markets, for example for congestion management or competing to reduce high balancing energy costs. On the other hand, in the medium/long-term, i.e. during planning processes, the availability, location and physical properties of the flexibility resources able to provide such products should be ensured on the basis of the studies carried out by the SOs. The FlexPlan project aims at developing a new toolbox which valorises the role flexible resources can play as a support of the system planning phase and, by analysing the results of its practical application to six different regional cases (RC), aims at demonstrating the advantages (in terms of reduction of the system TOTEX) which could be potentially brought by flexibility resources.

This deliverable is the concluding result of the FlexPlan work package dedicated to "Regulatory Analysis" and the last in a series of three reports that are looking into regulatory aspects related to the topics of the FlexPlan project, which include:

- Guideline for the compliance of FlexPlan network planning tool with EU overall strategies and regulatory conditions [6]

- Identified regulatory limitations and opportunities, based on the regional cases (D6.2) [7]
- Lessons and recommendations on Pan-European level regulation, policies and strategies (D6.3) the present document)

On this pathway, this deliverable represents the last step of the FlexPlan project by analysing the results of the planning simulations for the 6 regional cases, capitalizing the results in terms of the role flexible resources could play in the future, analysing present barriers for the correct deployment of such resources and elaborating regulatory guidelines to remove them. Thus, the final purpose is to collect recommendations for the regulatory bodies (European Commission, National Regulatory Authorities) on how to achieve an optimal deployment of flexible services so as to minimise overall system costs (capital and operational) in agreement with what envisaged by the system planning studies realised by the SOs. In this regard, recent studies of international organizations and agencies (ACER, CEER, IRENA, EURELECTRIC, etc.) have been analysed to extract and then focus the attention on some key points considered essential for a successful development. Both new possibilities as well as useful amendments on existing regulations are included if they are considered efficient in promoting the use of flexible resources.

In order to attain what explained above, a precise methodology has been employed, which can be summarized in 3 subsequent action points:

1. Analyse the results of the 6 regional cases in order to have an overall picture of the role flexibility can play as a support to congestion management from the short term (2030) till the medium term (2040) and the long term (2050).
2. Clarify which aspects prevent the present regulation to attain the optimal situation shown by the results of the 6 regional cases: which barriers and which regulatory gaps are at the base of them. Ten aspects ("factors") have been located, grouped into two broad categories (factors acting in the medium term at the time of the system planning to ensure the right amount of flexibility is present in the system and factors acting in real time preventing/enabling the resources to provide the right number of services whenever requested).
3. For each of the ten factors, relevant documents (both at EU level and national level) as well as position papers of the EU stakeholders have been analysed in order to grasp the on-going debate on this regard and finally, guidelines have been elaborated by summarizing the vision of the FlexPlan consortium.

The present deliverable is organized in the following chapters:

- Chapter 2 explains the reason for the choice of the 10 relevant factors: an in-depth investigation is carried out to understand why these topics are considered to be the milestones for the future regulation to achieve an optimal deployment of the flexible resources and their optimal integration into the electricity system.
- In chapter 3 each mentioned topic is analysed in depth. European and national documentation is reviewed to understand the present rules of the play and the present debate on the different issues. Public consultations are examined, as well as stakeholders' opinions, to take into

account different points of view. Finally possible barriers and suggestion on how to overcome them are discussed to help the deployment of flexible resources.

- Chapter 4 aims at summarising the lesson learnt and the way forward into a set of regulatory principles ("guidelines") which could be considered as the FlexPlan ultimate contribution, namely, to propose some focal points for the implementation of future regulations.

2 Methodology of the study

The development of a regulatory framework to guide a proper use of flexibility resources has become a very important need and the scope of this deliverable is to provide guidelines and recommendations which could help in creating such framework. The analysis followed a stepwise approach firstly observing the problem from a global point of view, understanding the needs of the system for flexibility resources. Then many regulatory aspects are deepened to analyse and highlight present barriers and opportunities brought by the in-force regulatory framework. In *Figure 2-1*, an overview of the overall process is given**Errore. L'origine riferimento non è stata trovata.**.

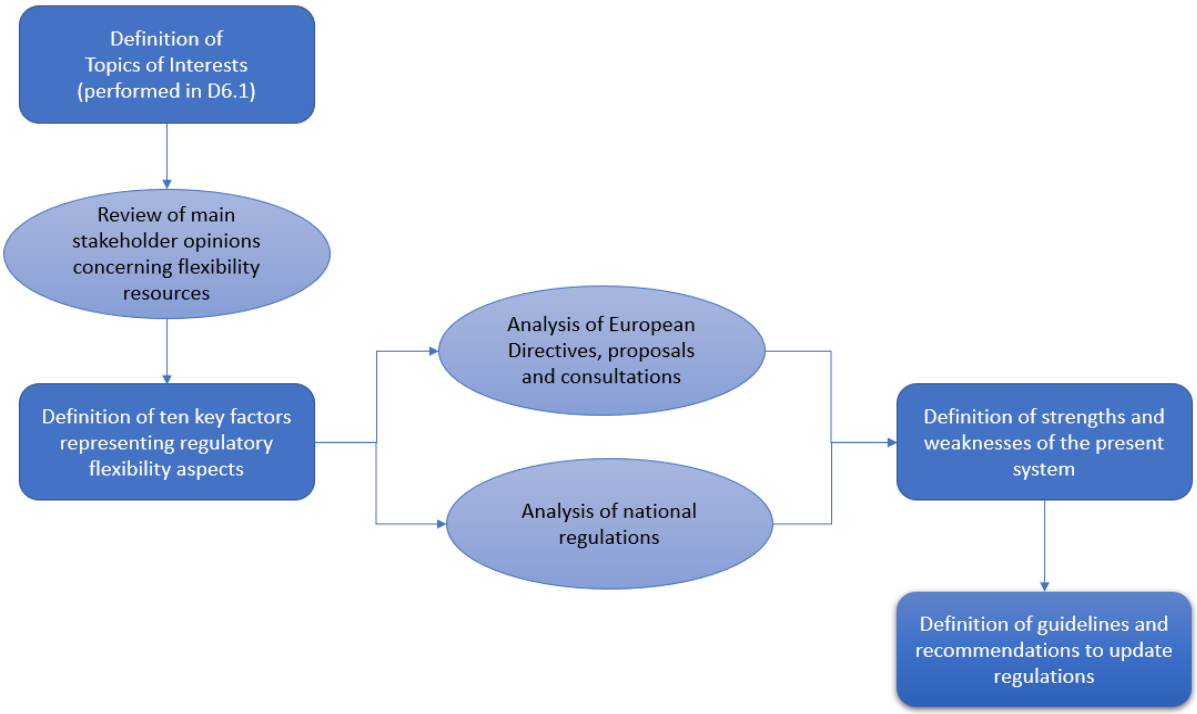

Figure 2-1 - Steps of the working methodology

The study restricts the focus to a pre-defined selection of issues, which have critical importance for FlexPlan project and are called "topics of interest". These topics represent either some key assumptions made within the project, or/and some attributes, which can be directly or indirectly decisive for the development and later for the implementation of the project outcomes. The identification of the topics of interest, used as a starting point for this activity, is described in Deliverable 6.1 [5], where a preliminary review of documents and a survey directed to TSOs and DSOs allowed to identify present procedures and practices. Indeed, the analysed topics of interests describe the main regulatory aspects that deal with flexibility resources and extrapolate present system barriers that prevent a sufficient deployment of flexible resources. Deliverable D6.1 focusses on rules, procedures and practices related to planning activities; instead, characteristics of other application fields have not been considered in this study because out of the general scope of the project. Here, after a further analysis, a total of ten key factors is selected among the identified topics of interests. These factors are listed in Section 2.1 and described in Chapter 0. Each factor has been investigated looking at European Directives, Regulations, network codes/guidelines and public consultations, mainly published by regulatory institutions, agencies and international organizations, which discuss the state-of-the-art and future possibilities for the deployment of flexibility

resources. Appendix I reports the review of the most relevant analysed documentation. After identifying the key factors, an overview of the present European system is extrapolated from published directives and proposals from the European Commission and European agencies. Whenever possible, national regulatory frameworks are investigated too. This literature review has been carried out in parallel with the analysis of the results coming from the simulations of the regional cases, which are discussed in deliverable 5.2 [6] of the FlexPlan project and which have been useful to understand which are the most influent regulation in the present system. The FlexPlan consortium organized a consistent number of brainstorming sessions during which observations, strengths and weaknesses have been brought to light and possible solutions or appropriate strategies were proposed to enable, accelerate and promote the deployment of flexibility resources. Finally, regulatory guidelines and recommendations have been elaborated.

2.1 Identified key factors

The definition of a certain number of key factors has been of great importance because it allowed to follow a systematic approach. These topics are defined so as to allow a sectorial analysis which facilitates the development of a coherent regulatory analysis. Furthermore, given the existence of a consolidated and complex regulatory framework, the definition of topics of interest is necessary to better understand in which cases an update of the regulation was required, so not to counteract present practices and rules, and in which cases a regulation is missing or lacks important details. The identified topics are:

- **Incentives for settling new flexibility resources**: it is necessary to build up a framework which promote investments in resources that have proven to be efficient for flexibility purposes.
- **Storage ownership:** up to now investment in grid infrastructures was limited to System Operators (SOs). However, the European Directive [2] does not allow SO-ownership, except for few exceptions. Therefore, National Regulatory Authorities (NRA) should provide a framework to regulate the modalities for private parties to carry out grid investments complying with optimal efficiency goals. Such goals should be pursued as the objective of the grid development studies carried out by the System Operators.
- **Responsibilities and data exchange between TSO and DSO in planning**: the increasing number of flexible resources connected to distribution grid requires a new planning methodology which include a reinforced coordination and cooperation between TSOs and DSOs, so as to make it possible for these resources to provide system services that don't stay limited to the distribution grids themselves but can also be considered as a resource for the transmission grid.
- **CBA update and internalization of environmental costs**: flexibility resources should be properly valorised when planning studies are conducted by the System Operators: every introduced benefit should be considered so as to allow them to be co-evaluated with traditional grid reinforcements.
- **Services that can be provided by flexibility resources**: flexibility resources should be deployed for the provision of services necessary to maintain system stability and reliability, different possibilities are available in order to exploit their potential and each of them should be investigated.
- **Markets flexibility resources can participate in**: in-force regulations set constraints concerning required technological characteristics for the provision of services or the participation to markets (as also specified in Art. 22 of EU Regulation 2019/943), thus which are flexibility resources allowed to participate to existing markets? Which services can they reasonably provide?

- **Products tailored for flexibility resources in Realtime (RT)-markets**: ad-hoc products must be defined to reap full benefit from flexibility potential especially when considering RT-markets. Flexibility resources should be able to compete at "level play field" conditions with traditional resources (gas fired power plants) for which these markets have ben designed.
- **Regulation on aggregators and possibility to include flexibility in their basket**: the role of aggregators could become a key one to manage flexibility resources, yet no formal definition of the entity is given by present regulations. They should act as intermediaries to guarantee the possibility for resources characterized by small-capacity and high uncertainty to participate to energy markets.
- **Interactions with capacity markets**: revising capacity remuneration mechanisms by providing locational signals for incentivizing investments in flexible resources (storage and flexibilization of big loads) in those places where System Operator studies show maximum potential is the right tool to make flexibility available where it is mostly needed. That could also be implemented by setting up new types of capacity markets **a**ble to provide differentiated prices for the different nodes of the system, so as to incentivize flexibility to settle where it could be more useful.
- **How proposed market reforms could affect flexibility remuneration**: recently published market reform hypotheses aimed at allowing to decouple energy market prices for the cost of fossil fuels should be able to consider and valorise the role of flexible resources as well

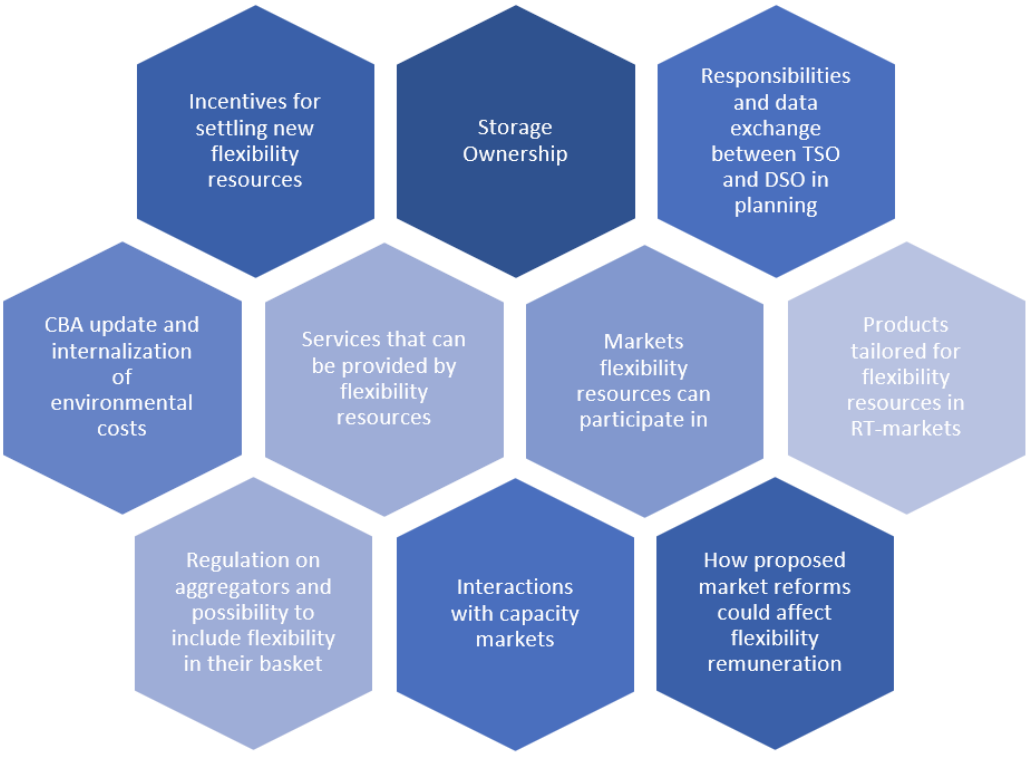

Figure 2-2 - List of topics of interest

3 Regulatory framework, stakeholders' positions, and FlexPlan Consortium opinions

In this chapter each of the factors identified and listed in Table 3-1Figure 2-2 will be analysed from different points of view. There will be an overview of the European and national regulatory frameworks, followed by an analysis of the point of views of the main European stakeholders, including TSOs and DSOs. Finally, the position of FlexPlan Consortium is exposed and barriers and opportunities referring to each topic are analysed.

3.1 Incentives for settling new flexibility resources

Considering the fact that flexibility resources are becoming a key additional factor to be considered in networks planning studies, their development and deployment must be unlocked and accelerated. For this purpose, local economic signals from the energy markets can play an essential role in the short term because they ensure a proper remuneration of new flexibility assets to the relevant investors. Furthermore, it is also required that investments in flexibility energy sources (FES) are incentivized and that differentiated economic signals are provided for the different nodes of the grid so as to promote an optimal deployment of these resources (see [7]).

3.1.1 European and national regulatory framework

The European commission aims at creating a market framework that rewards flexibility. EU Regulation 2019/943 and Directive 2019/944 ([1], [2]) consider the use of incentives to promote the development of a flexible system. In details, EU Regulation 2019/943 suggests the development of a market framework that offers adequate incentives for the investments on generation capacity, including energy storage and demand response (Art.3). Both IEM Directives consider not only direct incentivization but also the introduction of market rules that facilitate the integration of distributed resources, demand side flexibility and energy storage. EU Directive 2019/944 (Art.32) suggests that DSOs should be enabled to efficiently use services from distributed generation and load avoiding costly network expansions. Art. 51 in the same document requires that TSOs shall fully take into account the potential for the use of demand response, energy storage facilities or other resources as alternatives to system expansion when elaborating Ten-Year Network Development Plan (TYNDP). An adequate remuneration should be considered to cover the sustained costs, including infrastructure and operational ones. In Italy, with the publication of Deliberation 646/2015/R/eel [8], it has been approved the new version of '*Testo Integrato Della Regolazione Output-Based Dei Servizi di Distribuzione e Misura dell'Energia Elettrica*' [9] where all incentives for DSOs and regulations which promote flexible resources are collected. According to this regulation, incentives shall be location-dependant, as matter-of-fact consistent incentives are given for installations where the necessity of flexibility resources is big. As a different kind of incentive, not for economic but mostly timesaving reasons, there is also the possibility to simplify the authorization procedures at least for small decentralized and/or distributed generation with limited size and potential impact (art.8 §3 of [2]).

European Commission in its proposal for council regulations [10], about energy intervention to address high energy prices, can be seen as a potential pathway to incentivize the deployment of flexibility resources. Indeed, it is specified that, in the case of a price cap is introduced, *demonstrative projects* should be exonerated from the cap on revenues regardless their low or high marginal costs.

3.1.2 Stakeholders' positions

Incentives, according to ENTSO-E, could be indirectly procured even strengthening long-term signals because a reduced uncertainty on future revenue streams would reduce capital costs [9]. One suggested pathway could be, for example, to increase the access to long-term bilateral contracts (Power Purchase Agreements or PPAs) which today are not accessible to all parties. Meanwhile, it is also necessary to analyse solutions to overcome periods where weather dependent resources are insufficient to cover demand, thus additional capacity remuneration mechanisms should be provided for back-up generation.

According to Bain & Co [13], in order to promote investments on storage capacities, competitive markets do not make investments really attractive due to absence of profitable use cases. An effective deployment should then consider all kind of storage solutions, not just batteries, in different time horizons that look beyond short-term storage needs. DSOs should be responsible for advising and guiding investments in storage and the right incentives should be developed to invest in storage systems.

Anyway, not only incentives on mature solutions should be considered: ENTSO-E expresses its position on innovative solutions in [12] recalling that it is important to promote development of new technologies that are not completely mature for this transition. A properly designed regulatory framework should then be designed to promote the development of innovative solutions; the use of a more holistic approach for the dimensioning of these investments is suggested according to the level of readiness of the technology (TRL)[1]. More details are available Table 3-1.

Research and Development Plan	TRL	Incentivising Mechanisms
Research, Development and Innovation Programmes and Projects	1-7	I. Extra budgets for TSO-led initiatives and projects based on approved operating costs. The remaining budget may be returned to tariffs. II. Experiment Budget for third parties/DSOs when involved for testing procedures. III. Pioneer Bonus to cover the cost of the grid operator actually conducting the activity.
First-of-a-kind Projects	6-8	I. Regulatory sandboxes where each regulated entity or market players proposes its regulatory derogations for testing purposes. II. WACC[2] or RoE[3]-adders complementary to the base remuneration of TSOs. They can be for both OPEX-based or CAPEX-based projects.
Uptake of Innovative Solutions	8-9	III. KPI-based incentives established according to particular benefits that the solution brings when it comes closer to full maturity. Differently from

[1] For more information about Technology readiness levels, please see ENTSO-E Technopedia TRLs.
[2] Weighted average cost of capital
[3] Return on Equity

		CBA, these KPI-based incentives can be used to achieve a specific target.

Table 3-1. ENSTO-E Vision on mechanisms for incentivising for innovative solutions

3.1.3 FlexPlan consortium opinions

Flexibility represents an important resource to solve network problems, as it has been demonstrated by FlexPlan by means of the performed simulations [6]; thus, it is important to promote developments and deployment of technologies that can improve system flexibility, and this requires to put in place incentivization mechanisms.

Firstly, to develop an efficient incentivizing framework, it is necessary to understand and highlight system needs so to guide investments in the right direction. The identification of forecasted bottlenecks in the transmission and distribution grid should guide the definition of the incentivization mechanisms. In this way it is ensured that investments in FES are made where the system mostly needs them. According to this, it is possible to understand how the incentivization mechanisms should not be defined in accordance with the kind of technology installed but mainly according to the benefit brought to the overall system.

Secondly, a proper regulation should be developed in order to favour the use of flexibility resources. DSOs, which up to now have invested in grid reinforcements to manage peak hours, should be encouraged to exploit flexibility potential from DER and an appropriate regulatory framework is essential to do so. In this context, a step forward has been done in Art.66 of EU Directive 2019/944 according to which incentives should be provided for the use of services from DERs.

Anyway, it is important to recall that incentives can consist either in a capacity remuneration (long term) and or in operative incentives (short term). On one hand a locationally differentiated capacity remuneration can be useful to promote the settling of new resources (see Section 3.9.3); on the other hand, resources such as demand response, which are characterized by relatively small costs, could be incentivized by means of a proper market reform ensuring competitiveness and a sufficient return on investments for FES.

The FlexPlan Consortium also agrees on the possibility of creating two different frameworks for big-scale and small-scale flexibility. According to their needs, small-scale flexibility, represented by demand-response of small households and consumers, should be motivated to participate in the flexibility service provision, not only by means of economic incentive, but also by means of a scheme which does interfere the least possible with usual habits and leaves up to them the possibility to choose how and when to provide the service. Large-scale flexibility, as for example demand response of industrial realities, can offer a big contribution in providing flexibility services for big amount of capacity. For this reason, large-scale flexibility should be supported as much as possible. Incentivizing mechanisms can push potential large-scale flexibility providers to change their usual habits offering flexibility services to TSOs and DSOs. FC considers that the biggest contribution of resources, such as demand response management, could be given by big-scale flexibility thus it is important to develop a regulatory framework which considers the actual costs of offering flexibility services in order to establish a fair remuneration.

3.2 Storage ownership and operation

It is well known that energy storage improves the security of energy supply contributing to increase system flexibility thus allowing the integration of higher shares of intermittent renewable resources. Anyway, the regulation in force in Europe fixes quite clear rules on storage ownership which 3.2.1., they will be critically analysed understanding the reasons that undergo the choices.

3.2.1 European and national regulatory framework

At present the use of storage by SOs is limited by the EU Directive 2019/944 [2] (art. 36 and art. 54) according to which transmission and distribution operators are not allowed to directly own, develop, manage or operate energy storage facilities. However, storage ownership may be allowed to SOs when storage facilities are fully integrated network components and the NRA has granted its approval by means of a dedicated authorization procedure, or when other parties did not qualify to own those services and such facilities are necessary to assure a reliable, secure and efficient grid operation. This solution is however limited from EU Directive 2019/944 which imposes that energy storages should be only used for service purposes in case they are owned by system operators (specified in art.36-2b of [2]), so they would not be allowed to participate in energy markets. Currently, in Europe TSOs and DSOs do not own and operate storage facilities, except for an Austrian DSO which owns and operate battery storages with a capacity of 2MW (see surveys in D6.1 [5]). In Norway DSOs can own and operate electric batteries if they are used exclusively for network operation purposes. At the same time the NRA has indicated that this practice will be terminated in the close future [15].

Anyway, given that TSOs and DSOs are responsible for ensuring a secure, reliable and efficient way of operating the system in the long-term, they must procure every possible mean to succeed. In line with EU Directive 2019/944 [2], transparent, non-discriminatory and market-base procedures should be conducted by system operators to procure the necessary resources owned by market participants. The possibility of shared ownership, in case a third party is not able to own the entire storage facility, is also considered. At a national level, the Italian Legislative Decree n.210 [16] suggests the development of a procedure for the procurement of new storage capacities based on auctions which must be competitive, transparent and non-discriminatory. By means of a public consultation [17], ARERA suggests that Italian TSO should provide a proposal for regulatory guidelines for the procurement of long-term storage capacity. Different ownership contracts shall be used depending on system requirements and available technologies of storage capacities, which agrees with the development of storage capacities different from batteries that look beyond short-term storage needs [13].

3.2.2 Stakeholders' positions

The European Federation of Energy Trades (EFET [18]) strongly agree to not allow system operators to own, develop and manage storage facilities because of generation of conflict of interests (system operators would act as market participants), lost value of the resources (system regulators assets can only be used for a limited number of purposes), market distortion (network operators are not subjective to competitive pressure as investments are spread across final users) and increase of network tariffs (to cover investments made by network operators). EFET expresses its position on the methodology for the procurement of storage facilities according to which it is necessary that SOs provide information concerning the system needs, purpose of the storage, technical capabilities of the storage, estimated

operating time and others. Concerning the tendering procedure, it is advised that technology neutrality is assured and participation of market participants across EU is allowed.

According to Bain & Co [13], given the limitation of storage capacities ownership for SOs, DSOs should put their expertise at the disposal of possible investors, guiding investments and promoting battery usage through co-investments or public-private investments, meaning to rent out some storage capacities.

Furthermore, if SOs are allowed to own, manage or develop storage facilities, [3] recommends that new Network Code on Demand Response should ensure that SO-owned storage should not be preferred over other flexibility resources, as for example demand response, maintaining technology neutrality for every competitive procedure.

3.2.3 FlexPlan consortium opinions

SO-ownership of storage facilities would for sure create a market distortion, for this reason SO-ownership should be considered as the last possible solution. Furthermore, while performing the simulations of the six regional cases, storage ownership has not been considered as a characteristic of the resource, thus a dedicated analysis should be carried out in order to understand how the results would be affected. Given the complexity in considering ownership in the model, a different approach could be used: when the results show the opportunity for a big deployment of flexibility services at a given location of the grid, if third parties are not available to own, manage or develop them and no other solutions are found, SO-ownership could be considered as a solution. Anyway, when this last chance possibility is chosen, disadvantages that come along with it must be considered in following evaluations: it is necessary to take into consideration the increase of network tariffs, the loss of value caused by the impossibility to use them to buy/sell electricity (as referred in EU Directive 2019/944 [2]). Thus, by means of an analysis which considers every drawback of SO-ownership, it is possible to understand if this solution is still efficient or not, and so if NRAs should approve the request for SO-ownership.

A further solution could be the definition of a framework which allow SOs to manage storage facilities on behalf of the owner without the possibility of extracting a profit coming from the market revenues. In this way, SOs, responsible for managing the facility, would bid in the markets in a competitive way without exercising market power but only favouring the system interests. This can be seen as a must-run service in which SO is able to exploit the potential of the flexibility resources making it available when mostly needed and the owner would be ensured of revenues coming from the participation to energy markets.

3.3 Responsibilities and data exchange between TSO and DSO in planning

The complexity of operational and planning activities is increasing along with a more active behaviour of consumers and a massive integration of DERs. As a result, the need for some changes in roles and responsibilities of TSOs and DSOs together with a reinforced collaboration between them is needed. TSOs and DSOs must enlarge knowledge on each other's network, as the planning on one network impacts neighbouring ones and, besides, the increasing number of resources at the distribution level should be deployed to provide services for the reliability of the entire system. In principle, to enforce a tightly coordinated procedure between TSO and DSOs, a big amount of data should be exchanged. However, technical feasibility makes it possible to exchange only a limited amount of data and in-force regulation imposes privacy and data-security for each SO. Based on these principles and according to the identified

needs of TSOs and DSOs, requirements for data exchange should be defined in terms of type of data, frequency of exchange and granularity.

3.3.1 European and national regulatory frameworks

According to EU Regulation 2019/943 [1], EU DSO[4] is responsible for promoting a coordinated operation and planning of transmission and distribution systems, including the means used such us data exchange between operators (art. 55). A coordinated access to resources such as distributed generation, energy storage or demand response should be delineated to rule DSOs and TSOs operations. To facilitate the coordination during planning procedure and improve transparency, according to EU Directive 2019/944, network development plans (NDPs) should be introduced also for distribution systems. Therefore, a transparent network development plan (NDP) should be published by DSOs at least every two years where medium and long-term flexibility services needs and planned investments for the next five-to-ten years required to connect new generation capacities and loads, should be assessed. Analyses on use of storage facilities, demand response and other flexibility resources, deployed as a substitute for network expansions, should be performed (art. 32). It is suggested to develop these topics in the forthcoming network codes.

In Belgium, NDPs need to be drafted by the TSO (Elia) and the DSOs. The NDPs are organized according to the distribution of powers and responsibilities between different levels of government. A summary of the different NDPs, their status and applicable rules for the development of NDPs is given in Appendix II. Data exchange between the TSO and DSO in planning is still limited, although for instance in Flanders the DSO must consult the TSO on their investment plan (see Art. 4.1.19 § 2 of [18]).

Some information concerning the Spanish framework have been provided by means of a survey conducted during FlexPlan project [5]. The DSOs must provide a plan for the next three years to the local governments (CCAA)[5] which must approve it after an evaluation of CNMC[6]. According to national regulations (Spanish Law 24/2013 on Electricity Sector, Spanish Royal Decree 1955/2000 and 1047/2013, Spanish Law 21/2013 on Environmental Assessment and Spanish Royal Decree Law 1/2019)[7] the DSOs submit transmission development proposals and provide information that may be needed for technical studies developed by the TSO. The main objective of the transmission plan is to design the transmission grid in a way that will comply with national and European energy policies and that will secure country's long term energy supply, considering environmental and economic efficiency criteria.

According to EU Directive 2019/944 each DSO is responsible for maintaining and developing a secure, reliable and efficient electricity distribution system in its area. Art.32 establishes that MSs shall propose a regulatory framework that allows DSOs to use local services to manage the network in a safe way. In the same way each TSO is responsible of ensuring reliability and efficiency of the system, cooperating with

[4] EU DSO is the European entity for distribution system operators composed by registered members and/or national association designated by the Member State and/or Union-level association [1].
[5] Autonomous communities in Spain
[6] National Markets and Competition Commission
[7] See bibliography: [47] and Agencia Estatal Boletín Oficial del Estado

neighbouring TSOs and DSOs. On this regard, the Italian Legislative Decree 210/2021 [14], Article 23, establishes the obligation for DSO to define and publish the flexibility needs.

With respect to what delineated in European Directives ([1], [2]), ACER published a draft for public consultation in summer 2022 concerning the guideline on demand response [17] (hereafter called: Guideline of DR) where among other things principles for the coordination and responsibilities of distribution and transmission operators are provided. According to the mentioned regulation each SO is responsible for solving congestion and voltage problems on its own grid; thus, it is responsible for covering the costs independently of the grid to which the activate resources are connected (art.64 of Guideline of DR). A section of the Guideline of DR is dedicated to SO coordination, mainly concerning operational data exchange, where the planning phase is not mentioned. Anyway a few interesting points are raised concerning planning procedures: given an area affected by congestion or voltage issues, characterized by probable and/or recurrence incidence, data exchange among all connection points and assets shall be granted to enable SO to solve the issue. It is recalled how IEM Directive 2017/1485 [19] (hereafter called: SO Regulation), where most articles concern data exchange between TSOs, should be updated including all SOs and not just TSOs. Meanwhile, SO Regulation reports information concerning data exchange between TSOs and DSOs in the control area of TSOs: TSOs define the observability area and DSOs connected or affecting the defined area are required to share real-time data and structural data; nonetheless, nothing is documented concerning forecasted and planning data exchange between TSOs and DSOs. In this regard, Guideline on DR gives some details suggesting that the DSO should provide information concerning the planning methodology to identify network developments, the used network development scenarios, the final aim of the project whether it deals with grid expansion for congestion management. ARERA, the Italian NRA, published the deliberation 540/2021/R/eel [20] concerning the regulation of data exchange among Terna, DSOs and Significant Grid Users (SGU) and, according to it, by means of a cooperation between TSO and DSOs the definition of data exchange methodologies and necessary information should be established.

3.3.2 Stakeholders' positions

Eurelectric outlines that, Art.32 of EU Directive 2019/944 [2], NDP of DSOs should at least include: a description of the scenario on which NDP is based, grid planning principles, including the ones on distribution infrastructure, and identify the main investments which are replaced by flexibility, giving information to flexibility service providers concerning the system needs[8]. According to Eurelectric, different NDPs should be developed between different voltage levels covered by DSOs across EU[9].

In summer 2022, ENTSO-E published a public consultation concerning the TYNDP 2022 [22] and, according to their opinion, the TYNDP should focus on where investments would help deliver the EU climate and energy goals. According to this, storage capacities, together with cross-border exchange and others, are the variables used to assess system needs. The definition of the TYNDP is developed in coordination of ENTSO-E and ENTSO-G, however, Eurelectric, in its response paper, suggests an improved cooperation of DSOs for the modelling of the distribution networks because they have a great overview of

[8] Eurelectric - Network Development Plans for DSOs in accordance with article 32(3) ad (4) of the Electricity Directive

[9] Eurelectric - Recommendations on the use of flexibility in distribution networks

flexibility resources connected to their grid which would improve the assumptions made on flexibility impacts.

During the public consultation of Guideline of DR, Eurelectric and ENEL agree with ACER concerning the data exchange and outline a possible methodology: given that DSOs should exchange information with neighbouring SOs, separate platform for only DSO congestion management could be an effective solution to kick start the market because liquidity would be increased at early stages for small DERs (not used for transmission ancillary services), and then in a second step a combined congestion management should be used.

3.3.3 FlexPlan consortium opinions

During the analysis of the results of the six regional cases, it has been outlined how a cooperation between TSO and DSO could lead towards a reduction of the overall system costs. Indeed, there are example where, even if no adjustments are made to the transmission grid elements but a congestion occurs when simulating the model representing the present state of the system, amendments in the distribution grid positively affect the overall system costs (see more details in D5.2 [8]) affecting the transmission congestion. This demonstrates the importance of the coordination of the transmission and distribution (T&D) NDPs.

One of the main problems in data exchange is the amount of data to be exchanged, together with the required precision and frequency. For sure, the higher the precision and frequency and the better the possibility of developing a TSO-DSO coordinated approach, anyway not only technological feasibility limits should be considered but also privacy of all internal data should be respected. In the present regulatory framework, there is no standard defined for the sharing of information and a great complexity is found in understanding how and which data should be shared. On this regard, the model used to simulate the six regional cases proposes a new methodology. The data are modelled so to aggregate all information without going into details on location, network states, characteristics of the installed devices and others. Then, the exchange of data occurs only at the border between SO responsibility regions. More information of this data modelling can be found in D1.2 [23] and [24]; the data exchange scheme can be found in Chapter 6.4 of Deliverable 7.3 (FlexPlan newsletters [24]).

3.4 CBA updates and internalization of environmental costs

DERs, demand response, electric vehicles, energy storages and all new flexibility opportunities provide many benefits to the European electricity network, but it is required to demonstrate their economic viability to promote their deployment. Cost Benefit Analysis (CBA) is the decision-making process applied to perform an economic analysis of a certain project and its impact on the system. To apply a CBA, it is necessary to determine indicators which can represent technical parameters, environmental impacts and overall costs and benefits that every resource brings to the overall system. A joint European methodology for cost-benefit analysis is given by ENSTO-E ([25]) and it can be either used as-is or adapted to a specific national framework. Given the uptake of flexibility resources, a third version of CBA (hereafter called: 3rd CBA Guideline) has been developed, and the relevant amendments concerning flexibility resources are described in Paragraph 3.4.1. A fourth version in now in consultation, but most changes concerning flexibility resources have been developed during the release of the third version. Then a review of

stakeholder position on present regulation is given and, finally, the methodology used in the FlexPlan approach is described and suggested to be taken as example for future updates.

3.4.1 European and national regulatory framework

The EU Regulation 2022/869 [27], repealing EU Regulation 2013/347 [28], recalls for an update of the smart electricity grid CBA methodology. Art. 4 §1.a concerns an efficient integration of actions of all users connected to the grid, considering the generation of electricity from RES or DERs, consumers' demand response, energy storage facilities, others. Annex V of [27] specifies also that each CBA should contain costs relative to Greenhouse Gases (GHG) and climate effects, as well as the costs expected for the evolution of flexibility resources and storage availability.

The most recent update of the CBA has been published in March 2021 and it is represented by the 3rd CBA Guideline[10] [26]. This release introduces some so called 'missing benefits' with respect to the 2nd version of the guidelines that have been taken into consideration during the development of TYNDP 2018 by ENTSO-E. For the scope of FlexPlan, the missing benefits of interests can be identified to be:

- Reductions of costs for ancillary services: focus on the effects of capacity reservation which block the use of these resources in other markets.[11]
- Reduction of necessary reserve for re-dispatch power plants: costs of retention of generation to make a resource available for redispatch are not included.
- Reduction of emissions (non-CO2)

Flexibility resources are, indeed, the most attractive asset to solve internal congestions in substitution to expensive re-dispatch power plants, thus they introduce additional benefits in terms of reduction of costs for ancillary services and a reduction for re-dispatch volumes. The 3rd CBA Guideline introduces a new benefit indicator called *"Redispatch Reserves or Reduction of Necessary Reserves for Redispatch Power Plants"* which analyses the impact of a certain project on the required power of redispatch by means of *Redispatching Simulations*.

The assessment of storage projects is performed similarly to the one of grid reinforcement projects (see [26] for further details). Anyway, in the 3rd CBA Guideline the possibility to distinguish a market-base model or a must-run model is not defined but left to projects promoters. Socio-Economic Welfare is considered as the most representative benefit for storage projects, indeed, storage assets allow congestion resolutions, generation portfolio optimization (arbitrage), reduction of price oscillations in peak and off-peak hours. As a result of generation portfolio optimization, CO2-emissions reduction is derived as well as integration of RES. Furthermore, system adequacy and flexibility are affected, but also the residual environmental impact is not negligible. It is natural to expect that the list of indicators will be updated according to the steady growing experience for operation of storage e.g. battery degradation costs can be considered.

[10] The 3rd CBA Guideline was resubmitted to the European Commission on 27/10/2022 and is waiting for approval (https://consultations.entsoe.eu/system-development/methodology-for-a-energy-system-wide-cost-benefit/ - accessed on 03 January 2023)

[11] The added value brought by ancillary services in the system stability was already analysed in the 2nd version, therefore the improvement mainly concerns the cost of these resources and the reduction of them thanks to a monetarization of factor.

On 20th December 2022 the 4th CBA Guideline has published for consultation [29]. In the mentioned draft, a sensitivity analysis is required also to evaluate a variation of storage capacities, RES generation capacities and flexibility in demand and generation. A sensitivity analysis is also suggested to evaluate separately the effects of the storage availability in terms of technical performances, trying to investigate technological variations and improvement of this rapidly developing technology.

Environmental impact, including CO2 variations and non-GHG emissions, are included in CBA by monetized and non-monetized factors. Overall, the monetization mostly concerns the price for CO2 emissions effects, the damage associated to climate change according to European objectives for CO2 emission reduction and no monetization is proposed for non-GHG emission. In the Italian CBA, defined by Terna, impact of CO2 and non-GHG emissions on society health and on environment are monetized too, respectively considering a different value, expressed in [€/ton] for CO2 and other gases external effects, see benefits B18 and B19 in [30].

3.4.2 FlexPlan approach

The FlexPlan simulations are based on the results of an Optimal Power Flow (OPF) run, thus all benefits are modelled in a way that can be included in an OPF. The 3rd version of the CBA considers quantitative and qualitative benefits, some of them monetized and some not, whereas FlexPlan approach is based on the monetization of all benefits and factors. For example, environmental benefits (air quality and landscape impact) are monetized as well in the objective functions, whereas in 3rd ENTSO-E CBA Guideline they are only evaluated as qualitative factors.

The coordination between TSO and DSO is also considered in FlexPlan model by means of a joint planning of transmission and distribution networks (T&D networks), whereas ENTSO-E considers only a transmission-oriented analysis.

Furthermore, there is a more detailed modelling of demand flexibility, in order to deeply evaluate the effect of this particular flexibility resource and simulate flexibility through power flow control through PST & HVDC, that are not currently considered in the 3rd CBA approach.

Anyway, the main difference between FlexPlan approach and 3rd CBA Guideline is represented by the methodology used to perform the analysis which, instead of analysing the effect of each candidate separately (TOOT and PINT approaches), is based on the simultaneous assessment of a basket of candidates within which the optimization selects the subset which minimises the system TOTEX (i.e. considering the sum of dispatching and investment costs).

3.4.3 FlexPlan consortium opinions

Analysing the points of strength and weakness of the present ENTSO-E CBA methodology, GHG-emissions are considered only when produced from energy generation thus excluding the environmental impact caused by the carbon cycle for other non-generation devices (lines, transformers, etc). In the FlexPlan tool, the carbon footprint for building new lines, the visual environmental impact and other factors, such as human health, are instead considered in the CBA in a monetized way. Additionally, the effect of pollutants on health is also monetised, by adopting a linearized approach that takes, however, into account the results of running complex 3D meteo models able to study the relationship between emissions and air concentration for each generation plant within the “meteo cell” where it is located.

The objective function also considers a probabilistic approach: different climate scenarios, representing each different a realization for load and RES hourly time series (wet or dry, windy or not, etc) are analysed, and their probability of occurrence is modelled too. All scenarios are considered in the objective function w weighted with their probability, thus giving rise to a probabilistic optimization model. The advantage is given by having a single optimization problem taking planning decisions while considering the uncertainty of occurrence of the different climate scenarios.

3.5 Services that can be provided by flexibility resources: market and non-market dispatch

Congestion resolution represents just one of the services that the electricity system users can provide to support an efficient use of the grid. Different flexibility services can be provided to the system, for example: balancing services, adequacy services, constraint management services and wholesale services [31]. Depending on the service, different technical requirements must be satisfied (activation timeframe, in-advance knowledge of generation availability, possibility to modulate the load, etc.) and this represents the reason why often some resources are not allowed to provide some flexibility services.

3.5.1 European and national regulatory framework

According to EU Directive 2019/944 [2], the use of flexibility by DSOs should be considered as an alternative to network investments when analyses demonstrate that they are cost-efficient. Indeed, this points out the reason for introducing flexibility resources in NDPs which is represented by the necessity to identify the flexibility services required by the system. According to the IEM Directive, every customer or consumer should be allowed to consume, sell o store electricity, thus providing a flexibility service which is beneficial for the distribution and transmission networks.

CEER, in its public consultation dedicated to the use of flexibility in distribution systems [32], identifies potential challenges that can be addressed by use of flexibility services among which there are the insufficient transfer capacity in network, renewable energy curtailment, reduction of system stability (due to reduction of inertia given by traditional flexibility resources), others.. Considering the different requirements, different services should be offered by flexibility and NRAs should develop a regulatory framework which exploit their potential. CEER identifies four ways to procure flexibility services:

- Rules-based approach: by modifying existing rules to impose flexibility requirements
- Network Tariffs: used to encourage network users to modify their consumption/generation
- Connection Agreements: to procure flexibility from new consumers which can offer a must-run service
- Market-Based Procurement: to acquire short-term or long-term flexibility directly from markets

and agrees that market-based procurement is the preferred option when a satisfying level of market liquidity is reached because of lower overall costs with respect to other solutions.

According to article 32 of EU Directive 2019/944 [2], it is necessary a legal framework to allocate roles and responsibilities of market participants, considering differently regulated entities and commercial ones. Flexibility procurement must be economically efficient and must not lead to severe market distortions. In addition, ACER, in its public consultation Guideline of DR [3], suggests that the new regulations should

specify principles for the use of remunerated forms for products used by SOs to solve congestions, as for example limitation on dispatching and then redispatching or non-firm agreements. Both procurement and activation should be market based, selecting the most cost-efficient resource, with the possibility of having different processes for short- or long-term procurement/activation. If non-market-based procedures are considered, then it is necessary to follow and clarify redispatching principles and the financial compensations mentioned in [1].

According to EU Regulation 2019/943, energy storage and demand response shall be redispatched according to market-based mechanisms and non-market-based should be considers only as last option or in case it is not possible to ensure effective competition in the area due to low number of resources. In details, in case of non-market-based procedure for redispatching are chosen, a financial compensation shall be given to power-generating, energy storage or demand response facilities to equalize the net missing revenues from the sale of electricity on the day-ahead market.

In Italy, the Legislative Decree 210/2021 [16] establishes that the national TSO in cooperation with DSOs shall propose a new framework for the procurement of long-term storage capacities. According to this framework, each owner of storage capacity should receive an annual remuneration and must provide the contractual capacity on energy and services markets. With the publication of the Consultation 393-22 [17], ARERA proposes the terms, conditions and methodologies for the procurement of storage capacity according to the system requirements. In exchange of a remuneration, evaluated on the basis of the provided service, different services can be offered: *time shifting,* which considers the movement of energy from hours characterized by low prices to ones characterized by high prices, and *ancillary service*, as for example resolution of intrazonal congestions.

3.5.2 Stakeholders' positions

Eurelectric, in its paper about the correct use of network tariffs [33], outlines how specific network tariffs should be adopted for flexible consumption, energy communities, aggregator and storage assets. Network tariffs should be defined in order to incentivise the use of the grid and allow non-distorted market access, they would also help in providing the right economic signals to new uses of FES for which historical data are insufficient. Static Time-of-Use (ToU) tariffs are preferred because they improve cost-reflectiveness and provide better price signals then flat tariffs. In the long-term ToU tariffs can optimize network expansion considering the consequent behaviour of the network users and can help in preventing congestions. The opposite results could be achieved either: they can lead to co-incidence of network use because of price signals, but a proposal could be to have different off-peak periods for different customers. Network tariffs, in order to be promoter of flexibility investments, should also consider the type of network users:

- Storage facilities, when used to offer network services, should be subjected to cost-reflective network tariffs that considers the added value of the assets and avoid double paying (when injecting or ejecting).
- Self-generation should be subject to both reduction of energy charges and energy supply thanks to proper network tariffs, a compromise should be found considering pros and cons of volumetric tariffs and capacity tariffs.
- Generators should be subject to equal network tariffs even if connected to transmission or distribution networks.

- Tailored tariffs should be designed for new market players such as prosumers and energy communities.

A further analysis about network tariffs is carried out by EDSO in [34] where tariffs are again divided according to the considered technology. In the present report it is underlined that convenient network tariffs could be used also for renewable energy generation when they are supported by storage facilities which allow a time-shifting of the production.

Further opinions are available from Eurelectric public consultation on Guideline of DR [3]: demand response in FCR services should always be treated in a market-based procurement or, at least, a compensation should always be provided for the actual offered service (art. 33).

3.5.3 FlexPlan consortium opinions

Use of flexibility resources by means of non-market dispatchment procedures should be avoided, especially if looking at a large-scale problem where market liquidity is substantial because a big amount of flexibility service providers (FSPs) can participate to competitive procedures. However, looking at small-scale problems as for example at the distribution level, where a limited number of FSPs is available a market-based real-time procurement could not be the best option but an agreement between parties which include a must-run obligation could represent the best option. The same can perhaps be said regarding voltage regulation services, which must be provided in the proximity of where the problem is, hence strongly reducing the liquidity of a potential market for reactive services. Regarding frequency containment reserve (FCR) the timeframe for providing the service doesn't allow to create a market for energy (whereas very often a "capacity" market has been created in the last years in many EU Countries) and in many countries there is still just an obligation for providing such service payless. Anyway, some pilot projects are going to define and prove the efficiency of using solutions different from market-based procurements. Moreover, it is necessary to take into account that sometimes the available flexibility resources could be used for other scopes than flexibility services, and this could affect the overall planning procedure where a flexibility resource is considered available for the service procurement. For example, considering storage systems, if no constraints for real time bidding are provided there is a risk that the resources that in the planning phase have been conceived as a support for congestion management are then offered in the day-ahead market for "arbitraging" between the prices of different hours. Thus, if some mechanism is put in place to incentivize a flexibility resource to be deployed in a given grid node for congestion management reasons, then, some constrains or priorities should be applied forcing that resource to put available such capacity for services provision. At the same time, it is important to safeguard that such capacity is not offered strategically by exploiting possible opportunities subsiding locally. In that case, it should be evaluated the possibility that the SO can offer this capacity on the real time markets on behalf of the owner ("must-run management"). According to this, a cooperation among private investors and SOs should be defined considering one main factor: SOs remuneration, in exchange for management of the resource on electricity markets, should not be dependent on the provision coming from selling/buying electricity in the markets. This requirement would assure no interest in profit for SOs and so reduce, or almost annihilate, the possibility to exercise market power.

From the DSOs perspective, given the variety of flexibility resources and the services they are able to provide, it would be reasonable to distinguish network tariffs according to the reason energy is injected or ejected to the system. For example, when storage facilities are absorbing energy from the network in order

to provide a service because of over-generation or congestions, the advantages brought to the system should be considered in the designing network tariffs. Anyway, management of these facilities for other purposes should be considered too. Therefore, it is necessary a regulatory framework which is able to define network tariffs according to the different usages of flexibility resources. A disadvantage of specific network tariffs is brought to light from a practical point of view: as highlighted by ACER in [35] not in every Member State (MS) distribution tariff methodology is set by NRA, but in some states DSOs individually define the tariff methodology which is not subject to NRA's approval. Furthermore, the costs recovered through distribution tariffs vary across Member States (MSs), indeed even if return on capital, depreciation and operational expenditure are generally recovered by tariffs in all MSs, cost of losses and cost of system services are not recovered by tariffs in all MSs. Thus, if the solution is found is specific network tariffs, the definition of a common framework may be time consuming and so not developed in the short term.

3.6 Markets flexibility resources can participate in

Flexibility resources represent an efficient way to improve system reliability but, in order to exploit completely their potential, it is necessary to maximize their possibility of participating in wholesale and balancing energy markets. Flexibility resources have the ability to ensure a cost-efficient functioning of the electricity system coordinating supply and demand. At European and national level big steps have been made in order to introduce and integrate as much as possible flexible resources considering flexibility as a resource to solve congestion management in the short-term but also in the long-term to analyse maintenance planning and network reinforcements. Anyway, different barriers are still present about participation to wholesale markets where only resources characterized by a substantial capacity are allowed to participate.

3.6.1 European and national regulatory framework

EU Regulation 2019/943 [1] in (3) states that in order to promote changes in the energy system it is necessary to update the electricity markets, meaning that given the new opportunities and resources, such as consumer participation, they should be considered is a market design. The regulation aims at obtaining integrated electricity markets, where demand response, distributed demand and supply, energy storage can participate in all markets. Article 3 specifies how market rules should facilitate the development of flexible generation and demand, and according to this, suggests that balancing markets should be constructed so to include energy storage and demand response according to their technical capabilities, individually or by means of aggregation.

EU Directive 2019/944 [2] recall as a first principle that all customers group should be allowed to access electricity markets and trade their flexibility and self-generated electricity, specifying the necessity of introducing new products to encourage participation of demand response. Furthermore in (42) it highlighted how legal and commercial barriers exist for example for self-generated electricity and the possibility of direct consumption of it.

Anyway, both regulations do not provide specific details in defining the target markets for flexibility, but some suggestions are given in ACER Guideline of DR [3]: SOs services should be procured in dedicated local markets or through locationally tagged bids in wholesale markets, in particular intraday and balancing markets. In case offers are introduced in intraday and balancing markets, it is necessary to delineate in the

new regulation weather and in which conditions bids offered in intraday or balancing markets can be used for local congestion management. In case local markets are developed it is important that the access is granted to all participant, including aggregators. Demand Response and other relevant resources should have access to all electricity wholesale markets. Furthermore, it is suggested that in order to allow access to all balancing markets, new rules should consider reducing the bid granularity to not higher than 0.1 MW for all available energy products, then an update on the balancing regulation should be conducted [36].

In order to promote the use of emerging trends like the increasing number of electric vehicles and DERs, an update of Network Code on Grid Connection (NC CG) is proposed by ACER [37]. On this regard, ACER states that it is necessary to update requirements for connection and operation of the distribution networks because of the significant changes brought by distributed generation which shall now be used also to procure energy to the transmission system. Different options, one for each technology analysed, are proposed to address the problem of grid connection, as for example the requirements for prosumers connected to the distribution grid which are generally small power generation modules that are now covered only by the network codes dedicated to industrial sites. This could lead to inconsistent treatment of small prosumers and thus a review should be carried out.

In Italy, in ancillary services and balancing markets demand response participation has been allowed through pilot projects (Resolution 300/2017 and 422/2018). The aim is to collect useful elements for an overall reform of electricity markets which points at opening them to new participants such as distribute energy resources, demand side response and storage facilities.

In Belgium, the specification of market-based flexibility by the DSOs is still in an early phase and experience with actual implementation projects is limited. For Flanders, Fluvius has published first, high-level specifications for the market-based procurement of flexibility services for the management of local congestion, non-frequency ancillary services and grid losses [12]. The Regulatory framework for the procurement of flexibility services by the DSOs was created in 2021[13]. In the Walloon Region and Brussels Capital Region, discussions on explicit, market-based flexibility solutions for DSOs are still rather immature.

3.6.2 Stakeholders' positions

Bain & Company, in cooperation with EDSO, highlights that the deployment of storage facilities is not opportunely promoted by present business case and an alternative approach which require multiple use cases is necessary, so to follow the estimated trend [13]. Short-term needs should be considered when storage solutions and demand-side management are considered as the future promises to ensure network supply-demand balancing. It is also suggested that DSOs should provide ancillary services to the market when decentralized and intermittent renewable energies increase their impact on the system stability; they should, indeed, invest and operate with mechanisms that comply with market rules. When a complete framework is obtained and profitable use cases are delineated, DSOs owned storage should be sold back to other parties.

[12] Fluvius. (2022) *'Specificaties voor de marktgebaseerde aankoop van flexibiliteitsdiensten voor het beheer van lokale congestie, niet-frequentiegerelateerde ondersteunende diensten en netverliezen'*.

[13] Energy Decree (Art. 4.1.17/4 and 4.1.17/6)

In its response to the public consultation NC GG, Enel supports a European harmonization aimed at defining a pattern of development of new storages coherent with system needs. Furthermore, Enel proposes to evaluate the possibility of issuing an Implementation Guidance Document (as the one proposed in the Storage Expert Group Final Conclusion[14]) detailing the requisites for different technologies/configuration. On this regard, it is fundamental that these technical requirements for BTM Storage will be determined in such a way so as not to discourage energy storage adoption for enhancing market participation options. Investments needed to improve DSO capabilities and face the new role should concern: grid real-time monitoring and control devices, functionalities for flexibility services planning and management (DERMS tool), TSO-DSO flexibility services coordination system. All those system-improvement related cost should be duly considered by NRA in DSO remuneration, as foreseen by EU Directive 2019/944; not only regarding power flows and steady state conditions (for instance voltage), but also operative aspects (islanding).

3.6.3 FlexPlan consortium opinions

To foster the deployment of flexibility resources, FlexPlan considers the possibility to allow flexibility owners to participate to all markets, even in day-ahead and intraday markets. Indeed, if they are allowed to participate to ancillary services market, they should be allowed to participate to the entire cascade of markets. However, if these resources are incentivized to be available for procuring congestion management services, then a minimum amount of energy should be mandatorily reserved for this purpose so that it can't be made available in other markets. Furthermore, incentivizing mechanisms generally comes along with the imposition of a price cap for the sold/bought energy, thus it is necessary to understand how this fixed price cap could affect market liquidity considering that only the amount of contracted capacity should be subject to a price cap.

DER are often characterized by small capacities and high uncertainty and often electricity markets set limits to the minimum amount of energy to be offered in a single bid and so they are not allowed to participate in markets. A possible solution is found by resorting to aggregator entities, that should also be affected by a lower uncertainty thanks to the possibility to carry out a risk management strategy that exploits the different kinds of exposure of the subjects included in their portfolio. This requires a formal definition of the role and corresponding responsibilities of Aggregator in the European regulatory framework, in a similar way as it has been done for other market actors.

3.7 Products tailored for flexibility resources in Realtime (RT)-markets

Flexibility providers can be made responsible in delivering flexibility to the grid via specific short-term markets. Specific markets already exist to the grid operator for reserve capacities, for example Firm Frequency Response (FRR), Frequency Containment Reserves (FCR) and Frequency Restoration and Replacement Reserve (FRR and RR), and they are categorized according to the type of services. Remuneration, in present flexibility markets, is mainly based on availability of the source and actual delivery of the service. Other tools at disposal to the system operators to manage the grid are: reactive power (procured when needed), re-dispatch (allows to solve congestion by re-organizing the flowing

[14] Storage Expert Group: Final Report

power at the high-voltage level), black start facilities (used in cases of blackout, assets that can deliver power when the voltage is zero, generally long-term contracts) and compensation of losses. The new investigated categories of flexibility resources should be introduced in the market organization by devising for them specific tailored products facilitating their "level playing field" participation in real time markets, i.e. so that they are not disfavoured with respect to the traditional resources (e.g. gas generators) for which these market were created a few years ago.

3.7.1 European and national regulatory framework

The balancing regulation ([36]) shall ensure an adequate and equal standing competition among market participants, including demand-response and resources connected to the distribution system. The regulation aims at facilitating the use of demand-response and storage facilities for balancing services, however there are no present regulation concerning products dedicated to flexibility resources participation in real-time markets.

According to the survey conducted during the analysis of the regulation (D6.1 [6]) some information of services provided from flexibility resources are defined:

- Portugal TSO states that flexibility is provided from external companies only to support balancing procedures. Italian TSO uses consumption, production and storage units of power capacity higher the 1 MW for congestion management, balancing and tertiary reserve.
- Slovenian TSO regularly procure flexible resources form external companies and, in addition, in cooperation with distribution companies, ELES can manage voltage sources on the distribution level (capacitor, reactor) in order to control the voltage on transmission level (no payment).
- Austrian DSO buys flexibility from flexibility owners, which are generally interruptible heat pumps, hot water boilers, etc. (mainly demand side).

Furthermore, key product characteristics in all Belgian frequency ancillary service markets have been adapted by Elia to ensure these products are technology neutral, are independent of the type of provider (generation, demand, storage) and can be offered by resources connected to the distribution and transmission grids. For instance, minimum bid size decreased to 1 MW, aggregation is allowed for all frequency services, procurement takes place on a daily basis, capacity can be reserved for shorter durations

3.7.2 FlexPlan consortium opinion

In order to create a framework for the flexibility resources to be used in RT-markets it is necessary to have a complete knowledge of their technical characteristics so to define tailored products taking into accounts all their possible operative constraints. As present real time market products are usually defined considering the operational constraints of traditional resources (e.g. gas fired power plants), thus it is necessary to analyse the need to define new products more specific for flexibility resources which allow their "level playing field" participation in the services markets.

As a market product, block bids could be considered for the procurement of flexibility services. The possibility of fixing a certain amount of energy to be absorbed or injected in the system during a time interval could help in organizing the load/supply curve according to system needs but also ensuring the FSPs the amount of energy that they necessitate.

Furthermore, it is necessary to define if a bid provided by an aggregator is considered as a single bid or to what extent the aggregator bid should be considered as a combination of bids that are still treated as single bid. In particular, this peculiarity occurs if it is allowed to an aggregator to introduce in its portfolio resources which are connected to different nodes and are all neighbouring to an identified bottleneck of the network: from the point of view of the network, an injection in one point compensated by an out-take in another one could not create a balanced outcome whenever this creates a congestion in some tie line. For this purpose, flexibility resources which are bid together should not be characterized not by a single offer representing the whole of the available capacity, but locational/nodal information should also be provided too. However, this could increase a lot the complexity of the optimization system to be solved to clear the market due to the big number of nodes to be considered. The possibility to consider different level of details in the definition of market architecture used for resolution of transmission planning or distribution planning cannot be completely excluded.

Considering different products, in terms of technologies, it is possible to refer to SmartNet projects where a definition of all different types and products is given in Chapter 3 of Deliverable 2.2 [38].

3.8 Regulation on aggregators and possibility to include flexibility in the basket

Aggregators bid on behalf of a pool of supply and/or demand which act as one single market participants in electricity markets. Generally, aggregators place bids following some price signals: e.g. reduction of consumption in case of high prices and shifting towards hours where prices are low. As consumers become more electrified and go towards self-generation and storage, their role in aggregating a great quantity of small contributions to provide flexibility to the system becomes more and more important. Aggregators, in this context, play an important role allowing to assemble a big number of small resources characterized by high uncertainty and not fit as single entities to participate in electricity markets. To foster flexibility deployment of small providers, it is advisable to analyse and develop and appropriate regulatory framework so as making the role of the aggregator and its responsibilities well defined and its business case viable.

3.8.1 European and national regulatory framework

One of the main scopes of EU Regulation 2019/943 [1] is to facilitate the aggregation of distributed resources of demand and supply ensuring a level-playing field integration. The Regulation, indeed, in the definition of market participants considers the person who performs aggregation functions included in the definition of a 'market participant' and states that market participation, balancing markets included, of final customers and small enterprises should be enabled by aggregation of supply and demand by means of unified offers.

EU Directive 2019/944 goes into more details on aggregation process for demand response flexibility. Art. 17 specifies that demand response should be allowed to participate in all electricity markets in a non-discriminatory manner through aggregation. In the same way, distribution and transmission operators should considers these participants when procuring ancillary services. Anyway, given that MSs are in charge of defining their relevant regulatory framework, each national regulation should be deepened; for the FlexPlan project in particular rules for data exchange between market participants have to be

considered. Furthermore, it is allowed to MSs to require financial compensation from electricity enterprises to other market parties affected by demand response activation, and in the evaluation of the compensation, should be considered even the benefit brought by the presence of the aggregator which manages the service. DSOs are responsible to ensure the effective participation of every product and service useful to achieve an efficient, reliable and secure operation of the system, aggregators should then be considered for flexibility service provision, especially for the mentioned reasons. In a similar way, TSOs when procuring ancillary services should do the same.

In the public consultation, on framework guideline for DR [3], ACER refers to EU Directive 2019/944 Art. 17 and underlines the necessity of having a European-wide harmonisation of aggregation models based on specific parameters, such as the compensation mechanism and the number of balance responsible parties at each connection point. It underlines that compensation models should not create barriers for participation in the aggregation process (24). ACER also suggests that several existing network codes and guidelines can be modified, if it will be necessary to comply with the forthcoming Guideline on Demand Response.

Some improvements have been also carried out in national regulations, for example in Italy, with the Public Consultation 685/2022 [39], power limits to participate to services markets have been removed, thus even aggregators characterized by few hundreds of Watt can contribute to grid regulation.

3.8.2 Stakeholders' positions

Eurelectric, in its response to ACER consultation of demand response [3], suggests that the identification of aggregation models should be left to a national implementation and suggests that the most suited model is the 'corrected model'[15]. Furthermore, the definition of the financial compensation should take into account the rebound effect. In addition, Eurelectric is negative towards modification of several existing network codes and guidelines as ACER suggests.

Willing to promote the deployment of aggregator solutions, together with other scopes, Tennet, SwissGrid, Terna and APG joined the Equigy platform[16] where new services and revenue sources are provided together with an optimization of the managed pool of flexibility resources. The platform is developed to simplify the integration of small resources into balancing markets and harmonise European standards.

3.8.3 FlexPlan consortium opinions

Undoubtedly aggregators allow small producers and consumers to participate in services markets, improving system reliability by increasing the capacity offered in these markets. Anyway, it is necessary to define to what extent resources can take part in a certain pool managed by a single aggregator, Guidelines for DR should define models for flexibility resources to delineate according to which criteria an aggregation of resources should be admissible in bidding, so as not to create further problems (e.g. congestion) in the network. On one hand, the possibility to aggregate different kind of technologies such as demand-response

[15] EURELECTRIC - Designing fair and equitable market rules for demand response aggregation
[16] Equigy - Crowd Balancing Platform

and small DERs should be allowed. On the other hand, as analysed in Section 3.7.2, constraints on the possibility for aggregators to join resources connected to different nodes should be considered too.

As already anticipated, locational information should be provided in the bids especially for DSOs operation. SOs should also benefit from locational information. At the present state this can be considered as an issue of prequalification: a resource is considered available only when it is guaranteed in advance that a dispatchment is possible, whatever the dispatch of all other resources. Anyway, if DSOs will be allowed in the future framework to manage local real time markets, it will be necessary to allow TSOs and DSOs to exchange locational information. This point is also linked to the necessity of a coordination between system operators. The FlexPlan model considers a mechanism of coordination in terms of data exchange between TSOs and DSOs, where the planning studies are carried out separately but in a coordinate way between TSO and DSOs by means of an exchange of information at the border between the different systems. On this regard, if a locational information is associated to the bid, it will be responsibility of the system operator, which has the overview of the network, to consider if the evaluated bid is acceptable or not. Issues arise when very small facilities are included. The problem should be solved considering an adequate coordination of TSO and DSO, leaving very small resources only to DSOs and sharing to TSOs only the relevant information.

3.9 Interactions with capacity markets

Capacity markets represent a mean to promote medium- and long-term investments, they indeed assure a remuneration to generators for their availability of producing electricity. The high penetration of RES is increasing the uncertainty and variability of energy production and, to contrast this increase, it is necessary to promote a significant introduction of flexibility resources in the system. Capacity remuneration mechanisms can help in this scope providing the right incentives for flexibility resources, but it is necessary to understand the different possibilities and interactions with the overall system.

3.9.1 European and national regulatory framework

In EU Regulation 2019/943 [1], article 23 concerns the European resource adequacy assessment (EERA) describing the principles on which the methodology to evaluate the European adequacy should be developed. Among them the assessment should consider scenarios with and without capacity mechanisms (CM), existing or planned, and so including or excluding CM revenues not yet awarded. When EU countries identify adequacy concerns, a development plan should be provided by each of them, and a guidance is given for its development [40]. As a rule, CM should be used only when market reforms are not sufficient to solve every adequacy issue.

IRENA, in [41], presents a new design of capacity markets which would allow the development of flexibility resources necessary to integrate high shares of non-programmable energy resources in the energy supply. Not only the integration of clean resources would be accelerated, but also there would be also benefits coming from the reduction of network required expansion. According to IRENA redesign, capacity remuneration mechanisms should consider which are the flexibility requirements of the system, consider the participation of demand response and introduce the participation of energy storage.

In some European countries, flexibility resources are already integrated in capacity remuneration mechanisms, for example in French and Greece capacity markets are developed to promote demand

response [17]. Many countries allow storage participation in capacity markets, storage resources are responsible for discharging energy when required by SOs and generally the remuneration is based on the duration of discharge. In Belgium Capacity Remuneration Mechanism (CRM) [18] and a Strategic Reserve Mechanisms (SRM)[19] are used to ensure adequacy. The CRM aims to compensate the electrical capacity holders for that portion of their relevant costs that are not compensated by revenues, and it is opened to all eligible capacity holders (existing or planned, production, storage or demand response). The SRM is used to offset any structural generation storages during the winter months making use of demand side management and out of market generation units.

Anyway, at present state capacity market mechanisms are mainly designed for conventional generation power plants, which are able to provide energy when needed; capacity remuneration should be updated considering all advantages brought by flexibility resources and thus incentivizing their development and establishing a service to be provided in exchange.

3.9.2 Stakeholders' positions

According to WindEurope [42], CRMs are essential to increase the deployment of electricity storage. Anyway, the design of these mechanisms should be based on system adequacy without distorting the electricity markets, technology neutrality is fundamental and should promote the zero-emission goal.

3.9.3 FlexPlan consortium opinions

CMs have been introduced because energy markets alone are not sufficient to provide a sufficient incentivization of investments in flexibility and firm capacity. However, some adjustments should be made considering that not only technological neutrality should be considered, but the remuneration should be based according to the service that a certain resource can provide and according to the real necessity of a resources connected in a particular point of the grid (locational dependency, which should correspond to the needs highlighted by the planning studies carried out by the SOs). This process is different from the normal approval process for grid expansion initiatives. In fact, if a SO highlights, as a result of its studies the necessity to deploy a new line, the regulator is charged to approve it and after this approval the SO can build the new line. In the case of storage, as the SOs (apart from few exceptions) are not allowed to own such kind of devices, once the Regulator approves the request to deploy it, then some mechanisms should be put in place in order to incentivize private investors to deploy a new storage where it could be mostly useful for the system. A (locational) capacity market could be a possible regulatory tool to implement such mechanism.

Both CMs and flexibility resources are a mean to tackle high electricity prices in periods of scarcity, indeed the first helps in increasing system adequacy and the second represents a substitution to expensive power production. Considering so, it is possible to think capacity markets as a temporary strategy to increase investments in flexibility resources, so that when a satisfying amount of flexibility resources is

[17] Italy and Poland's electricity markets face uncertain future – EURACTIV.com
[18] Legal basis: Capaciteits Remuneratie Mechanis, Product sheet can be found here
[19] Legal basis: JUSTEL - Geconsolideerde wetgeving. Product sheet can be found here

achieved, there won't be the necessity of capacity markets anymore because of a satisfying level of system adequacy.

However, it is necessary not only to promote investment of flexibility resources but, to promote the use of these resources in a correct way, a regulatory framework which encourage the installation and use of these resources in a proper way. For this reason, it is possible to distinguish *capacity markets* from *capacity remuneration*. On one hand, *capacity market* is intended as a process to build up auctions to build up new flexibility resources in specific location, it should create incentivizing mechanism for the development of the resources where they are mostly needed. Eventually, during planning procedure, SOs identify nodes characterized by critical conditions due to system needs. In this case, capacity markets represent an efficient mean to promote investments on flexibility resources, such as storage facilities, to be connected to that specific node. Regulatory authorities should organize incentivization mechanisms based on local price signals, which are an indicator to understand which regions are affected by lower system adequacy and reliability. Therefore, capacity market mechanisms should be driven by local price signals in order to incentivize the development of the grid, in terms of installation of new flexibility resource, where mostly needed. Different remuneration should be considered depending on local signals, so that biggest bottleneck of the network will be favoured when investments must be made. On another hand, *capacity remuneration* should be considered when existing capacity should be forced to bid for flexibility services than in energy markets. Therefore, a regulation should be put in force that ensures that the amount of capacity that is meant to be used for flexibility purposes is kept available and not offered in other markets. For this purpose, a capacity remuneration should be considered when flexibility markets are developed, so to avoid that most part of the resources is sold during day-ahead or intraday markets, reducing the overall available flexibility during real-time operations. Two possibilities can be investigated: the first is a capacity remuneration which is related to a flexibility service, where the contracted capacity cannot be offered in every market but must be reserved for flexibility purposes, and the second is a capacity remuneration based of the actual provision of flexible capacity in a flexibility market, so to encourage flexibility providers to offers the resources directly in flexibility markets. This leads towards two different remuneration procedures: the first would be characterized by an annual price proportional to the contracted capacity, the second would be based on an extra remuneration proportional to the actual modulation (in €/MWh) of the resource.

It must finally be noted that the implementation of (locational) capacity markets and of capacity remunerations should be conceived in alternative: if a capacity market already provides adequate incentives for a new resource to settle in a given system node, this incentivization should already be accompanied by an obligation to retain such capacity and not to offer it in other markets, as well as a possible price cap non the bidding price for that capacity.

3.10 How proposed market reforms could affect flexibility remuneration

Among the identified barriers, some of them can be considered market related. Price caps in spot markets, indeed, can be considered as market-related barriers which are introduced to protect consumers and to avoid the abuse of market power when demand elasticity is lacking. However, price caps come along with drawbacks such as a slowing down investments for the development of generation capacity due to a missing money problem. Recent market reforms are investigated in the following paragraphs.

3.10.1 European and national regulatory framework

The proposed market reforms [43] of the European commission aims at introducing strategies necessary in order to avoid dramatic increases in electricity prices. Identified possibilities range from the reduction of the demand during peak hours to the introduction of revenue caps on inframarginal technologies. The removal to market barriers to renewable PPA is considered, allowing these resources to operate under long-term contracts implemented through Contract for Differences (CfD). Furthermore, the possibility to introduce a temporary solidarity contribution, proportional to last year revenues with respect to previous years, from fossil fuel companies is expected.

Another strategy proposed as is collected in [44]; it suggests dividing the wholesale power market into two segments/phases:

- Firstly day-ahead-market opens for resources that operate when available (not on demand) submitting volume-based offers and being remunerated through contracts for differences.
- Secondly, on demand resources (fossil fuel plants, hydropower plants, demand response and electricity storage) submit offers price and volume based which are accepted according to the remaining necessities and thus generating a market-clearing price.

As results the final overall cost is given by a weighted average of the remuneration established in CfD and the realized clearing-price.

In [45] a further market review is proposed. It Is based on a combination of long-term contracts, to foster investments in generation, and short-run energy markets, to provide signals for efficient real-time operation and consumption. For short-term markets, in order to avoid market power and leave the possibility of cross-border trading, a pay-as-clear auction should be considered and the participation to this market should be compulsory for all demand and supply units. Long-term contracts should be signed between the regulator and the generators and should be based on prices which reflects the production technology. Counter-party risk is then reduced with respect to PPAs between private companies, thus investments result less risky and liquidity in forward markets is expected to increase. Different CfD are proposed: 1) *two-way CfD*, based on the usual concept of CfD and with the possibility of establishing a reference quantity ex-ante avoiding capacity withholding, 2) *flexibility contracts*, based on the introduction of a flexibility bonus or penalty depending on the necessity of energy in a certain timeframe and remunerated considering the difference between the actual hourly market price and the average price, 3) *reliability options*, based on a pay back proportional to an eventual positive difference between reference price and strike price in exchange of a capacity payment. Capacity payments methodologies are recommended for energy storage and demand response because they make the time shifting of demand or supply very attractive solving the missing money problem.

3.10.2 Stakeholders' positions

Eurelectric, in its response to the market reform which introduces price cap on electricity production [46], considers the possibility of generating a market distortion due to this reform, slowing down and endangering the energy transition. Indeed, it is possible that if price cap for inframarginal technologies is too low they disincentivize the willingness to sell energy and thus reducing the overall available flexibility. Furthermore, problems would be encountered in understanding where the real production comes from, considering that hedging contracts are often employed especially for non-programmable generation. When

flexibility resources come along with non-programmable generation, the price cap could damage the overall revenue for flexibility resources.

According to Europex[20], the price cap should be defined so to avoid negative effects on price formation, considering the equilibrium between supply and demand and the use of spot prices used for settlement purposes. Furthermore, all markets and market timeframes should be included, even balancing markets, to ensure equal situations in all markets and avoid arbitrage opportunities.

3.10.3 FlexPlan consortium opinions

It is not easy to understand to which category storage and demand response should be allocated on the basis of the proposals listed above: they could be considered as RES but also as conventional power plants. Actually, they are in-between them according to their characteristics because they are generally characterized by low marginal costs, but they can be considered as an alternative to gas-fired power plants because of their programmability. For this reason, it should be specified in which conditions these technologies should or not be subject to a cap on market revenues: in case they are deployed for the provision of flexibility services they should not be subject to a cap on revenues; in case they are used to buy/sell electricity into markets with arbitrage purposes, a cap on revenues should be considered. Furthermore, the introduction of a solidarity contribution of fossil fuel companies could contribute to the remuneration of demand side services as well as support investments for other flexible resources.

Furthermore, a two-stages market is a typical architecture where market power arises because, knowing the presence of a following market characterized by high prices, bids in the first stage would be characterized by higher prices than usual ones based on technological marginal prices. It is then not easy to understand the real outcome of such market reform due to the great number of factors to be considered, anyway flexibility resources should still be categorized more specifically understanding which stage of the market they should participate to.

With respect to the proposal of a new market framework given in [44], FlexPlan consortium considers that the use of long-term contracts could be very successful, as well as the introduction of capacity markets dedicated to flexibility resources. Anyway, as mentioned in Section 3.9.3, locational criteria should be applied so to avoid promoting the installation of resources in zones where they are not necessary and, instead, to attract investors to install new facilities where the system lacks resources. This would also deal with the main weakness of paying for capacity with respect to paying for output: paying for output pushes investors toward promising locations but if capacity prices are defined according to system need the same effect would be achieved

[20] Position Paper - Europex

4 Conclusions

The present deliverable analyses the possible barriers encountered when implementing the FlexPlan methodology in the present EU end national regulatory context.

In analysing the different regulatory aspects, we singled out 10 key factors that should be considered and tackled in order to create the conditions for a "level playing field" participation of flexibility resources (storage devices and flexible loads) in the real time markets for the provision of ancillary services to the system. Part of them have to do with the planning horizon (long term) and party have to do with the real possibilities to bid in the real time by competing with traditional resources in the flexibility markets.

By summarizing the most noteworthy points highlighted in this deliverable, we elaborated the following guidelines:

- Investments in storage and flexibility will remain mostly in the hands of private investors. **National Regulatory Authorities should translate the suitability of deploying new storage or flexibility in strategic network locations into opportune incentivization tools for potential investors.** This complicates the traditional scheme, where System Operators after carrying out planning analyses were the only subject entitled to invest.
- Such incentivization tools should contain a locational element able to drive potential investors to prefer an investment in critical nodes, identified on the basis of the studies led by the System Operators. **This can be carried out either by means of locational capacity markets or by means of long-term contracts obliging the flexibility providers to reserve an adequate amount of capacity to be offered in services markets. Alongside this constraint a price cap could be also fixed so that strategic behaviours are prevented.** In alternative, a "must-run" management of particularly strategic "flexibility" elements by the system operators themselves could also be conceived, where SOs offer these resources in real time markets on behalf of the private investors, who retain the profit derived from it.
- **Real time market should be reformed by defining products that allow "flexibility" providers to compete with traditional resources on a "level playing field" basis.** Operative constrains of storage and demand side management should be fully considered.
- Despite some significant yet incremental steps done in 2019/944 Directive**, active use of Demand Response has been inhibited due to lack of a comprehensive regulatory framework for the subject**. In that sense it is difficult to underestimate the importance of the forthcoming Network Code for Demand Response. The FlexPlan Consortium acknowledges the significance of the presented ACER's Framework Guideline for the Code, which presents an outline for the main subjects to be stipulated. The final document shows a great improvement after the public consultation accomplished in autumn 2022. It also creates a logical connection between network development planning as described in Arti. 32 and demand response, as an alternative to system expansion.
- Despite recognising the importance of aggregation for demand response, 2019/944 Directive failed to define the role and responsibilities of Aggregator, the key element in the puzzle. **The role and responsibilities of aggregators should be accurately designed within the redefinition of real-time market architectures.** In the final version of the Framework Guideline more details have been specified, but the role of Aggregator still remains somewhat

unclear and probably has to be properly addressed at another legal level (e.g. in a new version of the 2019/944 Directive). Here, the FlexPlan consortium assumes that an aggregator should act by compensating positions with opposite risk exposures, thus favouring real-time markets operation. However, the business case of the aggregators must also be considered so that their operation is capable to provide them with the needed revenues, without which no real subject, even in presence of a specific regulation, will ever volunteer to take such responsibility.

- **In future energy systems, TSO and DSOs should coordinate their planning activities.** In fact, most of the potentially flexible loads as well as most distributed generation are being connected to distribution systems. However, it is not thinkable to allow a really integrated planning of transmission and distribution: on one side the optimization problem would be too complex and on the other system operators are not allowed to exchange private data with other subjects, be they even other system operators. Therefore, a coordinated approach can be suggested in which by means of an exchange of data at the border between different systems, DSOs can, in case advantageous for the system, oversize their network so as to get fit to provide services to transmission. The T&D decomposition approach proposed by FlexPlan can be, in our opinion, a good starting point for reasoning on this approach.
- Cost-benefit analysis must take into account positive effects of flexibility resources. Key importance must be attributed to GHG and other pollutant reduction. **Environmental aspects should be put in monetary terms so that they can be co-evaluated with more traditional ones (social welfare, etc).**
- **Market reforms are now investigated in Europe, so as to decouple market prices from gas prices (possibility of price-caps or two-stage markets). These reforms, while considering the role of generators and loads, usually don't consider explicitly the role of flexible resources (e.g. arbitrage between market prices at different times).** Taking into account the fact that storage and DSM will be two major players in the future provision of ancillary services, a clarification on the nature of the service provided by these subjects would bring to more forward-looking reform of market mechanisms.

5 Bibliography

[1] European Commission, "Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity," 5 June 2019. [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2019.158.01.0054.01.ENG&toc=OJ:L:2019:158:TOC. [Accessed 5 January 2020].

[2] European Commission, "Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU," 5 June 2019. [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2019.158.01.0125.01.ENG&toc=OJ:L:2019:158:TOC. [Accessed 5 January 2020].

[3] European Union Agency for the Cooperation of Energy Regulators, "Framework Guideline on Demand Response (Draft for public consultation)," 2022.

[4] CEER, "Flexibility Use at Distribution Level, A CEER Conclusions Paper," 2018.

[5] CEDEC, E.DSO, ENTRSO-E, Eurelectric, GEODE, "TSO-DSO Report, An Integrated Approach to Active System Management," 2019.

[6] FlexPlan Consortium, "D6.1 Guideline for the compliance of network planning tool with EU overall strategies and regulatory considitons," 2020.

[7] FlexPlan Consortium, "D6.2 Identified regulatory limitations and opportunities based on the regional cases," 2023.

[8] FlexPlan Consortium, "D5.2 - Grid development results of the regional studies".

[9] ENTSO-E, "A Power System for a Carbon Neutral System," 2022.

[10] Autorità di Regolazione per Energia Reti e Ambiente, "Delibera 646/2015/R/eel - Testo integrato della regolazione output-based dei servizi di distribuzione e misura dell'energia elettrica, per il periodo di regolazione 2016-2023".

[11] "Testo Integrato della regolazione OUTPUT-BASED dei servizi di distribuzione e misura dell'energia elettrica - Periodo di regolazione 2016-2023".

[12] European Commission, "Council Regulation on emergency intervention to address high energy prices2022," Brussels, 2022.

[13] Bain & Company, EDSO Collaboration, "Reccomandations on Role of DSOs in the European Union's Recovery Plan and the Acceleration of the Green Deal Agenda," 2020.

[14] ENTSO-E, “Position on Innovation uptake through Regulation,” June 2022.

[15] The Norwegian Water Resources and Energy Directorate, “Batteri tilknyttet nettet,” 2022. [Online]. Available: https://www.nve.no/reguleringsmyndigheten/kunde/nett/tilknytning-av-forbruk-og-produksjon/batteri-tilknyttet-nettet/.

[16] “Decreto Legislativo 8 novembre 2021, n210,” 2021.

[17] Autorità di Regolazione per Energia Reti e Ambiente, “DOCUMENTO PER LA CONSULTAZIONE 393/2022/R/eel - CRITERI E CONDIZIONI PER IL SISTEMA DI APPROVVIGIONAMENTO A TERMINE DI CAPACITÀ DI STOCCAGGIO ELETTRICO,” 2022.

[18] European Federation of Energy Traders, “EFET position paper on the ownership and operation of storage assets,” Amsterdam, 2019.

[19] Vlaandered verbeelding werkt, “Decreet houdende algemene bepalingen betreffende het energiebeleid,” 2009.

[20] European Commission, “Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (Text with EEA relevance.),” 2017.

[21] Autorità di Regolazione per Energia Reti e Ambiente, “Regolazione dello scambio dati tra Terna Spa, imprese distributrici e "Significant Grid User" ai fini dell'esercizio in siurezza del sistema elettrico nazionale,” 2021.

[22] ENTSO-E, “High Level Report TYNDP 2022 - version for public consultation,” 2022.

[23] FlexPlan Consortium, “Probabilistic optimization of T&D systems planning with high grid flexibility and its scalability,” 2022.

[24] M. Rossi, M. Rossini, G. Viganò, G. Migliavacca, D. Siface, I. Faifer, H. Hergun and I. B. Sperstad, “Planning of distribution networks considering flexibility of local resources: how to deal with transmission system services,” *CIRED,* 09 2021.

[25] FlexPlan Consortium, “D7.3 - Newsletters published twice a year”.

[26] ENTSO-E, “3rd ENTSO-E Guideline for Cost Benefit Analysis of Grid Development Projects,” Brussels, 2021.

[27] European Commission, “Regulation (EU) 2022/869 of the Euopean Paliament and of the council of 30 May 2022 on guidelines for trans-European energy infrastructure, amending Regulations (EC) No 715/2009, (EU) 2019/942 and (EU) 2019/943 and Directives 2009/73/EC and (EU) 2019/944,,” 03 06 2022.

[28] European Commission, “Regulation (EU) No 347/2013 of the European Parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure and

repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and [..],” 2013.

[29] ENTSO-E, “4th ENTSO-E Guideline for COst Benefit Analysis of Grid Development Projects - Draft version 4.0 for public consultation,” 2022.

[30] Terna, “PIANO DI SVILUPPO 2021 - Documento per l'applicazione dell'analisi costi benefici applicata al Piano di Sviluppo 2021,” 2021.

[31] USEF, “White Paper: Flexibility Deployment in Europe,” 2021.

[32] Council of European Energy Regulators, “Guidelines of Good Pracitces for Flexibility Use at Distribution Level,” 03 2017.

[33] Eurelectric, “The Missing Piece - Powering the energy transition with efficient network tariffs,” 2021.

[34] EDSO, “FUTURE DISTRIBUTION NETWORK TARIFF STRUCTURES GUIDANCE”.

[35] ACER, “Report on distribution tariff methodologies in Europe,” 2021.

[36] European Commission, “Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing,” 2017.

[37] European Union Agency for the Cooperation of Energy Regulators (ACER), “PC_2022_E_08 - Public Consultation on the amendments to the grid connection network codes,” 2022.

[38] G. Leclercq, M. Pavesi, T. Gueuning, A. Ashouri, P. Sels, F. Geth, R. D'hulst and H. Le Cadre, “SmartNet - D2.2 Network and market models,” 2019.

[39] Autorità di Regolazione per Energia Reti e Ambiente, “Testo Integrato del Dispacciamento Elettrico - Accesso del servizio di diapcciamento, organizzazione dei mercati,” 2022.

[40] European Commission, “Guidance for Member States on implementation plans pursuant Art. 20 (3)-(8) of Regulation (EU) 2019/943 (“Market Reform Plans”)”.

[41] International Renewable Energy Agency (IRENA), “Redisigning capacity markets - Innovaton landscape brief,” 2019.

[42] WindEurope, “WindEurope priorities on the EU legislative proposal on Electricity Market Design,” 12 2022.

[43] European Commission, “Proposal for a COUNCIL REGULATION on an emergency intervention to address high energy prices,” Brussels, 2022.

[44] Council of the European Union, “Any other business - Proposal for a power market design in order to decouple electricy priced from soaring gas prices,” 22 07 2022.

[45] N. Fabra and CEPR, “Electricity Markets in Transition - A proposal for reforming European electricity markets,” 2022.

[46] Eurelectric, “Draft Council Regulation proposing a price cap on electricity producers' market revenues COM(2022) 473 - Eurelectric position paper,” 09 2022.

[47] BOLETÍN OFICIAL DEL ESTADO, “Ley 24/2013, de 26 de diciembre, del Sector Eléctrico.,” 2013.

[48] Council of European Energy Regulators, “CEER Paper on DSO Procedures of Procurement of Flexibility,” 16 07 2020.

[49] Autorità di Regolazione per Energua Reti e Ambiente, “Delibera 08 novembre 2022 557/2022/R/eel - Modelità per l'ottenimento delle agevolazionidi cui al decreto del Ministro della Transizione Ecologica del 21 settembre 2022 in tema di energia elettrica da fonti rinnovabili prelevsta da impianti di elettrolisi”.

Appendix I

Framework Guideline on Demand Response. Draft for Public Consultation (2022-06-02)
TOPICS OF INTEREST FOR FLEXPLAN (Check the box) ☐Subsidies for settling new flexibility resources ☒Storage ownership ☒Responsibilities and data exchange between TSO and DSO in planning ☐CBA update (ENTSO-E and national) and internalization of environmental costs ☐Services that can be provided by flexibility resources: market and non-market (must-run) dispatch ☒Markets flexibility resources can participate in ☐Products tailored for flexibility resources in RT-markets ☒Regulation on aggregators and possibility to include flexibility in their basket ☐Interactions with capacity markets ☐How proposed market reforms (revenue cap for inframarginal rent, "Greek proposal for two-stages") could affect flexibility remuneration.
SUMMARY OF THE POINT OF INTEREST IN THE DOCUMENT **Storage ownership:** When it comes to the ownership, the document reaffirms the restricting terms of Dir. 2019/944. The document states explicitly that the new Code on Demand Response should maintain technology neutrality and shall not favour demand response and storage (2). However, it also requires that the new code should ensure that demand response and other resources should be preferred over SO-owned storage (35). The code should make more specific requirements for SO tender procedures, required by 2019/944 for ownership of storage and guidance for development of the related CBA (36). (*Eurelectric demands removing these provisions (36)-(38) from the document*). **Responsibilities and data exchange between TSO and DSO in planning**: The document requires that DSO publish their planning methodology in network development plans (NDPs) (98). Otherwise, the document refers to TSO-DSO date exchange only with regard to operational planning, referring to the SO Regulation and operation of local markets. The document has a section dedicate to SOs coordination, which requires definition of several terms, including establishing principles for interaction within SO coordination group (which includes DSOs affected by SOs services) (60). It also states that SO coordination group shall be cooperated at least on network development planning (62). Furthermore, this that SOs receive from each other data according to Art. 43(3) and 44 of SO Regulation. *(Eurelectric demands removing 61-62*). Otherwise, the document emphasises data exchanges in preparation, operation and settlement phases (but not planning). **Markets flexibility resources can participate in**: The FG requires that demand response and other relevant resources should have access to **all** electricity wholesale markets (18). SO services can be procured through dedicated local markets or through locationally tagged bids in wholesale markets, especially intraday and balancing (51). The new rules should provide coordination of local and wholesale markets, promoting TSO-DSO coordination (52). The overall market design should minimise possibilities for withholding capacities and market abuse; maximise liquidity, possibility to propose bids procured in one market to another, do not distort electricity wholesale markets by procuring SO services (52). Pricing mechanisms for locationally tagged bids can be different from the general principles on these markets (53). The new rules may include that bids offered on intraday or balancing market can be used for congestion management in transmission or distribution grids (53). The document also requires definition of rules for the local markets (56) emphasising free access and transparency. **Regulation on aggregators and possibility to include flexibility in their basket**: In general, the document refers to 2019/944 Art. 17, but it requires more detailing for different terms and aspect e.g. it requires from the MSs an exhaustive list of aggregation models that may be applied. It underlines that compensation models should not create barriers for participation in the aggregation process (24). It also requires European-wide harmonising of the aggregation models, including analysis by ENTSO-E and EU DSO

RELATIONSHIP WITH FLEXPLAN APPROACH AND METHODOLOGY

The document defines the main structure, scope and in some cases principles, which should be included into the forthcoming Regulation on Demand Response. It has to be mentioned that the first version received several critical feedbacks from the major European stakeholders e.g., Eurelectric and it is natural to expect a serious revision.

Enel Response ACER CEER GC NC consultation

TOPICS OF INTEREST FOR FLEXPLAN (Check the box)

☐Subsidies for settling new flexibility resources
☒Storage ownership
☐Responsibilities and data exchange between TSO and DSO in planning
☐CBA update (ENTSO-E and national) and internalization of environmental costs
☐Services that can be provided by flexibility resources: market and non-market (must-run) dispatch
☒Markets flexibility resources can participate in
☐Products tailored for flexibility resources in RT-markets
☐Regulation on aggregators and possibility to include flexibility in their basket
☐Interactions with capacity markets
☐How proposed market reforms (revenue cap for inframarginal rent, "Greek proposal for two-stages") could affect flexibility remuneration.

SUMMARY OF THE POINT OF INTEREST IN THE DOCUMENT

The deployment of storage capacity at scale needs to consider two major factors:

- The business case for storage is not sustainable today in most situations, and therefore an approach

requiring multiple use cases will be necessary to make the investments attractive.

- The deployment of storage solutions should promote the integration of renewable energy in the Network and should not prevent the development of a true flexibility market. For deployment to be effective and sustainable, the evolution of the storage market and regulatory framework needs to cover all kinds of storage solutions, not just batteries, and those solutions must consider different time horizons that look beyond short-term storage needs. As part of their mission as market enablers, DSOs need to play a role in promoting and, when relevant, leading the development of competitive storage solutions. This is critical both to ensure the integration of renewables in the power grid and for system balancing. Within this context, the role of DSOs in battery and storage solutions could include:
  - Advising and guiding investments in storage to locations that improve system sustainability
  - Promoting battery usage through co-investments or public-private investments (for example, renting out some storage capacities)
  - Providing technical expertise for broader storage capabilities beyond short-term flexibility (for example, long-term solutions that benefit the network) and batteries (for example, R&D and innovation support for hydrogen-to-gas conversions)

Beyond the storage question, DSOs should provide ancillary services to the market in the context of the development of decentralized and intermittent renewables. Local demand-side management (DSM) and other flexibility services may help ensure local network supply-demand balancing. DSM should become an area where DSOs can invest and operate with mechanisms that comply with market rules.
Without the priming role of DSOs, the EU will not be able to capture the experience curve benefits in due time and profit from a decrease in the total cost of storage ownership.

RELATIONSHIP WITH FLEXPLAN APPROACH AND METHODOLOGY

The development of competitive storage solutions other than batteries should be supported, for instance integration of power-to-gas conversions and long-term flexibilities (such as hydrogen or other renewable sources of gas)
The EU may also consider promoting cross-country storage experimentations (without going through TSOs) at a lower grid level where flexibilities and supply-demand optimization opportunities exist from a market point of view but also favour the integration of the additional renewable capacities to come.

Enel Response to ACER-CEER GC NC consultation
TOPICS OF INTEREST FOR FLEXPLAN (Check the box) ☐Subsidies for settling new flexibility resources ☐Storage ownership ☐Responsibilities and data exchange between TSO and DSO in planning ☐CBA update (ENTSO-E and national) and internalization of environmental costs ☐Services that can be provided by flexibility resources: market and non-market (must-run) dispatch ☒Markets flexibility resources can participate in ☐Products tailored for flexibility resources in RT-markets ☐Regulation on aggregators and possibility to include flexibility in their basket ☐Interactions with capacity markets ☐How proposed market reforms (revenue cap for inframarginal rent, "Greek proposal for two-stages") could affect flexibility remuneration.
SUMMARY OF THE POINT OF INTEREST IN THE DOCUMENT Enel supports a European harmonization aimed at defining a pattern of development of new storages coherent with system needs. Furthermore, Enel proposes to evaluate the possibility of issuing an Implementation Guidance Document (as the one proposed in the Storage Expert Group Final Conclusion) detailing the requisites for different technologies/configuration. On this regard, it is fundamental that these technical requirements for BTM Storage will be determined in such a way so as not to discourage energy storage adoption for enhancing market participation options.
RELATIONSHIP WITH FLEXPLAN APPROACH AND METHODOLOGY Investments needed to improve DSO capabilities and face the new role include grid real-time monitoring and control devices, so as functionalities for flexibility services planning and management (DERMS tool), TSODSO flexibility services coordination system. All those system- improvement related cost should be duly considered by NRA in DSO remuneration, as foreseen by EU Directive 944/19. And not only regarding power flows and steady state conditions (for instance voltage), but also operation aspects (islanding).

Eurelectric / The missing piece - Powering the energy transition with efficient network tariffs
TOPICS OF INTEREST FOR FLEXPLAN (Check the box) ☐Subsidies for settling new flexibility resources ☐Storage ownership ☐Responsibilities and data exchange between TSO and DSO in planning ☐CBA update (ENTSO-E and national) and internalization of environmental costs ☒Services that can be provided by flexibility resources: market and non-market (must-run) dispatch ☒Markets flexibility resources can participate in ☐Products tailored for flexibility resources in RT-markets ☐Regulation on aggregators and possibility to include flexibility in their basket ☐Interactions with capacity markets ☐How proposed market reforms (revenue cap for inframarginal rent, "Greek proposal for two-stages") could affect flexibility remuneration.
SUMMARY OF THE POINT OF INTEREST IN THE DOCUMENT tariff design in long-term view to consider system evolution: •Significant changes in the structure and volumes of electricity generated and transported through the grid with increasing decentralised and volatile production. •Growth in electricity consumption with new and sometimes flexible consumption patterns. •Significant additional storage assets including batteries and electric vehicles that may challenge as well as interact positively with grid capacity. •New markets and players such as prosumers that both consume and produce, citizens 'energy communities, aggregators, electric vehicle charge point operators, heat-pumps etc.

•The increase of demand side flexibility and the ability of all players to react to tariffs.
RELATIONSHIP WITH FLEXPLAN APPROACH AND METHODOLOGY Focus on • Static ToU network tariffs contribute to manage congestion and to optimise network expansion. • Storage as Specific Users of the Network

FUTURE DISTRIBUTION NETWORK TARIFF STRUCTURES
TOPICS OF INTEREST FOR FLEXPLAN (Check the box) ☐Subsidies for settling new flexibility resources ☐Storage ownership ☐Responsibilities and data exchange between TSO and DSO in planning ☐CBA update (ENTSO-E and national) and internalization of environmental costs ☒Services that can be provided by flexibility resources: market and non-market (must-run) dispatch ☒Markets flexibility resources can participate in ☐Products tailored for flexibility resources in RT-markets ☐Regulation on aggregators and possibility to include flexibility in their basket ☐Interactions with capacity markets ☐How proposed market reforms (revenue cap for inframarginal rent, "Greek proposal for two-stages") could affect flexibility remuneration.
SUMMARY OF THE POINT OF INTEREST IN THE DOCUMENT E.DSO revisit its previous position on electricity distribution tariff systems published in 2015 on principles to be drawn by the National Regulatory Authorities (NRAs) and legislators when redesigning distribution network tariffs with the aim to align the interests of DSOs, owners of distributed generation, and society. Considering the evolving role of DSOs in the energy transition and the European Union Agency for the Cooperation of Energy Regulators (ACER) ambition **for tariffs to reflect long-term avoidable costs.** Where network tariffs activate flexibility, e.g. the flexibility of a home battery, this flexibility is called implicit. This is to be distinguished from explicit flexibility, e.g., flexibility provided through specific products or through special contracts. In this paper E.DSO do not consider explicit flexibility.
RELATIONSHIP WITH FLEXPLAN APPROACH AND METHODOLOGY Consistent tariff support an efficient network planning and use, to prevent unnecessary reinforcements, but also to buy time for the necessary reinforcements. Applying appropriate incentives can offer good opportunities for customers to keep their bill low.

Council Regulation on an emergency intervention to address high energy prices (2022/0289)
TOPICS OF INTEREST FOR FLEXPLAN (Check the box) ☒Subsidies for settling new flexibility resources ☐Storage ownership ☐Responsibilities and data exchange between TSO and DSO in planning ☐CBA update (ENTSO-E and national) and internalization of environmental costs ☐Services that can be provided by flexibility resources: market and non-market (must-run) dispatch ☐Markets flexibility resources can participate in ☐Products tailored for flexibility resources in RT-markets ☐Regulation on aggregators and possibility to include flexibility in their basket ☐Interactions with capacity markets

☒How proposed market reforms (revenue cap for inframarginal rent, “Greek proposal for two-stages”) could affect flexibility remuneration.

SUMMARY OF THE POINT OF INTEREST IN THE DOCUMENT

Strategies to monitor and moderate energy prices during normal and abnormal market conditions are described. In accordance with EU regulation useful approach are:

1. Reduction of the demand: reduction of 10% on the gross electricity consumption and specifically of 5% on energy consumption during peak hours.
2. Introduction of a marginal revenue cap for inframarginal technologies at European level together with the removal of market barriers to renewables PPA.
3. Extension to small and medium-sized enterprises of public interventions in electricity price up to a maximum annual consumption (80% of beneficiary’s highest annual consumption over last 5 years)
4. Temporary solidarity contribution from fossil fuel companies proportional to the profits of last year with respect to previous years.

RELATIONSHIP WITH FLEXPLAN APPROACH AND METHODOLOGY

Flexible resources should not be affected by the price cap, indeed it is specified that ‘demonstrative technologies’ should be exonerated from this regulator. This points out incentives on the use of flexible resources such as storage energy facilities.

Furthermore, according to regulation, the reduction of the consumption during peak hours (correlated with demand side response) should involve a compensation when there is an actual reduction of consumption with respect to the expected one.

The solidarity contribution collected from extra profits of fossil fuel companies could be used to help reducing energy consumption through demand reduction auctions and to support investments into other flexible resources.

Proposal for a power market design in order to decouple electricity prices from soaring gas prices

TOPICS OF INTEREST FOR FLEXPLAN (Check the box)

☒Subsidies for settling new flexibility resources
☐Storage ownership
☐Responsibilities and data exchange between TSO and DSO in planning
☐CBA update (ENTSO-E and national) and internalization of environmental costs
☐Services that can be provided by flexibility resources: market and non-market (must-run) dispatch
☐Markets flexibility resources can participate in
☐Products tailored for flexibility resources in RT-markets
☐Regulation on aggregators and possibility to include flexibility in their basket
☐Interactions with capacity markets
☒How proposed market reforms (revenue cap for inframarginal rent, “Greek proposal for two-stages”) could affect flexibility remuneration.

SUMMARY OF THE POINT OF INTEREST IN THE DOCUMENT

In order to monitor and reduce energy prices, it is suggested to separate the wholesale power market into two segments/phases:

1. Firstly day-ahead-market opens for resources that operate when available (not on demand) submitting volume-based offers and being remunerated through contracts for differences.
2. Secondly, on demand resources (fossil fuel plants, hydropower plants, demand response and electricity storage) submit offers price and volume based which are accepted according to the remaining necessities and thus generating a market-clearing price.

As results the final overall cost is given by a weighted average of the remuneration established in CfD and the realized clearing-price.

RELATIONSHIP WITH FLEXPLAN APPROACH AND METHODOLOGY

Not particularly of interest for FlexPlan.

Firstly, the methodology of price calculation could generate mainly a constant price during the day thus it is not possible to identify price signals for demand-side response.

Secondly, this market model does not incentivize the development of renewable resources given that prices of energy produced by these technologies are limited.

ARERA'S RESOLUTIONS nr. 300/2017 and nr. 422/2018

TOPICS OF INTEREST FOR FLEXPLAN (Check the box)

☐Subsidies for settling new flexibility resources
☐Storage ownership
☐Responsibilities and data exchange between TSO and DSO in planning
☐CBA update (ENTSO-E and national) and internalization of environmental costs
☐Services that can be provided by flexibility resources: market and non-market (must-run) dispatch
☒Markets flexibility resources can participate in
☐Products tailored for flexibility resources in RT-markets
☒Regulation on aggregators and possibility to include flexibility in their basket
☐Interactions with capacity markets
☐How proposed market reforms (revenue cap for inframarginal rent, "Greek proposal for two-stages") could affect flexibility remuneration.

SUMMARY OF THE POINT OF INTEREST IN THE DOCUMENT

In the Ancillary Services and Balancing Markets demand response participation has been allowed through pilot projects (Resolutions nr. 300/2017 and nr. 422/2018) aimed at collecting useful elements for an overall reform of these markets opening them to new participants (such as non-programmable renewable sources, distributed energy resources and demand side response and storage systems, including electric car batteries) also through aggregators (Mixed Enabled Virtual Units - UVAM).

RELATIONSHIP WITH FLEXPLAN APPROACH AND METHODOLOGY

To date, the resources that provide flexibility services through aggregators (UVAM) are evaluated over a limited and defined time horizon (from real time up to a maximum of one year). It is more difficult to estimate their behaviour over a longer time horizon (for example ten year) as that considered for infrastructural development assessments.

ITALIAN LEGISLATIVE DECREE N. 210/2021 AND ARERA'S CONSULTATION N.393/2022

TOPICS OF INTEREST FOR FLEXPLAN (Check the box)

☐Subsidies for settling new flexibility resources
☒Storage ownership
☐Responsibilities and data exchange between TSO and DSO in planning
☐CBA update (ENTSO-E and national) and internalization of environmental costs
☐Services that can be provided by flexibility resources: market and non-market (must-run) dispatch
☐Markets flexibility resources can participate in
☐Products tailored for flexibility resources in RT-markets
☐Regulation on aggregators and possibility to include flexibility in their basket
☐Interactions with capacity markets
☐How proposed market reforms (revenue cap for inframarginal rent, "Greek proposal for two-stages") could affect flexibility remuneration.

SUMMARY OF THE POINT OF INTEREST IN THE DOCUMENT

Article 18 of Italian Legislative Decree n. 210/2021 requires TSO to submit to the approval of the Ministry a proposal on the evolution of storage capacity need and a proposal for market based, transparent and non-discriminatory auctions for the procurement and realization of such storage capacity. In case the storage capacity need is not completely satisfied by means of the abovementioned auctions, the Decree foresees the TSO to submit to the Ministry approval a plan for a direct realization by the TSO itself of the needed storage capacity. Furthermore, the Decree asks the Italian NRA (ARERA) to define all the auctions criteria which ARERA have defined in a consultation Document (DCO 393/2022, consultation process still ongoing until November 11th).

RELATIONSHIP WITH FLEXPLAN APPROACH AND METHODOLOGY

Terna already considers storage contribution to network flexibility services in the evaluation of infrastructure projects.

ACB METHODOLOGY APPLIED TO THE 2021 DEVELOPMENT PLAN IN ITALY

TOPICS OF INTEREST FOR FLEXPLAN (Check the box)

☐Subsidies for settling new flexibility resources
☐Storage ownership
☐Responsibilities and data exchange between TSO and DSO in planning
☒CBA update (ENTSO-E and national) and internalization of environmental costs
☐Services that can be provided by flexibility resources: market and non-market (must-run) dispatch
☐Markets flexibility resources can participate in
☐Products tailored for flexibility resources in RT-markets
☐Regulation on aggregators and possibility to include flexibility in their basket
☐Interactions with capacity markets
☐How proposed market reforms (revenue cap for inframarginal rent, “Greek proposal for two-stages”) could affect flexibility remuneration.

SUMMARY OF THE POINT OF INTEREST IN THE DOCUMENT

The document contains the methodology by which Terna carries out the assessment of the benefits and costs of the main projects (Capex > 15 M €) included in the National Development Plan.

RELATIONSHIP WITH FLEXPLAN APPROACH AND METHODOLOGY

In planning new development interventions, storages are already considered as scenario input and consequently Terna's ACB methodology already considers their contribution to network flexibility services in the evaluation of infrastructure projects.
In addition, the methodology allows to evaluate any environmental benefits (as indicators B18 and B19) deriving from the projects (related to the reduction of pollutant emissions due to the thermoelectric generation).

Appendix II

Level	Current practice
Federal	The Federal Development Plan sets out a detailed estimate of transmission capacity requirements, based on multiple scenarios, and the investment program of Elia. It is drawn up in accordance with the Electricity Act of 29 April 1999 on the organization of the electricity market (Art. 13). The Development **covers a period of ten years** and is **updated every four years**. The Federal Development Plan is also elaborated in consultation with the other European network operators, amongst others in the context of the non-binding European 10-year development plan, which is published every two years. The last version of the plan is the one for the period 2020-2030.
Flemish Region	The Energy Decree (Art. 4.1.19) stipulates that the DSO must annually draw up an Electricity and Gas Investment Plan. Fluvius now prepared its first **Investment Plan in the longer term (10 years)** and held **a public consultation** on those plans. Fluvius has recently published its **investment plan 2023-2032** considering the feedback of the consultation, according to the reporting model imposed by VREG. In a last step, the investment plan needs to be approved by the VREG. The investment plan **focuses on alternatives to grid investments in the form of mitigating measures such as the introduction of a capacity-based distribution grid tariff and flexibility services** and also incorporates a proposed **assessment framework to evaluate grid investment versus market and technical flexibility**. The provided information is however still quite high-level and should be further developed.
Walloon Region	The establishment of the investment plans in the Walloon region also constitutes an **annual exercise** and the plans cover a maximum period of 5 years. The plans should at least **cover a period corresponding to the current tariff period**, but to assure continuity also the years of the next tariff period are covered. The **topics of smart grids in general (also encompassing demand side flexibility) and electromobility should also be covered**, focusing on expected / realized projects. The last version of the investment plans covers the period 2022-2026. **Formal approval by the regulator**, CWAPE, is foreseen. The topic of flexibility was not yet covered in detail in these investment plans.
Brussels Capital	Sibelga, the DSO for electricity and natural gas within the Brussels-Capital Region, annually submits its plans for investments in the electricity and gas distribution networks for the next 5 years to the regulator, Brugel. Brugel organizes a public consultation on the draft electricity and gas investment plans of Sibelga. The last version of the investment plan covers the period 2022-2026 In this investment plan specific attention is paid to the influence of EVs, the energy transition and its impact on the distribution grid. Currently Sibelga is working on new estimates of the reinforcement needs of its networks, the results of which are expected by the end of 2022. The use of flexibility will be considered in this next investment plan.

Table 0-1 - Current status and practices for NDPs in Belgium