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Policy framework and business models enabling flexibility markets

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Abbreviation	Definition
aFRR	Automatic Frequency Restoration Reserve
ASP	Ancillary Service Provider
BRP	Balance Responsible party
BSP	Balance service provider
CHP	Combined heat and power
DAMP	The market clearing price in Turkey
D	Deliverable
DERs	Distributed energy resources

DSO	Distribution system operator
Ei	The Energy Market Inspectorate (‘Energimarknadsinspektionen’ in Swedish)
ELDER	Electricity Distribution Services Association
EMRA	The Energy Market Regulatory Authority in Turkey
EWRC	The Energy and Water Regulatory Commission of Bulgaria
FCR	Frequency Containment Reserve
GDPR	General Data Protection Regulation
GOs	Guarantees of origin
IBEX	Bulgarian Independent Energy Exchange EAD
IKN	Non-concessioned network (‘icke koncessionspliktig nät’ in Swedish)
KVKK	Personal Data Protection Law in Turkey
LFM	Local flexibility market
mFRR	Manuel Frequency Restoration Reserve
NEMO	Nominated electricity market operator
PuL	The Swedish Personal Data Protection Act
RCP	Energy community in Switzerland
REDII	Revision of the Renewable Energy Directive
SDL	A market for system services in Switzerland
SRI	Renewable Energy Remuneration System
SvK	Swedish national power grid (‘Svenska kraftnät’ in Swedish)
T	Task
TSO	Transmission system operator
WP	Work Package

Contents

Executive summary

Local flexibility markets are under technical development in the FlexiGrid project, in order to help Distribution system operators (DSOs) solve problems of local congestion or voltage band violations. This report aims to map and analyse the regulatory and policy environment relevant to local flexibility markets in the EU, Sweden, Bulgaria, Switzerland, and Turkey. To properly define the analysis and make sure it captures regulatory subjects that are most relevant for the project, five themes and 13 sub-themes have been selected based on work carried out earlier in the FlexiGrid project. The themes for each country to review are 1) market actors, 2) market and product, 3) infrastructure, 4) contract, bidding, and settlement, and 5) data security. Furthermore, business models and value chains serve as a basis for the assumed structure of future markets. The analysis especially focuses on identifying gaps and barriers and proposes how the countries may learn from each other.

In analysing the business models and value chains, we categorised the flexibility resource owners into four groups, i.e., household, community, commercial and public. Based on that, we investigated their different types of resources and value logics to better capture and utilise flexibility through co-creative workshops. In the process of reviewing regulations and policies, we started from EU-level legislation to investigate why the highlighted themes are more relevant and important, if the current regulatory framework addresses certain themes, and how and to what degree the particular theme is addressed or not addressed. For each specified country, we employed a similar standardised assessment and a consistency assessment. There are many ongoing changes and discussions to current regulations which is a challenge as the information quickly risks becoming obsolete. In this report, we review both the existing regulations and the ongoing discussions regarding future legislations. The majority of the report is mainly relevant to the rules and regulations that were in place until the first six months of 2022.

As the value model shows, different owner groups differ for certain flexible resources. Therefore, potential models that provide a measure of available flexibility capacity must follow a stakeholder analysis or resource-specific owner segmentation. From there, this research can point to certain dimensions to enhance the product and value proposition used by the DSO. Importantly, there is a need to communicate and understand the different drivers owned by sellers, which means building closer relationships and co-creating solutions around flexible resource utilisation.

The regulation reviews reveal different stages of local flexibility market development in different countries and on EU-level. Meanwhile, there are lots of discussions and propositions ongoing which may impact the upcoming legislations and shape the designs of local flexibility markets. Many new concepts and new actors, such as aggregators and citizen/renewable energy communities, are proposed and the corresponding legislations are at a high level rather than specific. Consequently, contradictions and conflicts emerge regarding the contractual and financial relationships between these new actors and existing actors (e.g. Balance Responsible Parties). Certain regulations on specific themes are already existing to a large degree but need to adapt to the local flexibility market context, such as data security, data exchange, and data access. Certain themes should be sufficiently clarified by the upcoming legislations since there are divergences in opinion from market players, such as the theme of market operator. There are also certain regulations that are totally missing, such as product prequalification, standardisation, and baseline design of flexibility product and services. Contractual agreements, bidding and market settlements also need to adapt to the local flexibility market, which are already existing in

current electricity market regulations. Local flexibility markets are likely to require modern and advanced metering infrastructure and IT systems capable of handling the information effectively. A lack of such infrastructure would be a costly barrier to overcome. Other necessary infrastructure such as energy storage facilities and network expansion should also safeguard the upcoming local flexibility market.

1. Introduction

1.1 Background

Due to an increased share of renewable energy production simultaneously as different sectors are electrifying to meet GHG emission reduction targets, the electricity system is facing multiple challenges. Local flexibility markets (LFMs) may be able to alleviate some challenges that Distribution system operators (DSOs) may face, such as problems with local congestion or voltage band violations. For a local flexibility market to be able to support a DSO it must function efficiently with respect to the market mechanisms. The market will involve the DSO which holds a natural monopoly, and which may be the sole buyer of flexibility on the local market, meaning that a monopsonist regulation and a conscious market design is likely to be of high importance to ensure an efficient market outcome.

While market design was developed and outlined in [1], this report aims to map and analyse the regulatory and policy environment relevant for local flexibility markets in the EU, Sweden, Bulgaria, Switzerland, and Turkey. To properly define the analysis and ensure it captures regulatory subjects that are most relevant for the project, five themes and 13 sub-themes have been selected based on work carried out earlier in the FlexiGrid project, especially the Deliverable 'D2.3 Local market designs for energy exchange and grid services' [1]. These five themes are:

- Market actors
- Market and product
- Infrastructure
- Contract, bidding, and settlement
- Data security

DSOs from each country represented in the project have compiled information on relevant rules and regulation, and their business models developed in the project serve as a basis for the assumed structure of future markets. The analysis especially focuses on identifying gaps and barriers and proposes how the countries may learn from each other.

For DSOs to be able to utilise local flexibility markets there must be suppliers of flexibility. Therefore, Chapter 2 focuses on small suppliers of flexibility and how regulation may support or hinder their participation on a local flexibility market and their willingness or ability to make flexibility resources available. Flexibility providers are divided into different groups: community, household, public, and commercial to capture different needs and conditions that may vary between the groups.

1.2 Methodology

FlexiGrid has designed three different local flexibility markets, where actors in a local flexibility market include: DSOs, aggregators, Balance Responsible Parties (BRPs), end-users, and a market operator. Whilst there might be slight differences between the market structures in terms of actors and their roles, commonly the DSO is the (sole) buyer of flexibility products which are used to support a reliable and secure operation of the distribution network. DSOs benefit from a local flexibility market through preventing congestions/overloads and maintaining the voltage, thus preventing grid damages and

postponing grid reinforcements. BRPs can also be the buyers and would be able to optimise their portfolios and reduce deviation (due to forecasting errors) penalties. The aggregators are considered as the sellers of the energy or flexibility products. The end-users can participate directly in the local flexibility markets or participate through an aggregator. The market operator, independent, the DSO or a BRP depending on the market structure, is responsible for clearing the market to maximise social welfare, and to allocate the payments according to contribution of each market participant [1]. The Transmission System Operators (TSOs) are not included as a buyer of flexibility in this report, however, could be an extension in future models. The black box in Figure 1 marks the boundary of a local flexibility market in this report.

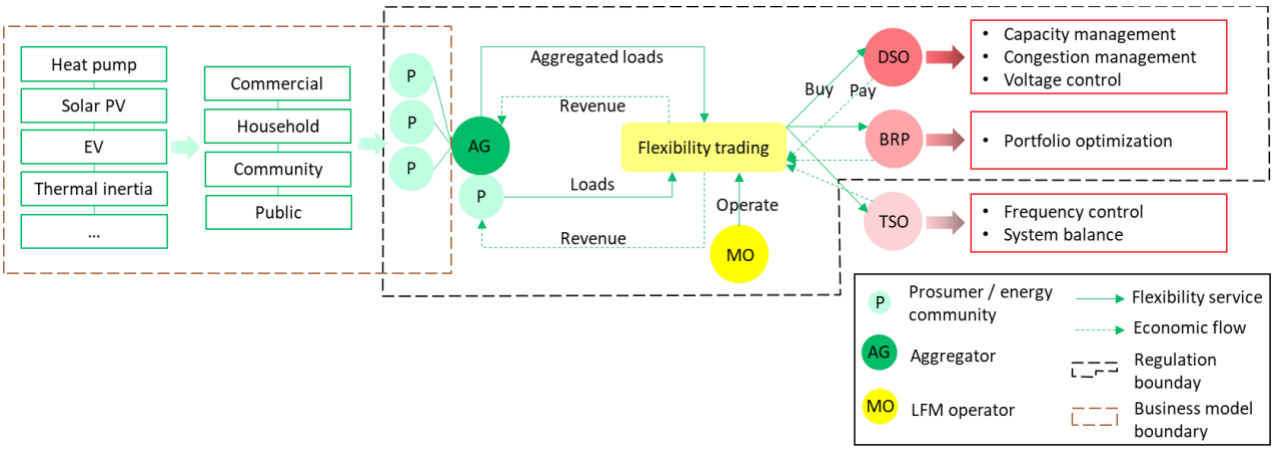

Figure 1. The boxes with dash lines mark the boundary condition for LFM regulation analysis and business model analysis in this report.

Previously in FlexiGrid, multiple reports have been produced and many analyses concerning value chains and business models, regulation, and different types of local flexibility markets have been accomplished. To ensure that the already produced material and previous findings are recaptured, this work commence with a review of previous work. The review involves an overview and compilation of the different market designs and value chains presented in previously submitted deliverables within the FlexiGrid project, and discussions with Swedish DSOs. Five themes are defined to focus and delimit the regulatory review. The themes are selected based on previously submitted deliverables within the FlexiGrid project to capture what is most relevant to cover in this review. For each topic, a detailed description of the current existing regulations is provided along with barriers and gaps at EU and national level.

For all countries involved in the FlexiGrid project, a thorough review of current regulations and policies on local flexibility market design is executed to highlight the critical and relevant regulations and recognise gaps. RISE initiated the review by creating a framework for how to gather information and applied this framework on EU and Sweden. Project DSOs from Bulgaria, Switzerland and Turkey then gather information on their respective countries' regulation using the same framework to ensure consistency and to avoid double work, especially for the EU member Bulgaria.

We reviewed the available public documents that featured by 'Law' 'Regulation' 'Directive' 'Decision', and even 'Recommendation', 'Opinion', and 'for public consultation' to capture the existing regulations and legislations, and their dynamic changes. Among these, we cited EU Regulation and Directive extensively. To make it clear, EU regulation is a binding legislative act, which have binding legal force throughout all

Member States, whereas an EU Directive is a legislative act that sets out a goal that all countries must achieve. It is however up to each Member State to devise their own laws on how to reach these goals. In this report, we use the term 'regulation' and 'legislation' interchangeably, despite the fact that they may bear different meanings in a legal context.

For the EU-level regulations, a standardised assessment is based on the template below.

Justification:

- Why the regulations of these highlighted themes are more relevant and important to the development of local flexibility market?

Regulation review:

- For each highlighted theme X, does the current EU regulatory framework address the sub-theme Y regarding local flexibility market?

Description:

- How does the current EU regulatory framework describe sub-theme Y regarding local flexibility market?
- To what extent is sub-theme Y addressed (or not) by the existing framework? (Describe which rules are necessary, highlight if there are different options/conflicts, recognise the missing regulations & over-regulations, and other important regulatory issues)

For the specific county's regulations, we use the similar standardised assessment plus a consistency assessment based on the template below.

Regulation review:

- For each highlighted theme X, does the county's regulations address sub-theme Y regarding local flexibility market?

Compare:

- Does the country's regulations comply with EU's regulation framework on this sub-theme Y regarding local flexibility market? (Only apply for Member State countries, i.e., Sweden and Bulgaria).

Description:

- How does the current national regulations describe sub-theme Y regarding local flexibility market?
- To what extent is sub-theme Y addressed (or not) by the existing framework? (Describe which rules are necessary, highlight if there are different options/conflicts, recognise the missing regulations & over-regulations, and other important regulatory issues)

The review focuses on existing regulation, however, there are many ongoing changes to current regulation, for example the implementation of the Clean Energy Package. This is a challenge as the information quickly risks becoming obsolete. To mitigate this risk, we also review ongoing discussions regarding future regulation, however the majority of the report is mainly relevant for the rules and regulations that were in place until the first six months of 2022.

In parallel with the regulatory review, an investigation and analysis of potential flexibility providers' incentives to provide flexibility on a local flexibility market was made. The investigation started by identifying resources that are underexploited as flexibility solutions for the electricity grid. By underexploited resources we mean currently existing assets in society, such as, smart energy use, assisted behavioural changes, heating systems (e.g. district heating, heat pumps, and thermal inertia), and energy storage capacities that are not widely used to provide flexibility for the electric grid. Resources were identified through interviews and by analysing grey- and academic literature. 16 resources are identified and sorted into four different categories based on ownership (see Table 1). The four categories of resource ownership are: households, community, commercial and public.

Using an explorative approach, i.e., developing understanding of a phenomenon from findings rather than starting from a theoretical preconception, we explore the variation of drivers and barriers connected to the utilising of the identified resources for each of the four categories of ownership. The owners' drivers and barriers for utilising different resources are explored by semi-structured interviews and in-depth focus group discussions. In total, 18 individuals, fairly equally distributed between the different categories, were involved in the data collection made between March and June 2022. Each interview lasted for approximately one hour.

The assessment identifies regulatory gaps and barriers and provides recommendations on how to address and prioritise between them. Moreover, based on the findings from the incentive analysis, we recommend focus areas for policy to target different types of potential flexibility providers with the main purpose to engage them on local flexibility markets.

It should be noted that, the content in this report is of informative nature and does not constitute legal advice for a particular case.

1.3 Report structure

The report is structured as follows: Chapter 2 provides an overview of the value chains that have been in focus during the FlexiGrid project. While the DSOs in the project have developed business models which are compiled in Work Package 9. Without redundancy, this report therefore only provides a value chain structure with the main roles and flow of information, money, and flexibility depicted. Chapter 3 presents the five themes of regulations which are 1) market actors, 2) market and product, 3) infrastructure, 4) contract, bidding, and settlement, and 5) data security. Chapter 4 provides an overview of the regulations. Chapter 5 analyses the identified gaps and barriers per theme. Finally, Chapter 6 presents the conclusions which can be considered for future regulation design on local energy communities.

2. Business models and value chain

A simplified schematic description on the market actors, their roles, and the transaction is shown in Figure 2.

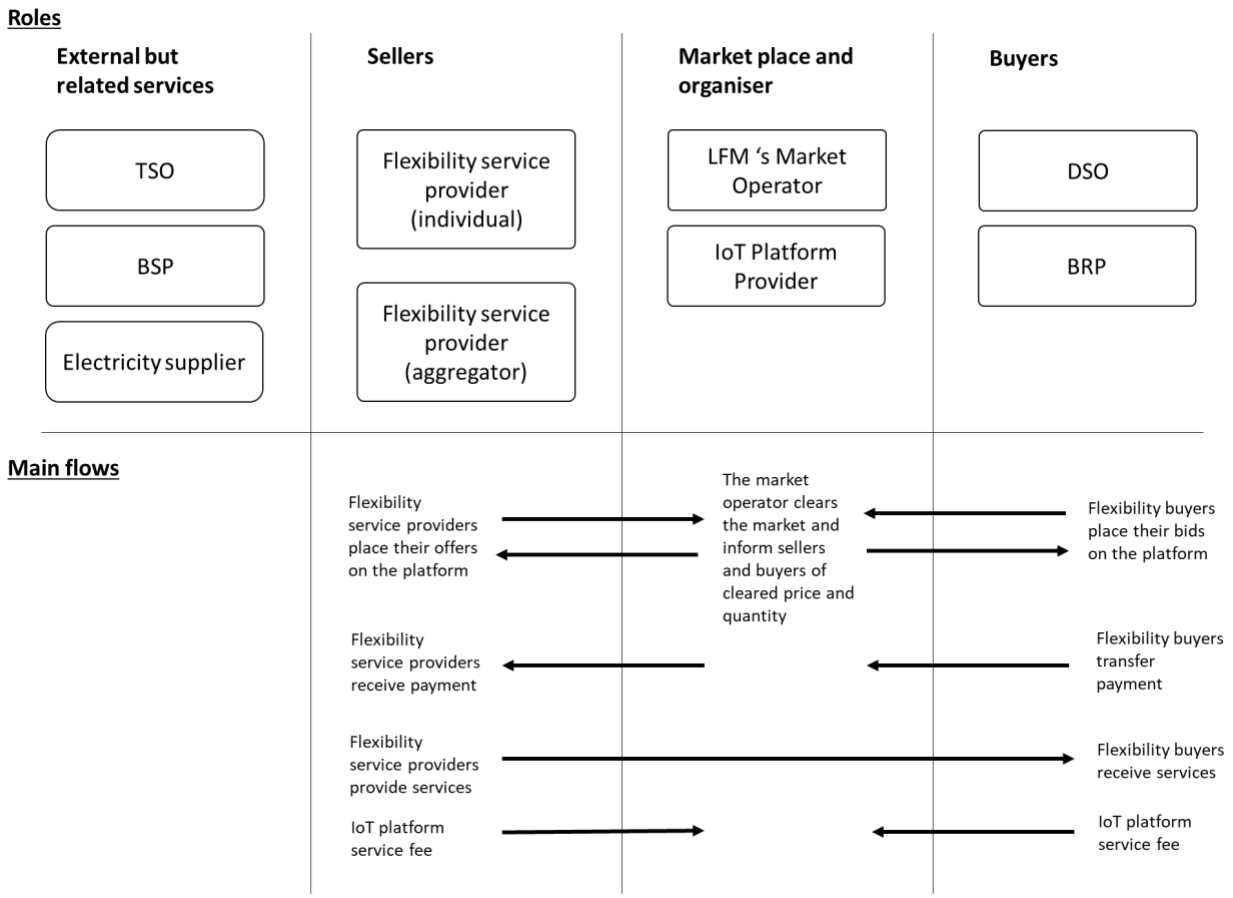

Figure 2. The simplified market actors, their roles, and corresponding transactions on a local flexibility market.

Sellers, which are also the owners of the flexibility resources are as explained previously sorted into four different categories–- household, community, commercial and public. Each of these categories features particular value ideas, or 'value logics', that entails how the owner of the flexibility resource understands the value of the specific resource. The owners' understanding of the value of the resource, underlies the logic of how a flexibility resource can be captured and utilised. Each category is thus bounded to different types of models for unlocking associated flexibility resources.

In this Section we present tentative models for unlocking flexibility resources in each category of ownership. The models are developed by co-creative workshops, including potential flexibility exploiters, such as, electricity retailers, technology providers and commercial property owners.

To start, a unified definition of flexibility resources can be linked with the definition of distributed energy resources and is proposed by [2] as 'Distributed energy resources (DERs) are a collection of technologies that produce, 'store, manage, and reduce the use of energy. Their common theme is that they are small enough to be distributed on the grid, at or near customers, rather than centrally located like a big power

plant.' These resources can entail a number of different technologies which authors Akorede et al.[2] have provided a conceptual overview of in Figure 3.

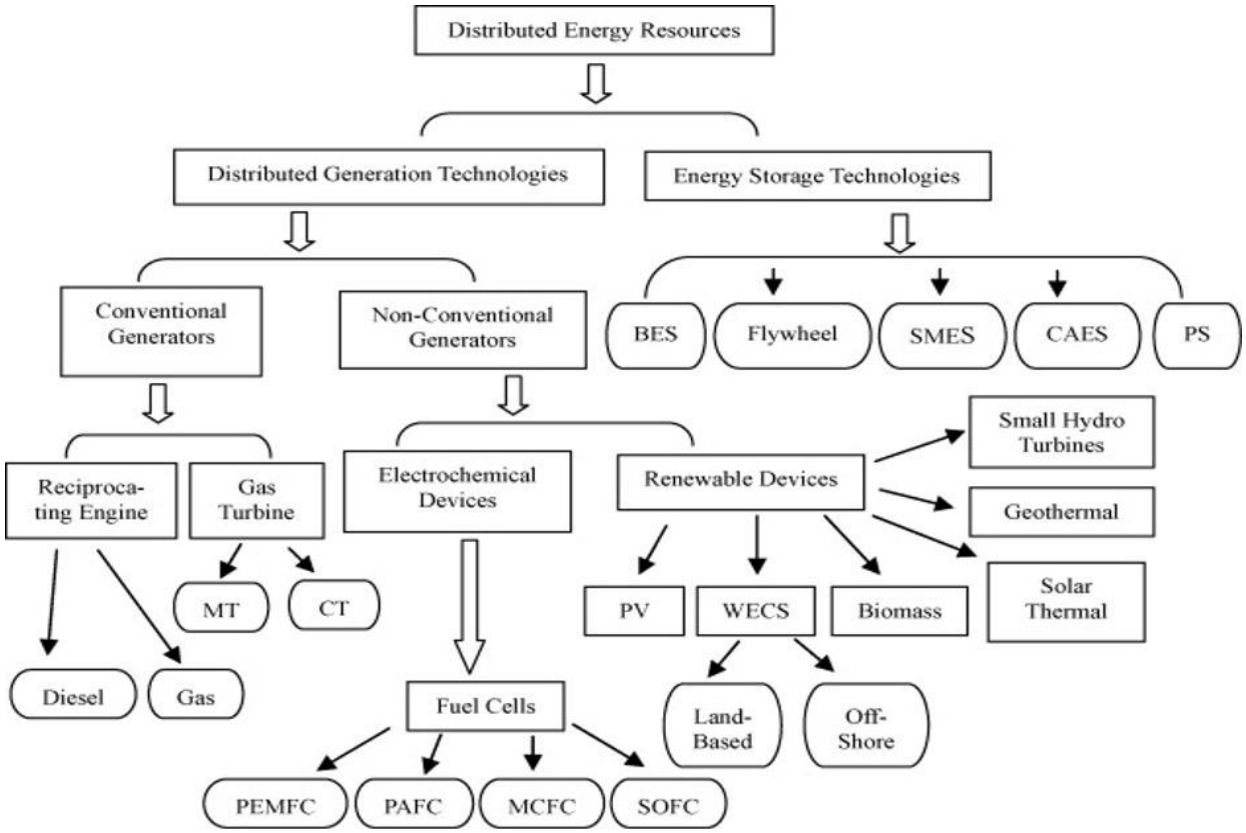

Figure 3. *A conceptual overview of distributed energy resources.*

In addition to these generative and storing type of resources, flexibility can also be provided by having some type of demand response from controllable loads, either automatically or manually. The interviews provided a list of potential resources found in Table 1, which are examples of resources that are found among different owners, although the list is not intended to be a complete inventory. For clarity, we have also described each resource according to ISGAN's categorisation of flexibility needs [3].

Table 1. Resources and their different categories of flexibility and ownership [3].

Resource	Utilisation from respondents (with comment)	Time span (ISGAN's flex category)	Household	Community	Commercial	Public
Ventilation systems	Frequency regulation	min, h (power; transfer capacity)	x	x	x	x
Refrigerators	Peak shaving	sec, min	x	x	x	x

	(Thermal inertia)	(power; transfer capacity)				
Cooling machines	Balancing surplus	min, h (power; transfer capacity)			x	x
Stationary Battery	Everything depending on type	sec – days (power, transfer capacity, voltage)	x	x	x	x
Electric vehicle	Smart charge, storage and power capacity	h, days (power, transfer capacity, voltage)	x	x		
Solar PV	Curtail–- grid relief	h (energy; transfer capacity)	x	x	x	x
Heating systems/Heat pumps	Balancing, peak shaving	min, h (power; transfer capacity)	x	x	x	x
Heat pumps in district heating	(Already connected to energy companies)	h, days (energy; transfer capacity)				x
Inertia in district heating	Back-up, peak shaving, balancing	days (power; energy; transfer capacity)			x	x
Large industries with electric power	Balancing	min, h (power; transfer capacity)			x	

Public vehicle charging stations (parking houses)	Balancing, peak shaving (Aggregated potential)	h (transfer capacity)	x	x	x	x
Charge infrastructure (not parking houses)	Balancing, peak shaving (Difficult to predict)	min, h (power; transfer capacity)			x	x
Small scale hydro power	Similar as large scale–- balance and power (Not flexible today)	h, days (energy)			x	x
Hydrogen production	Balancing	h, days, year (energy)			x	x
Biogas	Back-up (for use with CHP plant)	h, days, year (energy)			x	x
Customer flexibility	Diverse (Shift use of certain appliances during day)	h (power; transfer capacity)	x	x	x	x

Results show that each category of resource owner had different drivers behind utilising their resources for flexibility. This means that although a resources, such as for example a heat pump, technically can be considered as one type of resource, different types of ownership can prescribe in what ways this resource can be utilised. It is therefore important to distinguish the key drivers connected to a resource in order to apply diversified strategies to unlock the resource as a flexibility solution for the electricity grid. In addition to these examples, we found that interview situations added important learnings around flexible resources and their utilisation in a future grid; in particular how sellers can contribute with their resources on a local flexibility market.

The different groups of owners do not only hold different and similar type of resources, but they are also connected with different type of value logics. Figure 4 provide a summary of connected value logics as well as types of actors in respective group.

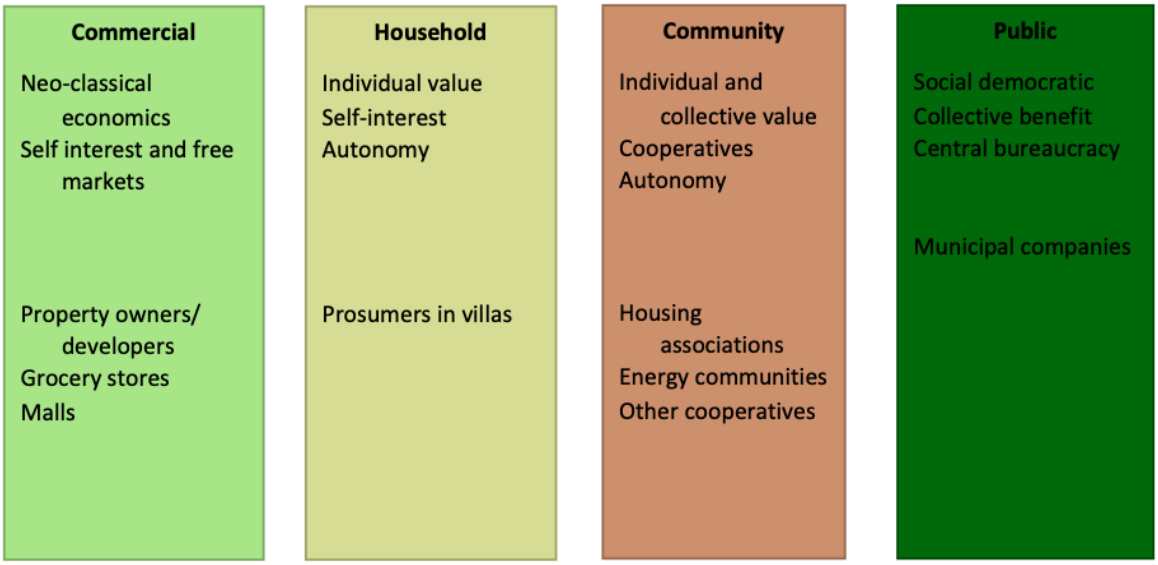

Figure 4. A summary of connected value logics and types of actors in respective group.

Although there are differences within the same groups, e.g., not all housing associations are exactly similar in their preferences, these value logics still provide a fundament to how the different groups understand and views value [4] which is related to their drivers and how a potential business model can be developed.

To give an idea of how these drivers manifest in respective value logic, we have been inspired by Schwartz's theory of basic values [5]. Schwartz's theory of basic values identifies ten broad and universal personal values that are arranged along two bipolar dimensions: openness to change versus conservation; and self-enhancement versus self-transcendence. The latter relates to a dimension between enhancing the sense of personal value versus considering oneself an integral part of a larger system. The theory builds on extensive evidence in social science and assumes that personal values are strongly rooted in personal beliefs [5]. When activated, these beliefs play an important role in people's decision-making and are important antecedents to behaviour. Personal values can thus be thought of as what characterise us as individuals. In short, Schwartz's theory of basic values tells us that people can, on daily basis, experience conflicts between, for example, (social) power, universalism, tradition and hedonism. And depending on their personal values they are motivated to different actions.

In this study, we explore how households, communities, commercial, and public actors view the value of potential flexibility resources and what drivers they may have for providing these resources on a flexibility market. While Schwartz's theory is developed for basic personal values (i.e., values at the individual level of analysis and for all situations), this study is made on a higher level of analysis (i.e., on households'- and organisational values) and in relation to perceived values of resources for flexibility. We have therefore used value dimensions that match the context of the study. One dimension is set between (energy) system benefits versus the actor's own (energy) benefits, while the other dimension is set, just like in Schwartz's theory, between self-transcendence and self-enhancement (see Figure 5). In combination, these two dimensions creates two sides: one focusing on the 'outside' (i.e., the combination of system benefits and self-transcendence), while the other side (i.e., the combination of own benefits and self-enhancement) is more of a 'self-focus'. It is important to note that there is not necessary a dichotomy in these dimensions – something that is perceived by an actor as own beneficial can also be perceived, by the same actor, as a value for others. For example, a general growth of the market is often considered beneficial from both

a self-focus and an outside-focus perspective. Although, there will be an emphasis on what is most important somewhere along the dimension.

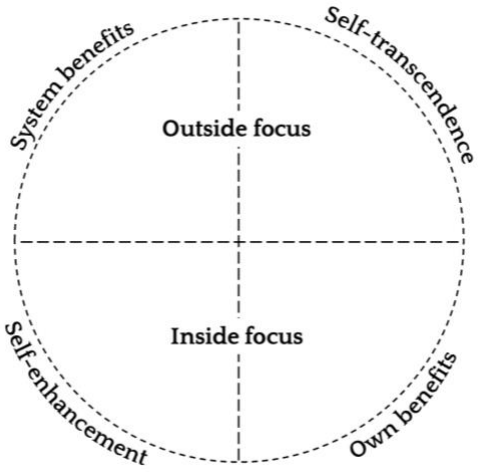

Figure 5. Value dimensions and actor's focus. Inspired by Schwartz's theory of basic values.

Let us shortly revisit the example of the heat pump. Depending on ownership, there are potentially different drivers for utilising the heat pump as a flexibility resource. For example, a public actor could stress the importance of acting on climate mitigations and providing energy system benefits (i.e., system benefits), while a private property owner could stress the importance of the building's environmental performance and them being an environmentally responsible actor (i.e., own benefits). The reasons, however, could be the same for them both: engaging in flexibility because it is important to identify as a frontrunner (i.e., self-enhancement reasons). It is also plausible that they engage because they want to inspire others to engage in providing resources for flexibility (which would then be accounted as self-transcendence reasons).

The results presented below show tendencies in how each group emphasise what is most important along the dimensions. In our presentation of each group, we use stars to highlight the value orientation of each group. The star placements are the result of a qualitative assessment of the interview responses and foremost highlight where the focus of the group is found. Stars shall not be thought of as descriptive, or summative, ways. For example, in the commercial group, there is no star in the self-enhancement quadrant, this indicates that there were no, or very few, values expressed that related to self-enhancement.

Community

The expressive terms chosen in this group, are for the self-focused quadrants Identity and Sharing. The community is a group where sharing becomes the group's benefit, i.e., own benefit. Sharing here is exclusively within the group, and not sharing with the outside. Self-enhancement is made by creating an identity as e.g., a future-oriented, sustainable or innovative community. The upper outside-focused quadrants are expressed as Sufficiency and Empowerment. For the system benefits, the community focuses on sufficient use to be able to deliver services for the outside grid. The community energy model can also be utilised as an inspiration to groups outside, and therefore empower other similar communities to take action for flexible resources (see Figure 6).

Figure 6. Basic values expression for Community group.

In this group, we found quite equal distribution of these value categories. Thus, everything seems to be important for this group and creating offers and value propositions to increase all value dimensions would be strategic.

Households

When it comes to households, different expressive terms are chosen. For the self-focused quadrants, resilience and Self-sufficiency are chosen. These are of course connected; however, self-sufficiency is more about controlling costs and utilising available space, e.g., roofs to implement PV technologies, which is related with own benefits. Resiliency on the other hand is about creating margins for disturbances, e.g., back-up power, and therefore more related with enhancing the self. The outside focused quadrants are named Sustainability and Benevolence. To focus on the outside system from a household perspective is connected with environmental sustainability, although increasing profitability is also present through new services to the grid, but possibilities are still in their infancy as well as the awareness in this group. Moving beyond oneself we have chosen to call benevolence in this group since there is descriptions of contributing to the greater good from single households (see Figure 7).

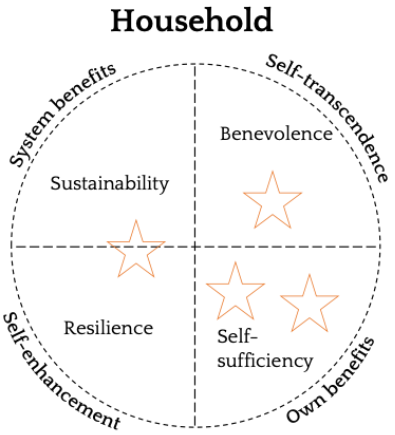

Figure 7. Basic values expression for Household group.

In this group, a lot of emphasis is on cost reductions and independence, which belongs to the own-benefit quadrant. Also, some descriptions of environmental action are found in this group, but rather as a

contribution to the greater good, than enhancing the system outside. The outer quadrants are mentioned, but mostly as a combination of the resilience and sustainability, and therefore the star is placed between the quadrants. From this, the value propositions should reflect the cost reductions as well as the less dependency aspect, for the household group. In addition, environmental values seem important and can add value if targeted with flexible use.

Commercial

In the commercial group, the self-focused quadrants are described as Influential and Profitability. As this group has a clear commercial value logic, monetary returns and shareholder dividends have influence on the decisions made, even if there are individuals striving for additional values. Thus, increasing profitability and own benefit is central, and with the self-enhancement, activities relating to influencing the policy environment to gain competitive advantages is chosen. For the outside-focused quadrants, the expressive terms Predictability and Inspirational is chosen. Outside system focus is related to increasing predictability of energy supply and decreasing economic fluctuances. To transcend the own focus, a commercial actor can inspire others to act in similar ways, although this is sometimes considered as giving away strategies and increasing the capabilities of competitors. In early markets however, a general growth of the market is often considered beneficial also for one's own business and can thus be a strategic choice (see Figure 8).

Figure 8. Basic values expression for Commercial group.

The values found in this group are mostly found in the own-benefits quadrant. Also, system benefits are described as well as the inspirational dimension. Thus, not surprisingly, the commercial group need to be provided a profitable offer, but also values predictability and can function as inspiration for others.

Public

The last group, public actors, have different expressive terms chosen. Self-focused values are described as Frontrunner and Growth. For a municipality, own benefits are related to citizen growth and increasing the domain of the public sphere. Self-enhancement is related to showing an innovative side and being a frontrunner in terms of adapting and implementing new solutions. The outside-focused quadrants are called Sustainability and Responsibility. Public focus on system benefits is related to increasing sustainability and lowering fossil impact from the municipality. When looking beyond oneself, there is a

responsibility toward other municipalities and society at large to show future oriented solutions to decrease environmental impact and increase social sustainability (see Figure 9).

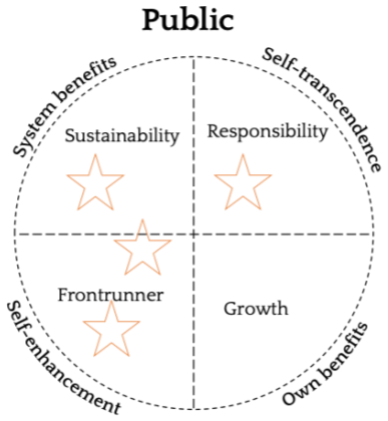

Figure 9. Basic values expression for public group.

The concentrations of values are found at the left side, with being a frontrunner and increasing sustainability. In addition, a responsibility toward other actors in similar situations is clearly being addressed e.g., by participating and presenting solutions and experiences in various seminars etc. There is however a lack of descriptions of own benefits with the public actors interviewed in this study. Therefore, public actors may be utilised as coordinators and be granted some responsibility for sustainable development for the utilisation of flexible resources. This can probably be applied to their own assets as well as inspiring actors and citizens within their municipality.

Concluding remarks for sellers

As these value models show, there are differences between different groups of owners to certain flexible resources. Therefore, a potential model providing a measure on available flexibility capacity must be followed by a stakeholder analysis or a division of the specific owners of the resources. From there, this study can point toward certain dimensions to enhance offers and value propositions used by DSOs. Importantly, there is a need to communicate and understand the different drivers that sellers have, which entail creating closer relations and co-create around solutions for the utilisation of flexible resources.

3. Regulatory review

3.1 What should be regulated and not

The term 'regulation' generally refers to the implementation of rules by public authorities and governmental bodies to influence the behaviour of private actors in the economy [6]. Regulations consist of a series of rules and expected behaviours that people and organisations should follow [7]. Such implementation of rules is justified by the goal of the maximisation of collective welfare, such as to deliver better economic and social outcomes and benefit the lives of citizens and business.

Local flexibility markets are still at infant stage which are predominantly represented by some pilot projects and research initiatives. For example, there are large-scale demonstration pilots being implemented across different European countries like FlexiGrid project. For a new market, the role of regulation can be decisive. Good regulations are pre-conditions for well functioned markets, but some regulations can also negatively impact the market performance. The regulatory framework should be adequate, but both under-regulation and over-regulation can be fatal in fostering a new market [8]. On one hand, providing higher level principles at EU level or national level could mean that it is easier for market players to use flexible assets and to increase market liquidity. We do expect potential EU rules to be relatively high-level as the structure of markets at a national level is very different across the EU. It is important to establish a sufficiently high quality and high level of regulations at EU by conducting an in-depth analysis and evidence-based law-making. The use of Regulatory Sandbox could test certain legislations within contained space and under a set of rules and supervision requirements. This approach can be used in different locations and countries to help break down regulatory barriers to local flexibility markets. Thus, the regulations will also likely evolve over time, as local flexibility markets become more mature. Furthermore, DSOs are one of the major stakeholders and buyers of flexibility provision in a local flexibility market; meanwhile they are regulated monopolies in nature. Special care should be taken to ensure that DSOs can carry out certain activities without distorting competition. ''

In principle, there are several over-arching and essential parts for a well-functioning market [9]:

- Full information
- Rational actors
- Standardised products
- Liquidity
- Low entry and exit costs
- Low transaction costs

In the design of local flexibility market, the overarching purpose is to establish the rules for trading, promote competition and prevent abuse of market power or other unfair trading practices. Although some basic principles can be defined at European level, the detailed regulatory framework for the access and use of flexibility will vary across Member States to reflect national specifications. As forementioned, excessively detailed regulation could hamper the innovation that local flexibility market requires.

3.2 Themes of regulation

The Clean Energy Package sets an overarching framework for redesigning the electricity market to ensure fair and equal participation by all flexibility service providers (FSPs). It also recognises the evolving role and tools of DSOs and TSOs to enable more active system management. Member states are currently adapting their national legislation to integrate these new requirements. Local flexibility markets, as part of the electricity market, enable localised flexibility trading by creating market signals and changing demand and supply.

The analysis concerns European countries of different progress in solutions that leverage flexibility towards offering electricity grid services. The scope is to explore the operational principles of European local flexibility markets, to assess the regulation on emerging flexible markets, and to propose new policy framework that facilitate the integration of flexible assets in the distribution grid. The countries reviewed are Sweden, Bulgaria, Switzerland, and Turkey. These countries were selected owing to their diversity in terms of generation mix and market design, which are all involved in local flexibility market designs and practices in FlexiGrid project. Gaps and barriers for local flexibility market development are also identified in order to form relevant country-specific recommendations. To correspond to the analysis scope in FlexiGrid D2.3, the boundary condition for regulatory analysis is presented in Figure 1 in Section "Methodology". Consequently, these themes below in Table 2 are highlighted in regard to FlexiGrid D2.3 [1] which cover all the important regulation aspects towards local flexibility market development.

Table 2. The highlighted themes and sub-themes for regulation analysis in this report.

Themes	Sub-themes
Market actors	• Aggregator • Balance Responsible Party (BRP) • Citizen energy communities • Distribution System Operator (DSO) • Market operator
Market and product	• Market entry and exit and market platforms • Product characteristics (e.g., prequalification, standardization, baseline)
Infrastructure	• Smart metering systems • Energy storage • Network expansion
Contract, bidding, and settlement	• Contract • Bidding, billing and settlement
Data security	• Access to data, data security, and privacy protection

3.3 Regulatory overview

EU Regulation 2019/943 requires Member States to develop and publish implementation plans with timelines to take measures to remove any identified regulatory distortions or market failures in the

internal electricity market[1]. EU Directive 2019/944 encourages the Member States to use flexibility in distribution networks, especially DSOs should be able to procure such service from providers of distributed generation, demand response or energy storage and promote the uptake of energy efficiency measures. In addition, the flexibility products and services should be provided with specifications and standardisation at least at national level. All necessary information shall be exchanged to ensure the optimal utilisation of resources. Remuneration for the procurement of flexibility products and services should be ensured. Finally, all participation of market actors should be based on transparent, non-discriminatory and market-based procedures[2]. This is considered to be the starting point to facilitate the planning and development of local flexibility markets.

Local flexibility markets are far from sufficiently mature. Market designs from relevant projects may differ significantly from each other. This fact is also helpful in this regard, as it means that regulations are not fully ready. We expect that the development and formulation of regulations will go hand in hand with the ongoing experimentation, development and implementation of local flexibility market practices. Despite the existence of a comprehensive European energy policy framework, progress towards flexible services in the distribution grid and the operation of flexible markets at the national level varies significantly between different European countries. This is largely dependent on national policies and regulatory frameworks.

At the time of writing, many relevant LFM activities are not explicitly covered by either the EU regulation or the national regulatory framework. Thus, they are neither explicitly allowed nor forbidden by current regulations. Table 3 below summarises the current situation of regulatory environment. The overview is aligned with the highlighted themes in Chapter 3.

Table 3. The regulation overview at EU level and national level local flexibility markets.

[1] EU Regulation 2019/943 Article 20.
[2] EU Directive 2019/944 Article 32-1.

Themes	Sub-themes	EU	Sweden	Bulgaria	Switzerland	Turkey
Market actors	Aggregators	Yes, concept was proposed. Regulations are at a high level.	Yes, discussion and propositions are ongoing. Current regulations may limit the LFM development. Regulations are about to change.	No, discussions are ongoing. Bulgaria follows and adheres to all European regulations and directives.	No, guides or regulations are to be established.	No, there is not an aggregator role in the current situation. But there is a goal in the 2017-2023 action plan of ministry. Relevant discussions are still ongoing.
	Balance Responsible Party (BRP)	Yes, but not sufficient and need to adapt to LFM designs.	Yes, discussion and propositions are ongoing. Current regulations may limit the LFM development. Regulations are about to change.	Yes, regulations and guidelines are not discriminatory towards any actors or technologies and should not limit LFM. Some degree of adaptation may be required.	Yes, but need to adapt to LFM designs.	Yes, but the current regulations are not optimum for LFM. So, these regulations need to be revised by authorities.
	Citizen energy community	Yes, concept was proposed. Regulations are at a high level.	Yes, discussion and propositions are ongoing. Current regulations may limit the LFM development. Regulations are about to change.	Yes, but regulations and guidelines are still under development and not easy to comprehend (can be hard to understand and there are some bureaucratic hassles).	Yes, established regulations exist. But need to adapt to LFM designs.	No, there is not a concept like that.
	Distribution System Operator (DSO)	Yes, established regulations exist. But need to adapt to LFM designs.	Yes, established regulations exist. But need to adapt to LFM designs.	No, guides or regulations for DSO involvement in LFM are yet to be established.	No, guides or regulations are to be established.	There are some relations between TSOs and DSOs regarding the grid management kind of processes but no, legal entities operating in the market cannot be direct partners of DSO.

	Market operator	Yes, discussions are ongoing.	Yes, discussions are ongoing.	No, guides or regulations are to be established.	No, guides or regulations are to be established.	There is not a task description related to LFM for market operator in existing regulations.
Market and product	Market entry and exit	Yes, regulations and guidelines are at a high level.	Yes, regulations and guidelines are at a high level.	No, discussions are ongoing.	No, guides or regulations are yet to be established.	No, there is not an expression related to flexibility market mechanisms or participant of them in regulations.
	Market platforms	Yes, regulations and guidelines are at a high level.	Yes, regulations and guidelines are at a high level.	No, guides or regulations are to be established.	No, guides or regulations are yet to be established.	Yes, but need to be developed for LFM applications.
	Product characteristics	No, guides or regulations are to be established.	No, guides or regulations are to be established.	No, guides or regulations are to be established.	No, guides or regulations are yet to be established.	No, guides or regulations are to be established. There are activities defined in the National Energy Efficiency Action Plan 2017-2023.
Infrastructure	Smart metering systems	Yes, but need to adapt to LFM designs.	Yes, but need to adapt to LFM designs.	No, installation is currently under consideration.	Yes, installation of smart meters was initiated in 2017. May need to adapt to LFM designs.	Yes, but on an initial level, still need some high-level discussion and regulation items. Also, consumers have very limited access currently. Also, regulations

						need to be updated for LFM designs.
	Energy storage	No, guides or regulations are to be changed or adapted to LFM designs.	No, guides or regulations are to be changed or adapted to LFM designs.	Yes, discussions are ongoing.	No, guides or regulations are yet to be established.	Yes, but DSOs can use them only for increasing the service quality. There is need to adapt to LFM.
	Network expansion	Yes, but need to adapt to LFM designs.	Yes, but need to adapt to LFM designs.	Yes, discussions are ongoing.	No, discussions are ongoing.	Yes, regulations and guidelines are at a high level.
Contract, bidding, and settlement	Contract	Yes, but need to adapt to LFM designs.	Yes, but need to adapt to LFM designs.	No, specific regulations or guidelines for LFM does not exist, but other regulations and guidelines may be sufficient.	No, discussions are ongoing.	No, guides or regulations are to be established.
	Bidding, billing, and settlement	No, guides or regulations are to be established.	No, guides or regulations are to be established.	No, guides or regulations are yet to be established.	No, discussions are ongoing.	No, guides or regulations are to be established.
Data security	Access to data, data security, and protection of privacy	Relatively established.	Relatively established.	Yes, but may need adaptation to LFM designs.	No, guides or regulations are yet to be established.	Yes, but need to be developed for LFM designs.

4. Main regulations, regulation gaps and barriers

4.1 Market actors

4.1.1 Aggregator

EU's regulation on aggregator's roles

The market actor of an 'aggregator' has been mentioned in EU Directive 2019/944 as 'a function performed by a natural or legal person who combines multiple customer loads or generated electricity for sale, purchase or auction in any electricity market'[3]. The concept of 'independent aggregator' was introduced as 'a market participant engaged in aggregation who is not affiliated to the customers' supplier'. Both of these concepts are essential parts to a local flexibility market, because they will act as intermediaries between customer groups and the flexibility market. This is encouraged by EU Regulation 2019/943 that the distributed demand supply should be facilitated to aggregate[4]. Especially the aggregation should enable final customers and small enterprises to access the electricity market[5]. This explicitly applies to the internal electricity market design. However, we believe the principles also applies to local flexibility market design.

Aggregators that combine a large number of small-scale resources are needed in order to coordinate and leverage customer flexibility. It is foreseeable that intense competition among aggregators may bring additional benefits, such as stimulating innovation and the development of new services and business solutions. In theory, aggregation services could be offered by energy providers, retailers, telecommunications companies, and even new specialty firms. However, the roles and responsibilities of aggregators have not yet been defined, which may hinder the commercialisation of end-customer flexibility. Regulations are recommended to define the concept, roles and responsibilities of aggregators and how they can be embedded in the actual local flexibility market. European countries, including EU Member States, are free to choose the appropriate implementation model and approach to governance for aggregations. But in any regard, the models and approaches should follow the transparent and fair rules for aggregators, and ensure the final customer adequately benefits from their activities[6].

A very important principle from EU legislation is that all market participants must be financially responsible for the imbalances that they cause in the electricity system. To that extent they shall be BRPs or shall delegate their balancing responsibility. This should apply to aggregators as well. That said, the link between an aggregator or an independent aggregator to a BRP should be clarified, which is detailed described in Section 4.1.2.

[3] EU Directive 2019/944 Article 2(18).
[4] EU Directive 2019/944 Article 1(b)
[5] EU Directive 2019/944 Article 3(e).
[6] EU Directive 2019/944 (39).

Sweden's regulation on aggregator's roles

A regulatory framework for independent aggregators does not exist in Sweden today, however, the Swedish Energy Markets Inspectorate (Energimarknadsinspektionen, Ei) has proposed several changes in its report 'Ei R2021:03' to the Swedish Electricity Act, specifically the balance responsibility, to comply with EU Directive 2019/944. These changes will therefore constitute the regulatory framework for aggregators in Sweden [10], which will facilitate the operation and acquisition of customers for aggregators. Ei had previously submitted the report 'Clean energy within the EU–- An implementation of five legal acts'[11] which was not sufficiently comprehensive. Thus, Ei put forward new proposals for amendments to the law in Ei R2021:03.

According to Ei's proposed Chapter 9, aggregation refers to the merging of several customer loads or produced electricity for sale, procurement or auctioning on electricity markets [10]. The proposed concept of 'aggregator' and 'independent aggregator' followed EU Directive 2019/944 as mentioned above. Swedish proposed legislation posed a stricter obligation on the aggregator's responsibility. That is, an aggregator who enters into a separate agreement on the supply of electricity to the flexible resource (balance point) must inform the customer that the agreement on aggregation also covers the supply of electricity to the balance point, as well as provide information on which electricity supplier supplies the electricity. Towards the customer, the aggregator must have the same responsibility as an electricity supplier for the delivered electricity. This means clearer protection and better information for the customers.

Furthermore, the potential additional costs brought by an aggregator should not outweigh the socio-economic benefits. For example, the function of aggregator might change data processing which induces costs on market participants and eventually be borne by the final customers. The regulations should consider this and ensure that the solution bring measurable benefits to the final customers.

Bulgaria's regulation on aggregator's roles

As a European Union's Member State, Bulgaria also follows and adheres to all European regulations and directives. Unfortunately, more often than not, the process of implementing the changes required by these sorts of documents is a bit slower in Bulgaria.

The first talks about aggregators in Bulgaria started with EU Regulation 2019/943, which formed the basis for a public discussion on a draft amendment to the Rules for Trade in Electricity hosted by the Energy and Water Regulatory Commission.

The results of the discussion were introduced in the National Implementation Plan [12], which was submitted to EU. The plan stated that there still is no single united definition for aggregators which is why they are currently being defined as yet another balancing responsible party. Aggregators are seen as responsible for providing consumption optimisation services (or in other words flexibility services for decreasing energy consumption), however, at the time of writing, there are no active aggregators in Bulgaria and there is no separate licensing regime for them.

A legal definition of aggregators "an b' seen In the Rules for trading electricity [13]- a company which is an electricity trader or a generator whose licence has been supplemented with the rights and obligations for a balancing responsible party and whose balancing group includes sites of generators, site of consumers or storage facilities as direct group members (the trading schedules of the direct members are

sent only by the aggregator to the balancing market operator). The Rules stipulate that all the entities that come under the aggregator need to be part of a single balancing group coordinator which can be either the aggregator itself or another balancing group coordinator. Which, again, actually makes the aggregator just another balancing responsible party as mentioned above.

The closest we come to aggregator" is actually the Report/Analysis of energy communities in Bulgaria [14]. Whilst not an official regulation, it is still an important document that highlights the current energy situation and provides recommendations on what regulations may be needed.

The report mainly focuses on energy communities, which are still at their conception phase (at least in Bulgaria), which is a term used for a group of people, organisations or SMEs coming together with the purpose of consuming, storing and/or selling energy from renewables that has been produced by an energy source of their own (owned by the community). In line with this, one type of energy community is actually aggregators.

In conclusion, there is still a need to draw up more detailed market rules on the aggregators' activity and business model to be used on the electricity market.

In line with the National Implementation Plan and with more documents such as the Report/Analysis of energy communities in Bulgaria, it is expected to soon see real examples of aggregators in Bulgaria.

Turkey's regulation on aggregator's roles

Aggregators are not currently defined by regulations in Turkey. As a result, most consumers in the distribution system cannot participate in electricity markets and only consumers who have generation or supply licenses can participate in electricity markets. However, no consumers can provide balancing services or participate in capacity mechanisms.

Even though consumers with generation or supply licenses can participate in the electricity market, there are several conditions that they must fulfil. Before analysing these conditions, current DSR ancillary services will be examined.

Today, there are two explicit DSR services in Turkey that cover consumers providing services directly and do not cover third-party aggregators. The first of them is defined as Demand Side Reserve. This instrument is provided by TSO through tenders and accessing the instrument is possible only when the TSO decided to run a tender. Pre-requisites of the tenders, such as minimum bid size, the capacity duration requirement and so on are decided by the TSO. Since the load reduction orders may be for less than an hour duration, there is a need to have a meter that records data in less than the hourly interval for consumers. The participants must have at least 10,000 MWh annual electricity consumption and have to be connected directly to the transmission network, meaning that residential and smaller business consumers are excluded.

The second instrument is an Interruptibility Scheme. In this scheme, TSO can ask large industrial consumers to reduce their demand in shortage situations. To attend this scheme, consumers must be connected to the transmission grid directly and must have the ability to reduce their demand with 15 minutes intervals. The minimum bid amount is 1 MW and there is currently not an aggregator role for this., thus residential and small business consumers cannot participate in this scheme.

Consequently, as indicated by the two ancillary services outlined, there are gaps and barriers in the current regulation. Independent aggregator license is not defined in the regulation, and this is a gap for

the local flexibility market. Besides, consumers that have supply licenses or cogeneration plants cannot participate in the market without a generation license, which is a barrier for local flexibility markets. Existing regulations allow a very limited part of the consumption side to be included in DSR services. But authorities emphasise the importance of the widespread use of demand-side participation. Thus, the National Energy Efficiency Action Plan 2017-2023[7] which is prepared under the coordination of the Ministry of Energy and Natural Resources of the Republic of Turkey, includes action E10, which is the 'Establishment of Market Infrastructure for Demand Side Response Application'. In this action, in order to implement the mechanism, it is aimed to bring together consumers with flexible loads (aggregation) and enable them to act in the balancing power market. In addition, the importance of defining independent aggregators as market participants in regulations and defining their responsibilities is emphasised.

Switzerland's regulation on aggregator's roles

Currently, there is no direct regulations on the role of aggregators in the Swiss legislation. In Switzerland, the aggregator cannot participate directly in maintaining voltage quality with Swissgrid.

There are specific aggregators for non-flexible renewable assets subject to the Renewable Energy Remuneration System (SRI). The aggregator aggregates the production of several SRI assets and values it on the energy market. The producer is remunerated by the aggregator at the market price, by an injection premium and management fees.

To capture diffuse flexibility, the aggregator deploys control equipment at its customers' sites and must ensure a mass customer relationship.

There are currently a limited number of aggregators in Switzerland that operate with different business models. The main aggregators are BKW FLAK, CKW Flexpool, ALPIQ, tiko.

EU's regulation on non-discriminatory rule and market power

'Non-discriminatory and fair rule' is one of the most important bases in EU electricity market legislation[8]. This means allowing and foster participation in local flexibility market through aggregation should be based on a non-discriminatory manner, similar to participation in balancing market[9], day-ahead and intraday market[10].

EU legislation also stipulated that the regulations must be designed so that each Member State must enable independent aggregation. Independence means that the customer must be able to choose an aggregator without approval from its electricity provider and that the aggregators must be able to enter the electricity market without the consent of other market participants. In addition, both aggregation

[7] Ministry of Energy and Natural Resources of the Republic of Turkey. National Energy Efficiency Action Plan 2017-2023. March 2018. Action 10 'The legal status and licensing qualification of the organization that will do the aggregation will be determined.

- A flexible consumption portfolio will be created by selecting industrial consumers with a large-scale flexible consumption structure (e.g., cement, iron-steel, etc.).
- Evaluations will be made for the inclusion of other consumers, including residences, in the application. Demo areas will be created within the scope of micro-grid, smart city and smart grid by supporting smart meter deployment and pilot applications in this area.'

[8] EU Directive 2019/944 Article 17(1)

[9] EU Regulation 2019/943 Article 6-1(c).

[10] EU Regulation 2019/943 Article 7-2(h).

units and non-aggregation units should be able to participate in the delivery of the product, which would allow a broader range of market participants to participate.

There are various responsibilities that the aggregators can take, other than aggregation. Aggregators may take the roles of energy retailers or BRPs. Assigning such tasks to the aggregator can have advantages and disadvantages. One of the main disadvantages is that assigning the role of retailing to the aggregator could allow it to exercise market power. Aggregators can deliberately create bids in the day-ahead market that would result in network congestions, which then force the DSO to activate their aggregated flexibility [15]. Possible measures to mitigate such issue might be long term contracts, flexibility price caps, and efficient monitoring of irregular market bids comparing them to DSO forecasts [15] [16]. Other research work also presented a concern regarding taking advantage of market power by aggregators and their dominant position in the auction [17] [18]. The regulations should ensure that those risks are minimised, either through clearly defined and outlined rules or through particular market design, e.g. Vickrey-Clarke-Groves auctions [18].

Sweden's regulation on non-discriminatory rules and market power

Ei's proposed legislation require that the Swedish regulations must be changed so that a customer can choose an aggregator without approval from his existing electricity supplier or another market player, while the aggregator takes financial responsibility for the imbalances caused by the aggregation where a flexible resource is activated. A transmission or distribution system operator, an electricity supplier or a balancing operator shall not prevent an aggregator from performing aggregation services [10].

In every respect, the regulation should, to the largest degree, ensure the marketplaces take aggregators as equal to other existing market players. Independent aggregators should in a non-discriminatory way have access to all markets without the consent from the customers' suppliers, or any other actors on the market, while being financially responsible for the imbalances that it may cause.

All aggregators who will attend local flexibility markets will take the responsibility for the imbalances they cause. The settlements of taking those responsibilities are complex and may largely discriminate against aggregators (see Section 'aggregators' financial responsible for the imbalances. In principle, regulations should be clear to ensure aggregators are not treated differently, worse, or better, from other market participants.

The non-discriminatory rule should also be present in the pre-qualification process for all participants in the markets. The local flexibility market operator should be careful not to impose disproportionate pre-qualification requirements that significantly harm the ability of an aggregator to assemble a bid.

Bulgaria's regulation on non-discriminatory rules and market power

One of the main components of the Bulgarian Implementation Plan is the facilitation of active consumer participation in the energy market, which is in line with one of the main aspects of having an efficient energy market.

As previously mentioned, talks about appropriate aggregator's regulation in Bulgaria are indeed ongoing, though currently this business model is non-existent in Bulgaria, and it is only being introduced as another balancing responsible party.

It is important to note that in Bulgaria there are many market failures and regulatory barriers incompatible with the requirements of Regulation 2019/943 of EU and even if all the current plans for reforms are implemented, there would still be 'residual' market failures on the internal electricity market in Bulgaria.

As of now, one such 'market failure' could be the fact that there is no licensing regime for aggregators and in turn there are no non-discriminatory rules to speak of.

Turkey's regulation on non-discriminatory rules and market power

The aggregator role is not defined in any regulations yet, as such there is a gap and there are no existing rules related to aggregators. However, the current market structure can be analysed to foresee future possibilities.

According to the current regulations, natural or legal entities whose annual consumption is more than the consumption value determined by the Board each year have the right to choose their suppliers and are defined as 'eligible consumers'[11]. The eligible consumer limit for 2022 has been determined by EMRA as 1100 kWh per year[12]. Eligible consumers can receive service from any electricity company other than the electricity distribution company in their region. In this way, they can use electricity more economically and advantageously. They can examine the advantageous offers offered to them according to their consumption amounts and choose the most suitable price or tariff for them. According to Market Balancing and Settlement Regulation Article 30/A[13], the Market Operator (EPİAŞ, also known as EXIST-Energy Exchange Istanbul) operates the systematic infrastructure in the eligible consumer processes which the suppliers apply for consumers they want to sell electricity by bilateral agreement.

Similar to this regulation, rights can be granted to consumers for the selection of aggregators to fill this gap. Thus, a market network can be created for demand collectors in which they can compete. Lower annual consumption limits can be suggested for demand-side participation to become more widespread.

Switzerland's regulation on non-discriminatory rules and market power

Since 2009, large consumers (from 100,000 kWh per year) can choose their own supplier. The small consumers are in the regulate market. A law project wants to give access to the market for all consumers. But with the current situation of the energy price, this project will certainly be delayed.

EU's regulation on aggregators' financial responsible for the imbalances

A key principle of EU legislations is that there is a clear obligation for all market participants to be financially responsible for the imbalances that they cause in the system (so called 'balance responsibility') [14], representing the difference between the allocated volume and the final position in the market. To that end, aggregators shall either be BRPs or shall contractually delegate their responsibility to a BRP of their choice. This was also stated in EU Directive 2019/944 Article 17[15] [16]. But it is clearly stated that the financial

[11] Electricity Market Law. Official Journal of the Republic of Turkey (No: 28603/6446) Article 3. March 2013.
[12] Energy Market Regulatory Authority. Official Journal of the Republic of Turkey (No: 31697/10623) Article 1. December 2021.
[13] Regulation on Amending the Market Balancing and Settlement Regulation. Official Journal of the Republic of Turkey (No: 29309) Article 30/A. March 2015.
[14] EU Regulation 2019/943 Article 5.
[15] EU Directive 2019/944 Article 17-3(d).
[16] EU Directive 2019/944 Article 17-4.

compensation should not create a barrier to market entry for market participants engaged in aggregation or a barrier to flexibility.

Sweden's regulation on aggregators' financial responsible for the imbalances

Swedish Electricity Act ('Ellag 1997/857') has regulated that an electricity supplier may only supply electricity at an outlet or input point where the financial responsibility is undertaken[17]. When the aggregator activates a flexible resource with a customer, there is a risk that the activation creates an imbalance. This imbalance means the custome''s consumption is different from the consumption pattern that the customer has in normal cases, and for which the electricity supplier or the BRP has planned. The cost thus arises in the operating hour but is regulated in connection with the balance settlement. It is the Nordic transmission network operator'' associated company eSett Oy that has the operational responsibility for the balance settlement. The imbalance, due to the activation of flexible resources by the aggregator, is the responsibility of the electricity suppliers. Since this responsibility is financial, the result is that the electricity suppliers (or BRPs, if electricity suppliers choose to delegate it to BRPs) have to compensate Svenska Kraftnät (SvK, Swedish national power grid and TSO) for the costs incurred due to the imbalance, even though electricity suppliers did not cause the imbalance.

Essentially, it is the aggregators that must be financially responsible for the imbalances they cause in the electricity system. They may therefore not perform their services for aggregation before balance responsibility is secured. In Ei R2021:03, Ei has proposed that this can be done either by the aggregator itself being the balancing party or by delegating that responsibility to a balancing party of its own choosing. An aggregator may only perform services for aggregation in a balancing point if the aggregator has undertaken the financial responsibility for the imbalances caused by the aggregation. Ei submitted the proposals for amendments to the law that are needed to enable these two models to be introduced in the Swedish Electricity Act.

There are no provisions in current Swedish regulations for a compensation mechanism between the aggregator and other market participants that are affected by the aggregator's activities. In the event that a compensation mechanism is to be introduced, the national regulations need to be supplemented. Ei R2021:03 also proposes that SvK be authorized by law to develop the method for the compensation mechanism and an assignment on how the models are to be implemented in the electricity markets [10].

However, an aggregator cannot be forced to enter into an agreement with a predetermined BRP, for example the one who is already responsible for the balance at an outlet or input point of the customer with whom the aggregator enters into an agreement. It is of course technically possible for an aggregator to activate a flexible resource, by agreement with the customer, without taking financial responsibility for the imbalances that arise in most cases. This form of aggregation occurs today. Aggregation carried out without financial responsibility for the imbalances it causes does not meet the requirements of the EU Directive 2019/944. This model is therefore not permitted under European regulations.

Bulgaria's regulation on aggregators' financial responsible for the imbalances

According to the current market rules and regulations, aggregators are viewed as another balancing responsible party.

[17] Swedish Electricity Act ('Ellag 1997/857') Chapter 8 Overall system responsibility and balance responsibility, etc.

All parties being aggregated should be part of the same balancing group. According to the 'RULES FOR TRADING ELECTRICITY' [13], the aggregator transfers the responsibility for balancing to the balancing group coordinator (same as BRP).

In the current scenario this means that the aggregator being a BRP is solely responsible for any imbalances. And if the current regulation remains, when aggregators enter the market their balancing and imbalances will still be handled by the balancing group coordinator.

Turkey's regulation on aggregators' financial responsible for the imbalances

It is an undeniable fact that when the portfolio created by aggregators with demand-side resources connected to the grid from the distribution system, provides demand-side participation services, these can cause increasing imbalances in portfolios of market participants which are responsible for the balance of related resources. Unfortunately, as the aggregator role is not defined in the current regulations in Turkey, there is not any defined rule about their financial responsibilities for the imbalances. However, suggestions were made in the reports prepared as a result of the studies on demand side participation.

In the Energy Efficiency Solution: Business Models report published by SHURA [19], it is emphasized that when demand-side participation services are provided through demand collectors, the imbalance created by the relevant demand-side resources should be determined by reference load methods and should not be reflected to any party by the System Operator which is TEİAŞ in Turkey. Otherwise, it has been pointed out that market participants responsible for the balance of related resources will not support independent aggregators to create a demand collector portfolio by using the consumers in their portfolio. In the same report, it is recommended that the imbalance that may arise between aggregators and suppliers be tolerated by the Market Operator.

Switzerland's regulation on aggregators' financial responsible for the imbalances

The TSO Swissgrid is responsible for balancing the electricity grid in Switzerland. The Balance Service Provider (BSP) is the commercial counterparty through which the aggregator provides balancing services to the TSO.

BSPs are under contract with the TSO and are responsible for the supply of balancing energy (Frequency Containment Reserve, FCR; automatic Frequency Restoration Reserve, aFRR; manuel Frequency Restoration Reserve, mFRR; and a market for system services called SDL).

EU's regulation on the relation between aggregators and BRPs

According to EU Directive 2019/944, both customers and aggregators have the right to act independently[18]. Customers are free to purchase electricity from the supplier of their choice and all customers are free to have more than one electricity supply contract at the same time. And a customer who wishes to enter into an aggregation agreement shall have the right to do so independently of and without approval from his electricity supplier. Meanwhile, aggregators, including independent aggregators, shall have the right to enter the electricity markets without consent from other market participants. In this way, aggregators can operate in the market on equal terms with already established players and more flexible resources can be useful in the electricity market.

[18] EU Directive 2019/944 Article 4, Article 13 (1) & (2), and Article 17.

It is worth noting the difference between an (non-independent) aggregator and an independent aggregator. The (non-independent) aggregator role can also be performed by an energy supplier who provides aggregation services. That is, either the supplier and the aggregator roles are integrated within a single market entry, or they have contractual relationships with each other. Whereas, an independent aggregator is an utility that can manage flexibility services without having any relations with a supplier [20] [21]. However, aggregator's financial responsibility with BRPs is not stated in any EU regulations.

Sweden's regulation on the relation between aggregators and BRPs

There are few aggregators in Sweden today and none of which are purely independent [22]. Balance responsibility models do not meet the EU Directive 2019/944 requirement that the aggregator may choose a balance responsibility party of its choice, for three reasons (Figure 10**Error! Reference source not found.**).

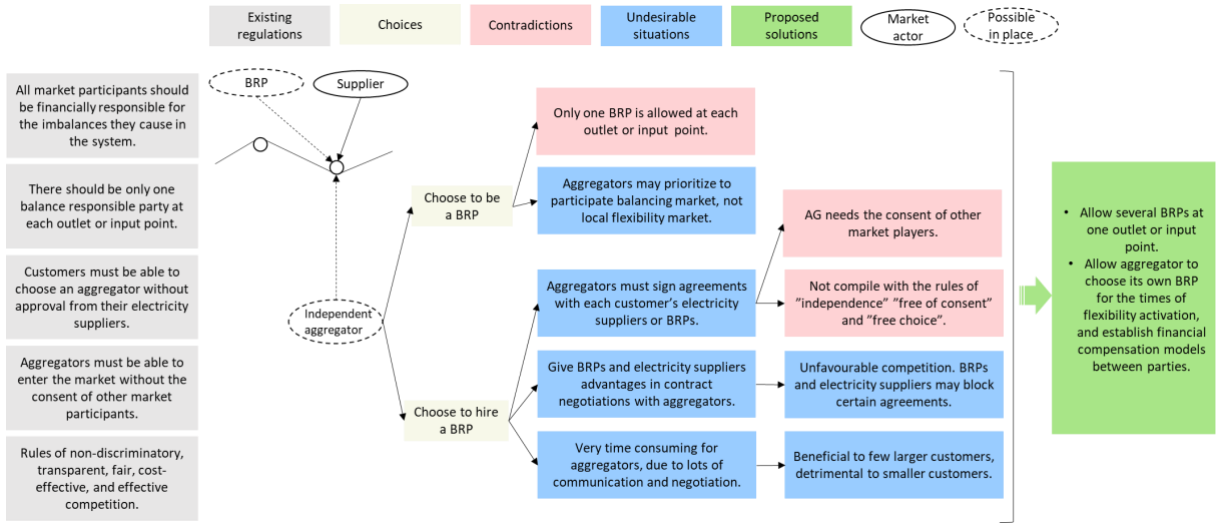

Figure 10. The current regulations on aggregators and BRPs, the contradictions, and the proposed solutions.

Firstly, according to the current Swedish Electricity Act ('Ellag 1997/857'), it only allows one BRP at each outlet or input point. This makes it possible to take balance responsibility possible for aggregators who are electricity suppliers, since electricity suppliers already have their own BRPs. In this case, they may prioritise the participation in other electricity market over the local flexibility market. Because there may be a greater need to aggregate smaller volumes into a bid to reach the minimum bid size in wholesale electricity market. If an independent aggregator wishes to participate in the electricity markets (including local flexibility market) and at the same time takes financial responsibility for the imbalances caused by the aggregation, the independent aggregator thus needs to contractually delegate their responsibility to a BRP of their choice. This in reality means the independent aggregator must sign agreements with each of its customers' electricity suppliers or BRPs. This is not compatible with the right of aggregators to choose to either be the party responsible for the balance or by agreement delegate the responsibility for the balance to a party responsible for the balance of their choice. Such an arrangement is also contrary to EU Directive 2019/944, which prohibits the requirement of consent from the customer's electricity

supplier or other electricity companies connected to the customer, such as its balance responsible[19]. The current Swedish regulations on balance responsibility must therefore be changed.

Secondly, the BRP that the aggregator needs to hire will in practice be either the same company that the customers' electricity supplier or will be appointed by and therefore contractually dependent on the customer's electricity supplier. This will put aggregators in an unfavourable place to negotiate with electricity suppliers and BRPs. If the terms of the agreement become unfavourable for the aggregator, this effectively means that the electricity supplier has the opportunity to block an agreement that is not in the interest of the electricity supplier.

Thirdly, in the current regulation designs, undue costs, including effort and time, are imposed on aggregators, which is contrary to EU Directive 2019/944[20]. An aggregator enters into local flexibility market by signing agreements with certain number of customers to aggregate their loads. Meanwhile, all customers have contracts with their electricity suppliers, respectively. In order for the aggregator to act, the aggregator is firstly required to find which BRP is connected to each of its customers' suppliers. Then the aggregator is required to sign an agreement with each of the customers individually. Lastly, the aggregator is required to sign a contract with each of the BRP for each of the suppliers individually concerning the distribution of balance responsibility. This is time consuming since it involves communication and negotiation with all the customers, electricity suppliers, and BRPs (Figure 11). In addition, this process benefits contracts with few larger customers rather than several smaller customers. Few larger consumers will significantly reduce the time and money required to aggregate these. This situation is thus detrimental to smaller consumers [22].

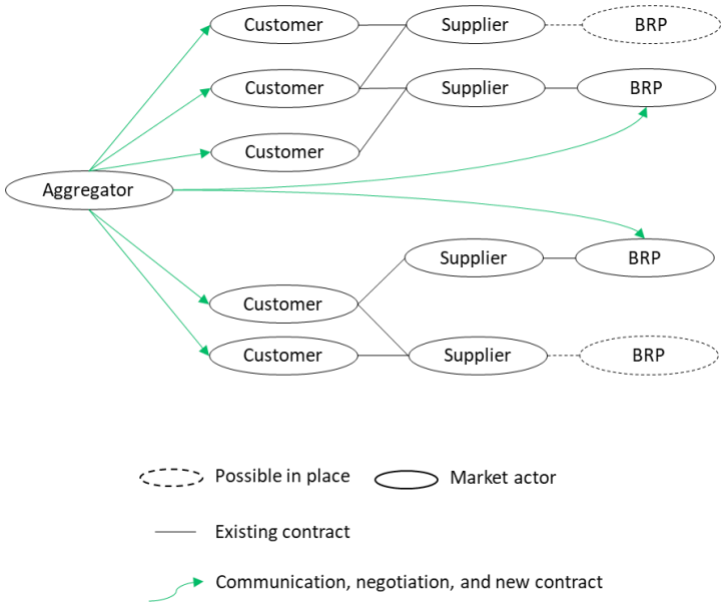

Figure 11. The communication, negotiation and contract process between an aggregator and other market participants.

[19] EU Directive 2019/944 Article 17 (3) (a).
[20] EU Directive 2019/944 Article 13-4, 17-2, & 17-3(e).

As a result, Ei R2021:03 assesses that the regulations need to be adapted to enable a balance responsibility model with several BRPs connected to the same output or input point, and models where the aggregator takes financial responsibility for the imbalances caused by aggregation through a system for financial compensation between parties.

Bulgaria's regulation on the relation between aggregators and BRPs

In view of the current legislation and the need to have all entities under the aggregator to be part of the same balancing responsible party, we cannot say that aggregators are 'independent'.

Though, it is important to note, that having in mind that there are still no aggregators on the Bulgarian energy market, this legislation will probably change based on:

- Lessons learnt from European directives and/or other European countries legislation practices.
- In line with the needs and necessities of the Bulgaria energy market, especially when end-consumers finally enter the liberalised market and are free to choose their own supplier.

Turkey's regulation on the relation between aggregators and BRPs

Aggregators are market participants with a supply or independent aggregator license who are responsible for ensuring that the portfolio they create with demand-side resources, participates in various market mechanisms. Demand-side market participants can provide demand-side participation either individually or by joining a portfolio of aggregators. Portfolios can be created by supply companies or by independent aggregators, whose primary role as a unique market participant is to pool demand-side resources.

Independent aggregators are more likely to deploy the flexible loads of the portfolio created by aggregating different types of consumption-side resources than consumption resources that provide individual demand-side participation services. In addition, consumption facilities that cannot individually meet the conditions for participation in market mechanisms, can participate in the relevant mechanisms by being included in the independent demand collector portfolio.

Since there are two types of aggregators, the active role of both types of aggregators in the market will increase the efficiency of the demand-side participation service and increase the solutions offered to consumers. Unfortunately, independent aggregators and consumers are not yet defined as market participants in the legislation in Turkey. Therefore, it is recommended that independent aggregators be defined as market participants and their responsibilities should be determined, thus removing this barrier.

Switzerland's regulation on the relation between aggregators and BRPs

Aggregators needs to be part of a BRP in order to commercialise their flexibility. For the moment, there is no regulation if aggregator use diffuse flexibility. But in the future, it could be problematic if the quantity of managed flexibility by the aggregator is too high and can impact other BRPs.

EU's regulation on aggregator's contract

EU Directive 2019/944 regulated that the aggregation contract of all customers is independent from their electricity supply contract and the sign of such a contract does not require any consent of their electricity suppliers. Especially, the customers, who have a contract with aggregators, should be free from any technical and administrative requirements, procedures or charges by their supplier. For contracts, the customers should be informed fully of the terms and conditions, including all relevant demand response

data, or data on supplied and sold electricity. All relevant data should be available free of charge for the customers. Such contracts should also be non-discriminatory regarding cost, effort or time[21]. For such an aggregator-prosumer contract, the flexibility loads, activation prices, time constraints and penalties for not meeting contractual obligations should be specified.

Apart from the forementioned contract between an aggregator and its customers on the designed local flexibility market, all other market participants will have a contractual relationship with the aggregator as well. Two other important types of contracts are aggregator-DSO contract and aggregator-BRP contract [23]. These contracts should define the amount of flexibility services, time period, activation mode, prices and compensations, rights and obligations, payment methods, and so on.

All contracts should obey the rules of being fair, writing in plain and unambiguous language, being well known in advance between market participants.

Contracts, especially long-term contracts, could mitigate the market power issue which is mentioned in 'non-discriminatory rules and market power' Section. More general regulations on contract could be found in Section 4.4.

Sweden's regulation on aggregator's contract

Sweden do not have plans to define a specific model for aggregation in the law but keeps the legislation on a more general level. However, regulations should cover aggregator-prosumer contract, aggregator-DSO contract and aggregator-BRP contract.

One of the most important aspects that should be clearly addressed in a contract is the economic compensation plans between market participants. There are no provisions in current Swedish regulations for a compensation mechanism between the aggregator and other market participants that are affected by the aggregator's activities. In the event that a compensation mechanism is to be introduced, the national regulations need to be supplemented and contracts should specify this.

Bulgaria's regulation on aggregator's contract

In this regard, though slightly different (due to the view of aggregators as BRPs), Bulgaria's situation is similar to Sweden – very general legislation and no specific model for aggregation.

Turkey's regulation on aggregator's contract

There is no existing regulation for aggregation contracts since there is no definition of aggregators in the legislation of Turkey. However, it is important to clarify the relationships of consumers and aggregators with other market participants in order to enable demand-side participation and the integration of independent aggregators into the market. It is recommended that the imbalance that can occur between independent aggregators and supply companies be tolerated by the Market Operator. In this situation, EPİAŞ will be responsible for this task as the market operator of Turkey. Also, it is suggested that the 'aggregated demand' can participate in the prequalification process for the consumers, who will participate in the balancing reserves as a whole, through independent demand aggregators.

[21] EU Directive 2019/944 Article 13.

In addition to these, it was suggested that when demand side participation service is provided through aggregators, the imbalance created by the relevant demand side sources should be determined by reference load methods. In reference load methods, it is calculated how much consumption the consumer who provides the demand side participation service will consume in the scenario where the service does not provide at the relevant hour. Then, performance measurement is done by using the difference between the actual situation and the calculated value.

Switzerland's regulation on aggregator's contract

Two business models can be distinguished for aggregators:

- Explicit contracting: The aggregator pays the owner for the provision of its flexibility in a transparent way according to the actual valuation generated on the markets. The aggregator retains a commercial margin for managing the flexibility.
- Fixed contracting: The remuneration model of the flexibility owner is based on the provision of a financial (CHF/month) or energy (kWh/year) compensation to the flexibility owner in exchange for its flexibility. The flexibility owner has no view on the value of its flexibility nor on the value generated by its flexibility and by the aggregator.

4.1.2 Balance Responsible Party (BRP)

EU's regulation on Balance Responsible Party (BRP)

The EU Regulation 2017/2195 ("the Electricity Balancing Regulation") sets the framework for a common and well-functioning European balancing market. TSOs must ensure that as much electricity is supplied to the electricity system as is consumed and use balancing services for this purpose. This balancing service means balancing energy or balancing capacity, or both[22]. Balance services are flexible production or consumption that TSOs buy from suppliers and the trading of balance services takes place on the balance market. The EU Directive 2019/944 is clear that aggregators, including independent aggregators, must be financially responsible for the energy imbalances they cause[23].

The Electricity Balancing Regulation introduces a distinction between roles of BRPs and BSPs. This Regulation clearly defines the BRP as a market participant or its chosen representative responsible for its imbalances. They trade in electricity market on behalf of their clients' portfolios. Balancing Service Provider is defined as a market participant with reserve-providing units or reserve providing groups able to provide balancing services to TSOs[24]. A BSP sells products directly to TSOs and is allowed to deduct its actions from the BRPs imbalances [24]. The aggregator manages the flexible loads to provide services to DSO and BRPs, the TSO being out of the scope at the present time. Since local flexibility market does not concern TSO, we exclude the regulatory analysis for BSP in this report.

As forementioned, BRPs could procure flexibility to optimise their portfolio and realise their energy obligations. They are only responsible for the balancing of their clients' portfolios. In that sense, BRPs compete with the DSO for the flexibility provided by the aggregators in the local flexibility market [21]

[22] EU Regulation EU 2017/2195 Article 18-6.
[23] EU Directive 2019/944 Article 17
[24] EU Regulation 2017/2195 Article 2 (6)(7).

[25]. Effective competition should be promoted. But it shall be regulated as well, especially the competition between a DSO and a BRP. The DSO on the local flexibility market seeks to buy flexibility products and services to mitigate a problem in a specific area. Its requests are locational dependent and concern the amount of delivered flexibility in the distribution network. It aims at cost-efficiently operating the grid. The BRP buys flexibility products and services to solve an imbalance in their portfolio. Its requests do not have location constraints but only concerns the amount of flexibility. It aims at maximizing the profit, therefore a BRP is willing to pay a higher price to purchase flexibility to avoid a much higher penalty after the ex-post imbalance settlement. On one hand, the requests from DSOs should be prioritised because the purpose of a local flexibility market is to help DSO solve imbalance problems. On the other hand, this means unfair competition through biasing the market towards the DSO's requests [21] (Figure 12).

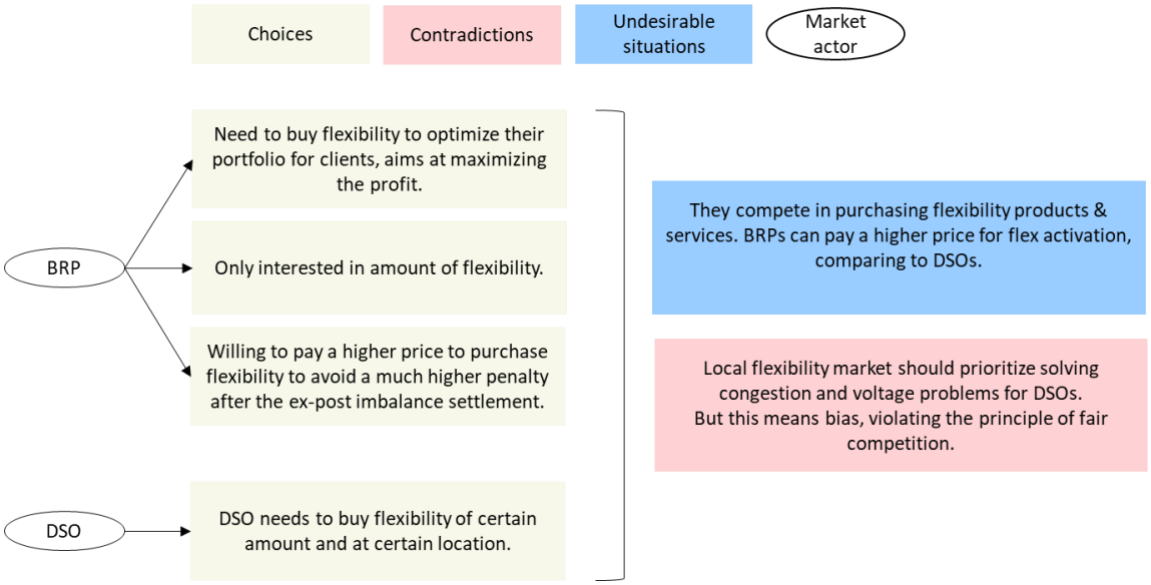

Figure 12. The roles of a BRP, compared to a DSO, on a local flexibility market.

Sweden's regulation on Balance Responsible Party (BRP)

The Swedish Electricity Act (1997:857) states that each point where electricity is withdrawn from (or inserted into) the grid must have a BRP to manage the imbalances at that point (the 'polluter pays' principle). According to the Swedish Balancing Regulation, the BRP takes that responsibility to prevent frequency deviations of the national electricity system. There are around 37 companies acting as BRPs in Sweden in 2020 [26].

The new player role of Balancing Service Provider (BSP) ('leverantör av balanstjänster' in Swedish) is also introduced in Sweden. The definitions on both BRP and BSP are in line with the EU regulations. The BSP is the one who submits a bid of balancing energy or balancing capacity directly to the TSO (i.e. Svenska kraftnät) without going through the BRPs. For the TSO, a harmonised balancing market means that the most cost-effective resources will be used for balancing. In the long run, this should lead to lower costs for the TSO. However, it is difficult to say what the total cost-benefit analysis will look like, since it is still being designed. The local flexibility market will be affected as well, but the exact way is depending on the TSO, for example, how the balancing products are designed.

Nowadays aggregators cannot participate on different balancing markets directly if they are not BRPs. There is no existing regulation regarding local flexibility market. But the role of BSP will enable aggregators to independently participate on balancing markets and future local flexibility markets.

Generally, those two roles are believed to facilitate the participation of demand flexibility, including aggregation of facilities and energy storage, while ensuring that they compete with other balancing services on equal terms and, where necessary, act independently when serving a single consumer facility. They will also promote effective competition, non-discrimination and openness in balancing markets.

Since local flexibility market in this project does not include TSO as buyers, more detailed regulation analysis on BSP is beyond this report. Other regulation gaps and barriers are in line with the EU-level analysis above.

Bulgaria's regulation on Balance Responsible Party (BRP)

Before going into the roles and responsibilities of BRPs and BSPs, here is a bit of background on how the balancing market in Bulgaria works. For the purposes of energy balancing, the TSO makes transactions with different market players, which through their consumption and/or production can cover the imbalances in the national energy market (definition given by the Rules for Trading Electricity in Bulgaria).

This happens on the so-called balancing electricity market, which aims to maintain a balance between production and consumption in the electricity system. This is achieved by stipulating schedules (deficit or surplus) for production and consumption of electricity and performing balancing energy transactions for each settlement period. Therefore, in order to achieve that all producers and consumers on the free market participate as members of balancing groups.

In the legislation, single market players could in theory also enter into direct transaction with the TSO, but in practice, market players participate on the balancing market through a balancing group.

It is important to note that the current legislation is still in the process of being changed and optimised according to the needs of the energy market as well as in line with European directives and legislation.

In accordance to the third package of energy liberalization directives, Bulgaria has started working towards creating favourable conditions for the development of the electricity sector and its market liberalization. This has also included implementing the necessary regulations for the functioning of the balancing energy market. Such conditions and regulations include the introduction of the 'day-ahead' stock exchange segment in 2016 as well as the stock exchange segment 'intra-day' in 2018 through Bulgarian Independent Energy Exchange EAD (IBEX).

Having said that and to complete the intro to the balancing market, we have to note that the balancing model in Bulgaria is transparent as it provides equal conditions for balancing, regardless of production technology, the size of the objects/sites and whether they are supplied at regulated or freely negotiated prices. Properly utilizing the use of the balancing market can lead to network developments that don't require huge investments as well as can contribute to increasing the flexibility of the electricity system.

Going back to the balancing group we mentioned above, in the market framework of Bulgaria, a coordinated balancing group is actually both a BRP as well as BSP. This makes it a market player which on one side provides balancing services and on the other, is in a way responsible for any imbalances that happen.

The actual financial responsibility, though, is as follows: the coordinated balancing group is financially liable to the TSO for any imbalances that it causes, while the market participants themselves (producers, consumers, prosumers) are financially liable for imbalances they've caused based on their agreed contract conditions with the balancing group.

The aim of having end-users, producers and energy traders enter the balancing market through a balancing group (instead of directly), is to reduce or save completely the balancing costs that result from imbalances (deviations of measured consumption or production compared to previously planned). The larger and more diverse the balancing group, the greater the preconditions for savings.

In the context of local flexibility market, BRPs could be seen as a potential early adopter of the concept. As they have less barriers and may directly benefit from a local flexibility market, it could be possible that they first implement such a market and then later on transfer it toward DSOs (or a separate market operator) when the legislation allows it.

Turkey's regulation on Balance Responsible Party (BRP)

Two different balancing mechanism participants have been defined in the Electricity Market Balancing and Settlement Regulation of Turkey. These are Balance Responsible Group and Balance Responsible Party. Balance Responsible Group refers to the group formed by the market participants by notifying the Market Operator and in which a market participant from the group assumes the liabilities regarding the balance responsibility on behalf of the group. BRP refers to the market participant who assumes the financial responsibility of the balance responsible group to the Market Operator regarding the energy imbalance on behalf of the balance responsible group or is not included in any balance responsible group.

Again, in the sixth Article of the same regulation[25], the general principles of balance responsibility are defined with five sub-Articles which are given below.

- For each settlement period and each bidding region, market participants are responsible for balancing between their supply to the system, purchases and imports of electrical energy on the one hand, and their withdrawal from the system, sales and exports of electrical energy on the other.
- Market participants assume financial responsibility towards the Market Operator for the settlement of energy imbalances and imbalances on a settlement period basis. The market participant who assumes this financial responsibility is called the BRP.
- The parties responsible for the balance may come together to form a group responsible for the balance. A BRP from within the group on behalf of the balance responsible group assumes the financial responsibility of the balance responsible group to the Market Operator regarding the energy imbalance.
- It is essential that the parties responsible for the balance ensure the balance by using all available means until the time of delivery. Balancing the system in real-time is the responsibility of the System Operator.

[25] Electricity Market Balancing and Settlement Regulation. Official Journal of the Republic of Turkey (No: 27200) Article 6. April 2009.

- The Market Operator receives the information it needs from all parties responsible for the balance in order to be able to identify the systematic violations of the liabilities related to the balance responsibility and to report these deviations to the Agency.

Switzerland's regulation on Balance Responsible Party (BRP)

The BRP manages the electricity imbalances of a balance group area on the electricity markets. It aggregates and optimises the generation, purchase and consumption forecasts of the participants in its control area and carries out day-ahead or intraday optimisation and nominations to the TSO.

The BRP is responsible for the deviations it causes in the transmission system. It can buy flexibility sources to reduce them and to reduce the penalties applied by the TSO for balancing energy.

4.1.3 Citizen energy communities

EU's regulation on citizen energy communities

In EU Directive 2019/944, a citizen energy community is encouraged to involve all consumers directly in producing, consuming, sharing energy, and participating in electricity market[26]. To achieve this, citizen energy communities could adopt new and emerging technologies and consumption patterns, such as smart distribution grids and demand response, in an integrated way. This concept, together with the concept of "renewable energy community" are proposed in EU Directive 2019/944 and EU Directive 2018/2001 (so called "Renewable Energy Directive, RED")[27]. They are similar but not totally consistent. However, the comparison of these concepts is beyond the scope of this report. This report analyses energy community as a new type of market actor represented by citizen energy community.

A citizen energy community is entitled to share the self-produced electricity within the community. This is enabled by owning, establishing or leasing distribution networks and managing them autonomously, thereby receiving fair compensation[28] [29]**.** Today, within the EU, there is co-ownership of production, virtual sharing of networks and physical sharing within geographical areas with the help of electricity trading companies. When the citizen energy communities are allowed and encouraged to manage distribution network, they act as DSO in their area of operation. This means they are subject to the similar obligations as a DSO[30]. If so, Member States shall ensure that citizen energy communities have the right to conclude an agreement network with a DSO or TSO. They shall also be subject to appropriate network charges at the connection points between their network and the distribution network and that such network charges be reported separately for the electricity fed into the distribution network and the electricity consumed from the distribution network outside the citizen energy community. In cases where the citizen energy community owns or operates networks, the relevant system operator for distribution systems shall, for reasonable remuneration in accordance with the supervisory authority's assessment, cooperate with energy communities to facilitate electricity transmission within these. Citizens Energy Communities shall then also be subject to non-discriminatory procedures and fees for registration or

[26] EU Directive 2019/944 Article 16.
[27] EU Directive 2018/2001.
[28] EU Directive 2019/944 Article 16-1(d).
[29] EU Directive 2019/944 Article 16-2(b).
[30] EU Directive 2019/944 Article 16-4.

licensing. The citizens energy communities must also have transparent, non-discriminatory and cost-based network charges and contribute to the overall cost allocation of the system. Those regulations are not in place in the current legislation framework.

When participating in all electricity markets including local flexibility markets, there are different ways such as by themselves, or through aggregation in a non-discriminatory manner[31] [32]. For the latter case, they act like aggregators of aggregating multiple flexibility resources and efficiently facilitating the relationship between consumers/prosumers and grid owners. In this manner, citizen energy communities may function as an aggregator with the purpose of providing flexibility. Similar to aggregators, citizen energy communities should also be financially responsible for the imbalances they cause in the electricity system. As mentioned earlier, the aggregation of tradable energy from citizen energy communities should also be linked to the party responsible for balancing. This leads to the same dilemma as above (see 'Aggregator' Section).

To date, the role, responsibilities and legal boundaries of citizens energy communities are still in a developmental stage and missing to a large degree. In any regard, the level playing field principle should be followed which protects citizen energy communities from undue payments, penalties or other undue contractual restrictions by their suppliers[33].

Sweden's regulation on citizen energy communities

Today there are different types of energy communities on Swedish market, even though there are no established rules on citizen energy communities in Swedish legislation. In general, there is no obstacle to the formation of a legal person for the purpose set out in Article 16[34]. Nor are there any barriers to providing for customer rights contained in the Articles of association or in the Articles of membership.

Ei has proposed to introduce new actors such as citizen energy community ('medborgarenergigemenskap' in Swedish) and renewable energy community ('gemenskaper för förnybar energi' in Swedish). According to Ei, citizen energy community can carry out activities like any other actor in addition to owning and operating networks. Renewable energy community can conduct renewable energy activities in all their forms and whose members shall be in the vicinity of these activities. Those proposals improve the opportunity and conditions for customers who want to act as prosumers, i.e., has its own production of renewable energy that can be consumed by the customer himself or fed into the grid. Ei has drafted the constitution proposal stating a citizen energy community is entitled to provide its members with environmental, economic or social benefits through three ways: 1) production, supply or consumption of electricity; 2) aggregation; 3) to provide charging points for electric vehicles, energy efficiency services or other energy services to its members [11].

As Ei proposed, citizen energy communities could internally share self-produced electricity whose production units are owned by the citizen energy community.

[31] EU Directive 2019/944 Article 2(11).
[32] EU Directive 2019/943 (39).
[33] EU Directive 2019/943 Article 17-3(e).
[34] EU Directive 2019/944 Article 16.

Comparing to the EU Directive 2019/944, giving citizen energy communities the right to own and independently operate electricity networks within their area does not fall within current Swedish legislation. If a citizen energy community is to be able to own and operate the electricity grid within its area, Swedish legislation requires either a grid concession for an area or the local grid can constitute a grid subject to non-concessioned network ('icke koncessionspliktig nät, IKN' in Swedish). A possible approach is that the network authority in an individual case may grant an exemption from the requirement for a network concession. This could apply to IKN, which is owned by a small cooperative, economic or non-profit association or a tenant-owner association. If the local energy community instead consists of several separate residential buildings, e.g., a residential area with terraced houses, chain houses or alley houses, the rules for IKN are not applicable today because the exemptions from network concessions that are allowed for IKN are very limited. An IKN also does not have the consumer protection provided for in Article 16, i.e., that the connection to the energy community is voluntary and that customers have the opportunity to leave with the same rules that apply when changing electricity supplier. Another alternative would be to create rules for separate network concessions for area or a simplified form of concession. In this case, it is needed to have some professional organizations which meet all requirements for an area concession including technology, safety and consumer protection. But this is a very complicated process. There are also significant legal problems here in finding a form of regulation and settlement between a citizen energy community and the grid company that holds the grid concession. Supposing that the citizen energy communities are given the right to own and operate networks, they will be obliged to contribute to network efficiency and grid development plans. These complex regulation settings will possibly make a citizen energy community not attractive. So, Ei proposed that there is no need to allow the energy communities to own and manage their own network (Figure 13). However, this is not in line with the EU Directive 2019/944[35].

There are likely a number of new tax law issues to be resolved related to energy communities, e.g., regarding energy tax and VAT, how electricity sharing transactions should be taxed, etc.

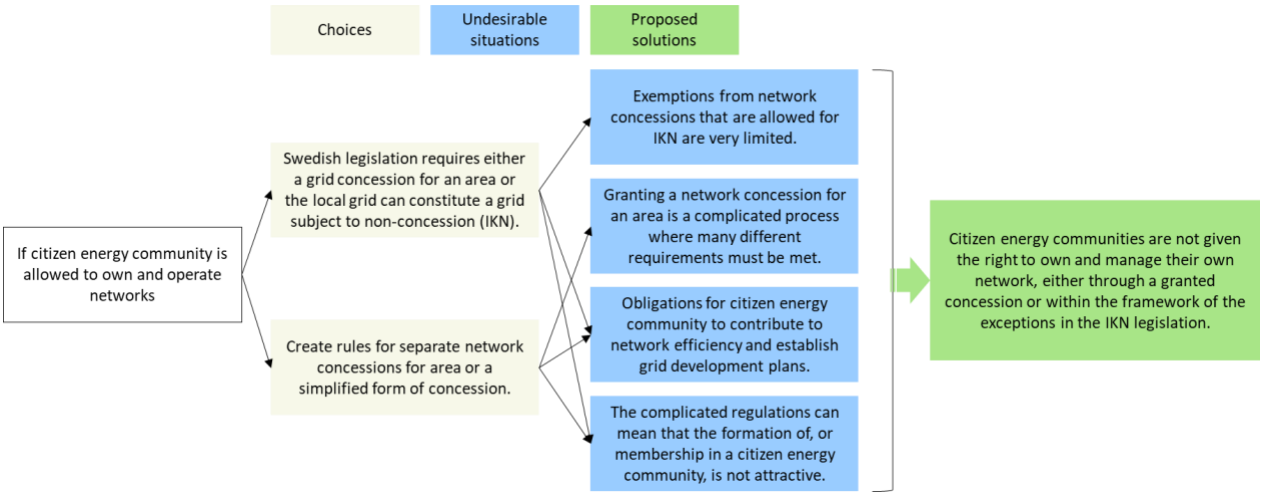

Figure 13. The reasons why citizen energy communities are proposed not to own and operate their own networks.

[35] EU Directive 2019/944 Article 16-2(b).

It is also not clear how citizen energy communities shall be regulated to participate in local flexibility markets or taking the roles or part of the roles as aggregators or BRPs. Current energy communities are perceived more for non-profit purpose, which refer to reduced carbon dioxide emissions, a better environment or increased community involvement in environmental issues. If they will participate in local flexibility market in the future, relevant regulations should be prepared in place.

Bulgaria's regulation on citizen energy communities

Currently in Bulgaria, there are no provisions in the legislation on the creation and functioning of energy communities. However, 'Integrated Plan in the Area of Energy and Climate of The Republic of Bulgaria 2021-2030'[27] encourages the promotion of local energy communities and their active participation in the energy market by prescribing that later on legislative measures will be implemented in the local regulatory framework.

By the end of 2020 there still weren't any energy communities in Bulgaria. However, starting around the middle of 2021 in line with Revision of the Renewable Energy Directive (REDII), talks and examples of such started showing (mostly from older projects that weren't introduces as such due to no legislation about energy communities to speak of at that time). Despite not having detailed and energy communities directed legislation, the current legislation framework is still open to their participation in the energy market.

Though, some argue that even currently, the overall legislation is still very complicated for entry of this type of market players. In addition, general information as well as needed procedures to create an energy community, are still not accessible or easy enough to the general public, making it hard to introduce energy communities and see many examples of them in Bulgaria.

There are many discussions on different types and legal forms of energy communities which aligns with the fact that currently there is no single definition of what energy communities are, but more of what are their characteristics and purposes. Commonly, energy communities are powered by RES and owned directly by citizens, cooperatives or bodies of local self-government (such as municipal authorities). In addition, energy communities usually have a purpose other than profit, for example fighting climate change.

More projects that incorporate all the characteristics of energy communities are expected in the next few years. However, there are still some obstacles (how to raise capital, where to get more information) and possible risks (what are the taxes, how will the legislation change) associated with energy communities and until they have been resolved the emergence of energy communities is likely slow.

Turkey's regulation on citizen energy communities

The concept of citizen energy communities does not yet exist in Turkey. For this reason, there is no definition or regulation containing comprehensive rules for these communities. However, there are studies in academia that address the disadvantages of this situation.

Yorgancıoğlu stated that the concept of citizen energy communities is important for the successful and cost-effective transition to a low-carbon society and fossil-free energy system in the Article Powering Communities Turkey and Citizen Participation. It is also mentioned that positive results can be observed when citizens participate in the policy process, create synergies, cooperate with others and reach consensus to bring about positive social and environmental change.

Switzerland's regulation on citizen energy communities

In Switzerland, the energy market is not open for small customers, but there is the possibility to create an energy community (RCP).

The RCP represents a single end consumer (Art. 18 para. 1 LEne). The DSO therefore measures the consumption and supply of the RCP as a whole. The DSO also measures the production of installations with a capacity of more than 30 kVA. For everything that happens within the RCP, i.e., behind the grid connection point, the RCP must be self-sufficient in terms of supply, e.g., for measuring the individual consumption of the RCP participants or stakeholders, the allocation of all electricity costs, the issuing and validation of guarantees of origin (GOs) and the settlement.

More projects that incorporate all the characteristics of energy communities are expected in the next few years. Unfortunately, there are still some obstacles (how to raise capital, where to get more information) and possible risks (what are the taxes, how will the legislation change) associated with energy communities and until they have been resolved the emergence of energy communities is likely slow.

Self-consumption means the direct consumption of electricity simultaneously with the production at the place of production or the simultaneous storage and future consumption at the place of production. This guide applies in principle to all technologies. However, since self-consumption and self-consumption aggregation (hereinafter 'RCP') are more likely to be realised with PV installations, the focus will be on these configurations in what follows.

If the RCP has a total annual electricity consumption of more than 100 MWh, it is entitled to grid access in accordance with Article 13(1) LApEl. It is irrelevant how much of the consumption was purchased from the grid or generated by the plant itself.

The annual consumption in the twelve months prior to the last reading is decisive for determining the grid access rights of end consumers in accordance with Art. 11 Para. 1 OApEl. In the case of a group, this annual consumption can easily be determined by a calculation based on the values of the end consumers previously measured individually. If this consumption limit is reached and the RCP wants to demand its own grid access, it must notify the DSO in its catchment area by 31 October each year. The RCP can then conclude a new supply contract with any electricity supplier - this can also be the current supplier.

4.1.4 Distribution System Operator (DSO)

EU's regulation on DSO

EU Directive 2019/944 clearly defines the tasks of DSOs[36], which lays strong foundation for the design of local flexibility market. The overall task for a DSO is to ensure the long-term ability of the system to meet reasonable demands for the distribution of electricity, for operating, maintaining and developing under economic conditions a secure, reliable and efficient electricity distribution system in its area with due regard for the environment and energy efficiency. DSOs should take appropriate measures to make their network resilient and flexible[37]. DSOs can be required to give priority to generating installations using

[36] EU Directive 2019/944 Article 31.
[37] EU Directive 2019/944 (83).

renewable sources or using high-efficiency cogeneration [38]. Considering its monopoly status with regulated income, in any event, DSOs shall not discriminate any market actors.

On local flexibility markets, Member States shall provide the necessary regulatory framework to allow and provide incentives to DSOs to procure flexibility services from providers of distributed generation, demand response or energy storage[39]. The current regulatory framework may not sufficiently incentivise DSOs to invest in flexibility acquisition. Since this means an increase in operation costs may occur in a short term. Thus, new regulatory framework should incorporate mechanisms that not only allow DSOs to procure system flexibility services but also to ensure the recovery of flexibility procurement costs and provide economic incentives for the use of local flexibility as an alternative for grid reinforcement. Other ways that could incentivise DSOs are, for instance, regulatory sandboxing. DSOs should also establish the specifications for the flexibility services procured and standardised market products for such services at least at national level[40].

Despite its benefits and affordability, EU Directive 2019/944 prevents DSOs to own, develop, manage, and operate energy storage facilities[41], nor own, develop, manage or operate recharging points for electric vehicles (except where DSOs own private recharging points solely for their own use)[42]. Therefore, the chances of using such storage facilities to participate in any electricity market do not exist. Energy storage and charging stations for EVs are usually invaluable technologies for local flexibility market. Thus, future regulations should give full consideration regarding this issue.

Referring to EU Regulation 2017/2195, DSOs may develop a proposal to define and use specific products to purchase flexibility[43]. The proposal should include information on the definition and duration of use of the specific product and other product characteristics. A discussion of products and their regulations can be found in the 'Market and product' Section.

TSO can use flexibility for the procurement and activation of reserve for balancing purposes. TSO–DSO coordination and information exchange is essential to ensure the optimal utilization of flexibility resources, the secure and efficient operation of the system and to avoid further grid problems [44] [28]. The regulations should cover this aspect as well.

Sweden's regulation on DSO

In line with EU's regulations, Ei's proposal does not allow DSOs to own and operate charging points for electric vehicles, except for their own use. The establishment of charging points for electric vehicles is expected to take place through other actors. Nor can the system operators operate and own energy storage, unless it is a fully integrated network component or if the market has failed to offer the service. The DSO's ability to conduct activities other than network operations is limited.

[38] EU Directive 2019/944 Article 31-4.
[39] EU Directive 2019/943 Article 32-1.
[40] EU Directive 2019/943 Article 32-2.
[41] EU Directive 2019/944 Article 36-1.
[42] EU Directive 2019/944 Article 33-2.
[43] EU Regulation 2017/2195 Article 25 & Article 26.
[44] EU Regulation 2019/944 Article 32-2, Article 40-6, Article 57.

The future regulation framework regarding the incentive issues, rights of defining flexibility products, and TSO-DSO coordination are similar to the EU-level analysis. The role of the DSO is under development in Sweden. There is a need for more active DSOs in line with the EU regulations.

Bulgaria's regulation on DSO

ESO EAD (Bulgaria TSO) is the owner and operator of the entire electricity transmission network of the Republic of Bulgaria. This is in line with Directive 2009/72/EC, which establishes common rules on how generation, transmission, distribution and supply should be handled in the energy market in the European Union.

The distribution of electricity, on the other hand, is handled through DSOs, each of which has demarcated territories. All four DSOs are privately owned by foreign shareholders. The main DSOs of Bulgaria and their metrics in accordance to the Annual report to the European Commission prepared by the Energy and Water Regulatory Commission (EWRC) of Bulgaria in July 2021 [29] include (Figure 14):

- CEZ Distribution Bulgaria AD /CEZ Group/: operates in West Bulgaria, covers around 40 000 sq. km, with market share of 40% (9 396 067 MWh)
- Electrodistribution North AD /Energo-Pro/: operates in North Bulgaria, covers around 30 000 sq. km, with market share of 24% (5 515 228 MWh)
- Elektrorazpredelenie Yug EAD /EVN/: operates in South Bulgaria, covers around 42 000 sq. km, with market share of 36% (8 545 693 MWH)
- Electrodistribution Zlatni Piasaci AD: operates in a limited area of activity

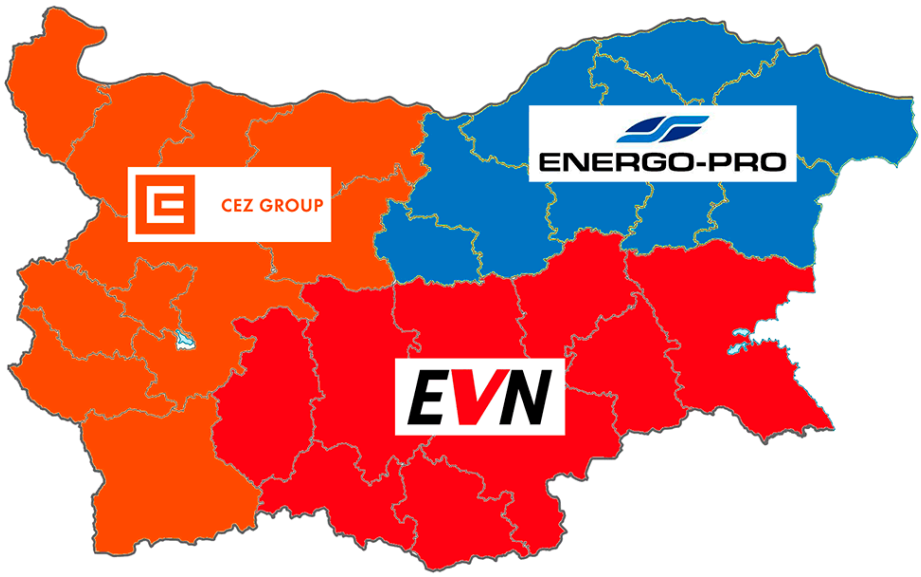

Figure 14. Main Bulgarian DSOs in electricity distribution areas.

In Bulgaria, DSOs have certain monopoly on the energy market. In order to limit their influence, they are strongly regulated and in line with these regulations they are highly conservative.

Similarly, to Sweden, DSOs in Bulgaria have limited ability to conduct activities other than network operations. Changes in legislation are definitely necessary if we wish to have DSOs take a more active role on the electricity markets and particularly in the context of local flexibility market.

Turkey's regulation on DSO

The privatization of DSOs in Turkey was completed in 2013. Today, 21 different regions are controlled by 21 different DSOs. The responsibilities and limitations of distribution companies have been specified in the Electricity Market Law[45]. The DSO is responsible for the reading, maintenance and operation of meters in the region determined in its license. Legal entities operating in the market cannot be direct partners of a DSO, and a DSO cannot be a direct partner of legal entities operating in the market (Figure 15).

Figure 15. Distribution Regions of Turkey.

The DSO cannot engage in any activity other than distribution. The exception to this provision is the purchase of electrical energy to be used to cover technical and non-technical losses of the general lighting and distribution system, and the sale of excess energy due to realizations, which is contracted to cover the system's technical and non-technical losses.

In the Regulation on Storage Activities in the Electricity Market[46], it is stated that DSOs can establish an energy storage system if they meet the following conditions.

- Proving to be more economical than new grid investment
- Provide the conditions required by the legislation, such as improving the supply continuity and/or technical quality of electrical energy, meeting new connection demands
- Ensuring that they are supported by cost-benefit analysis

However, electricity storage facilities established by DSOs within the scope of distribution activities are not subject to wholesale and retail electricity sales and balancing power market, in which other market participants can participate.

[45] Electricity Market Law. Official Journal of the Republic of Turkey (No: 28603/6446) Article 9. March 2013.

[46] Regulation on Storage Activities in the Electricity Market Official Journal of the Republic of Turkey (No: 31479) Article 8. May 2021.

TEIAS acts as TSO in Turkey. TSO authority and responsibilities have been defined by the Electricity Market Law[47]. TEİAŞ is responsible for making a transmission investment plan for the new transmission facilities to be established, establishing new transmission facilities, operating the transmission system in accordance with the competitive environment in electricity generation and supply, and investing in substitution and capacity increase in the transmission system when necessary. In addition, TSO responsible to oversee the implementation of the regulations on network, balancing and settlement and ancillary services, to carry out the necessary investigations for this purpose, to report to the Authority on the results and to demand that necessary measures be taken.

Switzerland's regulation on DSO

The DSO operates and develops the distribution network and is responsible for ensuring a secure and cost-effective supply of electricity to all its customers in its service area. It is also responsible for the supply of its captive customers.

The DSO may seek to use the flexibilities available in its service area to improve the level of service on its network or to limit the costs, particularly for reinforcement. In Switzerland, the remuneration model naturally encourages reinforcement, remunerated by the WACC - the regulations encourage the systematic evaluation of flexibility alternatives.

4.1.5 Market operator

EU's regulation on market operator

In EU Regulation 2019/943, the market operator is an entity that provides a service whereby the offers to sell electricity are matched with bids to buy electricity[48]. On a local flexibility market, the market operator is the entity that manages the operation of the most important aspects of the local flexibility market, such as bidding, clearing and settlement of the market. A market operator shall ensure that a flexibility market is operated in accordance with the design principles. A market operator could be nominated by national authorities.

For a local flexibility market, the role of a market operator is not addressed in the EU framework, which only covers the functions of the wholesale market operator including balancing market operator. Furthermore, through the current regulations, it is unclear if local flexibility market needs an independent market operator, who can designate it, take its roles, and how it shall be regulated. In EU Regulation 2019/943, the DSO has the task to facilitate distribution grid users' access to markets[49], but it is unclear if the DSO should or should not be the market operator itself.

In the economics literature, it is often suggested that the market operator should be an independent, neutral third party e.g. market operator of another organised market or a private competitive entity [30]. This is to avoid any risk of conflict of interest and ensure non-discriminatory access for all market participants. In some local flexibility market designs, DSOs acted as a market operator [15] [31]. Opinions from such as ENTSO-E and DSO Association (CEDEC, E.DSO, Eurelectric, GEODE), recommend avoiding EU regulation on developing the role of flexibility market operator in EU regulation, to enable the

[47] Electricity Market Law. Official Journal of the Republic of Turkey (No: 28603/6446) Article 8 Sub-Article 2. March 2013.
[48] EU Regulation 2019/943 Article 2(7)-(8).
[49] EU Regulation 2019/943 Article 55-1(c).

development of innovative solutions at national level [32]. ENTSO-E and DSO Association suggests that at present, the EU framework should not define rules or definitions on this topic. Instead, the Member States should make their own decisions and innovations. Therefore, they advise against defining any more roles.

Sweden's regulation on market operator

On day-ahead and intraday market, Nordpool and EPEX act as the market operator. But there is no relevant regulation on market operator for local flexibility market in Sweden. The market operator shall be nominated and enable market participants to efficiently trade flexibility products according to the trading rules. Similar to regulations on market operators at EU level, this should be clarified in Sweden as well. Certain qualified and specialised market platform developers like NODES should be suggested if it can take the role of local flexibility market operator or not, which in reality, it acts as an independent market operator engaged in several projects in more than ten countries across Europe.

Bulgaria's regulation on market operator

On day-ahead and intraday market (as well as all other current energy markets), IBEX (independent Bulgarian energy exchange) acts as the market operator. There is no reason to think that flexibility markets would be different.

Though it is possible to have new market operators emerging, especially as the full liberalization of the energy market will happen almost simultaneously as the current power exchange for electricity license expires.

Turkey's regulation on market operator

EPİAŞ is responsible for operating the day-ahead, intraday and balancing markets in Turkey, and managing the eligible consumers in the spot markets. Also, EPİAŞ provides comprehensive, real-time data for the electricity markets with the EPİAŞ Transparency Platform. This platform provides transparency in these markets as well as equal access to the data for market participants. In current regulations, there is not any flexibility market responsibility has been defined for EPİAŞ and this create a gap. Also, there is no definition of another authority or responsibility in regulations for the Market Operator in the flexible market.

Switzerland's regulation on market operator

Access to the day-ahead market platform EPEX Spot enables energy to be traded on the Swiss and possibly the European market. Participants buy or sell electricity the day before for the next day according to their hourly coverage forecasts.

Beyond day-ahead trading, some players can optimise their production and possibly their consumption over longer cycles (week, month, quarter) to capture a value differential on the Spot.

In Switzerland, electricity marking requires DSOs to purchase GOs in parallel with the Spot market. Flexibility could also be applied to this market in the future in case of seasonal marking: the use of seasonal flexibility could allow the volume of seasonal GOs to be made more flexible.

With the progressive development of NERs, electricity markets are getting closer and closer to the point of delivery with the gradual introduction of the intraday 1h, then 30 minutes and then 15 minutes market.

In 2018, the introduction of XBID facilitates intraday trading between 10 European countries (Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Latvia, Lithuania, the Netherlands, Norway, Portugal, Spain and Sweden).

Switzerland is then progressively excluded from intraday trading with Europe and will experience an erosion of traded volumes between 2017 and 2021 on all markets.

The increased coupling of European markets (XBID, PICASSO, etc.) and the exclusion of Switzerland from these mechanisms reduce cross-border trading opportunities. In 2021, following the introduction of the Local Implementation Project and Single Intraday Coupling in Italy, implied intraday auctions between Switzerland and Italy can no longer be carried out.

4.2 Market and product

4.2.1 Market entry and market platform

EU's regulation on market entry and market platform

EU Directive 2019/944 states that the regulations should ensure no undue barriers to new market entry, operation and exit[50]. This applies to the internal market for electricity and also should apply to local flexibility market design. Especially, the Member States should facilitate access to the network for new generation capacity, energy storage facilities, and demand response through aggregation. Any financial compensation payments should not create a barrier to market entry either[51].

There are no regulations on market platforms for local flexibility market at EU level. Referring to the balancing market, the platforms for the exchange of product and service should apply a model with merit order lists in order to ensure cost-efficient activation of bids[52]. The market platform should be based on the principle of non-discrimination and ensuring equitable treatment of all participants.

Sweden's regulation on market entry and market platform

According to the Swedish Electricity Act, DSOs are not allowed to set technical requirements that make it difficult for consumers or other actors to provide flexibility services or in any other way hinder their participation. However, they are allowed to set requirements to ensure a safe, reliable, and efficient operation of the electricity network. This rule should be considered to apply to local flexibility market as well.

There are no regulations on trading platforms in Sweden. In some pilots, independent marketplaces such as NODES are used to enable flexibility trading. A range of different options exist as long as they satisfy the IT/communication requirements to enable easy access to data, market information, and be secure. This means a single platform or multiple interoperable platforms [32].

[50] EU Directive 2019/944 Article 3 and Article 17.

[51] EU Directive 2019/944 Article 17-4.

[52] EU Regulation 2017/2195.

Bulgaria's regulation on market entry and market platform

Relevant information for market entry is one of the aims Bulgaria has set in its 'Integrated Plan in the Area of Energy and Climate of The Republic of Bulgaria 2021-2030' [27] in regards to eliminating regulatory and trade barriers to consumers. Thus, allowing them to use, store and sell on the market the electricity produced by them and to participate in the market by providing system flexibility through energy storage and optimised consumption.

In addition, in the same plan, Bulgaria focuses on increasing flexibility in the electricity system by envisioning and starting dialogues through which to start creating appropriate conditions, through legislative measures, for the establishment of active consumers, aggregators or energy communities, as well as their active participation for the optimization of consumption of different market segments.

Most of this has not yet been implemented in the current legislation, but based on the natural path of development, we can assume that when changes are made, they will most probably be similar to the ones in Sweden.

IBEX is a designated and licensed market operator, which aims to provide multiple electricity trading platforms based on the needs of the market. Since legislation changes from 2018, all produced energy for the free market is traded on its platforms.

Other energy platforms have also started emerging on the Bulgarian market as well as collaborations with international partners/platforms have also been happening.

Legislation exactly targeted at energy market platforms in Bulgaria is not available at this point.

Turkey's regulation on market entry and market platform

As stated in Article 17 of the Electricity Market Law[53], the distribution tariffs to be prepared by the DSOs include the prices, provisions and conditions regarding the services to be applied to all real and legal persons benefiting from the transmission of electricity through the distribution system, without discrimination between equal parties. Distribution tariffs consist of the costs that will cover all costs and services within the scope of the execution of the distribution activity, such as distribution system investment expenditures, system operating costs, technical and non-technical loss costs, disconnection-connection service costs, meter reading costs and reactive energy cost. The target rates for technical and non-technical losses to be taken as a basis for the tariffs of distribution companies are determined by the Board in a way that encourages reducing these losses. The costs related to technical and non-technical losses are included in the distribution tariffs and are reflected to the consumers, provided that they do not exceed the target rates determined by the Board. The procedures and principles regarding the determination and change of the target rates for technical and non-technical losses, including the costs to be incurred in the tariffs and their reflection to the consumers are regulated by the Board. Here, the Board refers to the EMRA.

[53] Electricity Market Law. Official Journal of the Republic of Turkey (No: 28603/6446) Article 17 Sub-Article ç. March 2013.

As it can be seen from the existing Articles of the regulation, the distribution tariffs are not including any expression related to flexibility market mechanisms or participant of them, and this is a gap for DSO's participation to the local flexibility market.

The Istanbul Energy Exchange (EXIST, EPİAŞ in Turkish) is the market operator responsible for operating the day ahead, intraday and balancing markets in the country and manages the eligible consumers in the spot markets. In addition, it provides a comprehensive set of real time data for the electricity and natural gas markets with the EPİAŞ Transparency Platform [33]. Transparency Platform is designed as a platform where the data of the electricity and natural gas markets can be seen by all the participants at the same time and the players operating in the market will reach the information on an equal basis.

Transparency Platform provides necessary data for the transparent, reliable, fair and predictable operation of energy markets; 6282-4 decision of the Energy Market Regulatory Board dated 13/05/2016; it is obliged to publish the 'Procedures and Principles for Ensuring Transparency in Organized Wholesale Electricity Markets'[54]. This decision, which forms the basis of the transparency platform and includes the data set to be published on the Transparency Platform, entered into force by published in the Official Gazette dated 28 May 2016 and numbered 29725, and was lastly updated with the Board Decision no. 10711 dated 06.01.2022.

Even it is a fact that the Transparency Platform will be useful for local flexible market services, there is no dataset or application related to the flexibility of market on this platform. However, this platform can be updated with necessary specifications to provide demand side access to the local flexibility market.

Switzerland's regulation on market entry and market platform

Due to the current regulated market for the small consumers, it is complicated to create new local electricity markets. Currently, different projects are still in development and is often based on the current Swiss legislation for self-consumption communities. We can mention the Quartierstorm project where a local electricity market was built in the pilot region of Walenstadt, allowing the 37 participating households to buy and sell locally produced solar electricity in their neighborhood.

4.2.2 Product characteristics

EU's regulation on product characteristics

There are certain characteristics to be considered for flexibility products and services, to ensure uniform conditions for the trading on local flexibility markets. Such characteristics are for example, product prequalification, product standardization, and product baseline. In general, there are no regulations on those product characteristics. In order to tackle this theme, we reference similar EU regulations on wholesale market including balancing market.

[54] Procedures and Principles for Ensuring Transparency in Organized Wholesale Electricity Markets (No: 29725/6282-4) Article 3 Sub-Article 1. May 2016.

Product prequalification process

According to EU regulations, 'prequalification process' means the process to verify the compliance of a provider of balancing capacity with the requirements set by the TSOs[55] [56]. In the context of local flexibility market, the requirements in a prequalification process shall be set by a DSO. The main goal of the product prequalification process is to ensure the flexibility providers could provide the flexibility products and services and guarantee the operational security. In terms of flexibility products and services, EU Directive 2019/944 regulates that the procurement should follow transparent, non-discriminatory and market-based procedures. The DSOs should establish the product specifications for the flexibility procured and standardised market products for such services at least at national level[57]. The specifications shall also ensure the effective and non-discriminatory participation of all market participants. DSOs shall exchange all necessary information and shall coordinate with TSOs to ensure the optimal utilisation of resources. This is in line with the product prequalification on balancing markets, day-ahead and intraday markets [58]. EU Regulation 2016/631 sets the detailed technical requirements on operational notification procedure for new power-generating modules to connect to system operators[59]. Similar regulations could be found in EU Regulation 2017/1485 on the balancing products, such as FCR prequalification process, FRR prequalification process, RR prequalification process[60]. However, there are no regulations on the product prequalification of flexibility products. Similar technical prequalification requirements shall be established to allow a minimum level of standardization.

There are some issues to be considered when designing the product prequalification process. Firstly, the product prequalification process should be user-friendly, streamlined and efficient. Secondly, the product prequalification process should be aligned per product and be aligned among different DSOs (in the case that several DSOs need to buy the same product).

Product standardization

The flexibility products serve the DSOs with grid capacity management, congestion management, and voltage control. Flexibility products must comply with the different needs from different DSOs, such as aforementioned resolving voltage deviations, relieving congestions, and deferral of grid investments. Each use case of flexibility requires the flexibility products to have certain technical characteristics [1]. But they should be sufficiently aligned and interoperable to allow efficient market-based allocation of flexibility services.

According to EU Regulation 2017/2195, it is necessary to regulate the standardization of balancing products, to allow an exchange of balancing services, the creation of common merit order lists and adequate liquidity[61]. In the context of local flexibility market, it is reasonable to set a similar minimum set of standard characteristics and additional characteristics defining standard products. EU Regulation

[55] EU Regulation 2019/943 Article 2(18).
[56] EU Regulation 2017/1485 (146).
[57] EU Directive 2019/944 Article 32-2.
[58] EU Regulation Article 6 and Article 7.
[59] EU Regulation 2016/631 from Article 29 to Article 37.
[60] EU Regulation 2017/1485 Article 155, 159, and 162.
[61] EU Regulation 2017/2195 (13).

2017/2195 sets a list of 'characteristics for standard product bid'[62] and a list of 'variable characteristics of a standard product to be determined by the balancing service providers during the prequalification or when submitting the standard product bid'[63]. Referring to this, some characteristics of a standard product bid could be, for example:

- preparation period,
- ramping period,
- full activation time,
- minimum and maximum quantity,
- deactivation period,
- minimum and maximum duration of delivery period, validity period, and
- mode of activation.

Some variable characteristics of a standard product could be, for example,

- price of the bid,
- divisibility,
- location, and
- minimum duration between the end of deactivation period and the following activation.

They could serve as a reference point for the definition of a common list of flexibility products to make them interoperable. These are common and non-exhaustive standardization requirements where the future flexibility products could choose from. Such requirements should be specified at the national level.

ENTSO-E and DSO Association also emphasises that the final choice of how to design the flexibility product should be left to Member States and their national regulators so that they can take into account the local circumstances inherent in local services, such as intra-regional redispatch [32]. So, DSOs should have dialogues with stakeholders to take local needs and specificity into consideration but avoiding too numerous and diverse products. That is, the standardization requirements should keep flexibility products open to innovation, dynamic development, and future evolution.

Product baseline

According to EU Regulation 2019/943, for demand response aggregators, the allocated volume consists of the volume of energy physically activated by the participating customers' load, based on a defined measurement and baseline methodology[64]. The purpose of the baseline is to serve as a reference point to calculate the delivered flexibility. The amount of delivered flexibility is the difference between the measurements of meter reading at the connection point and the baseline. For the former, it is required to measure the real-time usage of the flexible resource, which distinguishes itself from the rest of an end-user's load. For the latter, a mathematical model or an estimate of how much electricity would have been used in the absence of an aggregator's action.

[62] EU Regulation 2017/2195 Article 25-4.
[63] EU Regulation 2017/2195 Article 25-5.
[64] EU Regulation 2019/943 (15).

ENTSO-E and DSO Association suggested baseline principles should be defined by EU and accepted by Member States. The methodologies to determine baselines can be various among countries, regions, and types of flexibility provisions, but a certain degree of standardization or uniformity is required. Meanwhile, the methodologies should be accurate, simple, transparent, unbiased, and without gaming options [32]. A lack of baselining methodology is a barrier for market access.

Sweden's regulation on product characteristics

According to SvK, before a unit or group are accepted to participate in any market, it must perform the so-called prequalification test with approved results. The test ensures that the unit or group meets the requirements and rules of the market in which it is to participate [34].

The problem with using a baseline is that it is only an estimation of the consumption. Energy consumption is dependent on many variables such as behaviour and weather. The use of a baseline thus entails an inherent complexity and uncertainty. These problems will affect the validation process which is a key feature in the financial settlement between the aggregator's BRP and the supplier's BRP. The EU has drawn attention to this problem and proposes that the commission should establish rules for the development of the baseline as well as the validation process and measurements requirements. However, such regulation does not exist today in Sweden

Today there are no regulations from either EU or Sweden regarding these baselines which creates a lack of uniformity that is a cause for confusion. The baseline will, depending on the market and balance responsibility model, sometimes be used for verification of flexibility. The measurements from the outlet by the network operator will only observe the total consumption behind that outlet, for example the consumption of a single-family house. This is not a significant problem for high consumption assets such as those belonging to an industry since turning off those assets will show a significant deviation compared to the baseline. However, this is a problem for smaller consumers with low consumption assets such as heat pumps and electric vehicles. In those cases, the reduced consumption may disappear due to 'noise' from increased consumption elsewhere within the customers' perimeter. For example, an aggregator turning off an electric vehicle may be counteracted by the customer turning on an oven that is not included in the baseline. This is therefore a problem for network operators as well as aggregators since the verification process is used to determine the flexibility activated and the revenue that should be paid to the aggregators. However, this is also an area where more deliberation and probably also practical experience from pilots would be valuable before a direction is chosen. It can be very difficult to set a meaningful baseline to begin with, and the heterogeneity of different flexible assets adds to the challenge. Hence, if standardised methodologies should be implemented on a wide scale, they should be thoroughly tested and analysed first.

There is thus a 'baseline problem' which refers to the difficulty of know what would have happened in the absence of activation. Yet, flexibility trading that goes by volume, where market actors bid for regulation up or down, depends on such a baseline. In addition, flexibility providers could also be incentivised to manipulate their baselines. Even if they do not, buyers may suspect it of them. This could cause a need for extensive procedures and oversight that could increase transaction costs. When the flexibility product is up- or downregulation and a baseline is required, there may be no perfect or even good solution to the baseline problem.

However, some researchers find that relying on baselines is not compatible with the active participation of DERs in local flexibility markets and other electricity markets. Because the lack of transparency and simplicity may lead to manipulation and inefficient use of available resources. They also propose the use of capacity limitations services to replace baseline method [35].

Bulgaria's regulation on product characteristics

Bulgaria's policy in regard to innovations (products and services) is aimed at creating incentives and supporting the introduction of new technologies so that to achieve an overall reduction in energy costs, enable the transition to lower and more sustainable consumption of energy as well as to implement new standards for energy efficiency. The project which elaborates more on this is the Innovation Strategy for Smart specialization of the Republic of Bulgaria 2021-2027 [36] (successor of a project with the same name that was active between 2014-2020).

Some of the highlights and targets according to this project and its documentation for the new active period, are mainly connected to the European Green Deal, transformation and digitalization of energy systems as well as Industry 4.0, all of which one way or another develop products in line with local flexibility markets.

As of now, no relevant legislation on baseline can be found.

Turkey's regulation on product characteristics

There is not a current regulation that defines the specifics of products in Turkey. However, suggestions were made regarding the issue in the Unlocking Demand Side Response in Turkey report [37]. To reassure investors that they will have the opportunity to reap the initial return on business and equipment costs, growing a reliable and dynamic demand-side participation market requires regular auctions to be announced in advance, and product and acceptance criteria to be known in advance.

To engage demand-side engagement customers and make it easier for independent demand collectors, platforms and products:

- It must not involve forms of direct discrimination, such as limiting the contribution of certain technologies or allocating contracts of different duration to different technologies without objective justification.
- It must not include indirect forms of discrimination such as designing tender works, auctions and capacity products in a production-oriented manner by nature.

The Action 10 in the National Energy Efficiency Action Plan 2017-2023 [38] has been defined the Establishment of Market Infrastructure for Demand Side Response Application. With this action, it is aimed to bringing together consumers with flexible loads (aggregation) for the implementation of the demand side participation mechanism and to gain mobility in the balancing power market. Institutional infrastructure will be established by making necessary arrangements for the implementation of the demand participation mechanism.

For this purpose, activities to be conducted have been defined as given below.

- The legal status and license qualification of the organisation that will do the aggregation will be determined.

- A flexible consumption portfolio will be created by selecting industrial consumers with a large-scale flexible consumption structure (for example, cement, iron-steel, etc.).
- Evaluations will be made for the inclusion of other consumers, including residences, in the application. By supporting smart meter deployment and pilot applications in this area, demo areas will be created within the scope of micro-grid, smart city and smart grid.

However, the details of the actions are not given in this plan. So, it can be said that the details of the product baseline have not been determined yet. But there are suggestions related the product baseline in the Unlocking Demand-Side Response in Turkey [37] which is given below.

- As a basic standard, all consumers should have the right (at their own expense) to switch to a smart meter with at least hourly resolution and access to a reliable and fast communication system to record and support demand-side engagement activities. It is foreseen that higher resolution will be needed for Ancillary Service Providers (ASPs) such as intermittent load program (like 15 minutes).
- Customers should have the right to request a flexibility assessment from their suppliers or an independent claims aggregator that includes another method of estimating demand-side participation savings based on certain tariff and usage assumptions.
- In order to ensure the visibility and controllability of distributed energy sources, first of all, smart inverters should be popularised and in addition, smart meters should be adopted rapidly.
- In order to support timely implementation, the regulatory framework and responsible parties for smart metering infrastructure installation should be determined and an incentive mechanism should be prepared to accelerate the development of business models to create the necessary installation capacity.
- In order to ensure decentralised energy resources access to markets, it is particularly important to involve demand-side participation, DERs and consumer group stakeholders in the policy development process and to listen to their concerns.
- Independent aggregators take a profit margin for themselves and offer the created value to the customer. Therefore, healthy competition in the independent demand aggregator market is important to ensure that demand-side participation customers get the most beneficial option for their flexibility.

All these recommendations should be considered in order to create a reliable and transparent flexible market structure that provides optimum benefit for all market participants.

Switzerland's regulation on product characteristics

At the moment, only products for ancillary services are well defined. Ancillary services ensure a continuous balance between consumption and production. Swissgrid has the legally prescribed task of procuring ancillary services using market-based processes. Power reserves for balancing the grid are held on various markets subject to voluntary auctions. The market is divided into the primary reserve PRL, which is common to Switzerland and several European countries, the secondary reserve and the tertiary reserve, which are managed at national level.

4.3 Infrastructure

4.3.1 Smart metering systems

EU's regulation on smart metering systems

Smart metering systems are the basis for considering time-differentiated network tariffs to better reflect the use of the network. All consumers should be able to benefit from the full deployment of smart metering systems. This could enable them to adjust their consumption according to real-time price signals and receive accurate billing information based on actual electricity consumption[65]. Smart metering systems could also benefit DSOs to have better visibility of their networks and to reduce operation and maintenance costs as a result. The cost reduction should eventually be passed to the consumers in the form of lower distribution tariffs.

Smart metering systems are in the centrum position for consumers' active participation in local flexibility markets. However, the deployment of smart metering systems is not systematically done among Member States. The deployment decisions should be made based on economic assessments with the consideration of long-term benefits to consumers and DSOs.

If the cost-benefit assessment to deploy smart metering systems has been positive, it is strongly recommended to introduce smart metering systems which are interoperable with consumer energy management systems and with smart grids**.** Similar to the functionalities of smart metering systems for electricity market, functionalities of smart metering systems for local flexibility markets should include accurate measurement of actual electricity consumption and provision to final customers of information on actual time of use[66]. All the data should be made easily and securely available and visualised to final customers on request. It should be provided at no additional costs of:

- the installation of smart metering systems[67],
- data on the electricity customers fed into the grid and their consumption data,
- retrieving their metering data or transmitting them to another party,
- validated historical consumption data,
- non-validated near real-time consumption data.

If the cost-benefit assessment to deploy smart metering systems has been negative, Member States shall ensure the final customer could request the installation bearing the associated costs[68].

In any regard, the requirements on smart metering systems should not pose any barriers for flexibility providers. It can be further regulated if 'additional/add-on device' is needed where the main meter may not fulfil the data requirements for certain flexibility products. But this should also follow the cost-**benefit** principle before installations.

[65] EU Directive 2019/944 (37) (52).
[66] EU Directive 2019/944 Article 20.
[67] EU Directive 2019/944 Article 5-7(f), Article 19.
[68] EU Directive 2019/944 Article 21.

Sweden's regulation on smart metering systems

If the customer has a fuse contract exceeding 63 ampere, hourly metering shall be applied. Customers with a fuse contract of no more than 63 ampere may be metered by the hour or by the month. Since 2012, network companies have been obliged to apply hourly metering without extra charge, if the customer's electricity contract so requires. This reform means that all customers have the opportunity to choose an electricity retail contract with a variable electricity price based on the applicable spot price per hour. If a customer does not have an electricity contract that requires hourly metering, but still wishes to have an hourly meter installed, the customer him-/herself must pay the extra cost. A change to this legislation is currently planned, however, meaning that all customers will be entitled to hourly measurement without extra cost.

On behalf of the Government, Ei has developed a proposal for functional requirements for smart electricity meters, where the following requirements are of particular relevance for stimulating demand side flexibility [39]:

- The network companies shall ensure that the customer gets continuous access free of charge to meter values and voltage values. The meter shall be equipped with an open, standardised interface and deliver near-real time values for power, meter reading, voltage and, as applicable, production. The customer shall have access to these values.
- The meter system shall register meter values at 60-minute intervals and shall be possible to adjust to a 15-minute interval.
- It shall be possible to read all registered data remotely.

As of 2021, the electricity meters at the outlets are required to have a time resolution of 60 minutes. The Swedish government has approved the regulations proposed by Ei that will require electricity meters to have a time resolution of 15 minutes for registering data as well as the possibility of real time display of consumption within a few seconds. These requirements will be enforced on the 1st of January 2025[40]. Local flexibility markets such as SthlmFlex have a time-resolution requirement of 60 minutes. Therefore, the aggregator does not need an additional meter since it can utilise the meter at the outlet. However, other markets have different requirements in terms of real-time sampling rate. For example, mFRR has a requirement of a 36 second sampling rate [41]. To participate on mFRR today, the aggregator is therefore required to add an additional meter to the technology that can provide this sampling rate. This additional meter will have to abide by the time resolution of the existing meter belonging to the network operator in addition to the requirements set by the specific market [10].

A particular problem is the fact that many customers living in multi-occupancy buildings do not always have access to their meters, which may be located in a separate locked space. If developments show that access to the electricity meter is an obstacle for the development of the market for energy services, or for customers taking action by themselves to reduce their electricity use, for example, there may be a need for new legislation to regulate access to electricity meters [42].

This is case in terms of metering is collective metering, which means that a property owner has an overall agreement with a network company and an electricity retailer that also includes tenants' consumption. Collective metering is used in circumstances such as development of property-wide micro-production of renewable electricity. Collective metering is usually combined with subsidiary metering, so that customers can be charged for their actual consumption, but this is not a mandatory requirement.

If customers can see their consumption at the same time as it occurs, in real time, customers will have even better knowledge of their electricity use and how different activities in the home impact it. For this reason, it is proposed that the future functional requirements for electricity meters shall include a requirement for a standardised interface, from which real time data can be delivered.

Bulgaria's regulation on smart metering systems

In accordance with the National Implementation Plan, currently it is being considered (it would be decided based on Cost-Benefit Analysis) whether smart meter or also called intelligent metering devices, should be installed to all customers without costs or charges for them or at the very least to be able to do so on demand based on a customer's request.

This would enable them to be able to easily participate on flexibility markets be it alone or as part of an aggregator's group. In addition, this way customers will have more information about their own consumption and thus make more informative decisions on who their energy supplier should be or whether and how they can take part in flexibility markets.

It is important to mention that the Third Energy Package (2019), the Clean Energy Package (2019) as well as the Electricity Directive (2019/944), greatly elaborate on the need to give consumers the right to be able to request the installation of smart meters as part of their active participation in the digitalisation of the energy system.

Most probably, such Cost-Benefit analysis will be done once the whole energy market in Bulgaria has been liberalised as there are more present-day market failures that need to be addressed beforehand. However, in the National Implementation Plan, Bulgaria does promise that at some point it will try to ensure that all consumers at regulated prices* will be able to have smart measuring devices installed free of charge as well as that they'll be directly informed about this possibility as well as that they'll be provided with the appropriate assistance.

*It is in a way indicated and assumed that consumers at regulated prices will probably be energy poor or vulnerable customer (a term which is yet to be defined in the legislation).

Turkey's regulation on smart metering systems

Smart meter systems are the most important of the technologies required for demand-side participation and these systems are a prerequisite for demand-side integration into electricity markets. Some of the key issues that affect smart meter systems in Turkey have been determined by laws and regulations. With the Electricity Market Law, ownership of the meters has been given to distribution companies as of the end of 2013[69]. The legal entities holding the distribution license are responsible for the meter supply and installation.

In the Electricity Distribution Services Association (ELDER) report [43] it is mentioned that only 3% of consumers have access to smart meter systems in Turkey. In the same report, ELDER stated that it is aimed to integrate into smart meter systems 80% of the electricity consumed in distribution by 2025, and 80% of the customers connected to the distribution system by 2035.

[69] Electricity Market Law. Official Journal of the Republic of Turkey (No: 28603/6446) Article 51. March 2013.

Regulations that cover financial issues related to meters have been enacted by authorities in Turkey. As stated in Article 51 of Chapter 8 of the Electricity Market Consumer Services Regulation[70], in case the meter malfunctions or the measurement accuracy is suspected, the control of the meter may be requested by the relevant legal entity or the consumer. This request is met by the legal entity holding the distribution license. If it is determined that the meter records the correct consumption, the meter control fee is paid by the requester. Apart from this, no charge can be demanded from the consumer regarding the meter replacement and other transactions to be made and all costs are paid by the relevant distribution company.

Despite the dissemination efforts of authorities and enacted regulations regarding smart meters, there are existing barriers to the widespread use of smart meters. The first of these barriers is cost-benefit analysis. The costs of smart meters can be measured quite precisely, but measuring their benefits is quite complex. Difficult to measure the benefits of smart meters may cause cost-benefit analyses to reflect the reality in a limited way. Measuring benefits less than actual benefits can cause costs to appear relatively high. Another economic barrier is the allocation of costs. For example, in a situation where DSOs bear all the costs of installing smart meter systems on the grid, the total electricity savings in the grid may increase, but consumers will benefit most from this situation. Attributing the investment costs to a single stakeholder may prevent the grid integration of smart meter systems.

Standardisation is one of the technical barriers to the grid integration of smart meters. In general, smart meters supplied from different manufacturers in the market are not designed to work with each other. If certain standards are not developed for smart meter systems, the benefits of smart meter integration of the grid will be decreased considerably.

Another barrier to the grid integration of smart meters is consumers' concerns about meter usage. Consumers are concerned that the security and confidentiality of the data collected with smart meters cannot be guaranteed and therefore unauthorised parties may access the relevant data. Also, consumers think that the various tariffs and initial investment costs to be applied with the installation of smart meters will increase their electricity costs.

There are also gaps and barriers caused by the legislation. Regulations to be made in the legislation will affect the costs and benefits of the grid integration of smart meters. Firstly, the necessary legal and legislative arrangements have not been implemented and this will cause gap for the local flexibility market. Secondly, as a barrier, the incomplete/insufficient existing laws and regulations may cause the grid integration of smart meters may be delayed/prevented and the benefits may be less than expected.

The SHURA Energy Efficiency Solution: Business Models report [19] includes several policy recommendations for the development of smart meters. These are given below.

- Smart meters can be made mandatory for public institutions and the electricity consumption limit required for smart meter installation can be reduced.
- Since the connections of smart meters providing communication with GSM/GPRS technologies can be interrupted as a result of the change of communication frequencies reallocated between

[70] Electricity Market Consumer Services Regulation. Official Journal of the Republic of Turkey (No: 30436) Article 51. May 2018.

companies with new tenders, a separate fixed communication network can be established for the communication of smart meters.

- It is recommended that DSOs operating distribution systems whose bidirectional energy flow has increased due to distributed generation resources should take a joint role with TEİAŞ in regional constraint management in order to use existing and to be installed smart meters more efficiently. Also, it is recommended that DSOs can reflect the constraint management costs on the bill.
- It is recommended to analyse the current status of smart meters and determine the minimum technical and functional requirements. The maintenance and control of the smart meter can be done by establishing two-way communication between the smart meter system and external connections. It is recommended to allow remote current and power control. It is recommended to define standards for privacy and data analytics issues.

Lastly, in the Sector Coupling for Grid Integration of Wind and Solar report of SHURA [44] some suggestions have been made for standards of smart meters. According to the report:

- As a baseline, all consumers should have the right to adopt a smart meter (at their own cost) with at least hourly resolution, and a reliable, rapid communication system, to record and reward DSR actions.
- Higher resolution (such as 15 minutes) will be necessary for those providing ancillary services.

Switzerland's regulation on smart metering systems

Smart metering systems installed at end consumers, production plants and storage facilities must be used for metering systems and information processes (OApEL Art. 8a37). These systems shall comprise the following elements:

a. an electronic electricity meter installed at the final consumer, storage agent or generating facility, which records active and reactive energy, calculates load curves with a measurement period of 15 minutes and records them for at least 60 days, has interfaces, in particular one for bidirectional communication with a data processing system and another allowing the end consumer, generator or storage operator concerned at least to consult its measurement data at the time of entry and, where applicable, the 15-minute load curve values, in a common international data format, and calculates load curves with a measurement period of 15 minutes and records them for at least 60 days, has interfaces, in particular one for bidirectional communication with a data processing machine and another that allows the end consumer, generator or storage operator concerned at least to view its measurement data at the time of entry and, where applicable, the 15-minute load curve values, in a common international data format, and records and logs interruptions to the electricity supply;

b. a digital communication system that ensures automatic data transmission between the electricity meter and the data processing system

c. a data processing system which allows the data to be viewed

The grid system operator shall, at the request of the final consumer, producer or storage operator, provide the technical specifications of the interface of its electricity meter.

Eighty per cent of the metering installations in a service area must meet the requirements of Articles 8a and 8b (OApEL) within ten years of the amendment of 1 November 2017 coming into force (OApEL Art. 31e). The remaining 20 per cent of installations may be used as long as their proper functioning is ensured.

4.3.2 Energy storage

EU's regulation on energy storage

Energy storage within the power system covers all power-to-power solutions, including batteries, pumped hydro storage and compressed air storage. It also covers power to hydrogen when the hydrogen generated is used for re-electrification. These storage facilities should operate in the electricity market on a competitive basis within a regulatory framework. For local flexibility market, the aggregation of loads encourages wider and more efficient use of storage facilities. The right of prosumers to produce and consume their own electricity will also lead to increased demand for storage services and small-scale storage solutions. Storage owners should also benefit from participation in local flexibility markets.

However, energy storage has not yet reached its full potential in the energy markets, let alone local flexibility markets. This is because both the technologies and the regulatory framework are not widely developed. Therefore, there are no regulatory consistencies among Member States regarding energy storage. For example, in some countries, storage facilities pay grid fees both as consumers and as producers, in others only as producers, or they have other special arrangements [45].

For the regulations on local flexibility market, storage owners should be allowed to provide a variety of services to system operators, such as for DSO, under non-discriminatory conditions. Furthermore, the current regulations do not allow DSOs to own, manage, or operate energy storage facilities. In certain cases, some market actors may not be interested in providing storage services in accordance with transparent market procedures. And DSOs may be granted the right to invest in storage facilities subject to regulatory approval and oversight. The purpose for doing this is not driven by pure commercialisation but operating their network efficiently and avoiding costly network expansion. These are not proposed in any regulation frameworks. In short, new legislative proposals for local flexibility market design should support the cost-effective use of energy storage solutions.

Sweden's regulation on energy storage

Energy storage systems have the potential to play a key role in the integration of renewable energy sources into the grid. However, the Swedish Electricity Act does not specify the use of energy storage (such as batteries). As a result, there are no clear regulations on how to deal with energy storage.

Following the EU Directive 2019/944 on internal market design, Sweden proposed that grid companies would not be allowed to own, develop, manage or operate energy storage facilities.

On September 29, 2016, the Government decided on a regulation on subsidies for the storage of self-produced electrical energy, which enables private individuals to receive subsidies for the installation of systems for the storage of self-produced electrical energy. The Government then decided on 29 September 2016 a regulation on subsidies for the storage of self-produced electrical energy (ordinance 2016:899) [46] which enables private individuals to receive subsidies for the installation of systems for the storage of self-produced electrical energy. The grant is limited in time and may only be given to measures that began on January 1, 2016, at the earliest and were completed by June 30, 2021, at the latest. The requirements placed on the system to which the grant must be able to go are that it must be

connected to a facility for self-production of renewable electricity that is connected to the electricity grid. It should contribute to storing electrical energy for use at a time other than the time of production, and to increasing the annual percentage of self-produced electrical energy that is used within the property to meet its own electricity needs. The grants and grants may be given with a maximum of 60 percent of the eligible costs, but no more than SEK 50,000.

The future technical potential is very uncertain but is estimated to increase with control of the charging of electric cars and the growth of data centres in Sweden, which often have a lot of spare capacity. In addition, increased use of energy storage by the various customer segments will also create greater demand flexibility potential.

Bulgaria's regulation on energy storage

For the purposes of adding more flexibility to the energy system in Bulgaria, the current legislation has been focusing on using energy storage as one such way.

In the 'Integrated Plan in the Area of Energy and Climate of The Republic of Bulgaria 2021-2030' [27] as well as in the current Bulgarian Energy Commission discussions, the further development as well as adding of new storage capacity, are seen as one of the most effective and optimised ways of reinforcing the grid and enabling flexibility.

The work towards increasing energy storage has been continued by the National plan for recovery and resilience [47] with its latest version from 06th of April 2022. The plan introduces the so called RESTORE (National infrastructure for storage of electricity from RES) project. The aim of the project is to allow RES to actively participate in the balancing of the energy system by providing equal and non-discriminatory commercial opportunity to producers of renewable electricity to preserve the energy generated by them.

Access to energy storage will be achieved by providing access to infrastructure for different types of services such as storage of energy by third parties. The idea is that this infrastructure for 'rent', can be used under standardised commercial conditions and schedules, and thus allow renewable asset owners to store surplus energy on them and have the option to decide what to do with it afterwards. The general idea is to use this additional stored energy as a flexibility resource to aid the balancing of the system

The ideas represented in this plan have received the good reviews from the European Commission.

Turkey's regulation on energy storage

On 9 May 2021, the Regulation on Storage Activities in the Electricity Market[71] has been enacted in Turkey to specify the limits and standards related to energy storage systems. The regulations which are about the DSOs activities have been defined in Article 8. These are given below.

- On condition that DSOs prove that is more economical than the new network investment with cost-benefit analysis they can establish the electricity storage facility on a facility basis within the scope of investment plans with the approval of the Board.

[71] Regulation on Storage Activities in the Electricity Market. Official Journal of the Republic of Turkey (No: 31479) Article 8. May 2021.

- Energy storage systems that are established by DSOs cannot be used outside of distribution activities.
- TEİAŞ, which is the Transmission Operator, has permission to establish storage facilities within the scope of pilot applications and without being subject to commercial activity on the condition that provided it is included in the investment plans.

As it can be seen in this regulation, DSOs have permission to establish energy storage systems, but these systems cannot be used for profit-oriented activities. This regulation is a barrier for using energy storage systems on the local flexibility markets.

Switzerland's regulation on energy storage

Thanks to its topography and high levels of annual rainfall, Switzerland has ideal conditions for the utilization of hydropower and therefore it has a big energy storage potential. Currently, the annual electrical production is 36.5 TWh which means the 57 % percent of the annual electricity consumption. In this quantity we have 47,5 % in storage power plants and approximately 4,2% in pumped storage power plants. It exits also other storage solutions in development like the Power2 gas or the batterie storage.

Recently, in order to increase security of supply in the winter, the Federal Council and ElCom will set up a hydroelectric reserve of 500 GWh (± 30%) from the winter of 2022/2023. Swissgrid is responsible for its implementation.

4.3.3 Network expansion

EU's regulation on network expansion

According to EU Directive 2019/944, DSOs should cost-efficiently integrate new electricity generation, especially installations generating electricity from renewable sources, and new loads such as loads that result from heat pumps and electric vehicles. By using services form DERs such as demand response and energy storage, DSOs should aim at efficiently operating their networks and avoiding costly network expansions [72]. Local flexibility market could provide necessary services for DSOs to achieve these goals. In Article 32 and Article 51 of EU Directive 2019/944, it further states that the network development plan shall also include the use of demand response, energy efficiency, energy storage facilities or other resources that the DSO is to use as an alternative to system expansion[73].

Sweden's regulation on network expansion

According to Swedish Electricity Act, TSOs and DSOs are responsible for their operation and maintenance and, if necessary, the expansion of its network and, where applicable, its connection to other networks. TSOs and DSOs are also responsible for ensuring that their network systems are safe, reliable, efficient and that can also meet reasonable requirements for safe electricity transmission and distribution. The regulations are clear regarding the network companies' responsibility for network expansion and its efficient operation.

[72] EU Directive 2019/944 (61).
[73] EU Directive 2019/944 Article 32-3.

Lack of network capacity is a relatively new phenomenon in Sweden and the regulations that regulate the network companies' responsibilities have not been tested or evaluated to any great extent. According to Ei's proposal in Ei R2020: 02, all DSOs will in the future draw up grid development plans that must be submitted to Ei. If the proposal is implemented, this means that a DSO, to a greater extent than today, will be required to coordinate network expansion with other network companies and with SvK. In the future, therefore, network development at all network levels will be permeated by a larger holistic view. Network development plans can help prevent network capacity shortages.

At the same time, for Swedish regulations, the efficient system operation should be included, not only network expansion and maintenance of the network. The DSOs' network development plans must also create transparency regarding the network companies' future needs for flexibility services and demand flexibility. In the Ei R2020:02 report, Ei proposes that a rule should be included in the Swedish Electricity Act which means that the use of flexibility services to improve the efficiency of the network operation should be able to affect the revenue framework for the network company. It indicates that incentives shall be introduced in the regulatory model that steer towards solutions other than traditional network investments when these are more cost-effective in the long run. With the introduction of the proposed incentive, the use of flexibility services will benefit provided, of course, that they are more cost-effective than traditional network investments [48].

Bulgaria's regulation on network expansion

When talking about network expansion, Bulgaria's goal is both the development (expansion) of the network (energy infrastructure) as well as its modernisation.

The outline of the expected network expansions can be found in the 'The plan for the development of transmission electricity network of Bulgaria for period 2017-2026' [49] prepared by the Bulgaria TSO - ESO EAD. The plan has been prepared in accordance with the requirement set by ENTSO-E.

The plan envisions building additional capacities of TPPs and NPPs. In accordance with the directives of the European Union, it also sets a plan to maintain the pace of adding renewable sources to the energy mix of Bulgaria. In order to be able to keep the balance between consumption and production as well as to be able to handle the volatility of wind and solar power plants, their addition to the network is limited.

As the EU Directive 2019/944 has still not been transposed into the Bulgarian legislation, the network development plans for distribution systems are not introduced yet as an activity to the DSOs.

Turkey's regulation on network expansion

The responsibilities of DSOs for network expansion have been defined by Electricity Market Distribution Regulation in Turkey. This regulation has been enacted to specify procedures and principles regarding the reliable and low-cost operation and planning of the distribution system and the users connected or to be connected to the system, as defined in the Electricity Market Law dated 14/3/2013 and numbered 6446.

Articles 21 and 22 of this regulation directly identify the obligations of DSOs. According to sub-Article 1 of article 21, DSO is responsible for establishing the necessary communication infrastructure for real-time monitoring of energy flow, receiving and finalising notifications regarding the system, and planning and implementing preventive maintenance and repair services in all stages from the entry of electricity to the distribution system and transmission to consumption points in the distribution region covered by its license.

Planning principles of the DSO have been defined by sub-Article 1 of Article 22. The DSO is responsible for preparing its investment planning according to these principles. According to this sub-Article, there are six principles that can be seen below.

- Meeting the demand based on demand forecasts
- Flexibility for technological developments and demand changings
- Quality of the service
- Providing higher service quality with the lower cost
- Technical losses, leakage, and free of charge consumption rates
- Providing coordination with the investment plan of the transmission system

As mentioned in the regulation, the network expansion covers the low cost and the high-quality services. The network expansion does not cover the new network investments only, it includes improvements such as decreasing losses and leakages, increasing the quality of services, flexibility etc.

Switzerland's regulation on network expansion

In the Revision of the LApeL (project) the regulation on the network extension is set as follows:

The 'ownership' of flexibility is attributed to the prosumer (Art. 17b bis). This flexibility could be valued by various parties, including the DSO, which should contract with the prosumer if it is more efficient and effective than a network reinforcement (Art. 9b), without being able to discriminate against it (e.g., favouring its solution). The DSO has guaranteed access in certain cases and will also be able to rely on a more open tariff framework, particularly with regard to power stamps (Art. 14). Many points of uncertainty (contracts, remuneration, deadlines, conditions, etc.) will still have to be settled by the OApEl or the industry.

4.4 Contract, bidding, and settlement

4.4.1 Contract

EU's regulation on contract

There is no established regulation on the contract of local flexibility market. One of the principles is, more broadly than exclusively, the terms & conditions of different markets should be made as compatible as possible to involve flexibility service providers and help increase liquidity [32].

Another one of the principles regarding the operation of electricity markets is that long-term hedging products shall be tradable on exchanges in a transparent manner and long-term electricity supply contracts shall be negotiable over the counter, in order to allow market participants to be protected against price volatility risks on a market basis and mitigate uncertainty on future returns on investment[74]. This principle should be considered to apply to local flexibility market as well.

In order to ensure high level of consumer protection, the contract shall follow the transparency rule regarding contractual terms and conditions, general information and dispute settlement mechanisms. The

[74] EU Regulation 2019/943 Article 3(o).

basic rights of customers should be clearly established in the contract[75]. Conditions shall be fair and well known in advance. The customers shall not be subject to discriminatory technical and administrative requirements, procedures or charges. The aggregation contract, that a final customer wishes to conclude, does not need consent of the final customer's electricity supplier. Same as forementioned, the customers should be fully informed about the terms and conditions of the contracts[76]. There shall not be a conflict between customer's electricity supplier and independent aggregator in the contract, such as undue payments, penalties or other undue contractual restrictions[77]. In most cases, the lack of liquidity will make long-term contracts more desirable because it ensures the availability of flexibility, even if it brings the attendant risk of over-contracting and liquidity being withdrawn from the market.

The regulatory authority in Member States shall monitor the practices of contracts and the occurrence of restrictive contractual practices, including exclusivity clauses which may prevent customers from contracting simultaneously with more than one supplier or restrict their choice to do so, and, where appropriate, informing the national competition authorities of such practices[78]. When a dispute regarding the contracts happens, the regulatory authority shall act as a dispute settlement authority[79].

Sweden's regulation on contract

For DSO-related flexibility, a key challenge is that many of the potential flexibilities available to solve local problems include small-scale demand-side resources that typically require aggregation and automated solutions to reach the market. There are currently no obligations or restrictions on the pricing structure of vendor contracts. As a result, suppliers are neither obligated to offer hourly rates to their customers nor are they prohibited from doing so. The Swedish Electricity Act only describes the general rule for grid tariffs that they should be objective, non-discriminatory, and set in a manner consistent with the efficient use of the grid and the efficient production and use of electricity. Thus, suppliers can use this dynamic pricing scheme to influence customer demand and induce load shifting.

Ei followed up on the hourly tariff reform and found that about one-third of electricity retailers offering hourly tariff contracts did not actively market their hourly tariff contracts. This means that electricity customers must contact customer service to obtain information about hourly rate contracts. One reason many electric retailers do not market hourly rate contracts particularly aggressively is that simplified billing rules based on concise consumption create risk for both the electricity retailers and BRPs. To strengthen the incentive for electricity retailers to offer customers contracts that encourage changes in consumption based on spot prices, Ei has proposed to repeal the simplified settlement rules [39].

Bulgaria's regulation on contract

The only way local flexibility markets are represented in Bulgaria is through demos of European projects. There is still no legal mechanism on how they will be set up, managed or how exactly they'll operate.

[75] EU Regulation 2019/943 Article 10-3.
[76] EU Regulation 2019/943 Article 13-2.
[77] EU Regulation 2019/943 Article 17-3(e).
[78] EU Regulation 2019/943 Article 59-1(o)-(p).
[79] EU Regulation 2019/943 Article 59-5(b).

So, it could be said that contracts about local flexibility market will most probably follow the approach of European directives, which will probably be in line with what has been written in the EU paragraph part of this point.

Furthermore, there is a quite extensive legislation on the different types of contracts available on the electricity market today, so new legislation will probably use it as reference and build upon already established practices.

Turkey's regulation on contract

In the current situation, there is not any regulation for the flexible market contract. The existing scheme only includes DSR ancillary services, and these services are related to decreasing consumption. In these services, agreements have been made via tenders or bilateral agreements.

On the other hand, there are regulations about the contract of the existing market structure. Currently, the spot market in Turkey includes two submarkets that are day-ahead and intraday markets. Both of these markets are operated by EPİAŞ. In the day-ahead market, demand and supply sides offer their bids which include quantity and price hourly for the following day. After that, these bids are matched by the market operator from lowest to highest. According to that, the market clearing price (DAMP) and the traded volume are specified hourly.

When the day-ahead market close, participants may supply their needs via the intraday market. Different from the day-ahead market, the intraday market is a continuous market. So, the offers are executed immediately if there are matched bids. Due to these properties, prices are volatile in this market.

To provide transparency in the market, hourly spot prices are published on the EIXST Transparency Platform by the EPİAŞ. This platform is open to the public so every user can see the hourly prices.

Also, there is a Balancing Power Market operated by the system operator and reconciled by the market operator, used for balancing activities in cases where the supply and demand cannot be balanced due to malfunctions and/or forecast deviations at the delivery time of electricity.

Even though there is no regulation in the current situation, suggestions have been made by researchers related to the flexible market contract for this gap. In the Unlocking Demand Side Response in Turkey report [37], it is recommended to have no supplier vet. Thus, suppliers may be permitted to engage in flexibility services, but will not have a monopoly over their customers, who should be permitted to contract with an Independent Aggregator, without suffering any discrimination from their supplier.

Switzerland's regulation on contract

As mentioned in one of the previous points, flexibility products are only well defined at this moment for the ancillary services. Since the end of 2008, Swissgrid has been procuring ancillary services (AS) in accordance with transparent, non-discriminatory and market-based procedures. Every provider who wishes to participate in the tenders must first meet the prequalification criteria. This ensures that the provider is in a position to provide the services offered.

Providers (so-called Ancillary Service Providers, or ASPs for short) must be prequalified by Swissgrid for the following ancillary services:

- Primary control

- Secondary control
- Tertiary control
- Extra-mandatory voltage support

4.4.2 Bidding, billing, and settlement

EU's regulation on bidding, billing, and settlement

As mentioned above, the flexibility products include products of grid capacity management, congestion management, and voltage control. The regulation analysis of bidding is also made above as part of the product attributes. In addition, the following potential attributes of bid offers of flexibility products are proposed during biddings, and the corresponding concurrent regulations are reviewed [32]:

- Validity period. This refers to the period when the bid offered by the flexibility service provider can be activated, where all the characteristics of the product are respected. The validity period is defined by a start time and an end time. There is lack of definition for flexibility product other than balancing in EU Regulation 2017/2195[80]. It is proposed to build new definitions in new network code for flexibility products or extend the regulations on balancing products in EU Regulation 2017/2195 to all flexibility products as well as the definition of 'standard product' to include them.
- Recovery time. This refers to the minimum duration between the end of deactivation period and the following activation. It is not explicitly defined but there is a reference in EU Regulation 2017/2195[81] as part of the list of variable characteristics of a standard balancing product bid. However, it does not need regulation intervention, which means no specific features for which an explicit definition is needed.
- Minimum and maximum quantity. This refers to the minimum and maximum quantity of a bid traded on the market, and it may be capacity or energy based depending on the nature of the product. It is not explicitly defined but there is a reference in EU Regulation 2017/2195[82] as part of the list of variable characteristics of a standard balancing product bid. However, it does not need regulation intervention, which means no specific features for which an explicit definition is needed.
- Direction of activation. This refers to if the unit is activated in one direction or another (up/down). It is not explicitly defined but there are many references in EU Regulation 2017/2195 and 2019/943[83]. However, it does not need regulation intervention, which means no specific features for which an explicit definition is needed.
- Divisibility. This refers to the possibility for a DSO to use only part of the bids, either in terms of power activation or time duration. There is a lack of definition for flexibility products other than balancing. There are some reference points from balancing products in EU Regulation 2017/2195[84] and it is also one of the characteristics for standards product in EU Regulation

[80] EU Regulation 2017/2195 Article 25-4(g).
[81] EU Regulation 2017/2195 Article 2-5(d).
[82] EU Regulation 2017/2195 Article 25-4(d).
[83] EU Regulation 2019/943 Article 2(16).
[84] EU Regulation 2017/2195 Article 2(35).

2017/2195[85]. It is proposed to build new definitions in new network code for flexibility products or extend the regulations on balancing products in EU Regulation 2017/2195 to all flexibility products as well as the definition of 'standard product' to include them.

- Ramping period. This is part of the characteristics for standards product in EU Regulation 2017/2195[86]. It is proposed that no specific features for which an explicit definition is required.

During the contracting and bidding process, the DSO, BRP, aggregators and local flexibility market operator communicate with each other to reach the agreement on flexibility trading price and quantity of flexibility. DSOs decide if and where there is congestion or voltage violation problems and thereby send requests of flexibility provision to the local flexibility market operator. Meanwhile, BRPs receive the portfolio forecasts and estimate the future imbalances and send requests of flexibility provision if needed. Based on all requests, the local flexibility market operator will send an announcement to the aggregators, where the aggregators accumulate the flexibility offers from their prosumers to offer flexibility bids.

After the bidding process, DSOs and BRPs would activate their procured flexibility products and services, through sending requests of activation to the market operator. The request signals would be passed to aggregators and then the prosumers. The flexibility products and services will be provided by scheduling and controlling the loads.

After the activation process, the transactions are made through settlement platforms among all market actors [50].

Sweden's regulation on bidding, billing and settlement

EU Regulation 2019/943 requires that wholesale tariffs have neither a cap nor a floor, apply to bids and clearings over all time horizons, and should include both balancing energy and imbalance prices. The nominated electricity market operator (NEMO) may apply harmonised limits on maximum and minimum clearing prices for day-ahead and intraday timeframes. Those limits shall be sufficiently high so as not to unnecessarily restrict trade[87]. Strict requirements on the number of bids and bid periods limit the possibility for aggregators to participate. Such market entry barriers for aggregators should be reduced.

Another barrier is the high minimum bid size for participation in different markets. However, over time, technological changes may alleviate the minimum bid size issue.

Bulgaria's regulation on bidding, billing and settlement

As stated in the previous point of this chapter, there is still no local flexibility market mechanism in Bulgaria thus bidding in the context of local flexibility market has still not been regulated. Most probably, when regulations start appearing, they will be in line with what is going on in EU, and for example, in Sweden.

When it comes to billing, there is yet a solution to be found. Most probably, regulations will be based on the demos carried out in Bulgaria and proven to have a successful business model or based on other

[85] EU Regulation 2017/2195 Article 25-5(b)
[86] EU Regulation 2017/2195 Article 25-4(b).
[87] EU Regulation 2019/943 Article 10.

European successfully implemented legislations. Based on that, for example taking FlexiGrid's demos, the billing process will be handled through:

a) Blockchain (transaction recorded in a ledger and accepted as a form of a recognised expense/income = invoice): which will require some Fintech regulations before it can be implemented
b) Market operator: having a market operator that handles the billing process
c) Automated or manual billing process for DSO and FSPs (or other players) participating on the flexibility market
d) Deduction from current bills, which would need some automation in DSOs (probably direct connection to flexibility market platform)

Similar to billing, as there still isn't a local flexibility market, there are still no regulations in regard to market clearing. The most obvious option would be that it is done automatically based on pre-defined conditions such as price, location and/or size of flexibility service.

Turkey's regulation on bidding, billing and settlement

There is no regulation related to the bidding of flexible services since there is not any legislation in the current market structure. However, in the Energy Efficiency Solution: Business Models report published by SHURA, it is suggested the aggregator portfolios may be organised by both supply companies and independent aggregators. Demand Side Participation of both parties will increase the efficiency of flexibility services and increase the solutions to end-users. However, it is critical to clarify the relationship between independent aggregators and other market participants for providing the demand side participation and integration of independent aggregators to the market.

Today, there is not a market concept that covers flexible market services clearly. However, natural or legal persons who can produce electrical energy in the type of activity regulated by the Regulation on Unlicensed Electricity Generation have been enabled to produce electricity without obtaining a license and establishing a company. This regulation has been enacted on 12/05/2019 and provides selling electrical energy to the grid for consumers.

Unlicensed electricity generation facilities based on renewable energy sources can be established by residential, industrial, commercial and lighting subscribers, with production and consumption at the same measurement point, without exceeding the power in the connection agreement (maximum power 10 kW for residential subscribers) and without equipping a distribution facility. Except for public institutions and organisations, solar energy-based production facilities can only be established as roof and wall-mounted applications.

Public institutions and organisations may establish unlicensed generation facilities based on renewable energy resources up to 5 MW on roofs, facades and lands, at the same measurement point as consumption facilities, provided that they do not exceed the power in the connection agreement.

The surplus electricity supplied to the grid by unlicensed suppliers based on all renewable energy sources is purchased by the related supply company for 10 years according to the monochromic active energy retail prices independently from the source type. The period is calculated from the date when the relevant generation facility starts to energise the grid and the amount of electricity is determined by using the net metering method.

Also, it is mentioned in the same regulation that, distribution and assigned supply companies; direct and indirect partners of them, legal entities under their control, persons employed in direct and indirect partnerships of these legal entities, and legal entities under their control, in the distribution region of the relevant distribution company and in the distribution region where the relevant distribution company is a shareholder cannot apply wind and solar energy-based generation within the scope of this Regulation.

Since the Regulation on Unlicensed Electricity Generation [51] provides for some small end-users to participate in the market, the regulation rules are very restricted. It is clear that a competitive flexible market structure cannot be provided with that kind of regulation. Also, the billing system of this regulation is another barrier to providing a competitive market for flexibility services.

The Unlocking Demand Side Response in Turkey [37] which is published by SHURA includes suggestions related to billing methods. According to that, after reaching a certain level of distributed generation, it is important that net metering implementation is replaced with other remuneration approaches, such as net-billing or buy-all sell-all, where the real costs of the system will be reflected on the prosumers. This will incentivise load shedding and load shifting together with the use of behind-the-meter battery storage for consumers. In the net-billing method, surplus electricity production is sold to the grid at a different rate (real-time) than the retail tariff price. However, in the buy-all sell-all method the customer agrees to all electricity generated by their PV system to the utility at a set rate and to continue to buy all of the electricity they will consume from the utility.

As mentioned in the previous Sections of this report, there are several sub-markets in Turkey for providing the market-clearing by operators. Firstly, the supply and demand balance are provided via the Day Ahead Market a day before by Market Operator. The hourly prices of the following day are determined in this way. If additional needs occurred on the following day, participants may offer new bids via the intraday market. These two markets are sub-markets of the Spot Markets.

Unfortunately, despite the Spot Market services supply and demand imbalances may be occurred due to malfunctions and/or forecast deviations at the delivery time of electricity. The Balancing Power Market is operated by the System Operator to meet these imbalances. Real-time balancing services are provided within 15 minutes via the Balancing Power Market. In addition, there is Ancillary Services Market which is also operated by the System Operator. Ancillary Services Market is operated to provide safe operation of the network in real-time.

In conclusion, the current market structure includes these markets to provide market clearing. Two types of operators are responsible for operating these due to their scope of them. However, any of them includes regulations related to flexibility services or the participants of them.

Switzerland's regulation on bidding, billing and settlement

In the below Figure 16, we can see the summary of the relation between the different actors. This is the current situation and the role of aggregator and flexibility provider need to be integrated.

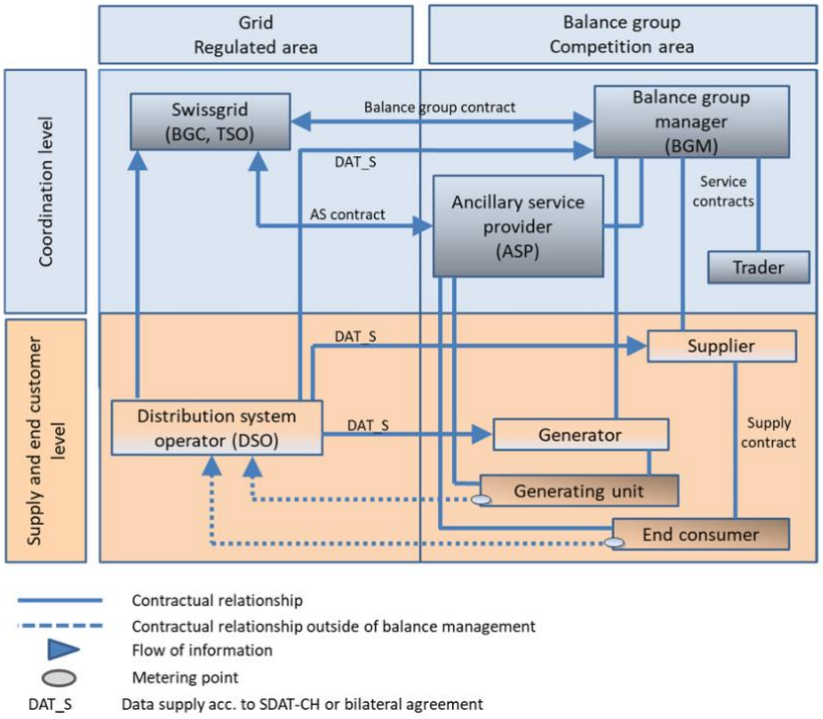

Figure 16. A summary of the relation between the different actors. Source: Swissgrid.

4.5 Data security

EU's regulation on data security

This topic is partially but not fully covered by the current EU regulations. EU legislation GDPR has largely addressed the data privacy related issues. EU Directive 2019/944[88] and other previous[89] [90] also cover this part. Summarising these regulations, we could conclude that the data exchange should follow non-discriminatory and transparent rules and procedures. Meanwhile, commercially sensitive information and customers' personal data should be fully protected[91]. These regulations apply to the local flexibility market design as well.

In EU Regulation 2019/943, the DSO is tasked with supporting the development of data management, cybersecurity and data protection in cooperation with other authorities[92]. Further investigation by market operators is necessary to facilitate data access, multilateral data exchange and data security in local flexibility markets. Increased information availability should lower barriers to entry for all market participants and increase market liquidity. This is expected to reduce the price of DSOs as buyers of flexibility products. However, information and data should be handled with care to prevent any gaming

[88] EU Directive 2019/944. Article 20(a), 20(c) 17-3(c), 23(1), 23(2), 23(4), 24(1), 24(2), 24((3).
[89] EU Regulation 2011/227, Article 11.
[90] EU Directive 2012/27 Article 9-2(b).
[91] EU Directive 2019/943 Article 17-3(c)
[92] EU Regulation 2019/943 Article 55-1(e).

or market abuse. Sharing of sensitive data should be avoided to prevent certain market participants from gaining any unnecessary competitive advantage.

In order to provide flexibility services, certain data such as current congested areas, validated historical data, and accurate forecast/scheduling data with sufficient granularity should be made accessible to all market actors. DSOs should have access to the data from smart meters. Their data exchange with other market actors should be sufficient, such as other DSOs or TSOs, so that congestion resolved in one area does not cause another congestion or balancing problem in another area.

The security of smart metering systems and data communication should comply with relevant EU security rules to ensure the high level of cybersecurity. The privacy of final customers and the protection of their data should comply with relevant EU rules[93].

Sweden's regulation on data security

EU Directive 2019/944 states in Article 31 that DSOs must be willing and able to provide system users with the information needed to access and use the system effectively. The Swedish regulator interprets this Article mainly on the basis of transmission costs and conditions. This is set out in the Swedish Electricity Act. Grid owners are expected to provide information on costs and conditions promptly. However, it is not clear whether the information referred to includes all necessary information for active consumers or aggregators.

Current privacy rules in the information exchange process are also seen as an obstacle for some participants. The Swedish Personal Data Protection Act (PuL) and the Data Protection Ordinance (GDPR) are seen by some participants as making changes to services and cooperation between different participants cumbersome. Secure transmission of information is also highlighted, as balance managers need to be aware of changes that occur when participants provide flexible services. Operators affected by the legislation must conduct a security protection analysis and take the necessary measures based on this. Measures may apply, for example, to information security, protection of premises and facilities, and personnel control. The new legislation places higher demands on information management, which is considered to make it more difficult [52].

Bulgaria's regulation on data security

Data protection in DSOs in Bulgaria is regulated through GDPR and EU Directive 2016/679. DSOs are registered as Personal Data Protection Officers and in line with that they collect and process the necessary personal data of their customers.

Each DSO has their own 'Privacy and data protection policy' that is part of every contract or service that the DSO procures for its customers. The full policy can also be found on the websites of each respective DSO. The type of data that is gathered for customers is also regulated in the Energy Law, the law on Energy from Renewable Sources, the Spatial Planning Act, the Rules for measuring the amount of electricity as well as the Rules for electricity trading just to name a few.

[93] EU Directive 2019/944 Article 20.

The Energy act prescribes that the DSOs and the electricity suppliers shall provide complementary information on:

- cumulative data for at least the three previous years or the period since the start of the electricity supply contract, if that period is shorter. The data shall correspond to the intervals for which frequent billing information has been produced.

- when an intelligent measurement system has been in place - detailed data according to the time of use for any day, week, month and year, which is made available to the final customer via the internet or the meter interface, covering the period of at least the previous 24 months or the period since the start of the electricity supply contract, if that period is shorter.

Turkey's regulation on data security

DSOs store various personal data in order to ensure the protection of the service standards they offer. These personal data include identity, communication, financial, user/subscriber/consumer transaction, transaction security, user/subscriber/consumer, risk management location, legal transaction and compliance, request/complaint management, family members and close, visual and audio, vehicle, employee candidate, employee, employee transaction, performance and career development, fringe benefits and benefits, audit and inspection, physical space security, reputation management and personal data included in the categories of special quality personal data.

When necessary, DSOs can transfer personal data and sensitive personal data to third parties in the country and/or abroad ('Third Parties') by taking the necessary security measures in line with the purposes of personal data processing. However, this transfer process is limited by law. These restrictions have been defined especially by KVKK (Personal Data Protection Law) [53].

Within the framework of the laws, in case of explicit consent of the data owner and in the presence of the following conditions without the explicit consent of the data owner, personal data can be transferred to Third Parties, by taking all necessary security measures.

- If the relevant activity regarding the transfer of personal data is clearly stipulated in the law
- If the transfer of personal data by the Company is necessary and directly related to the establishment or execution of a contract
- In case the transfer of personal data is mandatory for the Company to fulfil its legal obligations
- Provided that personal data has been made public by the data owner, limited transfer by the Company for the purpose of making it public
- If the transfer of personal data by the Company is mandatory for the establishment, exercise or protection of the rights of the Company or the data owner or third parties
- If it is mandatory to carry out personal data transfer activities for the legitimate interests of the Company, provided that it does not harm the fundamental rights and freedoms of the data owner
- In case it is compulsory for the person or someone else to protect his/her life or physical integrity, who is unable to express his/her consent due to actual impossibility or whose consent is not legally valid

If the personal data is to be transferred abroad, the data controllers in the foreign countries must be declared by the Board to have adequate protection ('Foreign Country with Sufficient Protection'). In the absence of adequate protection, data can be transferred to foreign countries where the data controllers

in Turkey and the relevant foreign country undertake adequate protection in writing and where the Board has permission ('Foreign Country Where the Data Controller Undertaking Adequate Protection Is Located').

The company can transfer sensitive personal data within the country or abroad in line with the legal data processing purposes, by showing due diligence and taking the necessary security precautions, including the methods prescribed by the Board (EMRA), and in the presence of the following conditions:

- Sensitive personal data other than health and sexual life can be transferred if the data owner gives explicit consent or without seeking explicit consent in cases expressly stipulated by law.
- Sensitive personal data related to health and sexual life can be shared in case the data owner gives explicit consent or with those who are under the obligation of protecting public health, providing preventive medicine, medical diagnosis, treatment and care services, planning and managing health services and financing without seeking explicit consent. Persons or authorised institutions and organisations with whom the data is shared must be under the obligation of data protection.

If the personal data is to be transferred abroad, the data controllers in the foreign countries must be declared by the Board to have adequate protection. In the absence of adequate protection, data can be transferred to foreign countries where the data controllers in Turkey and the relevant foreign country undertake adequate protection in writing and where the Board has permission.

All these specified data can be shared with the following persons or authorised institutions and organisations by DSOs:

- Supplier
- Group Company
- Supply Company Commissioned by EMRA
- Legally Authorised Public/Private Institution
- Institutions or Organisations with which Reference is Shared

Studies show that many detailed data about users and stored and shared within the limits of the law by DSOs. In addition, since flexible market-specific participants such as aggregators are not defined in current regulations, these participants are not mentioned in data sharing laws.

According to the studies, the fact that the use of smart meters is inevitable for the flexible market and the third parties accessing the meter data will be able to access all the above-mentioned detailed information of the end users will be a barrier for flexible markets. Unfortunately, apart from the research carried out by some DSOs on international examples that can be adapted to Turkey, there is currently no regulation regarding data security and security standards of smart meters. Therefore, consumers will be concerned about accessing their confidential information by third parties such as when they are at home and what they are doing at home.

Suggestions for security and privacy regarding smart meters have been made in the Energy Efficiency Solution: Business Models report published by SHURA [19]. According to that, in order to meet concerns of consumers about data security and privacy regarding smart meter installation and to prevent unauthorised parties from accessing the relevant data, the regulation should determine how the data collected from the meters will be processed, stored, evaluated and who is authorised to access the

relevant data. Methods such as data encryption and digital signature should be used to prevent unauthorised parties from accessing the data. Encryption is very important for data security in meters that provide communication with PLC technology and data concentrator. If encryption is not available, users with a connection to the same data concentrator can access other users' data. Thus, personal data should ideally be protected by law.

The restrictions on the protection of personal data have been defined by Article 12 of the Electricity Distribution System Regulation[94]. In the regulation, it is stated that the distribution company is responsible for taking measures to ensure the protection of personal data regarding the data it obtains and processes within the framework of the execution of market activities within the scope of the relevant legislation, within the scope of KVKK [53]. In sub-Article 2, it is mentioned that the distribution company responsible for publishing the data that it is obliged to publish on its website within the framework of the relevant legislation regarding the electricity market, in accordance with the provisions specified in the KVKK.

In the Section 2, Article 7 of the Personal Data Protection Law[95] it is mentioned that 'Despite being processed under the provisions of the Law, personal data shall be erased, destructed or anonymised by the controller, ex officio or upon demand by the data subject, upon disappearance of reasons which require the process'.

Also, obligations regarding data security of data responsible parties have been defined in the Article 12 of the same law[96]. According to this Article, the controller is obliged to:

- Prevent unlawful processing of personal data,
- Prevent unlawful access to personal data,
- Ensure the retention of personal data.

The controller shall take all necessary technical and organisational measures for providing an appropriate level of security in order to fulfil these obligations.

In case of the processing of personal data by a natural or legal person on behalf of the controller, the controller shall jointly be responsible with these persons for taking the necessary measures.

The controller shall also be obliged to be audited regarding to data security under the Law. The controller shall be obliged to conduct necessary auditions or have them conducted in his own institution or organisation, with the aim of implementing the provisions of this Law.

The controllers and processors shall not disclose the personal data they obtained/collected to third parties and their purposes shall not be incompatible with the original purposes for collecting the data against the provisions of this Law. The controllers and processors shall remain responsible for this obligation even after the termination of their task.

[94] Electricity Distribution System Regulation. Official Journal of the Republic of Turkey (No: 31810) Article 12. April 2022.
[95] Personal Data Protection Law. Official Journal of the Republic of Turkey (No: 6698/29677). Article 7, Sub-Article 1. March 2016.
[96] Personal Data Protection Law. Official Journal of the Republic of Turkey (No: 6698/29677). Article 12. March 2016.

In case the processed data are obtained unlawfully by other parties, the controller shall notify the data subject and the Board within undue delay. Where necessary, the Board may announce such breach at its official website or through other methods it deems appropriate.

As it mentioned above before, the Personal Data Protection Law covers Articles about data protection in the Electricity Distribution System Regulation. Thus, DSOs have to collect and store data regarding these laws. Otherwise, legal sanctions will be applied.

Since these laws does not include Articles directly related to local flexibility market and its specific participants, it can be said that data and personal information of end users are comprehensively protected by laws. Legal entities are responsible for data protection of their customers and users. Even it is expected that end users and flexibility market participants will be worried about their data privacy, these can be reduced with applying these laws with tight control mechanisms. There is no need for additional law.

Apart from legal part of the topic, there may be technological needs for local flexibility market applications. Advanced cybersecurity solutions can be developed for reducing the data protection issues.

Switzerland's regulation on data security

Only smart metering systems may be used whose components have been successfully tested to ensure data security.

Based on an analysis of the protection requirements carried out by the OFEN (Federal office of energy), the grid system operators and manufacturers shall issue guidelines for this verification that define the components to be verified, the requirements that they must meet and the procedures for the verification.

The verification shall be carried out by the Federal Institute of Metrology. The Federal Institute of Metrology may assign this task in whole or in part to third parties.

5. Conclusions

This report reviews the regulations and policies for the upcoming local flexibility markets. The regulations are far from ready yet and therefore need continuous development. Some conclusions for the EU legislation and respective partner countries are presented in the following paragraphs.

EU

The legislation at EU level is decisive to develop the local flexibility market. At the current stage, there are far from sufficient regulations on the local flexibility market which can be perceived as a major barrier. In the design of local flexibility markets, the primary objective is to establish trading rules that promote competition and prevent abuse of market power or other unfair trading practices. While some basic principles can be defined at the European level, the detailed regulatory framework regarding access and use of flexibilities should vary from Member State to Member State to reflect national norms. As noted earlier, overly detailed regulation may discourage the innovation needed in local flexibility markets.

On the one hand, providing a higher level of principles at EU level or at the national level may mean easier access to flexible assets for market participants and increased market liquidity. The non-discriminatory and fair rule is one of the most important bases in EU electricity market legislation. We do expect the potential EU rules to be relatively high because of the very different market structures at the national level across the EU. However, it is important to have a complete regulatory framework in place rather than ignoring certain aspects from the outset. These regulations are likely to evolve over time as the local flexibility market becomes more mature. In addition, DSOs are one of the primary stakeholder types and purchasers of flexibility provisions in the local flexibility market; at the same time, they are essentially regulated monopolies. Particular attention should be paid to ensuring that DSOs conduct certain activities and do not distort competition. On the other hand, overly strict regulations can be disastrous for new markets.

EU legislations are developing to adapt not only the emerging new actors, such as aggregators, citizen energy communities, and market operators, but also re-constructing certain roles of existing actors, such as DSOs, BRPs, and so on. The design of flexibility products and services could refer to the existing electricity markets, such as the wholesale market including balancing market. But the future regulation should consider the uniqueness of flexibility products and services, and their serving purpose. Correspondingly, the contractual agreements, bidding process, billing, and market settlement should be regulated. EU legislation should also ensure a strong infrastructure setting for local flexibility market evolution, such as smart metering systems and energy storage. Last but not least, relevant data exchange and communication should be guaranteed as sufficient, and data security requirements should comply with EU security rules to protect customers.

Sweden

Swedish regulatory framework closely follows EU legislation regarding local flexibility market design, and it also needs to be changed to adapt to the new market requirements. Ei has proposed different regulation changes to higher authorities which is perceived as favourable to local flexibility market development. The regulatory framework and the available Swedish markets, as well as the business models, for aggregators have changed in recent years and will continue to do so due to new legislation and business

opportunities. According to Ei, there are 5-10 aggregators in Sweden today. Some of these companies operate as an aggregator for technologies that can be found in single-family households, such as heat pumps and electric vehicles. Many, if not all, of these provides some sort of implicit demand side flexibility as well where they optimise electricity usage through for example smart charging. The companies can then take advantage of the situation where they already have the technical control over the customers' assets to aggregate these for sale on, for example, flexibility markets. However, issues of financial responsibility, the compensation models, the collaboration with BRPs, and their market power should be well regulated but not over-regulated. Similar to the EU, Swedish legislation should also set up standardised requirements on flexibility products and services, such as product prequalification, product standardisation, product baseline, and other attributes. Sweden has good infrastructures such as smart metering systems. But how infrastructure like smart metering systems and energy storage could be better used with cost-effective installation and higher resolutions of data should be discussed. Sufficient data exchange and timely access to correct data are necessary. Towards the end-users, stricter requirements for monetary compensation for offering flexibility, and higher demands on information management are about to be regulated.

Bulgaria

As repeatedly stated in this deliverable, local flexibility market design is to a great extent still in its conceptual phase, which makes it a market mechanism non-existent in any of the countries that have been described in this report, Bulgaria included. As seen in the analysis of local flexibility market related regulations, there is still a lot of room for improvement before such a business/market model can be implemented in Bulgaria. Discussions are on-going though and there are already many aspects of the legal framework which foretell that one day local flexibility market will be much more than just a concept.

It is important to note that there won't be one standard definition and way of work of local flexibility market. Different countries will have specific regulations related to local flexibility market based on the way their electricity market works. So, in the context of the EU, though there are some directives with quite detailed and specific regulations in regard to flexibility markets, mostly each country has the freedom on when and how to implement the necessary regulatory changes. EU directives are very progressive in this regard, while Bulgaria takes a more conservative approach by internally discussing necessary regulatory changes in depth while simultaneously observing the effect of similar changes in the countries that have already adopted them. Much regulatory changes and adaptation schemes would be necessary to enable Bulgaria's electricity market to host a local flexibility market, but changes are happening and definitely in 5-10 years the establishment of such a market in Bulgaria will be more than just possible.

Turkey

Currently, a local flexible market model has not been established in Turkey. A regulation has been issued for prosumers, but their participation in the market is highly restricted. However, the government and official institutions such as EMRA are working to determine the necessary infrastructure needs for the integration and dissemination of renewable energy technologies, energy storage systems, electric vehicle charging stations and prosumers in the energy markets. Because, in order to create a local flexible market model, first of all, it is also necessary to eliminate the technological deficiencies in the grid. For that purpose, action plans have been created by ministry. Also, various R&D projects are funded by EMRA to create a roadmap for smart grids and also address grid deficiencies in this regard. For example, the

domestic smart meter production project funded by EMRA will pave the way for the dissemination of smart meters included in the ministry's action plan.

As stated, the infrastructure and regulatory requirements necessary to create a flexible market mechanism are examined through major research projects or studies conducted by independent research institutes. These studies basically cover both the market mechanisms that the end user can actively participate in and the smart/optimal use of the necessary infrastructures. The results to be obtained with these studies may create meaningful outputs for regulatory institutions, and together with these results, market players, DSOs etc. will be able to make suggestions to add or update existing regulations to the relevant regulatory institutions. As summary, when the issues covered in the report are evaluated as a whole, it can be foreseen that the local flexible market model can be applied in Turkey if the necessary regulatory frameworks are defined, and infrastructure deficiencies are eliminated.

Switzerland

In summary, we can conclude that the regulations on flexibility use are still in development in Switzerland and the objective of the new law project is to complete this leak of regulation. We can distinguish two components in the regulation of the valorisation of the flexibility:

- The valorisation of the flexibility on the structured market as the Spot, the intraday or the SDL are currently well defined and used.
- The valorisation of the flexibility on local flexibility market is still in development and the business models need to be demonstrated.

With the massive deployment of the NERs, new regulations need to be defined in order to well integrate these new energy sources and ensure the security of electricity supply. This security must be achieved through the development of these new models for valuing flexibility within a framework of integrated regulation.

The important points to note in the new law project (LApEL) are:

- Flexibility regulation creates a property right of the flexibility holder: end consumers, storage operators and generators should be able to offer their flexibility freely.
- The Federal Council shall determine the proportion of guaranteed rights of use that can be adjusted or controlled for each generation technology. It may also lay down transparency and publication obligations for DSOs and lay down provisions for the protection of flexibility holders.
- The draft revision provides incentives for the development of a flexibilities market and encourages novel business models, such as aggregators and virtual power plants, which pool the potential of smaller flexibility units (e.g., households, etc.). This leads to cost savings for DSOs and additional revenues for self-consumers.
- DSOs shall take flexibility into account when developing the grid and consider in particular flexible alternatives to grid reinforcement. Guaranteed rights of use for DSOs shall be defined in such a way as to lead to an optimised development of the grid.

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