D4.3 ANM SOLUTIONS - REGULATORY REVIEW AND IMPLICATIONS

VERSION 2.0

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ERA-Net Smart Energy Systems (ERA-Net SES) is a transnational joint programming platform of 30 national and regional funding partners for initiating co-creation and promoting energy system innovation. The network of owners and managers of national and regional public funding programs along the innovation chain provides a sustainable and service oriented joint programming platform to finance projects in thematic areas like Smart Power Grids, Regional and Local Energy Systems, Heating and Cooling Networks, Digital Energy and Smart Services, etc.

Co-creating with partners that help to understand the needs of relevant stakeholders, we team up with intermediaries to provide an innovation eco-system supporting consortia for research, innovation, technical development, piloting and demonstration activities. These co-operations pave the way towards implementation in real-life environments and market introduction.

Beyond that, ERA-Net SES provides a Knowledge Community, involving key demo projects and experts from all over Europe, to facilitate learning between projects and programs from the local level up to the European level.

http://www.eranet-smartenergysystems.eu/

EXECUTIVE SUMMARY

This report provides an overview of current EU and national regulation and policies relevant for the implementation of ANM solutions. An overview and discussion of applicable economic regulation of DSOs is also included.

New and innovative approaches for meeting ambitious renewable energy targets have become a focus area of EU policy and regulations. This includes identifying and implementing alternatives to traditional network expansion, for example new technologies, methods, and markets to provide increased flexibility in consumption, generation, and power transfer capacity. ANM solutions comprise local network management of active and reactive power to avoid overload situations, maintain voltages within limits, minimise the need of RES curtailment, and enable further RES uptake beyond the theoretical design limit of the electricity network. It is the concept of a control system, integrated with ICT and the power system, with the ability to manage generation, load and electrical tolerances for DSO-driven purposes.

A range of EU policies and regulations supporting the implementation of ANM solutions are expected to be transposed into national laws within the next year; including measures to enable participation, application, and operation of non-traditional network management strategies. However, since the legal framework is yet to be put in place, any large-scale implementation of innovative network operation is still to transpire. The details of the national laws will also have to be determined, which may have a big impact on the effectiveness of overarching EU strategy.

From the perspective of ANM solutions, the most important aspects of the new policies and regulations is that they are increasing the possibilities for consumers to actively participate on the electricity market and thereby also be part of ANM solutions. Examples of this in the new EU policies and regulations this are active consumers, citizen energy communities and aggregators, but also regulation on the implementation of smart metering systems, how to share information and allow access to third parties.

It is unlikely however that this new regulation is enough for alternative gird operation to take off. There are several barriers remaining such as the question of balance responsibility, lack of standards and profitability concerns.

Moreover, for DSOs to better utilise available flexibility services, changes further down the regulatory chain of command are necessary, particularly in the method of economic incentive regulation. One such change could involve a framework which removes the separate treatment of operational and capital expenditure and instead introduces a total expenditure approach. It is also possible for regulators to introduce new and innovative incentives to steer DSOs towards certain behaviours. However, the regulatory framework must keep its main focus on safety and security and remain predictable to avoid mixed signals and inefficiency through stranded or avoided investments.

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INTRODUCTION TO ANM4L

The ANM4L (Active network management for all) project, anm4l.eu, will develop solutions to enable integration of renewables with the agility required from developments in demand and production.

> *Alternatives to traditional network expansion are needed to ensure sustainable development of the power grids. New technologies, methods, and markets are emerging to provide increased flexibility in consumption, generation, and power transfer capacity.*

ANM4L aims at demonstrating innovative active network management (ANM) solutions to increase integration of renewable energy sources (RES) in electricity distribution systems.

ANM solutions will consider management of active and reactive power to avoid overload situations, maintain voltages within limits, minimise the need of RES curtailment, and enable further RES uptake above the theoretical design limit of the electricity network.

Core research and development activities include the development of:

- Active network management methods for local energy systems.
- Business models to provide decision support for market players.
- An integrated toolbox to support the planning and operation of the distribution system.

The toolbox, methods and business models for ANM will be demonstrated in Sweden and Hungary. The project will also prepare solutions and recommendations for replication in other local and regional energy systems.

The ANM4L project is an international cooperation with a consortium consisting of partners in Sweden, Germany and Hungary:

- RISE Research Institutes of Sweden (coordinator)
- Municipality of Borgholm
- Lumenaza GmbH
- Lund University
- RWTH Aachen University
- E.ON Energidistribution AB
- E.ON Észak-dunántúli Áramhálózati Zrt.
- E.ON Group Innovation GmbH

DOCUMENT INFORMATION

This deliverable is part of work package 4 (WP4): Business models for ANM in local and regional energy systems.

The main objective of WP4 is to create decision support for investments and operation, through development of business case methods and models.

This document provides a review of relevant regulation in the Directive on common rules for the internal market for electricity (EU) 2019/944 (which upon launch of the Clean energy for all Europeans package replaced Electricity Directive (2009/72/EC)), and the Regulation on the internal market for electricity (EU) 2019/943 (which upon launch of the Clean energy for all Europeans package replaced the Electricity Regulation (EC/714/2009)) combined with a brief overview of related national regulation in Sweden and Hungary. In addition, the relevant methods of economic regulation for distribution system operators are reviewed. The report investigates how relevant parts of the above-mentioned regulations may have an impact on the implementation of ANM solutions in distribution networks.

The report is structured as follows. First, chapter 1 defines the scope of work and outlines relevant notations, abbreviations and acronyms used in the report. Chapter 2 outlines relevant definitions used throughout the report. Chapter 3 provides a background to the need for ANM solutions and shortly gives an introduction to the Clean energy for all Europeans package. Chapters 4-6 introduce selected parts of the above-mentioned regulations and discuss how these may affect the implementation of any ANM solution. Chapter 7 provides learnings from the Swedish regulator's, the Swedish Energy Markets Inspectorate's, annual investigation on the introduction of flexibility in Sweden, in this report from the perspective of engaging households and other similar parties in ANM solutions such as demand response or demand side management. Chapter 8, the final chapter and the discussion section of the report focuses on financial barriers hindering development identified in the regulation and in the annual investigation by the Swedish regulator.

1 INTRODUCTION

1.1 Scope of work

This deliverable is part of Work package 4 (WP4): *Business models for ANM in local and regional energy systems.* The overall objective of WP4 is to create decision support for investments and operation.

This report provides a review of relevant regulation in the Directive on common rules for the internal market for electricity (EU) 2019/944 (which upon launch of the Clean energy for all Europeans package replaced Electricity Directive (2009/72/EC)), and the Regulation on the internal market for electricity (EU) 2019/943 (which upon launch of the Clean energy for all Europeans package replaced the Electricity Regulation (EC/714/2009)) combined with a brief overview of related national regulation in Sweden ang Hungary. In addition, relevant methods of economic regulation for distribution system operators are reviewed. The report investigates how relevant parts of the above-mentioned regulations may have an impact on the implementation of ANM solutions in distribution networks.

The Clean energy for all Europeans package was launched in 2016 and implemented in 2019. The package consists of a new set of rules to ensure continued transition and reach the goals stipulated in the Paris Climate Agreement from 2015, i.e., a minimum 40 percent reduction of greenhouse gas emissions by 2030. The package was implemented when the Council of ministers of the EU formally approved the last four out of eight new legislations thereby future proofing the European electricity market. [1] [2]

Member states are continuously working on implementing the new directives and regulations in national law. When possible and if relevant, this report covers both current and future national regulation. Additionally, any relevant national regulation that does not stem from EU regulation is covered in this report.

1.2 Notations, abbreviations and acronyms

Table 1 below provides an overview of the notations, abbreviations and acronyms used in this report.

Table 1: List of notations, abbreviations, and acronyms

ANM	Active Network Management
ANM4L	Active Network Management for all (project name)
BESS	Battery energy storage systems
BRP	Balance responsible party
CAPEX	Capital expenditure
DG	Distributed Generation
DR	Demand Response
DSO	Distribution System Operator
DSM	Demand Side Management

ERA-Net SES	ERA-Net Smart Energy Systems
MC	Marginal Cost
OPEX	Operating expenditure
RES	Renewable Energy Source
TOTEX	Total expenditure
WACC	Weighted average cost of capital
WP4	Work Package 4

BACKGROUND

The energy system is currently undergoing a radical transformation minimising greenhouse gas emissions and maximising the share of renewable energy sources (RES) in the energy mix. The electricity market is a key enabler of this transformation, creating new opportunities and challenges for market participants while recent technological development provides opportunities for active consumer participation.

The recent technical developments have allowed RES to be economically viable. This has resulted in a paradigm shift forcing the traditionally one-directional distribution grids to be utilised in a bi-directional manner with an increased amount of distributed generation (DG). [3]

The main challenge with this transformation is managing intermittent electricity generation by weather dependent sources such as wind and solar that are not adaptable to demand, [4] and often located at the edge of the grid. Grids are commonly structured similarly to a spiderweb, adapted to centralised generation with heavy lines close to the generation facilities and lighter lines further out. Fluctuations caused by intermittent generation in the periphery can therefore have a larger impact on the grid compared to if the intermittent generation facility had been placed at the centre. [3]

Distribution system operators (DSOs) are monopolists and therefore heavily regulated to protect consumers. There are multiple approaches for the DSOs to manage the issues brought by the increasing share of RES, many of which are dependent on the regulatory landscape within which they operate. The European Commission is continuously working on adapting relevant regulation to correspond to current and future conditions. Both Hungary and Sweden are member states of the European Union and therefore national laws and regulations are heavily influenced by EU regulation.

The Clean energy for all Europeans package addressed all pillars of the Energy Union[1]. It was launched in 2016 and implemented in 2019. The package consists of a new set of rules to ensure continued transition and reach the goals stipulated in

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1 The European Energy Union is a strategy founded by the Juncker Commission in 2015. Its purpose is to strengthen the European energy security, sustainability, and competitiveness through five pillars: Energy security, solidarity and trust; A fully integrated European energy market; Energy efficiency contributing to moderation of demand; Decarbonising the economy; and Research, Innovation and Competitiveness. [24] Since 2015, the Commission and its member states have worked on achieving the strategy through implementing different packages and following up on 27 National Energy and Climate Plans (NECPs). [25] A key objective of the Energy Union is to not leave any citizens or regions behind. All consumers, including vulnerable and energy poor, should be able to reap its benefits. [23]

the Paris Climate Agreement from 2015, i.e., a minimum 40 percent reduction of greenhouse gas emission by 2030. [5]

The package was implemented when the Council of ministers of the EU formally approved the last four out of eight new legislations, thereby future proofing the European electricity market. [5]

The four legislations implemented in 2019 are the Directive on common rules for the internal market for electricity (EU) 2019/944 (replaces Electricity Directive (2009/72/EC)), the Regulation on the internal market for electricity (EU) 2019/943 (replaces the Electricity Regulation (EC/714/2009)), the Regulation on risk preparedness in the electricity sector (EU) 2019/941, and the Regulation (EU) 2019/942 establishing a EU Agency for the cooperation of energy regulators (ACER) (replaces regulation 713/2009). [6]

Note that some of these legislations are directives while some are regulations. While an EU regulation applies in in all member states regardless of national laws and regulations, an EU directive is a set of rules that sets objectives to be achieved but leaves it to the Member States to formulate their own detailed national laws and regulations.

Designing and implementing efficient regulation is challenging. This report focuses on existing and (when possible, for more information see section 1.1) future regulations in Sweden and Hungary and how the regulatory framework, especially the income regulation, shape DSO behaviour.

1.3 Available options to manage grid issues

As described in multiple reports published as part of the ANM4L project the available tools and resources to manage voltage levels and avoid overload situations and allow for more generation from intermittent RES can be categorised into four different groups (see for example Ref. [7] and [3]):

- Generation control;
- Flexible consumers;
- Equipment in the grid, and
- Flexibility enablers.

In addition, the DSO can also reinforce or expand the grid.

If the DSO procures flexibility from an external party (e.g., using generation control or flexible consumers), a specific mechanism or market may be necessary to facilitate trade.

2 REGULATIONS ENABLING ANM SOLUTIONS

Swedish and Hungarian regulations are heavily influenced by EU regulation. EU directives are transposed into EU member states national law, which directly influence how the electricity market function, including roles and responsibilities of its actors. Electricity network owners and operators, given their position as monopolistic providers of electricity transmission and distribution services, are particularly influenced since the legal framework, through the national electricity network regulations, determines the level of their revenue. The following sections reviews the EU directives and regulations relevant for enabling ANM solutions. First, properties of electricity network economic regulation are outlined and discussed, which is then followed by a review of recent EU regulations and the impact on Hungarian and Swedish national law. The aspects of EU regulations are grouped into three categories:

- *Regulation enabling ANM solutions* aims to capture regulations that aim at setting up a landscape suitable for these kinds of solutions before they are implemented;
- *Regulation enabling participation* aims to capture regulations that aim at enabling participation of different actors, and
- *Operational regulation* aims to capture regulations that aim to regulate the solution itself, how it is used and to solve new operational issues.

2.1 Economic regulation of electricity networks

During the 1980s and 1990s many countries unbundled (removed vertical integration between the different segments) and privatised much of their electricity sectors. The move to reduce the state involvement in the generation, transportation and supply of electricity was driven by both political agendas and principles from the field of economics of prospective efficiency gains through competition. Electricity networks are capital intensive, creating high economies of scale and thus high barriers to entry for new actors. As a result, electricity networks, transmission and distribution of electricity, are considered to be natural monopolies. This means that it is more efficient (less costly) to only allow one company to own and operate the electricity network within a defined area rather than to open up to many companies and competition.

However, the concentration of market power to one or more actors is generally associated with inefficient practices such as excessive pricing and lack of innovation and technological advancement. Therefore, as natural monopolies, DSOs and TSOs are subject to economic regulation to prevent monopoly pricing, discriminatory network access and to ensure sufficient investment and maintenance for a safe and efficient level of supply [8] [9].

Since privatisation, the general objective of regulation, in addition to stringent security requirements, has focused on improved efficiency in the operation and maintenance of networks. This is achieved through improved short-run efficiency (making the best use of existing resources) and long-run efficiency (appropriate long-run investments). National regulatory authorities (regulators) have an informational disadvantage in terms of the operational environment, technical specifications, costs and behaviour of the firms that they regulate. This means that network companies may be able to abuse its monopolistic position to its advantage. For example, by overstating its costs or reducing spending leading to poor managerial efforts, in order to maximise its own profits. Abuse of a monopolistic position would come at a cost to electricity consumers and reduce overall social welfare.

Traditionally there are two main types of regulatory frameworks applied to network companies to overcome issues related to information asymmetry; price cap regulation and cost of service regulation. In price cap regulation, the regulator determines a price cap or fixed price for distributed energy. Whilst consumers are protected against monopoly pricing or unexpected increases, the network company and its managers are motivated to first exaggerate its costs to the regulator and then, through operational advances, reduce its actual costs without the requirement to share any savings with consumers. The gains from costs reductions, which may reduce quality of supply, will thus remain solely with the network company. Meanwhile, in a cost of service framework the regulator agrees to compensate network companies for a certain level of service. Provided that the regulator is able to accurately audit costs, the network company will be reimbursed fully for its true production costs and the company will not have an incentive to exaggerate its costs. Consumers would share potential benefits of cost reductions, however, the network companies have no incentive to innovate or develop procedures to reduce costs as this would lower its overall compensation since only realised costs will be reimbursed.

As a result of the difficulties in encouraging truthful reporting and behaviour from regulated companies, regulators have often applied a combination of price cap and cost of service regulation. Many also rely on benchmarking of network companies' costs and productivity to determine the overall allowed revenue. Benchmarking of companies' performance reduces the informational gap between regulated companies and the regulator and it encourages performance improvements. Regulatory methods that incentivise certain behaviour and efficiency improvements are typically referred to as incentive regulation. The regulatory frameworks for Hungary and Sweden [10] are outlined, below.

The Swedish electricity grid is divided into three different levels; the high-voltage transmission network, owned and operated by the state-owned TSO, the medium-voltage regional distribution network, owned and operated by 18 regional DSOs, and the low-voltage local distribution network, owned and operated by 152 local DSOs. The 170 DSOs vary in size, operational environment, and ownership structure, including state, municipal, and privately-owned. The Swedish Energy Markets Inspectorate, the regulator in Sweden, work on assignment from the government to ensure a well-functioning energy sector, safe and secure supply of energy, and to support energy consumers interests. Included in this work the economic regulation of networks. Since 2012, the regulator applies an ex-ante revenue cap to both the transmission and distribution networks. The network companies propose the TOTEX (total expenditure) (divided into CAPEX (capital expenditure), non-controllable OPEX (operating expenditure) and controllable OPEX) to be used to determine the revenue cap, which is assessed and finally set by the regulator for a four-year period. The revenue cap is set to cover operational costs and a reasonable return on capital. The depreciation of assets follows a straight-line method dependent on expected economic life and vary between different types of assets. There are 17 different asset categories and six different depreciation times, varying between 10 and 50 years. The regulator also applies incentives to improve efficiency of controllable OPEX, determined through a benchmarking exercise, and to improve quality of supply. An overview of the Swedish revenue cap and its different building-blocks are depicted in Figure 1, below.

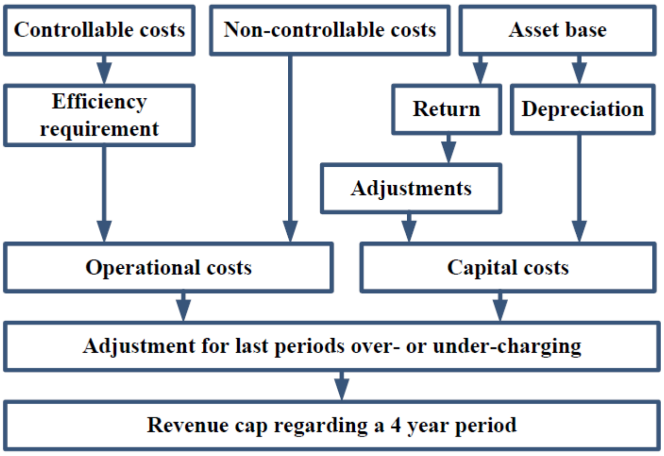

Figure 1 - Overview of the Swedish revenue cap [11]

The Hungarian electricity grid is made up of one TSO, which is publicly owned, and six DSOs, of which one is publicly owned and five that are privately owned companies. The Hungarian Energy and Public Utility Regulatory Authority (HEA) oversee the market and the electricity networks are regulated by a hybrid model where a revenue cap is set ex-ante in a price-cap-like system (i.e., the revenue cap is determined by price/tariffs multiplied by the quantity of distributed energy). The regulator performs a cost review for each network company and the justified costs (OPEX, CAPEX, depreciation and network losses) are calculated and included in the revenue cap together with the distributed energy. An efficiency incentive is applied to OPEX, determined through a benchmarking exercise, and an incentive for improved quality of supply is applied through a bonus/penalty system based on the quality of supply in the previous regulatory period. Depreciation follows a straight-line method and is determined based on expected economic life of the different types of assets, with the annual rate varying between 2.5% and 7%.

Similar to Hungary and Sweden, many European regulators apply incentive regulation to electricity network companies to encourage firms to become more efficient, increase investments, and to make sure that consumers benefit from cost reductions. Incentives generally come in the form of financial rewards or penalties but can also consist of other schemes, for example reputational incentives. A range of incentives allows regulators to increase their focus from mainly considering safety requirements and efficiency improvements to include other aspects that can contribute towards meeting wider policy objectives, including those related to climate change goals and the energy transition. For example, recent developments have seen an increased focus on network customers' objectives through the introduction of incentives to improve quality of supply, a feature in most European regulatory frameworks, and active customer engagement, implemented by the Great Britain regulator Ofgem.

It is also possible to introduce incentives to encourage DSOs to look beyond traditional network expansions, and apply ANM solutions and other measures, in order to increase network capacity. For example, to promote energy efficiency, lower network losses and reward peak-shaving, the Swedish regulator recently introduced an incentive to encourage efficient utilisation of network [11]. The incentive should support the development of new and innovative processes, including operation and maintenance, which can delay investment in and expansion of the grid. However, the fundamental framework remains the same.

Both Hungary and Sweden apply revenue cap regulation following a similar general building-block principle where allowed revenue is made up of $OPEX + depreciation + asset\ base \times WACC$. OPEX and CAPEX are treated differently – OPEX is remunerated within the period they occur whilst CAPEX is added to the asset base and reimbursed over time through depreciation and an allowed return on the invested capital. By investing in assets, DSOs will grow its asset base and therefore its guaranteed return for many years. Different types of assets have different expected economic life and therefore depreciation ratios. Assets such as cables and lines have a long expected economic life, typically 40-60 years, whilst IT infrastructure and equipment in the grid may have about 10 years expected economic life. This means that DSOs will maximise its expected return by investing in large infrastructure that depreciate over a longer time and that they therefore may be more willing to invest in network expansion than an ANM solution.

There is a level of substitutability between CAPEX and OPEX and depending on the objectives of the regulator this could be utilised. However, a balance must be established to avoid potential OPEX-bias, leading to short-term operational focus, and CAPEX-bias, leading to long-term over-investments and overengineering. Moreover, OPEX is benchmarked against other DSOs and an efficiency incentive is applied. Benchmarking and establishing efficiency requirements on CAPEX is generally considered challenging due to the nature of capital investments, which vary greatly between different years and different DSOs. As a result, the efficiency requirement imposed on OPEX, in addition to the guaranteed long-term return on

CAPEX, may lead DSOs to prioritise CAPEX expenditure, i.e., induce CAPEX-bias, particularly in assets with long expected economic life, over OPEX expenditure.

The current regulatory framework is fit for the traditional DSO role, i.e., the passive transporter of electricity with no need to consider bi-directional electricity flow or prosumers. However, with changing circumstances, new actors, roles, responsibilities, and objectives, the economic regulation will need to be updated to encourage and allow DSOs to take on a more active role and to find and implement alternative solutions to traditional network expansion. It is possible that updates would have to go beyond introducing additional incentives to the current framework, a more fundamental review may be required. The regulatory framework for DSOs could possibly be adjusted to become more similar to the framework applied to TSOs, with more clearly defined incentives for the efficient and economic operation of the system, including separate allowances for acquiring balancing services.

Furthermore, a possible solution to overcome potential CAPEX-bias is changing from a system that treats CAPEX and OPEX differently to a system where all costs are treated in a similar manner, so called TOTEX-regulation [12]. Reducing the distinction between OPEX and CAPEX and adapting the tools that determine efficiency could allow regulators to change the way DSOs are regulated, as a result of new economic objectives, roles, and responsibilities. Changing the efficiency requirement to include DSOs' total costs, rather than only controllable OPEX, is a recent proposal from the Swedish regulator. An example of the suggested framework is illustrated in Figure 2, below.

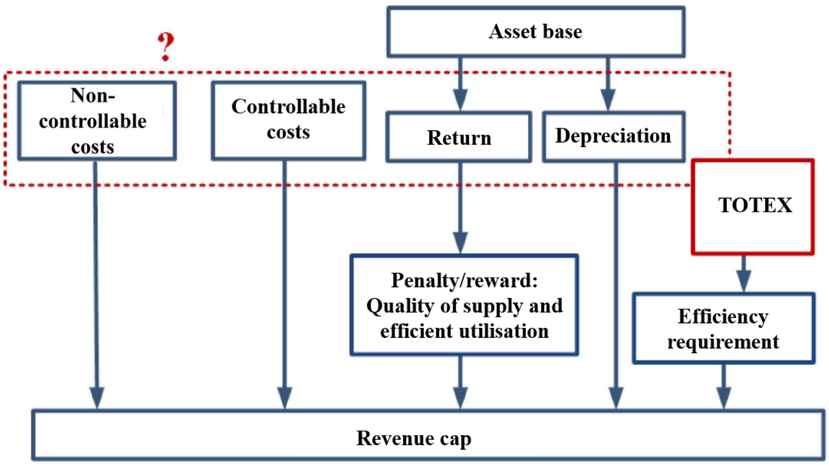

Figure 2 - Alternative Swedish revenue cap with efficiency requirement applied to TOTEX (adapted from [13])

2.2 EU regulation

2.2.1 Smart metering systems

A smart meter is a device that records and communicates information such as electricity consumption and voltage levels and therefore allows consumers to actively monitor and adapt their actual consumption and/or allow for a third party to do so. It is a necessary tool for consumers who wish to actively engage on the electricity market and/or in some other way offer flexibility services to the DSO.

Articles 19, 20 and 21 of EU directive 2019/944 states that member states should, if/when deemed economically beneficial based on a cost-benefit assessment (CBA), ensure that smart metering systems are introduced to support active participation of consumers in the electricity market. Consumers are however entitled to a smart metering system even if the CBA assess a system wide deployment to be unprofitable but then at their own cost.

The functionality requirements are in short that the smart metering system should be able to provide final consumers with information on actual time of use as well as validated historical consumption. Information should be free, easily available, and secure. Upon request of a consumer the system should be able to handle and account for electricity fed into the grid. The information provided to the consumer should be easy to understand and allow the consumer to compare offers. A third party should be able to act on behalf of the consumer, among other things this entails that the consumer should be able to relay information to the third party (see chapter 2.2.3). Regarding pricing, the smart metering system should allow consumers to be settled at the same time resolution as the national settlement period.

In 2018, the Swedish government decided to deploy “the next generation” of smart meters in Sweden. The work has commenced and is due to be completed before 2025. A CBA concluded in 2015 that deployment of smart meters would be beneficial. The smart meters will be able to measure hours and have a user interface that makes it possible for customers to read their own consumption data. They will make it possible for consumers to actively engage on the electricity market and at the same time allow for a safer operation of the grid. [14]

For Hungary, the results of the first and second CBA however show inconclusive results and the results from a third CBA conducted in 2018 were in 2020 still under review[2]. Some DSOs are working on smart metering deployment (mainly in relation to pilot projects), however there is no large-scale rollout underway. [15] Because the CBAs have been inconclusive there are no requirements for a large-scale rollout, but the CBA must be repeated every fourth year or more often. [16]

While smart meters in households are not necessary for all ANM solutions, the available solutions are limited in their absence. The possibility to engage consumers on the electricity market is for example not available. However, other types of technologies may be just as important in an ANM solution and the discussion of smart meters is changing into also including a more integrated use of information

2 The authors of this report have not been able to find any more recent information.

and communication technology (ICT) and digitisation. Such technology can be, for example, smart household appliances (such as heat pumps) that in an ANM setting can allow network owners to remotely adjust loads by communicating directly with the appliance rather than with the consumer.

2.2.2 Information

As previously mentioned, some ANM solutions involve a third party or an active consumer that need access to information. The EU directive 2019/944 therefore stipulates in article 31 that the DSO must be willing and able to provide system users with information needed for efficient access to and use of the system.

The Swedish regulator interpret this article mainly in term of fees and conditions for transmission of electricity. This is regulated in the Electricity Act. Chapter 4, paragraph 11, states that a grid owner swiftly should hand out information on fees and conditions. [17] It is however unclear if the information referred to include all necessary information for an active consumer or an aggregator. The Hungarian Electricity Act states in section 24 that information should be shared to any eligible party subject to consent of the customer without any discrimination.

Closely related to the above-mentioned technologies, information, and ANM solutions in general is cybersecurity which is generally discussed throughout directive 944/2019.[3] As stated in article 20, "the security of the smart metering systems and data communication shall comply with relevant Union security rules, having due regard of the best available techniques for ensuring the highest level of cybersecurity protection while bearing in mind the costs and the principle of proportionality". For grid owners working with ANM solutions it is important that measures to ensure security are being taken already when the solutions are beginning to be implemented. Furthermore, different actors involved with the same or interlinked systems would benefit from common standards.

2.2.3 Third party access

Third party access is usually regulated for industries with natural monopolies such as operators of electricity grids and other vital infrastructures that cannot be economically duplicated. The motivation for this regulation is to uphold competition in the provision of a service or product closely related and often dependent on the natural monopoly. Absent third party access regulation, there is a risk of monopolists abusing their power by for example hindering third party access using measures such as unjustifiable high tariffs or discriminatory terms and conditions. A third party can for example be an aggregator in need of accessing smart meters out in the grid.

EU directive 2019/944 article 6 regulates third party access and states that each member state must ensure that it is based on publicly available tariffs applicable to

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[3] See paragraph 57, article 20, article 40 and Annex II.

all customers and applied objectively and without discrimination between system users. Access can however be denied due to lack of necessary capacity. But in contrast to previous regulation, grid owners must now provide relevant information on what measures would be required to strengthen the network and thus allow for new connections. Furthermore, the article has (compared to previous regulation) been expanded to also apply to citizen energy communities that manage distribution networks.

Swedish regulations are in general well adapted to meet the requirements stated in the above article, see ref. [17]. No regulation currently applies to citizen energy communities. However, that should not have an impact on grid owners' ability to utilise ANM solutions. Also, Hungarian regulation, Electricity Act section 142, states that use of the electricity system and network access fees should be transparent, publicly available and proportionate, and applied objectively in a non-discriminatory manner. In contrast to Swedish legislation, section 66/B in the Electricity Act regulates energy communities and recognises that they may be involved in generation, storage, consumption of electricity, flexibility services, electricity sharing, aggregation, electro-mobility services and charging services for electric vehicles.

2.2.4 Energy storage

Energy storage is a key component to ANM solutions. As lithium-ion battery prices continue to decrease energy storage becomes an increasingly affordable tool. [18] Battery energy storage systems (BESS) can support grid owners with reactive power compensation, management of peak loads, and other DSO level services. As with all ANM solutions, this may reduce future grid reinforcement needs.

Despite its benefits and affordability, EU regulation (Article 36 in 944/2019) prevents grid owners to own, develop, manage, and operate energy storage facilities. There are reasons for this regulation. DSOs are heavily regulated monopolies and therefore not allowed to participate in unregulated electricity markets. As BESS could be used to provide services in the electricity and balancing markets the fundamental rule is therefore to not allow DSOs to own, develop, manage, and operate energy storage facilities. Furthermore, BESS may be owned and operated by producers of electricity. They would, in contrast to the DSO, be allowed to sell stored electricity on electricity markets thereby increasing its usage potential as the DSO simultaneously can utilise the resource as an ANM service by procuring it from the producer.

Article 36 in 944/2019 allows for member states to make exceptions and allow DSOs to own and operate BESS in two occasions; first, if such a facility is necessary for the grid owner to fulfil their obligation, that they will not be used to participate on any electricity market and the facilities are entirely integrated grid components, and second, if an open, transparent, and non-discriminatory tendering procedure, that was reviewed, approved, and deemed necessary by the regulating authority, was unsuccessful in acquiring the required services from a third-party. Tendering procedures vary between countries and each the regulatory authority of each country may provide guidelines or procurement clauses to help distribution system operators ensure a fair tendering procedure. In Sweden, the procurement tendering process for companies supplying utilities such as network owners is regulated by law (2016:1146).

While Swedish regulators have allowed for grid owners to own, develop, manage, and operate energy storage facilities as part of their grid operations, they have not been allowed to use the storage facility to participate on the market, for example to sell stored electricity. The current Swedish regulation is less strict than the new EU regulation and it is therefore likely to be updated and only allow grid owners to own energy storage facilities under the above mentioned exceptions. [19]

Hungarian regulators allow DSOs to own energy storage facilities. According to Section 33/C of the Electricity Act a DSO may install and operate an electricity storage facility if it complies with the lowest possible cost principle. The facility should be incorporated into the distribution network to ensure the secure and reliable operation of the distribution system although not used for congestion management. Furthermore, it must not exceed a nominal output capacity of 0.5 MW. The current Hungarian regulation is likely to change within the near future, however the exact formulation is unknown.

3 REGULATIONS ENABLING PARTICIPATION

3.1 Active customers

Many flexibility resources are located in households and the owner of each resource must take an active decision to provide the local DSO with flexibility. The EU definition of an active customer is, according to point 8 in article 2 in 2019/944 "… a final customer, or a group of jointly acting final customers, who consumes or stores electricity generated within its premises located within confined boundaries or, where permitted by a Member State, within other premises, or who sells self-generated electricity or participates in flexibility or energy efficiency schemes, provided that those activities do not constitute its primary commercial or professional activity".

The rights and obligations of active consumers are regulated in article 15 in 2019/944, see box 1 below. While the requirement of being "financially responsible for the imbalances they cause in the electricity system; to that extent they shall be balance responsible parties or shall delegate their balancing responsibility in accordance with Article 5 of Regulation (EU) 2019/943" likely is challenging for the lone consumer the regulation otherwise does not hinder household participation in ANM services, and much of the technical and administrative burdens can be alleviated by an aggregator or citizen energy community, see chapter 3.2 and 3.3 below. The challenges related to household participation are probably more about incentives and knowledge than regulation, see chapter 5.

According to the Swedish Electricity Act (3 chapter, 16a §§) 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. See more on technical requirements in chapter 5.1 below. Similar regulations apply in Hungary where the DSO is required to treat all actors equally, thereby they may not hinder any actors' participation due to too advanced technical requirements. However, there are no regulations specifically on active customers as of yet.

BOX 1: ARTICLE 15, EU 2019/944 – ACTIVE CONSUMERS

1. Member States shall ensure that final customers are entitled to act as active customers without being subject to disproportionate or discriminatory technical requirements, administrative requirements, procedures and charges, and to network charges that are not cost-reflective.

2. Member States shall ensure that active customers are: (a) entitled to operate either directly or through aggregation; (b) entitled to sell self-generated electricity, including through power purchase agreements; c) entitled to participate in flexibility schemes and energy efficiency schemes; (d) entitled to delegate to a third party the management of the installations required for their activities, including installation, operation, data handling and maintenance, without that third party being considered to be an active customer; (e) subject to cost-reflective, transparent and non-discriminatory network charges that account separately for the electricity fed into the grid and the electricity consumed from the grid, in accordance with Article 59(9) of this Directive and Article 18 of Regulation (EU) 2019/943, ensuring that they contribute in an adequate and balanced way to the overall cost sharing of the system; (f) financially responsible for the imbalances they cause in the electricity system; to that extent they shall be balance responsible parties or shall delegate their balancing responsibility in accordance with Article 5 of Regulation (EU) 2019/943.

3. Member States may have different provisions applicable to individual and jointly-acting active customers in their national law, provided that all rights and obligations under this Article apply to all active customers. Any difference in the treatment of jointly-acting active customers shall be proportionate and duly justified.

4. Member States that have existing schemes that do not account separately for the electricity fed into the grid and the electricity consumed from the grid, shall not grant new rights under such schemes after 31 December 2023. In any event, customers subject to existing schemes shall have the possibility at any time to opt for a new scheme that accounts separately for the electricity fed into the grid and the electricity consumed from the grid as the basis for calculating network charges.

5. Member States shall ensure that active customers that own an energy storage facility: (a) have the right to a grid connection within a reasonable time after the request, provided that all necessary conditions, such as balancing responsibility and adequate metering, are fulfilled; (b) are not subject to any double charges, including network charges, for stored electricity remaining within their premises or when providing flexibility services to system operators; (c) are not subject to disproportionate licensing requirements or fees; (d) are allowed to provide several services simultaneously, if technically feasible.

3.2 Aggregators

Aggregators are frequently discussed, and many find it likely that this type of actor will play an important role on the future energy market. Just as the name imply, an aggregator can gather actors and sell their aggregated flexibility to a DSO or to other consumers. From the perspective of the DSO, this is a convenient solution as they only need to establish a contract and relationship with the aggregator, instead of each actor.

For DSOs looking to implement demand response or load control as an ANM solution, an aggregator is likely to simplify the relationship between the DSO and the consumer/prosumer and minimise the administrative burden. Furthermore, by representing the consumer/prosumer the aggregator can contribute with a more even distribution of knowledge between buyer and supplier.

Article 13 regulates consumers and prosumers right to enter and exit contracts with aggregators and article 17 in 2019/944 states that each Member State has a responsibility to "allow and foster participation of demand response through aggregation" and that system operators (TSO and DSO) treat actors that offer ancillary services such as flexibility via aggregation of demand response equal to other producers regardless technical capabilities.

The new articles specifically addressing aggregators have not yet been implemented in Swedish legislation. [19] In February 2020, NordREG, the organisation for Nordic energy regulators, published a report with recommendations on a common Nordic regulatory framework for independent aggregators. To allow for cross-border cooperation they propose to develop a harmonised regulation for all Nordic countries. [20] The Swedish Energy Markets Inspectorate will propose a suggestion for regulation of aggregators that will ensure alignment with the regulation of bordering nations and that DSOs and TSOs treat their services equal to those of similar market actors. The addition of aggregators in national legislation is likely to only increase the possibilities for DSOs to utilise local flexibility resources.

Hungarian regulators have incorporated aggregators throughout the Electricity Act and, from a regulatory perspective, they are allowed to engage consumers and other actors to deliver aggregated flexibility services to DSOs.

3.3 Citizen energy communities

Article 16 in 2019/944 regulates citizen energy communities. The definition of a citizen energy community is, according to point 11 in article 2 in 2019/944, defined as "(...) a legal entity that,

- is based on voluntary and open participation and is effectively controlled by members or shareholders that are natural persons, local authorities, including municipalities, or small enterprises;
- has for its primary purpose to provide environmental, economic or social community benefits to its members or shareholders or to the local areas where it operates rather than to generate financial profits; and
- may engage in generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy

> efficiency services or charging services for electric vehicles or provide other energy services to its members or shareholders."

Citizen energy communities are of high relevance for ANM solutions involving consumers and/or prosumers, especially demand response. Like aggregators, they may be a way of aggregating multiple flexibility resources and efficiently facilitate the relationship between consumers and grid owners. Citizen energy communities may function as a non-profit aggregator with the purpose of providing environmental, economic or social community benefits, in this case by offering large amounts of flexibility within a clearly defined framework that all members of the community accept.

BOX 2: ARTICLE 16, EU 2019/944 – CITIZEN ENERGY COMMUNITIES

1. Member States shall provide an enabling regulatory framework for citizen energy communities ensuring that: (a) participation in a citizen energy community is open and voluntary; (b) members or shareholders of a citizen energy community are entitled to leave the community, in which case Article 12 applies; (c) members or shareholders of a citizen energy community do not lose their rights and obligations as household customers or active customers; (d) subject to fair compensation as assessed by the regulatory authority, relevant distribution system operators cooperate with citizen energy communities to facilitate electricity transfers within citizen energy communities; (e) citizen energy communities are subject to non-discriminatory, fair, proportionate and transparent procedures and charges, including with respect to registration and licensing, and to transparent, non-discriminatory and cost-reflective network charges in accordance with Article 18 of Regulation (EU) 2019/943, ensuring that they contribute in an adequate and balanced way to the overall cost sharing of the system.

2. Member States may provide in the enabling regulatory framework that citizen energy communities: (a) are open to cross-border participation; (b) are entitled to own, establish, purchase or lease distribution networks and to autonomously manage them subject to conditions set out in paragraph 4 of this Article; (c) are subject to the exemptions provided for in Article 38(2).

3. Member States shall ensure that citizen energy communities: (a) are able to access all electricity markets, either directly or through aggregation, in a non-discriminatory manner; (b) are treated in a non-discriminatory and proportionate manner with regard to their activities, rights and obligations as final customers, producers, suppliers, distribution system operators or market participants engaged in aggregation; (c) are financially responsible for the imbalances they cause in the electricity system; to that extent they shall be balance responsible parties or shall delegate their balancing responsibility in accordance with Article 5 of Regulation (EU) 2019/943; (d) with regard to consumption of self-generated electricity, citizen energy communities are treated like active customers in accordance with point (e) of Article 15(2); (e) are entitled to arrange within the citizen energy community the sharing of electricity that is produced by the production units owned by the community, subject to other requirements laid down in this Article and subject to the community members retaining their rights and obligations as final customers.

   For the purposes of point (e) of the first subparagraph, where electricity is shared, this shall be without prejudice to applicable network charges, tariffs and levies, in accordance with a transparent cost-benefit analysis of distributed energy resources developed by the competent national authority.

4. Member States may decide to grant citizen energy communities the right to manage distribution networks in their area of operation and establish the relevant procedures, without prejudice to Chapter IV or to other rules and regulations applying to distribution system operators. If such a right is granted, Member States shall ensure that citizen energy communities: (a) are entitled to conclude an agreement on the operation of their network with the relevant distribution system operator or transmission system operator to which their network is connected; (b) are subject to appropriate network charges at the connection points between their network and the distribution network outside the citizen energy community and that such network charges account separately for the electricity fed into the distribution network and the electricity consumed from the distribution network outside the citizen energy community in accordance with Article 59(7); (c) do not discriminate or harm customers who remain connected to the distribution system.

Current Swedish law encompasses all demands put forward related to active consumers but, as Article 16 is a new regulation, none of those related to citizen energy communities. The Member States was given two years to incorporate the new directives into national laws. The Swedish Energy Markets Inspectorate was therefore commissioned to formulate a proposal for such national legislation. In 2020 the proposal was sent for referral to relevant stakeholders such as authorities and municipalities, grid owners and housing associations. The suggested Swedish legislation does not allow citizen energy communities to own or operate electricity grids. However, that is not of importance from an ANM perspective, and the coming legislation may very well offer great support to DSOs and active consumers that wish to engage in this type of ANM solutions.

While citizen energy communities are not yet implemented in Swedish law, they are in the Hungarian Electricity Act. Similarly to when it comes to aggregators, there are nothing in the regulation that prevents them from working with flexibility services. There are some restrictions such as they are not allowed to engage in cross-border cooperation etc., but nothing that prevents being active offering ANM services to Hungarian DSOs.

3.4 Network tariffs

Network users pay network tariffs to the DSO. The fee normally consists of two parts; one fixed tariff that is set based on the connection size and one variable part that depends on the amount of electricity consumed. Household consumers normally pay a fixed rate regardless of when the electricity is consumed and network constraints are thus not factored in the distribution tariff. However, article 18 in 2019/943 opens for more variable network tariffs: *where appropriate, time-differentiated network tariffs may be introduced to reflect the use of the network, in a transparent, cost efficient and foreseeable way for the final customer*. Time-differentiated network tariffs enable DSOs to send price signals to customers based on system users' consumption or production profiles. For example in the Öland case where the distribution network at times is unable to transfer all wind produced electricity, the DSO can set a lower than normal tariff when wind prognosis is showing strong winds and higher than normal when wind prognosis is showing light winds. The mentioning of time-differentiated network tariffs is new in 2019/943.

While this is not mentioned in either Swedish or Hungarian law, nothing is seemingly hindering DSOs to apply a variable network tariff, as long as the tariff is non-discriminatory within a consumer group. [21] The Swedish Energy Markets Inspectorate is currently running a pilot project where DSOs are given more freedom to trial new approaches for collecting consumer tariffs that will increase the efficient utilisation of the grid (see [22] for more information). At the time of writing there are no published results from the pilot project and it is not clear how many DSOs have trialled new tariffs. In 2021 the Swedish DSO Göteborg Energi Elnät introduced a new model for network tariffs for houseowners. The new model consists of a fixed cost and two variable costs that both depend on the houseowners power outlet. The house owner pays for how much electricity the household uses (electricity transmission fee), and for how much electricity the household uses at one and the same time (power fee). The household's highest power peak during the month determines the household's power fee. [23]

3.5 Entitlement to a dynamic electricity price contract

Dynamic pricing is an enabler for flexibility as it allows consumers to adjust their consumption by reacting to a price signal, but it is not strictly necessary for ANM solutions. Grid owners are not allowed to participate on the electricity market and whether dynamic pricing is available or not to consumers when purchasing electricity from electricity suppliers or not is not critical. However, it may be easier to implement ANM solutions that involve action from consumers if they are used to dynamic pricing and have access to a smart meter.

Article 11 in 2019/944 states that all Member States must ensure that electricity suppliers are able to offer dynamic pricing to consumers with smart meters, and that those consumers can request a dynamic electricity price contract from at least one supplier. All suppliers with more than 200 000 customers must be able to offer a dynamic electricity price.

Member States must ensure that the suppliers provide consumers with information about opportunities and risk, costs, and the need of a smart meter. National regulatory authorities are responsible to assess risks and prevent abusive behaviours related to dynamic pricing.

Swedish electricity suppliers are not hindered in any way to apply dynamic pricing and most suppliers offer it if they are able, i.e., if the consumer has a smart meter installed. Hungarian electricity providers must, according to section 45 of the Electricity Act, provide one or more contracts based on dynamic pricing to final consumers.

4 OPERATIONAL REGULATION

4.1 Order of prioritisation

The ANM4L project does not discriminate between different technologies and ANM solutions, and the task of prioritisation between different alternatives is therefore relevant. The DSO may have multiple ANM solutions available for solving a grid problem and while technical and financial aspects are evident the regulatory aspects must also be considered when deciding which ANM solution should manage the problem.

Article 12 and 13 in 2019/943 states that the system operators must prioritise to keep production of renewable energy sources active when facing a situation that forces them to dispatch production. This means that non-renewable alternatives and alternatives that does not hinder production of renewable electricity should be dispatched first.

The absolute majority of all production facilities in Sweden are renewable or nuclear hence the prioritisation problem is less of an issue. However, although not demanded by regulations, there may be reason to prioritise adjusting loads and utilising equipment in the grid. As countries become more interconnected the production mix of each individual country becomes less important and the combined production mix becomes increasingly important, especially for exporting countries. If a producer of renewable electricity in Sweden curtails their production, it may lead to a producer of non-renewable electricity compensate for the curtailed production instead of renewable electricity being imported. Hungary has an energy mix involving more fossil energy sources, see Figure 4, and should therefore aim to dispatch energy from those sources first or utilise other ANM solutions if possible.

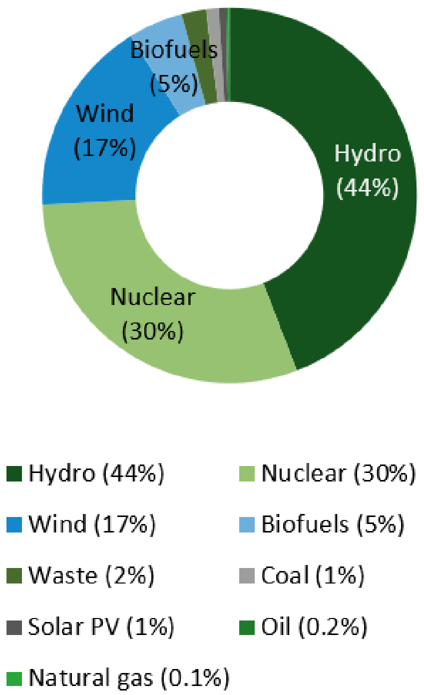

Figure 3 Electricity generation by source, Sweden 2020 [24]

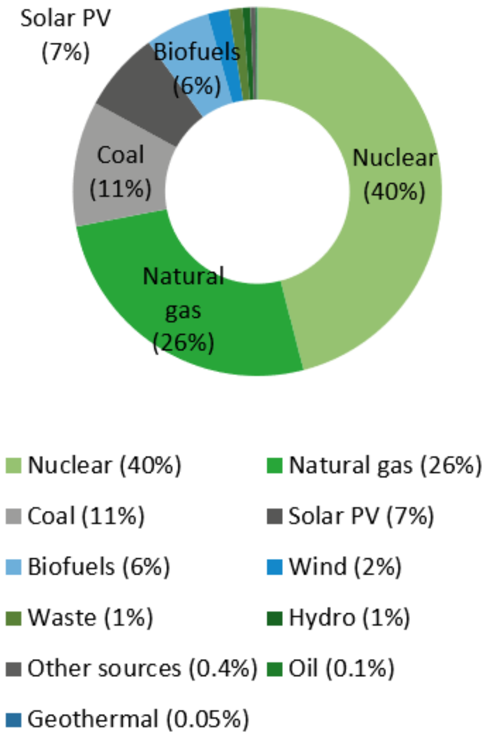

Figure 4 Electricity generation by source, Hungary 2020 [24]

4.2 BRP

There are two potential challenges related to balance responsibility and ANM solutions:

- First, when curtailing electricity production, it may be that the production plans reported by the producer no longer match the actual production upon evaluation. This can lead to the relevant BRP facing financial charges.
- Second, as briefly mentioned previously, active consumers and other flexibility providers are responsible for any imbalances they may cause.

There are no alleviating measures for small flexibility providers such as private households or small firms. While it is unlikely that this would lead to any actual issues for these parties, as it will likely be solved through contracts and would amount to small numbers, it may however hinder participation due to uncertainty.

The Hungarian Electricity Act (Section 66/D) states that "the aggregator shall be subject to financial responsibility for any imbalance caused in an alien balance group reduced or increased by the imbalance adjustment" meaning that the consumer will not be financially hurt by any imbalance fees as long as they are connected to an aggregator.

Furthermore, Regulation 2019/943 states that pricing methods for any "products for balancing electricity should create positive incentives for market participants in keeping their own balance or helping to restore the system balance in their imbalance price area, thereby reducing system imbalances and costs to society" which indicates that the DSO when entering a contract with a smaller flexibility provider should ensure that they will be protected against any imbalance fees if they arise as a consequence of the DSO activating an ANM solution.

5 STATUS OF FLEXIBILITY IN SWEDEN

Every year since 2015[4], the Swedish Energy Markets Inspectorate examines the current state of flexibility services. [19] As part of these examinations, market participants are invited to share their views on desirable requirements, barriers and overall conditions for flexibility, either as ancillary services or as electricity for sale. The discussions mainly focus on services involving third parties and not internal ANM solutions.

The barriers brought up in these investigations are interesting from a regulatory perspective if they persist over time, and if there are reason to believe that the market is unable to overcome them.

5.1 DSO requirements for third parties

In the investigation from 2020[5], as well as in previous investigations, most DSOs state that they have not been approached by any new or existing market participants regarding flexibility and if it were to happen, they do not have any *formal* technical requirements on customers or aggregators providing services for changing electricity consumption, however there are examples of technical demands that they would like to see fulfilled in order to enter into an agreement: [19]

4 Except in 2016 due to the publication of reference [26].

5 The latest available as of finalising this report in September 2021.

- Any installations of equipment should be performed by a licensed electrician and the equipment must not disturb the DSOs communication with the smart meter or negatively affect the quality of supply.
- The DSOs want to make sure that the flexibility services offered by consumers and aggregators are reliable, efficient, and available as expected. In the 2020 investigation the DSOs formulated the following criteria for fulfilling a reliable, efficient, and available service.
  - Product requirements such as activation within a certain time frame, reliability, availability as promised and ability to validate the called service.
  - Requirements for interoperability such as the use of a common platform and API for smooth communication programs and platforms.
  - Requirements for data exchange, such as forecasts for access to flexibility.
  - Technical requirements regarding, for example, control systems and technical equipment.
  - Requirements for information to electricity network companies.
  - Requirements for balance responsibility.

Some general non-technical demands are also put forward by the DSOs, most of administrative nature. If an aggregator wishes to access any measuring data of a consumer, prosumer, or producer the aggregator must bring forward a power of attorney and in order to receive real time data an agreement must be signed with the DSO. In addition, the general terms and conditions for connection of electrical installations to electricity networks and transmission of electricity to such installations developed by the industry association Energiföretagen Sverige AB and the Swedish Consumer Agency must be complied with. Most DSOs would also find it convenient if services from third parties is based on third party's own applications and software. [19]

In summary, the demands put forward by the DSOs are to a large extent related to being able to trust the services provided and thereby ensure the security of supply of electricity.

5.2 Observed barriers

DSOs experience challenges with having flexibility solutions as part of their network planning. Uncertainties regarding reliability, such as correct, standardised measurement values, and the flexibility resources' availability over time are addressed. [19]

In addition, several problems are expressed regarding economic viability. The DSOs fear that many flexibility solutions are cost-driving and difficult to make profitable. At the same time, they find it difficult to motivate customers, both private households and small businesses, to participate in flexibility solutions due to a lack of financial incentives. This means, for example, that the opportunities for savings or extra income are considered to be low, but also a lack of knowledge about flexibility and its benefits is deemed problematic. Positive environmental values are not considered significant enough either. [19]

Players who can or want to provide flexibility services to DSOs also experience problems with profitability. It is difficult to offer products in a yet undeveloped market with a lack of willingness to pay and a lack of standardized products. [19]

Furthermore, obstacles linked to the balancing market are also identified. There is a lack of balance market products adapted to decentralised small units. For example, there is a requirement for pre-qualification per unit and there are no balancing market products suitable for aggregation. [19] However, the issue of balancing markets is related to flexibility at the system level and not the local level which is the focus of this report.

6 DISCUSSION

The new Directive on common rules for the internal market for electricity (EU) 2019/944 and the Regulation on the internal market for electricity (EU) 2019/943 offer support for flexibility, including different ANM solutions such as those utilising equipment in the grid and flexible consumers. However, the new regulations and directives are not yet implemented in Swedish law and whilst Hungary has come further regarding the legal framework, the market for alternative gird operation has yet to take off. This discussion focuses on financial barriers hindering development identified in the regulation and in the annual investigation by the Swedish regulator, starting with the incentive regulation.

DSOs are inherently risk averse and not willing to invest in a solution that may not work as planned, both in terms of technical and financial aspects. Risk aversion is embedded in the fundamental operation of DSOs given the importance to society of secure and efficient electricity supply. This is reflected in the regulatory frameworks that determine the DSO role, responsibilities, and its revenue. For DSOs to better utilise available flexibility services, changes further down the regulatory chain of command are necessary, particularly in the method of economic incentive regulation. One such change could involve a framework which removes the separate treatment of OPEX and CAPEX and instead introduces a TOTEX approach. It is also possible for regulators to introduce new and innovative incentives to steer DSOs towards certain behaviours. However, the regulatory framework must keep its main focus on safety and security and remain predictable to avoid mixed signals and inefficiency through stranded or avoided investments.

To limit the financial uncertainty DSOs must perform analyses and develop methodologies that allows them to assess what is the most efficient option. This can be done by a cost benefit analysis. In the ANM4L project a simplified cost benefit analysis to be used as a first assessment is being developed. Its purpose is to swiftly compare two or more scenarios involving different types of solutions to a problem, for example ANM solutions or network expansion, and use the results to identify which scenarios to focus on in an extended analysis. The financial risk will most likely never be eliminated but only limited, meaning that the DSO must be willing to take on some risk. The technical uncertainty for the DSO is also challenging but is already being managed through various pilot and demonstration projects such as ANM4L.

Further regulatory changes could boost the utilisation of flexibility in the distribution networks, however, there are additional factors hindering development and the role of regulation is not to push actors into participating on a market that they otherwise would have avoided. The fact that there are additional factors hindering development is evident from the annual investigation of the Swedish Energy Markets Inspectorate, see chapter 5.2.

When focusing on ANM solutions that involve active customers, aggregators, and other similar actors, it seems that these actors are also facing financial barriers. Due to the inelastic nature of price elasticity of electricity pure monetary incentives to engage consumers are likely not enough. Based on the annual investigation of the Swedish Energy Markets Inspectorate there is likely a lack of knowledge on the customer side which may mean that if the general public was better informed they would potentially show greater interest.

To enable trade, all actors in the value chain must benefit. The DSO must find the ANM solution to be the most efficient solution to their problem[6], the aggregator (if any) must profit[7], and the customer must find that the benefit exceeds any inconvenience and cost, monetary but also time spent.

[6] Here, the incentives regulation is relevant.

[7] Unless the aggregator is a citizen energy community, then they must only cover their costs.

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