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Explicit Demand Response for small end-users and independent aggregators

Status, context, enablers and barriers

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Contents

Abstract

Accommodating an increased share of electricity generated from renewable resources on the one hand, and more active consumers on the other hand, puts pressure on the electric grids in the EU and requires the system to become more flexible. Demand-side flexibility can be cheaper than investments in the transmission or distribution networks, and including it in the system increases the reliability and resilience of the grid. In the European Union, the EU Directive 2019/944 formalizes the role of Demand Response in the electric system, and gives the opportunity for a new entity, the Independent Aggregator, to pool together the resources of multiple end-users and participate with them in the markets. This report examined the progress of explicit Demand Response for small end-users across 26 EU Member States, and the status of Independent Aggregators as of the end of 2021. Through a survey, expert interviews, and desk research, it found that the engagement of small end-users in explicit Demand Response has increased in most of the Member States since the previous report. Even though the first step towards making explicit Demand Response available to end-users is through their supplier, which is the case in 22 EU Member States, independent aggregation is recognized by the national legislation in 19 cases, of which in 7 countries independent aggregators of small end-users also exist and operate. The gap between the number of Member States where independent aggregation is enabled (19) and those where it also exists in practice (7) has to do with market barriers (e.g., unclear business case), regulatory barriers (e.g., lack of secondary legislation defining responsibilities), technology constraints (e.g., lagging roll-out of smart meters) – as well as with the particular conditions in each Member State and its approach to explicit Demand Response as a resource. This situation could be remedied if communication between Member States and the exchange of best practices were strengthened, focusing on measuring success and enabling a cost-benefit approach.

Acknowledgements

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Executive summary

The European Commission, Joint Research Centre (JRC) reviewed the progress of Member States toward opening markets for Demand Response as of the end of 2021, in particular, the status of independent aggregation in line with the EU Directive 2019/944, with a focus on small end-users.

Article 17 of EU Directive 2019/944 builds on the provisions of Article 15 from the Energy Efficiency Directive (2012/27/EU) and places Demand Response through aggregation on equal footing with other market participants.

> The Member States shall allow and foster the participation of demand response through aggregation. The Member States shall allow final customers, including those offering demand response through aggregation, to participate alongside producers in a non-discriminatory manner in all electricity markets.
>
> The Member States shall ensure that transmission system operators and distribution system operators, when procuring ancillary services, treat market participants engaged in the aggregation of demand response in a non-discriminatory manner alongside producers on the basis of their technical capabilities.

Further, in Article 17 the EU Directive 2019/944 outlines the elements of the regulatory framework to be adopted in the Member States:

— 3.(a) the right for each market participant engaged in aggregation, including independent aggregators, to enter electricity markets without the consent of other market participants

— 3.(b) non-discriminatory and transparent rules that clearly assign roles and responsibilities to all electricity undertakings and customers.

Article 17 of EU Directive 2019/944 was due to be transposed by 31 December 2020.

As the transposition of Article 17 is still ongoing in most of the Member States, the opening of the markets towards Demand Response has continued in line with the provisions of the previous Directive. The possibility to engage in Demand Response is first made available through electricity suppliers, who are optimally positioned to also harvest demand-side solutions. The suppliers can balance their position or avoid possible local congestions by offering their end-users the possibility to engage in implicit Demand Response through, e.g., dynamic tariffs. Explicit Demand Response can also be addressed through agreements focusing on flexibility, where the consumers allow the suppliers to manage their load when the system needs flexibility.

However, as suppliers are primarily focused on managing electricity, they are not always interested in exploiting the full potential of the available flexibility. Here is where the Independent Aggregator can improve the competition by offering an alternative to suppliers and retailers and thus realizing the potential of the flexibility resource. The possibility for the Independent Aggregators to effectively serve in this niche in the market requires a regulatory framework and a business case.

The significance of the particular segment of small end-users (e.g., households) is threefold. First, the small prosumers are featured prominently in the roadmap towards decarbonized grid in the EU, as they are encouraged to participate actively in the system and engage with all of their assets, including demand. Second, they constitute a homogenous group of users with similar consumption patterns and potential, lending themselves naturally to aggregation and adding up to a sizeable share in electricity consumption. Third, seeing as the engagement of large commercial and industrial consumers in Demand Response is a “low hanging fruit” due to their substantial margins of flexibility, involving small end-users in the system would allow them to become a relevant resource as well.

Hence, this report focuses on small end-users and follows:

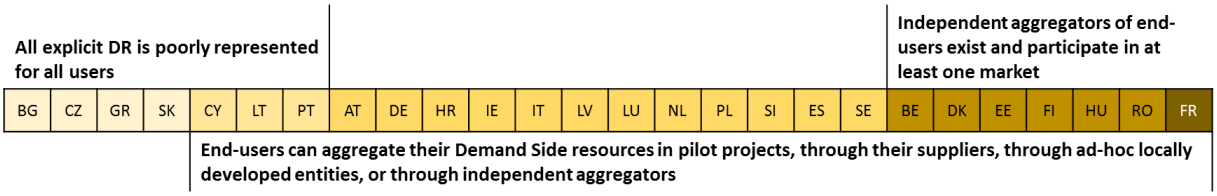
1. Their access to explicit Demand Response
2. Their possibility to aggregate (either through retailers or Independent Aggregators)
3. The availability and status of Independent Aggregators in particular, as well as the enablers and barriers they encounter

As the previous JRC report indicated in 2016, in Europe, the market was almost entirely shut to explicit Demand Response as recently as in 2013. The situation was found to be very different in 2021, as in most of

the EU Member States, Demand Response is now recognized and is eligible to participate in at least one market (mainly wholesale, but also capacity, balancing, ancillary services markets, etc.)

The JRC report in 2016 also identified three groups of Member States: those where Demand Response (DR) was yet to be seriously engaged with; those where participation in Demand Response was possible only through the retailers; and finally, a small group of four Member States (including the UK) where both Demand Response and Independent Aggregation were enabled. As of the end of 2021 when the data collection for this report has ended, the aggregation of small end-users and their participation in at least one market (regardless of whether through an independent entity or through the supplier) is legally allowed and technically possible in 22 Member States. It is important to note that the availability of service does not necessarily mean that the actor is active in the market; however, given the range of services and multitude of markets in which explicit DR can participate under conditions varying from one Member State to another at different levels of maturity – the resulting status of Independent Aggregators falls into a spectrum rather than into a clear category. In this context, of the 22 Member States, independent aggregators of end-users that can participate in at least one electricity market could be found in only seven: Belgium, Denmark, Estonia, Finland, France, as well as Hungary and Romania, where the market was just emerging.

Figure 1. Degrees of market representation for explicit DR across 26 EU Member states as of 2021**.**



Source: JRC, 2021

The key insight for the results of this report is that the availability of the option to engage in DR is largely regulatory, and it is different from the actual engagement in DR on the ground, which requires a regulatory framework but also the additional performance of the business case (whether "the effort is worth it"). Further, the engagement of small end-users in explicit DR comes in aggregated form, as only the aggregated load can clear the size threshold for participation in the markets. Once small end-users decide to engage in explicit DR, the initiative to aggregate does not depend on whether the aggregators are independent or not. Further still, whether there are independent aggregators on the market does not correlate back with the transposition of Article 17 of the Directive.

Therefore, the enablers and barriers identified by this report fall into two categories: direct enablers/ barriers for independent aggregators, and enablers/ barriers for explicit Demand Response, as indirect factors.

Engagement of small end-users in explicit Demand Response correlates with factors such as the size of dispatchable loads, the roll-out of smart meters, potential for savings in the electricity bill, but also with structural factors in the system such as the need for flexibility and openness to use demand response as a flexibility source. Not the least, the level of awareness and education on the side of end-users plays a role.

Figure 2. Status of explicit Demand Response and Independent Aggregators across the EU Member States in 2021.

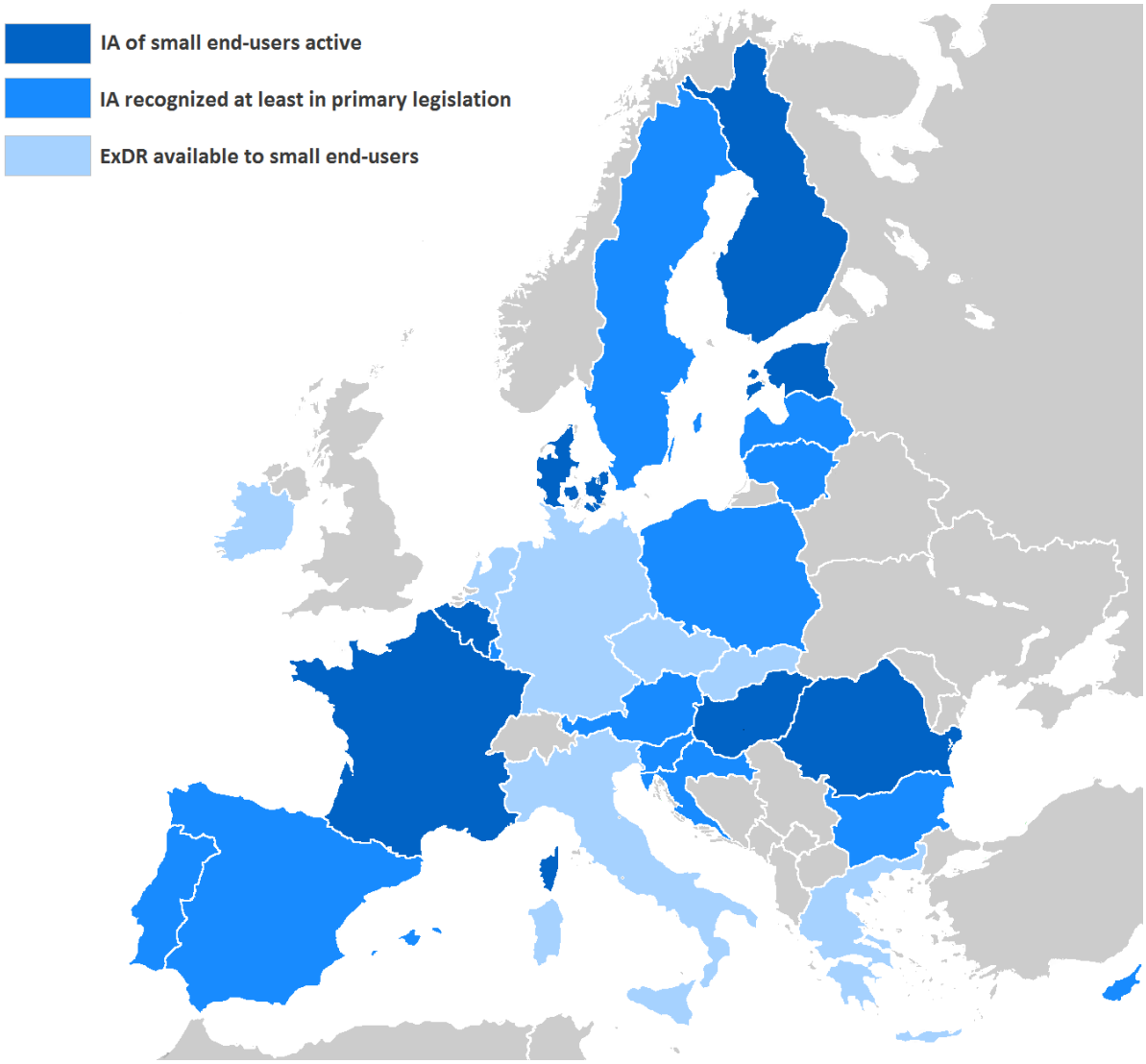


Illustration of report findings using map from Wikimedia Commons

Once the end-users have the possibility to engage meaningfully in explicit Demand Response, the first step is usually through their supplier, who acts as an aggregator. Further regulatory, technical and market factors determine whether independent aggregation is also operational, such as a compensation mechanism, the existence of flexible markets at the DSO level, accessible minimum bids, the possibility to engage in value stacking. However, evidence in this report shows that if the business case is strong enough, then the independent aggregators are willing to engage with the hurdles from the other barriers.

With the diversity of background conditions across the EU, there is no standardized definition of the aggregator role and of the contractual relationship with the supplier, which makes comparisons difficult as well as the documentation of progress. However, the evident progress that was made between 2017-21 could have been quantified with indicators such as the number of demand-side MWs bid into the markets, frequency of calls, levels of reliability and number of Euros earned by stakeholders. However, as the Member States are not required to measure their progress, and the communication between stakeholders is insufficient for allowing growth or replication of best practice, the situation is still to be remedied. The quantification of success could contribute towards a comprehensive cost-benefit analysis of Demand Response programs at the level of Member States and create a common ground for sharing of best practices among the Member States, which would, in turn, stimulate growth.

1 Introduction

The Paris Agreement and the EU Green Deal call for the decarbonisation of the electric grid as part of the contribution of the energy sector to mitigating climate change. As the share of Renewable Energy Sources (RES) in the generation of electricity is growing steadily across the EU, the CO_2 emissions from electricity generation are decreasing, but the system faces new challenges associated with the fluctuations caused by the intermittent nature of RES.

At the same time, the liberalization of the EU Electricity Market and the evolution of the electric system towards a smarter grid encourages the energy end-users to become more active than before. Enabled by the variety of options and technologies that are now available to them, such as microgeneration, energy storage, electric vehicles, and consumption management, these active consumers (prosumers) can engage more in the electric system and thus gain a more prominent role. It is estimated that by 2050 roughly half of the EU citizens could become prosumers.

The existing electric grid, designed to serve a centralized production and rigid consumption patterns, cannot accommodate the growing share of RES and the increasingly active end-users in its current situation. Maintaining a reliable supply through a resilient network requires strengthening the electric grid, therefore, capital investments at the levels of transmission and distribution.

Nevertheless, making adjustments on the demand side alleviates some of the pressure on the grid and thus contributes to investment deferral, making demand side solutions often a cheaper option for the economic efficiency of the grid. In addition to that, by enabling demand-side participation, the system benefits from a reliable source of flexibility in the grid.

As an economically sound option that can help all users lower their electricity bills while at the same time adding value to the systems, demand-side solutions are known as Demand Response (DR) or Demand Side Flexibility (DSF). DR programs encourage customers to adjust their consumption patterns in order to avoid or reduce pressure on the electric grid. That is realized either through time-varying electricity prices that reflect the value and cost of electricity at different times (price-based, *implicit* DR), or by rewarding consumers for changing their consumption upon request (incentive-based, *explicit* DR). Implicit DR is comparatively easier to implement (assuming smart meter roll-out), whereas explicit DR creates controllable loads that can assist with the local RES and provide further services to the system.

Consumers engage in *explicit* DR by increasing or decreasing consumption and can earn from their flexibility individually or by pooling their resources and contracting with an aggregator who will represent them and act on their behalf. Flexible electricity demand can compete directly with supply in the wholesale, balancing and non-frequency ancillary services markets. This is achieved through the control of (aggregated) changes in load traded in electricity markets, providing a resource comparable to generation, and receiving comparable prices (for explanations regarding the markets, see Annexes).

1.1 Status and policies regarding explicit Demand Response at the EU level

In the European Union, the role of DR is formally recognised and regulated. The 2012 Energy Efficiency Directive (EED) 2012/27/EU defines the technical and contractual actions to support DR and includes provisions to enable its participation in the wholesale and balancing markets. The Electricity Directive 2019/994/EU amends the EED and, in Article 17, addresses DR through aggregation.

The previous JRC report on the status of Demand Response in the EU, published in 2016, found that despite continued positive development, no Member State had completed the work of placing demand and supply-side resources on an equal footing. Aggregation, particularly the independent aggregation, was only emerging in a limited number of Member States (MS)[1].

In the meantime, the new Electricity (Recast) Directive 2019/944 has come into force, and Article 17 addresses Demand Response through aggregation:

> §1 Member States shall allow and foster participation of demand response through aggregation. Member States shall allow final customers, including those offering demand response through

[1] https://publications.jrc.ec.europa.eu/repository/handle/JRC101191

aggregation, to participate alongside producers in a non-discriminatory manner in all electricity markets.

Further, the new entity of independent aggregator is recognized:

> §3(a) Member States shall ensure that their relevant regulatory framework contains the right for each market participant engaged in aggregation, including independent aggregators, to enter electricity markets without the consent of other market participants.

Right now, industrial consumers are the most engaged with Demand Response and demand-side flexibility, and the industrial loads and distributed generators are the assets that enable participation. Flexibility is monetized in TSO ancillary services (and capacity mechanisms, if applicable), which are also the value streams most easily accessible by flexibility providers[2]. DSOs also recognize that active consumers who use their flexibility in the optimal operation of the grid are part of the smart grid and should be supported with management platforms[3].

It is worth mentioning that explicit DR can be a tool for congestion management as well. When electricity demand and supply are not well-matched, or when the amount of required energy exceeds the capacity of the grid lines, the quality and stability of the electricity in the grid decreases for all participants, and the risk of failure in the system increases. Avoiding this situation involves congestion management measures such as modifications and reinforcements in the network, but also generation rescheduling and curtailment of load transactions. Regarding the contribution from on the part of consumption, its modification upon request through explicit DR can contribute to investment deferral for DSOs and TSOs. In most of the EU, constraint management services through DR are still at the trial stage, with the notable exception of the Netherlands, where these services allow the participation of demand-side flexibility and aggregation[4].

While the participation of large facilities in explicit DR is a common business practice, the participation of small consumers is just emerging, and it is encouraged to varying levels across the EU. In France, for instance, of the maximum volume contracted for DR in 2022, roughly half is reserved for small consumers (under 1 MW)[5]. Some of the largest DR potential for small end-consumers lies in heating and cooling (e.g., heat pumps), but also in various other dispatchable loads such as home appliances. Adding behind-the-meter charging and generation, as well as EV charging, in particular, diversifies the possibilities to engage in explicit DR.

The most significant technical precondition for participating in explicit DR is the availability of smart meters, namely the second generation (2G) smart meters that allow 15min time frames, compared to the 1h time frames provided by the previous generation. As of 2018, about 10% of households in the EU were equipped with smart meters, and by 2024 it is expected that almost 77% of European consumers will have a smart meter for electricity[6]. However, the deployment is uneven across the EU, seeing as the outcome of the cost-benefit analysis was unfavourable in some MS (e.g., Belgium).

1.2 Independent aggregators

Small end-users are beneficiaries of the opportunity to aggregate because, in the present power system, this is how they can participate in the markets with their explicit DR[7]. The function of pooling resources (e.g., aggregating consumer loads) can be performed by the retailer, who is naturally well-positioned to access, collect, and utilise the flexibility resources of its customers efficiently. However, retailers may also lock in customers with price-based mechanisms (implicit DR) that are difficult to negotiate and prevent the small users in particular from realizing the value of their flexibility.

An *independent* aggregator (IA), on the other hand, can offer an alternative that empowers small users to understand the value of their flexibility better and engage in DR through all the options available to them. The new entity of the independent aggregator is enshrined by Article 17 of the EU Directive 2019/944, and the transposition of the Directive into national legislation in the MS is ongoing. If the IA is enabled to access the market without prior permission from the retailer, as the Directive foresees, this also supports competition on

[2] https://smarten.eu/eu-market-monitor-for-demand-side-flexibility-2020
[3] http://www.cedec.com/en/documents/directory/2021_117
[4] https://cdn.eurelectric.org/media/5557/flexibility-final-report-2021-030-0531-01-e-h-9A846946.pdf
[5] https://www.services-rte.com/en/news/launch-of-demand-response-call-for-tenders-2022.html
[6] https://data.europa.eu/doi/10.2833/492070
[7] https://www.entsoe.eu/Technopedia/techsheets/aggregation-of-small-scale-demand

the electricity markets in which the customer should be allowed to have multiple contracts with different market participants without one foreclosing the other.

IA can further make use of value stacking as well as offer a variety of services (including, e.g., distributed storage) based on the resources of the customers they aggregate.

The variety of possible business models poses a number of challenges to the existing market model in the form of new roles and rules that have yet to be defined. For instance, whether an aggregator should be responsible for (and thus, pay for) the costs of the unmatched positions they cause for balance responsible suppliers[8]. In order to accommodate this new player in the market, the TSOs and DSOs are pushed to improve their coordination through information sharing and collaboration[9].

Therefore, it is no surprise that there is a lack of standardization in the definition of the aggregator role and in the contractual relationship with the supplier across the EU. Most of the MS have already introduced the entity of aggregator in the relevant regulation of electricity markets, but the secondary legislation and adaptation of market rules, procedures, responsibilities and business models for the DR are yet to be drafted in many of them. Compensation schemes, prequalification requirements, technical modalities, baseline calculation methods are just a few technical parameters that require further work across the EU.

So far, IA cannot participate in all markets everywhere in the EU. In fact, their eligibility to participate in markets is the most advanced only in Germany, France, Hungary, and Slovenia (day-ahead and intraday, balancing, redispatching and congestion management for TSOs, congestion management for DSOs, other services to DSOs). Another category of MS comprises Estonia, Ireland, Italy, Lithuania and Romania, where IA are only eligible to participate in day-ahead, intraday and balancing markets[10].

However, while a regulatory framework and eligibility to access the markets are essential for engagement in explicit DR and aggregation of small loads, evidence shows that it is not sufficient. Of the countries enumerated in the first category above, only in France does a real environment exist for independent aggregators of small loads. A particular case is that of Hungary, where the legislation is very new and the local appetite for aggregation has been found to be high (number of registered aggregators reaching 21 within months, at the time of writing), but the engagement in explicit DR has been historically very low and the business case for small-load aggregation is unclear yet. On the other hand, engagement in explicit DR and aggregation can be found to be high even if the access is not ensured on all markets (e.g., Estonia).

1.3 Implicit DR, Explicit DR, and Independent Aggregators

Engagement in Demand Response as such is a fairly common practice across the EU, even for small end-users.

However, DR is often understood as *implicit* DR, in which customers react to price signals by shifting their consumption patterns to minimize their bills. Adapting the use of household appliances to day/ night tariffs is a popular basic way of participating in implicit DR. Implicit DR can be offered by suppliers but cannot be addressed by aggregators.

Engagement of small end-consumers in *implicit* DR can drive or be driven by the adoption of smart meters and can educate consumers towards a more conscious consumption – both of which indirectly enable the adoption of *explicit* DR. At the same time, as retailers are the only entity that can offer implicit DR, this can also have a lock-in effect for customers who would not take the further step towards *explicit* DR.

On the other hand, when enabled to engage in *explicit* DR, consumers can aggregate their loads, but also generators and storage. Depending on their configuration and on whether they are behind-the-meter, the aggregated assets can result in a variety of entities ranging from aggregated loads alone to VPPs, distributed storage, V2G options, power-to-X. In search for a business case, aggregators of assets can engage in value stacking (wherever they are permitted), making the scope of *flexibility services aggregators* a loosely defined one. Wherever engagement in explicit DR is possible, aggregators were found to be the market creators[11].

[8] https://www.ceer.eu/flexibility-procurement.
[9] https://eepublicdownloads.azureedge.net/clean-documents/SOC%20documents/SOC%20Reports/210957_entso-e_report_neutral_design_flexibility_platforms_04.pdf.
[10] https://www.acer.europa.eu/electricity/market-monitoring-report.
[11] https://smarten.eu/eu-market-monitor-for-demand-side-flexibility-2020

However, in order for the market to flourish, the rules regarding baseline calculation, compensation, and responsibilities need to be clear and not constitute barriers for the new players. As evidence from France illustrates, even if markets have been open for DR from small users since 2007, and the potential for DR is significant, including electric heating from up to 7 million homes, in reality, the participation is small and decreasing[12].

1.4 Scope and aim of this report

In this context, the aim of this report is twofold. First, it traces the status of Demand Response across the Member States, with a particular focus on *explicit* DR. Second, it outlines the status of the transposition of Article 17 of EU Directive 2019/944 and presents the situation of independent aggregators (IA) in the MS.

Additionally, seeing as the small prosumers are encouraged and enabled to participate in the electricity system with their production, storage and load, they constitute a relevant segment to be analysed.

Therefore, this report outlines the status of explicit DR and of IA in the MS, with regard to small active consumers, and examines the enablers and barriers to both.

At the end of 2020 and in the first months of 2021, the JRC has carried out a survey regarding the transposition of Article 17 of the Directive 2019/944. In order to reach findings that reflect the experience on the ground, stakeholder groups that were approached with questionnaires were NRAs, utility companies, aggregators, as well as experts from academia and industry associations.

[12] https://dr4eu.org/wp-content/uploads/2021/07/workshop6-balancing-markets.pdf

The form and method of the questionnaire used for the previous DR Report have been maintained in order to track progress with regards to the status of DR in the EU. The novelty introduced in this report is the focus on small (e.g., residential) end-users and the status of independent aggregators; therefore, the questions were adjusted to address this scope. Detailed explanations about technical modalities, clarification of market structures and the definition of key concepts can be found in Annexes

Annex 1: Introduction to Demand Response).

A total of 57 answers have been recorded.

In addition to the compilation of written answers, further expert interviews were carried out, as well as new desk research.

As a result, each country fiche addresses the status of explicit DR and of independent aggregators in the MS, with regard to small active consumers, and examines the enablers and barriers to both. The indicators are summarized and analysed in the Conclusions.

2 AUSTRIA

Box 1. Austria - practical info

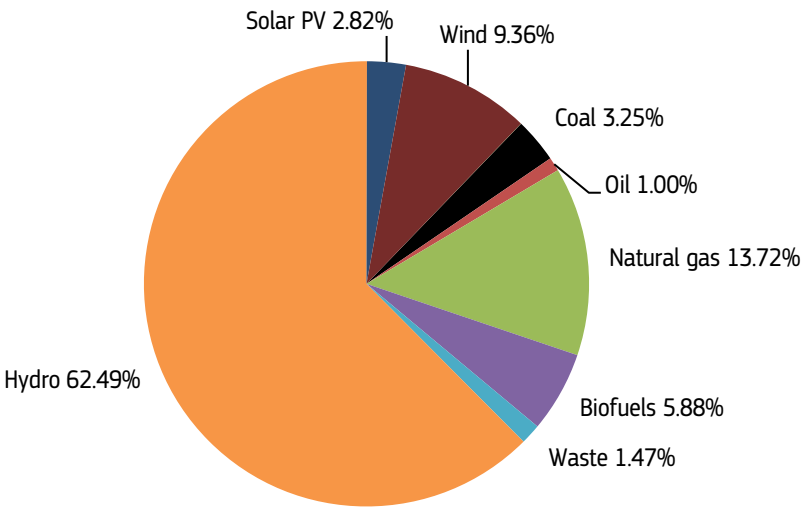
– Mission 2030, link.

– Government Programme 2020 – 2024, link

2.1 Background

The Austrian Climate and Energy Strategy 2030 (#mission2030) was launched in 2018 and contains the structure of Austria's energy and climate policy to 2030. The goals included in the strategy, among others, are 100% renewable electricity consumption, eliminating electricity import dependency and reaching a share of 46-50% renewable energy in the total primary energy supply. In order for this target to be reached, #mission2030 includes 12 flagship projects such as: Renewable Heat, 100 000 Roof-Mounted Photovoltaics and Small-Scale Storage Programme, Green Finance, Energy Research Initiative I: Building Blocks of the Energy System of the Future and Energy Research Initiative II: Mission Innovation[13].

Figure 3. Austria's Electricity generation by source 2020.



Source: IEA, 2020.

According to the Austrian NECP, the grid reserve is planned to be included in the Electricity Industry and Organization Act. Industrial plants and smaller renewable generation units can be integrated when grid reserve is reduced to 250-500 kW. This applies to industrial demand-side measures and allows aggregated delivery from decentralized structures through pooling. The current government program includes even more ambitious targets, and it is expected that stable conditions will support aggregators, whereas the reduction of bureaucracy will aid participation in the market. The simplification of grid tariff structures will make it more transparent for consumers so that they can consider future dynamic pricing. Aggregators and third parties will need a clear legal framework.

In 2019, research facilities and experts from 63 Austrian companies created "Mission Innovation Austria", a plan regarding the implementation of energy research initiatives during 2020-2030[14]. Briefly, the plan contains three missions for developing essential components of the future energy systems, identifies 14 innovation targets for completing these missions, which are mostly on energy efficiency and flexibility, and

[13] https://www.iea.org/reports/austria-2020.
[14] https://nachhaltigwirtschaften.at/de/e2050/highlights/mission-innovation-austria-fokusgruppen.php

describes 39 specific development plans, supported from private and public funds and led by the involved companies.

2.1.1 Players and context

In Austria, there are two TSOs: Austrian Power Grid AG (APG), which operates the greatest share of the network, and Vorarlberger Übertragungsnetz GmbH (VUEN). There are currently 120 electricity distribution network operators, and each is responsible for the distribution of electricity in a specified geographical part of the country.

APG participates in the ownership structure of the balance group coordinator APCS Power Clearing and Settlement AG. Key players in the Austrian electricity market include Verbund AG and EVN. Verbund is Austria's leading electricity company and of the largest producers of hydropower electricity in Europe. Electricity players from the Austrian market can participate in both Energy Exchange Austria (EXAA) as well European Power Exchange (EPEX Spot), in order to fulfil their needs on day-ahead market.

As of 2018, the common German-Austrian bidding zone where electricity was traded freely was broken up, in an effort to ease grid congestion by limiting loop flows[15].

2.1.2 Prosumers and flexibility services

Through the flagship project of Mission 2030, "100 000 Roof-mounted Photovoltaics and Small-scale Storage Programme", the government offered support for the deployment of small storage systems together with PV generation units with the aim that the future buildings cover a greater share of their energy consumption. At the same time, the self-consumption of renewable electricity is promoted. This project aims, among other things, to create framework conditions for microgrids, increase the use of roof areas by installing photovoltaic panels, and eliminate the tax on self-generated electricity[16]. The current government programme sets out a 1-million-roofs-photovoltaic programme based on the Renewable Energy Expansion Act.

On 1 February 2021, APG, together with TSOs from neighbouring countries Swissgrid (Switzerland), Terna (Italy) and TenneT (Germany and the Netherlands), joined the crowd balancing platform EQUIGY. The purpose of the digital "crowd balancing platform" EQUIGY is to enable small players to participate in grid balancing, as well as to aid new participants to manage the energy transition[17].

2.2 Transposition of Article 17 of the EU Directive 2019/944

Transposition into national law is in preparation. The consultation on the transposition closed in late 2020 (Republik Österreich Parliament, 2021) and the new package defines a prominent role for energy communities[18]. According to the analysis of the local industry association Oesterreichs Energie, the new draft proposes a focus on self-consumption in the energy communities, whereas in regards to the flexibility resources at the system level, green hydrogen has been highlighted[19]. The EAG (Renewable Energy Expansion Act) went into force mid-2021[20].

2.3 Demand response and aggregators

Access for DR aggregators to various electricity markets is already ensured, but there are no mechanisms in place for compensating BRPs for any deviations caused by DR activation.

[15] https://web.archive.org/web/20220524050900/https://www.bundesnetzagentur.de/SharedDocs/Pressemitteilungen/DE/2018/20181001_E-Control.html

[16] https://www.bundeskanzleramt.gv.at/dam/jcr:903d5cf5-c3ac-47b6-871c-c83eae34b273/20_18_beilagen_nb.pdf

[17] https://web.archive.org/web/20210723221808/https://www.apg.at/de/media-center/presse/2021/02/02/apg-tritt-europaeischem-konsortium-equigy-bei

[18] https://www.bmk.gv.at/service/presse/gewessler/20210311_eag.html

[19] https://oesterreichsenergie.at/downloads/publikationsdatenbank/detailseite/energiebrief-02-2021

[20] https://www.parlament.gv.at/PAKT/VHG/XXVII/ME/ME_00058/index.shtml.

2.3.1 Status of regulation concerning aggregators

In Austria, aggregators can act in cooperation with the suppliers of residential consumers and participate in the markets. Residential customers are enabled (through aggregation) to access the balancing market. Access to the wholesale market (both day-ahead and intraday) via supplier is based on 15 min measured values.

Aggregators of small end-users could be implemented in the future with the Renewable and Citizens Energy Communities (REC and CEC) introduced recently in Austrian law. These energy communities would be entitled to offer aggregator services, amongst other services. The new EAG law in force since mid-2021 provides only that REC and CEC are allowed to offer aggregation services.

Regarding commercial aggregators bundling loads of residential consumers:

— Aggregation is limited to REC and CEC. There is currently no definition of "Aggregation" in Austrian Regulation/Laws

— Participation of residential customers in the electricity market is practically limited to very few offers of dynamic tariffs.

The current law defines aggregators as pooling generation and consumption (min 1 MW capacity) and it is not clear whether the new law will address this limitation.

Participation in the wholesale market requires establishing a balance group, which has high financial requirements. This means that regulators allow the participation of aggregated residential loads in balancing and wholesale markets, but due to high transaction costs and very small flexibility potentials of households, aggregators are, in reality, interested in industrial consumers.

2.3.2 TSO Programmes

Regarding the balancing market, aFRR (secondary control) and mFRR (tertiary control) are generally open for aggregators, also aggregating residential loads. In aFRR, the minimum size of the (aggregated) load is 1 MW for the first bid, for the following bids 5 MW. In mFRR, the minimum size is 1 MW. Aggregators can participate in the market for congestion management at TSO-level with a minimum bid size of 1 MW.

APG was already working on an operational system in order to attract and integrate small customers in various markets. A flexibility platform was proposed in 2019 as a result of collaborations between the TSO and DSOs.

The participation of APG in EQUIGY gives access to know-how from the neighbouring countries, as the platform can be accessed both by aggregators and by operators[21].

2.4 Enablers and Barriers to Demand Response and Independent Aggregators

According to the Austrian NECP, steps have been planned in order for aggregators to be attracted by the sector:

- units of grid reserve will be reduced to 250-500 kW, enabling smaller units to be integrated along with industrial plants
- reduction in bureaucracy and stable conditions for aggregators
- simplification of tariff structures and more transparency for end consumers, taking into account future dynamic pricing.

According to the "Mission Innovation Austria", a strengthened DR participation is an indirect consequence of the ambitions for digitalization of the network, which is in turn part of the smart grids' strategy.

[21] https://web.archive.org/web/20210723221808/https://www.apg.at/de/media-center/presse/2021/02/02/apg-tritt-europaeischem-konsortium-equigy-bei

The introduction of Citizens Energy Communities and Renewable Energy Communities in the Austrian law will be able to provide aggregation services and support to aggregators of small loads. The existence of platforms where small players can be active and participate in balancing markets constitutes an advantage.

While aggregators and DR are enabled and legal, practical hurdles are still in place.

The roll-out of smart meters stands at 27.2% (at the end of 2020) and the commitment is to reach 95% by 2024[22], meaning that before reaching that target in 2024 end-users encounter this technological constraint towards engaging in explicit DR before 2024.

Structurally, the Austrian system currently relies on hydro power generation for its flexibility needs, and according to the draft of new legislation, green hydrogen is expected to contribute towards balancing the additional growth of the RES share.

Hence, as of 2021, Austrian aggregators are mostly interested in industrial consumers because of the small flexibility potential of households and high transaction costs, even if regulators allow the participation of residential loads in the wholesale and balancing markets. There are no mechanisms in place for compensating balance responsible parties for any deviations caused by DR activation. Participation of residential customers in the electricity market is practically limited to very few offers of dynamic tariffs.

[22] https://www.e-control.at/documents/1785851/1811582/Monitoringbericht_Smart+Meter_2021.pdf

3 BELGIUM

Box 2. Belgium - practical info

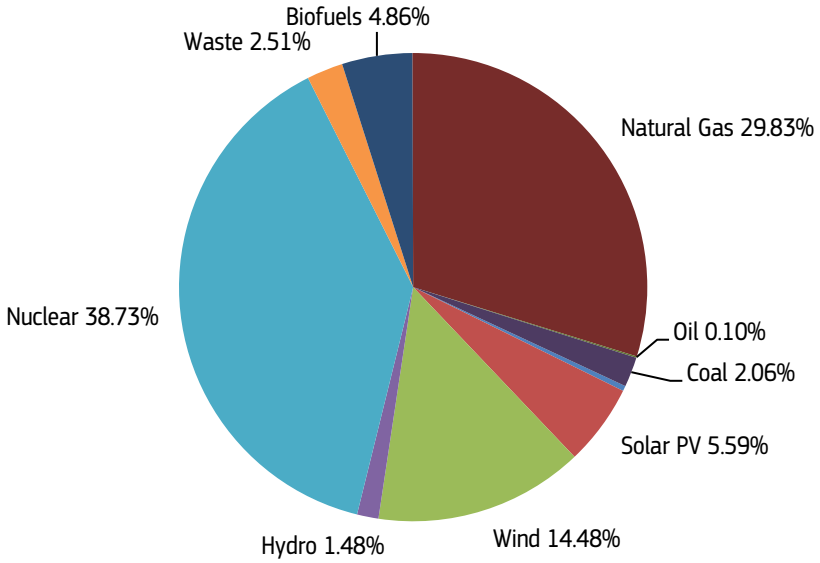
– Elia 2021, Flexibility and Adequacy study, link

– Market Implementation Guide, link

3.1 Background

The Belgian electricity grid is one of the most interconnected in Europe. To meet electricity demand, Belgium relies on nuclear generation that is to be phased out between 2022 and 2025 and on imports from neighbouring countries[23]. Coal-fired electricity generation was phased out in 2016. Nevertheless, Belgium still relies on fossil fuels in the form of gas-fired. Since the cost-benefit analysis of smart meters deployment was not fully convincing for all Belgium regions, the smart meters penetration rate is still relatively low[24]. In Wallonia, the smart meters rollout is to be completed by the end of 2029, whereas in Flanders only in 2034[25].

Figure 4. Belgium's Electricity generation by source 2020.



Source: IEA, 2020.

The Belgian electricity system is facing some key challenges, including[26]:

- The risk of shortages in electricity supply due to the phasing out of nuclear-fired electricity generation and high dependence on imports
- Limited domestic renewables potential referring both to wind and solar
- The necessity to boost the flexibility of the electricity system in particular through booting the DR and establishing the capacity market mechanism.

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23 In 2020, the export and import were nearly balanced due to a lower load as a result of Covid-19 pandemics and higher renewables share.

24 https://cdn.eurelectric.org/media/5089/dso-facts-and-figures-11122020-compressed-2020-030-0721-01-e-h-6BF237D8.pdf.

25 https://ec.europa.eu/energy/sites/ener/files/documents/adopted_opinion_be_en_0.pdf.

26 Elia 2021, Flexibility and Adequacy Study.

3.1.1 Players and context

Elia is the only TSO in Belgium. At the distribution level, there are numerous DSOs active, most of them in Wallonia.

In terms of the regulation, there is one national regulator (CREG) and three regional regulators at the federal countries' level, which leads to some inefficiencies in terms of, e.g., different support schemes and prolonged decision making.

The wholesale markets are run by EPEX SPOT Belgium and Nordpool, and the balancing market is coordinated by the TSO.

3.1.2 The participation of DR and prosumers in the market

The Belgian electricity market has achieved significant progress regarding DR participation. Since 2013 the Belgian TSO Elia has expanded a broad range of DR programmes that are run automatically. There are several DR aggregators active in the Belgian electricity market, including providers of DR services (e.g., ReStore, Flexcity, Next Kraftwerke).

In terms of prosumers' development, Belgium did not set up an explicit goal. However, some support programmes are available both on the federal and regional levels[27]. Prosumers can decide whether or not to be aggregated and whether to supply the generated electricity into the grid at peak times.

3.2 Transposition the EU Directive 2019/944

Belgium has transposed Article 17 of the EU Directive 2019/944 into the national regulation to a significant extent.

In particular, the role of the DR aggregator is defined in the regulation (as "flexibility service provider"). In the draft decree proposed by the Flemish parliament in February 2021 regarding the transposition of the Directive 2019/944 the flexibility aggregator is added as an entity allowed to participate in the markets, and it is expected that energy communities can soon perform the role of aggregators as well[28].

3.3 Demand response and aggregators

Aggregated end-users can access the balancing markets via DR aggregators. The balancing markets are designed based on the principle of technology neutrality. Barriers hindering DR participation in the balancing markets such as, amongst others, symmetric bidding requirements and insufficient granularity of the products were removed. DR can also participate via DR aggregators in the wholesale markets. However, certain barriers still exist in this context for residential end-users (both regarding access to the balancing and wholesale markets). Specifically, certain metering requirements need to be met, synthetic load profiles are still used and DSOs do not currently allow participation of low-voltage service points (except for DR aggregators).

Within the "transfer of energy—ToE" framework, electricity customers have the right to valorise their flexibility through their supplier or through a flexibility service provider of their choice. This market model obliges flexibility service providers to neutralize the impact of the activation of DR on the imbalances caused for the supplier or the balance responsible party[29]. Through ToE, flexibility service providers first could access the primary and secondary reserve markets, as well as Day-ahead and intra-day markets[30]. More recently, the framework has been aligned close with the EU rules for FCR, FRR and balancing capacity markets. The rules for participation in ToE as of July 2021, include technical modalities, penalties, baseline calculations and compensation[31].

DSOs do not contract services from DR aggregators.

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27 https://web.archive.org/web/20220121124705/https://www.solarpowereurope.org/belgium-country-profile/..

28 https://docs.vlaamsparlement.be/pfile?id=1668780.

29 https://www.elia.be/en/electricity-market-and-system/electricity-market-facilitation/transfer-of-energy.

30 https://economie.fgov.be/sites/default/files/Files/Energy/Belgian-electricity-market-Implementation-plan.pdf.

31 https://www.elia.be/-/media/project/elia/elia-site/electricity-market-and-system---document-library/transfer-of-energy/2021/20210603_toe-rules_clean-1_nl.pdf.

The aim of transforming the market at the distribution level is supported by a new data clearing house that enables data exchange among market actors (Atrias) and by a new market communication standard that facilitates the integration of smart meters and distributed generation (the Market Implementation Guide)[32].

3.4 Enablers of and barriers to Demand Response and Independent Aggregators

Even though the National Energy and Climate Plan formulates cautious targets, the favourable political and legal environment and a systemic need for flexibility constitute a structural enabler for end-users to engage in explicit Demand Response. The technical prerequisites regarding the use of DR are largely defined, and in Belgium, there is a considerable track record regarding the use of industrial and commercial DR and aggregation.

However, the low penetration rate of smart meters and the slow pace of roll-out foreseen over many years prevents the engagement of end-users from reaching its full potential. The definition of a framework for handling the impact of activations requested by the DSO for local congestion management on the Balance Responsible Parties / imbalance in the balancing zone is lacking, and a framework to use non-certified metering data is not available

The fact that the DSOs do not use DR slows down the end-user engagement in explicit DR, but, in this context, the independent aggregators benefit from less competition in the market.

[32] https://www.vreg.be/nl/gegevensuitwisseling-tussen-marktpartijen.

4 BULGARIA

Box 3. Bulgaria - practical info

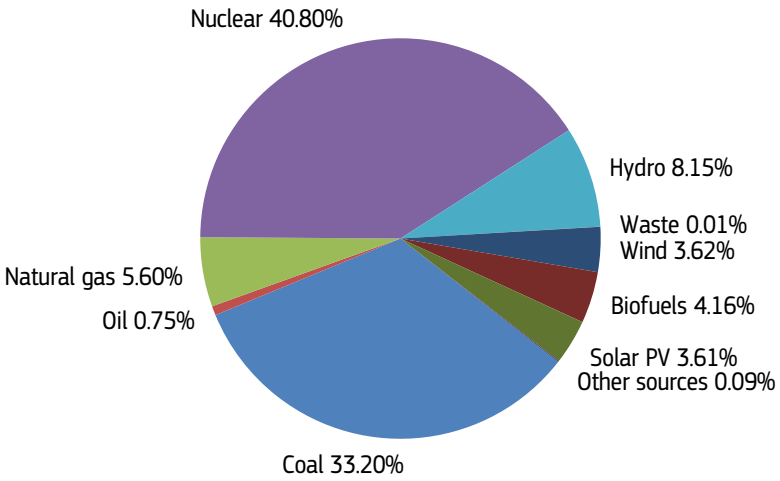
– Integrated Energy and Climate Plan of the Republic of Bulgaria 2021 – 2030 link;

– Agency for Sustainable Energy Development in Bulgaria link.

4.1 Background

The complete liberalization of the electricity market is anticipated to be reached over the next three to five years. For small industrial consumers and households, the process of phasing out the subsidised prices started in 2020. A short-term measure is a derogation under Article 5(6) of Directive (EU) 2019/944 on common rules for the internal market for electricity until the retail market is fully liberalised[33].

Figure 5. Bulgaria's Electricity generation by source 2020.



Source: IEA, 2020.

For the moment no detailed timetable and plan for smart meters rollout that concerns the electricity and gas supply (distribution). As well, no substantial information and timeframes for other objectives such as demand response, storage and non-discriminatory participation of renewable energy[34].

4.1.1 Players and context

Main participants to the market are the 3 DSOs: CEZ Distribution Bulgaria AD, ENERGO-PRO Varna EAD and EVN Bulgaria EAD, and the TSO Elektroenergien Sistemen Operator (ESO EAD).

The Bulgarian Energy Holding EAD (BEH) is the successor of the state-owned oil and gas company, and the largest state-owned organization. Among others, the holding is engaged in electricity generation, supply and transmission. Part of the holding is Natsionalna Elektricheska Kompania EAD (NEK EAD), the largest electricity generator from renewable sources in Bulgaria. The Independent Bulgarian Exchange (IBEX) provides access through its platforms to day-ahead market, intraday market and bilateral contracts trading (and auctions).

[33] https://ec.europa.eu/energy/sites/default/files/documents/bg_final_necp_main_en.pdf.
[34] https://ec.europa.eu/energy/sites/default/files/documents/staff_working_document_assessment_necp_bulgaria_en.pdf.

4.1.2 Prosumers and flexibility services

The market for distributed solar PV in Bulgaria has grown in spite of the fact that during the years, frequent retroactive changes were made to the feed-in tariff policy, which generated uncertainty in investments. In June 2021, there were around 2 273 PV generation units of up to 1 MW connected to the grid[35]. In addition to that, customer-sited PV installations had a positive evolution in the recent past.

Prosumers in Bulgaria can use PV resources in one of the four types of contracts:

— Feed-in tariff projects: all generated electricity is given to the grid under a long-term contract;

— Pure self-consumption projects designed only for self-consumption, without the possibility to inject surplus production into the grid;

— Prosumer projects where consumers use part of their generation to self-consumption as well the surplus can be exported to the grid and

— Merchant projects in this case the project was developed in order to sell the output on the free market or via bilateral contracts[36].

For residential customers, one or two tariff prices are available, whereas business customers can choose between three tariffs[37].

Apart from the Standard Balancing Group, the Special Balancing Group coordinates renewable electricity producers operating power generating facilities with a total installed electrical capacity of less than 1 MW. The public supplier created a virtual trading balancing group to/from which exchange schedules are communicated in order to aggregate all sales and purchases made by it, in line with the applicable regulations and rules[38].

4.2 Transposition of Article 17 of the EU Directive 2019/944

Article 17 of the EU Directive 2019/944 is not yet transposed.

4.3 Demand response and aggregators

Aggregation and demand response are not yet regulated, but a dynamic pricing framework has been introduced, which can raise the responsibility of end consumers in their electricity consumption habits and may emphasize the country's commitment to a liberalized retail market.

4.3.1 Role of the aggregator

Bulgaria plans to adopt legislation in order to increase energy system flexibility by allowing demand response, as well as plans to establish conditions that encourage active consumer behaviour. The plans aim to create opportunities for energy communities or associations through aggregators, but also in order to attract and increase the active involvement regarding demand response in different market segments[39].

4.3.2 Wholesale markets

The wholesale market cannot be accessed through demand response programs.

Steps forward towards electricity market liberalization have been taken, in line with the EU Third Liberalisation Package. Electricity generated for the free market is traded only via Bulgarian Independent Energy Exchange (BNEB) platforms, as a result of the legislative amendments adopted in early 2018.

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35 https://portal.seea.government.bg/en/ByProducerAndEnergyObject.

36 https://www.e3analytics.eu/wp-content/uploads/2021/06/E3A_Bulgaria_Analysis_of_Distributed_PV_ENG_FINAL.pdf.

37 CEZ Electro Bulgaria AD: https://www.cez.bg/en/prices/electricity-prices/for-supply.html; ENERGO-PRO Varna EAD: https://www.energo-pro.bg/en/regulated-market/household-customers/applicable-electricity-prices; EVN Bulgaria EAD: https://www.evn.bg/Home/Electricity.aspx.

38 https://www.nek.bg/index.php/en/our-business/public-electricity-supplier/special-balancing-group.

39 https://ec.europa.eu/energy/sites/default/files/documents/bg_final_necp_main_en.pdf.

4.3.3 Within the TSO and DSOs

The procurement of balancing services is done via daily auction. Since 30 September 2021, ESO has been conducting auctions only with a contracting period of one day for all legally required balancing capacities (FCR, aFRR and mFRR). ESO has developed a web-based platform and rules in order to be able organize auctions for balancing capacities procurement, which are in line with requirements of the European legislation. Applicants can be prosumers, generation units, storages and aggregators[40].

4.4 Enablers and Barriers for Demand Response and Independent Aggregators

The regulatory framework for demand response and aggregators in Bulgaria does not exist for now. A detailed timetable and plan for smart meters rollout are not in place, and information and timeframes for objectives as non-discriminatory participation of renewable energy, demand response and storage are not available.

Full electricity market liberalisation is forecasted to be reached over a duration of three to five years.

However, by putting in place a platform for auctions for balancing capacities procurement, the TSO has made a step forward to enable explicit DR even if, at the moment, there are no aggregators.

[40] http://www.eso.bg/doc?news=426.

5 CROATIA

Box 4. Croatia - practical info

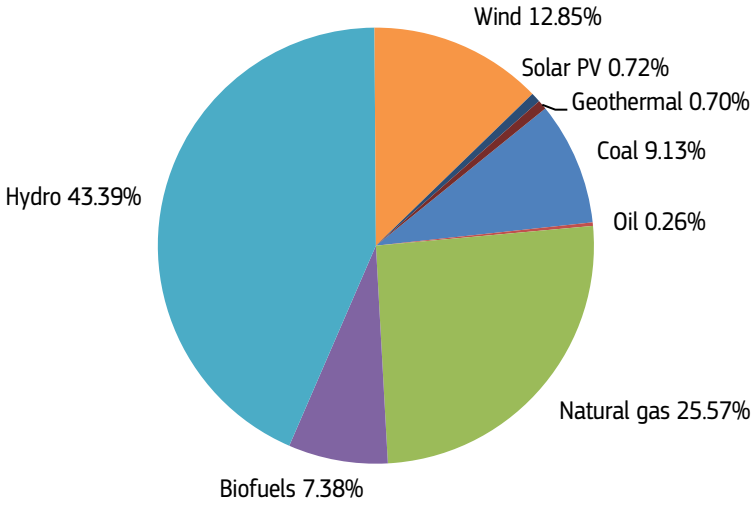
– Integrated National Energy and Climate Plan for the Republic of Croatia, link.

– Annual Report on the Activities of the Croatian Energy Regulatory Agency for 2020, link

5.1 Background

Low liquidity characterizes the Croatian electricity market, which is mostly controlled by state-owned energy holding company HEP. Distribution, transmission and production are unbundled. In case end consumers have the necessary smart meter, they can opt for electricity at dynamic tariffs.

Figure 6. Croatia's Electricity generation by source 2020.



Source: IEA, 2020.

Among the priority investments regarding electricity distribution is the rollout of smart meters by 2025, which is defined in the Energy Development Strategy and whose analytical backgrounds have been developed. Pilot projects for smart metering are foreseen, in which the active participation of consumers will be explored in order to obtain additional information on the characteristics of grid users and possibilities of their active participation. Additional reversible power plants with a capacity of 150 MW are planned by 2030, in order to strengthen the regulatory scope of the electricity system and to increase the energy storage capacity in the grid[41].

5.2 Players and context

Hrvatski Operator Tržišta Energije (HROTE) is the Croatian Market Operator. The TSO is Hrvatski operator prijenosnog sustava d.o.o. (HOPS) and HEP operator distribucijskog sustava d.o.o. (HEP-ODS) is the only DSO. The regulatory agency of Croatia is Hrvatska energetska regulatorna agencija (HERA).

Croatian Power Exchange Ltd. (CROPEX), equally co-owned by HROTE and HOPS, organizes the day-ahead and intraday markets, where it acts as Central Counter Party between sellers and buyers of electricity.

[41] https://ec.europa.eu/energy/sites/default/files/documents/hr_final_necp_main_en.pdf.

5.2.1 Prosumers and flexibility services

At the end of 2020, out of 3 040 metering points in Croatia, 644 were prosumers with a total connection capacity of 79 MW in the delivery direction, and they delivered during the year an amount of 29 GWh of electricity to the network. Additionally, 851 metering points have the self-supplying status compared to 146 one year earlier. Self-supplying generation units delivered 1.9 GWh of electricity to the network in 2020, a fairly high value considering the fact that this category was introduced into legislation in 2019[42].

Croatia targets to achieve 300 MW from PV prosumers by 2030. Towards this objective, prosumers are incentivized with the abolition of tax for self-produced electricity below 25 000 kWh, and with aid for small-scale solar generation and storage. The long-term solar output for all unit sizes (not only small generation units) is forecasted to reach 768 MW by 2030 and 1 245 MW by 2040[43].

5.3 Transposition of Article 17 of the EU Directive 2019/944

Article 17 of the EU Directive 2019/944 is technically transposed in the Croatian Law through the new Act on Electricity Market passed in October 2021. It requires consumers participating to DR to pay a fee to their supplier.

5.4 Demand response and aggregators

According to the current electricity market model, residential end-users are supplied by suppliers (in other countries referred to as retailers). A supplier is, by definition (i.e., by its activities on the market), the aggregator of its customers' loads and consumptions. Suppliers also buy excess of their customers' self-production in the case of prosumers.

5.4.1 Status of the regulation concerning aggregators

The definition of aggregators is provided by the Power system balancing rules adopted by the TSO HOPS Ltd. and approved by the Croatian Energy Regulatory Agency (HERA). The definition recognizes an independent aggregator that is not affiliated to the customer's supplier (i.e., retailer). Nevertheless, a network user must inform its supplier (i.e., retailer) as well as the TSO or DSO before joining an aggregator's portfolio.

5.4.2 Within the TSO and DSOs

Aggregator's portfolio may comprise network users connected to transmission or/and distribution network, i.e., an aggregator may aggregate resources from both networks. Thus, residential end-users can participate in the balancing and ancillary electricity markets through an aggregator. According to the power system balancing rules, the aggregator may offer and provide balancing services in the balancing capacity market and balancing energy market. Currently, there is no ancillary electricity market at the DSO level.

Starting with 14 December 2020, as a result of a previous pilot project Securing mFRR balancing service from Demand Side Response ('DSR'), HOPS conducts the process of procuring mFRR balancing capacity and/or balancing energy through public tender[44].

All individual network users and aggregators who have signed a Balancing Service Agreement with the TSO can be balancing service providers[45].

According to HEP ODS, households have four tariff models at their disposal: the Blue tariff model (for customers with single-tariff or multi-tariff meter), the White tariff model (for customers with a multi- tariff meter), the Red tariff model (for connected power more than 22 kW) and the Black tariff model (so-called "managed consumption"). The Black tariff model implies the delivery of electricity for the household category, where the supplier remotely determines the time of electricity use (energy is not available to the customer 24 hours a day). Due to the limited time in which electricity is delivered to the customer, the Black tariff model is

42 https://www.hera.hr/en/docs/HERA_Annual_Report_2020.pdf.
43 https://web.archive.org/web/20210522070924/https://www.solarpowereurope.org/croatia-country-profile/..
44 https://www.hops.hr/en/procurement-procedure-of-mfrr-balancing-capacity-andor-balancing-energy-for-through-a-public-tender.
45 https://www.hops.hr/en/balancing-services.

a supplementary tariff model. The model is applicable to consumers in households where the time of electricity use can be adjusted to the time in which electricity is available (storage heaters, boilers, etc.)[46].

5.4.3 Within the wholesale and retail markets

At the moment, the technical modalities on the use of Demand Response have not been developed by a national regulatory authority. End-users can participate in the market through aggregators.

The project bigEVdata was launched by HEP together with the University of Zagreb. The aim of the project is the development of a complete innovative solution that will integrate big-data modelling of the habits and behaviour of consumers who access charging stations, and that will enable the efficient use and management of the charging network for electric vehicles. The target of the project are companies in the area of electromobility[47].

5.5 Enablers and Barriers for Demand Response and Independent Aggregators

In Croatia, end-users have the possibility to engage in Demand Response, and independent aggregators are defined and recognized by legislation. Dynamic pricing has been available for some time.

The Energy Development Strategy foresees the introduction of advanced metering systems by 2025, and this is a priority for the distribution system. All individual network users and aggregators who have signed Balancing Service Agreement with the TSO can be balancing service providers. The TSO procures mFRR balancing capacity and/or balancing energy through public tender.

However, In Croatia, the electricity market is concentrated, and the liberalisation process is lagging behind.

Demand Response is not yet fully supported, and the technical modalities on the use of Demand Response have not been developed. Article 17 has been transposed but the fact that end-users engaging in DR are required to pay a fee to their suppler constitutes an important barrier by disincentivizing participation.

[46] https://www.hep.hr/ods/korisnici/kucanstvo/tarifni-modeli/34.
[47] https://bigevdata.eu.

6 CYPRUS

Box 5. Cyprus - practical info

– EuroAsia Interconnector link;

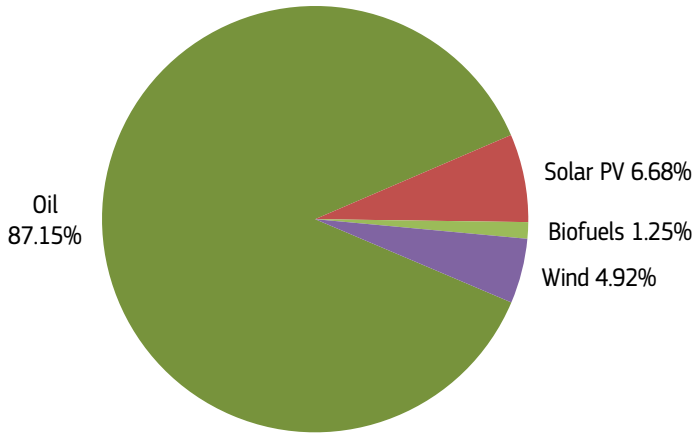
– Cyprus' Integrated National Energy and Climate Plan, January 2020 link

6.1 Background

Due to the geographical constraints of Cyprus as an island without hydrocarbon energy resources, the electricity generation relies on imported fuels, and the power generation system operates in isolation. Taking into consideration the challenges of electricity supply and generation on the island, demand response could offer solutions for flexibility and capacity resources.

The Memorandum of Understanding (MoU) was signed in March 2021 between the Ministers of Energy of Cyprus, Greece and Israel. It regards the cooperation of the three countries on the EuroAsia Interconnector Project of Common Interest (PCI3.10). The EuroAsia Interconnector will have a capacity of 2000 MW connecting these three countries and its first phase is expected to be operational by 2025[48].

Figure 7. Cyprus Electricity generation by source 2020.



Source: IEA, 2020.

6.1.1 Players and context

The Electricity Authority of Cyprus (EAC) is an independent, public corporation established in order to exercise and perform functions relating to electricity transmission, distribution, generation and supply. The Cyprus Energy Regulatory Authority (CERA) and Cyprus Transmission System Operator (CTSO) is the Management Unit of the Transmission System. EAC is also the owner of the distribution system.

The electricity market was designed based on the European market model Net Pool and regulated all sales and purchases of electricity on the entire market. This includes the balancing market, daily market and futures market. The intra-day market is expected to be included soon[49].

[48] https://euroasia-interconnector.com/signhistoriccooperation.
[49] https://tsoc.org.cy/electricity-market/the-electricity-market.

6.1.2 Prosumers and flexibility services

At the moment, final residential customers participate in the markets only through net-metering, net-billing and self-produced schemes.

The aggregated RES-only generation, according to the Trade and Settlement Rules (TSRs), is currently limited to a range between a minimum of 1 MW and a maximum of 20 MW. A new draft law has been submitted, which expands aggregation to sources from generation, regardless of the technology or fuel used, from storage systems and from demand response. The TSRs will be amended and reviewed accordingly. It is also foreseen that aggregators could participate in the reserve markets, balancing markets and wholesale markets to the same extent as conventional generators[50].

6.2 Transposition of Article 17 of the EU Directive 2019/944

Article 17 of the EU Directive 2019/944 is transposed in the Cyprus Law through the new Electricity Market Law passed in September 2021. §124 of the new law addresses explicitly Demand Response through aggregation. Apart from the primary legislation, certain provisions and amendments were promoted through the market rules and the transmission and distribution rules.

Technical modalities for the implementation of the use of demand response have been included in the market rules and the transmission and distribution rules.

6.3 Demand Response and aggregators

At the moment, Demand Response, aggregators and flexibility services are not supported by the electricity market in Cyprus.

Pilot projects carried out by the University of Cyprus and supported by EAC enabled dispersed prosumers to offer ancillary services to the DSO through controllable demand response[51]

6.3.1 Status of regulation concerning aggregators

The draft bill introduces the definitions of the “independent aggregator”, a market participant engaged in aggregation who is not affiliated to the customer's supplier; and of the “aggregator”, the natural or legal person participating in the electricity market engaged in aggregation, i.e., the activity combining loads or energy produced, including energy from storage systems, by more than one customer for sale or auction in any electricity market

6.3.2 Within the TSO and DSO

According to the provisions of the draft bill, the Cyprus Energy Regulatory Authority (CERA) determines by a regulatory decision the framework within which the participation of the Demand Response through aggregation is allowed and promoted. According to the regulatory decision, when the Cyprus TSO (TSOC) and the DSO procure ancillary services, they treat market participants engaged in the aggregation of demand response in a non-discriminatory manner alongside producers on the basis of their technical capabilities.

6.3.3 Within the wholesale markets

RES generators with a capacity limited to 20 MW operate outside the National Grant Schemes. According to CERA, these units can participate in the electricity market[52].

6.4 Enablers and Barriers for Demand Response and Independent Aggregators

The constrained island state of Cyprus counts as a structural enabler for demand response programs. The participation of end-users in these programs would be highly valuable for the energy system.

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50 Cyprus’ Integrated National Energy and Climate Plan, 2020.
51 Becoming energy self-sufficient using sustainable energy sources.
52 https://www.cera.org.cy/en-gb/ilektrismos/1167/electricity-market-participants.

The new law passed in 2021 brings Cyprus closer to a competitive operational market, made up of the forward electricity market, day-ahead market and balancing market. The intraday market will be included at a later stage. This is expected to create the solid ground for the implementation of demand response programs and attract aggregators to the market.

In the upcoming new legislation, it is expected that customers, including those who offer aggregated demand response services, can participate alongside the electricity producers in all electricity markets in a non-discriminatory manner.

However, the smart meter rollout in Cyprus is below 20%[53]. The Ministry of Energy Commerce and Industry is funding the installation and expansion of smart meters in households[54], and the tender for the smart meter infrastructure closed in November 2021[55], but the targets for the rollout are set for 2027, which prevents participation in Demand Response programs to the full potential before that date.

Regulatory barriers to independent aggregators are being addressed by the legislation currently under development.

[53] Distribution Grids in Europe, Facts and Figures, eurelectric 2020.
[54] https://meci.gov.cy/en/funding-programmes/list-of-the-ministry-of-energy-commerce-and-industry-s-funding-programmes.
[55] https://www.eac.com.cy/EN/EAC/Tenders/Pages/TenderViewer.aspx?tid=2794&tp=0.

7 CZECH REPUBLIC

Box 6. Czech Republic - practical info

– National Action Plan for Smart Grids 2019 – 2030, Updated NAP SG link;

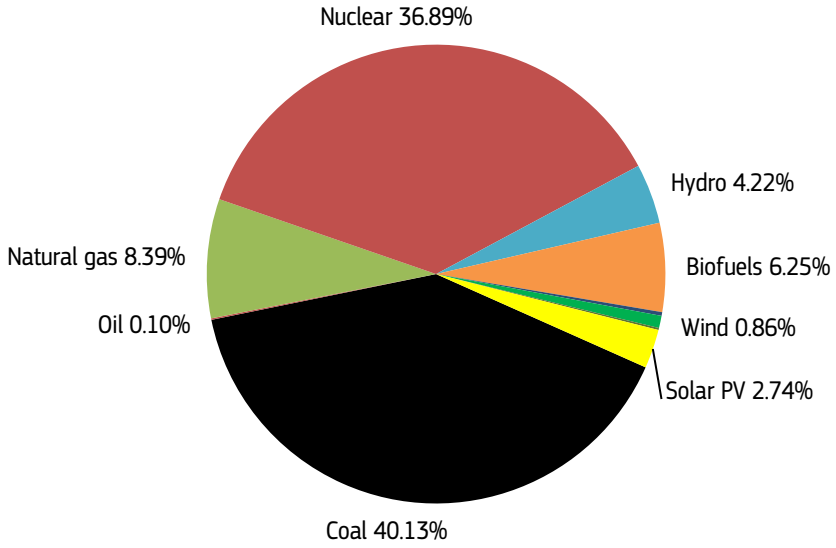
– National Energy and Climate Plan of the Czech Republic, November 2019 link.

7.1 Background

In the Czech Republic, the transition to a low-carbon energy future has been decided to include more nuclear power, for which a new bill has been signed in September 2021.

The National Action Plan for Smart Grids 2019 – 2030 (NAP SG) was approved in September 2019. Government Resolution No. 149 from 2015 offered the base for the NAP SG 2019-2030. Among the main objectives are the measures to create conditions for higher penetration of decentralized sources of electricity, especially from renewables, as well aggregation and electromobility[56].

Figure 8. Czech Republic's Electricity generation by source 2020.



Source: IEA, 2020.

In 2020 the main support to renewable electricity generation was offered through feed-in tariffs and green bonuses (feed-in premiums). Values for these are set annually by the Czech Energy Regulatory Office. The purchase price in case of feed-in tariff is the minimum guaranteed price, regardless of the market prices of electricity. The green bonus is offered as supplementary payment when the electricity is sold in the market or for self-consumption. Renewable electricity producers have to choose between these and cannot combine them. According to the draft revision of the Energy Act, feed-in tariffs will be eliminated for newly built renewable generation units. For units below 1 MW it is purposed to continue the green bonus scheme, but for generation units above 1 MW (above 6 MW in case of wind generation) is intended to organize auctions where the lowest subsidies will be selected.

7.1.1 Players and context

The electricity supply market in the Czech Republic has been liberalised since 2006, and end-consumers are able to choose their electricity supplier. ČEPS a.s., is the sole Czech Transmission System Operator (TSO) and there are 3 DSOs as follows: ČEZ Distribuce a.s., EG.D a.s. and PREdistribuce a.s. OTE, a.s. (OTE) is the Czech

[56] Národní akční plán pro chytré sítě 2019 - 2030 - Aktualizace NAP SG.

electricity and gas market operator, which organize trading in the day-ahead electricity market and the intraday market. The Energy Regulatory Office is Energetický regulační úřad (ERU). ČEZ Group (České Energetické Závody), the Czech Energy Plants, operates mainly in trading, distribution, generation and sale of electricity and heat, as well trading and sale of natural gas, provision of comprehensive energy services from the new energy sector and coal mining.

7.1.2 Prosumers and flexibility services

The Terms and Conditions of the balancing market have undergone some significant changes effective as of 1 January 2021. The modifications concern the introduction of an integrated aggregator, energy accumulation battery systems, as well the decrease of the required minimum capacity for balancing services providers to 1 MW from the existing 3 and 10 MW. Bids will be free of charge[57].

End-user residential aggregators and customers do not have the possibility to participate in the markets. The relevant legislation is being prepared.

7.2 Transposition of Article 17 of the EU Directive 2019/944

Article 17 of the Directive has not yet been transposed in the Czech Republic.

7.3 Demand response and aggregators

7.3.1 Products provided by the TSO

ČEPS, a.s. conducts projects aimed at strengthening the reliable operation of the Czech electrification system. The Technology Agency of the Czech Republic conducts the THÉTA program, which includes projects in power flexibility, moderation and aggregation, such as Dflex, SecureFlex and MAFRI. The BAART research project addresses energy accumulation battery systems to provide power balance services[58].

7.3.2 Products provided by the DSOs

The ripple control system facilitates primarily the demand control. The ripple control technology has long been used in the Czech Republic in order to influence consumption. The ripple control system is a unidirectional group communication system using the electricity distribution network as a joint transmission channel shared by many receiving end stations. DSOs are the ones who operate, manage and finance this system. Costs are included in the price of electricity distribution. A key reason for using ripple control is to spread consumption evenly, to optimise the operation of the distribution system. Additionally, it can be used to handle emergencies in the grid[59].

7.4 Enablers and Barriers for Demand Response and Independent Aggregators

In the Czech Republic, the ripple control system has been working since the 1960s as a demand response type of mechanism. Through this, end-consumers already have a basic knowledge about how DR programs work, which will show its advantages once Article 17 is fully transposed and the additional technical and market conditions are met.

However, in particular, the roll-out of smart meters is expected to begin only in 2024[60], after the cost-benefit evaluation for the roll-out has shown a negative NPV[61].

The ripple control system, while certainly putting the end-consumers at an advantage, is built-in and covers approximately 46% of overall households and 31% of overall small-business electricity consumption, thus creating a lock-in effect, making it more difficult to shift to a novel solution in the form of explicit DR.

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57 https://www.ceps.cz/en/news/ceps-has-updated-the-terms-and-conditions-grid-code-in-order-to-allow-new-providers-to-participate-in-balancing-market.

58 https://www.ceps.cz/en/innovations.

59 National Energy Efficiency Action Plan of the Czech Republic, 2016.

60 First Analysis of the COVID-19 Pandemic's Effects on the Energy Sector, Interim Report, CEER 2021.

61 Supporting country fiches accompanying the report Benchmarking smart metering deployment in the EU-28.

8 DENMARK

Box 7. Denmark - practical info

– Market Model 3.0, link

– Denmark Energy Agreement, link

8.1 Background

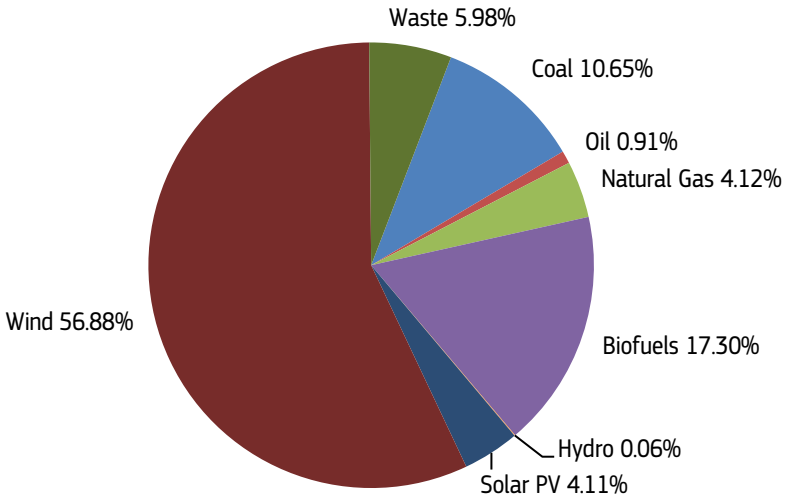
Within the goal of enhancing the use of renewable energy for energy consumption in Denmark, the key priorities of the Danish transmission system operators include the preparation of the system to accommodate a relatively high share of wind and solar sources. In this sense, the aim of the Danish TSO Energinet is to ensure that demand-side response can operate in the electricity market on equal terms with generation-side response. The use of storage options, as well as the electrification of other sectors, are promoted.

In Denmark, wind energy accounts for the largest share of total primary energy consumption and power generation in Europe. The Danish grid integrates successfully fluctuating renewable energies while maintaining a very stable and secure power grid, thanks to its flexible household power system and high connectivity.

The electric grid has a high level of interconnectivity and the national goal in this field will be to upgrade and increase it through projects coordinated with neighbouring countries. Denmark is currently focusing on the functioning and integration of power markets, with an emphasis on creating cross-border markets for balancing products.

Cross-border capacity is expected to improve with the DK1DE interconnector and with the steps taken by Svenska Kraftnät (TSO, Sweden) on the Swedish interconnector. Denmark is also focused on developing more functional markets to increase the flexibility of energy systems and accommodate new players and technologies.

Figure 9. Denmark's Electricity Generation mix in 2020.



Source: IEA, 2020.

8.1.1 Players and context

The Danish transmission system is owned and operated by Energinet. The distribution network is instead divided between 16 major DSOs and more than 26 smaller DSOs.

The Danish Energy Regulatory Authority (DERA) oversees the electricity, natural gas, and district heating markets. DERA is a fully independent regulatory body governed by a board of seven people (plus two alternates), all of whom are appointed by the Minister of Energy, Utilities and Climate.

Denmark forms part of the Nord Pool AS, a European power exchange owned by Euronext and by the continental Nordic and Baltic countries' Transmission system operators (TSOs): it operates power trading markets in Denmark, Sweden, Finland and in other 12 continental Nordic and Baltic countries' TSOs.

The Danish Utility Regulator (DUR) is the independent regulator in Denmark and, together with Iceland, Sweden, Finland and Norway, forms the NordREG group.

8.1.2 Prosumers and flexibility services

Denmark aims to promote favourable conditions for flexible electricity consumption in order to make use of Demand Response[62].

Today the explicit use of flexibility is limited due to several barriers to independent aggregation and the high level of rigid taxes that do not accurately reflect the needs of the grid. Prosumers are mostly limited to working with their supplier, as independent service providers must be registered themselves as suppliers and a Balance Responsible Party (BRP). This significantly reduces the available offers, and most of the ancillary services continue to be provided by retailers.

In Denmark, the smart metering rollout was completed in 2020. There is a central data hub already in use for the Danish electricity market actors, and all consumers in Denmark have the option to access their own data in Datahub through Eloverblik.dk, a public website deployed by Energinet[63].

EV owners, however, have more possibilities than in most EU countries to take advantage of the flexibility their vehicles provide. A handful of companies offer a wide range of services, from fixed or reduced energy prices for charging and tariff avoidance to a state of charge guarantee. In exchange, these companies use connected vehicles, pooling them with other resources as a source to provide ancillary services, as in the electricity balancing markets.

The Energy Agreement from 2018 investigated how a new tariff system could be structured, among other things, to facilitate demand response and a more flexible energy system with efficient use of the existing infrastructure. It also proposes increased electrification of the heating system through lowering taxes on electricity for households[64].

The implicit use of flexibility is more widely available and slowly growing. Most customers now have different dynamic price contracts available to them, and many DSOs have implemented time-of-use tariffs. This is all possible thanks to an advanced penetration of smart metering equipment. Adoption of dynamic pricing is still low, however, with around 10% of Danish consumers using it, mainly due to the low impact of the energy component in the final electricity bill.

8.2 Transposition of the EU Directive 2019/944

The EU Directive 2019/944, a new electricity law and 11 executive orders have been adopted. Further implementation of guidelines about how DSOs will demand flexibility services and how the TSO will make energy corrections if aggregators are delivering flexibility.

In Denmark, the necessity for a high number of flexibility providers in the grid is recognized, as well as the fact that in order for this to be efficient, the entity of the aggregator is called for[65].

The Danish Climate Act from 2020 constituted an important impetus for Market Model 3.0, as did the implementation of the EU's Clean Energy Package and particularly the revised Electricity Market Directive 2019/944.

The details of participation in DSO-markets are yet to be developed. Moreover, the DSO market value is unknown, so part of the discussion is to develop support mechanisms to get the market started.

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62 Integrated National Energy and Climate Plan for Denmark 2020-2030.

63 Supporting country fiches accompanying the report Benchmarking smart metering deployment in the EU-28 - Publications Office of the EU (europa.eu).

64 Denmark Energy Agreement, 2018.

65 Market Model 3.0 | Energistyrelsen (ens.dk).

8.3 Demand Response in the Ancillary services Market

The Danish electricity market is open for participation from renewable energy, demand response and storage, including via aggregation. The Danish TSO is legally required to provide its activities to the best possible competitive conditions in the power market.

Aggregators, including independent aggregators, can participate in the flexibility markets. In recent years the terms of the framework have improved, the requirements for online measurement and BRP to provide FCR have been lowered, and bids have been lowered too (from the past 10 MW to the current 5 MW and 1 MW bid limits).

The roles of the aggregator and of the Balancing Service Provider are defined, and the responsibility of balance is required to be assigned clearly.

Most of the tender conditions for suppliers of ancillary services are the same in the two bidding zones (western Denmark DK1, eastern Denmark DK2): aFRR supply capability, manual reserves mFRR, and the properties required to maintain power system stability. In DK1, requirements include additionally the primary reserve – FCR, and Secondary reserve – aFRR. In DK2, on the other hand, the additional requirements include Fast Frequency Reserve, FFR; Frequency-controlled disturbance reserve, FCR-D; and Frequency-controlled normal operation reserve, FCR-N[66].

As part of NordREG, in 2020, Denmark has contributed to developing the Nordic Regulatory Framework for Independent Aggregation, which proposes legislative changes in order to enable the legal basis for a common Nordic market for aggregation services[67].

8.3.1 Explicit flexibility services

The Nordic TSOs are currently developing a new Nordic Balancing Model. The scope of the model is a common Nordic capacity market for aFRR and mFRR, and the implementation of a 15-minute imbalance settlement period.

The FCR is open to DR and (independent) aggregation across Denmark. The conditions in DK2 include an energy transaction and remuneration for the activated volume. The aFRR is open to DSF and aggregation too, however, the minimum bid size of 5 MW and the product design make it difficult for new market players to enter the market. The mFRR is open to DSF and (independent) aggregation[68].

In the common Nordic market for mFRR the Danish market for ancillary services is partly integrated with neighbouring countries as part of the implementation of the electricity balancing guideline. In the wholesale day-ahead and intraday timeframe the market coupling is ongoing, and all bidding zone borders are coupled through the single intraday market coupling since 2018.

8.4 Enablers and Barriers for Demand Response and Independent Aggregators

At a structural level, Denmark's high share of wind in the national energy mix, which leads to the high flexibility needs of the system, counts as an enabler for DR programs.

When planning network expansion at the distribution level, the requirement for the DSOs to consider whether energy efficiency measures through DR or decentralized production may reduce or replace the need to expand capacity, leads to the DSOs being drivers of DR engagement.

From the regulatory point of view, there are no specific barriers that prevent an independent service provider from signing a contract with a customer or aggregator to provide demand flexibility. There is no distinction between bidding in the market from a single source and bidding from aggregated sources. An upgrade of the market model is ongoing to facilitate demand management such as aggregation, and to support the use of flexibility at the distribution level. For this reason, the market model has been revised to define and consider the aggregator as an independent role.

To facilitate participation of aggregated demand response, an aggregator model is being developed to allow distributed resources to enter the energy and system services market with larger market participants.

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66 Ancillary services to be delivered in Denmark. Tender conditions.
67 Nordic Regulatory Framework for Independent Aggregation, 2020.
68 Flexibility Deployment in Europe, USEF 2021.

The roll-out of smart meters is complete in Denmark, which enables the end-users to engage in DR (both implicit and explicit) to the full potential. The establishment of an hourly settlement model in the retail market supports the engagement as well.

However, the market design currently favours generation, and the residential consumers are subjected to very high taxes, leading to the energy costs being a relatively small fraction in the electricity bill. In addition to this, there are no reserve requirements in the Danish system. The division of Denmark into two bidding zones raises the challenge for aggregation across bidding zones.

9 ESTONIA

Box 8. Estonia - practical info

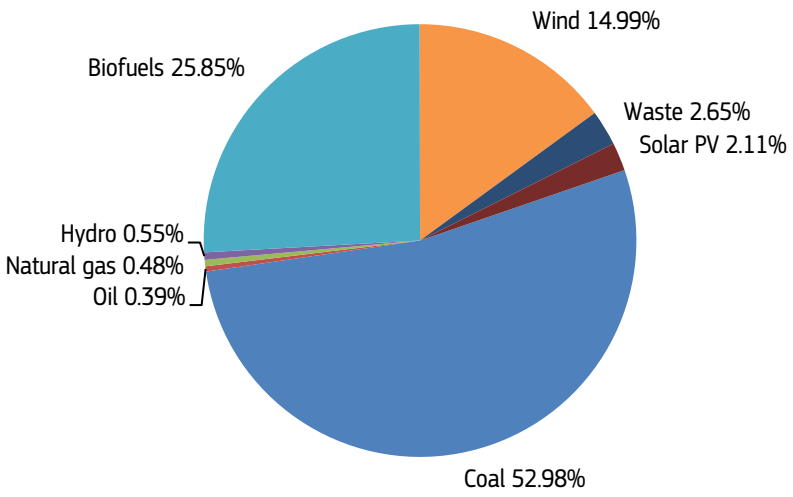
– Proposals for the market framework in Estonia for Demand Response through independent aggregation 2020, link

– Estonia's 2030 National Energy and Climate Plan, link

9.1 Background[69]

Estonian energy supply is based on the domestically produced oil shale, an energy-rich sedimentary rock that can be used both for heat and power generation as well as in the production of liquid fuels. This grants Estonia a high degree of energy independence but also leads to high carbon intensity. Estonia announced to stop producing shale oil in 2025 and aims at carbon neutrality by 2050.

Figure 10. Estonia's Electricity Generation mix in 2020.



Source: IEA, 2020.

The main renewable energy source is wood from domestic forests. The development of wind energy is hindered by administrative barriers. Estonia has reached its targets for emissions reduction and renewable energy for 2020. As a leader in digitalization, the country has also already reached a 100% deployment rate of smart meters.

Starting in 2025, Estonia aims to synchronise its electricity system with the Nordic or continental Europe grid. Wind generation is to be significantly increased and investments in network development are necessary.

The plans of phasing out shale oil and increase wind production pose at the same time some key challenges to the electricity system: ensuring the supply security after the phase-out, regulatory reforms to accommodate the wind, and enhancing electricity networks.

9.1.1 Players and context

Elering AS is the single TSO in Estonia. Although there are 34 local DSOs at the distribution level, one DSO company Elektrilevi dominates 89% of the market[70].

[69] Energy Policies of IEA Countries – Estonia Review 2019.
[70] Distribution Grids in Europe, Facts and Figures, eurelectric 2020.

Estonia is also part of the Nord Pool, the Nordic electricity market. Since 2010, Elering and Nord Pool have been cooperating to create a daily electricity market between all of the Baltic States[71].

The liberalization of the balancing market is more complicated in Estonia than for other EU Member States, as the electricity system of the Baltic States is not synchronised with the synchronous areas subject to EU law and the price of the balancing service is considerably influenced by balancing deliveries from Russia[72].

9.1.2 The participation of DR and prosumers in the market

The number of Estonian prosumers, mainly using solar PV and electric vehicles, has recently grown fuelled by governmental support schemes. Regarding electric mobility, in particular, considerable progress has been made and now Estonia has one of the most developed charging infrastructures in the EU, with charging stations within 60 km of one another across the country. However, payments for the explicit use of flexibility are low, which is the reason why only some industrial end-users participate[73].

This is in spite of the mass rollout of smart meters and the variable pricing that they enabled.

9.2 Transposition the EU Directive 2019/944

The transposition of Article 17 of the EU Directive 2019/944 is in progress.

An initial concept of the involvement of independent aggregators into the Estonian electricity system (including the market model, settlement principles and data exchange mode) was subject to public consultations in July -August 2020. This initial concept fosters equal treatment of DR at all market levels which implies, in particular, enabling independent aggregators and allowing them to contract end-users without the permission of a supplier and balance responsible party[74].

Independent DR aggregators are active in Estonia and can access the balancing market. mFRR products are available for DR as well. The market framework for day-ahead and intraday markets is under development. There is no access to the wholesale market. The technical requirements regarding the use of DR are under development.

9.3 Enablers of and barriers for Demand Response and Independent Aggregators

The current Estonian energy mix, as well as the commitments to phasing-out of oil shale production and increasing the share of wind energy, indicate room for flexibility in the market, which could be partially sourced from increased participation in DR. An increasing number of prosumers including electric mobility users result in larger shares of dispatchable loads. The participation of small end-users in DR is further enabled by the completed roll-out of smart meters.

However, the implementation of the regulatory framework for DR is still to be completed, preventing Estonian small-end consumers from seizing the full potential of DR in their system.

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71 http://www.baltic-course.com/eng/energy/?doc=23171.
72 National Energy and Climate Plan for Estonia 2030.
73 The smartEn prosumers map 2020.
74 Proposals for the market framework in Estonia for demand response through independent aggregation, 2020.

10 FINLAND

Box 9. Finland - practical info

– Demand and Supply of Flexibility - Final Report, link

– Finland's Integrated Energy and Climate Plan, link

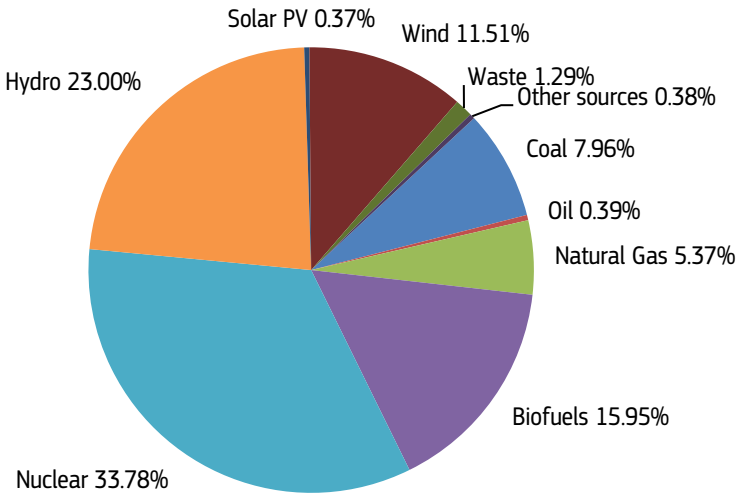
10.1 Background

Finland has made progress towards decarbonisation, mostly in power generation, thanks to large shares of nuclear, hydro and bioenergy. Fossil fuel use has decreased greatly in the past years as well. Despite this good record, the cold climate, long distances and energy-intensive industries could have delayed the country's carbon-neutral energy transition.

In 2020, Fingrid continued to develop the internal transmission system to increase the capacity of the main transmission corridor in the North to South direction: increasing market integration and intermittent generation demand flexibility, not only from generation but also from the transmission system. That has been considered a key target of the Finnish energy policy.

One of the most anticipated transformations in the short term is the participation of demand in the power market, as Finland is opening the flexibility markets to independent aggregators.

Figure 11. Finland's Electricity Generation mix in 2020.



Source: IEA, 2020.

10.1.1 Players and context

Fingrid Oyj is the sole national transmission operator in Finland. The Finnish state has held a controlling stake in Fingrid Oyj since 2011. In 2020 there were 77 distribution network operators in Finland, and the number of high-voltage DSOs has decreased to nine[75]. The main companies involved in the Finnish electricity distribution business include Caruna Oy, Caruna Espoo Oy, Elenia Oy, and Kajave Oy.

Energiavirasto, the Finnish Energy Market Authority, regulates and promotes the operation of the electricity and gas markets, emission reductions, energy efficiency and the use of renewable energy.

[75] National Report to the Agency for the Cooperation of Energy Regulators and to the European Commission, 2020.

The Finnish electricity market is part of the Nordic electricity market, Nord Pool. Finland joined this deregulated electricity market in 1998. Nordic countries (Norway, Finland, Sweden, and Denmark) have separate TSOs, though they share a single electricity market.

Nord Pool AS is a European power exchange owned by Euronext and the continental Nordic and Baltic countries' TSOs, which delivers power trading across Europe. Nord Pool operates power trading markets in Denmark, Sweden, Finland and other 12 continental Nordic and Baltic countries.

Around 20 aggregators, both independent and suppliers, are active in Finland, and they bring together both generation and flexible loads where clients receive a payment in exchange for the services provided.

10.1.2 Prosumers and flexibility services

In Finland, consumers have the option of choosing a dynamic pricing system. Customers who choose a dynamic price tariff structure pay the hourly price, retailer's premium, and a monthly fixed fee to the retailer with whom they opted to enter into a contract in the liberalized market (as opposed to regulated markets), and the price is determined based on the Nord Pool spot price for the price area of Finland; then the customer, who chooses a dynamic price tariff structure, pays the hourly price, retailer's premium, and a monthly fixed fee to the retailer with whom they opted[76].

Markets open to flexibility services, the implicit use of flexibility, and incentives for self-consumption enable consumers in Finland to play a variety of roles. Consumers who also generate electricity typically use it for self-consumption to save money on their energy costs. Although there are no clear restrictions for injecting into the grid, prosumers are responsible for their own balancing and must find a provider that would accept their excess production. However, this is usually simple because most suppliers have generator contracts in which the injections are paid at market price.

Both explicit and implicit flexibility is readily available in Finland. Implicit DR is widely used since metering infrastructure is very developed in the country. All suppliers offer dynamic pricing contracts, and 11% of customers have contracts with an hourly granularity and prices linked to the day-ahead market.

Large and industrial loads (more than 1 MW) make up for the highest percentage of DSF participation in Finland, with a total of 300 MW available. A significant development noticeable in commercial and industrial customers with loads below 1 MW is the installation of batteries in shopping centres and the growing popularity of greenhouses. Moreover, building automation technologies and domestic electrical water heaters are emerging trends, with aggregation of residential assets already possible[77].

Research has shown that the economic case for adopting flexible heating by residential customers is mainly driven by the retail tariff structure, and therefore the time horizon for the profitability of investment in heat control systems is 2030[78].

10.2 Transposition of EU Directive 2019/944

Operating aggregated resources is possible in the current legislative framework in Finland.

In general, power demand can and does participate actively in all electricity markets, and it's common that BRPs bid aggregated resources in different electricity markets. Independent aggregators are not yet recognized in legislation but will be in the very near future. However, also independent aggregation is already enabled in balancing and ancillary services markets.

Article 31 of the EU Directive 2019/944, which outlines the tasks of and DSOs, and includes clarifications with regard to market participants engaged in aggregation, is not yet fully transposed in the Finnish legislation, but many of its requirements are included already. In the Finnish legislation, there is no separation of residential and non-residential customers when it comes to requirements set in Art 31. Customers are treated on a level playing field. In practice, residential customers do not participate in electricity wholesale markets directly but via their supplier. Thanks to hourly metering, spot-priced contracts are possible and actively benefited also by the residential customers.

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76 Time-of-use tariffs – Innovation Landscape Brief (irena.org).
77 EU Market Monitor for Demand Side Flexibility 2020, smarten.
78 Demand and Supply of Flexibility, Pöyry for Fingrid, 2018.

In comparison to pooled resources, residential end-users have access to a variety of markets under the same rules and responsibilities. That is not a network issue, but all clients are treated the same regardless of whatever network they use. At this time, aggregated resources are able to participate in all electricity markets.

Residential customers cannot participate in multiple power markets directly since it is impractical, but they can and do participate indirectly through their provider. Residential consumers can react to spot-prices and profit from being flexible because smart hourly metering and spot-priced contracts are available.

10.3 Demand Response in the Ancillary Services Market

As part of NordREG, in 2020, Finland has contributed to developing the Nordic Regulatory Framework for Independent Aggregation, which proposes legislative changes in order to enable the legal basis for a common Nordic market for aggregation services[79].

10.3.1 Implicit flexibility services[80]

Transmission and distribution tariffs in Finland are mostly energized. Transmission tariffs are flat or peak/off-peak tariffs (winter working day or other). Most DSOs only have peak/off-peak tariffs, but there are others also offering tariffs based on peak capacity. It is also possible to choose a 'night tariff' or 'night control.' The Active Customer pays a cheaper tariff and allows the DSO to control household electrical heating (using smart meters) at night. However, the control is similar every day and there are no other explicit control commands from the DSO.

There are dynamic supply tariffs for industrial and residential customers. The roll-out of smart meters is complete (with second-generation now in roll-out), offering the possibility to make hourly energy prices available to the customers. In 2019, approximately 10% of domestic customers chose dynamic supply tariffs.

In Finland, independent aggregator activities are already permitted in frequency-controlled reserves (FCR-N, FCR-D and FFR).

10.3.2 Explicit flexibility services

Frequency containment reserve (FCR) is divided into two products: FCR-N, for normal operation, and FCR-D, for disturbances. In Finland, both are open to DSF and (independent) aggregation.

Manual frequency restoration reserve (mFRR) is open to DSF and aggregation. Independent aggregation is in a pilot phase, and larger scale testing will start soon. Automatic frequency restoration reserve (aFRR) is also open to DSF, and there are plans to open it to independent aggregation, in accordance with the result from the mFRR pilot.

10.4 Enablers and Barriers for Demand Response and Independent Aggregators

From a regulatory point of view, Finland is very advanced in implementing the 2019/944 EU Directive, establishing a legal framework for the independent aggregators. Having a complete regulatory framework and a track record of using it represents an enabler for independent aggregation and a benchmark for best practices among the EU Member States.

Many elements of the flexibility requirements already exist in Finnish electricity market legislation, such as fully deregulated retail markets, balancing responsibility, and customers' ability to choose dynamic tariffs, among others. Each of these requirements is a functional enabler for engaging in Demand Response.

Another enabler is the installation of smart meters, and the outlook for more EVs in the system is likely to be favourable as well. The regulatory and policy openness to aggregators is very clear (thus, even though the independent aggregator's position is still not specified legally, this does not appear to be a problem).

The high share of wind in the energy mix could be considered as a further structural enabler, as it is related to the high flexibility needs of the local power system, and it could raise incentives to foster the deployment of DR as flexibility resource.

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79 Nordic Regulatory Framework for Independent Aggregation, 2020.
80 Flexibility Deployment in Europe, USEF 2021.

An energy subsidy scheme is expected in Finland, targeted at housing companies with the aim of supporting improvements in energy efficiency and measures aiming toward smart, flexible energy consumption. The subsidies will be granted proportionally to the energy efficiency benefits achieved[81].

Explicit use of DSF, although available, is less widely used than implicit DSF. Technical requirements for most products are designed in a way that the demand side can participate without significant barriers.

81 Integrated Energy and Climate Plan for Finland.

11 FRANCE

Box 10. France - practical info

– Volumes that can be contracted for Demand Response in France in 2022, link

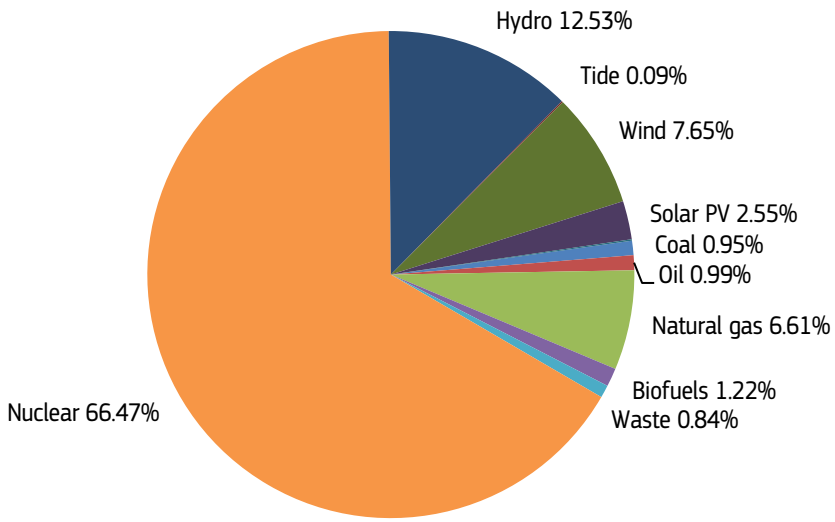
– Integrated National Energy and Climate Plan for France, link

11.1 Background

France generates about 70% of its electricity in nuclear power plants. This leads to low electricity prices and low CO_2 emissions per capita, and provides a high degree of energy independence. France is the largest bet exporter of electricity in the world[82]. By 2035 the share of nuclear electricity production is to be reduced to 50%. Coal-fired plants are to be decommissioned by 2022. As a result, significant investments in particular in expanding the share of renewables and in the modernisation of the nuclear generation fleet are required.

The French electricity system is highly concentrated and dominated by the state[83]. The roll-out of smart meters (for electricity, Linky) was expected to continue through 2021[84], with a target of 35 million meters to be installed at the "particulier" level[85].

Figure 12. France's Electricity Generation mix in 2020.



Source: IEA, 2020.

The expected reduction of the share of nuclear power leads to supply security concerns in the French electric system, and, along with the plan to boost the share of renewables, points to new increased balancing needs. Peak demand in France is among the highest in Europe, and demand is very temperature-sensitive in the cold months[86], which poses a further challenge to the system.

82 https://www.world-nuclear.org/information-library/country-profiles/countries-a-f/france.aspx.
83 Report on the French Power System, Agora Energiewende, 2015.
84 Integrated National Energy and Climate Plan for France.
85 https://particulier.edf.fr/en/home/contract-and-consumption/meter/linky-meter.html.
86 ENTSO-E Winter Outlook 2020–2021.

11.1.1 Players and context

RTE is the only TSO in France. At the distribution level, there are 144 DSOs, but ERDF is clearly dominating the market. Both RTE and ERDF are owned by EDF, which is a majority state-owned company[87].

The French Energy Regulatory Commission CRE is an independent administrative authority that was created in 2000.

11.1.2 The participation of DR and prosumers in the market

France belongs to the countries with the highest activity of prosumers which is encouraged by governmental support schemes. Regarding small solar PV installations, France holds the third position in the EU and is the second-largest EU market for electric mobility, with sales tripling between 2019 and 2021, partly in connection with the electric bonuses granted under the country's recovery plan[88].

French prosumers are mostly focused on self-consumption and feeding in the excessed generation, but they can also monetise flexibility on electricity markets which is, however, limited by high transaction costs[89].

Demand from residential consumers, in particular the demand for electric heating, is not controllable and does not respond to price signals in France. As for voluntary demand reduction, it is uncertain if consumers are actually cutting consumption[90].

As one of the European DR leaders, France has a well-developed DR aggregation market with several DR aggregators, including Energy pool, Smart Grid Energy, Agregio, Total Flex, Engie, Alpiq for large electricity loads; Eqinov, flexcity, Enerdigit for medium sized consumers and Voltalis for end-users.

France intends to reach 6.5 GW of demand side-based flexibility by 2028.

In the demand response call for tenders for 2022, the maximum volume that can be contracted is 7 940 MW, of which roughly half is reserved for subscribed power sites of 1 MW or less[91].

11.2 Transposition the EU Directive 2019/944

As one of the pioneers in establishing a regulatory framework for DR, France has transposed Article 17 of the EU Directive 2019/944 into the national regulation ("Code de l'énergie") to a significant extent. In particular, DR and the role of DR aggregator are defined, and independent DR aggregators are allowed to cooperate with electricity customers without consent from the customer's supplier (already since 2013).

11.3 Demand Response and aggregators

The French Energy Code incentivizes market participants to develop demand side management capacities[92] through a capacity obligation mechanism in which suppliers are required to obtain sufficient capacity guarantees to cover the consumption of all of their customers during periods of peak national demand.

Small electricity consumers can provide DR even without a smart meter: in such a case, the aggregator is responsible for data provision, which is controlled by the TSO by means of regular audits. Prequalification is carried out at the level of the pool and not of a single end-user which fosters market participation of smaller loads.

Based on the customer's consent, free access to the customer's data is permitted.

DR is allowed to participate in all electricity markets, including the capacity market and energy markets, including day ahead, intraday markets, balancing markets, FCR, congestion management.

In addition, a specific support mechanism was established for DR (based on annual DR tenders): this capacity-based DR mechanism allows an entity to be remunerated for power made available over a specific period which can be activated by the network operator or a DR operator. Awarded DR capacities receive in this way

87 Report on the French Power System, Agora Energiewende, 2015.
88 https://www.euractiv.com/section/electric-cars/news/electric-vehicles-sales-in-france-tripled-in-past-two-years.
89 EU Market Monitor for Demand Side Flexibility, smarten 2020.
90 France 2021 Energy Policy Review, IEA.
91 RTE Demand response call for tenders for 2022.
92 https://www.cre.fr/en/Electricity/Wholesale-electricity-market/wholesale-electricity-market.

an additional revenue opportunity. The remuneration is a fixed premium which corresponds to €/MW capacity available per year. Different conditions to participate are envisaged, e.g., a maximum period of eligibility is limited to 6 years for sites with a capacity below 1 MW and 4 years for sites with a capacity exceeding 1MW. This mechanism was adapted to mitigate the risks of supply shortages as a consequence of the Covid-19-pandemics.

French DSOs can contract DR resources for congestion management at the distribution level.

Provided a sufficient pooled capacity, residential DR aggregators can also access the wholesale market, the balancing platform and the ancillary reserve. DR aggregators (or end-users) have to pay compensation to the suppliers for the volumes curtailed and sold in the market.

There have been, however, time limits imposed on residential consumers to provide DR. Specifically, residential customers are allowed to provide DR for 10 minutes every 30 minutes, and only during a maximum of 6 hours in a row, then followed by no DR for two hours. This implies that residential DR can only deliver 1/3 of the available capacity (MW), and 1/4 of the available volumes (MWh). The flexibility from residential end-users comes mostly from controllable electric heaters and the limitations imposed on the residential end-users have to do with the rebound effect that follows DR activation in the use of electric heaters. Improvements in baseline calculation methods, as well as impact assessment, can help alleviate these limitations.

In terms of measurements, the TSO requires for the FCR services that the consumption is measured every ten seconds for every site. DR aggregators consider, on the other hand, measurements per sample as sufficient and more cost-efficient.

Technical prerequisites for the use of DR have been established. Some provisions are, however, still considered insufficient or disadvantageous in comparison to traditional generators.

11.4 Enablers of and barriers to Demand Response and Independent Aggregators

The potential for Demand Response to become a more prominent resource of flexibility in the French electricity system is enabled by the structural changes regarding the goal to reduce the share of nuclear power, coupled with ambitions to increase the share of renewables.

The advanced rollout of smart meters and a growing share of prosumers, including electric mobility users, make it possible for end-users to engage in explicit DR, supported by a favourable regulatory and policy environment and by a considerable track record in the use of DR. Support mechanisms are in place, such as a fixed premium in €/MW capacity available per year.

The market is not reaching its full potential due to prequalification requirements, such as those regarding measurements that do not sufficiently address the peculiarities of DR. The financial compensations paid to suppliers for the volumes curtailed and sold in the market are seen as high from the point of view of DR aggregators, constituting an economic barrier. Finally, residential end-users can, in reality, deliver only one-third of the available capacity, which puts a constraint on the market size.

12 GERMANY

Box 11. Germany - practical info

– Draft bill addressing DR aggregators (SteuVerG), link

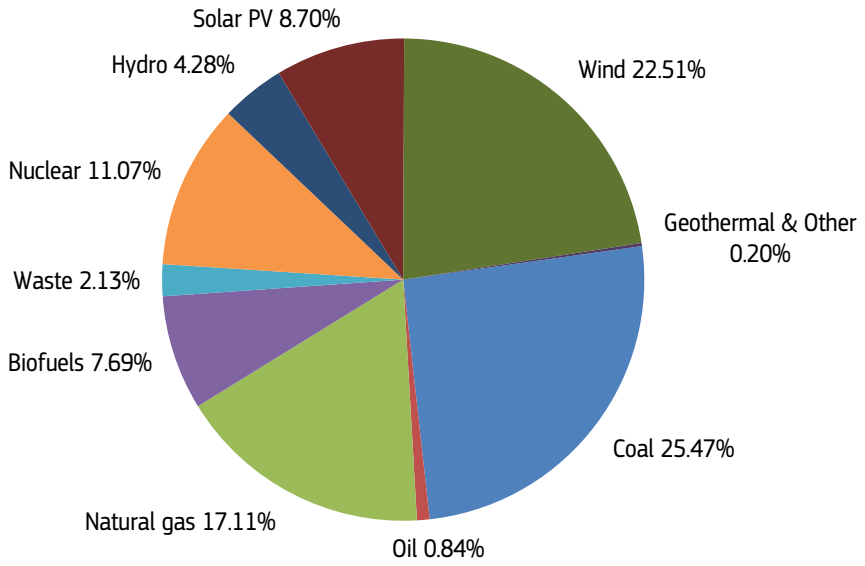
– Marktreformplan 2021, link

12.1 Background

Since 2010, Germany has been committed to the Energiewende, an ambitious strategy aiming at the sustainable transition of its energy system. Nuclear power is to be phased out by 2022, and the end of coal use has been recently envisaged by 2030[93]. In 2030, 80% of all electricity is to be supplied by renewable energy sources, and carbon neutrality is aimed for 2035. Germany has been an EU leader in developing offshore wind and photovoltaics. Both transmission and distribution networks in Germany demonstrate resilience despite the high penetration of renewables[94].

Electricity prices in Germany are among the highest in the EU which is caused by high taxes and renewables support. Due to a negative result of the cost-benefit analysis of smart meters' deployment, their penetration rate is still low. One of the challenges in this context are rigorous certification requirements for smart meters. According to the current law, based on a cost-benefit analysis from 2013, customers with a yearly electricity demand of over 6 000 kWh are to get smart meters installed[95].

Figure 13. Germany's Electricity Generation mix in 2020.



Source: IEA, 2020.

The need to accommodate the growing share of renewable electricity generation involves increased flexibility needs, and necessitates an expansion of the transmission and distribution network. Ensuring the security of electricity supply after the phasing out of nuclear and coal power plants is a further challenge in the German electricity system, while the discussion on a fair and transparent allocation of the costs and benefits of the Energiewende is still ongoing.

93 https://www.reuters.com/business/cop/exclusive-germanys-government-in-waiting-agrees-phase-out-coal-by-2030-sources-2021-11-23.

94 https://www.cleanenergywire.org/factsheets/set-and-challenges-germanys-power-grid.

95 Cost-benefit analysis for the comprehensive use of smart metering systems, EY for BMWi, 2013.

12.1.1 Players and context

In Germany, there are four TSOs – TenneT, 50Hertz, Amprion, TransnetBW – and over 800 DSOs, some of which belong to large companies such as E.ON, or EnBW, and only 182 are regulated by the Federal Network Agency BNetzA, with around 700 being regulated at the State level[96].

Balancing responsibility in terms of keeping a balance between production and demand is structured in portfolios, called balancing groups, and managed by balance responsible parties (BRPs), often suppliers[97].

12.1.2 The participation of DR and prosumers in the market

The role of DR in Germany is still limited. So far, the flexibility has been mainly provided by peaking power plants and hydro power, which has distorted price signals for DR[98].

Nevertheless, Germany is at the forefront of prosumers' development in the EU which is supported by governmental schemes. In particular, solar PV is widely used.

The share of electric mobility has grown significantly due to the increase in subsidies, and Germany has the highest market share of EV across the EU. However, the development of charging infrastructure is to be accelerated.

Prosumers are theoretically allowed to access the energy market via supplier or an aggregator. However, the valorisation of flexibility is so far only possible at the TSO level and predominantly seized by commercial and industrial customers. Residential users do not participate in explicit DR, and implicit DR is offered by some suppliers only[99].

As of 2021, the first subsidised installation cohorts have started leaving the Renewable Energy Sources Act system and are expected to participate in the energy markets without funding. The new business models would be financed through instruments such as PPAs. Systems that can be flexibly controlled and claim no fixed feed-in payment under the Renewable Energy Sources Act can participate in the balancing energy market[100].

12.2 Transposition the EU Directive 2019/944

Germany has not fully transposed Article 17 of the EU Directive 2019/944 into the national regulation.

Nevertheless, the German Energy Industry Act of 2005 (Energiewirtschaftsgesetz EnWG) requires that potential contribution from DR have to be taken into account in the planning and extensions of distribution networks (§ 14d(5)[101]), and as of summer 2021, an amendment ensures that flexibility service providers be treated in a non-discriminatory fashion in the markets ((§ 14d [102]).

12.3 Demand Response and aggregators

Draft rules on the control of customer assets at a low voltage level, which among others allowed only DSOs to control customers' assets and thus hindering demand aggregation business model (Steuerbare-Verbraucher-Gesetz SteuVerG[103]) has been withdrawn in January 2021 following criticism from stakeholder groups[104]. In the draft bill, aggregation was to be possible behind the meter only (smart home, e.g., electric car, heat pump and home storage), but not on grid level (no smart grid).

Currently, DR can provide ancillary services to the TSO. However, according to commercial players, there is no business case for grid services at medium or low voltage levels for the DSO. Instead, a regulated grid approach is announced that will prevent competition.

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96 Monitoringbericht 2019, Bundesnetzagentur und Bundeskartellamt.
97 The role of aggregators in facilitating industrial demand response: Evidence from Germany, Energy Policy, 2020.
98 Umsetzungsplan für Deutschland nach Art. 20 Strombinnenmarktverordnung (BMVO) („Marktreformplan"), 2021.
99 The smarten map for prosumers, 2020.
100 Integrated National Energy and Climate Plan for Germany.
101 Energiewirtschaftsgesetz - EnWG.
102 https://www.buzer.de/14c_EnWG.htm.
103 Entwurf eines Gesetzes zur Digitalisierung der Energiewende, Referentenentwurf, BMWi, 2020.
104 https://www.verbaende.com/news.php/bne-begruesst-Ruecknahme-des-Gesetzentwurfes-des-SteuVerG-durch-das-BMWI?m=139367.

Although residential DR is legally allowed to access markets, high administrative and transaction costs represent a significant barrier in this regard. Additionally, there are regulatory changes announced that are expected to hinder residential DR aggregation. In particular, a draft regulation shall allow grid operators to control consumption directly instead of incentivizing voluntary prosumer action (§ 14a EnWG).

Technical prerequisites for the use of DR are defined for balancing markets and interruptible loads at the TSO level. TSOs are working on adaptions of prequalification conditions to ensure that EVs can participate in balancing reserve markets. At the DSO level, however, the definition of technical prerequisites is still lacking. Due to the increasing share of electric vehicles, the definition of technical prerequisites at the DSO level is becoming increasingly necessary.

From a regulatory point of view, in Germany, aggregators can access energy markets, and the electricity grid and end customers can cooperate with aggregators of their choice.

12.4 Enablers of and barriers to Demand Response and Independent Aggregators

The ambitious climate goals that lead to the German “Energiewende” and to major changes in the energy mix must accommodate a high share of renewables and the resulting need for flexibility to ensure their network integration. The growing number of prosumers, including electric mobility users, create a favourable context for a strengthened position of demand response in the market. In particular, for the German end-users, the high electricity prices and a track record in energy-saving programs create indirect incentives for engaging in explicit Demand Response, should there be programs available.

However, there is an unfavourable political and regulatory framework in particular regarding network charges for industrial end-users that promote constant (instead of flexible) load. Structurally, the need for flexibility is already well covered by conventional peaking power plants and in the National Energy and Climate Plan, there are no measurable targets for different sources of flexibility (demand response, energy storage, and distributed generation). The low penetration rate of smart meters slows down the possibility to participate in DR, and due to all of these constraints, there is no viable business model to use DR at the DSO level.

13 GREECE

Box 12. Greece - practical info

– Market Reform Plan for Greece, link

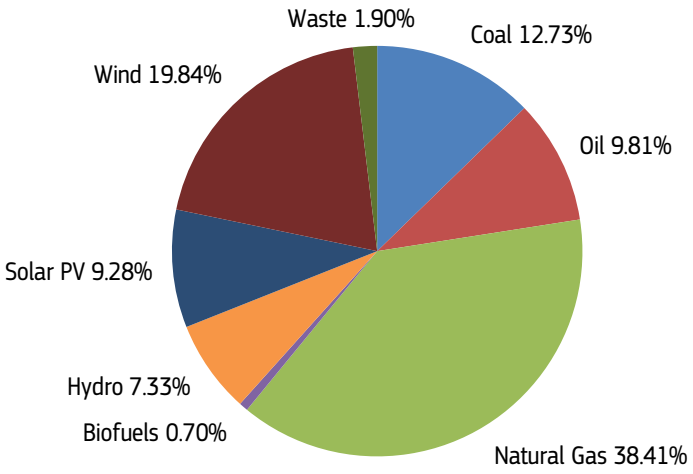
– Methodologies and Technical Decisions in the Balancing Market, link

13.1 Background

Even though renewable energy shares have been increasing in recent years, the national energy balance in Greece still relies heavily on natural gas and oil, which account for about half of electricity generation. One of the significant issues is the renovation of the power system; in particular, given the large number of islands, one of the main goals will be to eliminate their energy isolation and connect them to the mainland system. The deadline for achieving this target has been set for 2029[105].

However, a new draft Climate Law as of 2021 targets the phasing out the production of lignite by 2027 and acceleration of the use of EV – towards an ambitious goal of halving Greece's emissions by 2030 and climate neutrality by 2050[106].

Figure 14. Greece's Electricity Generation mix in 2020.



Source: IEA, 2020.

Enhancing energy efficiency is an important horizontal priority with numerous benefits and the Greek government strives to adopt an appropriate combination of regulatory interventions and financial instruments that will allow the potential for energy savings to be realized[107].

13.1.1 Players and context

The only operator of the transmission system in Greece is IPTO (Independent Power Transmission Operator). The mission of the Company is the operation, control, maintenance, and development of the national transmission system of Greece to ensure the reliable and efficient electricity supply, as well as the operation of the electricity market following the principles of transparency and equality. On the other hand, the distribution network is operated by HEDNO, the only DSO in Greece.

In Greece, the Regulatory Authority for Energy (RAE) is an independent regulatory authority established by Law 2773/1999, which transposed Directive 96/92/EC into the Greek legal order, and it is empowered to

105 https://www.admie.gr/en/nea/deltia-typoy/map-interconnections-be-completed-2030.
106 https://www.ft.com/content/e772f173-44ba-4a7f-94c6-21416f3f4af5.
107 National Energy and Climate Plan for Greece 2021-2030.

monitor the operation of all sectors of the energy market, provide advice to the competent State bodies, and adopt regulatory measures towards the full liberalization of the electricity and natural gas markets.

13.1.2 Prosumers and flexibility services

Net-metering is used to provide assistance to Greek prosumers.

A new energy storage policy framework reached parliamentary proceedings in 2021. Prosumers would see an increase in the upper limit for net-metering installations from 1 MW to 3 MW in the mainland grid, and for small end-users, the new framework would boost the use of storage. These measures aim to increase the number of net metering participants while simultaneously minimizing the impact on regulated costs. The proposal calls for the modernization of net metering schemes and the facilitation of aggregator involvement, as well as changes to the electricity market design to allow decentralized energy schemes to participate.

An 80% rollout of smart meters was expected to be reached by 2020[108]. This target has not been achieved although the project is funded by the EIB[109], and the new projection is to be completed by 2026. One incentive for the deployment of smart meters in Greece is reportedly the issue of electricity theft.

Demand management and demand response plans are expected to be put into place. Demand response participation should eventually expand to include not only large industrial consumers, but all consumers, whether individually or via aggregators.

Consumers' role is now being upgraded, enabling them to provide power to the grid from small-scale RES plants as well as flexibility services through demand response schemes or smart charging for electric vehicles. In the future, it will be possible to carry out transactions directly, without the mediation of a third party, through the direct exchange of data between the parties concerned.

13.2 Transposition of EU Directive 2019/944

In Greece, the concept of DR and aggregation has not yet been implemented for residential consumers. The transposition of the Directive, originally planned for October 2021, has been scheduled for the first quarter of 2022. RAE, the regulator, actively participates in the development of technical modalities in collaboration with the network operators and other organizations.

Aggregated residential demand is not permitted in wholesale electricity markets, specifically the forward, day-ahead and intra-day markets. It is allowed to participate in the balancing market as explained above (pending the publication of the final guidelines and codes by the TSO that operates that market).

The Greek legislation does not foresee that "final customers, including those offering demand response through aggregation, to participate alongside producers in a non-discriminatory manner in all electricity markets". Demand response is explicitly limited to the balancing market (Real Time Balancing Market) by law and is not allowed to participate in the other electricity markets.

Article 31 is not transposed in the Greek legislation. The DSO does not procure (energy or flexibility) services for the operation of the system. The services foreseen in Article 31(8) do not exist in Greece – neither in operation nor regulation/market codes. There is no evidence to suggest that the DSO or the Regulatory Authorities are preparing something on this front.

Participation of demand-side response in the balancing market is planned for February 2022. Participation of RES with full balancing responsibility is expected for March 2022.

13.3 Demand Response in the Ancillary Services Market

The integration of demand response, both for individual consumers, load representatives and demand response aggregators are confirmed in the time plan and will require amendments of the Balancing Market Rulebook and the technical specifications, as already provided in the submitted timeline.

Infrastructure (regulatory framework, IT systems and adequate metering) allowing DSR participation in the balancing markets is under preparation, with an expected timeframe in February 2022 (for the Balancing

[108] Benchmarking smart metering deployment in the EU-28, Tractebel Impact for DG-ENER, 2019.

[109] https://www.eib.org/en/press/all/2021-220-eur-330-million-eib-backing-to-ppc-to-upgrade-electricity-distribution-roll-out-smart-meters-and-increase-renewable-energy-across-greece.

Market). The DSR implementation plan, with a timeline until February 2022, is meant to include DSR participation in the balancing market for aggregators with load portfolios or RES portfolios (and later storage, depending on pending regulation)[110].

DSR is expected to go live by February 2022 in the Balancing Market in a pilot stage for mFRR products. The integration of DSR introduces specific technical requirements and practical issues concerning the connection and interrelation of the two different markets that need to be assessed and clarified by the market operators (NEMO & IPTO) to enable DSR participation. End-user residential aggregators and customers cannot participate in the markets yet, as the main barrier is the lack of transposition of the EU Directive 2019/944, as well as the lack of smart meters.

IPTO, which runs the balancing market, recently released an initial set of guidelines for aggregated demand participation in the balancing market via FCR, aFRR, and mFRR products for public consultation. Residential load aggregators are allowed to participate in the market under these principles, once they have fulfilled several requirements, as the minimum bid of 1 MW[111].

Demand flexibility (both power and energy) anticipated to be expressed as a Price-Quantity curve, more suitable for generation units but not for dispersed loads. If enabled, the maximum power bid is assumed to be available at any time unit throughout the day, which is unrealistic for bundled residential loads with predictable usage patterns. Each load must be pre-qualified independently in order to participate in the FCR market limiting the aggregator's capacity to alleviate individual load non-performance via VPPs.

13.4 Enablers and Barriers for Demand Response and Independent Aggregators

In addition to establishing new power plants and boosting interconnections, enabling demand response technologies will play a significant role in securing electricity supply in the context of the new climate ambitions of Greece. In the future years, efforts aiming at restructuring the internal electricity market and boosting competition will be pursued to enhance demand and consumer participation in the electrical market in general.

It's worth noting that the current institutional structure includes measures to make demand response systems easier to implement. Demand-side transition policy measures, in particular, may encourage the proliferation of interruptible load mechanisms, a tool that has so far mostly benefited large-scale energy consumers who can lower their usage for grid safety and wholesale electricity market price reduction.

Household electrification is expected to act as an enabler for more flexibility services.

However, one of the main obstacles for independent aggregators in Greece is the inadequacy of the legal framework for bringing these new players to the market. Another barrier is represented by the lack of necessary technology, as the participation of all electricity consumers in the electricity market will not be possible until the completion of the smart meters' installation project, which is expected in the following decade. To date, smart meters have been placed at medium-voltage customer sites and in few low-voltage customer locations, at a pilot phase.

110 Market Reform Plan for Greece, 2021.
111 Methodologies and Technical Decisions, IPTO.

14 HUNGARY

Box 13. Hungary - practical info

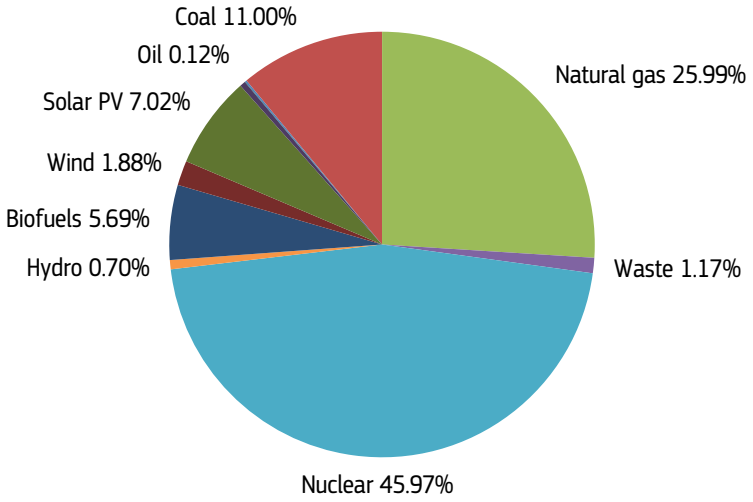
– Act No. LXXXVI of 2007 on electricity link;

– National Energy and Climate Plan link.

14.1 Background

Since 2021, the Modernisation Fund and non-refundable funds of the operational programmes support the implementation of smart networks and network upgrades in Hungary, battery energy storage and spread of seasonal electricity storage. Under the relevant operational programmes of 2021-2027, with non-refundable aids, the following projects are planned: promotion of network flexibility, smart metering and Demand-side regulation. The investment plan further includes projects developing renewable energy, and reducing natural gas consumption which can be implemented with carbon credit funds, pilot projects planned for testing complex consumer DSR solutions, renewable communities and independent aggregators, and power-to-gas production (biomethane, hydrogen)[112] .

Figure 15. Hungary's Electricity generation by source 2020.



Source: IEA, 2020.

14.1.1 Players and context

Hungary has one TSO, MAVIR, and 6 DSOs: E.ON Dél-dunántúli Áramhálózati Zrt., E.ON Észak-dunántúli Áramhálózati Zrt., OPUS TITÁSZ Zrt., ELMŰ Hálózati Kft., MVM Émász Áramhálózati Kft., MVM Démász Áramhálózati Kft. The National Regulatory Authority is MEKH (Eng. HEA).

Market places are the Hungarian Power Exchange (HUPX) for day-ahead market and intraday market, as well as the Hungarian Derivative Energy Exchange (HUDEX), where Physical Futures products are traded. The retail market is liberalized for industrial consumers and regulated prices households. Big multinational companies from the field are present on the retail market next to the Hungarian Electrical Works Private Limited Company – MVM Group. The Hungarian Energy Trader's Association (HETA) is a key player in the market.

[112] National Energy and Climate Plan for Hungary 2021-2030.

14.1.2 Prosumers and flexibility services

The goal of the Hungarian government is to have at least 200 000 rooftop solar panels in households, with an average of 4 kW, by 2030. A small household power plant (HMKE - "háztartási méretű kiserőmű") is defined as a power plant connected to the low-voltage grid (with a voltage not exceeding 1 kV) with a connection capacity of not more than 50 kVA, thus by approximation, small power plants with an installed capacity of up to 50 kW. At the end of 2019 a total of 59 298 solar HMKEs were connected to the grid with an installed capacity of 481.8 MW, and in June 2020 there were already 72 501 such small power plants online, with the total installed capacity of 584.15 MW[113].

During the third quarter of 2021, 8 657 HMKEs were connected to the grid with a total installed capacity of 77.67 MW, and the total capacity of HMKEs reached 1 024 MW by the end of September 2021[114]

14.2 Transposition of Article 17 of the EU Directive 2019/944

Article 17 of the EU Directive 2019/944 is transposed in the Act LXXXVI of 2007 on Electric Energy (Act on Electricity). Rules are mostly connected to the registration of the aggregators and the change of the aggregator.

14.3 Demand response and aggregators

Aggregation of the load is legal in Hungary, but the market is highly centralised and the establishment of new entrants is difficult. Energy policy has been directed to social welfare and because of this has resulted in reduction in utility costs. Import agreements and the extension of traditional power production are done to ensure the safety of the electricity supply, as Hungary is a net electricity importer.

14.3.1 Role of the aggregator

The related legislation entered into force on the 1st of January 2021 and a few market participants have already shown interest in becoming aggregators. At the time of writing this report, 21 aggregators were registered, according to the NRA web page[115].

As claimed by the NRA, aggregators are likely to play an important role as intermediaries between user groups and the market, as there are many - and there will be more – small players, active users who would not be able to enter the market on their own, but an aggregator can represent them.

14.3.2 Within the TSO and DSOs

The market design of the demand response is under development by the TSO and DSOs (with the involvement of the NRA). Based on the Act on Electricity that implemented high-level provisions of the directive, the detailed rules and market design will be set in the commercial and distribution code.

Regarding the electricity supply to households, the two-zone tariff was also used in the past with the name "night electricity". In 2008, the terminology was changed to "controlled electricity supply". Nowadays, two-zone tariffs are available to all large suppliers, but given that households supply is subsidized; as a result, these offers are similar. Specifically, the options are: A2 – recommended for those households which use electricity during nights and weekends (off-peak hours), B basis – for consumers with a controllable connection point, H – special pricing for heat pumps and for renewable electricity used for heating equipment[116].

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113 http://www.mekh.hu/toretlen-a-haztartasi-meretu-naperomuvek-terjedese.

114 http://www.mekh.hu/mekh-1000-mw-fole-emelkedett-a-haztartasi-kiseromuvek-beepitett-teljesitmenye.

115 http://www.mekh.hu/aggregatorok-nyilvantartasa.

116 ELMŰ-ÉMÁSZ Energiaszolgáltató Zrt. https://web.archive.org/web/20220118005540/https://elmuemasz.hu/egyetemes-szolgaltatas/szolgaltatasok/villamos-energia; MVM Next Energiakereskedelmi Zrt. https://www.mvmnext.hu/aram/pages/aloldal.jsp?id=659111; E.ON Hungária Zrt. https://www.eon.hu/hu/lakossagi/aram/egyetemes-szolgaltatoi-arak.html.

14.4 Enablers and Barriers for Demand Response and Independent Aggregators

The residential customers in Hungary show modest interest in participating in the Demand Response due to the low electricity bill (households have subsidised price of electricity), but also because this market segment is very new in Hungary and the rules for this customers segment are under development.

However, the young market shows promising perspectives, as there are already some new independent aggregators registered, as well as four electricity storages (at the moment of writing the report) with more than 20 MW installed capacity[117].

Regarding the main market enablers, aggregators are defined, as well as the registration procedure[118]. In the last few years, Hungary has invested considerably in photovoltaic generation and because of this, the renewable production capacity has increased greatly. These newly built capacities generate balancing needs, and (aggregated) DR can be part of the solution, keeping in mind that, at the moment, mostly inflexible generation units are present. Additionally, because Hungary is a net importer of electricity, the good management of energy resources is very important.

The major barriers are related to electricity prices for households that are subsidized, and because of cheap electricity, there is not enough incentive to engage in DR. Low concentration level is mostly true for the Hungarian electricity market, with few suppliers (and most of them are large traditional companies). End consumers, both industrial consumers and households, have a cautious behaviour, preferring not to switch suppliers, and working with large reputable companies.

117 http://www.mekh.hu/villamosenergia-ipari-engedelyesek-listaja.
118 http://www.mekh.hu/aggregatorok-nyilvantartasa.

15 IRELAND

Box 14. Ireland - practical info

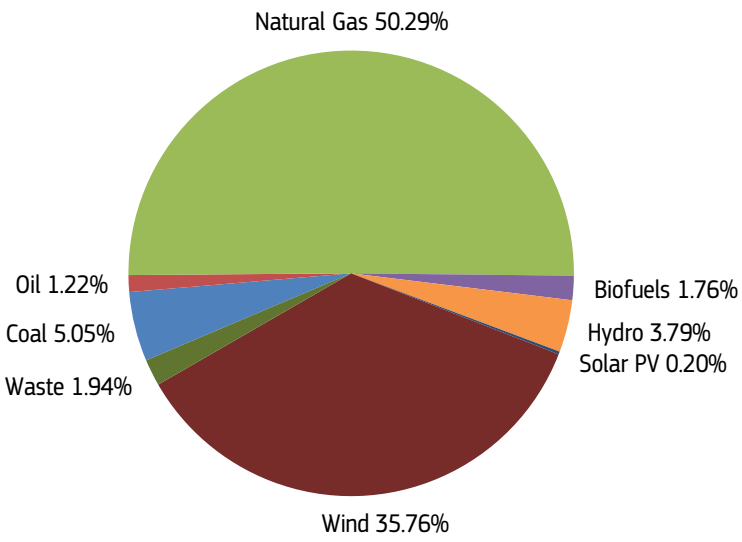
– Market Reform Plan, link.

– Smart Meter Upgrade Phase 2, link.

15.1 Background

In 2018, Ireland was Europe's second-largest wind power generator, and it strengthened its energy security by expanding local gas production and reduced its reliance on oil as a source of energy. In 2020, wind power generation accounted for around 35% of total electricity output, up from 10% in 2017. Despite a significant increase in wind power, natural gas still accounted for more than half of all electrical output.

Figure 16. Ireland's Electricity Generation mix in 2020.



Source: IEA, 2020.

However, the electricity demand profile in Ireland is comparatively inflexible due to the relatively small proportion of heavy industry in the domestic economy. But as the rapid growth of wind power in Ireland has increased the need for flexibility, the Irish TSO has worked on specific programs to foster DR. In 2017, 362 MW of capacity reserves were provided by 19 Demand Response providers[119]. The winter peak demand reduction (now phased out in order to encourage more market-based DR solutions), the interruptible load (STAR) and Powersave were schemes designed to reduce the load when the total demand is close to the available generating capacity. Even small (aggregated) DR providers were already then enabled to participate with demand reduction and capacity reserves.

In the wholesale electricity market for Ireland, 600 MW of demand-side capacity successfully cleared in the first T-4 auction to take place under the Capacity Remuneration Mechanism for 2022/23, of which more than half (334 MW) was new capacity[120].

15.1.1 Players and context

Ireland's national electricity transmission System Operator is EirGrid, responsible for ensuring the supply and transmission of power all over the country. ESB Networks is Ireland's only Distribution System Operator (DSO).

[119] Electricity Transmission Performance Report, Eirgrid 2017.
[120] Final Capacity Auction Results 2022/2023 T-4 Capacity Auction.

In Ireland, the Energy Regulatory Agency is the Commission for Regulation of Utilities (CRU), Ireland's independent energy and water regulator. The CRU was originally established as the Commission for Energy Regulation (CER) in 1999. The CER changed its name to the CRU in 2017 to better reflect the expanded powers and functions of the organization. Its counterpart in Northern Ireland (and close collaborator within the Island of Ireland) is the Utility Regulator (UR).

The Single Electricity market (SEM) is the wholesale electricity market for the island of Ireland. A new set of wholesale market trading arrangements for the SEM have been introduced under the I-SEM design project that went live in 2018, including the introduction of new day-ahead, intraday and balancing markets. The new market design included the introduction of a new competitive State-Aid compliant Capacity Remuneration Mechanism (CRM) replacing the previous administratively determined Capacity Payment Scheme[121].

On SEMO, the Single Electricity Market Operator, a total of 43 registered units were Demand Side Units (DSU) in 2021[122]. PowerHouse is one of Ireland's DR aggregators focused on large commercial energy consumers[123].

15.1.2 Prosumers and flexibility services

In Ireland, the roles of prosumers in residential, commercial, and industrial settings are substantially different. Flexibility is primarily used by consumers for energy bill reduction and on-site optimization, but commercial and industrial customers can additionally engage in demand response programs and interruptibility schemes, combining them with feed-in tariffs and on-site optimization.

Household prosumers can employ a variety of technologies to reduce their usage, but they have limited engagement with the energy system. So far, implicit DR options have been restricted, with just day/night tariffs available to homes. The implementation of the National Smart Metering Program, re-scoped to include delayed Phase 2 and Phase 3, is expected to reach its first milestone in September 2023. Suppliers will be obligated to provide clients with dynamic pricing under this program. With a typical day/night/peak-time rate, various options will be available[124].

Although consumers are not yet able to employ explicit DSF, business and industrial units can engage in markets through DSU. Through demand adjustment, these units can engage in TSO markets such as balancing, capacity, system services, and day-ahead markets. Multiple assets can be combined into a single DSU that bids in the market as a single entity.

Consumers can now participate in Demand Side Management through tariff-based schemes that incentivize them to shift their usage to less expensive off-peak hours. In Ireland, EirGrid also runs two system operator-based programs, Short Term Active Response (STAR) and Powersave, which are designed to maintain the grid secure during times of stress.

These programs are directed toward large electricity consumers. Medium to large electricity users can join a Demand Side Unit (DSU) or Aggregated Generating Unit (AGU) in addition to participating individually in EirGrid's schemes (AGU). A Demand Side Unit is made up of one or more demand sites that can reduce demand when EirGrid or SONI tells them to. The Demand Side Unit has one hour to reduce its demand and must be capable of doing so for at least two hours.

15.2 Transposition of the EU Directive 2019/944

The EU Directive has not been transposed yet; however, existing regulation already addresses the provisions of Article 17.

There are existing market participants that fulfil aggregation activities as envisaged by the Clean Energy Package. These activities are undertaken by demand side units (DSUs), Aggregator Generator Units (AGUs), Assetless Supplier Units (ASUs) and Suppliers. As all these market participants have pre-existing routes to market, the non-discriminatory access requirements for aggregators is met by the current market arrangements[125].

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121 Implementation Plan for Ireland To meet the requirements of the recast Electricity Market Regulation 2019/943.
122 https://www.sem-o.com/documents/general-publications/List-of-Registered-Units.xlsx.
123 powerhousegeneration.com.
124 Smart Meter Upgrade Phase 2 Scope, CRU2021.
125 Consultation on Energy Communities and Active Consumers, CRU 2021.

In Ireland, DSUs can participate in the day-ahead, intra-day and balancing markets in a non-discriminatory fashion along with renewables and battery storage. In addition, all technologies are permitted to participate in the capacity mechanism[126].

Aggregators can engage in the balancing market[127]. There are currently no ancillary services available to residential end-users. However, as part of the implementation of the Emergency and Restoration Network Code (EU Regulation 2017/2196), the CRU has asked the TSO and DSO to investigate a market for black start services, which may include creating the opportunity for residential end-users to access ancillary services.

15.3 Demand Response in the Markets

Demand Side Management involves users of electricity having the capability to change their usage from their normal or current consumption patterns. It can benefit customers by lowering prices and giving them more control over the energy they use and create, as well as assisting the TSO in efficiently managing the power system, such as accommodating rising renewable electricity generation and providing increased capacity.

When establishing the Capacity Remuneration Mechanism, the SEM determined that DSUs, while able to participate in CRM auctions, would be exempt from Reliability option (RO) payments where the contracted demand is delivered. This exemption has been removed in 2020 and replaced with an interim solution involving a change to the Trading and Settlement Code[128].

Box 15. Demand Response Schemes currently in operation in Ireland

Short Term Active Response (STAR)

Electricity customers are required to make their load accessible for short-term outages under this system. This service provides the system with "reserves" that are used in the case of a large generating unit failure. The STAR plan, formerly known as the "Interruptible Load" scheme, has been in place for more than two decades. Interruptions are initiated by an under-frequency relay situated on the consumer's premises, and each interruption lasts around 5 minutes – interruptions are not announced. Customers who participate in the system pay for the installation of metering, communications, and control equipment. Customers are paid based on the amount of energy they make available for the interruption in exchange for this service. Customers that enrol in this program can also enrol in Powersave or be a part of a DSU, but not both.

Powersave

The Powersave program's goal is to encourage big and medium-sized customers to cut their electricity consumption on days when total system demand is near to supply. Participating clients are compensated based on the number of kWh saved during a Powersave Event. A Powersave Event can be scheduled on any business day and time throughout the year. When a Powersave Event is called, customers are notified via email and text messaging. Customers who take part in this program can also take part in STAR, but they cannot be members of a DSU.

15.4 Enablers and Barriers Demand Response and Independent Aggregators

The ancillary market opened to DSR in 2016 under Interim Arrangements leading up to the launch of Ireland-Single Electricity Market (I-SEM). Due to a more diversified product range, demand side participation should expand significantly through I-SEM. Ireland's significant share of wind in the national energy mix, which has resulted in high system flexibility needs, is a key enabler for DR initiatives.

The installation of 2.4 million smart meters by ESB Networks is expected to be completed in 2024 as part of the National Smart Metering Program, and will include the ability to measure energy exports[129]. The completed rollout of smart meters will act as a further structural enabler for engaging in explicit DR.

126 National Energy & Climate Plan for Ireland 2021-2030.
127 https://www.sem-o.com/markets/balancing-market-overview.
128 Implementation Plan for Ireland To meet the requirements of the recast Electricity Market Regulation 2019/943.
129 https://www.cru.ie/home/smart-meters.

However, consumer engagement is hampered by difficult and costly prequalification procedures. Because each consumer is viewed as if they were a large generation unit, aggregators are unable to protect consumers from these practices.

16 ITALY

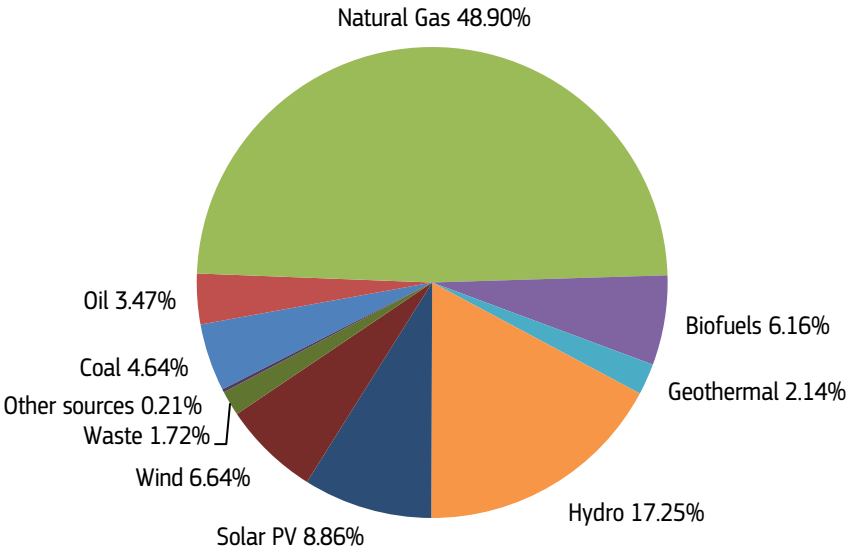
Box 16. Italy - practical info

– Statuto di utilizzo e di integrazione degli impianti di produzione alimentati dalle fonti rinnovabili e di generazione distribuita, link in Italian

– The UVAM (Virtually Aggregated Mixed Units) pilot project, link

16.1 Background

Figure 17. Italy's Electricity Generation mix in 2020.



Source: IEA, 2020.

Given the ongoing transformation of the energy sector that pursues a goal of 55% renewable electrical energy and a growing share of domestic renewable energy, Italy has established new goals for electricity security. The goal is to decrease energy dependency from 77.7% in 2016 to 75.4% in 2030 and to 74.6% in 2040. The increase of storage capacity has been established as priority target too, with almost 1 000 MW through 2023, divided between hydroelectric and electrochemical production, and 6 000 MW in addition to 4 000 MW disbursed storage by 2030. Italy expects to enhance its interconnectivity stage to 10% by 2030[130].

Italy has also been successful in market liberalization and infrastructure development, especially in the energy sector, with electricity prices converging across the country due to improved north-south transmission and market coupling. To promote and achieve both transition to green energy and energy security, Italy promotes energy efficiency in all sectors as a tool to protect the environment, improve energy security and reduce energy costs.

16.1.1 Players and context

In Italy, the only TSO is Terna. The distribution network is instead divided between 127 DSOs as of 2019. The largest of these is E-Distribuzione (formerly Enel Distribuzione), which covers a major share of the Italian electricity demand. The most important local operators are A2A, ACEA, IREN, DEVAL, and HERA[131].

The Italian Regulatory Authority for Energy, Networks and Environment (ARERA) carries out regulatory and supervisory activities in the sectors of electricity, natural gas, water services, waste cycle and district heating.

130 Integrated National Energy and Climate Plan for Italy 2021-2030.
131 ARERA Annual Report 2020 Summary.

Terna has joined seven other major European carriers and TSOs in launching a common initiative to support an electric system that allows achieving carbon neutrality by 2050. Specifically, the objective of the TSOs with this initiative is to analyse in depth how their activities contribute to decarbonisation and to develop ways to support the electricity system to be carbon neutral[132].

Since September 2021, Italy has joined the European intraday electricity market[133].

Italy was divided into six bidding zones until 2020, with a commitment to reassess new once improved interconnection relieves the congestions between the existing bidding zones.

16.1.2 Prosumers and flexibility services

In Italy, there are 740 000 self-consumption units, covering around 9% of the total electricity consumption. So far, incentives to become a prosumer in Italy rely on feed-in tariffs and premiums. Customers have fixed price and variable price contracts for electricity available to them.

Existing flexibility programs that may be a good opportunity for consumers are not yet profitable enough to create business cases due to market access barriers. Meanwhile, regulators continue to coordinate the technical requirements for flexibility to participate in different electricity markets, especially in the ancillary services.

Prosumers have limited capacity to explicitly monetize their flexibility. The Virtually Aggregated Mixed Units (UVAM) pilot project (see box below) enables power generation and demand to provide balancing services. Given the low-price margins, only industrial customers can take advantage of the interruptibility programme. The role of the independent aggregator has been recently introduced in these markets, but it still needs to be fully integrated[134].

Finally, 99% of the Italian end-users are currently equipped with a 1G smart meter, and the roll-out of the 2G smart meters is expected to be completed (reach over 90% Low Voltage connection points) by 2024[135].

16.2 Transposition of the EU Directive 2019/944

The EU Directive 2019/944 isn't transposed in Italy yet. However, the content of article 17 has been already applied in Italian regulation. Also, the right of each market participant involved in the aggregation to enter the ancillary services market without the need for consent by some other market participant will be guaranteed soon, removing the pre-existing obligation of consent by the balance responsible party.

Technical modalities on the use of Demand Response are not developed in cooperation with the regulators, as specified in Article 31(8) of the Directive. Hence the technical modalities on the use of demand response are available only as far as global services provided to TSO are concerned: these modalities are proposed by TSO, after public consultation, and are finally discussed and approved by the regulator.

Some residential customers have difficulties in participating in the ancillary services market as the hourly measures (necessary for participation in that market) are not yet available for all connection points. This problem will be solved when the new smart meter 2G is installed for all final customers and all measurement data will have an hourly treatment for settlement purposes.

The capacity market does not seem to be open to DR, but to generation. Aggregation on the demand side is technically possible.

16.3 Demand Response in the Ancillary Services Market

Currently, only global ancillary services may be provided to TSO, whereas DSOs are evaluating their own needs of flexibility.

The current regulatory framework allows demand response participation to Energy (Day-Ahead and Intraday), Ancillary Services and Capacity Markets. DR has been enhanced in these markets through pilot projects that prepared the opening of these markets to new participants such as non-programmable renewable sources,

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132 Decarbonising the Energy System: the role of TSOs. 2021.
133 https://www.arera.it/allegati/com_stampa/21/210528eng.pdf.
134 The smartEn Map for Prosumers, 2020.
135 Integrated National Energy and Climate Plan for Italy 2021-2030.

distributed energy resources and demand-side response and storage systems, including electric car batteries, also through aggregators[136].

16.3.1 Virtually Aggregated Units (UVAs)

Terna has opened the ancillary services market to distributed resources through pilot projects.

The UVA (virtually aggregated units) are composed of aggregations of consumption and/or generation points as well as storage systems (including e-mobility charging stations), connected to the grid at any voltage level, and falling within the scope of aggregation defined by Terna. Starting in 2017 from aggregating only consumption points (UVAC) and only production points (UVAP), the projects identified by Terna have "evolved" towards mixed aggregations (UVAM)[137].

The UVAM (Virtually Aggregated Mixed Units) project was launched in 2018 after concluding the UVAC and UVAP projects. It enables distributed resources (consumption and production units) as well as storage systems to participate as aggregates in the ancillary services market. The main participants are large commercial and industrial units that are remunerated both for the energy activated (Eur/ kWh) and for resource availability (Eur/kW). In 2019, over 120 UVAM were qualified for the ancillary services market (MSD) with a total capacity of around 830 MW. In 2020, the number almost doubled to 231 units, of which 171 are concentrated in the Nord region of the country[138].

In Italy, UVAMs must have a modulation capacity of at least 1 MW and can aggregate mixed points.

UVAM are currently able to provide services like as congestion resolution, balancing, and tertiary reserve in Italy. Terna uses UVAM to test various services (such as secondary frequency/power control) and plans to incorporate residential consumers as well progressively.

Independent aggregators then include in their portfolio units certified by Terna as UVAM. On the Italian market, the independent power aggregators EGO is active in the dispatching and trading of electricity, and holds UVAMs. It also provides services on the new Ancillary Services Market (ASM), recently opened to all power generating and consuming operators[139]. Similarly, EnelX has carried included UVAM units in the Nord region, and through 2020 it ran a pilot project that enabled residential energy storage systems to offer balancing services to the electricity grid[140].

16.4 Enablers and Barriers for Demand Response and Independent Aggregators

The pilot programs in Italy (UVAM) have had a very promising start, especially when compared to other European nations, leading to the conclusion that the Italian flexibility market is mature and ready to expand consumer engagement. The pilot project's consistent results point to a bright future for adding more residential DR aggregators to the system. In this context, the adoption of electric vehicles and the planned implementation of smart meters in the next years must be viewed as enablers.

The Draft Annual Law for Competition was approved by the Italian government in November 2021. As far as the energy sector is concerned, the bill ensures a strengthened infrastructure for EV charging stations[141].

The main barriers for independent aggregators in the Italian power market are currently represented by the failure to define the perimeters of action of this emerging entity, as well as the precise methods of calculating the imbalances that aggregation would generate for distribution companies. The institutional arrangements of the Italian energy sector are complex and need to be modernized and strengthened.

Finally, independent aggregators are limited to pooling resources within one bidding zone, which constitutes a geographical constraint towards aggregators of small loads, who need to be able to pool many consumers in order to qualify for minimum bidding and realize a business case. Conversely, the elimination of the Single

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136 Italian Implementation Plan, 2020.
137 Distributed Resources in the Italian Ancillary Services Market: taking stock after two years. Terna, 2020.
138 Statuto di utilizzo e di integrazione degli impianti di produzione alimentati dale fonti rinnovabili e di generazione distribuita, ARERA 2020.
139 https://ego.energy/en/trading/electricity.
140 https://www.enel.com/media/explore/search-press-releases/press/2020/01/enel-x-launches-first-project-in-italy-to-aggregate-residential-storage-units-offering-network-balancing-services-.
141 https://www.governo.it/it/articolo/comunicato-stampa-del-consiglio-dei-ministri-n-45/18476.

National Price across the bidding zones, and thus exposing consumers to zonal prices, could support engagement in DR[142].

[142] Italian Implementation Plan, 2020.

17 LATVIA

Box 17. Latvia - practical info

– Aggregator Rules, Regulations of the Cabinet of Ministers No. 157, 2020, link

– National Energy and Climate Plan of Latvia, link

17.1 Background

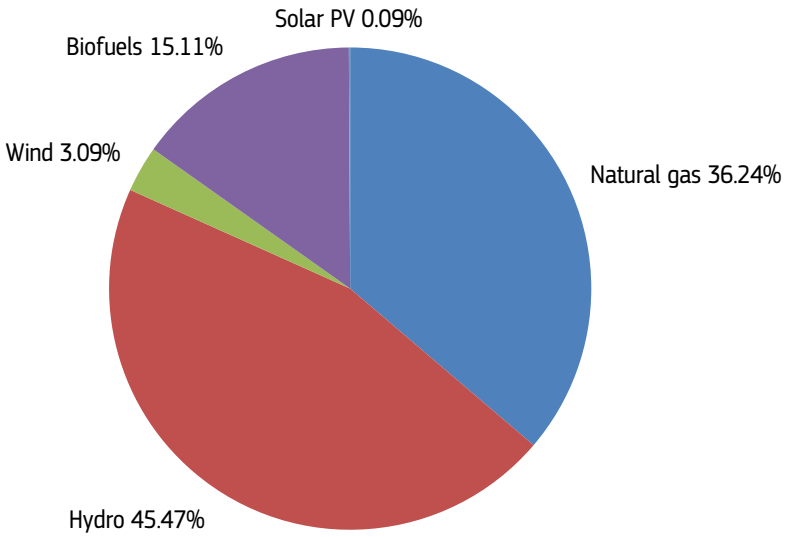
Due to the considerable hydropower resources, Latvia is one of the EU's leaders in renewable electricity generation and consumption. In 2019, Latvia reached the third-highest share of renewables (40.97 %) in energy use in the EU, following Sweden and Finland. The EU average amounted to 19.7 %[143].

Nevertheless, the potential of wind and solar electricity generation is still only partially seized due to unfavourable regulations, in particular regarding available land, but also due to adverse societal attitudes[144].

The key challenge the Latvian electricity system is facing in the next decade is the threat of shortages in electricity supply due to the fact that a significant part of large thermal power plants is to be phased-out[145].

The installation of smart meters is to be completed by 2022, with a targeted coverage of 99% of all customers[146].

Figure 18. Latvia's Electricity Generation mix in 2020.



Source: IEA, 2020.

17.1.1 Players and context

Ast is the only TSO in Latvia and there are 11 DSOs[147], of which JSC "Sadales tikls" serves 99% of the electricity customers. The largest electricity producer is JSC "Latvenergo"[148].

The Latvian electricity market operates within the Nord Pool electricity exchange that links the Nordic and Baltic regions as well as Northern Europe.

143 https://eng.lsm.lv/article/society/environment/latvia-third-in-eu-for-renewable-energy-use.a420046.
144 https://eng.lsm.lv/article/economy/economy/why-does-latvia-use-so-little-wind-and-solar-energy.a404359.
145 https://www.ast.lv/en/events/electricity-system-changes-attention-must-be-paid-generation-and-balancing-capacity-reserves.
146 National Energy and Climate Plan for Latvia 2021 - 2030.
147 Distribution Grids in Europe Facts and Figures 2020 , eurelectric.
148 https://www.sprk.gov.lv/en/content/electricity-0.

The Public Utilities Commission (SPRK) carries out the regulation of public services in energy, electronic communications, post, municipal waste management and water management sectors in accordance with the law "On Regulators of Public Utilities" and special legal acts of the regulated sectors.

The liberalization of the balancing market is more complicated in Latvia than for other EU Member States, as the electricity system of the Baltic States is not synchronised with the synchronous areas subject to EU law and the price of the balancing service is considerably influenced by balancing deliveries from Russia[149].

17.1.2 The participation of DR and prosumers in the market

PV panels, solar collectors, and heat pumps (HP) are the most popular equipment for household energy generation in Latvia[150]. A settlement system for microgeneration is in place, allowing prosumers to inject excess electricity (e.g., by a rooftop PV unit) into the network and subtract it from the network demand. However, the number of prosumers is still low in Latvia because of the underdeveloped solar sector and the limited support for micro-generation[151].

Demand response solutions, both implicit and explicit, have been available to end consumers in Latvia, but the optimization of energy consumption is at an early stage, and no aggregators participate in the market[152].

17.2 Transposition the EU Directive 2019/944

The transposition of Article 17 of the EU Directive 2019/944 into the Latvian legislation is still not completed.

However, rules for aggregators of demand response are defined in a new Cabinet of Ministers regulation that came into force in March 2020, and that has been designed specifically for aggregators of DR. DR services are allowed to participate in ancillary services markets as well as in wholesale electricity markets[153]. The bill does not, however, address independent aggregators.

17.3 Demand Response and aggregators

Currently, in Latvia, DR aggregators are regarded as regulated utilities and have similar rights and obligations as suppliers. The activities of independent aggregators are partly limited. While aggregators are not required to conclude agreements with retailers, they need to negotiate with a balance responsible party of a customer they intend to cooperate with (which may be a different entity than the retailer). Moreover, DR aggregators need to comply with a range of system security and imbalance accounting-related requirements (that are similar to requirements of electricity retailers). By 2022 it is, however, envisaged to establish a regulatory framework for DR aggregators[154].

The regulatory authority, PUC, is responsible for the compilation of aggregators' register.

Both end-users and DR aggregators are allowed to valorise DR on the balancing market based on the technical and data exchange requirements that are defined in the Latvian Network Code. Further, day-ahead and intra-day markets are open to DR aggregators too.

DR aggregators can provide services to DSOs.

Although residential DR is enabled by the regulatory framework, there is only a limited market interest in it which might be due to small households' loads available (100–150 kWh per month) and insufficient financial incentives compared to infrastructure investments needed to enable it. Implicit residential DR via dynamic pricing has, however, been gaining popularity in Latvia.

17.4 Enablers of and barriers for Demand Response and Independent Aggregators

In Latvia, supply security concerns are expected due to the necessity to phase-out outdated thermal power plants. As the need for flexibility in the system increases, it can create opportunities for flexibility from DR.

149 National Energy and Climate Plan for Estonia 2030.
150 Analysis of Latvian Households' Potential Participation in the Energy Market as Prosumers, Lebedeva et al., Clean Technologies, 2021.
151 https://eng.lsm.lv/article/economy/economy/why-does-latvia-use-so-little-wind-and-solar-energy.a404359/.
152 Measuring the impact of demand response services on electricity prices in Latvian electricity market, IEEE 2020.
153 Aggregator rules, Regulations of the Cabinet of Ministers No. 157, Riga, March 2020, (protocol No. 17 § 3).
154 National Energy and Climate Plan for Latvia 2021 - 2030.

The completion of the mass rollout of smart meters expected in 2022 means that should end-users wish to engage in demand response programs; they will have the necessary tools available to them.

However, the underdeveloped prosumers sector means that there is very little dispatchable load. This could change if the support schemes for EVs have the expected outcome and stimulate an increase of EV in the system. For independent aggregators, in particular, a clear regulatory framework is required.

18 LITHUANIA

Box 18. Lithuania - practical info

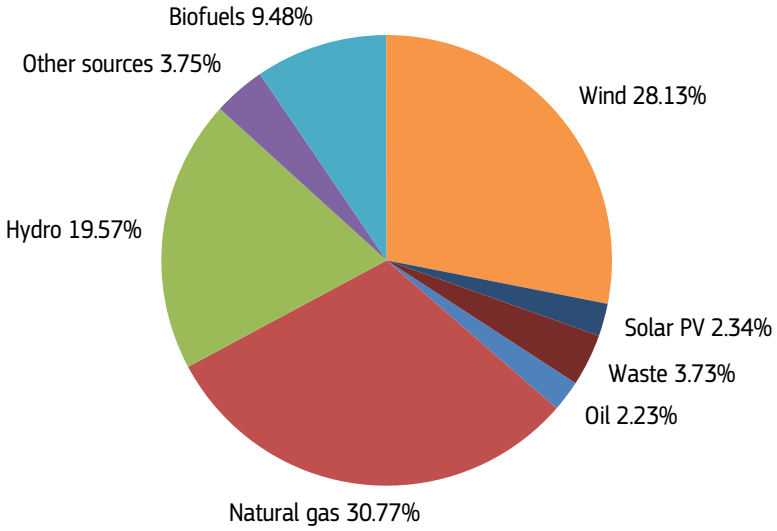
– Lithuanian Electricity Market Development and Implementation Plan, link;

– National Energy and Climate Plan, link

18.1 Background

Since the closure of the only nuclear power plant in 2009, Lithuania evolved into a net importer of electricity. Electricity imports cover about 75% of its demand.

Figure 19. Lithuania's Electricity Generation mix in 2020.



Source: IEA, 2020.

Lithuania aims to decrease import dependency by boosting the share of domestic renewables in particular via energy prosumers. The Lithuanian renewables target for 2020 was achieved as early as in 2014. By 2030, the government envisages reaching at least 45% of renewables in final energy consumption and 80% by 2050, with 100% in the electricity mix. To further strengthen the electric system, the interconnectivity and synchronisation with the European network are sought (in particular regarding the integration into the Baltic and Nordic electricity markets).

Increasing the flexibility by introducing electricity storage, smart grids and modern balancing services poses some new challenges to the Lithuanian electricity system, but the aim is to enhance the resilience of electricity networks. Progress in market liberalization and deregulating tariffs are also expected.

It is planned to install 1 million smart meters between 2022 and 2025 for 70% of electricity customers, including commercial end-users and households, with a demand exceeding 1 000 kWh per year. All remaining end-users will receive smart meters after 2024, but at their own cost[155].

18.1.1 Players and context

Litgrid is the only Lithuanian TSO. There are five DSOs, five large electricity producers and several small renewable producers.

The regulating authority is VERT, Valstybinė energetikos reguliavimo taryba (National Energy Regulatory Council).

[155] Lithuania 2021 Energy Policy Review, IEA, 2021.

Lithuania is also part of the Nord Pool electricity exchange that links the Nordic and Baltic regions as well as Northern Europe.

The liberalization of the balancing market is more complicated in Lithuania than for other EU Member States, as the electricity system of the Baltic States is not synchronised with the synchronous areas subject to EU law and the price of the balancing service is considerably influenced by balancing deliveries from Russia[156].

18.1.2 The participation of DR and prosumers in the market

The prosumers sector has started to develop in Lithuania. From an estimated 2% in 2020, 30% of all electricity customers are to become prosumers by 2030[157]. Over 10 000 prosumers were reported in 2021, and the ambitious target is to reach 500 000 by 2030[158].

In parallel, the National Energy and Climate Plan favours the active role and protection of prosumers and consumers[159], without, however, specifying measurable targets with regard to demand response.

At the moment of writing there are three independent DR aggregator operating in Lithuania. The aggregator cooperates predominantly with large refrigerating units and warehouses.

18.2 Transposition the EU Directive 2019/944

The transposition of Article 17 of the EU Directive 2019/944 is not completed in Lithuania. In particular, a clear definition of the role of DR aggregators, including respective rights and obligations, is missing. Accordingly, DR aggregators have not been properly legally empowered to act on the market.

The TSO has been carrying out public consultations on the transposition regarding, in particular, the baseline methodology, deployment of balancing service contract, resolving of imbalances and sales contract. The timeline for the elaboration of the transposition documents was perceived as very tight by some market actors. This seems to have affected the quality of the respective documents, especially regarding the consistency and compliance with other legal acts.

18.3 Demand Response and aggregators

Although a dedicated regulatory framework is not available, the only independent DR aggregator can access the Lithuanian balancing market. DR aggregation is envisaged to provide support only to the TSO. The DSOs cannot use DR aggregation to address problems at the local network level, which limits the revenue sources for DR aggregators.

In practice, residential electricity consumers, because of reduced small dispatchable load, do not have the possibility to valorise their flexibility in the markets.

The definition of the technical prerequisites for the use of the DR is currently ongoing.

18.4 Enablers of and barriers for Demand Response and Independent Aggregators

The Lithuanian electricity system is targeting a growing share of renewable energy, which in turn is expected to create more flexibility needs in the system. The ongoing rollout of smart meters and the ambitious plans regarding the development of prosumers create the conditions for the valorisation of flexibility and constitute enablers for engagement in explicit demand response.

However, end-users still have a low awareness level with regard to their options in demand response. A clear, expanded regulatory framework is required for independent aggregators to access the markets.

156 National Energy and Climate Plan for Estonia 2030.
157 Lithuanian Electricity Market Development and Implementation Plan.
158 https://enmin.lrv.lt/en/news/electricity-prosumers-already-number-more-than-10-000.
159 National Energy and Climate Plan for Lithuania 2020-2030.

19 LUXEMBOURG

Box 19. Luxembourg - practical info

– Creos Annual Report 2020 link;

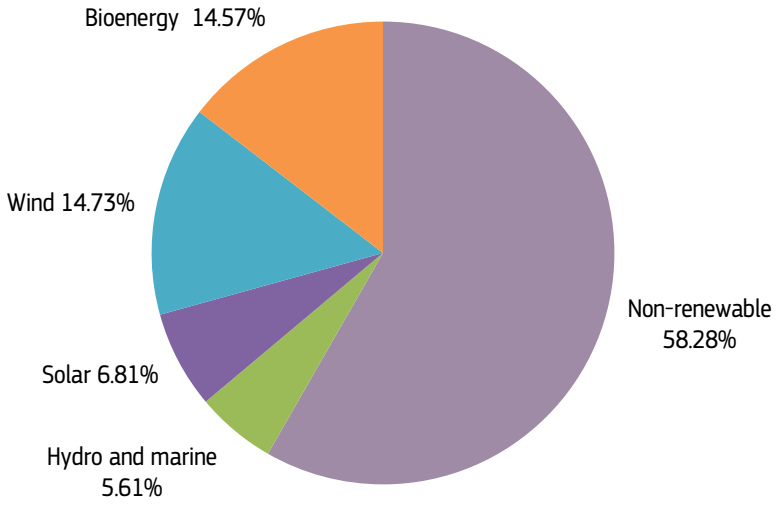
– Luxembourg's Integrated National Energy and Climate Plan for 2021-2030 link.

19.1 Background

Luxembourg relies heavily on fossil fuels and is highly dependent on energy imports (86% of its energy demand in 2018 was imported)[160]. Hence, the electricity system of Luxembourg has very strong connections with its neighbouring countries with regard to cross-border capacities.

These facts have a great impact on local generation, on the electricity grid and on the development of demand response programs. Luxembourg has asked for an exception based on Article 44(2) of the Electricity Directive, thus the electricity market is not fully unbundled.

Figure 20. Luxembourg Electricity generation in 2019.



Source: IRENA, 2020.

Luxembourg is part of the joint market with Germany. A top priority is congestion management and further development of capacity calculation, necessary for the day-ahead market. Regarding the intraday market, conditions were harmonised with the framework conditions from Germany, and there is active participation in the integrated XBID platform[161].

In the Pentalateral Energy Forum, energy ministers from Luxembourg, Belgium, the Netherlands, France, Austria, Germany and Switzerland discussed the progress of their regional energy cooperation and agreed on the priorities for 2021, including harmonization of infrastructure and research[162].

160 https://www.iea.org/reports/luxembourg-2020.
161 Integrated National Energy and Climate Plan for Luxembourg 2020-2030.
162 https://www.benelux.int/nl/kernthemas/holder/energie/pentalateral-energy-forum.

19.1.1 Players and context

Encevo is present all along the energy value chain, from the supply, storage, production, transport, distribution, trading and services. The group is represented by three different entities where Enovos is responsible for the production of renewable energies and energy supply, Creos is the TSO and Enovos Services is responsible for energy-related services such as energy efficiency, distributed production, eco-mobility and others.

The national regulator is Institut Luxembourgeois de Régulation (ILR) – Luxembourg Regulatory institute.

19.1.2 Prosumers and flexibility services

Currently, end-users residential aggregators and customers are able to participate in the balancing markets for Frequency Containment Reserves (FCR) energy, also known as primary control reserve. Participation in the Frequency Restoration Reserve (FRR), also known as secondary and tertiary reserve, balancing market are expected to be implemented in the second quarter of 2022.

19.2 Transposition of Article 17 of the EU Directive 2019/944

Article 17 of EU Directive 2019/944 has not been fully transposed in Luxembourgish national law yet. However, aggregation of RES producers for participation in all electricity markets is currently possible in Luxembourg.

19.3 Demand response and aggregators

19.3.1 Wholesale Market

In theory, an aggregator can group residential units to bid in the German FCR market. However, there is not a significant large-scale take-up of aggregator activities in core markets. The aggregation market seems to remain small in Luxembourg.

Aggregators and end-users can participate only in the FCR market, where the German prequalification rules apply.

Even if there are no day-ahead or intraday markets available, market participants can submit offers on EPEX Spot, which is possible due to the fact there is no congestion on the interconnectors with Germany.

19.3.2 Establishment of technical modalities enabling Demand Response

The major technical requirements for participation in all markets, including market participants offering energy from renewable sources, are defined and are subject to a prequalification process. Technical modalities on the use of DSR are subject to NRA approval.

19.3.3 TSO Driven programmes

Due to the small size of the country and because lack of generators the situation is very particular. Based on a bilateral contract between the Luxembourgish and German TSOs, the balancing market is integrated with Germany, which carries out all balancing activities.

19.4 Enablers and Barriers for Demand Response and Independent Aggregators

While aggregators are recognized by law, they are not recognized in market rules. Aggregation independent from the retailer is currently not possible. The exception is the FCR market, where BSP's can aggregate units for their bid in the German FCR market. Luxembourg is a part of the German load frequency control (LFC) area, units located in Luxembourg can bid in the German FCR market. However, there are no units from Luxembourg currently participating in the FCR market.

In 2020, around 95% of power meters and 92% of smart gas meters were installed in Luxembourg. The first energy communities are expected to start forming in Luxembourg[163].

However, from a consumer perspective, there is still a lack of economic interest for customers to participate in DR given the relatively high entry barrier in terms of cost for on-site technical requirements. As of today, flexibility is not sufficiently remunerated, and its value is too low compared to capital expenditures. Aggregators and customers are not enabled to participate in the markets, with the exception of the FCR market, where the German prequalification rules apply.

It is important to note that, since Luxembourg is part of the German bidding zone, any aggregator of residential end-users in Germany should be enabled to aggregate Luxembourg end-users as well. Aggregation should be possible cross-border, covering the entire bidding zone. This effectively ties the use of explicit DR and the development of independent aggregation in Luxembourg to the situation of DR in Germany.

[163] CREOS Annual Report 2020.

20 THE NETHERLANDS

Box 20. The Netherlands - practical info

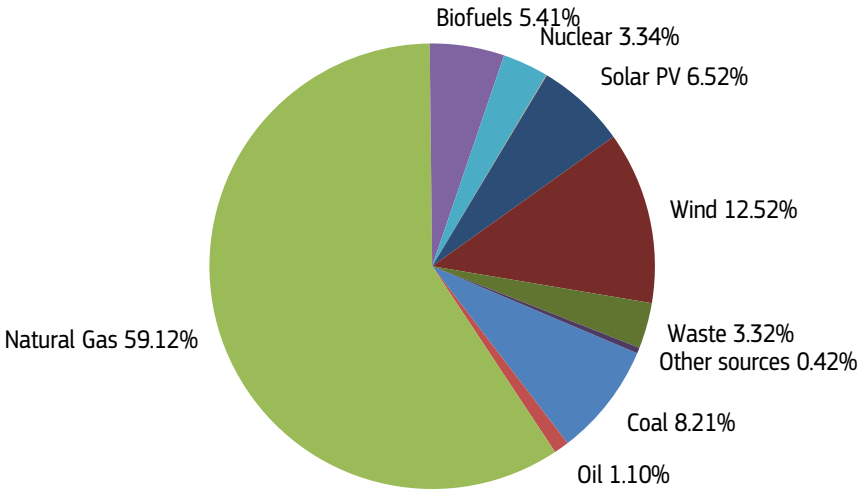
– Government Strategy on Hydrogen, link;

– Netherlands Climate and Energy Outlook 2020, link

20.1 Background

The Netherlands is committed to a rapid transition to a carbon-neutral economy that supports economic growth and energy security. Domestic energy production is sustained mostly by natural gas, which is also a key fuel for industry and for heating. However, since 2018, the Netherlands has become a net importer of natural gas, and the share of renewables has the ambitious goal of reaching 75% by 2030, from 18% today[164]. Extensive electrification of nearly two million vehicles, heating systems and industrial processes powered by electricity or low-carbon hydrogen is part of the transformation of the Dutch electric system[165].

Figure 21. Electricity generation mix in The Netherlands in 2020.



Source: IEA, 2020.

Research shows that the ensuing demand for flexibility in the Netherlands can be met predominantly by (foreign) power trade and, to a significant extent, by (domestic) demand response[166]. In its aim of reaching carbon neutrality and enabling this target through a mix of different sources of flexibility that accommodate intermittent renewable energy sources, the Dutch government promotes a mix of different sources for flexibility. They are needed to meet the future flexibility challenge including storage, interconnection, green hydrogen flexible generation, demand response, etc. By promoting the construction of a robust, low-carbon hydrogen market, the Netherlands intends to maintain its role as an energy hub for the EU in its transition towards a carbon-neutral economy. The Strategy on Hydrogen outlines the systemic role of hydrogen in a zero-carbon energy supply for the Netherlands, and supports the National Hydrogen Programme in which the production and use of low-carbon hydrogen are to be phased in by 2030[167].

164 Netherlands Climate and Energy Outlook 2020.
165 The Netherlands 2020 Energy Policy Review, IEA.
166 Energy Transition Implications for Demand and Supply of Power System Flexibility: A Case Study of the Netherlands Within an EU Electricity Market and Trading Context. Sijm et al., in: The European Dimension of Germany's Energy Transition, Springer, 2019.
167 Government Strategy on Hydrogen, 2020.

20.1.1 Players and context

The only transmission system operator (TSO) in the Netherlands is TenneT. The distribution network is instead divided between 6 DSOs, the three main ones of these are Liander, Enexis B.V. and Stedin B.V.

At the end of 2021 a total of 61 suppliers were active on the retail market1 is moderately concentrated, as the three largest suppliers serving about 70% of the market.

The retail market is highly concentrated, as the three largest companies serve about 80% of the market.

The national regulatory authority is the Netherlands Authority for Consumers and Markets (Autoriteit Consument en Markt, ACM), which states the conditions for such aspects as the operation of the grids, metering and the exchange of data and system services through the Electricity Grid Code (NetCode Elektriciteit).

20.1.2 Prosumers and flexibility services

In the Netherlands, prosumer opportunities vary greatly depending on the type and size of prosumer, but at the level of small end-users the primary activities are self-consumption and on-site optimization. They are facilitated by a feed-in premium financed through both non-tax levies as well as taxes paid by customers via the energy bill[168].

The prominent role of self-consumption and on-site optimization is related to a lack of opportunities to directly monetize flexibility with aggregators or retailers.

GOPACS is a grid operator platform for congestion solutions, and is a collaboration between the TSO and the DSOs, is currently being tested. While it is not a market itself, it integrates with current markets and provides a way to monetize flexibility, especially for large loads[169]. Given the market context and business models in the Netherlands, this platforms has been mainly used by industrial consumers.

The Netherlands has one of the world's densest charging station networks for EV, with the majority of them supporting smart charging. Some operators and service providers are already providing smart charging solutions to various degrees. Operators are testing and implementing vehicle to grid (V2G). However, rather than monetizing their flexible load, car owners' services are still based on decreased costs and other supply services, such as a state of charge guarantee. There is an aggregator active that is a BSP and offers capacity from aggregated pool of cars in the balancing capacity markets in NL.

20.2 Transposition of EU Directive 2019/944

The transposition of the EU Directive 2019/944 into national law is currently ongoing.

A new piece of legislation ('Energiewet 1.0') is expected to transpose into national law the EU Directive 2019/944. As of November 2021, a revised version of the bill was sent to the supervisory authorities involved for the formal test of feasibility and enforceability[170]. The text addresses aggregation (including that of small prosumers) but without mentioning explicitly independent aggregators[171], and the industry representatives of aggregators point out unsolved competition issues due to the agreement with the supplier, even if that is required only after the DR contract is signed between the consumer and the DR aggregator[172].

Currently, in the Netherlands, there is no specific designation of 'aggregators' alongside other market participants; in the Netherlands, the principle holds that all parties active on an end-user's connection must have covered the balancing responsibility for their actions. Market parties that wish to engage in aggregation using the flexibility resources of an end-user in their portfolio must agree on the terms and conditions with the supplier that is active on that connection. The industry representatives of aggregators point out unsolved competition issues due to the need for an agreement with the supplier.

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168 Status Review of Renewable Support Schemes in Europe for 2018 and 2019, CEER 2021.

169 https://web.archive.org/web/20220121162110/https://www.tennet.eu/tinyurl-storage/detail/dutch-grid-operators-launch-gopacs-a-smart-solution-to-reduce-congestion-in-the-electricity-grid/..

170 https://www.rijksoverheid.nl/documenten/publicaties/2021/11/26/wetsvoorstel-energiewet-uht.

171 Conceptvoorstel van wet houdende regels over energiemarkten en energiesystemen, 2021.

172 Contribution to the public consultation on a legislative change in the Netherlands on the Participation of demand response through aggregation, DR4EU, 2021.

20.3 Demand response in the ancillary services market

Based on the Energiewet 1.0, all market participants wishing to engage in aggregation will have to agree on the terms and conditions with the retailer/supplier. Although in this sense 'independent aggregation' is not facilitated, the retailer/supplier cannot prevent a market participants engaged in aggregation from including a specific connection in its portfolio. If needed, the Ministry shall step in to define necessary conditions for such collaboration (financial compensation, data exchange etc.) between market participants wishing to engage in aggregation and retailers/suppliers.

DSOs are relatively active themselves (or via their subsidiaries) on the market for demand response.

20.3.1 Explicit flexibility services

Small end-users can engage in wholesale, balancing, and ancillary service markets if they fulfil the relevant requirements (e.g., a minimum bid size); nonetheless, participation is limited in practice.

Residential end-users can employ net metering to pay for an on-site generation; but, under these contractual agreements, end-users are less exposed to pricing signals and have no incentives to sell their generation capacity in wholesale/balancing/ancillary services markets. This is true even for end-users who do not generate on-site; in general, price volatility is inadequate to enable DR[173].

20.4 Enablers and Barriers for Demand Response and Independent Aggregators

The Netherlands currently hold various flexibility sources, allowing it to respond to the elimination of supply and demand depending on market conditions. For the increasing flexibility needs in the future, green hydrogen is being promoted together with other means. However, there is no specific goal to increase the flexibility from demand response, storage or regulated capacity[174].

Further, even though the mass rollout of smart meters has been proposed in a Smart Meter Bill since 2008, the lack of public acceptance due to data privacy concerns and later public pushback due to technologic failures has resulted in only 11% smart meter penetration at the Netherlands at the end of 2018[175]. The status of the national target for 80% of small Dutch consumers to be supplied with a smart meter by 2020 is unclear as the last households are expected to receive one in 2022, but new concerns have been raised regarding the communication technology embedded in the devices[176]. A crucial step in the full implementation of smart meters in the Netherlands is the smart meter allocation (allocatie 2.0[177]), which at the moment is under development.

Structural barriers related to flexibility needs, as well as the technical barrier associated with the rollout of smart meters, resulting in the fact that small end-users engagement in DR is limited in the Netherlands.

From a regulatory and market point of view, significant actions have been taken, such as the opening of all grid services for demand response. However, significant barriers remain and are in favour of ancillary services provided by conventional generation: the obligation to deliver services symmetrically for FCR, as the one to inform the BRP about which actor is providing the DR; and the penalties for the delivery of ancillary services which in the case of DR aggregation have more powerful effects.

Although independent aggregators are permitted, market actors interested in aggregation have to rely on traditional suppliers to provide the data needed to pre-validate end-user connected groups and must submit an EAN code (i.e., a registered code for that electrical connection) as well as an active BRP for each connection.

Meanwhile, end-users wishing to participate in demand response are currently limited to options offered by retailers/suppliers. So far, participation in the DSR market through aggregation is limited to parties that already have access to end-users through suppliers.

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173 Flexibility Deployment in Europe, USEF, 2021.
174 Integrated National Energy and Climate Plan for The Netherlands 2021-2030.
175 Navigating implementation dilemmas in technology-forcing policies: A comparative analysis of accelerated smart meter diffusion in the Netherlands, UK, Norway, and Portugal (2000-2019). Geels et al., Research Policy 50 (2021).
176 https://www.netbeheernederland.nl/nieuws/uit-net-nl-special-slimme-meter-nextgen-de-meter-van-over-morgen-1473.
177 https://www.nedu.nl/wat-is-allocatie-2-0-eigenlijk/

21 POLAND

Box 21. Poland - practical info

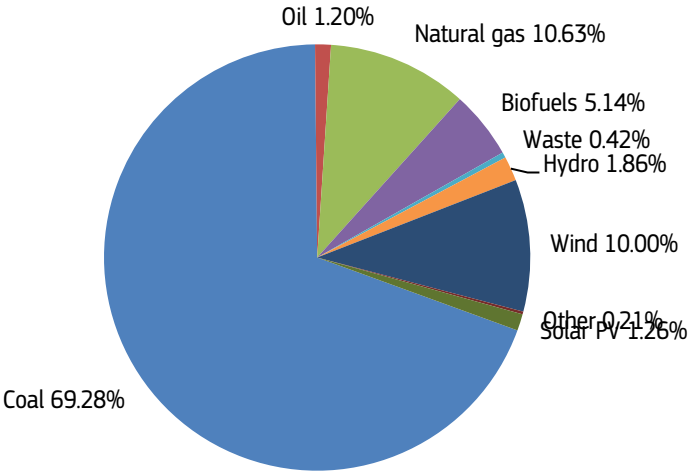
– Energy Policy of Poland until 2040, link;

– Registry of DR aggregators in Poland, link

21.1 Background

Poland is one of the most coal-dependent countries in Europe. In 2020, the share of coal- and lignite-fired electricity dropped slightly below 70%, despite new coal-fired power plants that became operational. Further, significant growth in photovoltaics was observed, though the overall share in electricity generation remains modest. On the other hand, wind electricity generation has been still facing a crisis due to the discriminatory regulation, the so-called "10h rule" that blocks the development of new onshore installations. This growth in the RES share is still insufficient for Poland to meet its EU obligations in this regard[178]. Despite of the pandemic-driven decrease in electricity demand, wholesale electricity prices have remained the highest in the region[179].

Figure 22. Poland's Electricity generation mix in 2020.



Source: IEA, 2020.

In 2021 a new energy policy for Poland, PEP2040, was published. To mitigate the threat of shortages in electricity supply it envisages the development of nuclear power. In 2033, the first nuclear block with a capacity of 1-1.6 GW is to become operational. The share of coal in electricity generation is expected to fall below 56% by 2030. Boosting renewables and DR is mentioned among the priorities. Further, PEP2040 envisages that 80% of households are to be equipped with smart meters by 2028[180].

The expected increase in electricity demand, coupled with an increasing share of renewables, is expected to put pressure on the Polish electricity system in the future. The risk of electricity supply shortages is amplified by the necessity to decommission the outdated coal-fired generation units. Further challenges that the Polish electricity system faces come from the necessity to improve energy efficiency in line with the EU targets to limit GHG emissions, as well as the already high wholesale electricity prices.

178 https://www.forum-energii.eu/en/blog/oze-2020.
179 Energy transition in Poland, Forum Energii, 2021.
180 Energy Policy of Poland until 2040.

21.1.1 Players and context

The Polish electricity system is highly concentrated and dominated by the state. There is one TSO, PSE, (state-owned) and about 164 DSOs, of which four state-co-owned and vertically consolidated energy groups (PGE, Tauron, Energa/PKN Orlen and ENEA) dominate the market. These energy groups also possess significant generation and distribution assets[181].

The Polish regulating authority is the Energy Regulatory Office (Urząd Regulacji Energetyki URE).

Since November 2019, the Polish market area has been part of the Single Intra-Day Coupling (SIDC) mechanism implemented using the XBID platform in implicit trading mode. As of January 2021, the operating power reserve (OPR) has been replaced by the capacity market mechanism[182].

21.1.2 The participation of DR and prosumers in the market

In Poland, there are several DR aggregators operating in the electricity market. The following DR aggregators are registered to operate until March 2022: TAURON Sprzedaż, Enel X Polska, Enspirion, Polenergia Obrót, LETRA[183]. At the time of writing, however, only one of the five aggregators would address small end-users through a scheme designed for EV.

The number of prosumers has been growing in particular due to the introduction of new support schemes. In summer 2021, there were 631 433 prosumer micro-installations, 99.9% of which were PVs. The total capacity of prosumer installations amounted to approximately 4 GW[184].

21.2 Transposition the EU Directive 2019/944

The transposition of the Article 17 of the EU Directive 2019/944 is still not completed in Poland.

In particular, the role of DR aggregators in terms of their rights and obligations is not defined in the regulation. In June 2021, a new draft energy legislation was published, including a definition of a DR aggregator both as a supplier and an independent aggregator[185].

21.3 Demand Response and aggregators

Residential DR is not available in Poland on a commercial basis. There have been several pilots implemented to test it. However, the characteristics of the residential electricity demand do not seem to be favourable for residential DR in Poland: DR-feasible electricity loads such as electric heating or air conditioning that are steerable without significantly affecting end-users' comfort constitute only a small share of the overall demand.

Technical prerequisites regarding the use of DR are not defined. In particular, network codes addressing DR's particularities need to be developed.

21.3.1 The capacity market

Electricity customers offering reduction capacity in the range of 2-50 MW can directly participate by concluding an agreement with the TSO as a responsible entity. Electricity customers with a reduction capacity below 2 MW can participate only via a DR aggregator. A certification process is obligatory for every participant. DR resources may apply for annual or 5-years-contracts, but only if DR projects incur capital expenditures. New generation capacities are allowed to apply for 15-years-contracts which is perceived as unequal treatment of DR resources. The results of the past capacity market auctions reveal that the vast majority of contracts went to coal-based resources[186].

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181 Report on the Polish power system, Agora Energiewende, 2018.
182 National Report of the President of URE 2021.
183 https://www.pse.pl/uslugi-dsr/agregatorzy-i-osd.
184 http://seo.org.pl/en/zainstalowana-przez-prosumentow-w-polsce-moc-przekroczyla-juz-4-gw.
185 https://www.parp.gov.pl/component/content/article/73686:projektowane-zmiany-w-ustawie-prawo-energetyczne-i-w-ustawie-o-oze-co-stanie-sie-w-2022-r.
186 Wytwarzanie, Przesyłanie, Dystrybucja I Handel Energią Elektryczną, Raport Branżowy, BOSbank 2020.

The requirements of the Polish capacity market are considered rather restrictive in terms of penalties for non-delivery, testing and measurement requirements. The capacity market is treated as a last resort measure, and at the time of writing, DR resources that were contracted via the capacity market were activated only in the course of testing.

Intervention DR: This service is acquired by the TSO in emergency cases when the capacity market reveals insufficient. Electricity customers offering a reduction capacity of at least 1 MW can directly provide the reduction to the TSO. Smaller electricity customers can participate via a DR aggregator.

21.3.2 Balancing market

It was planned to open the balancing market to DR resources of at least 1 MW of the reduction capacity starting from January 2021. The eligible DR resources need to be connected within one transmission network node, power grid with a voltage of 110 kV or a node connecting the grid with a voltage of 110 kV with the medium voltage grid.

Electricity customers can be contracted by a DR aggregator without the prior consent of the supplier, but the supplier needs to be informed about it.

21.4 Enablers of and barriers to Demand Response and Independent Aggregators

The challenges in the Polish electricity system, such as the growing share of renewables and of prosumers, can be in part addressed by DR, therefore creating a structural enabler for engagement in explicit DR. The emergence of a market for flexibility services where five aggregators are active at the time of writing (though mostly addressing large consumers) indicates that the opportunity is being seized.

By 2030, it is expected that the share of system services of the demand side in the operation of the energy market will increase due to the amendment to transmission network codes which set out the detailed rules for participating in system services on the demand side[187].

However, the insufficient awareness among customers regarding DR and an incomplete regulatory framework for aggregators prevents the engagement in explicit DR from reaching its full potential. The background, in particular at the level of residential consumers, is that the structure of residential electricity demand leaves very little dispatchable load to operate with, and the regulated tariffs for households do not result in a motivating revenue stream. The rollout of smart meters is expected to be completed only towards the end of the decade. At the level of the TSO, the use of DR is often a last resort emergency measure, whereas for congestion management at the level of DSOs the use of demand-side solutions is also a novel option.

[187] The National Energy and Climate Plan for Poland 2021-2030, Part 1-3.

22 PORTUGAL

Box 22. Portugal - practical info

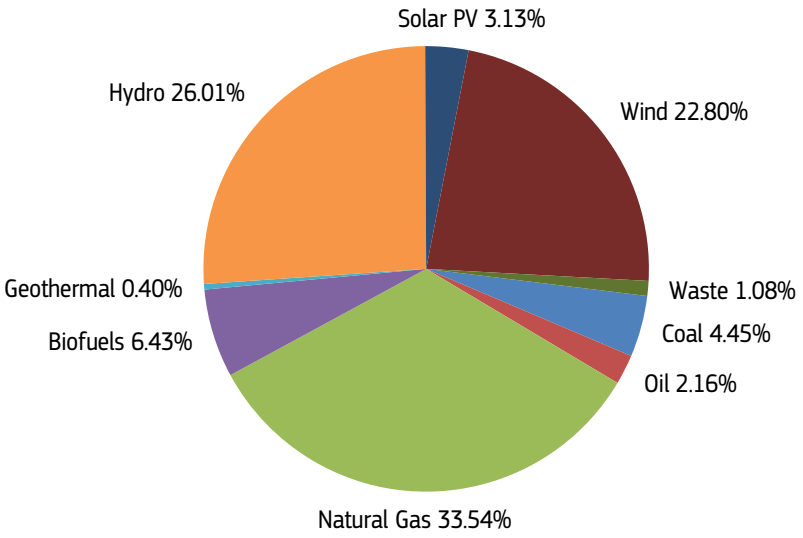
– Pilot Project for the participation of Demand in the regulated reserve market, link ;

– Hydrogen Strategy of Portugal, link

22.1 Background

Portugal has been among the performers in Europe in what concerns the transition to clean energy, particularly in the integration of renewable energy sources. In 2020, solar and wind energy accounted for about 25% of the power generation sector, and this trend is expected to keep growing.

Figure 23. Portugal's Electricity Generation mix in 2020.



Source: IEA, 2020.

Portugal's energy policy has been set as a key goal to achieve decarbonisation of the economy through widespread electrification, the rapid expansion of renewable electricity production and improved interconnection with the rest of Europe, with ambitious targets for clean hydrogen. The country is an international leader in wind energy integration, and the RES and storage auctions, introduced in 2019, are driving the rapid launch of PV systems and batteries.

Through its National Energy and Climate Plan, Portugal aims to reduce greenhouse gas emissions of 55% and reach the share of 47% of renewables in final energy consumption by 2030. In the short term, Portugal's strategy is to launch two new auctions to increase its pumping capacity for a total of 2 GW of renewable capacity. The last bid took place in 2020 and offered 700 MW of solar power (maximum capacity should be connected with BESS). The government is also planning the commissioning of a new 500 MW floating solar power plant in 2022[188].

As the flexibility needs in the Portuguese electric grid are currently addressed with hydro and natural gas, Portugal has also approved in 2020 a Hydrogen Strategy aimed to lower the country's dependence on the import of natural gas and achieve a 5% share of hydrogen in the final energy consumption by 2030[189]. The strategy is supported by an agreement with The Netherlands, which share the goals and ambitions regarding the production of green hydrogen from renewable sources[190].

188 National Energy and Climate Plan for Portugal 2021-2030.
189 Estratégia Nacional para o Hidrogénio aprovada em Conselho de Ministros.
190 Memorandum of understanding between Portugal and the Netherlands concerning green hydrogen.

22.1.1 Players and context

Transmission in continental Portugal is carried out by Rede Eléctrica Nacional SA (REN), under an exclusive public service concession contract with the state. REN is the transmission system operator (TSO). The TSO must connect all entities (including generators) to its network on a non-discriminatory basis if technically and economically feasible and subject to connection requirements. The TSO receives compensation for the use of its facilities, as set out in the Tariffs Regulation approved by the Regulatory Entity for Energy Services (ERSE).

Distribution is subject to a public concession regime, where operators obtain the right to carry out the distribution. EDP Distribuição SA is the main distribution system operator (DSO). An agreement to use the distribution grids and pay the tariffs in the Tariffs Regulation is concluded before access is given, which must be approved by ERSE. The liberalised retail market is highly concentrated among just four companies. In 2019, EDP Comercial, Endesa, Iberdrola and Galp together accounted for 78% of retail supply and 79% of consumers, with the residential segment being the most concentrated[191].

Only one aggregator, acting as a Balancing Services Provider (BSP) and only as a pilot project, is currently offering aggregated demand services to the ancillary services markets (regulation reserve market). The only other active aggregators are mediating between renewable energy system generators and the day-ahead and intraday markets, acting as Balance Responsible Parties (BRP). However, the national energy regulator is currently adopting the EU Electricity Directive, which will allow prosumers to participate in different markets and be remunerated for it.

22.1.2 Prosumers and flexibility services

Facing relatively high retail electricity prices, both at the industrial and household level, mainly due to the significant tariff and tax component of the price, Portuguese consumers generally use their assets for self-consumption and onsite optimization. Interaction with the grid is limited, and it is usually an option for larger prosumers. Due to regulatory constraints, explicit use of flexibility is quite limited.

Although most users are in the large consumer sector, implicit flexibility is possible: dynamic tariffs for those consumers are adjusted to spot market pricing. Households and medium-sized businesses can choose between two options, each of which adjusts its prices monthly according to the spot market.

Because quarter-hour consumption measurement is not yet practicable, households do not have actual dynamic pricing contracts. Static time-of-use network rates are available to both industrial and household users, with three price blocks for domestic customers during the day, and four price blocks for industrial clients.

Generators, particularly those who are unable to participate in the feed-in tariff, are encouraged to consume their own production. The surplus can be injected into the grid by trading it in the market, through bilateral contracts, or through a market facilitator (a responsibility that aggregators are increasingly taking on, called "last resort aggregators"). Generators under 1 MW have the option of guaranteed off-take through these last-resort aggregators if they choose not to operate through a market agent.

22.2 Transposition of the EU Directive 2019/944

The compliance with the provisions of Article 17 of the EU Directive 2019/944 in the Portuguese legal framework is ensured by the Commercial Relations Code (RRC)[192] of 2020, by provisions in the Decree-Law n.º 162/2019,both of which address aggregation and allow independent aggregators; the former replaced by the Decree-Law n.º 15/2022 that establishes the procedures for aggregators' registration.

Further, access to the wholesale, balancing and ancillary services markets is possible to all market agents, including clients, according to the following provisions:

— Enter into a Network Use Agreement with the network operator to which the facilities are connected, according to the Access to Networks and Interconnections Code (RARI)[193] last amended in 2017.

— Enter into an Ancillary Services Market Adhesion Agreement with the Transmission System Operator[194].

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191 Portugal Energy Policy Review, IEA 2021.
192 https://www.erse.pt/atividade/regulamentos-eletricidade/relacoes-comerciais.
193 https://www.erse.pt/atividade/regulamentos-eletricidade/acesso-as-redes-e-as-interligacoes.

— Consider Articles nº 243 and nº 244 of RRC to access the wholesale market.

22.3 Demand Response in Ancillary Services Market

In 2019 ERSE has started a pilot project of demand participation on the regulated reserve market. The pilot project aimed to ensure equal treatment in the participation of qualified consumers, or their representatives, in the regulation reserve market. The minimum requirement to participate in the Pilot Project consumers qualified by the Transmission System Operator (TSO) was to have an offer capacity of no less than 1 MW, get the necessary qualification proving the technical and operational ability, and be connected to the grid at a voltage level equal to or greater than medium voltage.

The results of the pilot project were regarded as largely positive and prompted regulators to maintain and prolong the conditions that made the project possible, and the network operators to point in favour of the extension of the pilot project for the participation of consumption in the Regulated Reserve Market[195].

It is expected, as the next step of the pilot project, to implement the aggregation of end-users and in which small end-users will be enabled to participate as well.

22.4 Enablers and Barriers for Demand Response and Independent Aggregators

Even if the flexibility market is quite mature in Portugal compared with other European countries, there still exist some barriers to the engagement in explicit demand response and to aggregation in the national electricity market.

From an institutional point of view, the complexity of balance responsibility is disadvantageous for aggregators and will continue to be so with the newly proposed models for independent aggregators.

The cost-benefit analysis for the rollout of electricity smart meters In Portugal has initially delivered an inconclusive result, delaying the starting date of the deployment until a revised CBA in 2015 delivered positive results and the penetration in 2021 was at 63% in Portugal mainland. Estimations based on the deployment rate indicated that Portugal may reach an 80% penetration by 2023[196].

From a financial point of view, the initial investment cost for the technical system is considered high for small customers (e.g., single-family houses). The low revenue streams received from market participation, as the energy share in the electricity bill is low in comparison with the share of taxes, may not justify the initial investment cost for an aggregator or customer.

Further, from a structural point of view, the need for flexibility in the system is currently addressed with conventional solutions, and the investments in green hydrogen indicate that demand-side solutions are not the first option in the Portuguese electricity system.

However, in 2015 Portugal introduced monetary incentives for battery electric vehicles (BEVs) in order to prompt EV's utilization, including favourable tax treatment for BEVs and support for EV charging infrastructure. An increased presence of EVs may provide customers with a more dispatchable load to operate with, and make new business models possible.

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194 Article 6 of Networks Operation Code "Regulamento de Operação das Redes" (ROR) approved by Regulation no. 557/2014, of 19 December, amended by Regulation no. 621/2017, of 18 December. Procedures n.º 3, nº 22 and Annex II of the Global System Management Procedures Manual "Manual de Procedimentos da Gestão Global do Sistema" (MPGGS) and amendments.

195 Projeto-piloto de participação do consumo no Mercado de reserva de regulação, report 2020.

196 Benchmarking smart metering deployment in the EU-28.

23 ROMANIA

Box 23. Romania - practical info

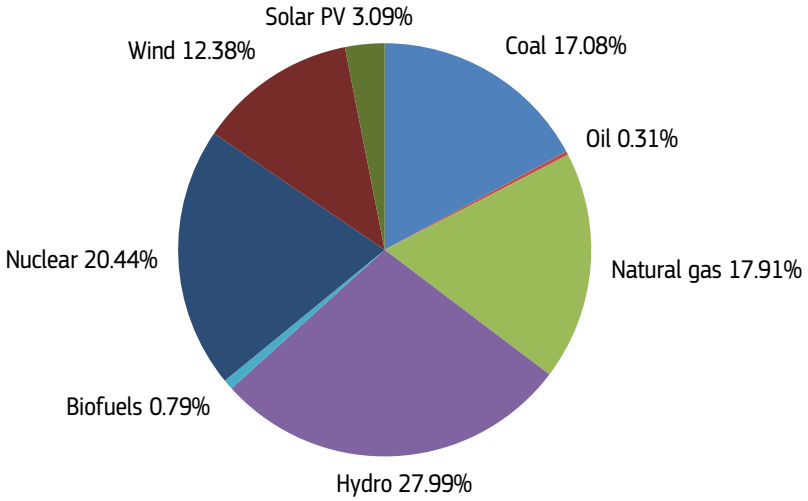
– Order 196/2020 regarding the licensing conditions for aggregators link;

– The 2021-2030 Integrated National Energy and Climate Plan link.

23.1 Background

Romania has committed to removing coal from its energy mix by 2032 and increasing the share of renewable energy, especially of wind. An essential role in turning the Romanian energy market into a "fit-for-RES" market is played by the digitalization of its distribution grids (smart grids) and transmission system. Starting with 2020, the day-ahead and intra-day markets are accessible to all participants, individually or by aggregation. In case final consumers can provide above 500 kW in the connection certificate, they may participate in the organised electricity markets directly or through aggregation[197].

Figure 24. Romania's Electricity generation by source 2020.



Source: IEA, 2020.

The liberalization of the electricity market in Romania started in 2007, the electricity system is decentralized, and the supply, distribution, transmission and generation are separated. Electricity supply on the Romanian market is carried out through one market segment. As of 2021, the regulated market is fully liberalized. Price regulation for industrial sectors was phased out starting from January 2014 but remained in force for households until the end of 2020. Demand response programs in practice are not available, even if it is legally allowed on the balancing markets through the retailers and on the wholesale market.

23.1.1 Players and context

The electricity market was liberalized in 2007, starting with 2014, the subsidized prices for the industry were phased out, and the full market liberalization was achieved on 1 January 2021.

The only Romanian TSO is Transelectrica and there are 6 DSOs: Distribuție Energie Electrică România (established in 2021, after the merger of the 3 distribution companies within the group: Electrica Distributie Transilvania Nord, Electrica Distributie Transilvania Sud and Electrica Distributie Muntenia Nord), Delgaz Grid, Distribuție Energie Oltenia, E-Distributie Banat, E-Distributie Dobrogea and E-Distributie Muntenia. The

[197] The 2021-2030 Integrated National Energy and Climate Plan of Romania.

Romanian national electricity supply company is Electrica Furnizare, and the largest state owned producers are Hidroelectrica S.A. and SN Nuclearelectrica S.A.

The Romanian Energy Regulatory Authority is ANRE.

23.1.2 Prosumers and flexibility services

Volumetric time-of-use tariffs are not available to low-voltage end-users in Romania[198], and the possibility for households and SMEs to opt for regulated prices is to be phased out by 2023[199]. Starting 1 January 2021 there are no regulated tariffs. A prosumer who owns a RES generation unit with an installed capacity of up to 400 kW can apply for certification with the DSO[200].

23.2 Transposition of Article 17 of the EU Directive 2019/944

Aggregators are recognized by the Romanian electricity legislation, both those affiliated to the consumer supplier and those independent from the supplier. The definition of independent aggregator is the one provided by the EU Directive 944/2019 ((19) "independent aggregator" is a market participant engaged in aggregation who is not affiliated to the customer's supplier). The Romanian secondary legislation provides the obligation for the supplier to conclude a transfer of energy contract with the independent aggregator, at a negotiated price (as allowed by the Law) or at the price of electricity without tariffs or taxes provided in the supply contract of the consumer (as provided by the ANRE order 61/2020).

Specifically, Article 17 has been partially transposed, as follows:

— The energy law (no. 123/2012) was amended provisionally in 2020 to include the terms of aggregation and independent aggregator, as well as the license for the aggregation activity and the recognition as market participants for the participants involved in aggregation, which implies the obligation to bear the financial balancing responsibility. Furthermore, a derogation from the general obligation (that electricity has to be traded publicly, transparently, centralized and non-discriminatory) was introduced, concerning the trade between the participants involved in aggregation and the owners of the generation capacities, as well as those between aggregators and the suppliers of the consumers whose loads they combine.

— The secondary legislation issued by ANRE allows the participation of aggregators, as market participants, to the centralized trading platforms (Order 49/2013, as modified by Order 65/2020; Order 78/2014, as modified by Order 65/2020; order 64/2020; order 82/2014 as modified by order 65/2020; Order 61/2020 utilizes the definitions from Regulation 943/2019 and Directive 944/2019; Order 62/2020).

— The regulations approved by Order 61/2020, establish that a transfer of energy (ToE) has to take place (and notified as contractual position) between the aggregator BRP and the consumer supplier BRP, to the amount equal to the difference between the measured consumption and the baseline consumption (a baseline methodology being also issued by Order 146/2020) and to the price of electricity without tariffs or taxes stated in the supply contract, so no financial compensation is necessary in the sense of Art. 17 (4) of the Directive 944/2019. The electricity Law was later amended, permitting also negotiated contracts, as presented above.

— The general terms associated with the aggregation license were approved by order 196/2020, stating that the object of the license is the provision of balancing services to the TSO and, as such, establishing permitting powers to the TSO. The document also provides minimum requirements for the aggregation contract, such as an object, duration, flexibility price/prices on domains of capacity, domains of generated/consumed/stored electricity variation, payment dates, rights and obligations, as well as fault termination clauses and requirements concerning aggregation contract updates, aggregator conduct in case of client debts and proper information upon the benefits and risks involved by market participation. The aggregation license conditions allow the licensee to trade into the day-ahead market, an intraday market and balancing (energy and capacity) market and to conclude electricity contracts with his clients and their suppliers.

198 Powering the Energy Transition Through Efficient Network Tariffs, eurelectric 2021.
199 The implementation of the electricity market design to drive demand-side flexibility, smarten 2020.
200 Prosumer's guide for the sale of electricity at regulated price, ANRE 2019.

— Order 146/2020 established the baseline consumption methodology, based on historical consumption data, closest to real-time data or agreed consumption by the supplier and aggregator, which stated that only consumers with smart metering were allowed to participate in the electricity markets, individual or by aggregation.

The secondary legislation will be updated and completed according to the provisions of the electricity law, amended in order to transpose the Directive 944/2019 provisions fully.

23.3 Demand response and aggregators

23.3.1 Status of technical modalities and market opening

The conditions for the technical qualification of resources for the provision of balancing services are to be proposed by TSO and approved by ANRE. The license conditions for aggregators (order 196/2020) include obligations concerning instrumentation required, such as interoperable SCADA solutions or IoT. The minimum offered quantity on the balancing market is 1 kWh (MWh with three decimal points), while on the platforms operated by the market operator, the minimum quantity is mostly 100 kWh. Also, dispatchable consumers, qualified by the TSO, can participate as balancing services providers on the balancing market.

23.3.2 Wholesale market

Aggregators can participate in the wholesale, balancing and ancillary electricity markets (secondary and tertiary regulation in public consultation at the time of writing). However, the concept of consumption-based aggregation is still not applied yet.

23.3.3 TSO and DSO driven programmes

At the moment, there are no TSO and DSO driven Demand Response programmes.

The Romanian electricity and natural gas law (123/2012) allows DSOs to trade in the wholesale market only to the extent to which it covers the electricity losses in the networks and the consumption of their own consumption places. At the same time, the TSO is allowed to participate in the electricity market only with the aim of covering the electricity losses in its network and the consumption of its consumption places, to maintain the production-consumption balance by operating the national balancing market and by trading with neighbouring TSOs according to national and ENTSO-E regulations and to ensure the market coupling mechanisms.

The DSOs and TSO can access the centralized trading platforms. The TSO operates the balancing market, where consumers, individual or aggregated, can participate. Participation to the balancing market is conditioned by the passing of a technical qualification process which is opened on an equal basis to generators, consumers and storage, individual or aggregated.

23.4 Enablers and Barriers for Demand Response and Independent Aggregators

In Romania, explicit demand response is not taking place in the market currently.

Consumption aggregation is defined but still to be fully transposed in the regulatory framework. The timeframe required to obtain an aggregation license and qualification from the TSO has so far prevented aggregators from emerging in the market. Further, even though a legal framework is in place, it can be unclear in some instances where it is a word-by-word but inexact translation of the EU directive, leading to confusion.

The main barriers are related to issues with the feasibility of the concept from the point of view of market attractiveness. Translating the idea into practice meets complex challenges: the remuneration model involves bilateral contracts between suppliers, customers and aggregators, the licensing process is complex. The baseline calculation approved by ANRE order 146/2020, comprises the calculation of baseline consumption based on historical measurements, except in case of participation in the balancing market, where the consumption value latest measured is taken into account as baseline consumption

However, due to the planned phase-out of coal, Romania is becoming an electricity importer and is facing very high prices in the wholesale market compared to previous years. Market opening and high wholesale prices led to a very large increase in prices on the retail market. Therefore, Demand Response programs and aggregators can become very attractive in the future.

At the same time, the rollout of smart meters is targeted to be completed by 2024[201]. The necessary framework is already in place so that all types of participants, including aggregators, are allowed to participate in all markets. The roles are defined for consumption-based aggregation, not specifically for residential end-users. The technical conditions are expected to be implemented soon by the regulator and the TSO.

[201] Benchmarking smart metering deployment in the EU-28, 2020.

24 SLOVAKIA

Box 24. Slovakia - practical info

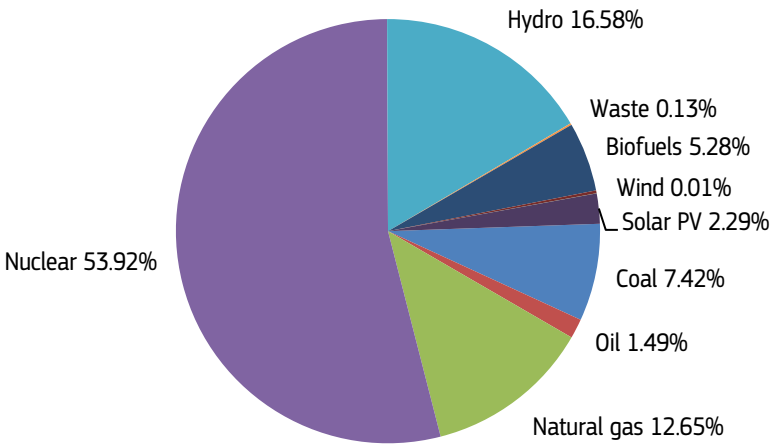
– Decree No. 24/2013 Coll. of the Regulatory Office for Network Industries on the Regulation of the Domestic Electricity and Gas Market link;

– Integrated National Energy and Climate Plan for 2021 to 2030, December 2019 link.

24.1 Background

In Slovakia, most of the electricity generation is provided through nuclear power plants. The country plans to reduce its greenhouse gas emissions by 40% until 2030 while at the same time increasing its RES share in electricity generation to about 27%.

Figure 25. Slovakia's Electricity generation by source 2020.



Source: IEA, 2020.

The Slovak National Energy and Climate Plan foresees the integration of flexibility sources, a nationwide rollout of smart metering systems, the enshrining of the aggregator that will enable market access for distributed flexibility sources, the creation of a technological model for DSOs regarding flexibility utilisation, as well as the creation of the legislative and regulatory framework for the flexibility market[202]. It is worth pointing out, however, that these plans do not include operational targets set in a timeline, and, regarding smart meters in particular, the start of the rollout has been slow due to an initial negative outcome of the CBA, followed by a revised CBA that came out inconclusive[203].

24.1.1 Players and context

The electricity wholesale market and generation have been liberalized in Slovakia since 2005. Therefore, there is no price regulation at the wholesale level. The biggest electricity provider is Slovenské elektrárne (owns 66% of generation), which is also the main electricity supplier to the three regional distribution companies in Slovakia ZSE (West), SSE (Central), and VSE (East of Slovakia)[204]. Slovenská elektrizačná prenosová sústava, a. s. (SEPS) is the only TSO, and the national regulatory authority is URSO (Regulatory Office for Network Industries).

202 Integrated National Energy and Climate Plan for 2021 to 2030 for Slovakia.
203 Benchmarking smart metering deployment in the EU-28, 2020.
204 https://www.seas.sk/o-nas/energetika-na-slovensku.

The short-term electricity Market Operator - OKTE, a.s., manages the short-term electricity market, which includes both intraday and day-ahead transactions. OKTE has also taken over the competence for imbalance settlement that has been shifted to them as a central entity from 3 regional DSOs[205].

Since June 2021, Slovakia has been part of the Interim Coupling project, which aims to connect the Multi-Regional Coupling (MRC) with the 4M Market Coupling (Czech-Slovak-Hungarian-Romanian market coupling) by introducing the Net Transmission Capacity (NTC) based on implicit capacity allocation on six new borders. The project makes an important step towards the extension of the European Single Day-Ahead Coupling[206].

24.1.2 Prosumers and flexibility services

Prosumers in Slovakia currently have a Feed-in tariff available to them. As the electricity prices are strictly regulated, and the profitability of small-scale PV installations depends largely on which DSO operates in the region, the overall appeal of small end-users becoming prosumers overall low and varies significantly across the country[207].

24.2 Transposition of Article 17 of the EU Directive 2019/944

Provisions of Article 17 have not been transposed in national legislation yet.

Technical requirements for the provision of aggregated flexibility, including from Demand Response should be established by the implementing regulations (e.g., a method for evaluation and settlement of the supplied flexibility; definition of a standardized product(s); system for financial compensation, conditions for control of the provided flexibility; certification requirements for aggregated flexibility providers; data sharing for flexibility provision, etc.), which are not done yet.

Modifications are called for mainly in the Decree of the Regulatory Office for Network Industries No. 24/2013 Coll., in Technical and Commercial Conditions of TSO and DSOs and in Operating Rules of the market operator in electricity. Also, the basic regulatory framework has to be defined in the primary legislation, mainly in Act No. 251/2012 Coll. on Energy, as part of the transposition and implementation of the Clean Energy Package (CEP) legislation.

24.3 Demand response and aggregators

24.3.1 Rules governing aggregation

In Slovakia, current national legislation does not regulate aggregation. However, as of September 2020, the aggregator is defined by Decree no 24/2013 Coll. on Market Rules in Electricity and Gas in § 2 letter (a) point 43.

A further objective in the development of the Slovak market is to increase the number of active prosumers, through the introduction of aggregators who could provide service of flexibility of energy supply and demand in an environment of rapidly changing market opportunities. The Regulatory Office and the Ministry of Economy participated in the implementation of network codes and the transposition of the Clean Energy Package into national legislation (including Directive (EU) 2019/944)[208].

24.3.2 Wholesale market

In the Slovak Republic, there is not yet a comprehensive legal definition of aggregation, including the conditions and technical requirements of the system operators (DSOs and TSO) and of the Market Operator (OKTE) for the provision of aggregated flexibility, including the flexibility of residential end-users. This is expected to change after the transposition and implementation of the Clean Energy Package legislation (specifically recast Electricity Directive 2019/944 and recast Electricity Regulation 2019/944).

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205 Status Review of Renewable Support Schemes in Europe for 2018 and 2019, CEER 2021.

206 https://www.epexspot.com/en/news/interim-coupling-project-go-live-confirmed-17-june-2021.

207 Janiček, F., Poničan, J., and Sadloň, M,: "Impact of the fixed and variable component of electricity price on the economic viability of a small-scale photovoltaic power plant", Journal of Electrical Engineering, Vol 72 (2021), no 2, 140-147.

208 URSO 2020 Annual Report.

24.3.3 TSO and DSO driven programmes

There are no TSO and DSO driven Demand Response programs in Slovakia.

24.4 Enablers and Barriers for Demand Response and Independent Aggregators

As the implementation of the Clean Energy Package (CEP) into national legislation has been slow, the structural need for flexibility in the system is low, and the electricity market is slow, the perspectives for the Slovak small end-users to engage in explicit Demand Response remain distant.

The lagging rollout of smart meters constitutes a clear technical barrier. Further barriers are related to the lacking definition of technical requirements which would establish under what conditions and how consumers could participate in electricity markets. Definitions of responsibilities for aggregators are also lacking.

However, the Regulatory Office and the Ministry of Economy are working on the implementation of network codes, and the work on the transposition of the Clean Energy Package into national legislation is ongoing. The reform of the electricity market continued in 2021.

Projects for smart grids and interconnections, such as the cross-border ACON smart grid project between the Czech Republic and Slovakia, as well as the Danube InGrid smart grid project between Slovakia and Hungary, aim to strengthen the integration of distributed and renewable energy sources[209]. ACON is forecasted to be completed by 2024[210].

[209] Integrated National Energy and Climate Plan for 2021 to 2030 for Slovakia.
[210] https://www.acon-smartgrids.cz/#Acon.

25 SLOVENIA

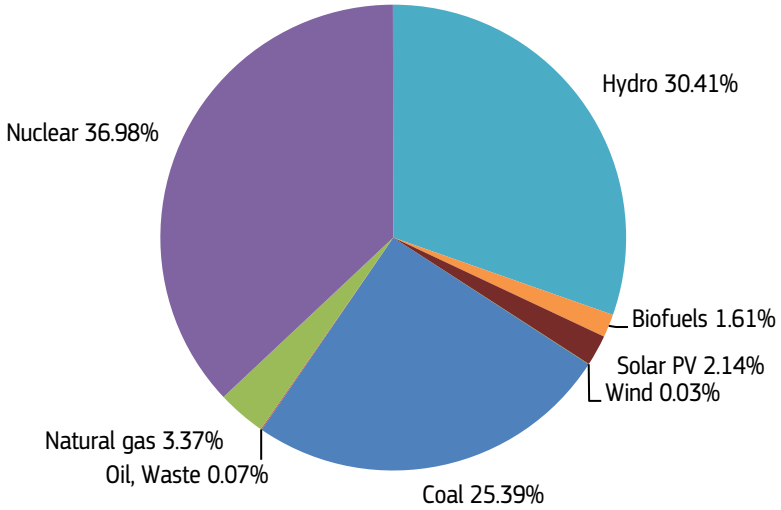
Box 25. Slovenia - practical info

– Electricity Supply Act (ZOEE) link;

– Integrated National Energy and Climate Plan of the Republic of Slovenia, February 2020 link.

25.1 Background

Figure 26. Slovenia's Electricity generation by source 2020.



Source: IEA, 2020.

In July 2021, Slovenia adopted the Resolution on Long-Term Climate Strategy until 2050 with the objective to become climate neutral and transition to net-zero emissions by 2050[211]. The electricity sector is expected to reach a 43% RES share by 2030, and the phase-out of coal in the electricity production is anticipated to reach the first milestone of a 30% reduction by 2030 as well[212].

25.1.1 Players and context

The TSO in Slovenia is Elektro-Slovenija, d.o.o. (ELES). An electricity DSO company is SODO d.o.o. and five distribution network companies: Elektro Celje, d.d., Elektro Gorenjska, d.d., Elektro Ljubljana, d.d., Elektro Maribor, d.d., Elektro Primorska, d.d.

The Market Operator is Borzen, which facilitates and provides coordinated operation of the Slovenian electricity system. The BSP provides its market participants with Day-ahead, Intraday and balancing and Long-term auction trading for physical products on the Slovenian market. The Slovenian energy exchange is BSP Energy Exchange LL C (BSP SouthPool) which provides day-ahead, intraday and balancing, as well Long-term auction trading for physical products on the Slovenian market.

The Energy Agency is the national regulatory authority, which directs and supervises electricity and gas energy operators and carries out tasks regulating energy operators' activities in the field of heating and other energy gases.

211 https://www.gov.si/en/news/2021-07-13-new-step-towards-slovenias-climate-neutrality.
212 Integrated National Energy and Climate Plan of the republic of Slovenia.

25.1.2 Prosumers and flexibility services

In Slovenia, prosumers have a Feed-in tariff available to them. Further, for households and small business customers self-consumption is also possible on a yearly compensation basis outside the support scheme[213].

Nevertheless, thanks to the government incentives and to the reduction of administrative barriers, the installation of small-scale PV units has been having a significant growth over the past years. Self-consumption is incentivized[214].

In 2019, the Japanese-Slovenian project "Premakni Porabo" (NEDO-Move Consumption) was concluded. Through ELES, households and small business consumers were enabled to actively manage their consumption of electricity, in order to pilot test the critical peak tariff and the use of flexibility to balance the system. The results provided insights into the flexibility potential of Slovenian households[215] and found challenges in the level of awareness that Slovenian users had regarding tariff models[216].

25.2 Transposition of Article 17 of the EU Directive 2019/944

"The law on energy supply" (Zakon o oskrbi z električno energijo, ZOEE), which was in public consultation through 2020 and entered into force in October 2021, addresses the transposition of Article 17 of the EU Directive 2019/944 in the Slovenian Legislation. Article 22 of ZOEE defines Demand Response through aggregation, and includes independent aggregators in its provisions.

Public consultations relevant for the bill were carried out through 2020 "Establishment of a market with flexibility of active consumption in Slovenia" and "Independent aggregator on Slovenian electricity markets - current aspects"[217]

25.3 Demand response and aggregators

The Slovenian Market Operator Borzen introduced a formal independent aggregation model already in 2019. This was created in order to regulate aggregated flexibility that was provided to frequency restoration balancing services (mostly for secondary reserve: aFRR and tertiary reserve: mFRR) and had been present in the national framework even before the Clean Energy Package was transposed[218].

The natural limit was found to be 43 kW, which separates the metered diagram from the unmetered diagram in the imbalance settlement. Thus, for larger consumers, the introduction of a regulated model with a correction is proposed, while for small consumers, an uncorrected model[219]

The first independent aggregation model (IAM) has been enforced in a limited scope (only for participation in balancing market and furthermore limited to two products only, namely aFRR, mFRR) in 2019 within the normative framework of the Rules on the market operation. The IAM implementation is based on a combination of the contractual model and the model without intervention. The Energy Agency conducted two public consultations on demand-side flexibility and independent aggregation resulting in a NRA position on CEP implementation and the proposal of Market Operator on the evolution of IAM. A new IAM was planned to be implemented on top of the "split supply" model in order to achieve full compliance with CEP provisions. This was eventually not carried through and it was suggested that an independent aggregator should establish its own balance group (BRP). Similarly, in case a retailer develops DR business, it can use for flexibility aggregation its existing balance group, i.e., include its DR operation in its position as a BRP.

Small end-users in Slovenia can participate in all markets through aggregation. In case end-users wish to participate directly in the market (not through an aggregator), which is highly unlikely, then the user has to be part of the balance scheme, which entails reserving substantial funds for financial coverage.

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213 http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED7867.
214 The smartEn prosumers map 2020.
215 https://www.lea-ptuj.si/aktualno/premakni-porabo.
216 Survey on existing demand-response (DR) actions and collective actions in the heating and cooling sector and overview of legal and other requirements and challenges, 2020.
217 https://www.agen-rs.si/posvetovanja.
218 Report on the Foundations for the adoptions of New Network Codes, INTERRFACE 2021.
219 Report on the Energy Sector in Slovenia 2020, The Energy Agency.

25.3.1 TSO driven programs

Aggregated residential end-users can access the wholesale market but in a limited scope of regulatory sandbox only. The participation of residential end-users is possible in the TSO balancing market. However, neither TSO nor DSO are allowed to play the role of an aggregator. The residential end-users can participate in balancing and ancillary electricity services through the TSO and DSO Demand Response programs based on compensation and implicit flexibility mechanisms available through NRA's Research and Innovation sandbox. Within qualified pilot projects, the TSO and DSO can play the role of aggregators in order to test the potential of the aforementioned DR mechanisms.

25.3.2 Distribution network services

DSO ancillary services have been recently roughly defined by the DSO in the Network Operation Code, but all the required technical modalities haven't been yet developed by DSO. Consequently, the corresponding local flexibility markets have not emerged yet and are pending the consent of the NRA.

25.3.3 Technical modalities

The Slovenian NRA has participated in the development of technical modalities on the use of DR in Slovenia, by developing and publishing the guidelines on implementation (through public consultations) or by issuing consent to the technical requirements. The public consultation "Relevant aspects of independent aggregation on Slovenian electricity markets" was prepared in partnership with the Slovenian Market Operator (Borzen), TSO (ELES), DSO (SODO) and all five distribution network companies.

25.4 Enablers and Barriers for Demand Response and Independent Aggregators

The development of the demand side flexibility market is being supported in Slovenia, and the participation of the smallest customers (residential customers and small businesses) is encouraged.

The rollout of smart meters was the most advanced at the distribution level (almost 75% of connection points in 2019[220]) and is planned to be completed by 2025.

However, Slovenian suppliers request (jointly) that independent aggregators be charged the full cost of compensation to suppliers of curtailed consumers, thus breaching the spirit of the EU Directive by creating a barrier for DR aggregators.

Currently, the market rules are still viewed as discriminatory, as they force independent aggregators to sign close contracts with electricity suppliers for activated flexibilities. Without a bilateral contract, DR volumes are not allocated to the aggregator, thus making it impossible to develop DR services as a business.

[220] Report on the Energy Sector in Slovenia 2019, The Energy Agency.

26 SPAIN

Box 26. Spain - practical info

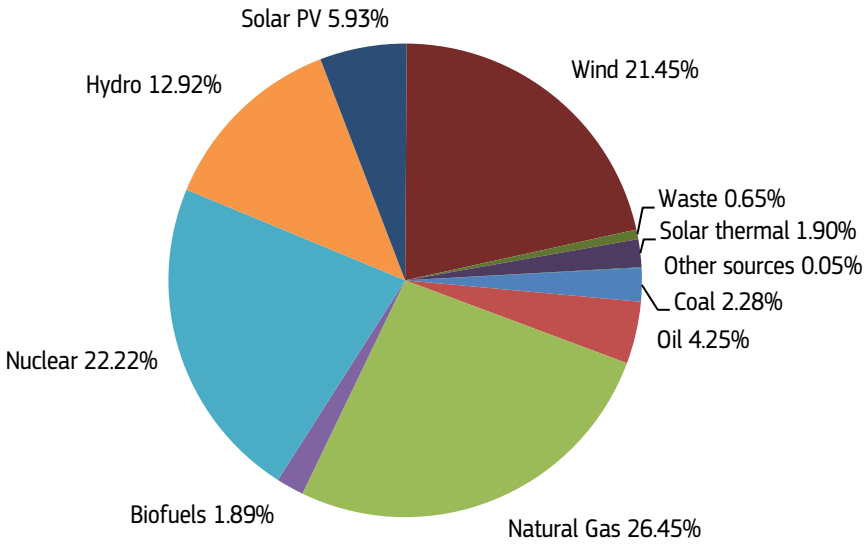
– Real Decreto-ley 23/2020, link

– REE Annual report 2020, link

26.1 Background

The present Spanish energy and climate framework is based on the 2050 goals of national climate neutrality, 100% renewable energy in the electricity mix, and 97% renewable energy in the total energy mix. As a result, it is focused on the rapid expansion of renewable energy, primarily solar and wind, as well as energy efficiency, electrification, and renewable hydrogen.

Figure 27. Spain's Electricity Generation mix 2020.



Source: IEA, 2020.

The incorporation of renewable energy-based generation facilities into the national electricity system may entail, as a collateral effect, the appearance of certain risks to the security of electricity supply, mainly caused by the variability and intermittency of generation inherent to this type of facility. Therefore, at the same time, one of the main objectives is to ensure the security of supply and to achieve it, Spain envisages a total storage capacity of about 20 GW by 2030[221].

Also, because of Spain's geographical characteristics, one of the objectives continues to be to improve its internal and external interconnection networks.

One of the most relevant transformations in the Spanish power sector will be the participation of demand in the electricity market. In particular, the new European regulation of the internal market already encourages Demand Response therefore, it is anticipated that the market will evolve to provide effective price signals through which active participation of demand and the possibility of its aggregation are guaranteed.

26.1.1 Players and context

In Spain the only TSO is Red Eléctrica de España. The distribution network is instead divided between 336 DSOs: The main five of these are ENDESA, Iberdrola, Gas Natural Fenosa, Viesgo and EDP, which cover a

[221] Estrategia de almacenamiento energético, 2021.

major share of the Spanish electricity demand. The national regulatory authority is CNMC (Comisión Nacional de los Mercados y la Competencia): this guarantees transparency and competition in the energy market, defends the interests of consumers and advises the authorities on energy issues.

Eight of the main European carriers and transmission system operators (TSO), including Red Eléctrica de España (REE) and the Italian operator (Terna), have launched a common initiative to support an electrical system that allows achieving carbon neutrality by 2050. Specifically, the objective of the TSOs with this initiative is to analyze in depth how their activities contribute to decarbonisation and to develop ways to support the electricity system to be carbon neutral[222]. TSOs contribute to Europe's decarbonization mainly by lowering and restricting the carbon impact of their own activities and value chains, but are also playing a key role in facilitating the energy transition by tackling the major challenge of integrating renewable generation and flexibility resources into the energy system, as well as assisting direct and indirect electrification of various sectors of the economy.

ASE group is the largest electricity aggregator in Spain; the group's services are aimed at companies that consume high and low voltage electricity, whatever their sector of activity[223].

26.1.2 Prosumers and flexibility services

Spanish prosumers had a limited role until 2018 when the so-called "sun tax" was abolished: the sun tax has been in force since 2015. The decree of law regulated how any self-consumption installation or any installation that produces energy towards the outside of it should be done, as is the case of domestic solar panels.

The first reason why the sun tax has been removed is because it charges the same thing twice. In effect, there is a central producer (electric networks) that, in turn, sell their energy to a company that consumers later hire. In this case, the company pays the supplier, but the sun tax makes consumers pay the company (intermediary) and the producing electricity network twice the same.

In addition to this, there are the reasons derived from energy dependence. The sun tax was a strong setback for the installation of renewables. This detriment occurred in a country where this type of energy is clearly a great commitment to the future due to the number of hours of sunshine per day and, at the same time, due to Spain's great dependence on energy. This sun tax arbitrarily increased an already expensive bill.

While this legislation has been removed, others continue to restrict demand-side participation in markets, limiting prosumers' ability to profit from their assets and to make explicit use of their flexibility. As it is, prosumers in Spain are primarily concerned with self-consumption and energy management.

In the current market environment, the independent aggregator has been acknowledged in new rules since June 2020. Prosumers have been able to supply balancing services to the electricity market through aggregation provided by suppliers (to reach the 1 MW threshold in the operating rules) since October 2020, providing an additional source of revenue.

The Royal Law Decree (R.D.L. 23/2020) has recognized and allows independent aggregators, even if the secondary legislation is still at the negotiations stage; the technical conditions are yet unclear and might continue to be restrictive as to aggregate generation loads and value stacking are not possible. Implicit use of flexibility is also available through a supplier.

26.2 Transposition of UE Directive 2019/944

Articles 17 and 31 are yet to be transposed in Spain. There is no development of the Demand Response for residential users yet. Currently, the figure of the independent aggregator has been introduced in the Spanish market by the Real Decreto Ley 23/2020, while the secondary legislation is being developed and is expected that will be fully operative in 2022. In April 2021, new tariff schemes for all types of users had been put in place with the objective of encouraging the consumption of energy when the grid is less congested, therefore making future DR programs more attractive for all categories of users[224].

222 Decarbonising the Energy System: the role of TSOs. 2021.
223 Agregador de demanda eléctrica para empresas (grupoase.net).
224 Informe del Sistema Eléctrico Español 2020, REE.

Since 2013, consumers can act as direct actors in the electricity markets; however, the volumes of energy demand needed along with the administrative process makes this possibility beneficial for large consumers mostly; currently, small end-users do not have access to those markets.

26.3 Demand response in the ancillary services market

The market participation of Demand Response is possible only under specific conditions and only in the balancing services (aFRR, mFRR and RR) and not to independent aggregators. There is no specific legislation yet in place for aggregators at the residential level.

The flexibility services in Spain are delivered through three main modes: frequency containment reserve (FCR), which is mandatory and not remunerated; automatic frequency restoration reserve (aFRR) that is still closed to independent aggregators; and manual frequency restoration reserve (mFRR) which has recently opened the participation also for storage, DSF and aggregation.

26.4 Enablers and Barriers for Demand Response and Independent Aggregators

The engagement of small Spanish end-consumers in explicit Demand Response is at the moment driven primarily by the availability of peak/off-peak tariffs and enabled by the rollout of smart meters that was completed in 2018[225]. Despite Spain's high share of wind in the national energy mix, which leads to high flexibility needs of the system and should be itself a strong enabler for DR programmes, the country envisages some delay compared with the rest of European countries deployment in this field.

The main barriers for independent aggregators in the Spanish power market are currently represented by the failure to define the perimeters of action of this emerging figure, as well as the precise methods of calculating the imbalances that aggregation would generate for distribution companies.

There is no dedicated legislation in place for aggregators at the residential level. Aggregation of loads can participate in the balancing services under specific conditions.

However, the market is dominated by incumbents. Retailers can participate in balancing services aggregating demand and self-generation. The Independent Aggregators are not allowed to participate in the markets yet (expected, however, in 2022). Suppliers can already participate in the balancing markets. Moreover, the TSO requests real-time telemetry to participate in balancing services, making aggregation of medium and small loads difficult. The DSOs are not incentivized to rely on demand-side flexibility.

[225] Integrated national energy and climate plan 2021-2030 for Spain.

27 SWEDEN

Box 27. Sweden - practical info

– Impact assessment of different models of independent aggregator financial responsibility and compensation in Sweden, link;

– Independent aggregators: Proposals for new rules for implementing the Electricity Market Directive, link in Swedish

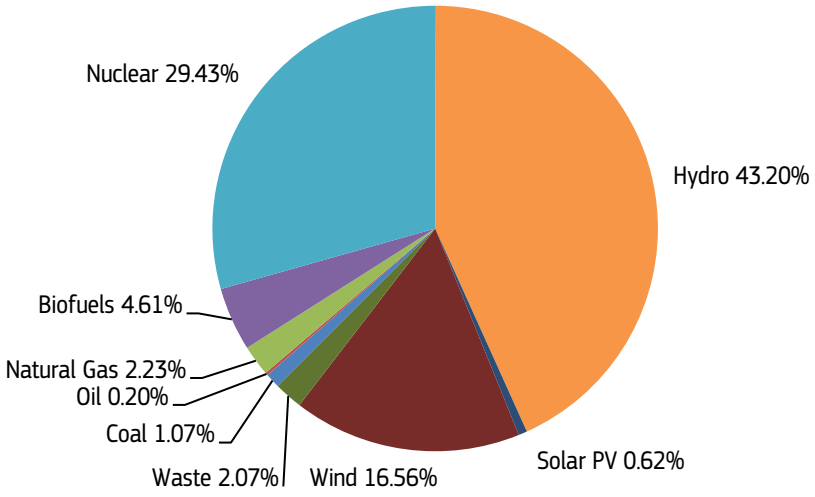
27.1 Background

Sweden aims to achieve a 59% reduction in GHG emissions by 2030 compared to 2005, and a net-zero carbon economy by 2045. Sweden was the first country in the world to implement carbon pricing, and it now has the highest carbon prices in the world, which was proven effective in driving decarbonisation.

Most of Sweden's electricity is generated by hydro and nuclear power, with wind power playing an increasingly important role. Bioenergy district heating and heat pumps are the primary sources of heat.

The transportation industry, which still relies on oil, produces the majority of Sweden's greenhouse gas emissions. In fact, the government is promoting advanced biofuels to help electrify and decarbonize transportation. The country is also promoting industry decarbonisation, with one of the first large-scale programs to produce hydrogen-based steel.

Figure 28. Sweden's Electricity Generation mix in 2020.



Source: IEA, 2020.

The electrification of the industrial and transportation sectors, as well as the urbanization of large cities, has led to higher electricity demand than ever in terms of both annual and instantaneous supply. In several of Sweden's largest cities, transmission and distribution infrastructure has not been modernized to meet growing demand, creating capacity bottlenecks and power shortages.

27.1.1 Players and context

There are currently approximately 170 distribution system operators (DSOs) and one transmission system operator (TSO) in Sweden. The Swedish TSO, Affärsverket Svenska kraftnät, is owned by the government. With a few exceptions, the TSO owns and operates all parts of the transmission system. All other entities that operate power systems in Sweden are defined as DSOs. The 170 DSOs are of varying size and ownership structure (state, municipal, private, and other), and they each have a so-called concession (permission) for the distribution of electricity, either for a defined geographical area (local DSOs) or for a specific line (regional DSOs).

Further, in Sweden, there are approximately 130 electricity suppliers and about 30 balance responsible parties[226].

The national regulatory authority (NRA) for energy in Sweden, the Swedish Energy Markets Inspectorate (Ei), monitors that the network operators are complying with the existing rules.

At the time of writing, there are 5-10 aggregators in Sweden. Some of these companies operate as an aggregator for technologies that can be found in single-family households, such as HPs and EVs. Many of them provide implicit DSF and can optimize electricity usage (e.g., through 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. This would then define the company as an aggregator.

The Swedish electricity market is part of the Nordic electricity market, Nord Pool. Nord Pool AS is a European power exchange owned by Euronext and the continental Nordic and Baltic countries' TSOs, which delivers power trading across Europe.

The Swedish electric grid is divided into four bidding zones.

27.1.2 Prosumers and flexibility services

The marketing and the use of flexibility in Sweden are currently limited to optimization and avoidance of electricity charges; customers can choose dynamic hourly contracts, but they are less interested. DSF cannot be used explicitly, and independent aggregators are not active in Sweden either: all these factors limit the potential for monetizing prosumer flexibility. However, the Swedish regulator Ei is currently developing a framework for deploying aggregators after the adoption of regulations on electricity market organizations. In addition, industrial consumers do not have the opportunity to participate in suspension plans. For these reasons, the main driving force for prosumers is the avoidance of power peaks.

For homes and small businesses, 75% of Sweden's network charges are fixed components that depend on the size of the connection, discouraging most small and medium-sized prosumers from using flexibility to avoid network tariffs. Industrial consumers primarily use flexibility for on-site optimization and to avoid peak power prices.

All prosumers with on-site generation can inject electricity into the grid and be rewarded for it. As of 2019, 17 700 households and commercial areas had solar PV installed and were selling their generation. The price of electricity supplied to the grid depends on the individual contract with the DSO and will fluctuate depending on the market price of injection. Sweden does not have a feed-in tariff system, and for this reason, it is recommended that prosumers consume as much power as possible and supply only the remaining power to the grid.

27.2 Transposition of the EU Directive 2019/944

Article 17 of the EU Directive 2019/944 has not been transposed in Swedish legislation yet. The new Swedish regulations that will enable independent aggregation is expected in 2022 and will facilitate the operation and acquisition of customers for aggregators.

However, aggregators are recognized in Sweden. The NRA is working on a proposal to the energy ministry on how articles 4, 13 and 17 of the Directive can be transposed into the Swedish electricity act. Currently, to perform aggregation and take economic responsibility for imbalances at the same time, the operator needs to enter into a contract with the BRP associated with the end user's existing electricity company, alternatively arranging the delivery of electricity by itself, alongside the aggregation. There can only be one BRP in each connection. Another type of aggregator that exists is the so-called uncorrected aggregators that act independently of the existing BRPs but take no financial responsibility for the imbalances they create.

As part of NordREG, in 2020, Sweden has contributed to developing the Nordic Regulatory Framework for Independent Aggregation, which proposes legislative changes in order to enable the legal basis for a common Nordic market for aggregation services[227]. Based on the NordREG recommendations, Ei is considering implementing the split-responsibility model to facilitate independent aggregators; even though the model has

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226 Oberoende aggregatorer: Förslag till nya regler för att genomföra elmarknadsdirektivet, 2021.

227 Nordic Regulatory Framework for Independent Aggregation, 2020.

been found to pose entry barriers for independent aggregators on a competitive market such as that of Sweden, they could partner up with a supplier and act in coordination[228].

27.3 Demand Response in the Ancillary services Market

27.3.1 Explicit flexibility services

To engage in aggregation in Sweden and at the same time take economic responsibility for imbalances, an entity needs to either be the BRP in the end-user's connection, or enter into an agreement with the BRP in the end-user's connection. The market for aggregation is currently quite small in Sweden but existing. For instance, the TSO offers aggregated residential end-users access to the FCR market - there is one (integrated) aggregator (provides both aggregation and electricity supply) that has recently been the first to qualify EV's into FCR(D).

There is also one example of aggregation from residential end-users to DSO. As for the TSO market, it has been difficult for actors offering non-traditional flexible resources (i.e., other than hydro) to the TSO market to enter and finish the pre-qualification process. There is no regulatory barrier against non-traditional resources to enter the TSO-market, but the prequalification process (set up by the TSO) is more suited for hydro resources. There is a dialogue on this topic between the NRA and the TSO, and the NRA has also raised this problem in a recent government assignment.

27.3.2 Procurement of automatic Frequency Restoration Reserve (aFRR) in Q4/2021 (weeks 40-52)[229]

The Nordic TSOs have decided to increase the current aFRR procurement as well as to increase volume on down-regulation.

27.4 Enablers and Barriers for Demand Response and Independent Aggregators

Structurally, the need for flexibility in the system is relatively low in Sweden, due to the high share of hydro in the electricity generation mix, but the confirmed plans that the future electricity system will contain an even larger proportion of variable wind and solar energy will require better demand response in consumer sectors[230]. Additionally, Sweden has the largest share of EVs in Europe with the Netherlands, which could act as an enabler for the deployment of explicit DR's programs, considering the higher flexibility needs that should follow the increase of EVs' charging batteries.

These drivers for more engagement in explicit DR are supported by early completion of the mass rollout of smart meters in Sweden (completed as of 2009)[231].

Nevertheless, even if the Swedish flexibility market is quite mature compared with other European countries, there still exist some barriers to the engagement of explicit DR in the national power market.

From a financial point of view, the high initial investment cost for the technical system could be acting as a barrier for the smallest end-users, as the low revenue streams received from market participation may not justify the engagement efforts.

From an institutional point of view, the complexity of balance responsibility is disadvantageous for aggregators and will continue to be so with the newly proposed models for independent aggregators: in particular, the lack of harmonized baselines values and measurement-related issues affect the validation. Harmonization of regulation needs to be completed as well. Finally, the inability to pool consumers across bidding zones can act as a further barrier for aggregators of small end-users, as they need a larger number of participants to realize their business case.

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228 Impact assessment of different models of independent aggregator financial responsibility and compensation in Sweden, Ei 2020.
229 Procurement of automatic Frequency Restoration Reserve (aFRR) in Q4/2021 (weeks 40-52) | Svenska kraftnät (svk.se).
230 Sweden's Integrated National Energy and Climate Plan.
231 Benchmarking smart metering deployment in the EU-28, 2020.

28 Summary and Interpretation of Findings

Explicit Demand Response programs have had a positive development across the EU Member States between 2017 and 2021, a time during which the EU Directive 2019/944 came into force. From the 26 countries included in this report, today, in 22 MS explicit Demand Response is available to small end-users at least at the level of emerging projects.

Table 1 summarizes the findings from the MS fiches, focusing on indicators that illustrate the progress of explicit DR and aggregation. The first column gives the benchmark on the status of explicit DR for small users in 2016. The second column explains whether small end-users can participate in explicit DR in 2021. The third column reports whether legislation concerning independent aggregators is in place in the respective MS (regardless of the size of the customers). Fourth, whether independent aggregators *of small end-users* are active on at least one market. The last column addresses the level of smart meter rollout in the respective MS as a control indicator. Explanations further below **Table 1** and visualization in **Figure 29**.

Table 1. Summary of findings based on the survey and desk research, summarized for selected indicators

Country	ExDR 2016	ExDR 2021	IA Legislation	IA	Smart meters
Austria	NO	YES	YES	NO	Medium
Belgium	OK	YES	YES	YES	Low
Bulgaria	NO	NO	YES	NO	Low
Croatia	NO	YES	YES	NO	Medium
Cyprus	NO	YES	YES	NO	Low
Czech Rep.	NO	NO	NO	NO	Low
Denmark	OK	YES	YES	YES	Completed
Estonia	OK	YES	YES	YES	Completed
Finland	OK	YES	YES	YES	Completed
France	OK	YES	YES	YES	High
Germany	OK	LIMITED	NO	NO	Low
Greece	NO	NO	NO	NO	Low
Hungary	NO	YES	YES	YES	Low
Ireland	NO	YES	NO	NO	Medium
Italy	NO	YES	NO	NO	High
Latvia	OK	YES	YES	NO	High
Lithuania	NO	YES	YES	NO	High
Luxembourg	NO	YES	YES	NO	Completed
Netherlands	NO	YES	NO	NO	Medium

Country	ExDR 2016	ExDR 2021	IA Legislation	IA	Smart meters
Poland	NO	YES	NO	NO	Low
Portugal	NO	YES	YES	NO	Low
Romania	NO	YES	YES	YES	Low
Slovakia	NO	NO	NO	NO	Low
Slovenia	NO	YES	YES	NO	Medium
Spain	NO	YES	YES	NO	High
Sweden	OK	YES	YES	NO	High
TOTAL	**8**	**22**	**18**	**7**	**9**

Source: JRC, 2021.

The indicators summarized in **Table 1** show that in 2021 aggregation of small (e.g., residential) end-users is already possible, at least in principle, in 22 MS – however, mostly through the supplier. At the time of writing, the transposition of Article 17 of the EU Directive 2019/944 was partial or ongoing in most MS. However, independent aggregators of DR are already recognized in the primary legislation of 18 MS. Of the 18, only 7 MS independent aggregators or small end-users also exist and operate on at least one market. For legibility, the indicators in the column heads have been abbreviated as follows:

— **ExDR 2016**: Status of explicit DR in the respective MS as found by the previous report in 2016, for small end-users. Seeing as in 2016 explicit DR was still emerging, "OK" applies even if the options that were available were extremely limited.

— **ExDR 2021**: Possibility for small end-users to engage in explicit DR and participate in some (not all) of the markets, regardless of whether Article 17 has been formally transposed in national legislation, whether there are independent aggregators available to them, or whether there is a business case for engaging in explicit DR.

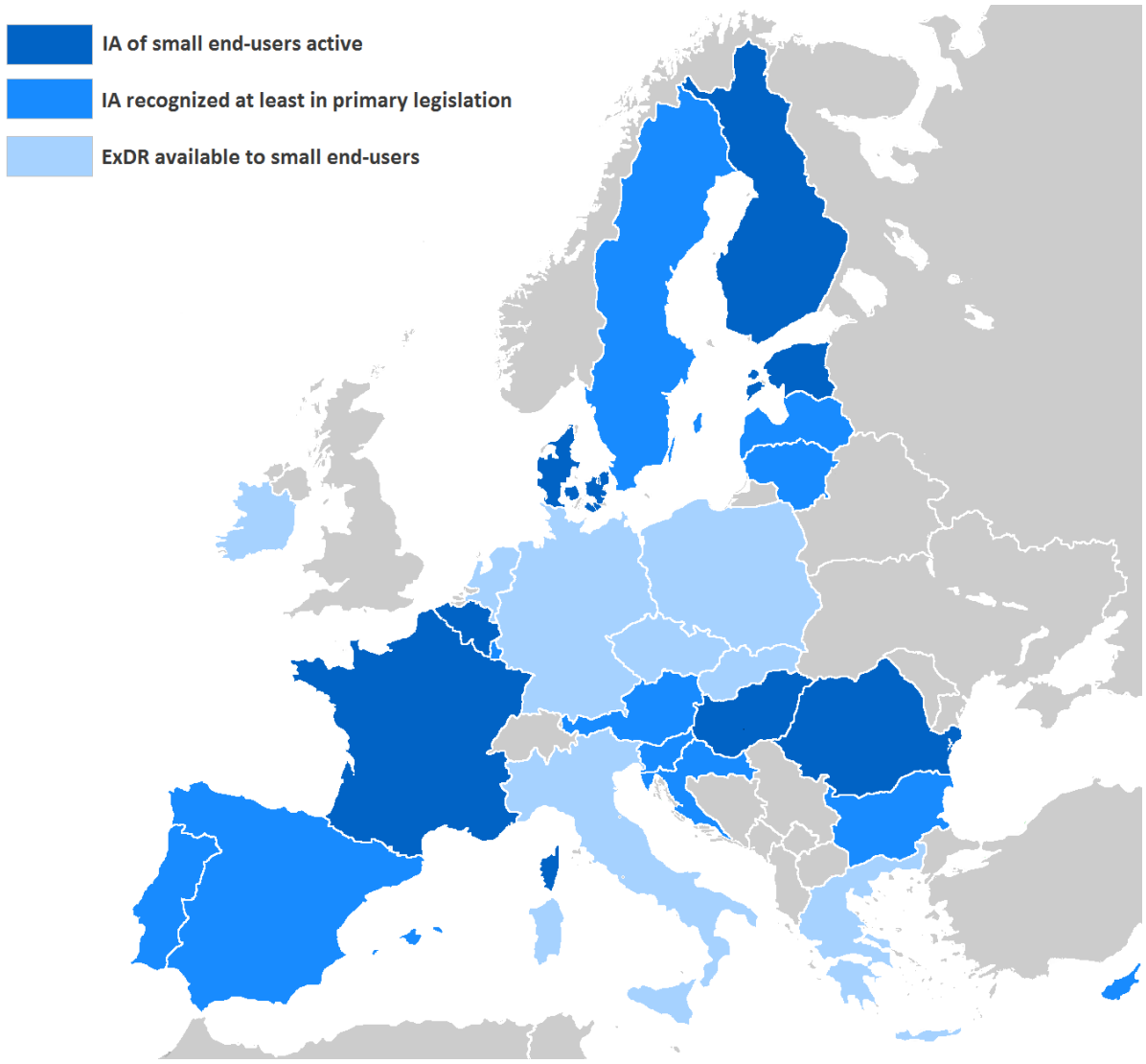
— **IA Legislation**: The availability of at least primary legislation regarding Independent Aggregators of DR in the respective MS, regardless of whether Article 17 has been formally transposed.

— **IA**: Existence in the respective MS of independent aggregators of small (residential) end-users as players on at least one market

— **Smart meters**: Status of the smart meters roll-out in the respective MS. "Low" designates a penetration of <20% and/or an implementation plan to complete towards the end of the decade; "Medium" designates a penetration of ~50% and if lower, then a plan to complete within the next 2 years; "Completed" if a rollout of >95% is reported.

Figure 29 illustrates the evolution of small end-users from having explicit DR available to them to having (at least primary) legislation regarding independent aggregators in place, and finally to having independent operating aggregators of small end-users in the market.

Figure 29. Status of explicit Demand Response and Independent Aggregators across the EU Member States in 2021.

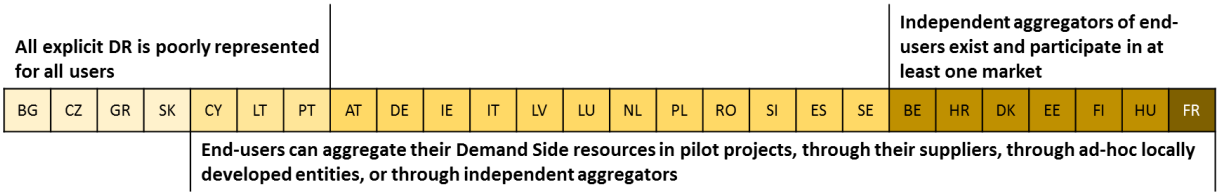


Source: JRC 2021

As far as the small end-users are concerned, their aggregation and participation in at least one market, regardless of whether through an independent entity or through the supplier, is legally allowed and technically possible in 22 MS. However, among the 22 MS, independent aggregators of end-users that can participate in at least one electricity market can be found only in 7 MS: Belgium, Croatia, Denmark, Estonia, Finland, France, and Hungary, where the market is just emerging.

The level of market access varies significantly across these 7 MS, and only in France do independent aggregators of end-users have access to all markets. In Denmark, on the other hand, even though legislation and market design are in place, the high level of taxes makes the business case difficult for the independent aggregators. It is worth pointing out that in the case of Croatia, Hungary and Estonia, the progress during the past five years has been the most remarkable: in what used to be markets shut for DR from all users (or with very small pilot projects), now market participation of end-users through independent aggregation is possible.

Figure 30. Degrees of market representation for explicit DR across 26 EU Member states as of 2021.



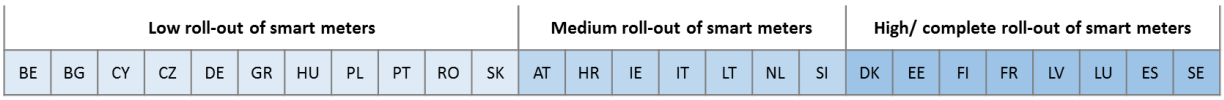
Source: JRC, 2021

As the overview in **Figure 30** illustrates, in the majority of MS, aggregation of end-users is possible, at least on some level. The middle cohort of 12 MS between AT and SE (the order is alphabetical) is the most diverse one, including countries where end-users are enabled to aggregate through a comprehensive legal framework, but the market does not reflect the range of possibilities (e.g., Romania), as well as countries where aggregation of end-users is possible through their supplier (e.g., Germany), and countries where there are locally developed entities through which end-users can participate in the markets (e.g., Ireland).

— The reality on the ground is that the access of small end-users to explicit DR and to aggregation varies a lot between Member States. One particularity is that emerging aggregators are interested in the residential end-users, but upon a closer look it emerges that they are only interested to address their Electric Vehicles (e.g., in Poland).

In the seven MS where independent aggregators exist and operate on at least one market, this is supported structurally by the need for flexibility in the system and enabled by a favourable regulatory and policy environment. The roll-out of smart meters is the prerequisite for engaging in DR, as well as the definition of technical modalities and compensation rules.

Figure 31. Status of smart meter roll-out at the residential level in 2021.



Source: JRC, 2021

As an indicator for the technical potential for the end-users to engage in explicit DR, the roll-out of smart meters is illustrated in **Figure 31** (the order of representation in each group is alphabetical). In eight MS, the roll-out is high or complete.

The diversity of approaches and markets in the 26 MS analysed for this report means that there is no unified outcome from the findings of this report with regard to the status of independent aggregation of small end-users.

However, the report reveals that the single most important predictor for the development of aggregated DR, in particular, that of small end-users, is also the most trivial one: the availability of explicit DR options to engage in, in the first place. Of the 7 MS that have registered poor progress in this field since the previous report, the roll-out of smart meters is low in 6 MS (with the exception of Lithuania). While aggregation of DR is possible in principle in some of these 7 MS (Cyprus, Lithuania, Portugal), the experience on the ground is still at a very early stage and does not represent a market of demand-side flexibility.

Further, the availability of explicit DR leads to aggregation of small users, if there is a business case and a legal framework for it, but in most cases via a supplier. The particular example, in this case, is Germany, where the development of end-user engagement in aggregated DR is limited by strong regulatory (and structural) barriers and, therefore very restricted.

Finally, the progress towards independent aggregators relies on fulfilling the two previous steps and on the removal of further regulatory and market barriers. As the comparison between **Figure 29** and **Figure 30** suggests, the existence and operation of independent aggregators of end-users are not connected with the transposition of Article 17 or determined immediately by the regulatory framework. Across the EU, 19 MS already have primary legislation addressing independent aggregators, but only 7 of them do such aggregators also exist and operate for small end-users. The gap suggests further regulatory barriers (secondary legislation) as well as market barrier.

29 Enablers and Barriers for Explicit DR and for Independent Aggregators

The country fiches indicate, based on responses to the survey, consultations with experts and on desk research, that the enablers and barriers to independent aggregators are country-specific, but they fall into one of the two categories: direct enablers/ barriers for independent aggregators, and enablers/ barriers for explicit DR, as indirect factors.

The key insight for the results of this report is that the *availability* of the option to engage in DR is largely regulatory, and it is different from *the actual* engagement in DR on the ground, which requires a regulatory framework but also the additional performance of the business case (whether "the effort is worth it"). Further, the engagement of small end-users in explicit DR comes in aggregated form, as only the aggregated load can clear the size threshold for participation in the markets. Once small end-users decide to engage in explicit DR, the initiative to aggregate does not depend on whether the aggregators are independent or not. Further still, whether there are independent aggregators on the market or not does not correlate back with the transposition of Article 17 of the Directive.

The installation of smart meters, especially of those in the 1st generation, is historically connected with implicit DR, but is an important enabler for engaging in explicit DR to the full potential. Contrasting the findings summarized in **Figure 30** and in **Figure 31**, most of MS where independent aggregators exist and operate also have a high or complete roll-out of smart meters (Denmark, Estonia, Finland, and France). In the MS with a Low or Medium roll-out of smart meters (Belgium, Croatia and Hungary), independent aggregators are ahead of the curve and operate in spite of the modest roll-out, suggesting that the potential for engaging in DR is not fully reached and that the overcoming this technical barrier can, in turn, strengthen the position of independent aggregators. On the other hand, in the MS where the smart meter roll-out is high or complete, but the market does not include independent aggregators for residential end-users (Sweden and Luxembourg), this suggests that the barriers to explicit DR are rather structural – i.e., dependence on the German market for Luxembourg, or institutional barriers in Sweden.

Further structural enablers for the recognition of DR as a resource were found to be connected to the energy mix and the corresponding need for flexibility in the system. A higher share of RES and/ or relatively low share of conventional balancing resources such as hydro and natural gas create a space for flexibility from explicit DR. Finally, the local approach to congestion management, if it allows the use of flexibility from DR, can count as a further enabler.

On the side of end-users, the local consumption habits play a significant role in determining the dispatchable load – i.e., to what degree is the household electrified and whether it includes EV.

However, both for end-users and for the system, the key enabler to engage in explicit DR is an optimal compensation mechanism. In a functional market, both the end-users and the system side (utilities and regulators) would agree that the price paid/ received for flexibility is a fair one. In the MS (e.g., Finland), where there is an established, stable and functional market of representative size for explicit DR, aggregated or otherwise, this counts as a key enabler.

Research for this report has found that the engagement of small end-users in explicit DR through independent aggregation addresses two levels of the discussion. The two levels are "engagement in explicit DR" and "participation of independent aggregators in the market": in order to enable independent aggregators of explicit DR first, the engagement in explicit DR needs to be enabled. The enablers and barriers for each of the two levels are summarized in **Table 2**.

Table 2. Summary of barriers and enablers to explicit DR and independent aggregators, as found across the 26 Member States.

	Enablers	Barriers
Explicit DR	High need for flexibility in the system	Low need for flexibility in the system
	Openness of the system to use DR as a flexibility resource	Preference to maintain status-quo for flexibility needs
	Advanced roll-out of smart meters	Reduced roll-out of smart meters

	Enablers	Barriers
	Educated end-users participating in *implicit* DR	End-users locked-in to participate in *implicit* DR alone
	Potential for financial savings in the electricity bill	Relatively cheap electricity that makes savings and explicit DR unattractive
	Relatively high degree of electrification that provides a share of dispatchable load (e.g., heat pumps, EVs)	Low degree of electrification that does not leave significant dispatchable loads
	Fair compensation mechanism	Compensation mechanism that does not reflect costs, benefits and externalities
Independent Aggregators	Primary and secondary legislation to outline the existence and operation of IA	Lack of appropriate legal framework (definition of roles, technical modalities, baseline calculation, etc.)
	Possibility to access the markets without prior permission	Permission from DSO/ retailer/ BRP
		Geographic constraints due to bidding zones
		High technical requirements (e.g., minimum bids)
		Data privacy concerns from end-users
	the existence of flexibility markets at DSO level	
	Possibility to engage in value stacking	Need for a large pool of end-users to create a profitable revenue stream

Source: *JRC, 2021*.

The transposition of Article 17 implies full legal recognition of independent aggregators. Following the requirement for the MS to transpose the EU Directive 2019/944 in the foreseeable future, and seeing as the respective National Energy and Climate Plans include sections regarding independent aggregators, the regulatory framework is expected to address independent aggregators in every MS soon. Compared to the situation from five years ago, today, the lack of a legal framework does not constitute a barrier for engaging in explicit DR aggregation anymore. A notable exception is represented by MS where the regulatory framework is in place but proposes a different approach to flexibility and thus actively discourages the aggregation of end-users by excluding them from the market design (e.g., Germany and The Netherlands).

Table 2 reflects the reality on the ground, and in the section regarding independent aggregators, the number of identified barriers is greater than the number of identified enablers.

The barrier cited most often by the industry is the lack of clear market rules and of a definition of technical modalities. However, this report found that *all* types of barriers are critical to independent aggregators: lack of an appropriate regulatory framework (secondary legislation), no functional market (fair and transparent compensation mechanisms), unfulfilled technical preconditions (advanced roll-out of smart meters) and an unconvincing business case (strong participation of end-users in DR and/or permission for value stacking). If either of the four barriers is too high, then independent aggregators are not enabled to participate in the market.

Conversely, however, evidence shows that if the business case is strong enough, the independent aggregators are willing to engage with the hurdles from the other barriers.

30 Conclusions

Explicit Demand Response has shown progress in most EU Member States, compared to the previous JRC report published in 2017. In the meantime, the EU Directive 2019/944 came into force, and Article 17 addresses Demand Response through aggregation and includes the entity of an *independent* aggregator alongside the other market participants.

Through a survey, expert interviews and desk research, this report has found that as the transposition of Article 17 into national law is ongoing, most of the EU Member States already enable participation in explicit Demand Response, but not necessarily through an independent aggregator. The main findings indicate that the status of explicit DR has improved, but not equally across the MS, and especially not with regard to small end-users. The possibility to aggregate and access the markets through *independent* aggregators depends on well-enabled participation in explicit DR.

Apart from strong participation in explicit DR, independent aggregators require further enablers in the form of an appropriate regulatory framework (secondary legislation), a functional market (fair and transparent compensation mechanisms), technical preconditions (advanced roll-out of smart meters) and a convincing business case (strong participation of end-users in DR and/or permission for value stacking). Barriers from additional categories (e.g., data privacy concerns) still need to be addressed appropriately.

With the diversity of background conditions and approaches from across the EU, it must also be pointed out that there is no standardized definition of the aggregator role and of the contractual relationship with the supplier across the EU, which makes comparisons difficult as well as the documentation of progress.

However, the measurable success that was made between 2017-21 could have been quantified in the number of demand-side MWs bid into the markets, frequency of calls, levels of reliability and number of Euros earned by stakeholders. However, as pointed out in the previous report, Member States are not required to measure their progress, and the communication between stakeholders is insufficient for allowing growth or replication of best practices. This situation is still to be remedied.

The quantification of success could contribute towards a comprehensive cost-benefit analysis of DR programs at the level of Member States. While highly complex and addressing fast-changing realities in a transforming EU, a CBA approach would benefit, in particular, the segment of small end-users in line with the ambitions to empower the EU citizens to engage more in the energy system. Additionally, it would create a common ground for comparisons and sharing of best practices among the Member States, thus contributing to a strengthened, better-interconnected and integrated system.

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List of abbreviations and definitions

ACM	Netherlands Authority for Consumers and Markets (Autoriteit Consument en Markt)
aFRR	Automatic Frequency Restoration Reserve
AGU	Aggregator Generator Units
ANRE	Romanian Energy Regulatory Authority
ARERA	Italian Regulatory Authority for Energy, Networks and Environment
ASM	Ancillary Services Market
ASU	Assetless Supplier Unit
AVAP	Virtually Aggregated Production Unit
BEV	Battery electric vehicle
BESS	Batteries and Energy Storage Systems
BRP	Balance Responsible Party
BSP	Balancing Services Provider
CBA	Cost-Benefit Analysis
CEC	Citizens Energy Communities
CEP	Clean Energy Package
CER	Commission for Energy Regulation
CERA	Cyprus Energy Regulatory Authority
CNMC	Comisión Nacional de los Mercados y la Competencia
CRE	French Energy Regulatory Commission
CRM	Capacity Remuneration Mechanism
CRU	Commission for Regulation of Utilities
DR	Demand response
DSF	Demand Side Flexibility
DSO	Distribution Service Operator
DSR	Demand Side Response
EAC	Electricity Authority of Cyprus
ENTSO-E	European Network of Transmission System Operators
ERA	Energy Regulatory Authority

ERSE	Regulatory Entity for Energy Services
ERU	Energy Regulatory Office / Energetický regulační úřad
EV	Electric Vehicle
EXAA	Energy Exchange Austria
FCR	Frequency-controlled reserve
FCR-D	Frequency-controlled disturbance reserve
FCR-N	Frequency-controlled normal operation reserve
FFR	Fast Frequency Reserve
HETA	Hungarian Energy Trader's Association
HP	Heat pump
HUDEX	Hungarian Derivative Energy Exchange
HUPX	Hungarian Power Exchange
IA	Independent Aggregator
IAM	Independent aggregation model
IPTO	Independent Power Transmission Operator
JRC	Joint Research Centre of the European Commission
mFRR	Manual Frequency Restoration Reserve
MoU	Memorandum of Understanding
NAP SG	National Action Plan for Smart Grids 2019 – 2030
NECP	National Energy and Climate Plan
NPV	Net Present Value
NRA	National regulatory authority
NTC	Net Transmission Capacity
OPR	Operating power reserve
RAE	Regulatory Authority for Energy
REC	Renewable Energy Communities
REN	Rede Eléctrica Nacional SA
RES	Renewable Energy Sources
RO	Reliability option

RR	Restoration Reserve
SEM	Single Electricity market
SEMO	Single Electricity Market Operator
SIDC	Single Intra-Day Coupling
SPRK	Latvia Public Utilities Commission
STAR	Short Term Active Response
TSRs	Trade and Settlement Rules
TSO	Transmission System Operator
UR	Utility Regulator
UVA	Virtually Aggregated Unit
UVAC	Virtually Aggregated Consumption Unit
UVAM	Virtually Aggregated Mixed Unit
URE	Polish Energy Regulatory Office (Urząd Regulacji Energetyki)
V2G	Vehicle to Grid
VERT	Valstybinė energetikos reguliavimo taryba (National Energy Regulatory Council
VPPs	Virtual Power Plants
VUEN	Vorarlberger Übertragungsnetz GmbH

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Annexes

Annex 1: Introduction to Demand Response

Demand Response is able to increase the system's adequacy and substantially reduce the need for investment in peaking generation by shifting consumption away from times of high demand. It can act as a cost-effective balancing resource for variable renewable generation. Adding stability to the system, lowers the need for coal and gas-fired spinning reserves – most running power plants burn fuel continuously in order to be ready to supply power at short notice. It furthermore decreases the need for local network investments, as it shifts consumption away from peak hours in regions with tight network capacity if market prices and congestion signals are aligned. Demand Response delivers these benefits by providing consumers – residential, commercial[232] or industrial – with control signals and/or financial incentives to adjust their consumption at strategic times.

Demand Response definition and types

According to the Directive, **Demand Response** means the change of electricity load by final customers from their normal or current consumption patterns in response to market signals, including in response to time-variable electricity prices or incentive payments, or in response to the acceptance of the final customer's bid to sell demand reduction or increase at a price in an organised market as defined in point (4) of Article 2 of Commission Implementing Regulation (EU) No 1348/2014 (17), whether alone or through aggregation. It is therefore s a tariff or programme established to incentivise changes in electric consumption patterns by end-use consumers in response to changes in the price of electricity over time or to incentivise payments designed to induce lower electricity use at times of high market prices or when grid reliability is jeopardised.

Demand Response programmes can be categorised into two groups:

— **A) Explicit Demand Response** is the type of DR referred to in Article 15. In this program, demand competes directly with supply in the wholesale, balancing and ancillary services markets through the services of aggregators or single large consumers. This is achieved through the control of aggregated changes in load **traded** in electricity markets, providing a comparable resource to generation, and receiving comparable prices.

— Consumers receive **direct payments** to change their consumption upon request (i.e., consuming more or less). Consumers can earn from their flexibility in electricity consumption individually or by contracting with an aggregator. The latter can either be a third-party aggregator or the customer's retailer.

— **B) Implicit Demand Response** (sometimes called "price-based") refers to consumers choosing to be exposed to *time-varying electricity prices* or *time-varying network tariffs* (or both) that partly reflect the value or cost of electricity and/or transportation in different time periods and react to those price differences depending on their own possibilities (no-commitment). These prices are **always part of their supply contract**. Implicit DR does not, therefore, allow a consumer to participate alongside generation in a market.

It is important to note that neither form of Demand Response is a replacement for the other. Many customers participate in Explicit Demand Response through an aggregator, and at the same time, they also participate in an Implicit Demand Response programme through more or less dynamic electricity price contracts, such as a day/night tariff. The requirements and benefits of each are different and build on each other. The two are activated at different times and serve different purposes within the markets. They are also valued differently. While consumers will typically receive a **lower bill** by participating in a dynamic pricing programme, they will receive a **direct payment** for participating in an Explicit Demand Response programme.

Explicit Demand Response provides a valuable and reliable operational tool for system operators to adjust the load to resolve operational issues. Implicit Demand Response (dynamic pricing) usually does not allow a customer to participate in the balancing or ancillary services markets or in most existing capacity markets. It will also not allow for regional demand-side services for TSOs and DSOs, and it does not provide the system as a whole with a dispatchable resource.

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[232] The term "commercial" is used here to mean all buildings and businesses which are not directly industrial or residential. In other words, municipal buildings, SMEs, businesses such as hotels, office spaces, etc.

For this – it is critical that Demand Response activation is addressed separately in (or apart from) the supply contract. This means that the offering is separated from the customer's electricity price.

On the other hand, Explicit Demand Response does not have the same market reach as a retailer-enabled dynamic pricing programme. **Both forms** are therefore required to allow all consumers to **participate and benefit from their flexibility fully**. However, the focus of this paper is on Explicit Demand Response.

The role of the aggregator

The separation of the supply contract – or the customer's electricity price requires a new role – the role of the aggregator.

— An **aggregator**, as defined in the E-directive performs a function as a natural or legal person who combines multiple customer loads or generated electricity for sale, purchase or auction in any electricity market. It is a service provider who operates – directly or indirectly – a set of demand facilities in order to sell pools of electric loads as single units in electricity markets. The service is provided separately from any supply contract[233]. The aggregator – a service provider who may or may not also be a retailer of electricity – represents a new role within European electricity markets, but is well established in the USA, Australia, South Korea and Japan.

— Most consumers do not have the means to trade directly into the energy markets because, for example, they are too small to manage the complexity. They require the services of an aggregator to help them participate. Aggregators (just like suppliers) pool many different loads of varying characteristics and provide backup for individual loads as part of the pooling activity, increasing the overall reliability and reducing risk for individual participants. They create one "pool" of aggregated controllable load, made up of many smaller consumer loads, and sell this as a **single resource**. These loads can include electric heating and cooling, fans, water boilers, grinders, smelters, water pumps, freezers, etc.

The Retailer Business Model and Demand Response

Aggregation services provided by an independent player or a retailer are a necessity for creating explicit DR programmes. However, there are certain business model factors that can make it difficult for many retailers to provide these services. These can be broken into two categories, the retailer's potential conflict of interests concerning DR and the required changes in the business model.

Demand Response is outside the expertise area of a traditional retailer. It is a highly specialised service offering centred largely on knowledge of heating and cooling systems, industrial process, and marketing. To be successful, retailers must either outsource this expensive expertise or hire and train new staff - they will **not** have these resources in-house. Added to this, Demand Response **disturbs** their existing revenue streams from generation and balancing. For example, retailers who own generation assets may earn an important part of their annual returns when prices are high. They also charge the large (and small) consumers for taking on their balancing risk – if they provide Demand Response they lower their income from generation, as well as the income from providing protection against balancing costs[234].

Some retailers do roll out Demand Response programmes – and do this well, EDF, E.ON, Dong Energy and Helsinki Energy being three examples). As in other competitive markets, such as Victoria, Australia and New York, there are also small independent retailers - who do not own generation assets - now emerging in Europe. A portion of these has made Demand Response a core part of their business model[235]. However, truly independent retailers, which are not owned by municipalities and do not own their own generation assets, serve a tiny proportion of European load (estimated at less than 2%).

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[233] An exception: A retailer may aggregate and automate their consumer's load in order to manage their own balancing risk, along with generation assets. The consumer may therefore not receive a direct payment but only a lower electricity cost. That said their load will be used in the same way by the retailer as a generation asset.

[234] When a customer receives a flat electricity price, they do so because the retailer has taken on the balancing risk (the risk that wholesale prices may go higher than planned). This is a form of **insurance** for the customer. Just as an insurance company will not want their clients and competitors to know what they earn from the insurance premiums, the retailer may not want consumers to know what they earn from taking on the balancing risk.

[235] The wholesale market structures (except in the Nordics), insurance requirements, balancing requirements, data requirements, registration requirements plus most of the technical barriers that face aggregators, also face small retailers providing DR. A retailer business is also more expensive to establish, an aggregation business requires €5-7 million, a retailer at least €15-€20 million and they will continue to have issues of scale.

To date, the activity of these retailers alone **has not created market momentum** or a positive cycle of investment in any competitive market globally. Without aggregators, the programmes stay small and subordinate to generation assets. That is why the role of the independent aggregator is important.

The upfront costs, the risk of failure and the decrease in known and trusted revenue streams means that a retailer will not engage in Demand Response easily. Established retailers who do engage seriously in Demand Response do so because they face at least one of three challenges:

4. A total collapse of wholesale market price, removing the value of their generation portfolio. However, this involves destroying the market signal.
5. Ownership of an inflexible generation fleet, such as nuclear or wind, which drives up balancing costs and does not provide the retailer with a means of earning from exceptionally high prices.
6. Threats from outside independent aggregators, who create market momentum, a sense of competition over services and who raise consumer awareness.

When a retailer states that, dynamic tariffs, feedback programmes or Demand Response programmes provide no positive business model – this is probably accurate. There may be no viable business model **for the retailer**. What **may not** be accurate is that these same programmes would create no benefit for industrial, commercial or residential consumers.

Clarifying the role of the independent aggregator is, therefore, an important enabler of consumer engagement and the healthy growth of market competition around Demand Response services in a Member State. An aggregator can only succeed when its customers succeed and benefit from Demand Response. Competition between participants, aggregators and retailers, therefore, spurs healthy competition in Demand Response services for customers and creates substantial volumes of flexibility. For example, the latest PJM Market Activity Report on Demand Response (from August 2015) shows that 82% of Demand Response capacity in PJM comes from independent aggregators. This trend has been increasing over the last few years. The shares are similarly high in other jurisdictions that have mature Demand Response markets, such as Western Australia, New Zealand or other US interconnections (e.g., New England and New York).

Annex 2: Definition of market types

Wholesale market: any market within the Union on which wholesale energy products are traded. Wholesale energy products, in turn, consist of contracts and derivatives related both to electricity and natural gas produced, traded or delivered in the Union and to the transportation of electricity or natural gas in the Union.

Balancing market: balancing refers to the situation after markets have closed (gate closure) in which a TSO acts to ensure that demand is equal to supply, in and near real time. Balancing markets ensure the security of supply at the least cost and can deliver environmental benefits by reducing the need for back-up generation.

Capacity market: in a capacity market, the utility or other electricity supplier are required to have enough resources to meet its customers' demand plus a reserve amount. Suppliers can meet that requirement by generating capacity they own, with capacity purchased from others under contract, or with capacity obtained through market auctions.

Ancillary services markets: ancillary services" refer to the functions TSOs contract to guarantee system security. Examples are: black start capability (the ability to restart a grid following a blackout); frequency response (to maintain system frequency with automatic and very fast responses); fast reserve (which can provide additional energy when needed), but also demand response (which involves customers changing their operating patterns to aid system balancing).

Primary reserve/Frequency Containment Reserve: Frequency Containment Reserves mean the operating reserves necessary for constant containment of frequency deviations (fluctuations) from the nominal value in order to constantly maintain the power balance in the whole synchronously interconnected system. Activation of these reserves results in a restored power balance at a frequency deviating from the nominal value. This category typically includes operating reserves with an activation time of up to 30 seconds. Operating reserves of this category are usually activated automatically and locally. The operating reserve is made up of the spinning reserve (generators' marginal increase of torque applied to the turbine's rotor), as well as the non-spinning or supplemental reserve (back-up generators or DR).

Secondary reserve/Frequency Restoration Reserve: The reserves used to restore frequency to the nominal value and power balance to the scheduled value after a sudden system imbalance occurrence. This category includes operating reserves with an activation time typically up to 15 minutes (depending on the specific requirements of the synchronous area). Operating reserves of this category are typically activated centrally and can be activated automatically or manually. In these Framework Guidelines, automatically activated reserves refer to reserves activated by an automatic controller.

Tertiary/Minute reserve/Replacement Reserve): The reserves used to replace already activated reserve capacities to be prepared for a further system imbalance. This category includes reserves with activation time from 15 minutes up to hours.

Interruptible loads: Interruptible loads are defined as consumption units (mostly large commercial or industrial) that can reliably reduce their demand by a fixed capacity upon request by the TSO.

Strategic/Winter/Grid reserves: Strategic reserves are organised by the TSO to ensure adequate security of supply throughout the winter period (usually lasting from the 1st of November until the 31st of March each year). Strategic reserves address the risk of structural shortages in the control area during the winter.

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