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DATA EXCHANGE IN ELECTRIC POWER SYSTEMS: European State of Play and Perspectives

THEMA Report 2017-03

Brief Summary

Disclaimer

This report addresses the needs for data exchange in the emerging power system and discusses data exchange models, firstly providing an extensive overview of the existing solutions and setting criteria for them in a second step. Data exchange platforms have been introduced in many European countries, driven by a need for efficient processes and better data quality, initially in retail markets. Recent regulatory developments mandate increased cooperation and aim to empower customers to participate actively in both the retail and wholesale energy markets, thus further increasing the requirement for data exchange between all stakeholders. Hence, future data exchange platforms can take on a role in the overall power system and point towards an integrated wholesale-retail market. The report concludes with an outlook on possible development trajectories in data exchange.

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THEMA Consulting Group is a Norwegian consulting firm focused on Nordic and European energy issues, and specializing in market analysis, market design and business strategy.

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Content

EXECUTIVE SUMMARY	7
1 INTRODUCTION	13
1.1 Background	13
1.2 Objectives of this report	13
1.3 Structure of the report	14
2 DATA EXCHANGE REQUIREMENTS	15
2.1 Current regulatory state of play and developments	15
2.2 Classification of data	20
2.3 Data requirements of different market actors	22
2.4 Processes and functionalities in data exchange	25
3 CURRENT STATE OF DATA EXCHANGE MODELS	26
3.1 Current state of play	26
3.2 Comparison of central Data Exchange Platforms	28
3.3 Details on selected data exchange models	30
3.4 Observations on the state of play	33
3.5 Key findings	34
4 OUTLINE OF MODEL ELEMENTS OF DATA EXCHANGE PLATFORMS	35
4.1 Criteria for using a Data Exchange Platform	35
4.2 Benefits of centralised Data Exchange Platforms	37
4.3 Possible future development	38
5 CONCLUSION	40
6 APPENDIX	43
6.1 Relevant Articles of the Draft European Directive and Regulation	43
6.2 Network Codes	45
6.3 Data requirements by stakeholder	46
6.4 Case studies	50
6.5 References	58
6.6 Acronyms	59
CONTACT	61



EXECUTIVE SUMMARY

Smart grids and innovative markets require extensive data exchange

The European electricity sector is currently undergoing a major transformation via the growth of distributed generation, renewables and storage, which makes its operation more complex to optimise. Digitalisation is a key driver for allowing active system management in the electricity grid, enabling Transmission System Operators and Distribution System Operators (TSOs and DSOs) to optimise the use of distributed resources for ensuring a cost-effective and secure supply of electricity for all customers. Digitalisation is also making it possible for end-users to become active market participants with their self-generation and demand flexibility. It will create a drive for innovation with respect to new services, technical solutions, products and markets. The electricity grid, together with an efficient data exchange infrastructure, is a major factor underlying European energy transition and the European economy.

While the transformation offers many new opportunities for all stakeholders, the operation of the electricity system becomes more complicated both at the transmission and distribution levels. The amount of available information is growing exponentially, and cooperation and coordination between TSOs and DSOs will be critical for meeting the requirements of all stakeholders. Consequently, the need for coordination between TSOs and DSOs with respect to the grid increases, and this is also the case across national borders. The traditional divide between wholesale and retail markets becomes largely obsolete as even smaller customers can

participate not only in the spot markets, but also in the balancing markets to provide ancillary services to the European electricity system, either directly or via aggregators. As the overall system is increasingly necessitating distributed flexibility, it grants the retail market a new cross-border dimension. The draft legislation on Clean Energy for All Europeans takes into account this change. Indeed, it seeks to further enhance the role of the customer, and acknowledges the increasing part played by TSOs and DSOs. In short, TSO and DSO coordination will be a cornerstone of energy transition and the active customer paradigm.

Data exchange platforms are a tool for improving coordination and market functionality

In the building of an efficient integrated European electricity market, information exchange and data management are becoming more connected. Increased information access and exchange not only leads to substantial efficiency gains in grid operation and planning, but also lowers market access barriers, ensures transparency in consumers' usage and creates new market opportunities (e.g., energy services companies). Efficient data exchange is also necessary for achieving a seamless integration between wholesale and retail markets.

Data exchange platforms (DEPs), also called data hubs, seek to improve data exchange processes between the different parties connected to the electricity system and market. The upcom-

ing use of DEPs and their functionalities are subject to different regimes and practices throughout Europe. Furthermore, several recent studies and reports have covered the development of DEPs primarily from a retail market perspective. This has also been the focus of several of the DEP projects that have been implemented or planned to date, however, there are certain examples serving both retail and wholesale markets, such as in Denmark and Estonia. The range of possible benefits from DEPs clearly goes beyond the retail market and the DSO level. DEPs that take a wider system perspective and facilitate innovation through stimulating the development of third-party applications (for example, in the Estonian DEP) can be said to constitute the state-of-the-art with regards to data exchange in the European context.

Data exchange rising on the policy agenda

In parallel with the development of DEPs, regulatory agencies, TSOs, DSOs and utilities are placing data exchange at the top of their agendas. Reports that highlight the role of data exchange in a broader context are **“The power sector goes digital – Next generation data management for energy consumers”** by Eurelectric, **“My Energy Data”** by the European Smart Grids Task Force and the **“TSO-DSO Data Management Report”** by CEDEC, EDSO, ENTSO-E, Eurelectric and Geode. The Eurelectric report **“The power sector goes digital”** contains a classification of data which is also the basis for our report. The latter offers a common ground for high-level principles of data management. Furthermore, the Council of European Energy Regulators (CEER) has recently published **“A Review of Current and Future Data Management Models”**, which includes recommendations on good data management and a status report from eight countries. The International

Energy Agency (IEA) is also taking on a role by establishing an Implementing Agreement for a Co-operative Programme on Smart Grids (ISGAN), designed to advance the development and deployment of smarter electric grid technologies, practices and systems.

In this context, one should also note the recent Communication by the European Commission on the Data Economy. The Communication notes the benefits of the free flow of data and data access to the economy, citing that already, today, the data economy accounts for 1.87% of EU GDP. At the same time, the need for strong privacy protection is underscored. The relevance of big data for promoting competition and efficiency is also recognised in recent reports, for instance by CERRE in **“Big Data and Competition Policy”**. It is important to link data exchange in power system issues to the broader data economy discussion at the European level.

Objectives of the report: Data needs, state of play and development potential for Data Exchange Platforms

The present report's objective is to provide an overview of the state-of-the-art in terms of how EU Member States are currently organising their data exchange as well as perspectives and solutions for their data exchange. Using the TSO-DSO Data Management Report as a starting point, ENTSO-E has requested THEMA to answer the following questions:

1. What are the data requirements of different stakeholders in the electricity sector, both in the transmission and distribution grid and in various markets for energy and other services?
2. What is the status regarding the development of DEPs in European electricity markets?
3. How can DEPs be developed in the short- and long-term to meet the needs of the different stakeholders and EU energy policy objectives?

The stakeholders addressed by this analysis include customers in the grid, TSOs, DSOs, retailers, regulators and various third parties in order to supply a broad perspective on DEPs and explore possibilities surrounding the role played by such platforms. The analysis is concentrated on the functionalities and contents of DEPs. Regulatory drivers for data requirements are also covered.

All stakeholders face an increased need for high-quality data in large volumes and with minimal delay

The shift from conventional to distributed renewable generation, the liberalisation of energy markets and the digitalisation of the system are paradigm shifts that entail significant changes in processes at all stages of the electricity value chain, from generation and operation of the grid to market functioning and consumption. All business processes are generating an increasing amount of data, which are becoming critical to efficient system functioning and a smart electricity market. Data exchange is also a prerequisite for a closer integration of retail and wholesale markets, especially with new actors, for demand-side response and aggregation, who need a sustainable business model to develop.

For the **consumers**, access to and control over metering data is necessary for understanding their own electricity demand, be active in the market and choose between suppliers and contracts. Data access will also enable consumer participation in demand response and the use of home automation services. In addition, it will be vital for the development of new entrants providing flexibility services, such as aggregators.

On the **retail** side, the advent of independent suppliers has significantly increased the interfaces for retail processes, such as exchange of metering values, supplier switching or contract cancellations. Each supplier must interact with each DSO, and establishing these communication links presents a market entry barrier

for new actors. Data quality and reliability of processes tend to vary widely between different metering responsible parties. This situation has motivated an increasing number of countries to introduce central DEPs.

For **TSOs**, the balancing of the system can be more efficient, but also more complex, with access to flexible resources at all grid levels. The new role of flexibility also impacts short- and long-term grid planning. Similar challenges are faced by DSOs regarding congestion management within their respective grids.

Balance-responsible parties face rising data requirements related to scheduling and imbalance settlement with market liberalisation, more active consumers and small-scale producers.

Last but not least, new actors, such as **aggregators** and **Energy Service Companies** (ESCOs) will require extensive access to data and data exchange with other actors (including TSOs and DSOs) to be able to offer flexibility on behalf of customers in various markets and help customers optimise their energy consumption and generation.

State of play: Towards centralised data exchange involving TSOs, DSOs and third parties

While today, decentralised data exchange is still the most common model across Europe, there has been a noteworthy trend towards central platforms. Several countries are in the process of implementing central solutions, like, for example, Norway, Sweden and Finland, or they are further centralising the existing data exchange, as in the cases of Belgium, Spain and the Netherlands. Others have just recently implemented a central DEP, including Denmark, Estonia or the United Kingdom, or have long-established central data exchange, such as Ireland and Iceland.

The establishment of central DEPs has been promoted by three main objectives:

- Improved efficiency in data management, which involves greater and more consistent data quality, transparency and exploitation of economies of scale for all involved stakeholders;
- Removal of barriers for new market entrants, including the facilitation of supplier switching and fostering of new services; and
- Empowerment of customers, which involves strengthening the opportunities for market participation, granting access to data for customers and authorised third parties, realising the potential of smart meters and facilitating demand response.

Decentralised solutions, like in Germany, Austria or Portugal, can reduce, but not fully eliminate, market barriers if the processes, data types and communication interfaces are legally binding and if the regulator has enough authority to enforce compliance. Variations in data quality and availability, even with standardised formats, can be a drawback of such models.

While the focus of the central DEPs established so far has been the retail market, we have observed that the perimeter extends to TSO-connected units on a number of the platforms. A variety of DEPs also seek to go beyond retail markets by supplying additional data and information to customers and by allowing customers to grant access to their data to third parties, such as energy service companies or aggregators, active in the wholesale market. This allows these new market players to develop and offer innovative services – from information products that may support energy efficiency measures to demand response that can elevate the flexibility potential that lies hidden on the demand side and with distributed generation.

A final observation on the state of play is that the governance model of central exchange platforms can vary. Governance of such DEPs implies TSOs, DSOs and third parties. The key feature of the party or parties responsible for a DEP should be full neutrality in order to avoid any discrimination in data access and delivery.



Central data exchange could be developed further

Customers, especially small consumers and prosumers in the distribution system, will start to take on a more active role in energy and reserve markets, directly or via aggregators. This necessitates and creates data exchange, for example, between TSOs, DSOs and aggregators to communicate grid congestions, between aggregators and suppliers to settle deviations from schedules and between TSOs and DSOs to exchange information on available and activated flexibility sources. All these topics are recognised by the proposed new EU legislation, and it will be a challenging task for the whole industry to find non-discriminatory, transparent and secure means of efficiently handling all the data needs across all stakeholders.

As they allow an extensive sharing of data, central exchange platforms can enhance the efficiency of processes, reduce market barriers and enable customers to make informed decisions pertaining to their demand, choose suppliers or actively participate in markets. For these purposes, the platforms must meet certain criteria:

- The platform must guarantee full neutrality. This does not mean that all actors should have access to the same data, but that any actor with a legitimate need and authorisation by the customer should have access without any form of discrimination;
- Stakeholders must have trust in the platform regarding data quality, data access and governance;
- The platforms should focus on exchange of data where several parties require access to the same type of data and a very high level of data quality is required. Given this, the platform can exchange many types of data and distribute information to the stakeholders with a legitimate need for access; and
- The platform should facilitate interoperability between national solutions. Besides, the geographical scope of a central platform can vary. A country-by-country approach can be a starting point.

Integration of wholesale and retail markets and customer empowerment could be main benefits with further development of central Data Exchange Platforms

Given the aforementioned criteria and development possibilities, we see several areas as interesting options for the further development of central DEPs. In general, the main benefit from a central platform is the opportunity to bring together data sources and potential applications and services, making data and new functionalities accessible. For instance, central platforms may provide communication between flexibility providers, aggregators, market operators and system operators surrounding activation of flexibility resources, prices and volumes (according to stakeholder needs). The function of a DEP in this respect could include making accessible standardised market data on wholesale prices, prices in balancing markets, load profiles and installed equipment for demand response. Other types of supporting data, like weather forecasts, can also be included. A central platform could also assist in promoting participation of distributed generation in the wholesale market through increased availability of data on generation capacities, historical generation and continuously updated

daily generation. The same benefits could apply to demand-side flexibility and storage.

DEPs might also serve to inform suppliers, generators and aggregators of grid congestions, and the effect such conditions may have on their ability to participate in energy or reserve markets. Such locational data could be essential for utilising distributed flexibilities.

Again, the platforms could have different functionalities and governance structures between areas. The important criterion for efficiency in this respect is that the solutions are interoperable.

Real-time data on grid operations are, on the other hand, less suitable for such central DEPs. Currently, SCADA systems efficiently handle the operational data exchange between TSOs and DSOs.

There is no ‘one-size-fits-all model’, but Data Exchange Platforms can offer benefits surrounding big data treatment and the creation of new energy services

DEPs can be the tool of choice for many of the new processes and data exchange needs in a more consumer-centric power system. Data stored and exchanged will grow beyond mere metering values to include market data, like weather forecasts or spot prices, grid congestions, unavailability of assets or possibly even grid-planning data where this is relevant for other stakeholders besides system operators. DEPs may mature from being focused on a fixed set of processes around the retail market to a more flexible architecture that allows third parties to offer services and functionalities. Finally, an increasing harmonisation of standards and formats across Europe may make it easier for companies to provide services across several countries.



1 INTRODUCTION

1.1 Background

The European electricity sector is undergoing a major fundamental change with the increasing digitalisation and roll-out of smart meters. New opportunities in market access and participation are arising for customers regarding demand flexibility and their own generation. With a rising share of electricity generation from renewable energy sources and inclusion of technologies, such as storage and demand response, the task of operating the system and the grid becomes more complex. This applies both to the transmission and the distribution grid. The European Commission's Clean Energy Package from November 2016 seeks to further enhance the role of the customer and increases the requirements laid out for TSOs and DSOs.

1.2 Objectives of this report

ENTSO-E has commissioned THEMA to craft a report that addresses the following questions:

1. What are the data requirements of different stakeholders in the electricity sector, both in the transmission and distribution grid and across various markets for energy and other services?;
2. What is the status quo with regards to the development of DEPs in European electricity markets?; and
3. How can DEPs be developed in the short- and long-term to meet the needs of different stakeholders and EU energy policy objectives?

The stakeholders covered by this analysis include customers on the grid, TSOs, DSOs, retailers, regulators and various third parties to provide a broad perspective on DEPs and explore the possibilities regarding the role played by such platforms.

The analysis is concentrated on the functionalities and contents of DEPs. We do not consider how DEPs should be regulated and organised. Regulatory drivers for data requirements are however covered.

1.3 Structure of the report

In Chapter 2, we describe the data requirements for the main actors in the different markets considering the most recent trends regarding policy and regulation. This is carried out at a generic level without reference to the specific technical and regulatory solutions for providing data. We also take into account principles for good data management. This answers question 1 from earlier.

In Chapter 3, we provide an overview of the status of DEPs in European electricity markets. The goal is to supply a high-level description of the main features of the current data exchange models with an emphasis on the countries that have begun to develop DEPs and similar solutions. This addresses question 2.

In Chapter 4, we discuss how DEPs can be developed over the short- and long-term to fulfil the data requirements of the various actors. The objective here is to link the generic analysis of requirements with the state of play and see how DEPs and similar solutions can help meet the requirements of different stakeholders, including TSOs, DSOs and grid customers in addition to the commercial market players and regulatory authorities. This answers question 3.

2 DATA EXCHANGE REQUIREMENTS

In this chapter, we describe data exchange requirements from the perspective of a variety of actors within the electricity market with a focus on data requirements for TSOs and DSOs in terms of TSO-DSO coordination. We commence by outlining a portion of the background from a regulatory/policy perspective, with a particular emphasis on the most recent developments and proposals at the European level. We then move on to our classification of the different types of data before covering the data requirements of various market participants. Taken together, these elements serve as the background for our overview of current data exchange models in Europe.

2.1 Current regulatory state of play and developments

There are several regulations, both in existence and under development, that explicitly or implicitly mandate data exchange between stakeholders within the power system. We start by summarising a number of the fundamental principles for data exchange that have appeared through recent discussions on the topic in Section 2.1.1. Section 2.1.2 features an evaluation of the requirements based on the new Clean Energy Package of the EU

commission. Section 2.1.3 highlights the relevant network codes that support frameworks for grid planning, operation and imbalance settlement and related data exchange. Section 2.1.4 and 2.1.5 summarise recent reports on data exchange and needs for the retail market and for the better integration of the retail and wholesale markets.

2.1.1 Collection of requirements and principles

Both the EU regulations and recent reports have a common set of general requirements for data exchange. The exact selection and weighting differs, and certain requirements follow from each other, but there is agreement on the main principles. These principles are:

PRIVACY AND DATA SECURITY

All data must be handled per the relevant data privacy regulations. Also, data security plays an equally important role – the well-founded trust of both private customers and commercial customers in the protection of their data is a prerequisite for acceptance of automated and efficient data exchange processes.

FACILITATE COMPETITION, MARKETS AND INNOVATION

Neutral and efficient access to data can be an integral prerequisite for efficient markets and competition. It can also enable innovation – many of the new services discussed in the energy sector depend on the availability of data.

NEUTRALITY AND NON-DISCRIMINATION

As data has a significant and increasing value to market players and stakeholders, it is paramount that access to data is neutral and non-discriminatory. This is related inter alia to harmonised standards that permits any stakeholder to access data with reasonable effort, and to non-discrimination regarding the time at which data is processed and made available to different stakeholders of the same group. Non-discrimination also includes access of third parties to data and respecting data privacy laws. To ensure neutrality, the entity responsible for handling data exchange processes must be neutral itself in the sense that the entity does not offer commercial services related to the data and is neutral with respect to different market actors.

TRANSPARENCY OF DATA EXCHANGE

To make certain there is confidence in neutrality and data security, the processes, rights and operations of data exchange should be transparent and well defined.

2.1.2 The EU regulatory framework

The draft Clean Energy Package explicitly or implicitly touches upon issues related to data management: ownership of data, eligibility to access data and requirements for data management. It also comments on the role of distributed energy sources and consumers in market operations.

General guidelines in the electricity directive and the electricity regulation recommend that access to markets and data should be non-discriminatory and transparent. With this, the electricity directive and regulation further demands consumer participation in all markets where appropriate via an aggregator.

DRAFT DIRECTIVE ON COMMON RULES FOR THE INTERNAL MARKET PERTAINING TO ELECTRICITY

The draft directive [1] sets in the preamble the objective of the new legislation, concentrating on enabling all customers to become active participants in energy markets. This includes improved, non-discriminatory access to data and options for supplier switching as well as the right to offer their own flexibility in a market-based manner directly or via aggregators to the system.

TRANSPARENCY IN THE POWER SECTOR

Data exchange can be a tool to improve transparency of actors in the power sector to regulatory authorities.

COST-EFFICIENCY AND SIMPLICITY

Many approaches to data exchange can be chosen, both in terms of scope and data exchange models. Cost-efficiency should be considered in the design decision. The TSO-DSO data management report overtly calls for simplicity with respect to existing and new business models and processes.

HARMONISED STANDARDS

Both cost-efficiency and neutrality benefit from harmonised standards, where possible based on existing standards, and ideally harmonised across Europe to further integrate the European energy market and allow companies to easily offer similar services in different European countries. Nationwide harmonisation is the minimal target.

Consumer- and supplier-related provisions

Chapters 2 and 3 list several rules concerning the electricity sector, specifically the rights of customers. While most articles do not plainly mandate data exchange, most of these rights have implied data needs. These rights can be summarised as the right to information concerning their own contract and billing information, the right to switch suppliers, the right to participate in energy markets directly or indirectly and the right to a smart meter. To exert these rights, customers require access to their own meter data, they must be able to grant access to their meter data and they have to be able to view market data, such as spot market prices. Articles 23 and 24 prescribes that exchange of such data must be non-discriminatory and efficient, that a common European data format is to be used and that customers must not be charged for access to their data. Article 14 mandates a certified comparison tool for customers. The relevant provisions in their current form are listed in the Appendix.

SO-related provisions

In addition to the longstanding task of operating the distribution grid in a secure, reliable and efficient manner, DSOs also have new responsibilities related to flexibility. This includes cooperation between DSOs and TSOs with regards to the utilisation of flexibility resources and communication of a transparent network development plan. Both of these new responsibilities require exchange of data concerning the grid and concerning consumers, producers and other assets in the grid that can supply flexibility. DSOs must be neutral and non-discriminatory regarding data access, and vertically integrated suppliers cannot have privileged access to data.

TSO-related provisions

TSOs have the same responsibilities as DSOs concerning the secure, reliable and efficient operation of their grids. This also includes the cooperation and data exchange with connected DSOs and neighbouring TSOs. At the same time, TSOs must safeguard their provision of non-discriminatory access to any data they are able to share.

National Regulatory Authority (NRA)-related provisions

NRAs are granted extensive rights and duties in order to oversee and ensure the efficient operation of the electric power system. While no specific data needs are mentioned in the directive, these are inherent to such duties. To monitor and regulate grid tariffs, grid investments, efficiency of the market or quality of service, NRAs need access to grid data, to market data such as, e.g., outcome of flexibility auctions, and historic consumption and production profiles.

Draft regulation on the internal market for electricity

The regulation [2] has several more specific rules surrounding, especially, DSOs and TSO-DSO cooperation. These relate to tariff structures for networks if smart meters are present, and data exchange between TSOs and DSOs for planning and operation.

2.1.3 Network codes

The network codes and guidelines feature rules indicate cooperation between stakeholders, and hence data exchange.

The draft **electricity balancing guidelines** [3] suggest that:

- distributed generation, storage and demand shall be allowed to participate in balancing;
- DSOs and TSOs shall cooperate on all necessary data exchange; and
- European platforms for TSO-TSO data exchange related to cross-border balancing energy exchange and imbalance netting are to be established.

The **system operation guidelines** [4], in the draft version from 4 May 2016, set forth requirements on data exchange between TSOs and DSOs. These include:

- Requirements on data exchange, data quality and related responsibilities;
- Requirements and rights in data exchange related to distributed generation and flexibility; and
- Requirements for cooperation with planning and security analysis across all time scales and all grid levels.

The relevant articles are summarised in the **Appendix (Section 6.2)**.

2.1.4 Reports on data exchange in the retail market

SMART GRIDS TASK FORCE – MY ENERGY DATA

An expert group under the European Smart Grids Task Force published a report entitled “**My Energy Data**” [5] that looks at energy data with a focus on customer data and customer services exclusively from the retail market. It further offers an overview of initiatives and developments in selected European countries, and explores the potential for a common format for energy data exchange at the European level. The data services discussed in detail are downloading data and sharing data.

The report notes implementation issues regarding customer rights, consent, authentication of the customer, responsibilities around the consent register, cyber security challenges, interoperability, technical performance and costs of implementation and operation. It further reviews which standards and formats are in use at the member-state level.

Lessons learnt in the case studies are listed, being

- Customers should have access to their data, either locally or remotely;
- Data should be in an easily understandable format;
- Data should be accessible with no additional costs and in near real-time;
- Format performance is critical; the format must be flexible and scalable; and
- Both a human-readable and machine-readable format are necessary.

Potential benefits of a common European format for data and data exchange, international cooperation and international benchmarking and service interoperability include facilitating the development of energy market services.

Finally, recommendations for future development are:

- Data services should be specified in terms of functionalities rather than based on specific hardware and (smart) meter installations;
- European interoperability of data exchange is desirable, but should respect existing standards in place in the Member States;
- Data format and service specifications should come from the industry.

EURELECTRIC REPORT – THE POWER SECTOR GOES DIGITAL

A recent report by Eurelectric, “**The power sector goes digital – Next generation data management for energy consumers**” [6], describes evolving roles in a digital power system: consumers are empowered by information, suppliers become service providers and DSOs become active system managers.

The report expounds three main recommendations concerning data and data exchange:

- “There is no ‘one-size-fits-all’ model applicable to all European countries for smart meter data management. However, common principles must be set at the EU level: **neutrality, non-discrimination, transparency, cost-efficiency, high quality, security and privacy**”;
- “The same regulatory principles should apply to all personal data collected from consumers. **Transparency and data privacy for the customer would thus be guaranteed and a level playing field for market players** assured, even if such players come from other sectors”; and
- With regard to grid data: “Regulators should ensure that smart grid data exchange between system operators and market players is enhanced across all relevant timeframes (network planning, operational planning and scheduling, day-ahead, intraday, etc.). Mutual processes, data management models, data formats and communication protocols for data exchange should be agreed upon at the EU level when applicable and efficient. Where this is not possible, Member States should **strive for standardisation at the national level as a minimum**”.

2.1.5 Report on the wholesale-retail market integration: TSO-DSO data management

The report, “**TSO-DSO data management**”, prepared by CEDEC, EDSO, ENTSO-E, Eurelectric and Geode [6] provides principles, recommendations and use-cases of TSO-DSO data exchange, with the focus on grid operation, planning and balancing.

DATA MANAGEMENT PRINCIPLES AND OBJECTIVES

The data management principles and objectives formulated by the TSOs and DSOs are **privacy and security**, **transparency** towards regulatory authorities, **fair and equal access** in accordance with the tasks of each stakeholder, **non-discriminatory processing** of data, **simplicity** regarding new and existing processes, **support of competition**, **cost-efficiency**, **harmonised standards** and **facilitating innovation**.

RECOMMENDATIONS

From these objectives, a set of recommendations is derived, namely:

- Data exchange should support efficient market functioning;
- The focus should be placed on services rather than on platforms;
- Third-party access to data should be established;
- Party or parties responsible for data management must be neutral;
- Standardisation of TSO-DSO data exchange is a necessity;
- Flexibility should be encouraged according to market rules while singling out system risks;
- Harmful interferences between congestion management and balancing should be avoided; and
- Efficient data access for TSOs related to users connected to the distribution grid should be made certain.

USE-CASES OF DATA EXCHANGE

This report further supplies a set of use-cases that stress the value and the necessity of data exchange.

Congestion management: Requires exchange of data related to balance settlement, availability of flexibility and effects on neighbouring grid areas; and cooperation between system operators in congestion management, which necessitates structural, schedule and real-time data exchange.

Balancing: Information exchange between DSOs and TSOs in terms of available flexibility, activation and distribution grid constraints preventing activation of balancing resources.

Use of flexibility: Needs data exchange in all directions between DSOs, TSOs and third parties. This use-case also requires a clear definition of the changing roles and rights in data exchange and access for DSOs, TSOs and third parties.

Real-time control and supervision: Driven by decentralised generation, real-time operation is becoming more challenging, calling for data exchange via SCADA between TSOs and DSOs concerning real-time measurements, system state, actions to be performed and so on.

Network planning: Both TSOs and DSOs must have sufficient data for their grid planning, a portion of which may be in the domain of neighbouring grid regions. Accordingly, exchange of data concerning grid planning and expected demand and generation developments in the respective grid areas is elementary for effective grid planning.

These use-cases share communication of the grid configuration, available assets and sources of flexibility, and are expected to support grid operation, especially in critical situations. Data exchange also fosters better coordination of network planning between TSOs and DSOs.

2.1.6 Summary of regulatory developments and reports

Common points and focus of all texts are:

- Closer integration of wholesale and retail markets by allowing customers access to real-time prices and market signals;
- Recognise the right of customers and need for the system
- to offer distributed flexibility and acknowledge calls for close cooperation between DSOs and TSOs; and
- Create an environment in which new services can be offered to customers. These are mainly service related to distributed generation, demand response and information services.

2.2 Classification of data

There are many ways to classify and describe the different types of data from the electricity market. We have opted to use a simplified classification of the types of data as employed by Eurelectric

in their report, “**Joint-Retail DSO Data**” [7]. These forms of data are meter data, grid data and market data.

Meter data

Meter data is typically collected at customers’ premises. This data is collected, processed and submitted by the Metering Responsible Party (MRP), which for end-customers, is often but not necessarily the DSO. This data must be gathered for all consumers and producers, independent from the grid level via which they are connected, and separate from whether they trade energy in the retail or wholesale market. Meter data must also be accessible to market players with the regulatory obligation of using this data (billing, supply, imbalance settlement, etc.). Meter data should be available to customers themselves and it should be possible for customers to grant access to third parties to it that offer additional commercial services.

In the table below, an overview of the different types of meter data and their respective owners and relevant explanations is presented.

SPECIFIC	EXPLANATION	OWNER
Consumption data	Consumption measured at the metering point	Consumer
Production data	Production measured at the metering point	Producer
Customer address	Address and contact of the producer/consumer	Consumer/Producer
ID, Location	Unique ID, Location and other master data from the meter	MRP
Contract	Contract(s) associated with the metering point, both energy and grid usage	Customer, Supplier, DSO/TSO
Balance Group (BG)	The balance group to which the metering point belongs	Balancing responsible party (BRP)

Table 1: Meter data

Grid data

Grid data includes all information about the grid, its configuration and measurements, and can be either real-time, planned or historic. In the table below, we summarise different types of grid data.

SPECIFIC	EXPLANATION	OWNER
Real-time data	Measurements of voltages, active and reactive injections or flows, frequency, power quality and grid-configuration	TSO, DSO
Historic measurements	Historic grid measurements, such as voltage angle and magnitude, frequency and power flows	TSO, DSO
Planned grid configuration	Planned grid configuration for, e.g., the day ahead operation of grids	TSO, DSO
Planned maintenance	Planned maintenance, including the associated changes to grid configuration, and start and end dates	TSO, DSO
Known outages	Known outages affecting the grid configuration and/or the demand and generation	TSO, DSO
Planned grid expansions	Planned expansions of grids and assets, usually with a long time horizon	TSO, DSO

Table 2: Grid data

Market data

Market data refers to all types of exogenous data, such as market results, weather data or information on installations at customer premises necessary to offer services related to those assets.

In the table below, we list the different types of market data. This listing is necessarily not exhaustive, though provides an indication of data that could be useful for different market actors and consequently be part of a DEP.

SPECIFIC	EXPLANATION	OWNER
Weather data	Weather forecasts from one or more data suppliers	External
Spot-market data	Results of the spot market	External
Appliance data	Data including type of appliance [e.g., electric vehicle, heat pump], consumption profile and connection to metering point	Consumer
Generation data	Data, such as type of generation, rating, availability and generation-specific parameters [e.g., PV panel orientation]	Producer
Schedule data	Schedule of a BG	BRP
Unit-level production/ consumption plan	Production and consumption plan per significant grid user (SGU)/grid location	Producer/Consumer
Flexibility data	Data on location and type of flexibility source, results of tenders [e.g., does this unit currently provide flexibility? Which product? For which market player?]	Depends on regulatory model and market design

Table 3: Market data

2.3 Data requirements of different market actors

This section features a broad overview of the data requirements of the various stakeholders that derive from their responsibilities and rights. Data requirements in this context refer to the data the actors need to participate optimally in the market or fulfil their regulated responsibilities. The collection is based on the regulations and reports described in Section 2.1. The list is not meant to

be exhaustive, normative or detailed in its description, but rather is intended to highlight the data needs of stakeholders and facilitate the comparison of existing data exchange models and discussion of future development paths for data platforms in the subsequent chapters.

Data needs per actor

A detailed description of the data requirements is found in [Appendix 6.3](#). In Table 4, we summarise the data requirements per actor.

MARKET ACTOR	DATA CATEGORY	USE-CASE
Consumer/Producer	Meter data	Transparency, Choice of Supplier, Demand Response, Home Automation
	Weather data	Demand Response, Home Automation
	Market data	Demand Response, Home Automation
Supplier	Meter data	Billing, Offers, Analysis and Forecasts
	Market data	Billing ¹ , Offers ¹ , Analysis and Forecasts
BRP	Meter data	Settlement Verification
	Market data	Balance Group Correction
TSO	Meter data	Grid Planning, Grid Operation, Imbalance Settlement, Network Tariff Allocation
	Grid data	Grid Planning, Grid Operation, Network Tariff Determination
	Market data	Grid Operation, Balancing, Imbalance Settlement
DSO	Meter data	Grid Planning, Grid Operation, Network Tariff Allocation
	Grid data	Grid Planning, Grid Operation, Network Tariff Determination
	Market data	Flexibility Procurement, Grid Operation
Aggregator	Market data	Offering Flexibility
	Meter data	Settlement of Flexibility
ESCO	Meter data	Offering New Services, Settlement
	Market data	Offering New Services
NRA	Meter data	Monitoring and Transparency
	Grid data	Monitoring and Transparency
	Market data	Monitoring and Transparency

¹ If the contract is based on, e.g., spot-market prices

Table 4: Data requirements of various market actors

Meter data needs

Meter data is collected by the Metering Responsible Party (MRP) - which may be the DSO. It is needed by almost all stakeholders in the system for a large variety of uses.

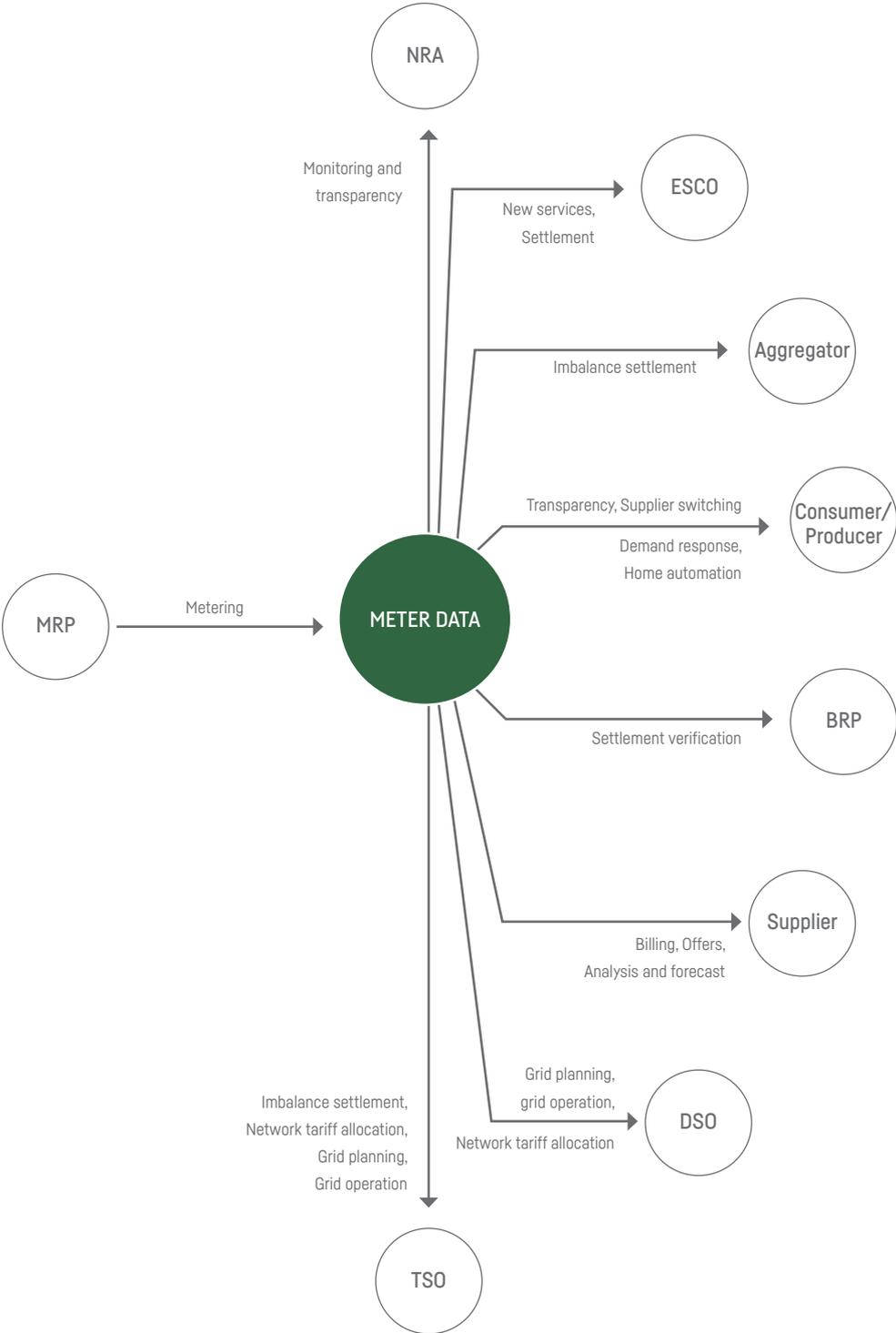


Figure 1: Meter data needs

Grid data needs

Grid data is provided mainly by system operators and utilised by either system operators and aggregators, consumers or producers. System operators exchange grid data for coordinating system operation and planning. The other stakeholders require grid data to use their flexibility in a grid-friendly manner. For example, if there is congestion within the distribution system, an aggregator or distributed generator could be informed about this congestion and adjust its production or consumption accordingly.

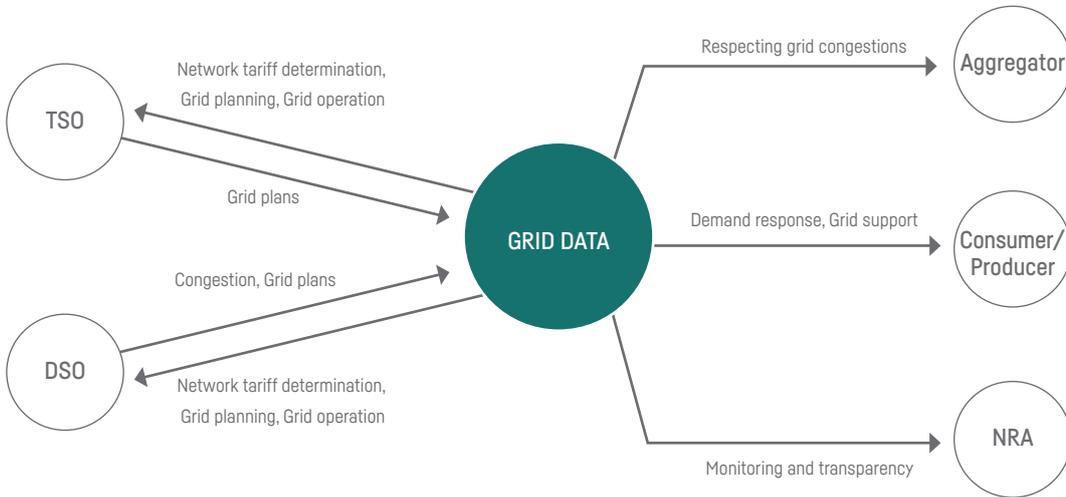


Figure 2: Grid data needs

Market data needs

Market data can be supplied by markets, external services, like weather services, aggregators who offer flexibility and provide data on locations and forms of resources or ESCOs who offer information services to stakeholders. Aggregators and ESCOs in turn use market data for their operations, as do a large number of other players for a variety of use-cases.

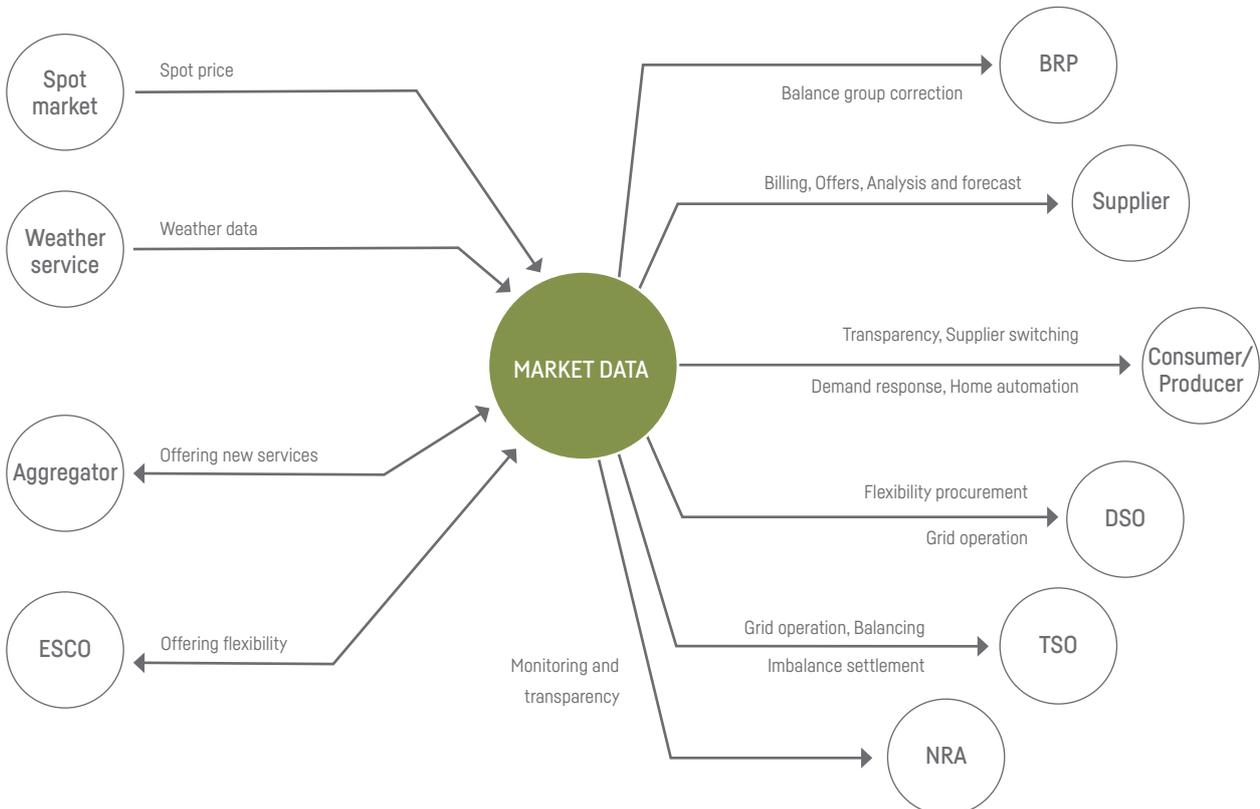


Figure 3: Market data needs

2.4 Processes and functionalities in data exchange

The previous sections describe the data needs and data requirements related to the responsibilities and rights of stakeholders of the power system. However, collection and access to data is only part of the equation – data exchange is equally defined by the processes and functionalities associated with the data. As an illustration, customer and contract data is associated with a certain metering point and becomes functional only if processes for handling this data are defined, e.g., initiating a supplier change or reading a meter value from the database. Definition of DEP specifications is beyond the scope of this report, and so we will therefore use the term functionalities to denote high-level business processes for its remainder. In the following is developed a list of typical functionalities required for power system data exchange. Note that none of these are necessarily featured within a DEP. They may also be implemented via another means, like, for example, through decentralised data exchange.

CUSTOMER FUNCTIONALITIES

The functionalities traditionally at the heart of DEPs relate to interactions between customers and suppliers. They are:

- Contract conclusion and cancellation;
- Change of supplier;
- Move of customer; and
- Billing.

SETTLEMENT FUNCTIONALITIES

For imbalance settlement, the functionalities that need to be executed include inter alia:

- Registration of balance group schedules;
- Imbalance settlement; and
- Computation of network-use charges.

TSO-DSO DATA EXCHANGE-RELATED FUNCTIONALITIES

Grid operation and grid planning can become more efficient with functionalities such as:

- Sharing of demand and production schedules;
- Sharing of demand and production capacities;
- Access to grid data;
- Access to flexibility data; and
- Forecast of demand and production.

NEW SERVICE-RELATED FUNCTIONALITIES

To offer services to customers, allow aggregators to act on behalf of customers or for NRAs to fulfil their responsibilities in power system oversight, functionalities like the following are needed:

- Access to own data by customers;
- Authorization of data access by owner of data;
- Registering a flexibility/generation/demand unit;
- Accounting of feed-in tariffs or certificates of origin;
- Information about grid constraints for aggregators; and
- Accessing market data.

For a number of these functionalities, there may not be a unique way to implement them. For example, forecasting of demand may be what stakeholders utilise the data from the data exchange for, it could be a process/functionality within the data exchange or it might be a service offered by an ESCO via a DEP possibly employing data from the data exchange.

In the next chapter, we analyse which functionalities today are found on DEPs, and this will define the state of play for DEPs. In the final chapter, an outlook on the possible developments for DEPs is found, featuring a discussion of which data exchange functionalities may be beneficially implemented in future DEPs.

3 CURRENT STATE OF DATA EXCHANGE MODELS

In this chapter, we supply a synopsis of the status of data exchange in European electricity markets. The overview is based on a survey carried out by ENTSO-E as well as previous work by THEMA on behalf of Nordic electricity regulators (NordREG), supplemented by updated information collected for this report. In addition, we provide a more detailed description of the data exchange models in Germany, Estonia, the Netherlands and Norway.

3.1 Current state of play

We distinguish between two different data exchange models, namely DEPs and decentralised data exchange.

With DEPs, we refer to a single platform that supports information exchange between electricity market actors. This central model implies that market actors have one point of access to the information needed to carry out different tasks as outlined in the previous chapter.

With a decentralised data exchange model, data are collected and distributed either directly from each individual customer to the various legitimate parties or via the DSO (or TSO in the case of customers connected directly to the transmission grid). This decentralised data exchange can be strictly standardised, bestowing an element of centralization upon the exchange protocol definition. However, the decentralised model implies in any case that all market actors communicate with each other, creating a large amount of interactions.



Figure 4: State of centralization of data exchange models in Europe

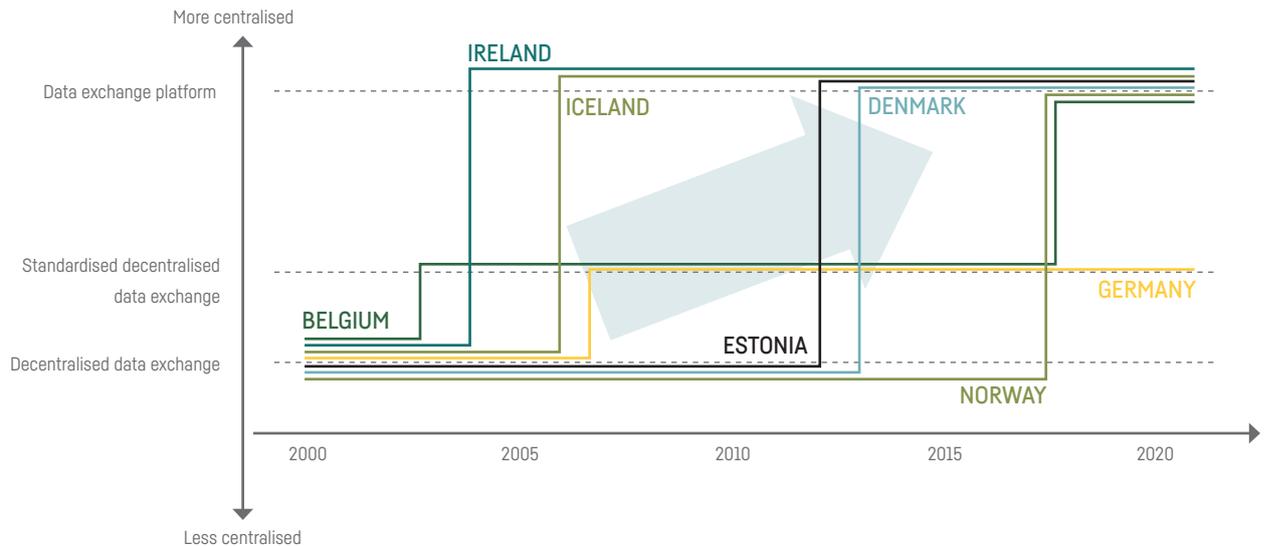


Figure 5: Timeline of data exchange model development across various EU countries

One can further distinguish between DEPs with central or distributed functionalities. For example, the Netherlands employs a communications platform with a distributed data storage system while Estonia has central data storage but permits decentralised development of applications to run on the DEP. The Norwegian and Danish DEPs are mainly centralised both regarding the platform and storage along with other functionalities.

The scope or set of metering points included with these platforms can vary, including retail and wholesale data depending on the country, as well as consumption and/or generation data. In most cases, retail market customers are the focus of the DEP. While smart meters are a driver of DEPs, they are not a necessary precondition.

Several countries are using decentralised data exchange, which sometimes is standardised to a large degree, such as in Austria, Germany or Portugal. Other countries have central data exchanges for portions of customers, like, for example, in Belgium for retail customers. Other countries make all meter data from production and demand at all levels centrally accessible, such as in Iceland and Denmark. Enedis, the largest DSO in France, is planning a central data access point with the introduction of Linky smart meters, but it is not clear yet if the other DSOs which operate the remaining five per cent of the distribution system will be participating in that platform. Hungary has a pilot project at early stages, and in Switzerland, an initiative by several DSOs has the goal of implementing a DEP, though so far without mandate by the regulator.

The map in Figure 4 also highlights countries where access to a customer's own data is a central design decision of the DEP. These countries are Denmark, Estonia, the UK, the Netherlands, as well as the new platforms in Norway, Sweden and Finland.

While the most common model for data exchange is that which is decentralised, there is a growing trend towards centralised solutions. With this, there are several cases of countries increasing the level of centralization in a step-wise fashion, e.g., Belgium, Spain and the Netherlands, but no case of a country reducing the level of centralization. Figure 5 outlines a rough timeline of DEP projects in particular countries along with the corresponding level of centralization of data access.

3.2 Comparison of central Data Exchange Platforms

This section compares several DEPs across Europe regarding ownership and regulation, types of data stored and data access and rights.

Table 5 features an overview of ownership and the time of implementation of the central DEPs. Ownership and operation is relevant as data exchange should be neutral and non-discriminatory. In several countries, the TSO is mandated to operate the DEP as a neutral party with respect to meter reading. In other countries, like Belgium and Ireland, the DEP is owned by the DSO(s) and operated by an independent subsidiary, this being motivated by the fact that traditionally, DSOs are responsible for metering retail customers. In Italy, the platform is directly owned by the state and independently operated.

Table 6 shows the data types accessible via the DEP. The focus on retail markets is evident – all platforms grant access to metering values and meter master data, as well as data on DSO-connected customers, which is always included. Load profiles are available where smart meters are deployed, and/or where large customers have quarterly hour metering, as in Ireland. Certain platforms also provide production data.

Table 7 summarises the findings on data access and rights along with services on the platforms. While most platforms handle both data from TSO- and DSO-connected customers, some, especially those owned by DSOs, focus on DSO customers and retail data. Wholesale data is frequently included, especially where imbalance settlement is a process included or supported by the DEP. In addition, customers increasingly have access to their own data, and can often authorise third-party access to receive quotes for contracts or other services. Market data is, so far, rarely included on platforms, but a recent trend has been to add an interface for external applications. This requires that customers can approve access to their data, thereby allowing a wide range of services and data to be offered to customers.

COUNTRY	IS THERE A DEP?	NAME OF DEP	OPERATIONAL SINCE	DEP OWNERSHIP	DEP OPERATOR
Belgium	Implementation	Atrias	2018	DSOs	Atrias
Denmark	Yes	DataHub	2013	TSO	TSO
Estonia	Yes	Estfeed	2012	TSO	TSO
Ireland	Yes	MRSO	2000	DSO	MRSO
Italy	Yes	SII	2016	State	Third party
The Netherlands	Yes	EDSN	2013, upgrade 2018	TSO and DSOs	Private company
Norway	Implementation	EIHub	2018	TSO	Subsidiary of TSO
Germany	No	[GPKE]	2011	[BNetzA]	[Stakeholders]

Table 5: Overview of selected DEPs; ownership and regulation

COUNTRY	WHICH DEMAND POINTS ARE INCLUDED?	NUMBER OF CONNECTION POINTS INCLUDED	METER AND MASTER DATA IS ACCESSIBLE?	LOAD PROFILES ARE AVAILABLE?	SMART METER ROLLOUT [14]	PRODUCTION DATA IS HANDLED?
Belgium	DSO data	n/a	Yes	Yes	No	Yes
Denmark	All	3.3 million	Yes	Yes	2016: >50% 2020: 100%	Yes
Estonia	All	750,000	Yes	Yes	~100%	Yes
Ireland	All	1.6 million	Yes	15 min for >100kVA	Start in 2017 2021: 87%	Yes, >5MW in DSO grid
Italy	All	37 million	Yes	1h for >55kW	2011: 95% 2016: 2 nd gen.	No
The Netherlands	Mainly DSO data	15.7 million (incl. gas)	Yes	Yes	2016: ~50% 2020: >80%	Yes
Norway	All	2.97 million	Yes	from 2019	Start in 2015 2020: 100%	Yes
Germany	All	42 million	Yes	Yes	Some	Yes

Table 6: Overview of selected DEPs; scope and meter data

COUNTRY	DEP HANDLES RETAIL OR WHOLESALE DATA	CUSTOMERS CAN ACCESS OWN DATA	CUSTOMERS CAN AUTHORISE DATA ACCESS	DEP CONTAINS MARKET DATA	DEP ALLOWS APPS OR ESCOs ON THE PLATFORM
Belgium	Retail	Planned	Planned	planned: flexibility	No
Denmark	Both	Yes	Yes	No	Yes
Estonia	Both	Yes	Yes	Yes	Yes
Ireland	Both, mainly retail	>100kVA	with written consent	No	No
Italy	Both	No	Indirectly via supplier	No	No
The Netherlands	Retail	No (planned)	No (planned)	No	No, external
Norway	Both	Yes	yes	No	No
Germany	Both	No	No	No	No

Table 7: Overview of selected DEPs; data access and rights

3.3 Details on selected data exchange models

In this section, we compare four data exchange models already implemented or close to completion in more detail. The chosen case studies are Germany, The Netherlands, Norway and Estonia. These cases all have standardised processes, but represent a wide range of different models for data exchange. Germany has a standardised, fully decentralised data exchange. The Netherlands has a central access point, which is an interface to decentrally

stored data. Norway is currently deploying a DEP operated by a TSO. Estonia's DEP is similar to Norway's, but is the most advanced in terms of data included and ability to offer external functionalities in the form of third-party applications. Both Norway and Estonia also feature the data of transmission system-connected customers.

3.3.1 Dimensions of comparison in the case studies

The detailed case studies are located in [Appendix 6.4](#). Therein, the four countries are analysed according to the following criteria.

BACKGROUND AND ORGANISATION

- What were the aims of and the reasoning for the introduction of a DEP?;
- Who owns and who operates the DEP?;
- To what extent is the DEP centralised?; and
- How is the platform organised?

TYPES OF DATA

- Scope: Does the data exchange cover residential customers, commercial customers or all customers? Is generation also addressed?;
- Data types: Description of the data available on the DEP; and
- What functionalities are offered by the DEP?

GERMANY

Germany operates a standardised, decentralised data exchange. This implies that all suppliers need to exchange data with potentially all DSOs, creating a large number of interfaces. The main driver for standardising the data exchange was insufficient data quality, and hence market barriers for new suppliers.

All data related to the retail market, metering services and imbalance settlement is exchanged via standardised exchange schemes. Therefore, both data of DSO- and TSO-connected customers is handled. Functionalities are all those needed for the aforementioned scope.

DATA ACCESS AND RIGHTS

- What are the rights of customers with respect to their own meter values?;
- Do third parties, such as suppliers or ESCOs, have access to metering values or can customers grant access to their data?; and
- What are the obligations and rights of other stakeholders regarding the data handled on the platform?

OUTLOOK

- What are the development possibilities and options currently being discussed?

Brief summaries of the case studies are found subsequently.

While the data exchange comprehensively covers both retail and wholesale market processes, it does not offer data access to end-consumers, and does not enable end-consumers the ability to grant access to their data.

To the best of our knowledge, there are no plans to extend the scope of the data exchange or to switch to a DEP.

NETHERLANDS

The DEP in the Netherlands is a central DEP primarily for data from retail processes. The introduction of the original central interface for data was inspired by the administrative challenges surrounding retail market liberalisation.

As the focus was and is clearly on retail market processes, the Dutch DEP does not handle data from transmission system-connected consumers. It does, however handle, data from distributed generation. Supported functionalities are retail market functionalities, such as exchange of metering values, switching of suppliers and preparation of the grid and energy bills.

Customers have no direct access to data on the DEP. Access to their own data with smart Meters is through external service providers.

The platform is continuously developing into a more centralised data agency with increased functionalities.

NORWAY

The Norwegian Elhub is a DEP with a central storage of data focusing on retail market processes and imbalance settlement. It was introduced mainly because of insufficient data quality and inefficiencies in retail market processes in a market with a large number of DSOs, where smart meter rollout was an additional driver. It is currently being built and will be operated by the TSO, Statnett.

Both DSO- and TSO-connected metering data is stored in the DEP. In addition to the typical retail market functionalities, the DEP will also provide imbalance settlement and reconciliation functionalities, handling of certificates of origin and quota obliged consumption as well as benchmarking of data quality and statistics reporting.

End-users will be able, via a graphical interface on supplier home pages, to verify their own data, approve access and download data stored in Elhub.

Future developments will most likely move the DEP towards harmonisation with their Nordic neighbours, specifically towards inclusion of market data and towards a supplier-centric model where the supplier is the only contact person for the customer.

ESTONIA

The Estonian Estfeed is, like the Norwegian equivalent, a DEP operated by the TSO. The main driver was the aim of enhancing efficiency for all stakeholders and enabling neutral access to metering data.

Both consumption and production data from customers within the distribution and transmission system is stored on Estfeed. It also features market data, such as weather data and spot-market data. The functionalities are quite comprehensive - in addition to retail market and imbalance settlement functionalities, Estfeed provides guarantees of origin, calculation of renewable energy sources (RES) subsidies and generation mix, joint invoicing, a comparison tool and, in general, a single point of access. Additionally, Estfeed allows external applications to use the data wherever necessary provided that customers agree to it.

Customers are a principal focus of Estfeed, thus they can not only access their own data, but also have wide-ranging options to grant access to third parties or define a representative on their behalf.

The future development of Estfeed may include further extension of the scope of data and addition of cross-sectoral or cross-border data exchange.

DATA TYPE	DE	NL	NO	EE
Consumption	o	o	+	+
Production	o	o	+	+
Data of TSO connected consumers	o	-	+	+
Meter master data (ID, location, customer contact, contracts associated)	o	+	+	+
Data access authorisation	-	+	+	+
Representative	-	-	-	+
Weather data	o	o	-	+
Spot price data	-	o	-	+

- + data is stored on the platform
- o data can be exchanged via the platform
- data is not available on the platform

Table 8: Case studies – data stored or exchanged

3.3.2 Comparison of the case studies

We grouped much of the findings into the following tables. First, we compared the type of data on the platforms (see table 8). We distinguished between data stored on the platform, marked by a '+', data that can be exchanged on the platform, denoted by a 'o', and data that is not available on the platform, indicated by '-'. All four platforms handle metering values and meter master data. The Netherlands operates a communication platform, where metering values are stored decentrally. As such, it lies between the decentralised data exchange in Germany and the centralised solutions of Estonia and Norway. Estonia and Norway include data from transmission system-connected consumers, which is also

exchanged through the decentralised scheme in Germany. For the other types of data, the scopes of the platforms varied and no platform covered all types.

Functionalities provided by the platforms are summarised in table 9. Again, retail market processes are supported by all platforms. Differences may be noted concerning access of customers to their own data, where the fully central DEPs have the best functionalities, and if the platform can be used to request quotes for new contracts based on historic consumption profiles.

FUNCTIONALITY	DE	NL	NO	EE
Data access for customer	-	o ^b	+	+
(Base for) energy usage bill	+	+	+	+
(Base for) grid usage bill	+	+	+	+
Supplier switching	+	+	+	+
Imbalance settlement data exchange	+	+	+	+
Requesting contract offers	o ^a	o ^b	-	+
Weather data	o	o	-	+
Spot price data	-	o	-	+

+ functionality is offered by the platform;

o functionality is partly or externally implemented ;

- functionality is not supported

a Only metering services

b Can be added by external applications such as the HelloData interface

Table 9: Case studies – functionalities

3.4 Observations on the state of play

Based on the overview and case studies in this chapter, we made the following observations pertaining to the state of play with regards to data exchange:

Efficiency of processes, removal of market barriers and empowerment of customers are the main drivers of central data exchange. The centralised platforms in existence have primarily been developed to meet the needs of the actors in the retail market with regards to meter data and the requirement to efficiently handle business processes. One main element found across all case studies was enabling competition and reducing market barriers for new suppliers. Several countries also emphasised customers, granting them better access to and control over their own data.

Data quality varied and generally improved with the introduction of DEPs. In all case studies where we analysed the quality of data, provision in decentralised schemes varied widely between different companies in a country. While a number of companies provided data with outstanding quality, others did not. The introduction of DEPs or strict standards forced all companies to adhere to at least a minimum standard in data quality, and thus improved (or was expected to improve) the availability and quality of data significantly.

So far, the focus is on retail data and processes. Increasingly, DEPs are including data from wholesale markets and TSO-connected customers. Other types of data, such as weather data or spot-market data, are included only to a small degree and in some countries. Grid data is not included on any DEP we analysed.

Increasingly, the need for customers to access their own data and to grant access is recognised. This permits customers to understand their own demand, reduce energy consumption and request quotes from suppliers, while elevating transparency and

control over sensitive data. ESCOs and aggregators can offer innovative services to customers, ranging from information services to demand response.

Decentralised, standardised data exchange allows for a functioning market, but encounters challenges regarding customer participation and new services. A decentralised solution based on standardised information exchange may meet many needs of DSOs, suppliers and BRPs in the retail market. It is, however, not apparent in such a framework how customers' access to their own data can be achieved in an efficient manner. It is also unclear how the model can be developed further to meet the needs of other stakeholders, such as TSOs, aggregators and ESCOs. Decentralised data exchange requires an all-inclusive set of standards and regulatory enforcement to work, and does not supply a single access point for information. Hence, it creates many interfaces and necessitates many communication connections between parties, especially in large control areas with a large variety of involved DSOs and suppliers

There is an obvious trend towards centralised DEPs. Centralised DEPs are becoming more widespread over time, and the process seems to be irreversible in the sense that no country is moving from a centralised to a decentralised solution once a degree of centralisation has been introduced. This demonstrates that there are significant economies of scale in DEPs and benefits for suppliers and customers regarding data access that are important for service quality, transparency and development of new services.

Governance of such DEPs implies TSOs, DSOs and third parties. The main feature of the party(ies) responsible for a DEP should be full neutrality. The party or parties responsible for data management should make certain there is full neutrality to avoid any discrimination with respect to data access and delivery.

3.5 Key findings

We found that the current state of play regarding DEPs has three main objectives:

EFFICIENCY

Market efficiency is improved in several ways. DEPs:

- are used to improve data quality and guarantee neutral access to data;
- safeguard transparency with respect to processes, access rights and responsibilities; and
- reduce the number of interfaces and assist leveraging economies of scale.

REMOVAL OF MARKET BARRIERS

Market-entry barriers for new suppliers and ESCOs are diminished by:

- allowing easier supplier switching, hence enhancing market functioning;
- decreasing costs for market participation by having a single point of access to data; and
- setting clear rules for data availability, bolstering the development of new services based on data.

EMPOWERING THE CUSTOMERS

Customers are being empowered to participate in markets by:

- giving them access to their own data; and
- allowing them to grant access to third parties, raising the value of smart meters and helping them make better informed choices on supply contracts.

The operation of the platforms is usually either by the TSO or through a group of DSOs, and in certain cases, also with an independent third party. The main criterion in all cases is neutrality of the operator.

A trend from decentralised data exchange to central platforms was clearly identified. The scope of data also increases, with more and more platforms including data from TSO-connected consumers from production and markets.

4 OUTLINE OF MODEL ELEMENTS OF DATA EXCHANGE PLATFORMS

In the previous chapters, we mapped out the state of play with regards to DEPs and the data requirements of different actors. Here, we discuss the possible elements that can form part of a DEP and a suitable process for development.

4.1 Criteria for using a Data Exchange Platform

In this section, we address which types of data should be handled by a DEP and in which situations DEPs are beneficial.

Lower market barriers and DEPs as neutral institutions

Efficient access to data reduces market-entry barriers for new actors, and transparent exchange models can limit market power of owners or collectors of data. DEPs can support competition in liberalised markets, and hence ultimately lead to reduced costs for consumers.

As data exchange becomes more and more relevant to business operations of various stakeholders, and as the value associated with data rises, it may become relevant to have a neutral institution that oversees data exchange processes. In the case of

disputes concerning data quality, because of delivery of data or access to it, a neutrally owned and operated platform can serve as an independent third party.

In general, A DEP permits there to be a single gateway for all data access, and could foster new services through an easier and wider access to data. Indeed, such open-data services can enable further utility and analysis of data, and promote innovation of new services.

Data-exchange topologies necessitating central data exchange

A DEP does not bestow the same benefits upon all types of data and data exchange. Generally, we see a DEP to be well suited if:

- the same type of data is exchanged between many actors;
- a group of actors of one type interacts with a group of actors of a different kind, e.g., several MRPs to several BRPs;
- One type of actor requires data from a group of actors of a different type, e.g., TSO requests grid data from several DSOs or grid customers;
- Data quality is important, e.g., metering data; and

- Processes which are executed frequently can be automated, e.g., invoicing and supplier switching.

A DEP may or may not be beneficial if:

- one type of actor supplies a group of actors with data, e.g., spot-market prices which can alternatively be published on a webpage.

A DEP may not be necessary or the tool of choice if:

- One type of data is shared between just two actors.

Trust of stakeholders in the DEP

To be accepted by stakeholders, a DEP must be trustworthy. Neutrality and non-discrimination are preconditions for this. This trust extends to:

- Data quality: Stakeholders must trust that the data on the platform is of good quality, and that the DEP can enforce timely and correct provision of data from the responsible

parties;

- Data access: The access must be transparent, non-discriminatory and efficient; and
- Governance: The DEP must be governed in such a way that all requirements concerning data quality, data access and neutrality are fulfilled, and that actions can be taken if a party violates these criteria.

Interoperability

The current generation of DEPs was designed with a national focus. Interoperability between the DEPs across Europe was not a requirement. To achieve an integrated pan-European market, and to reduce market-entry barriers for suppliers, aggregators and ESCOs from other countries, future DEPs should integrate

interoperability both regarding data formats and data as well as functionalities supported by the DEPs. This would significantly diminish the cost of entering a new market - business processes could be translated from one market to the next.

4.2 Benefits of centralised Data Exchange Platforms

We considered that the interface between the retail and wholesale market is a particularly interesting area for the role of DEPs. The spot markets for electricity act as a reference for the value of energy at a certain point in time. However, most retail customers pay tariffs that hide these price signals from them. While it is not expected that end-customers directly participate in wholesale markets soon, it is understood that a closer connection between the retail markets and wholesale markets is beneficial to harvesting the flexibility potential on the demand side.

We saw three vectors with respect to how better retail-wholesale integration can be achieved: 1) real-time or spot-based retail contracts; 2) participation of aggregation of small loads and distrib-

uted generation in the wholesale energy market; and 3) participation of such aggregations in flexibility products. All vectors require efficient exchange of data between several stakeholders, hence DEPs can be a tool to support enhanced integration between retail and wholesale markets. A detailed discussion can be found in the Appendix.

Effectively, a DEP can connect data sources with appliances and services, and this creates value. The additional value is realised via a closer integration with the wholesale market that allows operating in a more cost-effective manner and harvesting the potential of flexibility that was previously untapped based on a lack of information.



4.3 Possible future development

Scope in data

It is hard to foresee all possible use-cases of a DEP and data needs that may arise in the future. Instead of defining all data and processes before implementation, an open, extendable DEP architecture should be opted for. Further, there is no one-size-fits-all model that can be translated to all countries. The starting point for any development should be collection of meter data and related services. From this, a DEP can be developed in different directions, depending on the needs of the market players. We foresee four rough dimensions in which DEPs might develop: wholesale functionalities, energy services, wholesale-retail integration and grid functionalities. These dimensions are largely independent of one another and can be added in any order. Figure 6 portrays how these dimensions are related to the data types defined in Section 2.2.

Meter data: Meter data and retail processes clearly fall into the first topological category of multiple sources to multiple users, and data access limitations or costs represent a significant market-entry barrier to the retail market. Consistently, retail markets are the main concern of existing DEPs, and the great benefits from DEPs can be observed in practice.

Schedule data and imbalance settlement: If market players submit their schedules, the DEP can be the central repository for all data concerning imbalance settlements – both between the TSO and BRPs, and within BRPs that may consist of several suppliers. This would affect the processes of the TSOs, BRPs and suppliers.

Congestion data and grid data: DEPs can be a central point to inform suppliers, generators and aggregators about grid congestions and the impact they may have on their ability to participate in energy or reserve markets. Such locational data may be essential to using distributed flexibility, and would fit the type of data that benefits from a DEP. Storing grid data on a DEP would allow TSOs and DSOs to coordinate their grid maintenance and upgrades or day-ahead planning – this may also be accomplished through bilateral data exchange as is the standard today. Finally, grid measurements can be used to compute and allocate grid tariffs.

Market data: Adding market data, such as weather forecasts and spot-market prices, may facilitate demand response and production flexibility, and may also permit advanced energy services. This dimension may affect all players, but is mainly of interest to suppliers, ESCOs and end-customers. Estfeed highlights this use-case.

Geographical scope: It is additionally important to define the geographical scope of data covered by future DEPs. Having a single European access point or harmonised (minimum) standards concerning interfaces, data and processes across different DEPs would significantly reduce market-entry barriers for suppliers or service providers going from one country to another. A definition of a European best practice could lead to convergence towards a harmonised model. We see as a minimum requirement that standards are harmonised per control area or country.

Transparency for customers: Based on meter data, the DEP can be developed into a transparency platform offering analysis and information to end-customers. An example where this is already a reality presently is the Estfeed DEP.

Real-time data: There is considerable exchange of data with strict real-time requirements, mainly between TSOs and DSOs. DEPs are not the tool of choice – they are not designed for real-time communication, and also use protocols different from those of the established SCADA data exchange. The same is also true for sending control signals via DEPs – on Elhub, this is even forbidden by the regulator.

Data on several platforms: It would also be possible that there are different datasets stored on different platforms operated by different entities. This might be beneficial with respect to neutrality in certain situations, and may increase trust in data security with certain stakeholders. However, in this case, interoperability between the different DEPs would be essential.

Scope in functionality

The scope is also defined by the functionalities offered through a DEP. Following the data scope and the reasoning for DEP criteria and relating to the exchange needs defined in Section 2.4, we have found:

- **Customer functionalities:** These are largely covered by current DEPs;
- **Settlement functionalities:** Certain platforms include these functionalities, e.g., Estfeed and Elhub. These can offer added value to the already existing meter data, and this requires that TSO-connected customers are also included in the data scope;

- **TSO-DSO data exchange functionalities:** This will likely continue to be in the form of bilateral data exchange; and
- **New service-related functionalities:** This is a broad category covering mainly different functionalities. Promising are functionalities related to customer information, and functionalities connected to provision of flexibility. With this, communication of grid congestions and a register for flexibility resources are critical.

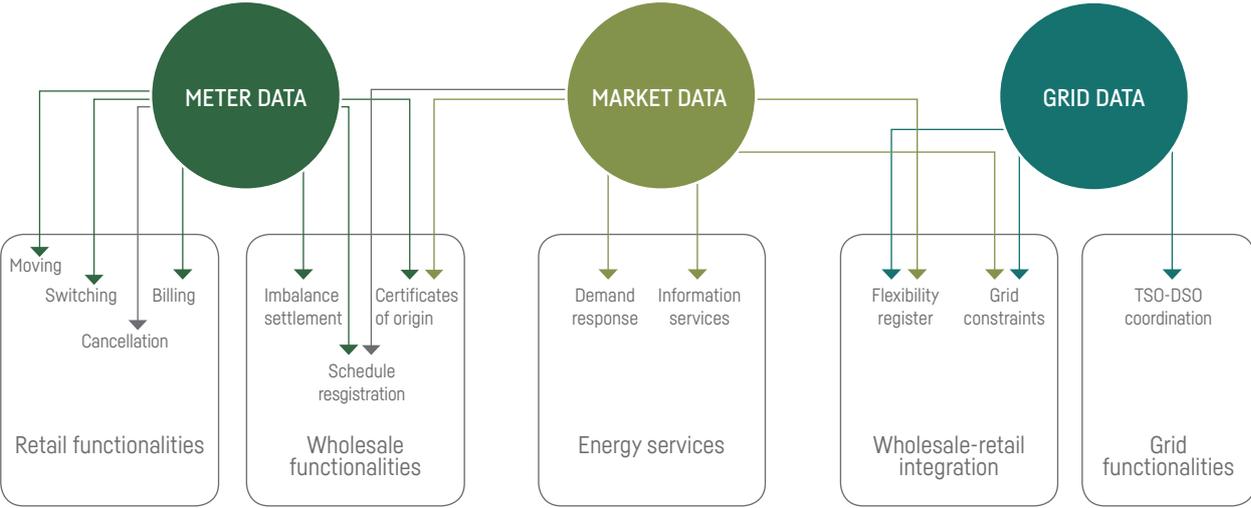


Figure 6: Data types and related functionalities

5 CONCLUSION

This report discusses data exchange in power systems, the current state of play with regards to DEPs and possible future developments of data exchange.

Drivers for change in data exchange needs

With the energy transition and continuing liberalisation of energy markets, the need for data exchange increases significantly.

- To achieve a better integration of retail and wholesale markets, customers must have access to spot market prices and be empowered to participate in wholesale markets directly or via aggregators
- To enable distributed demand and generation to offer flexibility – crucial for economic operation of future power systems – data must be exchanged between these flexibility sources, TSOs, DSOs and markets
- To reduce market barriers and increase efficiency in markets, access to data must be non-discriminatory and efficient
- To foster innovation and support ESCOs in their provision of new services, neutral, transparent access to data is paramount

These drivers have been recognised by the European Commission and are consistently represented in the Clean Energy Package. Many recent reports address these topics, and grid codes are currently being adjusted in the light of these requirements. Meanwhile, this report sought to **provide a state of play** of the current data exchange and exchange platforms to elicit substantiated discussion on the future of data exchange in power systems.

State of play

Main drivers for the introduction of DEPs were:

- the decrease of market-entry barriers;
- elevating the efficiency of retail processes; and
- improving the quality and availability of data.

We found that:

- there is a persistent trend towards more centralised data platforms;
- DEPs have been fundamental to increasing efficiency, neutral data access and customer rights; and
- Data exchange schemes with varying architecture and scope are available. However, they share common criteria, such as non-discrimination, neutrality, privacy, data security and efficiency.

Possible future developments

There are many areas in which DEPs may develop, such as inclusion of grid data, inclusion of market data or promoting the use of flexibility sources.

- The scope of data platforms is currently focussed on retail market data and functionalities. However, the most recent platforms include wholesale data and market data that includes weather forecasts and spot prices
- It may be beneficial to extend the focus to all data related to flexibility provision, performance control and settlement. This includes data on available flexibility sources, baselining and grid congestions that prevent flexibility provision
- Other data, such as grid planning data, may also be included on an exchange platform. This can be the same platform as the meter data or an independent platform

We do not foresee a one-size-fits-all solution. Rather, we envisage there to be a number of **criteria and requirements** pertaining to data exchange. These are:

- Full neutrality, which is required to lower market barriers;
- The data exchange must be trusted by all users to reach acceptance. This is related to data quality, data access and governance of the DEP; and
- Interoperability between national solutions is to be conceived early on as to further integrate the pan-European power market. Harmonisation at a national level is a minimum requirement.

Furthermore, a central data exchange (at the national level):

- is beneficial and will improve market efficiency if several parties need access to the same type of data;
- can support the goal of further integration of wholesale and retail markets and support small customers participating in wholesale and balancing markets; and
- allows improvement in the processes related to storing data, providing an access regime and delivering data to the mandated parties.



6 APPENDIX

6.1 Relevant Articles of the Draft European Directive and Regulation

Below are the relevant statements from the preamble and relevant articles of the draft of the European Directive of the European Parliament and of the Council on Common Rules for the Internal Market in Electricity in the version from 30 November 2016 [1].

Preamble

- [7] Consumers should participate in flexibility services
- [26] All customers should have access to flexibility markets, aggregators should be allowed to act as intermediaries
- [36] Smart meters should be interoperable, allow for supplier switching and for demand adjustment
- [37] Data transparency should allow customers to obtain supply offers
- [38] Data is accessible under non-discriminatory rules
- [42] DSOs should be allowed to use services from distributed energy sources such as demand, storage or distributed generation, in a market based manner, to reduce network expansion cost

Consumer and supplier-related provisions

Article 4: Free choice of electricity supplier – Customers are free to choose their electricity supplier.

Article 10: Basic contractual rights – Customers have the right to a contract that is well specified, and to receive transparent information on applicable prices and tariffs and on standard terms.

Article 11: Entitlement to a dynamic price contract – Customers have the right to a dynamic electricity price contract.

Article 12: Right to switch suppliers and rules on switching-related fees – Customers have the right to switch suppliers in a non-discriminatory manner regarding cost, effort or time.

Article 13: Contract with an aggregator – Customers have the right to conclude a contract with an aggregator, independent of the suppliers' consent.

Article 14: Comparison tools – Customers shall have access to at least one tool to compare offers of suppliers.

Article 17: Demand response – Prescribes that final customers have the right to “participate [...] in a non-discriminatory manner in all organised markets”. It also defines the rights of aggregators and precludes compensation payments from aggregators to suppliers, except for compensation payments related to balancing [17.4].

Article 18: Billing and billing information – Customers have the right to receive clear and transparent bills.

Article 20: Smart metering functionalities – Customers shall have access – where cost-benefit is positively assessed – in near real-time to their own demand measurements, in order to facilitate energy efficiency, demand response or other services.

Article 23: Data management – Data exchange with respect to consumption and supplier switching shall be organised in an efficient, non-discriminatory and simultaneous manner. Defines the right of suppliers, TSOs, DSOs and ESCOs to access consumption and production data with the consent of the customer, and how costs and access are to be regulated.

DSO-related provisions

Article 31: Tasks of DSOs – DSOs shall ensure their long-term ability to meet demand and operate the grid in a secure, reliable and efficient manner.

Article 32: Tasks of DSOs in the use of flexibility – 1. DSOs should “procure services ... including local congestion management ... from resources such as distributed generation, demand response or storage”. DSOs are required to coordinate with TSOs regarding flexibility resource utilisation. 2. DSOs shall provide a transparent network development plan.

TSO-related provisions

Article 40: Tasks of TSOs – TSOs shall ensure long-term ability to meet demand in close operation with neighbouring TSOs and connected DSOs, manage energy flows, provide connected operators of any other system with sufficient information and procure ancillary services in a non-discriminatory manner.

NRA-related provisions

Article 59: Duties and powers of the NRAs – NRAs have the power to monitor, benchmark and/or approve of quality of service,

Article 24: Data format – Member States shall define a common European data format and non-discriminatory and transparent procedures for accessing the data, listed under paragraph 1 of Article 23. Customers shall not be charged for access to their data.

Article 34: Tasks of DSOs in data management – DSOs shall “ensure that all eligible parties have non-discriminatory access to data”. Specifically, vertically integrated utilities shall not have privileged access to data.

Article 37: Confidentiality obligation of DSOs – DSOs must not disclose sensitive data obtained through their business processes or about their own activities in a discriminatory manner.

Article 41: Confidentiality obligation of TSOs – TSOs must not disclose sensitive data obtained through their business processes or about their own activities in a discriminatory manner.

market efficiency, grid tariffs and grid investment plans. They shall provide information on the formulation of grid tariffs.

Draft regulation on the internal market for electricity

Below are the relevant Articles of the Draft of the Regulation of the European Parliament and of the Council on the Internal Market for Electricity in the version from 30 November 2016 [2].

Article 16: Charges for access to networks – Where smart metering systems are installed, grid tariffs may be time-dependent, reflecting the use of the network, in a transparent manner.

Article 51: Tasks of the EU DSO entity – The to-be-established EU DSO shall coordinate with ENTSO-E on operation and planning of

transmission and distribution grids, and cooperate in monitoring implementation of network codes.

Article 53: Cooperation between DSOs and TSOs – DSOs are required to cooperate with TSOs concerning planning and operation of their networks, including exchange of all necessary data. In addition, TSOs and DSOs must work together in coordinating access to flexibility sources within the distribution grid if these sources are relevant to both.

6.2 Network Codes

6.2.1 Electricity balancing guidelines

Article 15: Cooperation with DSOs – DSOs and TSOs shall cooperate, and DSOs shall provide information necessary to the settlement process and limits on activation. Costs shall be allocated fairly.

Article 18: Terms and conditions related to balancing – There is an allowance for aggregated demand, distributed generation and storage to participate in balancing.

Articles 19–22: European platform for the exchange of balancing energy/imbalance settlement – European platform for the exchange of balancing energy from replacement reserves [19], frequency restoration reserves with manual [20] or automatic [21] activation and imbalance-netting process [22].

6.2.2 System operation guidelines

Articles 23, 24 and 33: Requirements for coordination of remedial actions by the TSO

Article 40: Requirements and provisions for data exchange, data quality and responsibilities

Articles 43 and 44: Data exchange between TSO and connected DSOs with regards to structural data [43] and real-time data [44]

Articles 48, 49 and 50: Data exchange between TSOs, DSOs and distribution-connected power generating modules with respect to structural data [48], scheduled data [49] and real-time data [50]

Article 51: Rights of TSOs and DSOs to access the data of significant grid users (SGUs) within the DSO grid, and the right of TSOs to receive additional information on power generation modules

Article 53: Requirements of data provision from demand response units to the TSO

Articles 64–71: Requirements for year-ahead grid planning

Articles 72–74: Requirements for operational security analysis, including interactions with DSOs and SGUs

Article 182: Data exchange requirements for prequalification of distribution system-connected flexibility sources, including pools of small units. Right of DSOs to temporarily restrict call of active power based on technical limits

The grid configuration in both vertically and horizontally neighbouring grid areas affects the power flows and thus operation of any grid. Therefore, the concept of observability area is introduced in the system operation guidelines.

6.3 Data requirements by stakeholder

Consumer/Producer

Data requirements for customers are related to their rights concerning the ownership of their data, free choice of supplier and participation in energy markets.

Access to own metering data – Many customers do not have a clear picture of their own electricity consumption, even if a smart meter is collecting their data on an hourly basis. Access to this data can assist customers in understanding their electricity needs better, help them choose appropriate contracts and enable them to identify energy efficiency potentials.

Control over own data – Metering values are the private data of customers. Suppliers and DSOs have a natural right to access this data as part of their contractual or regulated responsibilities. Beyond that, customers should be in control of what entities have access to their metering values, and they should be able to grant third parties access to the data if they opt to. Granting access allows ESCOs to offer services and suppliers to offer supply contracts based on customer-demand profiles. This becomes especially relevant if contracts are based on time-of-use tariffs or complex regulations apply, such as those for large customers.

Switching suppliers – In the liberalised market, customers can freely select their supplier. For this process, data needs, such as current meter reading or contract start and end dates, must be exchanged between the customer, DSO, old supplier and new supplier, as well as the affected balance groups.

Demand response – To participate in demand response (in the sense of price sensitivity), customers need to understand their own consumption profile and determine if there is flexibility along with gaining access to price signals, such as spot prices.

Home automation – Home automation can result in significant energy savings, but may also permit customers to participate in demand response or aggregation. Access to data, including weather data and dynamic prices, combined with historic consumption data could allow customers to predict and shift their heating or cooling demand, forecast their production from renewable sources and plan optimal operation strategies for local storage solutions.

Supplier

Suppliers require meter data for handling billing and purchase of energy as well as various data for forecasting and analysis.

Analysis/forecasts – To purchase the correct amounts of energy on the wholesale markets, suppliers must understand the demand structure and potentially the structure of generation within their portfolio to forecast as accurately as possible. This requires meter data, though market data, such as appliances and distributed generation facilities on customer premises, may play an important part, as well. Reducing costs by improving forecasting is one main option for suppliers to enhance their efficiency, and ultimately offer better deals to customers.

Billing – Billing is one of the central tasks of a supplier. For the billing process, meter data of a high quality is vital. Additional market data, such as spot prices, may be required depending on the contract.

Offers – If suppliers are granted access to meter data by a customer that they do not yet have a contractual connection with, they can make detailed offers with cost estimates. For more complex contracts, additional market data, like appliance data, may be of interest.

Balancing responsible party (BRP)

BRPs need to provide a schedule for their balance group and to verify the imbalance settlement by the TSO.

Submit schedule – BRPs must gather the production and consumption programmes for all consumers and producers in the BG, either directly or from their suppliers, and submit this schedule to the responsible TSO. In addition, bilateral agreements on physical delivery must be communicated to the TSO.

Verify settlement – After the imbalance settlement, BRPs should verify the settlement using metering data and potentially split the payments between all suppliers, producers and consumers in the BG.

BG correction – In order to account for imbalances added to the schedule by the provision of ancillary services, reserve providers and aggregators have to share the activation pattern a posteriori with the BRP.

Transmission system operator (TSO)

Access to data is either essential or beneficial to the efficient fulfilment of all TSO responsibilities.

Imbalance settlement – Settlement of imbalances in the balance group model is a responsibility usually of the TSO. For this, the TSO has to collect the schedule of a BG from the BRP a priori and the meter data a posteriori.

Balancing – Keeping up the production and consumption of electric energy is one of the main responsibilities of TSOs, and the procurement of reserves is a significantly costly item. To facilitate market-based, efficient procurement, TSOs need knowledge of and access to as many sources of flexibility as possible, including the rising share of generation and flexible demand within distribution grids. For flexibility sources in the distribution grid, TSOs must be informed by DSOs of temporary grid congestions rendering certain sources unavailable, following the agreed upon market-based rules.

Grid planning – Knowledge of the type of distributed generation, regardless of whether it is renewable or not, and about demand structure is necessary to predict future demand and production patterns, to identify correlations with demand in other grid regions and resulting flows in the high voltage grid or to understand the dependency of net demand on weather effects. The growing share of distributed generation is indeed a paradigm shift - previously, it may have been sufficient to establish peak demand scenarios, but today, the asset base within the distribution grid has a significant

effect on the operation of the transmission system. Detailed data on the asset base fosters creating reliable forecasts for future demand and production profiles, especially in situations where the net vertical load is a combination of demand and distributed generation. Making use of [aggregated] meter data can help TSOs plan grid extensions much more accurately in such a scenario. This in turn permits a better utilisation of transmission system assets and thus a more economic operation.

Grid operation – The same rationale for grid planning applies to grid operation – the increased share of distributed generation and distributed decision making in the power system makes it ever more relevant for TSOs to grasp the current situation in the connected distribution systems for their own grid operations, as well. As such, the current grid configuration, power plant production plans and demand structure are pertinent data.

Network tariffs – Computation of grid tariffs is a complicated, strongly regulated task that is closely linked to the monopoly position of grid operators. Network tariffs are usually based on energy and/or power demand of a customer, and, especially in the high voltage grid, may have additional reactive power components. The EU Regulation allows for locational and time-dependent grid tariffs, but the Directive also calls for transparency with respect to all interested parties. For computation, allocation and transparency of network tariffs, data has to be collected and exchanged. This is mainly grid data for tariff determination and meter data for tariff allocation.

Distribution system operator (DSO)

Grid planning – Like TSOs, DSOs can significantly improve their grid planning with better access to more detailed data. Presently, there are very few measurements of demand profiles and utilisation of distribution system assets, especially in the low voltage grid. Such data can be gained from aggregating meter readings with sufficient time resolution. This therefore ensures DSOs can design the grid according to actual needs rather than based on conservative estimates with respect to loading. In addition, the increase in distributed generation and storage makes it valuable to comprehend demand and production structures within the distribution system, ideally with high-locational resolution. Efficiency gains can arise, inter alia, from grid planning, assessment of new distributed generation connections and more selective asset maintenance.

Grid operation – Distributed generation and demand flexibility challenge traditional distribution operation approaches, and highlight the need for a more active role in grid management by DSOs. This can and should be driven by data, with a combination of demand data, production types, weather data and flexibility

options enhancing visibility and the capacity to act. Data-driven operational models have the potential to significantly diminish the expected needs for grid reinforcements coming from distributed generation and new demand, such as electric vehicles.

Flexibility procurement – Under the clean energy package, DSOs have the responsibility of coordinating with TSOs to obtain the optimal utilisation of flexibility resources, and to procure flexibility in a transparent and market-based manner. Accordingly, data on flexibility sources must be shared, and grid limitations should be communicated to TSOs and flexibility providers.

Network tariffs – Just as with TSOs, DSOs have a right to collect grid tariffs, and an obligation to be as transparent as possible regarding the computation and allocation of these tariffs. With the introduction of smart meters, DSOs have new options for grid tariff allocation, such as power-based tariffs, time-of-use tariffs or locational tariffs. Fair allocation depends on many factors, and robust data can facilitate more transparent and efficient determination and allocation of network tariffs.



Aggregator

Aggregators are businesses that combine several, usually small demand and/or production sites, and offer their flexibility in terms of ancillary services or the wholesale market.

Offering flexibility – When offering flexibility, aggregators must exchange data with several other actors. This includes inter alia the DSO of which the grid flexibility is located to make certain that no grid congestions prevent the provision of flexibility; the customer needs to be informed about activations; the TSO or DSO procuring the flexibility and so on.

Settlement – Aggregators do not necessarily take on the responsibility of acting as supplier to their customers, hence for the imbalance settlement process, the activation by aggregators needs to be taken into account. This data exchange can be complex, depending on the setup and available measurements. Here, data transparency can improve market access for aggregators and decrease conflicts between the involved parties, ultimately permitting more customers to benefit from participation in flexibility aggregations.

Energy Service Companies (ESCOs)

Offering new services – ESCOs are companies that offer new, value-added services to customers, such as demand and production transparency, infrastructure outsourcing or recommendations on contracts and appliances. ESCOs may be commercial or non-profit businesses, and cover a wider range of services. The field of ESCOs is rapidly developing, and data needs depend on

the specific use-case. Generally, ESCOs are interested in meter data of the customer to analyse the demand, and usually certain additional information, such as weather data, energy prices, information about appliances or distributed generation, customer premises, etc.

National Regulatory Authorities (NRAs)

Monitoring and transparency – NRAs require access to meter, grid and market data to monitor the efficiency of operations of the power system and to control grid tariffs and functioning of the

markets. This data includes grid development plans, historic meter data, demand and production structures, market outcomes and much more.

6.4 Case studies

6.4.1 Germany – edi@energy

Germany does not employ a central data exchange. Rather, a decentralised system with standardised, legally binding message exchange and processes was adopted.

BACKGROUND

The main driver for the standardised data exchange in Germany was the liberalisation of the retail market. This resulted in the need to handle a large number of processes regarding supplier switching, network usage tariffs, more complex imbalance settlement and also freedom of choice for metering services. Several approaches and standards were developed within the industry, but adoption was lacking as none of these standards were legally binding. With this, data quality was not always sufficient, and processes were not reliable or efficient. This led to conflicts, especially between vertically integrated utilities and independent suppliers, and to a significant market-entry barrier for new suppliers.

Hence, the German regulator, **Bundesnetzagentur**, mandated standardised data formats processes in its ruling from 11 July 2006 [8].

ORGANISATION

The edi@energy data exchange model consists of standardised messages, data types and processes, including a set of allowed communication channels. It does not feature a central access point or communications platform, but instead decentralised data exchange with bilateral communication between market players.

The data exchange rules are based on the UN/EDIFACT standard. The specific message types and their fields are defined by the industry association **Bundesverband der Energie- und Wasserwirtschaft** [BDEW], and detailed information about their implementation is published.¹⁾

Rules regarding due dates for data transfer are found in the electricity market regulations, **Geschäftsprozesse zur Kundenbelieferung mit Elektrizität** [GPKE] [9], for business processes relating to supply of end-customers, **Wechselprozesse im Messwesen** [WiM] [10] for switching the MRP, and **Marktregeln für die Durchführung der Bilanzkreisabrechnung Strom** [MaBiS] [11] for imbalance settlement. The rules are legally binding.

1) <http://www.edi-energy.de>

TYPES OF DATA

Scope

Data exchange touches all consumers and producers in Germany. It has three main pillars, namely data exchange related to retail customers, imbalance settlement and measuring service provision.

Data types

All data is stored decentrally by the stakeholders. The data that can be exchanged by the edi@energy standard are metering values, meter master data, customer master data, information on contracts regarding grid operators, suppliers and metering responsible parties, quotes related to metering services and bills.

Temperature data is utilised for computing temperature-dependent standard load profiles. Where this is performed, the ID of the weather service provider and the reference measurement are communicated rather than the measurement itself.

Functionalities

- Reporting of meter values for retail customers and distributed generation
- Requesting and changing master data
- Switching suppliers
- Invoicing of grid usage and energy usage
- Requesting contract offers and ordering contracts with respect to metering services
- Reporting of data related to imbalance settlement, such as the BG of the metering point and meter values

DATA ACCESS AND RIGHTS

Data rights

Customers cannot access their own data through the edi@energy system – the system is only accessible to market players. However, all customer data is protected by strict German privacy laws.

All other stakeholders have the right to access any data relevant to their business processes.

Responsibilities

Each company must provide communication links based on one of three standards (AS2, Email or X.100) and allow at least communication based on email via SMTP. Additionally, each company must publish one unique contact that all other stakeholders can refer to. Each company must also reply to requests for establishing data exchange within three days, otherwise the company creating the delay in establishing the communication link is responsible for delays in data exchange and related costs. If communication parameters change, all other companies with whom data exchange has been established must be actively informed. Even after the end of communication exchange, the communication link must be upheld for three years.

The processes in GPKE and WiM relate to supplier switching, meter reading and other retail processes. All stakeholders are required to act on requests by other stakeholders immediately or by due dates defined in GPKE and WiM.

The imbalance settlement of MaBiS lists the duties of the involved parties: **DSOs** are responsible for measuring, validating and communicating metering data in their grid region, and to submit the relevant metering data to the TSO, BRPs and suppliers that have customers within the grid region. DSOs are also responsible for splitting metering values into quarter-hourly profiles – this is *inter alia* relevant for metering data from residential customers without smart meters. For certain standard load profiles, temperature data must be considered when computing the profile from meter data. **TSOs** (in their role as the imbalance-settlement responsible party) inform the BRP about their exact imbalances, specified by grid area and with a 15-minute resolution. The **BRP** then has the right to examine the data and possibly decline imbalance settlement.

OUTLOOK

There is currently no plan to replace the standardised, decentralised edi@energy messaging system with a more centralised DEP or data exchange solution, or to extend the scope of the data exchange. The message types are regularly updated and adjusted based on current market needs.

6.4.2 The Netherlands – Energy Data Services Netherlands (EDSN)

The Dutch data exchange is progressing from a central interface with decentrally stored data towards a central data agency.

BACKGROUND

In 2007, **Nederlandse EnergieData Uitwisseling** (NEDU), a Dutch industry organisation consisting of DSOs, the TSO, BRPs, suppliers and metering operators, decided to implement a central data exchange.

The motivation for this came from the administrative challenges that were associated with market liberalisation. The Netherlands has eight DSOs, 28 BRPs, 64 energy suppliers and 8 large producers, resulting in a very large number of potential data exchange connections. Using a central interface for data exchange reduced the number of required connections significantly.

ORGANISATION

The data exchange is organised by EDSN ²⁾, a company owned by the TSO and all DSOs.

EDSN operates a platform for data exchange to ensure market facilitation. The platform consists of a bundle of registries, exchanges and services allowing market actors, both commercial as well as those that are regulated, to access the information they need for their operations.

TYPES OF DATA

Scope

All customers in the Netherlands are represented on the EDSN platform. The platform also handles production master data from decentralised generation units.

Data types

Data accessible via the platform includes meter values, meter master data, contracts associated with a meter, including start and end dates, and customer master data. Data on grid tariffs is accessible and used by suppliers to invoice their customers. All generation units are registered, including their master data. Moreover, all market players – suppliers, DSOs, BRPs and so forth – must register their master data. Finally, data for allocation and reconciliation, that is all processes associated with imbalance settlement for customers without hourly or 15-minute metering, is sent via EDSN.

Most master data, except for production installations, is stored in a register on the EDSN platform. Meter data is transmitted through EDSN, but is stored on DSO systems [12].

Functionalities

The functionalities handled via the EDSN platform include:

- Reporting of meter values to suppliers;
- Administration of retail market processes, including supplier switching and moving as well as prevention of overlapping supply contracts;
- Provision of allocation and reconciliation data; and
- Preparation of grid and energy bills.

DATA ACCESS AND RIGHTS

Data rights: Customers cannot access their own data or grant access to their own data via the platform. Otherwise, all data is protected by privacy laws and access to data by eligible parties is regulated through the Information Code [13].

Responsibilities

All responsibilities are described in the Information Code [13], which describes the data exchange processes in the retail market.

Suppliers are responsible for invoicing customers, both for energy and network usage. Suppliers then settle grid charges with DSOs.

DSOs measure, validate and make accessible all metering data. They also manage the meter master data.

OUTLOOK

The Dutch data exchange is moving continuously from a data exchange interface to a central agency that offers greater functionalities and stores data directly. Currently, allocation and reconciliation between market players is being implemented. Data services for customers are becoming more widely available, with many applications offering data transparency with regards to meter data. Finally, the HelloData ³⁾ initiative has the objective of providing customers with an interface to connect to the real-time data from the meter, and to forward this data to new energy services. It is expected that this will also facilitate demand response.

2) <http://www.edsn.nl>

3) <https://hellodata.org>

6.4.3 Norway – Elhub

The Norwegian Elhub is a centralised DEP with central storage of data focusing on retail processes and imbalance settlement.

BACKGROUND

The Norwegian data exchange model was historically based on a decentralised setup, combined with a central communications portal operated by the imbalance settlement-responsible party (the TSO, Statnett) for making queries into the DSOs' own databases for suppliers to facilitate supplier switches. A consultancy report from 2011 recommended that a central DEP should be developed. The regulator, **Norges vassdrags- og energidirektorat** (NVE), was given the task of developing the DEP for Statnett in 2013, and the DEP ("Elhub") is due to become operational in early 2018.

The background for the establishment of the DEP was the need to improve transparency and service quality for both suppliers and end-users to increase retail market competition. With more than 140 DSOs at the time, there was great variation in efficiency and service quality regarding retail market processes. It should also be noted that most DSOs were part of integrated utilities that owned supply activities, leading to possible distortions of competition. Additionally, the introduction of mandatory smart metering for all Norwegian end-users by 2019 would result in a large increase in the amount of data to be collected, stored and processed. There would also be major economies of scale in developing joint solutions and in simplifying communication and imbalance-settlement processes. A third objective is to facilitate the introduction of a supplier-centric retail market model as well as facilitate international (Nordic) retail market integration and the introduction of additional services from ESCOs and other third parties. Therefore, the introduction of the DEP was primarily to serve the needs of retail market actors and improve DSO efficiency by centralising several tasks related to data management.

ORGANISATION

The DEP is owned and operated by a wholly owned subsidiary of Statnett, known as Elhub. In the Norwegian regulatory framework, the TSO and imbalance settlement-responsible licences are separate, and the DEP is mandated in the imbalance settlement-responsible license and the metering and settlement regulation. DSOs and suppliers have been involved in the development work through *inter alia* expert groups and testing of the technical solutions. The regulator also follows the process closely.

TYPES OF DATA

Scope

Elhub is a central DEP accountable for storing all meter data and supplying imbalance settlement data to the TSO (from May 2017, the company, eSett Oy, will take over settlement responsibilities in Finland, Norway and Sweden). The DEP will also provide the necessary data for supplier switching and moving. The DSOs remain in control of collecting meter data and sending it to the DEP. The DSO also owns and operates the meters.

Data types

The DEP will contain the following data:

Consumption and production measured at the metering point, address and contact of the producer or consumer, unique ID and location of the meter and both the grid usage and energy supply contracts associated with the metering point.

Grid tariff data can also be stored on the DEP, and this is relevant if the DSO wants the DEP to produce the invoice for the grid tariffs.

The type of data included is mainly meter data, which is a consequence of the original objectives for the DEP that were mainly related to the retail market and the DSO services in that regard.

Functionalities

The functionalities to be handled by the DEP include:

- Storing meter data and consumption and production data (meter values);
- Benchmarking of meter value quality;
- Reporting to the imbalance settlement-responsible party;
- Reporting to the electricity certificate register. This applies both to consumption and production data;
- Calculation of losses and adjusted consumption profiles (for metering points that are not subject to hourly metering)⁴⁾ per metering grid area (for the imbalance-settlement process) and per DSO;
- Reporting of meter values to suppliers, balance-responsible parties (if different from the supplier), third parties, producers (where relevant) and DSOs; and
- Administration of retail market processes, including supplier switching and moving, and preparing invoices for the suppliers, including calculation of consumption taxes and exemptions from such taxes where applicable.

In order to maintain operational security of the grid, Elhub is specifically designed to not have operational control functions or be able to disconnect or reduce loads. The DEP owner must also establish a documented risk management system. All information exchange according to the Ediel format must be encrypted.

DATA ACCESS AND RIGHTS

Data rights

A central point of the revised regulation is that end-users own the meter values themselves, and Elhub is a main instrument for this.

DEP users cannot gain access to data on the DEP without an agreement with the end-user, i.e., a contract for power supply, grid connection or an agreement with a third party authorised by the end-user. Suppliers have access to information on their own customers and DSOs have access to information on end-users connected to their respective grids.

Consumption and production data at an hourly resolution must be available on the DEP by 09:00 the day after. Hourly values are to be stored for three years. This also applies to other data, such as customer information, supplier switches, change of customer location (moving) and start of meter utility.

Responsibilities

End-users will not have direct access through the DEP. The **DEP** is responsible for developing a web plug-in for end-user access via suppliers or third parties. The end-user will be able to download historical consumption data in a standardised format through the plug-in, but not graphical presentations of data. The plug-in will further inform the end-user about what entity has access to the end-user's own data and on functionality for removing such access. However, this functionality cannot be employed to stop suppliers from accessing data that are necessary to invoice the end-user. The **supplier** will lose access once a contract is terminated unless the supplier has been granted access through a separate agreement as a third party. To promote competition, DEP users (e.g., suppliers, third parties) will not have access to information on other eligible parties that have access to customer data.

There will be a web portal for market actors plus EDI/XML messaging. This also includes a query service to be used for supplier switches, moving and new contracts.

The DEP is also required to enable the reversal of processes, like, for instance, supplier switches completed in error, up to a period of three years.

The DEP must report to the **regulator** on meter data quality, new meter points, supplier switches, transfers of meters (moving), generation, consumption and power exchange per metering grid area and per supplier.

The supplier has to make historical consumption data available for the end-user via the internet. The information must be presented in a fashion that enables comparison of consumption, prices and costs over time.

Third parties must be registered on the DEP and meet technical criteria with regards to data exchange formats.

4) Smart meters are mandatory from 1 January 2017, but exemptions are possible.

OUTLOOK

As the DEP is yet to become operational, the main emphasis is on implementation rather than future development. However, the DEP is specifically designed to facilitate future development processes. In the main concept study by Statnett, the following areas are mentioned:

- **Nordic retail market integration:** The Nordic association of energy regulators, NordREG, has recommended that all Nordic countries establish a central DEP to contribute to harmonisation of market rules;
- Facilitate inclusion of price information and additional services provided by third parties through the use of open standards and open interfaces for smart meters; and
- Introduction of a supplier-centric model with the supplier as the sole point of contact for customers and with one invoice for both electricity purchase and network tariffs.



6.4.4 Estonia – Estfeed

The Estonia case describes a central DEP with additional, decentralised functionalities and inclusion of market data.

BACKGROUND

In response to the trends of digitalisation, distributed generation and increasing consumer awareness, Elering is developing a smart grid platform called Estfeed. Estfeed is a central DEP that allows network companies, energy producers and consumers to interact more effectively and make the data collected during energy consumption understandable and usable for end-users. It began in 2012 when a central DEP featuring hourly readings from every single electricity meter was created. Thereafter, the goal was to ensure neutral access to metering data for all consumers and generators as well as to facilitate supplier switching in order to be prepared for full market opening a year later. In 2016, a central DEP with similar functionalities for gas meter data was built.

Currently, the objective of Estfeed is to create a comprehensive smart grid platform that permits market players to interact securely and transparently. Estfeed brings together data sources and applications. Estonia completed a full roll-out of smart electricity meters in 2016, enhancing even more so the value of data possible to glean from the platform. Estfeed is a portal that offers developers a chance to access this information flow. By interpreting and combining data, they can create useful applications for themselves or their customers (end-consumers). The aim of the applications is to bolster efficiency, either in terms of cost-optimization or for end-consumers.

Estfeed is an integrated component of the Estonian public information exchange platform, X-Road (servers, secure data communication channels, message formats and chip cards). Special attention is paid to the software components necessary to make certain there is consumer privacy and security of the system. Elering, as a TSO, is neutral party and is thus well-placed to provide that kind of data exchange service to the public in a reliable and independent way.

ORGANISATION

Estfeed is owned and operated by Elering, the Estonian TSO.

The platform further allows external data owners to make their data available over the platform and external developers to offer applications/services that add functionalities beyond those of the DEP.

TYPES OF DATA

Scope

Estfeed houses data from all customers, regardless of whether they are connected at the TSO or DSO level (ca. 750,000 metering points for electricity and ca. 60,000 for gas). This involves both consumption and production data.

Data types

The Estonian DEP is special, as it not only contains metering and meter-related data, but also market data, such as spot prices and weather data.

The meter data is collected for electricity and gas as well as in pilot areas for district heating. It includes the unique, standardised EIC code of the meter and the address of the meter. For each metering point, the supplier contract and grid contract associated with the meter are saved, including the name of the person in whose name the contract was agreed and the start and end dates where applicable. The content or specifications of the contracts are not stored on the platform.

The market data includes weather forecasts and spot-market data. All data available over the platform can be utilised by external third parties to offer services, like demand response, to end-customers. Access to meter data necessitates customer consent.

Functionalities

The high-level functionalities [business processes] handled by Estfeed include:

- Handling of and access to metering data – enabling easy, transparent and equal access to metering data by all stakeholders (including consumers, suppliers, BRPs, aggregators and any other interested parties). Features data collection, transfer to central databases, data storage, data verification, data sharing and management of authorisations;
- Supplier switching;
- Managing open supply chain (including change of BRP; balance responsibility is ensured through a continuously open supply chain);
- Balance scheduling;
- Balance settlement;
- Calculation of RES production and subsidies along with calculation of residual mix;
- Register for Guarantees of Origin;
- Joint invoicing with network invoice forwarding;
- Comparison tool; and
- Single point of access to different types of data (electricity, gas, heat, prices, weather, etc.).

DATA ACCESS AND RIGHTS

Data rights

A central aspect of Estfeed is the rights of customers with respect to their data. Customers can:

- access their own data;
- view their own contracts;
- see who accessed their data;
- grant access to third parties; and
- grant the role of representative to third person or party.

The right of a customer to access their own data increases transparency and enables comparison with similar customers. As such, it is expected that energy efficiency is promoted and customers are motivated to adjust their demand.

Transparency for customers is also enhanced by the ability to view their own contracts and see who accessed their data.

The ability to grant access to data and the role of a representative makes the supplier-switching processes much more efficient. Suppliers can make personalised offers, valued based on the actual consumption by the customer.

Roles and responsibilities

The **TSO** operates the DEP as a neutral party.

The **DSO** is responsible for recording, collection and verification of meter data. This includes splitting of meter values into hourly values if necessary. The DSO submits data (including master data and grid contract information) to the DEP.

Suppliers use the meter data stored on the DEP as the basis for their billing processes. They can make offers to customers based on their meter data if authorised by the customer to do so. Further, suppliers submit supply contract-related data to the DEP.

BRPs can obtain data from the DEP necessary for balance management.

End-customers can monitor their own historical consumption and can grant access to third parties to their data to receive new supply offers and services. They can also see the contracts associated with their electricity consumption points.

Third parties (aggregators, ESCOs, market data providers, etc.) can connect to the DEP with their applications.

OUTLOOK

A DEP can ultimately facilitate applying the benefits of the Internet of Things (IoT) in the energy domain. Therefore, Elering foresees opportunities in making available additional data, like: (a) meter data for heating and water sectors; (b) market data (e.g., from the real estate registry and other public information systems as well as from individual devices); and (c) certain kinds of operational data (e.g., in order to organise real-time data exchange between system operators and aggregators). Important future development perspectives include cross-border and cross-sectoral data exchange. This all necessitates paying more attention to data privacy and cyber security requirements along with data exchange standards and protocols.

6.5 References

- [1] European Commission, Proposal for a directive of the European Parliament and of the Council on common rules for the internal market in electricity, COM (2016) 864, Brussels, 2016.
- [2] European Commission, Proposal for a regulation of the European Parliament and of the Council on the internal market for electricity, COM(2016) 861, Brussels, 2016.
- [3] European Commission, Commission regulation (EU) of establishing a guideline on electricity balancing (Draft v. 24 Jan 2017), [2017].
- [4] European Commission, Commission regulation (EU) of establishing a guideline on electricity transmission system operation (Draft v. 4 May 2016), [2016].
- [5] European Smart Grids Task Force, My Energy Data, 2016.
- [6] CEDEC, EDSO, ENTSO-E, eurelectric, GEODE, TSO – DSO Data management report, 2016.
- [7] Eurelectric, The power sector goes digital – Next generation data management for energy consumers, 2016.
- [8] Bundesnetzagentur, Beschlusskammer 6, BK6-06-009, Entscheidung vom 11 July 2006, Bonn, 2006.
- [9] Bundesnetzagentur, Geschäftsprozesse zur Kundenbelieferung mit Elektrizität (GPKE), konsolidierte Lesefassung, 2011.
- [10] Bundesnetzagentur, Wechselprozesse im Messwesen (WiM), konsolidierte Lesefassung, 2011.
- [11] Bundesnetzagentur, Marktregeln für die Durchführung der Bilanzkreisabrechnung (MaBiS), konsolidierte Lesefassung, 2011.
- [12] EDSN Energie Data Services Nederland, EDSN Diensten 2013, 2013.
- [13] Autoriteit Consument & Markt, Informatiecode Elektriciteit en Gas, 2014.
- [14] USmartConsumer, European Smart Metering Landscape Report, Madrid, 2016.
- [15] THEMA Consulting Group, Mapping of TSO and DSO roles and responsibilities related to information exchange, NordREG, 2015.
- [16] CEER, Review of Current and Future Data Management Models, Dec 2016.
- [17] CERRE, Big Data and Competition Policy: Market power, personalised pricing and advertising, 2017.
- [18] IDC, European Data Market, SMART 2013/0063, 2016.
- [19] European Commission, Communication from the Commission to the European Parliament, the Council, the European economic and social committee and the committee of the regions – Building a European Data Economy, Brussels, 2017.

6.6 Acronyms

The following acronyms were used in this report.

ACRONYM	MEANING
BDEW	<i>Bundesverband der Energie- und Wasserwirtschaft</i> , German industry association for energy and water
BG	Balance Group
BRP	Balancing Responsible Party
CEDEC	European Federation of Local Energy Companies
CEER	Council of European Energy Regulators
CERRE	Centre on Regulation in Europe
DEP	Data Exchange Platform
DSO	Distribution System Operator
EDI/XML	Electronic Data Interchange/Extensible Mark-up Language
EDSO	European Distribution System Operators
EIC	Energy Industry Council, Standardisation body
ENTSO-E	European Network of Transmission System Operators for Electricity
ESCO	Energy Service Company
EU	European Union
Eurelectric	Union of the Electricity Industry
GEODE	<i>Groupement Européen des entreprises et Organismes de Distribution d'Énergie</i> , Trade association of independent gas and electricity distributors
GPKE	<i>Geschäftsprozesse zur Kundenbelieferung mit Elektrizität</i> , German electricity retail market processes
MaBiS	<i>Marktregeln für die Durchführung der Bilanzkreisabrechnung Strom</i> , German imbalance settlement rules
MRP	Metering Responsible Party
NEDU	<i>Nederlandse EnergieData Uitwisseling</i> , Dutch industry organisation consisting of DSOs, the TSO, BRPs, suppliers and metering operators
NordReg	Nordic Energy Regulators
NRA	National Regulatory Authority
NVE	<i>Norges vassdrags- og energidirektorat</i> , Norway's NRA
SCADA	Supervisory Control and Data Acquisition
SGU	Significant Grid User
SMTP	Simple Mail Transfer Protocol
TSO	Transmission System Operator
WiM	<i>Wechselprozesse im Messwesen</i> , German rules on switching metering responsible party

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