Benefits of an Energy Data Platform in Luxembourg

Commissioned by the Ministry for Energy and Spatial Planning

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Project description

In this report, we analyse the potential benefits of establishing a National Energy Data Platform (NEDP) in the electricity and gas markets in Luxembourg. Drawing on experiences from similar projects in other European countries, interviews with stakeholders and data on the Luxembourg energy markets, we expect the benefits to be considerable. In particular, the NEDP should enable an efficient path towards establishing a national energy ID and clarify roles and responsibilities in the market. This should unlock further benefits in the form of lower operational costs, more competition and data-driven innovation in energy services. We also give recommendations on how the realised benefits can be monitored going forward.

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THEMA Consulting Group offers advice and analyses for the energy transition based on in-depth knowledge of the energy markets, a broad understanding of societal challenges, extensive consulting experience and solid professional competence in socio- and business economics, market analysis as well as technology.

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SUMMARY

The government of Luxembourg has decided to introduce a National Energy Data Platform (NEDP) for the electricity and gas markets. The platform is to be developed by the Transmission System Operator, CREOS. The long-term objective of the platform is to provide a central point for storage and exchange of energy market data between DSOs, suppliers, customers, generators, aggregators, energy communities and authorities, which is expected to bring a wide range of benefits to stakeholders and participants in the Luxembourg energy sector. To support the development of the NEDP THEMA has been commissioned by the Ministry for Energy and Spatial Planning to describe and, where possible, quantify the expected benefits of the platform.

Our frame of reference for the analysis of benefits from the NEDP are the requirements for data exchange and business processes in well-functioning retail energy markets. This entails inter alia:

- A high degree of competition with low barriers to entry
- Easy customer access to their own data for consumption and self-generation
- Error-free customer master data
- Efficient collection and distribution of metering values
- Harmonised and standardised market communication processes
- Efficient reporting to regulatory authorities

We expect that the NEDP will be able to meet these requirements when sufficiently developed. We consider that the second stage of the NEDP (level 2) will be a key milestone in that respect. At level 2 most bilateral market communication processes will be replaced by a central data exchange and the NEDP will be the main reference point for data exchange including customer master data. In particular, we expect the NEDP to be a catalyst for resolving two key issues that hinder the development of the Luxembourg energy markets today:

- In the current market, DSOs and suppliers frequently experience errors in master data and data quality issues in general. This creates a need for work to correct errors manually, which is time-consuming. This is particularly important with respect to supplier changes and customers moving within and to/from Luxembourg and a seamless billing process.
- Market participants and end-users perceive that there is an unclear definition of responsibilities for different aspects of data exchange. For instance, there is no single source of truth for customer master data, and it is not clear who will be held responsible for data errors. Adding to this is the fact that several energy companies were or still are vertically integrated, which reduces transparency.

Compared to a centralised data platform, resolving these issues with an alternative decentral solution is possible, but complex and costly. With a decentral solution, a set of standards would need to be defined and enforced, and corresponding regulation and monitoring aimed at all DSOs and market participants would need to be implemented. Also, work must be done to correct the underlying errors in the master data in particular, which requires a coordinated effort on the part of all involved stakeholders. Related to this is the issue of a national energy ID, that will create a one-to-one correspondence between metering point and individual customer and would be an important factor but is not yet in place. The centralised approach by the NEDP on the other hand creates a pressure for change and a common framework for establishing necessary standards and processes, as well as effective error management.

With data quality issues resolved and roles and responsibilities assigned, the NEDP will unlock further benefits:

- Based on experiences from countries with datahubs in operation in the electricity market, such as Denmark and Norway, we would expect the NEDP to lead to **more competition and innovation** in the energy retail markets due to lower barriers to entry, access to customer data and increased transparency and accountability. While these benefits are difficult to quantify, by way of illustration a 1 EUR/MWh lower margin in the electricity and gas retail markets yields an annual reduction in energy costs for Luxembourg's end-users of 14 million EUR with a net present value of more than 100 million EUR (assuming a ten-year lifetime and a real discount rate of 4.81%). This is primarily a redistribution from retailers to customers and not a welfare-economic benefit, but it illustrates the potential value to customers of increased competition. If customers are able to optimise their energy use and manage risk more efficiently, this will on the other hand yield an economic benefit and not just redistribution. Using the same illustration of a change of 1 EUR/MWh in the value of energy use from optimisation and risk management, the benefits can exceed 100 million EUR in net present value.
- Other benefits include new opportunities for **centralised data analytics**, **data security** and **privacy improvements** and more efficient **implementation of standards and business processes** in the retail energy markets. The latter benefit can amount to around 100 000 EUR per year according to data for one retailer in the Luxembourg energy markets.
- Finally, the NEDP should be able to provide **increased operational efficiency**. Benefits from increased efficiency are difficult to quantify at this stage due to a lack of relevant data, but we can make some qualified estimates based on inputs from stakeholders and experiences from other markets. We have concentrated on benefits from more efficient moving and supplier switching processes and regulatory reporting. We have estimated the value of less time spent on these activities and corroborated with data from the operative datahub in Norway and the planned hub in Switzerland. We estimate that the benefits from the NEDP in this category when sufficiently developed will amount to 7-16 million EUR in net present value measured over a 10-year period.

The findings can also be useful for the further implementation of the NEDP. In particular, we identified two main concerns that will be important in the communication with stakeholders:

- Against the background of the limited complexity and size of Luxembourg's energy markets and the concentrated industry structure, the benefits of a full-size NEDP must be well documented and justified.
- Tangible benefits for the end-customers must be clearly shown.

  Here, our analysis can be of help as it compares a centralised NEDP with a decentralised approach and identifies and analyses the beneficiaries and corresponding benefits in a structured way. For the end-customer, the benefits from the NEDP are higher potential competition due to easier market access of new players, new energy services, more efficient processes that result in faster processing and lower costs, cost transparency and privacy protection improvements.

1 INTRODUCTION

1.1 About the NEDP and our analysis

The constant change in the energy landscape harbours new challenges. Driven by climate change and the expansion of renewable energy sources, the generation and consumption structures are changing rapidly in both the electricity and gas sectors. While the traditional approach to designing power-systems consisted of connecting a few central, large generation units and distributing their electricity to many end consumers, today and in the future, it is necessary to connect a vast number of decentralised generators and distribute their electricity to end users or deal with the feed-in of prosumers and bidirectional power flows. Data plays an important role for planning purposes, rendering system operation safe at all times, or reliably billing the energy flows ex post. The primary goal remains to ensure the reliable and safe supply of electrical and thermal energy to end users. To face the data needs of this ongoing radical transformation of the market, Luxembourg has introduced a law on 3rd of February 2021 that provides a framework for the introduction of an Energy Data Platform, that shall be developed by the TSO CREOS[1]. Draft law 7876 aims to further refine the legal provisions for the NEDP. The objective is to centralise energy data and to give secure and useful access to individuals and companies who have the corresponding rights. This should improve statistics about the market and market communication and open up for standardised and efficient reporting to authorities. It is planned to implement the Energy Data Platform for electricity and natural gas in three phases, with the first stage to go live by July 2023.

Other ambitions of the platform are to increase data transparency and empower customers, increase the quality and efficiency of market processes, and stimulate innovation in energy services. The finalised roll-out of smart meters for gas and electricity to all clients allows for the next step of digitalisation of the energy sector to pass on benefits of more data availability to clients and increase efficiency for all involved stakeholders. Additionally, the hub can be used to improve the supply of new energy services and flexibility in the power sector, as well as to enable energy communities.

To support the development process, THEMA was given the task to describe and quantify the benefits of this data platform. The report is developed on behalf of the Ministry for Energy and Spatial Planning.

1.2 Methodology and information base

To be able to describe and quantify the benefits of the data platform we first acquired a detailed overview of today's markets and processes.

Next, we identified who will be affected when the NEDP is implemented. For the DSOs and suppliers, we determined which processes will be affected and how.

The benefits of the NEDP should be evaluated using a reference that is not the current state of play, and we therefore compared the NEDP solution with a counterfactual that includes future needs with respect to data exchange.

We also studied other countries that have introduced similar data platforms, to gain an understanding of what kind of benefits they achieved and how large the benefits were.

[1] Loi du 3 février 2021 modifiant la loi modifiée du 1er août 2007 relative à l'organisation du marché de l'électricité.

The information was acquired through interaction with the Ministry for Energy and Spatial Planning (workshops, relevant reports etc.) and interviews with key actors in Luxembourg:

- TSO
- DSOs
- Luxmetering
- Power suppliers
- Gas suppliers
- Third parties
- Regulator

We also conducted interviews for the international case studies.

1.3 Reader guide

This report is structured into four main chapters.

After this introduction we begin with a survey of some of the international use cases about national data platforms in Chapter 2. We take a closer look at Norway and Denmark, two countries that have implemented data platforms some time ago and had the possibility to see them in operation. We consider if and how far the benefits that the countries had planned to realise from their data platforms have materialised. We conclude the chapter with an overview over some other European countries that have implemented or are about to implement their own data platform.

In Chapter 2.4 we describe the current power and gas market in Luxembourg and information flows. We focus on the residential market as this is the one most relevant for the NEDP due to their higher customer fragmentation. I. e. there is a large number of customers with limited consumption that needs to be managed, rather than only few industrial customers with large consumption that can be handled in an effective way also without an NEDP.

Chapter 4 specifies the changes in the processes that we expect with the implementation of the NEDP.

Chapter 5 then is the core of the report. We give an overview over all benefits that can in principle be realised with the NEDP and finally quantify where possible for the case of Luxembourg, based on the stakeholder interviews we conducted during the project.

We then provide an overview of possible Key Performance Indicators for the realisation of NEDP benefits before we conclude the report with a summary of the main findings and some recommendations in the end.

2 INTERNATIONAL EXPERIENCES

In this chapter, we summarise some of the experiences from datahubs in European electricity markets that have been introduced or suggested. We focus on the Norwegian and Danish experiences, while also referring the main conclusions from a study of a prospective Swiss datahub for the electricity and gas markets.

2.1 Norway introduced an energy data platform in 2019

The Norwegian data hub, Elhub, was operationalised in February 2019. Norway has about 120 DSOs and at least as many suppliers. Elhub functions as a central database supporting the processes of supplier switching, moving and closing as well as distributing and aggregating metering values. The data hub was introduced together with regulatory changes and changes in the market processes in the end-user market.

The motivation for establishing Elhub was that it would be the most economically efficient way to meet several changes in the end-user market:

- roll-out of smart meters
- supplier centric model
- a common Nordic end-user market

The conclusion that Elhub would be the most economically efficient solution was made in a report from 2012, where such a centralised solution was compared to a decentralised solution (Statnett, 2012). In the same study, Elhub was estimated to bring economic benefits of 15-30 million EUR a year over a 20-year period. The Norwegian TSO, Statnett, was then given the task of developing a data hub.

In 2020, the first benefit realisation analysis was completed (Oslo Economics, 2020). This study concluded that the data platform had realised most of the expected qualitative benefits, mainly:

- increased data quality and enabled faster data exchange
- enhanced neutrality and increased competition
- improved customer rights and access included data security and privacy

The increase in data quality is highlighted as one of the largest benefits of the data platform, as it is necessary for good, neutral and transparent market processes.

After the introduction of Elhub, several innovative suppliers have been established in Norway that rely on functionality from Elhub. One such example is the company Tibber that provides customers with the opportunity to link several smart consumption solutions to their supply contract. EV users can add their wall chargers to their account and the app chooses the best time to perform charging with savings for the customer in mind. The same can also be done for smart lighting services, home heating or self-generation. Another supplier, Motkraft, markets itself as the first non-profit supplier that does not make money through its tariffs and only operates cost-neutrally. Lean structures allow the company to undercut its competitors.

The benefit realisation analysis also estimated how much of the economic benefits due to cost reductions in key business processes were realised. Changes in operating expenses were collected through interviews with 34 companies (mainly DSOs & suppliers). The study found that only a small amount of these expected economic benefits was realised at this point. At only 1,5 years after go-live, the companies were still settling in to accommodate the new operational processes.

Through the interviews, it became clear that the companies who had been able to achieve reductions in operating expenses were those who had actively made adjustments in their own processes.

2.2 Denmark

The Danish Transmission System Operator Energinet was given the task of developing a datahub for the Danish retail electricity market. The datahub become operational in 2013. A new version of the datahub is scheduled to go live in the second half of 2022. The hub contains both customer data and metering point information, and metering values. It includes functionality for third-party access to customer data (upon authorisation), handles customer moving and switching and compiles statistical information.

The introduction of the Danish datahub was not accompanied by a cost-benefit analysis, and there has been no comprehensive or systematic ex post analysis of the realised benefits. However, the datahub points to several benefits that have been observed since 2013:

- A key motivation for establishing the datahub was to increase efficiency in operations, get better data on network losses and facilitate competition in the retail electricity market. Smaller DSOs had difficulties in setting up metering points correctly and handle switches. Deviation settlements created a need for workarounds in aggregating data.
- The quality of data has improved significantly over time.
- Competition has also increased, with lower prices for end-users and lower retail margins. The barriers to entry are lower, and the old monopolies have been broken up.
- New services are being offered to end-users, based on easier access to frequently updated data.
- Initially, DSOs where skeptical, but Energinet now sees that DSOs are increasingly asking the hub to develop new features, which is more cost-effective than individual DSOs trying to find common solutions.
- The experiences with respect to security and privacy are also good, with a functioning access control regime and logging of all access in a central place.

The new version of the datahub is mostly driven by technical considerations, such as the challenges for data handling posed by the move towards more frequent data delivery requirements (e.g., quarter-hourly metering) and changes to message formats.

2.3 Switzerland

In 2018, THEMA and Devoteam carried out a study on behalf of Bundesamt für Energie in Switzerland of a prospective datahub for the Swiss retail electricity market. A key part of the study was a cost-benefit analysis of different datahub concepts, including a communication hub, a datahub light and a full datahub. The full datahub concept is broadly comparable with the Norwegian and Danish datahubs and the Luxembourgish NEDP level 2/3. The cost-benefit analysis comprised both qualitative benefits and benefits that could be quantified using data from other Swiss studies and interviews with market participants. The analysis was done under different assumptions about inter alia retail market opening (as only a part of the Swiss market had been liberalised) and smart meter rollout.

In the qualitative analysis of the full datahub, the main benefits were identified as higher quality and efficiency with respect to business processes in the retail market. Data access and improved services for end-users were other key benefits, along with potential IT system cost savings. Increased competition and improved opportunities for regulatory control were also highlighted.

In the quantitative analysis, the net present value of the total benefits added up to around 116 million CHF over a seven-year period and with a real discount rate of 4.5 per cent, where the main benefits were found through more efficient processes for moving and supplier switches. Increased data quality (both customer data and metering values) was another important benefit. Finally, IT investment and operation costs were expected to be lower with the full datahub including metering values. Overall, the study found that the benefits of a full datahub exceeded the costs and had an expected net present value of around 60 million CHF (average over a set of scenarios).

A decision on a Swiss datahub has not been made as of April 2022. However, an updated study by AWK Group and E-Bridge Consulting from 2021 found even larger possible benefits both with a datahub light and a full datahub than in the THEMA and Devoteam study.

2.4 General observations from international experiences

The benefits are largely dependent on the context which makes a general transfer of methodology from country to country difficult. Market and industry structure, status of smart meter rollout and the use of other energy carriers all have an effect on how large potential benefits are, how easy they are to realise and how they can be quantified.

Sophistication complexity and life cycle of existing IT systems, for example, strongly affect the benefit the datahub can have in this area. Standardisation of processes generally helps to minimise the effort to tailor the new system to every DSO's and supplier's business processes.

In addition will many likely (or unlikely) benefits be realised over time, and it is difficult to foresee the exact magnitude and time frame. Among these benefits are increased competition and innovation through easier data access for aggregators, energy service companies and other third parties.

Often, the implementation of a centralised datahub gives incentives to other measures that lead to more efficiency in the system, e.g., implementation of more efficient regulatory processes.

In conclusion, implementing a datahub is not straightforward and there remains a need for constant process development even after its initial setup.

3 DESCRIPTION OF STATUS QUO

3.1 General market characteristics

Generally, Luxembourg's electricity and gas markets are rather small compared to the surrounding markets and not as fragmented as markets in other countries. There are only a handful of electricity and gas suppliers and grid operators and both markets have one supplier that covers a substantial share of the end customers. This limits the complexity of the market considerably. It also makes changes in legacy systems expensive per customer.

Both markets experience only a small number of supplier switches as the incentives for such a switch are low: The number of suppliers is small and there is not much active competition for attracting customer between them.

In contrast, the number of customers moving is high especially because of the substantial number of expats moving in and out of the country.

3.1.1 Electricity market

In 2020, the total number of points of delivery (PoDs) in Luxembourg was 323 715, where 262 258 or more than 81 % belong to the residential sector. The other 19% are commercial and industrial customers. The total annual consumption was 6.3 TWh, with 0.95 of them or 15 % consumed by households in the residential sector.

99% the electricity market follows a supplier-centric model. The DSO sends the bill for grid usage to the supplier, who forwards it, together with their own bill for electricity consumption to the end customer. In other words, the customer directly interacts with the supplier only and has just one single bill to account for. This of course requires that both supplier and DSO have identical customer databases (see chapter 3.2).

There is one TSO, who owns and operates the transmission grid, five DSOs in total, who own and operate the distribution grids, and one industrial system operator.

The TSO and the largest DSO (>290 000 or 90% of the total number of PoDs) are divisions that belong to the same company: CREOS Luxembourg.

The other four DSOs are Sudstroum (~18 000 PoDs), Hoffmann Frères Energie et Bois (Electris) and two municipal grid companies that belong to the cities of Diekirch and Ettelbruck, respectively, all with between 4 000 and 5 000 PoDs. The industrial system operator Sotel has only 11 larger industrial customers.

Just like the grid companies, the residential supplier market is dominated by one large company, in this case ENOVOS. It is also the only non-integrated supplier of considerable size. Together with NordEnergie, Steinenergy and LEO (Luxembourg Energy Office) they belong to the Encevo Group. Together, these companies cover almost 91% of the residential market. The rest is divided among Sudstroum, Steinergy and Electris (ILR 2021).

The communication processes necessary between DSOs and suppliers are the market communication processes (MaCo). The two dominating players among the DSOs and suppliers, CREOS and ENOVOS manage some of these processes for the smaller companies. Consequently, there is a high degree of standardisation of the communication protocols.

Most suppliers (ENOVOS, Sudstroum) and the largest DSO CREOS, already have a customer platform to access data, but, according to information retrieved from stakeholder interviews, the usage rate among customers seems to be fairly low.

The end-users have mostly long-term contracts with a typical price level around 17 ct/kWh in 2021. This means that customers do not feel the impact of high wholesale market prices right away but will of course do so in the long run.

Most of the PoDs are equipped with smart meters already that send the consumption data via the PLC-based smart meter infrastructure to Luxmetering and the DSOs automatically (see Section 3.2). The physical rollout of smart meters was completed at the end of 2020 and the activation of the meters was ramped up in 2021. Suppliers now receive the consumption data from the smart meters on a daily basis for the previous day.

Nonetheless, the market for extra electricity services (such as energy efficiency, custom-tailored energy supply services, …) offered by third parties, that in principle can benefit from smart meters, is still immature. A price comparison tool operated by the regulatory authority called Calculix exists, that compares electricity and gas providers based on yearly consumption.

More than 8000 PV systems with a total of 187 MW are connected to the grid, producing about 160 GWh per year. Most of these systems are residential systems. Space for larger PV systems is scarce and the deployment potential is therefore limited. All PV systems have their own metering point, making consumption and production of the prosumers easy to identify, independently of self-consumption rates. Most PV systems fall under a feed-in-tariff scheme that guarantees stable remuneration of the produced electricity over the period of 15 years. More and more PV systems are old enough to fall out of this scheme but still produce a considerable amount of energy that now needs to be compensated for in some other way.

One possible solution are Local Energy Communities (LECs), and the legislator, regulator and grid operators have already prepared for this concept. However, the implementation of LECs is currently limited, mainly due to little knowledge about the potential and limited profitability compared to feed-in-tariff schemes.

3.1.2 Gas market

The southern part of Luxembourg and the northern municipalities along one major gas pipeline have access to natural gas as an energy carrier. Generally, there is a wish to reduce natural gas usage in the country as part of the energy transition away from fossil fuels. The country-wide consumption of natural gas declined gradually from 9.1 TWh in 2016 to 8.9 TWh in 2019, before plummeting to just under 8.1 TWh in 2020 in the wake of the Covid pandemic.

The gas distribution network is owned and operated by three different operators. SudEnergie and the city of Dudelange operate a total of about 40% of the grid in terms of total network length, covering the south-west area of Luxembourg, and CREOS operates the remaining 60% covering the rest of the country.

There are a total of nine suppliers for natural gas, four of whom are active on the residential market: Electris, SudEnergie and the Encevo Group with ENOVOS and LEO.

The physical rollout of smart meters was completed at the end of 2021. The activation of the meters has increased significantly over 2021 for electricity but has not been completed, while for gas, the activation has started more recently. Besides smart meters of electricity and gas, some municipalities have started with smart water pilots but there is no large-scale roll-out as of today. Heat applications might also be moved to smart metering eventually, but the process is at an even earlier stage as for the water sector.

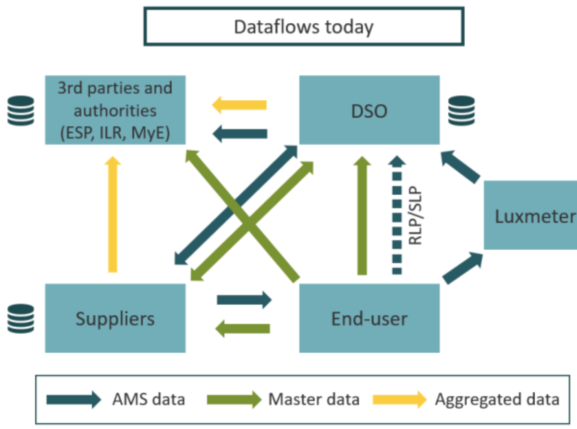
3.2 Description of relevant processes today

Here, we give an overview of today's processes and the actors involved. Current data exchange mainly happens bilaterally in the Luxembourgish market. In response to the decision to roll-out smart meters across the country, the DSOs established Luxmetering GIE, a company responsible for handling the hardware purchase, collecting metering data and passing it on to the DSOs. Suppliers that want access to this data cannot approach Luxmetering directly but have to go through the DSOs to obtain the relevant data. MaCo standards then automate transmission of load profiles and meter readings between DSOs and suppliers. Similarly, end-users rely on data solutions of their suppliers to monitor their own consumption.

Interactions in the market are thus complex and difficult to keep track of. Also, from a regulatory point of view, this poses difficulties, as monitoring the market participants becomes more difficult with rising amounts of data having to be handled. This effectively limits the realisation of productivity gains from more and different types of data available through the smart meter roll-out.

The basic structure of the dataflows is illustrated in Figure 1.

Figure 1: Schematic illustration of today's dataflows. Note that all measurement data have to pass through the DSO.



3.2.1 Luxmetering

Luxmetering GIE was established in 2012 and is owned by the seven electricity and gas DSOs. The economic group of interest (GIE) is responsible for the specification, purchasing, installation and management of the national meter reading platform, as well as for coordinating common hardware purchases (data concentrator units, handheld units and communication hardware), on behalf of the DSOs and the rollout of this hardware.

Luxmetering collects and transfers all the data from the smart meters on quarter-hourly resolution for electricity and hourly resolution for gas on several instances per day. They then validate the meter data and flag missing values (no preliminary estimation), before they publish the data to the respective DSO. For customers with RLP or SLP measurements (customers who either did not agree to change to a smart metering system or could not be equipped, e.g. for technical reasons), DSOs use their own proprietary communication and measurement system. Data from the smart meters are published with a standardised communication interface called MDUS (xml-based).

Luxmetering data only contains meter IDs (no information about the customer). Only in the DSO's systems, the ID is matched with information about the customer and data from suppliers about the PoD. Luxmetering archives the data for 15 years.

In case of communication issues in the AMS infrastructure, Luxmetering troubleshoots with field devices and DSO communication channels. In case of corrections, the DSO informs Luxmetering and they make new data available. There is no direct connection of Luxmetering's B2B data platform to the DSO's systems and the data provided by Luxmetering is not validated by the DSO's systems.

Finally, Luxmetering manages a central public-key infrastructure (PKI) for all smart meters in Luxembourg that should ensure the integrity, confidentiality and authenticity of smart-meter related data.

3.2.2 DSOs

Today, each DSO needs to communicate directly with all the relevant suppliers. The DSOs send data to the market every day before 8 AM for electricity and 12 AM for gas. The responsibility for billing grid fees and taxes is allocated to the grid companies who then pass on the process to the suppliers who include the positions in their bills to the end customer.

Due to the lean structure of Luxmetering, that solely deals with data collection and validation, as well as acting as a coordination forum for DSOs, the grid companies are tasked with technical validation of all meters other than the smart meters. For RLP customers, consisting of industry and commercial players, the automated meter reading (AMR) head-end system is used for technical validation. Quarter-hourly value readouts for power and hourly readouts for gas devices are performed. Monthly reports are issued to compare load profiles to meter reads. For SLP clients, annual indexes are created that are then corrected by DSOs based on usage factors when meters are controlled.

MaCo standards allow for the (recently established) automation of transmitting load profiles and meter reads to suppliers via MSCONS Lux for power and standardised CSV forms for gas.

The MaCos contain information about a range of actions that one market participant needs to communicate to another player to align databases and prevent errors. The LUXMACO, operational since October 2017, includes:

- Switch of supplier
- End of supply (by supplier/DSO)
- Start/end of basic replacement supply
- Metering data (index/load curve – aggregates)
- Master data changes
- Business data requests
- Inventory lists
- Grid invoices
- Locking/unlocking of electricity/gas delivery
- Cancellation

The DSOs are also responsible for passing on to the suppliers the information on the billing of grid fees and taxes.

3.2.3 Suppliers

The suppliers are on the receiving end of the MaCo processes. They receive measurement data from the DSO and match their information about client master data with the grid companies to the ones in their own database.

They then send the bill including the grid fees from the DSO and the fees for energy usage to the customer.

3.2.4 3rd parties and authorities

Authorities and other third parties (communities, energy service providers) that wish to get access to measurement data, either on customer or on an aggregated level have to make a request to the DSO.

The landscape for 3rd parties other than the regulator is still underdeveloped. In fact, developing this segment with suppliers of innovative energy services is one motivation of implementing the NEDP. An example for a communication process that already has relevance today is monitoring the progress in the *Klimapakt für Gemeinden* (Climate Pact 2.0) which is based on the European Energy Award. Municipalities can achieve different community energy labels based on external audits. Once the labels are awarded, progress in the proposed plans should be measured. Often consumption and/or production data, i.e. data that in the future will be stored in the NEDP, can be useful in doing so. A similar initiative that takes the concept to commercial companies is under development.

3.2.5 End-users

The end users send their master data to any contract partner they engage with. This includes both the chosen supplier for the electricity supply contract and the (mandatory) DSO for the network usage agreement but also any other third party they wish to assign. After the implementation of smart meters, the measurement data are sent to Luxmetering automatically via the smart meter infrastructure, without any further responsibility of the end user.

3.3 Challenges with today's processes

Considering today's situation of the Luxembourgish market and the involved business processes, three different types of challenges became apparent from the stakeholder interviews.

Technical challenges

Probably the most prominent challenge mentioned was the lack of a single source of truth for master data. As clients enter separate contracts with the DSOs (grid connection contract), suppliers (supply contract) and third parties (e.g. smart home providers), their master data is stored in separate databases at each of the entities. This is a major source of low process efficiency as errors in the datasets trigger an intricate process to correct the data and align them in the different databases. This leads to e.g. billing delays or in the worst case to uncollectable or wrong payments if names are stored differently in different databases and suppliers cannot obtain the right metering values to base their calculations on.

Another cost factor that was mentioned several times is the burden of the reporting process to authorities. To monitor the functioning and efficiency of the market and create statistics, ILR collects data from DSOs and suppliers that are often based on Excel forms that have to be filled by the companies in regular intervals. Collecting the desired data and putting it in the right format imposes costs to them that could be drastically reduced via the automation of processes or giving access to specific datasets to the regulator.

Process / organisational

Data quality was named as an issue. However, it was not the data quality itself, i.e. the number of errors (missing, not matching, wrong data) per amount of data, that was seen as problematic. It is the process of managing data errors that was considered the main challenge. Correcting mistakes and creating a cohesive dataset should be in the interest of all market parties. As there exists no single source of truth for master data, ownership to correct missing or erroneous data lies in the sphere of responsibility of DSOs and suppliers. However, the obligations (for example towards the customer), costs for correcting data, incentives consequences for resulting delays and ownership of correcting poor data are not always clearly defined and aligned properly. This makes the management of data errors an ineffective process.

Market transparency and access

The small size of the Luxembourgish market, in combination with the market processes that are specific to the market, act as a barrier-to-entry to new entrants and thereby impacts competition. Furthermore, the presence of only a handful of actors and their interlinkages to some degree limits transparency.

The very strong market concentration in both the electricity and gas market represents yet another layer to this issue, as the dominant position of the leading companies and their experience with the particularities of the existing market communication system also creates advantages that are hard to make up for small, and especially foreign entrants.

Additionally, third parties' ability to receive the needed metering data for performing their services, e.g. aggregation, require interaction of at least two parties (with customers, to enter into a contract, the relevant DSO, to acquire the necessary data), and might thus hinder the ability to offer their innovative services, flexibility to the market. Even if the customer mandates a third party to access their data they are not transferred in a standardised way, as there is no adequate API for aggregator activities, unless the aggregator also is a supplier and participates in the MaCo. It is even challenging for the end-customers themselves to get access to their own smart-meter data from a neutral source.

3.4 The counterfactual scenario

Even though the complexity of the energy market in Luxembourg today is limited compared to other countries, both with respect to market size and number of players, the transformation of the energy sector will lead to more complex data flows that will become increasingly difficult to manage also in Luxembourg. This evolution will happen with or without a centralised data platform. In order to create an understanding of the full benefit potential of the NEDP, we describe here a counterfactual future scenario where the performance of the existing decentralised data structure in Luxembourg in meeting these future challenges is assessed.

In the 1990's the energy services value chain was essentially dominated by large, vertically integrated utilities that covered everything from energy production over distribution and customer sales. Unbundling in the form of establishing independent network companies was the first step towards a more complex structure. In the future, this trend of fragmentation of this value chain will likely continue and even pick up pace. New services, new technologies and new business models will drive this fragmentation: The rising share of distributed production in the form of prosumers and resulting bidirectional flows on the power grid, emerging innovative energy services that digitalisation offers, also at the intersection of gas and power markets, and new sensor types in smart homes that optimise consumption patterns by automatically steering appliances, also via aggregators, all are parts of this development.

To optimally react to those changes, new data communication paths emerge and have to be organised in an effective way.

With the increase of the number of stakeholders needing access to data in different forms the number of communication interfaces will also increase. The complexity that has to be dealt with in a decentralised data architecture will thus grow exponentially. New bottlenecks might occur that pose major inefficiencies in the data flow. Especially where data is needed in (close to) real time, these inefficiencies represent major potential barriers for further development.

This move to closer real time actions and reaction to these developments on the market by an expanding group of players is actively pushed within the EU. A first step is the multiplication of metering values per meter per day rising to 24-96 values. 24/7 access to this data, as well as more active response to price developments and green qualities of the supply mix, also through e.g. hydrogen feed-in in the gas markets, will likely lead to transversal shifts in the habits of end users. Sector coupling of gas and electricity markets will evolve over time and also open new opportunities for 3rd parties and new market entrants that specialise in the optimisation of customer consumption patterns, the offering of storage services and coordinated self-generation on residential level via local energy communities.

This trend towards vastly growing amounts and types of data is another challenge that presumably will be more difficult with a decentralised data solution.

One last aspect is the needed flexibility to react to future, today unforeseeable developments. New data, new combination of data via advanced analytics methods may be required in the power market of the future. A constant adaptation of business processes in a more competitive market, as well as a dynamic regulatory framework will be required. A decentralised data structure that are designed to host specific data types only does not have the flexibility required to react to such developments. Different proprietary solutions and data formats and thus lack of standardisation can potentially contribute to a data architecture that is too slow to adapt in the desired speed to harvest benefits that lie in data analytics.

The next chapter discusses the foreseen adoption of the NEDP, the processes in each phase and how they will change compared to today's market functioning.

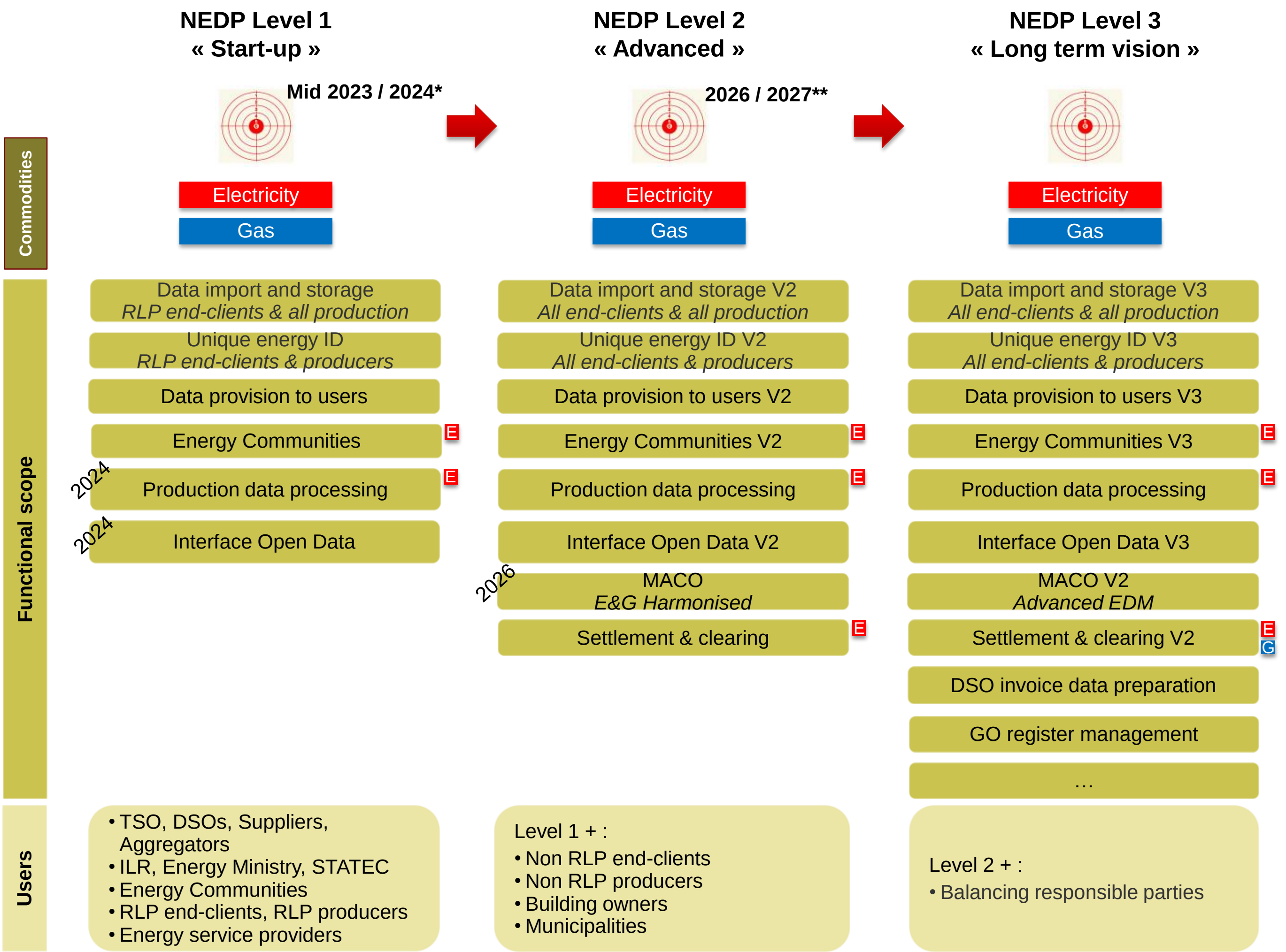
4 CHANGES WHEN NEDP IS ESTABLISHED

The abovementioned challenges are to be met by an improved data infrastructure for the exchange of energy data, which enables efficient data exchanges across all players active in the power market, in a further step also creates a structure to harmonise dataflows of the electricity and gas markets in Luxembourg.

4.1 The NEDP will be implemented in three phases

It is planned to implement the Energy Data Platform for electricity and natural gas in three phases, with the first version to go live by July 2023. The three phases (expansion levels) are summarised in Figure 2.

Figure 2: Functional roadmap of the Platform



Level 1

Level 1 of the NEDP, the "start-up" phase, is expected to be launched from mid-2023, and begins with the migration of first data flows and master data onto the energy platform.

To test the concept of the NEDP in the first iteration, only RLP end users and producers will be included at this stage. Energy-related data regarding these clients will be imported and stored in the NEDP. A large change compared to today's system is also the distribution of unique energy IDs to RLP clients and producers in order to create a unified database for the TSO, DSOs, suppliers and future 3rd parties. Introducing the energy ID is a mandatory step and factually a precondition for the functioning of the NEDP.

It will also allow a much easier dissemination of the data on the hub to the respective users, by also giving them access to the select data that is relevant to them and restricting their access to other data that is central for the data privacy of the corresponding end-user. Explicit consent of the client is necessary for the service provision of 3rd parties.

Luxembourg has already implemented a legal and regulatory framework for the creation of Energy Communities. It is expected that the data platform can serve as a catalyst for the creation of more Local Energy Communities in the country when necessary data access and data sharing become more effective.

Furthermore, phase 1 will facilitate the aggregation of data for regulatory monitoring and statistical purposes. At the same time, the data platform is also meant to serve as the national register of power plants. Here, dataflows to the platform will be established in 2023, whereas the processing of production data is planned to commence in 2024. This will lead to a more efficient management of production data and therefore a more efficient processing of the payments of the compensation mechanism. Also in 2024, energy data will be provided to an open-data platform that will help improve information flows about the functioning of the Luxembourgish energy market.

No market communication processes will take place in the NEDP in level 1, meaning it will only function as a reporting hub. In this phase, Luxmetering will continue to publish end-user smart metering data to the DSOs, who will complement the datasets with missing and manually read data and then file them in their own databases. Suppliers will still get access to non-RLP end-user data via DSOs at this stage. At the same time, a new DSO-NEDP interface will be developed and implemented, where the DSOs are to synchronise their RLP master data in preparation for the next step of integrating all user data into the data platform.

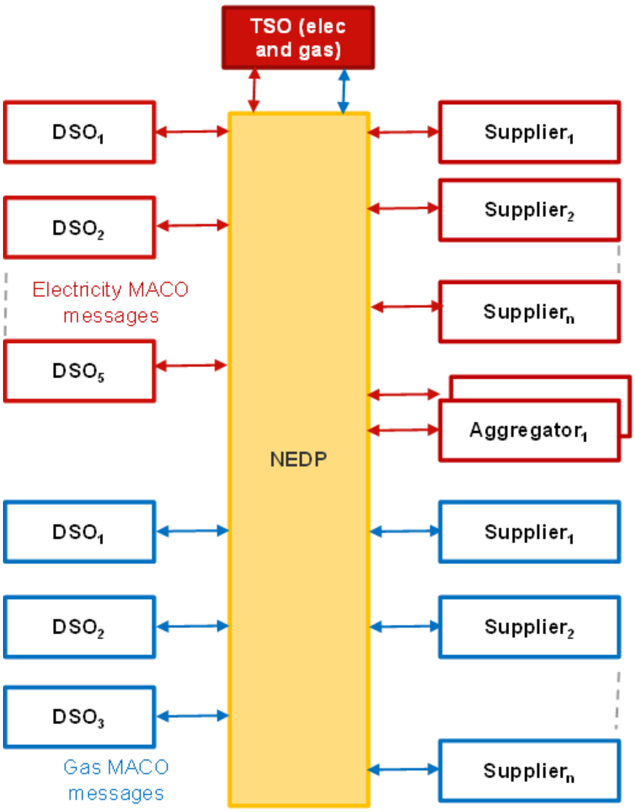
Level 2

The second phase, "Advanced", concludes in 2026 with the implementation of the new market communication process. It will lead to a full harmonisation between electricity and gas markets. From 2027, all end-user data will be included in the NEDP, with all data exchange processes happening centrally through the NEDP rather than through each DSO's IT system. As illustrated in Figure 3, DSOs, suppliers and aggregators will only need to be interfaced with the NEDP. Luxmetering will from this date on publish data directly to the NEDP.

Balancing settlement and clearing calculations carried out by the TSO and the DSOs will also be based on the aggregated data on the NEDP from 2027.

This step will also allow to generate reports specifically tailored to individual municipalities in order for them to monitor their progress towards climate and energy policy targets under the Climate Pact 2.0 (and be monitored accordingly by the authorities responsible for handing out subsidies related to the programme).

Figure 3: The new market communication process



Level 3

The third phase outlines the NEDP's "Long term vision". The MaCo will here be updated to enable advanced energy data management. More processes will be centralised, such as data aggregation for settlement and clearing for gas, as well as invoice data preparation and provision for both electricity and gas. A further possible option that is under discussion is that the national Guarantees of Origin register for renewables could be moved from ILR to the NEDP and be handled there.

To utilise operational synergies, the smart meter platform of Luxmetering might be integrated into the NEDP at this stage, but this is not decided yet.

The flexibility of the data platform should also allow to implement additional features and store data from other digitalisation processes in the energy sector as the energy transition continues. CREOS explicitly underlines that new trends that involve large data needs, e.g. flexibility services, should be enabled by the NEDP. Furthermore, water and heat data might also be integrated into the data platform at a later stage.

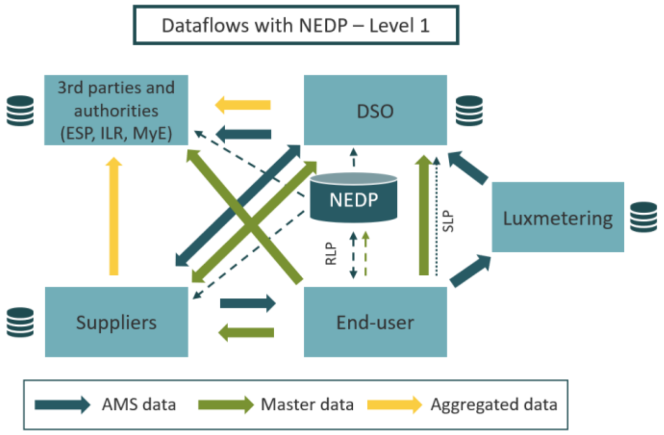
4.2 Detailed description of how relevant processes will change after the EDP is introduced

Level 1

While the start-up phase does not include the data for end-users connected to the low-voltage grid, it already sets up the reporting structure used for when the NEDP becomes the central platform for data exchanges and market communication. While still only serving as a reporting hub, and that for the moment only for RLP clients and all generators, regardless of metering type, interfaces for DSOs, suppliers as well as 3rd parties and authorities are set up. Additionally, the unique energy ID for RLP master data leads to a convergence of previous databases at stakeholders on the way to establishing the data platform as the single source of truth.

The complementary character of the NEDP in this phase becomes apparent when looking at the illustration of data flows in Figure 4. Here, dataflows remain as they were before the NEDP introduction.

Figure 4: Schematic illustration of the dataflows in the start-up phase of the NEDP.



Market communication and market processes still work in their traditional ways (cf. Figure 1). The difference is that now, the data of RLP clients, instead of being passed on to the DSOs, is directly transferred to the datahub. Stakeholders with the necessary permissions can access the relevant RLP from the interface with the NEDP. This step will also help create statistics from aggregated data for Luxembourg's statistics office and allow for more efficient compliance monitoring by the regulator.

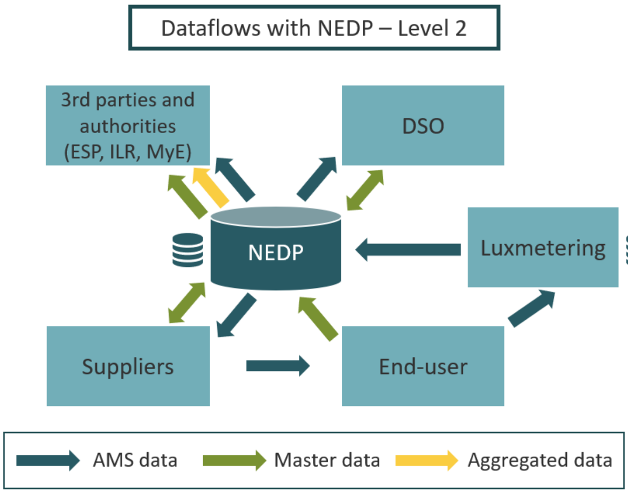
Level 2

With the go-live of phase 2, the "Advanced" EDP, the dataflow structure changes drastically. Now, old flow patterns are almost completely replaced as all end-user data, for AMS data via Luxmetering, ends up being centrally logged on the datahub. The new dataflow structure is illustrated in Figure 5. It becomes evident when comparing with level 1, that this is where the NEDP starts creating value for the energy market, as MaCo harmonisation takes place, data quality issues can be improved through the introduction of the energy ID for all users, the central hub communication and the EDP becoming the single source of truth for all master and metering data in

Luxembourg. As depicted, the NEDP also introduces the possibility of accessing aggregated end-user data for 3rd parties and authorities.

In general, this step entails a clear simplification of data flows and positions the energy data hub in the centre of the communications architecture of Luxembourg's energy markets. It will also improve the information accessible to prosumers that are willing to engage in setting up local energy communities. Billing processes, as well as settlement and clearing also will be introduced at this stage for the electricity sector but are not depicted in the figure below.

Figure 5: Schematic illustration of the dataflows after successful implementation of stage 2 of the NEDP.



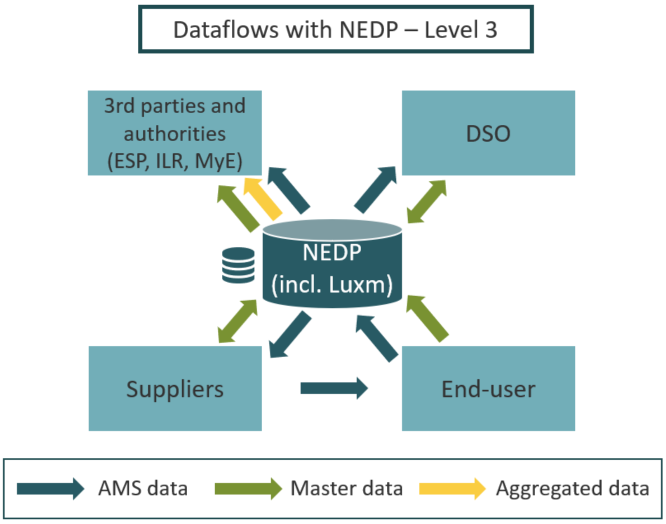
Level 3

For the further development of the NEDP, the question remains how the changes on the energy markets will transform the need for data handling on the data platform. The integration of Luxmetering into the hub could reap additional benefits, as apparent synergies could be used in IT structures and costs saved on the upkeep of database structures (see Figure 6).

This step should also further advance the integration of the gas sector in the data platform and include data handling of balancing responsible parties into the settlement and clearing. The preparation for DSO invoices can at this stage also be taken over by the NEDP, after data quality issues have been removed and the data on the hub is sufficiently validated over time.

Furthermore, the addition of other services, e.g. the management of the GO registry, may take place over time. Constant adaptations and the need to flexibly improve the services of the NEDP to respond to new innovations and sector coupling will further increase possible future benefits.

Figure 6: Schematic illustration of dataflow changes with the potential integration of Luxmetering into the NEDP.



5 POTENTIAL BENEFITS OF THE NEDP

The objective of the NEDP is to centralise energy data and give secure and useful access to the data to authorities as well as companies and individuals with the right to access specific data. This should improve statistics about the market and market communication. In this chapter, we describe the possible benefits of the NEDP, and quantify some of the key benefits for which data was available. This analysis is targeted towards the benefits that the data platform can achieve at the "Advanced" Level 2 and onwards, as this is where we believe the main benefits to start manifesting.

Some of the discussed benefits will materialised in the future, where we expect the complexity of the data flows to increase considerably (cf. Section 3.4).

5.1 The 10 types of potential benefits

Error! Reference source not found. gives an overview of the expected benefits from the NEDP that we have identified based on the interviews with Luxembourg stakeholders and the international experiences previously described. The benefits fall into two categories:

1. *Benefits that will be supported by the introduction of an NEDP but are not an automatic outcome of its implementation alone. Processes and structures outside of the NEDP have to be adjusted to unlock these benefits' full potential. This adjustment can (and should be) a part of the NEDP implementation project.*
2. Specific benefits related to the introduction of the NEDP.

The first category comprises two types of benefits that are key to improving the functionality of the retail electricity and gas markets in Luxembourg and which are perceived as barriers to development today:

A. Increased measurement and data quality
B. Accountability and definition of responsibilities

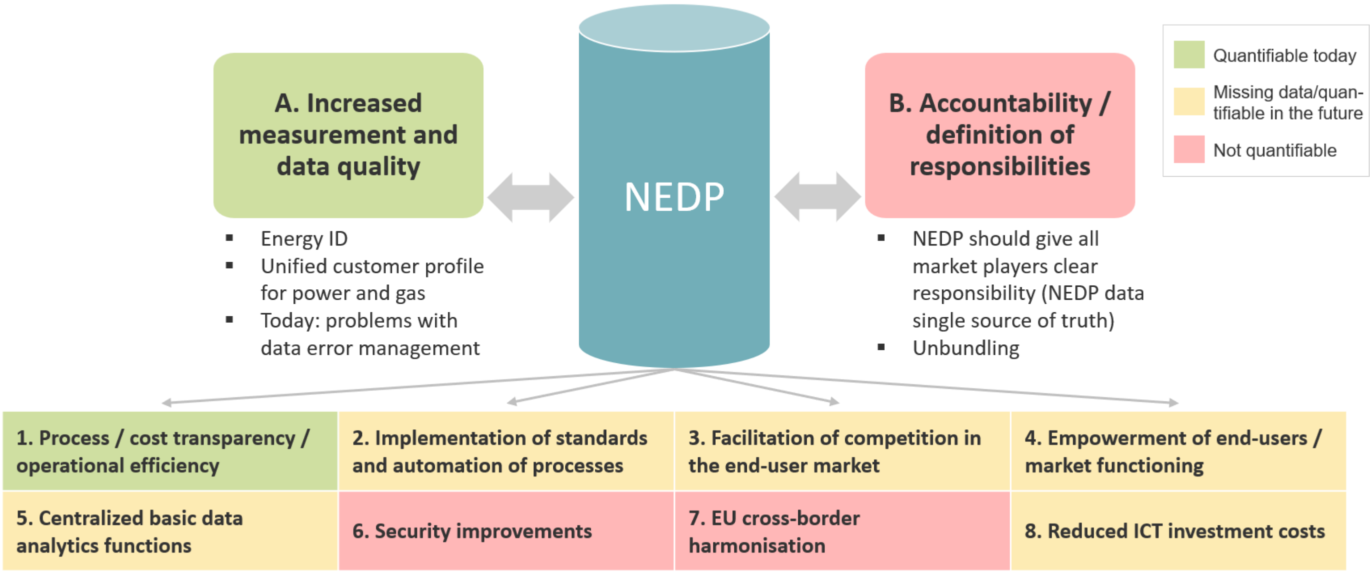
Addressing them as part of the wider NEDP market reform process is a precondition to reap the benefits in the second category that are shown in the bottom part of the graphic. In this category we find a total of eight types of benefits, including increased operational efficiency, improved competition and market functioning, data analytics, security improvements and ICT investments. The benefits in this second category are difficult to realise without having solved the first two issues that we highlighted, data quality and accountability. Furthermore, we assessed which of the categories can be quantified:

Green coloured boxes indicate that it is possible to compare today's processes with the expected design changes of the NEDP and we therefore also conducted a quantitative analysis of them. In order to capture the entire value of the NEDP, its implementation has in principle to be compared to the counterfactual scenario in the future (see Chapter 3.4). However, since the ongoing dynamic changes in the structure of the power and gas markets make it challenging to define the market processes in 5-15 years, we focus our quantitative analysis on observable processes in the present.

Categories in yellow could theoretically be quantified. However, comparative data will either only available in the future or an assessment would require access to more process data of the relevant companies and an in-depth analysis of their implications that would exceed the scope of this report. We therefore qualitatively assess yellow categories and outline, where possible, what cost savings possible changes could entail.

Red categories are in our view too abstract to be quantified at all.

Figure 7: The introduction of the NEDP brings the potential to realise benefits in several categories that THEMA tried to assess qualitatively and, if possible, also quantitatively. The respective categories are described and assessed in detail in Chapters 5.1 and 5.2. They are categorised according to whether they are quantifiable today, quantifiable with wider data access or as soon as data can be collected on a before/after basis or not quantifiable due to abstract impacts that are impossible to measure.



In the following, we describe the benefits per category in more detail and assess their importance qualitatively.

5.1.1 Increased data quality

Today, retailers and DSOs in both the electricity and the gas market report issues with the quality of the customer master data such as name and address of the customer. There is no single energy ID that is linked to a metering point, which means that the same customer can be registered with a different profile with different suppliers and DSOs. This, in turn, makes it difficult to carry out standard processes such as moving in and out or changing suppliers. Correcting errors is a time-consuming process which increases costs for suppliers and DSOs and ties up labour that could be used for other purposes. Hence, increased data quality provides an economic benefit.

Establishing a single and unique national energy ID would go a long way towards resolving these data quality issues. In principle, this can be achieved without establishing the NEDP. However, the NEDP can serve as a catalyst to speed up the process and ensure that the energy ID is introduced in an efficient manner. The NEDP would enable the setting of clear deadlines and allocate responsibility for developing the national energy ID which is likely to be more difficult in a decentralised model. With a decentral solution, a set of standards would need to be defined and enforced, and corresponding regulation and monitoring aimed at all DSOs and market participants would need to be implemented. Also, work must be done to correct the underlying errors in the master data in particular, which requires a coordinated effort on the part of all involved stakeholders.

A related benefit was observed with the introduction of the Norwegian datahub, where there were large discrepancies in the customer master data between electricity DSOs and retailers prior to the introduction of the hub. While this process took considerable time and effort, it was necessary in order to facilitate the development of the electricity retail market and innovation, and it is likely that the clean-up process of the master data would have taken longer and been more costly in a decentralised model without significant pressure for change.

5.1.2 Accountability and definition of responsibilities

Another barrier to developing the Luxembourg energy retail markets is the perceived lack of accountability of stakeholders and a lack of clarity with respect to the definition of responsibilities for different aspects of data exchange. For instance, there is no single source of authenticated master data or metering values, and it is not clear who is to be held accountable for errors in data. The strong market position of formerly vertically integrated incumbents is another issue that reduces the transparency and can make it difficult for customers and third parties to understand who is responsible for different aspects of data exchange and quality. Accountability with respect to data quality and integrity and clear responsibilities in data exchange are important to enable the further development of the retail electricity and gas markets.

Again, this is a benefit that could also be realised without establishing the NEDP. However, we would argue that the establishment of the NEDP can facilitate the definition of clearer roles and responsibilities in data exchange, making it possible to increase transparency and hold the relevant organisations accountable for data and process quality.

5.1.3 Process/cost transparency and operational efficiency

In this category, we placed the different data exchange requirements that follow from the business processes in the retail energy markets:

- Moving in and out of customers
- Supplier switching
- Billing

All these processes require that master data and metering values are exchanged, for instance between two suppliers and a DSO in the case of a supplier switch.

In the current model with decentralised data exchange, market participants experience several problems and costs that arise from imperfect data exchange. These could be related to errors in the master data as described above. For instance, if a supplier and a DSO have different names registered for the same customer, or there are errors in the address or metering point ID, the DSO and the suppliers must spend time on correcting the data if the end-user is going to be able to change supplier. At worst, a supplier change may not be feasible due to data errors. Another issue is that some DSOs may have limited resources for handling data exchange processes, causing delays and costs to suppliers and end-users.

With a centralised model for data exchange under the NEDP, we would expect data exchange to be more efficient than in a decentralised model. Part of the reason is that the NEDP should enable significant economies of scale through a larger organisation being able to handle all of the relevant data exchange processes for the entire electricity and gas market in Luxembourg, rather than having the tasks spread between the DSOs. Quality should also improve, partly through the national energy ID that we have argued will be a benefit from the NEDP, and partly through a larger organisation with more resources and flexibility that should also reduce delays. Having said that, the concentrated industry structure is likely to reduce the potential benefits compared to e.g. Norway or Switzerland (with more than 100 and 600 DSOs respectively).

Another area where the NEDP can yield efficiency improvements is regulatory reporting. Today, DSOs and suppliers are required to report on different aspects of their activities to both ILR and the national statistics body. With the NEDP this reporting can be simplified and automated to some extent.

5.1.4 Implementation of standards and automation of processes

The market communication processes and standards for communication such as data formats are subject to significant changes over time. Increasingly, market communication processes are also automated. Implementing new standards and changes to market communication processes is easier and cheaper with a data platform compared to a decentralised solution where all DSOs and market participants must implement changes individually. A data platform that covers both gas and electricity also makes it possible to harmonise processes across different energy markets. An important step regarding this will be the harmonisation of Luxembourg's MaCos for both the electricity and gas market, with a view to expanding this to water and heat in the longer term. We do not have sufficient data to estimate this benefit at industry level, but from information gained through interviews the potential cost savings may amount to around 100 000 EUR per year for a typical retailer in the Luxembourg energy markets.

Another possible benefit from the NEDP could be the ability to use open standard data formats to a larger extent as opposed to the current proprietary standard employed, although this is in principle also possible to implement in a decentralised solution through regulation.

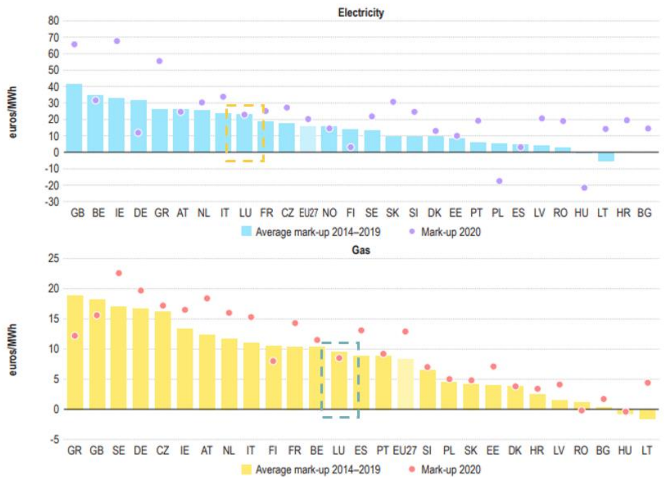
5.1.5 Facilitation of competition

Errors in customer master data and difficult access to data such as metering values pose significant barriers to market entry. Slow and costly market processes add to these barriers. This reduces competition in the retail energy markets as new players face high costs of entering and participating in the local markets. The data from ACER shown in Figure 8 indicate that retail margins in the Luxembourg electricity and gas markets are higher than in several other European countries, which is a sign of weaker competition compared to other countries.[2]

A data platform will enhance competition by reducing the barriers to entry. Specifically, new entrants will be able to get access to the necessary customer data in an easier manner. Harmonised rules, standardised processes and easier access to metering values will also lower the costs of competing in the retail electricity and gas markets.

While the benefits from more competition are difficult to quantify, by way of illustration a 1 EUR/MWh lower margin in the electricity and gas retail markets yields an annual reduction in energy costs for end-users of 14 million EUR with a net present value of more than 100 million EUR (assuming a ten-year lifetime and a real discount rate of 4.81%). This is primarily a redistribution from retailers to customers and not a welfare-economic benefit, but it illustrates the potential value to customers of increased competition.

Figure 8: Average annual mark-up in retail electricity and gas markets for HH consumers in the EU and Norway (in EUR/MWh, 2020)



5.1.6 Empowerment of end-users

For end-users, a data platform will enable them to get easy access and they will be able to grant access to own consumption (or self-generation) data to third parties that can be used to receive tailored offers to optimise consumption across energy carriers while taking into account self-generation, if applicable. From international experience, we know that easy data access for new suppliers is a key enabler of innovation in the retail markets.

If customers are able to optimise their energy use and manage risk more efficiently, this will yield an economic benefit and not just redistribution. Using the same example as above of a

[2] *ACER Market Monitoring Report 2020 – Energy Retail and Consumer Protection Volume*

change of 1 EUR/MWh in the value of energy use from optimisation and risk management, the benefits can exceed 100 million EUR in net present value.

Easy data access is also a key enabler of new ways of operating such as smart tariffing and local energy communities, which are dependent on correct metering values and more or less immediate access to the necessary real-time data. Real-time data will not be accessible in the platform in its currently foreseen form, and it not dependent on the platform to be introduced. However, we consider that introducing real-time data in the NEDP will be less complex and costly than in a decentral solution.

5.1.7 Centralised data analytics

Reliable and updated information about the electricity and gas markets is necessary for stakeholders including the TSO, generators, national statistics authorities, and the regulator. Collecting the data from a central platform is more efficient than from each individual DSO and supplier, and central collection should also enable more high-quality data to be delivered. It will also help in setting up standardised, aggregated data formats that can immediately be generated as outputs that are used by the relevant entities.

Furthermore, reliable consumption and generation data are necessary for subsidy schemes and allocation of Guarantees of Origin. For larger consumers and generators, a data platform will likely yield limited benefits, but for smaller market participants (including households, e.g., with self-generation or participating in demand response schemes) smart metering in combination with easy and natural access to data are critical for the schemes to operate efficiently and provide correct pay-outs.

A good example showing the benefits of the NEDP would be the monitoring of municipalities as part of the Climate Pact 2.0. Klima-Agence's certifications are decisive for the subsidy sums that a municipality can obtain. These annual subsidies can reach 9-11 mEUR, depending on the certification level. Obtaining aggregated municipality data from the NEDP about progress being made could simplify the evaluation process and help to centralise and refine Klima-Agence's monitoring. By that, it could lead to a more efficient tracking that would increase the impact per Euro spent on climate measures per municipality.

5.1.8 Security improvements

Data privacy and security are important to maintain, and the requirements are increasingly stricter as a consequence of GDPR regulations and a stronger emphasis on cybersecurity. A key advantage of a data platform is that the necessary security can be developed and maintained at a single point, which also enables economies of scale. However, this may be partly offset if the DSOs and suppliers have a need for storing the same data locally, hence requiring a similar set of security arrangements as the data platform. With a central platform, it is in any case easy to monitor access to data and possible breaches of requirements with respect to privacy and security.

5.1.9 EU cross-border harmonisation

Increasingly, EU regulations impact DSOs and suppliers through the development of network codes and the consequent need for data exchange. E.g., Directive 944/2019 requires Member States (Article 24) to facilitate interoperability of energy services within the EU and non-discriminatory and transparent procedures for data access.

In this respect, flexibility and interoperability are two keywords. Also, reporting obligations close to real-time statistics to the European DSO and TSO entities will likely increase over time. The NEDP will also help creating an efficient central open data interface between the national and European actors. The Estonian TSO Elering, together with several other European TSOs, executed a program where they called for pilot projects that implement novel business models that specifically make use of pan-European data exchange in the energy sector (Elering 2021).

5.1.10 Reduced ICT investment costs

A centralised data platform can give reduced ICT investment costs at DSOs, suppliers, authorities and other parties such as Luxmetering, if tasks like collection, validation and correction of data can be done centralised by the hub.

Experience from other countries with datahubs, e.g. Norway, shows that benefits are possible but also dependent on the need for parallel ICT infrastructure for handling smart metering and customer data that has to be kept, despite main dataflows being conducted via the data platform. This is highly dependent on the life cycle of existing ICT infrastructure and individual reinvestment strategies among the stakeholders. In principle, it could even lead to additional costs if the NEDP does not replace other data processes and infrastructure over time.

Figure 9: Benefit per category for each stakeholder group. Each of the presented categories has inherent potential benefits for the different actors on Luxembourg's energy markets.

	1. Process/cost transparency/ operational efficiency	2. Implementation of standards and automation of processes	3. Facilitation of competition in the end-user market	4. Empowerment of end-users/market functioning	5. Centralized basic data analytics functioning	6. Security /privacy improvements	7. EU cross-border harmonisation	8. Reduced ICT investment costs
End-users	+	O	++	++	O	+	O	O
DSOs	+	++	O	+	++	++	+	++
Suppliers	++	++	+	+	+	++	+	++
Authorities	+	O	O	O	++	O	O	+

Stakeholders can profit in different ways from the introduction of the NEDP

For end-users, especially a more competitive end-user market and access to 3rd party services and innovations will be the main benefits, while improved privacy and security, as well as more efficient supplier/DSO operations translated in cost savings will be additional gains from the NEDP. Figure 9 Figure 6: Schematic illustration of dataflow changes with the potential integration of Luxmetering into the NEDP summarises the main qualitative benefits and indicates which stakeholders are affected in the categories we identified.

For DSOs, the energy data platform will enhance operational efficiency, the automation of processes, improve data analytics and reporting to authorities, and security through one interface and access at the hub. As sensitive data is stored in a secure environment, this might also improve ICT investment costs for the grid companies to further develop their own solutions. Further ICT investment savings can also be expected, also from simplifying open data sharing via the NEDP, e.g., with EU entities. As end users become more aware of their consumption patterns, the data hub might facilitate the introduction of smart grid tariffs that help reduce grid costs over time.

Suppliers will benefit from lower barriers-to-entry as MaCos become harmonised and transparent. This could also be the case over time as European regulation increases cross-border harmonisation that will be aided by the NEDP. Similar to DSOs, they are also to gain from operational efficiency, process automation, security improvements and ICT cost reductions while their reporting obligations will also be simplified.

Authorities will mainly build on more efficient reporting standards and data collection processes to compile statistics. Increased transparency as well as time savings when dealing with data collection are other, more marginal benefits. The NEDP could also help in the DSO benchmarking process.

5.2 Calculating the NPV of benefits

In the previous section we described the possible benefits from the data platform qualitatively and gave estimates of their value where possible. For some of these benefits sufficient data are available that allow to calculate the net-present value (NPV) more accurately.

We calculated quantitative benefits related to the following market communication processes, i.e., benefits that mainly fall into category A and 1 above:

- Moving in and out
- Supplier switches (included supplier of last resort)
- Reporting to the regulator

These processes were selected as it is possible to describe the related benefits without very detailed supplementary analysis, and relevant data are also available. The other benefits do not meet these criteria. For instance, ICT costs under different solutions cannot be estimated without a thorough analysis of decentral and central ICT solutions, compared to the future needs and the existing systems in the sector. Oher benefits such as empowerment of end-users/improved market functioning (4), security and privacy improvements (6) and EU cross-border harmonisation (7) are difficult to quantify as it is difficult to describe the mechanisms generating the quantitative benefits, and in any case the relevant data are not available. The value of innovation in energy services is to a large extent dependent on the consumers' willingness to pay for different services, which is difficult to measure in practice. It is possible to quantify the cost benefit of a centralised data analytics function also (category 5), but the improvements in quality of analysis is difficult to quantify. Regarding implementation of standards and processes (2), we received information on the costs of adapting and implementing changes for suppliers today, but we do not have sufficient information to estimate the reduction due to a single platform as some of these costs are likely to be shifted to the platform.

Hence, we focused on the benefits that can be studied primarily from apparent accounting costs in energy companies and where these costs are reflective of the economic costs. We considered the costs of both DSOs and suppliers in this respect.

The benefits are calculated on an annual basis in real 2022 EUR and as net present values, using an assumed lifetime of the data platform of 10 years and a discount rate of 4.81 percent based on the regulatory WACC. For the moving and supplier switching processes, the expected reduction in time use is 45 %. We based this estimate on a consideration of inputs from Luxembourg stakeholders, ranging from 0-70% reductions, and estimates for cost reductions from a full datahub (similar to the NEDP level 2) from the Norwegian and Swiss studies referenced (in the Swiss study a cost reduction of 75% was estimated with a full datahub). However, we adjusted the reduction downwards to account for the more concentrated industry structure in Luxembourg. Also, we emphasise that the cost reductions are dependent on the NEDP resolving the data quality issues discussed above. It also requires harmonised market communications processes and clear roles and responsibilities combined with lean processes. A lifetime of 10 years was chosen based on experiences with other energy data platforms and similar IT projects that require redesign and hardware replacements after a period of time (in addition to the continuous updates and adjustments that are part of any data exchange solution whether it is decentralised or centralised).

As a basis for the quantitative analysis, we interviewed key stakeholders in Luxembourg's energy markets, both DSOs and suppliers, and asked for quantitative estimates of specific parameters. In addition, we used our experiences from the Swiss electricity and gas markets and data from Elhub in Norway to corroborate and adjust the inputs of Luxembourgish stakeholders.

The main source of benefits that we quantified relates to the hourly effort by employees of DSOs and suppliers that follows from more efficient processes and fewer errors due to a higher data quality. We compared the baseline costs of the selected processes in a decentral data exchange solution with the expected cost reduction from the introduction of a central data platform. Acknowledging the uncertainty in the cost reductions, we defined three scenarios for the benefits, low, average and high.

For the processes we were able to quantify, the net present value of the benefits over a ten-year period is estimated to range between 7.8-10.6 million EUR, with an average estimate of 9.2 million EUR. The following two illustrations show the net present value of the average benefits and the total range. As can be seen from the first figure, the main source of benefits is due to more efficient moving processes. In the following sections we describe the assumptions behind these results.

Figure 10: Net present value of benefits (average estimate). EUR million

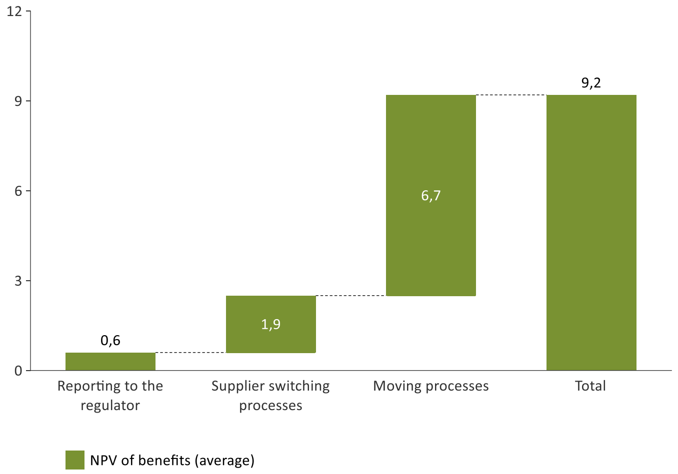
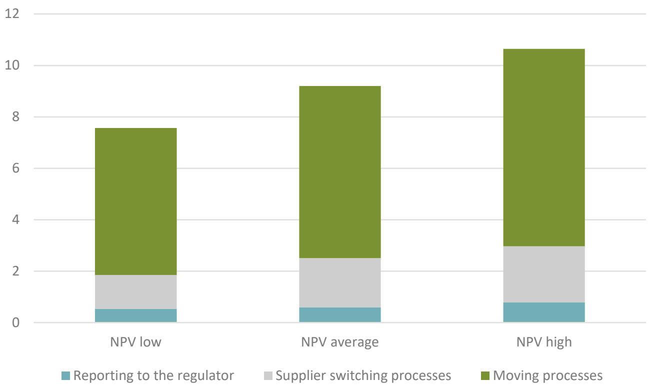


Figure 11: Net present value under different assumptions - low, average and high estimate. EUR million



We performed two sensitivities to the calculation of benefits from the NEDP. First, we also estimated the potential cost savings if the higher estimate of a 70% cost reduction is applied (based on the range estimated by Luxembourg market participants). This gives benefits in a range of 11.8-16.1 million EUR, with an average of 14.0. Second, we estimated the net present value of benefits using a lower discount rate of 3 percent, based on recommendations in the Guide to Cost-Benefit Analysis of Investment Projects by the European Commission [3]This gives benefits in a range of 8.5-11.7 million EUR, with an average of 10,1 million EUR.

5.2.1 Category A, 1 : Moving

Many people move within and to/from Luxembourg. The share of customers moving per year is assumed to be 17.5 per cent, which is the average rate reported by a set of stakeholders.[4] When a customer moves, one or more DSOs (depending on whether the customer moves out of the DSO's area) must update their customer master data with the new address of the customer. The supplier must also update its data. If the move is within Luxembourg, the customer must be registered at the new address as well. The main benefit of a data platform stems

3 https://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/cba_guide.pdf

4 In the Swiss study by THEMA and Devoteam the corresponding moving rate was around 14 per cent.

from the central storage of master data and consequently fewer discrepancies and errors. There are also some likely benefits from the central storage and easier accessibility of metering values at the time of the move, which simplifies settlement and billing and removes any uncertainties in that respect.

Today, the moving process takes about 8 minutes for the DSO, and we have used a similar estimate for the supplier. After the NEDP is established, the expected reduction in time use is 45 per cent.

Suppliers

The benefits will be shared between DSOs and suppliers. In the Swiss study, THEMA estimated that 60 per cent of the benefits accrued to the DSO and 40 per cent to the supplier. We do not have any information on this split in the Luxembourg market.

5.2.2 Category A, 1: Supplier switching

The share of customers who change their supplier is only 0,3 % each year in the electricity market, the switching rate is even lower in the gas market. In addition to switching supplier, there are switches related to e.g. supplier of last resort and temporary connections. The total share of switches is 4.85%. In the analysis, we used a switching rate of 5 per cent which is in line with what we would expect in a well-functioning retail market, and which can also be interpreted to reflect switches related to the default supplier.

The inefficiencies in the current system are largely similar to what we described above for the moving process, and hence the benefits from a data platform are also similar.

Today, the switching process takes about 8 minutes for the DSO, and we again assumed a similar time use for the suppliers involved. After the NEDP is established, the expected reduction in time use is 45 %, again based on inputs from Luxembourg stakeholders, considerations of other international examples and the industry structure.

5.2.3 Category 1: Reporting to the regulator

Each year both DSOs and suppliers need to report data to the regulator and the national statistics organisation. Based on estimated time use for Luxembourg stakeholders today, we identified a potential reduction of 700-1300 hours spent on reporting annually in total. With hourly costs provided by stakeholders, this yields an annual cost reduction of EUR 53 500-100 000.

6 MONITORING OF BENEFITS

In the previous chapters we described and analysed the possible benefits from the NEDP, concluding that the potential benefits are substantial. However, it is necessary to monitor the development and eventually the operations of the NEDP closely to ensure that the benefits are realised. For that purpose, we present our recommendations in this final chapter on how Luxembourg authorities can monitor the benefits from the NEDP over time, aiming at defining a set of Key Performance Indicators (KPIs). These KPIs can be used for several purposes during the development process. One such purpose could be to monitor progress and to inform decisions about project milestones, i.e., whether the project has been developed sufficiently to move to the next stage. It will also be useful for the public debate about the platform and to identify needs for further development. When the platform is established, one may also use the KPIs to create regulatory incentive mechanisms.

As our starting point we used the framework from the benefit realisation report of the Norwegian Elhub published in 2020, tailored to the particulars of the Luxembourg energy markets and the planned functionality of the NEDP. We then summarise the proposed indicators according to the categorisation of benefits in the previous chapter.

6.1 Data quality and data exchange

With respect to data quality, the Elhub report analysed how the data platform had contributed to increased data quality and faster data exchange. Aspects of data quality and exchange that were assessed included the following:

- Metering data quality
- The basis for balancing power settlement for suppliers
- Customer and meter asset data quality
- Exchange of metering values, customer and asset data.

The assessment was based on a combination of quantitative indicators and qualitative information:

- Data that shed light on metering value quality and master data quality were collected from Elhub and the official statistical authority Statistics Norway. This included data for the completeness of metering values and measured consumption at different intervals from the time of consumption (e.g., D+1, D+2, D+5, where D denotes the day of consumption).
- Interviews with market participants were carried out, to get qualitative feedback on their perception of data quality and data exchange processes.

We consider that these indicators are highly relevant for the NEDP as well, given the functionalities included and the defined objectives of the platform. Considering the limited number of market participants, carrying out interviews with a representative set of actors should be feasible. We also consider that regular reporting of specific data quality parameters should be possible if the parameters are defined at an early stage and the reporting routines are in place.

Monitoring statistical indicators should be possible on a fairly frequent basis. Elhub publishes monthly market reports that include a section on data quality. Interviews can be carried out less regularly, although it is also possible to use a simple survey that is sent out annually as an example.

6.2 Neutrality, competition and third-party access

Another Elhub objective is to contribute to enhanced neutrality and increased competition. This was assessed based on the annual Elhub customer satisfaction survey among market participants who inter alia were asked on the degree to which they agreed (or disagreed) with a set of statements, such as "*whether Elhub acts in a neutral, transparent and fair manner towards all market participants*" and "*whether Elhub acts in a manner that increases the degree of equal treatment of suppliers and third parties*". In addition, interviews with market participants and statistical indicators on e.g., supplier switches were used as inputs in the assessment.

We consider that these indicators are relevant also for the NEDP and that the necessary data can be collected through simple customer satisfaction surveys regularly, combined with statistical data from the electricity and gas markets on e.g., supplier switches, retail margins and new entrants. The statistical indicators can be collected at different intervals depending on the availability of data (monthly, quarterly or annually).

6.3 Customer rights and access

This category comprises customer rights and access to data, data security and privacy. The stated objective in this category was that Elhub should contribute to improvement after Elhub go-live. Again, this was assessed qualitatively, primarily based on the annual customer satisfaction survey where market participants inter alia were asked whether Elhub handled data security in a sound manner and whether Elhub had contributed to increased protection of personal data and privacy. The possibilities of customers to access their own data was also considered based on a review of the functionalities of Elhub, as well as other observations such as the introduction of encrypted messages.

Again, we find that these indicators are relevant for the NEDP and can be assessed in a similar manner, e.g., through a customer satisfaction survey and observations on NEDP functionalities and standards.

6.4 Economic benefits

The category of economic benefits consists of the cost savings related to the different business processes such as supplier switches, moving of customers, and termination of contracts. The expected benefits were quantified at different stages of Elhub development, and the initial effects were then quantified through interviews with DSOs and market participants in the 2020 report (after a short period of operations). These benefits broadly correspond to those quantified in the previous chapter, with the exception of regulatory reporting which was not part of the Elhub studies.

The economic benefits as described here are probably not suited for very frequent analysis as the benefits will be realised over time. However, assessing the cost savings every 2 years would be feasible in our view, based on interviews with DSOs and market participants. An initial analysis should be carried out to provide a baseline and a target to aim for.

6.5 Other potential benefits

Other potential benefits can come in the form of lower costs of implementing regulatory changes, which can impact both personnel and IT costs as it should be cheaper to implement changes at one central platform rather than in the IT systems and business processes of all market participants. We can also include the development of services that increase value for customers based on NEDP data alone or in combination with other data sources, possibly also based on IT applications that are included in the hub. These benefits can be quantified or assessed qualitatively depending on the type of benefit and availability of data.

It is difficult to describe this category in advance, and it will depend on the local context and future regulatory changes at the European and national level. Hence, our recommendation is to identify potential benefits through active engagement with stakeholders, for instance through the NEDP governance structure, participation in user forums and interviews.

6.6 Summary

The KPIs discussed above can be mapped to the categories of benefits we described in the previous chapter (see table on the next page). In order to measure the development over time, it is necessary to prepare routines for collecting data from statistical sources. Furthermore, a framework for conducting regular customer satisfaction surveys should be established, along with interviews with key stakeholders. It should also be investigated how the NEDP governance structures can be used for monitoring benefits.

Table 1: Possible benefits from the NEDP, KPIs and data sources

Benefit category	KPIs	Data source
A. Increased measurement and data quality	Observed errors in data and time used for corrections Qualitative assessment of improvements	Statistics Interviews
B. Accountability and definition of responsibilities	Qualitative assessment of improvements	Interviews Customer satisfaction survey
1. Process/cost transparency/efficiency	Quantified cost savings	Interviews
2. Implementation of standards and automation of processes	Quantified cost savings	Interviews
3. Facilitation of competition in the end-user market	Number of new entrants Retail margins Supplier switches Qualitative assessment of improvements	Interviews Customer satisfaction survey Statistics
4. Empowerment of end-users/market functioning	Observed availability of new services	Interviews Customer satisfaction survey
5. Centralised basic data analytics functions	Qualitative assessment and observed activities	Interviews
6. Security improvements	Qualitative assessment of improvements	Interviews Customer satisfaction survey
7. EU cross-border harmonisation	Qualitative assessment and observed activities	Interviews
8. Reduced ICT investment costs	Quantified cost savings	Interviews

7 CONCLUSIONS

In this report we described potential benefits of a National Energy Data Platform (NEDP) to be introduced in Luxembourg. The benefits were identified based on a review of international experiences, in particular from Norway and Denmark with datahubs in operation and from studies of a prospective Swiss datahub. The international experiences were combined with a study of the planned functionalities of the NEDP and interviews with Luxembourg stakeholders including market participants, grid companies and authorities. We identified 10 different types of benefits.

Most importantly, we expect the NEDP to be a catalyst for resolving two key issues that hinder the development of the Luxembourg energy markets today:

A. Increased measurement and data quality
B. Accountability and definition of responsibilities

Resolving these two issues present the most important benefits since they are mandatory to unlock the remaining eight. While this is in principle possible with an alternative decentral solution, we assume that the NEDP implementation project has the potential to provide a more efficient and speedier development of the necessary solutions.

Related to this is the issue of a national energy ID, that will create a one-to-one correspondence between metering point and individual customer and would be an important factor but is not yet in place. The centralised approach by the NEDP on the other hand creates a pressure for change and a common framework for establishing necessary standards and processes, as well as effective error management.

With data quality issues resolved and roles and responsibilities assigned, the NEDP will unlock further benefits. These can be classified into the following eight categories:

- Process/cost transparency and operational efficiency
- Implementation of standards and automation of processes
- Facilitation of competition
- Empowerment of end-users
- Centralised data analytics
- Security improvements
- EU cross-border harmonisation
- Reduced ICT investment costs

The lion's share of the benefits will only be quantifiable in the future. This because a) data will have to be gathered to perform exact calculations and b) some of these benefits will materialise fully only in the future, when we expect data flows to be much more complex than today. However, by way of illustration, a 1 EUR/MWh lower margin due to increased competition from lower barriers to entry and more efficient business processes would yield an annual reduction in energy costs with a net present value of more than 100 million EUR. A similar approach can be used to illustrate the benefits can be gained from optimisation of energy use and better risk management.

We calculated the NPV of some of these benefits where data was available, in particular those related to higher operational efficiency and lower costs due to less time spent on e.g., moving and supplier switching and regulatory reporting. These are estimated to range between 7.8-10.6 million EUR.

We propose a methodology that allows monitoring the benefits during and after the different phases of implementation. We advise to gather the necessary data regularly from statistics – that should be readily available after NEDP implementation – , stakeholder interviews and surveys, in order to make sure that the proposed benefits are actually captured.

Finally, our analysis identified two concerns that are important for the communication with stakeholders in the further development of the NEDP that were raised from several sides during the interviews:

- Against the background of the limited complexity and size of Luxembourg's energy markets and the concentrated industry structure, the benefits of a full-size NEDP must be well documented and justified.

- Tangible benefits for the end-customers must be clearly shown.

Addressing these concerns proactively will potentially help engaging relevant stakeholders even more in the implementation process. In this respect, our analysis should provide a platform for stakeholder engagement and communication. We compared a centralised NEDP with a decentralised approach, and we identified and analysed the beneficiaries and corresponding benefits in a structured way, linking the benefits to the specific Luxembourg context. On this background, we emphasise that for the end-customer, the benefits from the NEDP are likely to be substantial and be related to higher potential competition and better opportunities for optimising energy use. This is due to easier market access of new players, new energy services, more efficient processes that result in faster processing and lower costs, cost transparency and privacy protection improvements.

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