FlexSys

Work Package 3 Market Uptake | T3.3 Market definition

Deliverable 3.5: Report on supplier processes adaptation to enable the inclusion of small scale assets in the provision of flexibility services

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Contents

List of acronyms

aFRR	Automated Frequency Restoration Reserve
BRP	Balance Responsible Party
DSO	Distribution System Operator
EMS	Energy Management System
FCR	Frequency Containment Reserve
mFRR	Manual Frequency Restoration Reserve
SMR3	Slimme Meter Regime 3
TOE	Transfer of Energy
TRDE	Technisch Reglement Distributie Elektriciteit
TSO	Transmission System Operator

1. Introduction

This report covers deliverable D3.5 'Report on business processes adaptation to enable the inclusion of small scale assets in the provision of flexibility services', which is part of Work Package (WP) 3, task 3.3 Market Definition of the FlexSys project. This deliverable highlights the main aspects that need to be taken into account from an electricity supplier's point of view when offering residential flexibility services to households and identifies challenges that need to be overcome. Offering new products and services as an electricity supplier to end customers implies meeting a set of requirements, adaptation and addition of new internal business processes. We examine the main processes and systems an electricity supplier needs to adapt in order to offer residential flexibility products.

When offering flexibility it is crucial that both suppliers and their end customers meet a set of market requirements. We therefore start this deliverable with market requirements that need to be met by suppliers such as consumer protection, contract terms and regulatory compliance. We continue by listing up both basic and more advanced requirements that households are expected to fulfil before being able to offer their flexibility to the grid.

In the following section 3, system requirements for the roll out of dynamic prices, energy sharing and more explicit flexibility are explained. For the energy sharing topic, we dive deeper into the challenges and possible benefits it can create.

After discussing the market and system requirements, we discuss the potential flexibility offers suppliers can consider to present to their end-customers in section 4. We start with a brief description of what different types of flexibility services a household can engage in. Next, some possibilities are given on which pricing formulas can serve as a source of inspiration for the valorization of flexibility towards a household.

In section 5 we summarize different challenges and opportunities residential flexibility can entail with regard to energy poverty and what role a supplier can play in this context.

We end the deliverable in section 6 with the main conclusions that can be conducted from this report.

2. Market requirements

2.1. For suppliers to offer flexibility services

Offering flexibility services to electricity supply customers requires careful planning and consideration of various factors. Primarily, suppliers that wish to offer flexibility services in Flanders must adhere to a range of market requirements, regulatory obligations, and contractual stipulations. These include compliance with local energy policies, ensuring consumer protection, and maintaining transparency in contract terms.

2.1.1. Consumer protection

The communication of the supplier about the terms and conditions of the flexibility services needs to be transparent and clear. Transparent pricing models and clear information on how prices are determined should be made available by the supplier, ensuring that contracts comply with consumer protection laws and fair terms are provided to the customers. In addition, secure and efficient systems for the exchange of data necessary for the implementation of the flexibility services should be maintained.

2.1.2. Contract terms

If a supplier and consumer have a contract of indefinite duration and the supplier wishes to change the price of the energy component of its supply contract with customers - asides from network tariffs and charges - it must announce this price change two months in advance. This notification towards the customer can be done via (e)mail. If a customer does not wish to accept the price change, they have the contractual right to unilaterally terminate the contract and switch to another supplier. This will be arranged no later than three weeks after the supplier receives the request to do so from the relevant grid operator.

In addition to its general conditions applicable to its electricity supply contract with consumers, a supplier can apply particular conditions to customers with e.g. a dynamic price contract.

In this contract, the hourly price is determined by the market price by which the supplier buys and sells electricity for the following day and applied to the Customer's actual consumption and injection in that hour. The price for the energy component is dynamic and therefore varies from hour to hour. The supplier can charge the customer a subscription fee, monthly or pro rata the number of days of the contract.

2.1.3. Invoicing and settlement

The supplier can send advance invoices with a dynamic contract. If no advance invoices are made, the supplier will make monthly settlements based on the customer's actual recorded metering data. Finally, the customer must have a digital meter (with SMR3 regime activated) in conformity with article 3.1.45 of the Flemish Energy Decree, which is fully functional in accordance with article 3.2.6 of the Technical Regulations for the Distribution of Electricity in the Flemish Region (TRDE).

2.1.4. Energy sharing

Suppliers with connection points that are involved in energy sharing face additional administrative and imbalance (and sometimes profiling) costs. A growing number of suppliers also charges these costs to the participants in the sharing scheme (in a flat fee or per kWh exchanged).

2.1.5. Regulatory Compliance: Belgian legislation on flexibility services

In Flanders, suppliers must comply with Belgian and Flemish energy regulations. In the case of flexibility services they also operate as a flexibility service provider. This role has separate rules, obligations and rights attached to it. The goal of European legislation is to set up a level playing field between suppliers acting as flexibility service providers for their supply customers on the one hand, and third party flexibility service providers on the other hand.

The general conditions and particular conditions relating to electricity supply contracts with a dynamic price are in accordance with Belgian energy legislation, and more notably:

(i) the Belgian Electricity Act of 29 April 1999 on the organization of the electricity market (the '**Belgian Electricity Act'**);

(ii) the Flemish Decree of 8 May 2009 laying down general provisions on energy policy (the '**Flemish Energy Decree'**);

(iii) the Decision of the Flemish Government of 19 November 2010 containing general provisions on energy policy (the '**Flemish Energy Decision**).

Firstly, Chapter IVbis of the Belgian Electricity Act (as amended by the Law of 13 July 2017) contains provisions on flexibility management services and rules to which a provider of flexibility services must abide. These rules are further detailed by the Belgian Commission for Electricity and Gas Regulation (CREG) at the request of the grid operator. They apply to the day-ahead market, the intraday market, the reserve market and the market to offset quarter-hourly imbalances, with the exception of the market to activate the primary frequency regulation (art. 19bis, §2, par.3 of the Belgian Electricity Act). In particular, they define:

- the principles for determining the activated flexibility volume;
- the principles for correcting the quarter-hourly imbalance created by the activation of flexibility by a flexibility service provider;
- the exchange of information and data necessary for the implementation of the energy transfer;
- the phased implementation of energy transfer in the various markets mentioned above.

To implement the abovementioned provisions of the Belgian Electricity Act, on 18 March 2018 the CREG published '**Decision implementing article 19bis §§ 3 to 5 of the Electricity Act of 29 April 1999 in order to enable energy transfers'**.

The CREG has further made available a model 'Contract for providers of flexibility services in the Day Ahead and Intraday Market' to be signed between the provider of flexibility services on the one hand and Elia Transmission Belgium (Belgian's Electricity System Operator) on the other (the '**contract FSC DA/ID**'). The contract FSP DA/ID describes the rights and obligations of Elia and the

provider of flexibility services that wants to valorize their flexibility on the Day-Ahead and/or Intraday markets.

Finally, the Flemish Energy Decree (Section V/1) stipulates the rights and obligations of flexibility and aggregation service providers and participants (**articles 4.1.17/1, /2 and /3 of the Flemish Energy Decree**), as well as provisions on the purchase of flexibility and ancillary services by the system operator. Many of these provisions are operationalized in technical regulations. Art. 4.3.63 of the technical regulation for electricity distribution in Flanders (TRDE) sets up the structure for creating local markets for flexibility (the market rules). These should be set up by distribution system operators and consulted with all market participants.

Most importantly, it creates the rights for everybody to participate in flexibility, both by themselves and by a flexibility service provider. The choice of provider should be free, like with the energy supplier, and should also be independent of the choice of an electricity provider. Suppliers acting as flexibility service provider have to adhere to the same rules as independent flexibility service providers. Every participant should be responsible for all imbalances they cause in the system, and should agree to some basic rules with the distribution system operator.

In exceptional circumstances, the electricity distribution system operator or the operator of the local electricity transmission system may require grid users and users connected to the local electricity transmission system to participate in flexibility ('reserved technical flexibility'). In case of unforeseen exceptional grid operating conditions and when all commercial resources have been exhausted, unless their purchase is economically inefficient, the electricity distribution system operator or the local transmission system operator may impose modulation of generation facilities and electricity storage facilities ('non-reserved technical flexibility'). If this is the case, the Flemish Energy Decision (Section IV/1) further details the rules on the reserved and non-reserved technical flexibility. The main provision of flexibility services should however be market based, both for the distribution grid operators as for the transmission grid operators.

2.1.6. Third party flexibility provider

If customers choose to market their flexibility with a third party flexibility provider, this potentially creates a series of conflicts of interest between the supplier and the customer. In the case of a non-profiled (real) offtake and injection, the activation of flexibility will change the predicted profile of the customer and thus lead to imbalance for the supplier. If this action could have been coordinated, there might have been an overall benefit to be shared between supplier and customer.

The problem is aggravated in the absence of transfer of energy (TOE) or other methods of energy exchange. With transfer of energy, the imbalance effect of the activation is neutralized for the supplier, who forecasts as if no activation took place. Without it, the imbalance occurs in his portfolio and is hard to distinguish from "regular" use of the access point. It therefore also effects future forecasts thus even creating imbalance costs in the future.

The problem is aggravated in the absence of a system that nullifies the effect of the activation for the supplier. An example of such a system at the high voltage level is the Elia Transfer of Energy (TOE) framework, but bilateral agreements are often preferred to this framework[1]. The purpose of

[1] Transfer of Energy usually refers to the framework Elia provides. Yet, this framework doesn't cover all potential activations, which is why market parties usually choose the Opt-out, which means they agree on a transfer price to neutralise the impact of the activation.

such a system is to firstly neutralize the imbalance effect of the activation for the BRP of the supplier. Without it, the imbalance occurs in his portfolio and is hard to distinguish from “regular” use of the access point. It therefore also effects future forecasts thus even creating imbalance costs in the future. Secondly, the system also provides a remuneration (either way) for electricity bought and sold on the day-ahead market, but not billed to the customer because of the difference in metering.

If TOE would be introduced at this low level, yet another set of problems exist. Supplier and flexibility provider will have to set conditions for the remuneration of the forecasted but not billed volume. As there might be many flexibility providers, a plethora of arrangements will need to be contracted. Even when all activations are covered by bilateral agreements, it is hard to account for all possible profit and losses from the point of view of the supplier. There are often also administrative costs for the settlement between FSP and supplier. Both these effects create an overhead cost that will eventually be paid by flexible consumers..

With high voltage customers, much of these issues get handled by an imbalance pass-through contract, in which the customer pays all imbalance costs, regardless of the activations for flexibility. This creates an incentive to account for imbalance costs when activating, and eliminates the need for TOE or an alternative system to settle the imbalance. The flexibility remuneration then often covers any additional imbalance costs towards the customer. However, at low voltage level pass-through contracts currently do not exist. Implementing pass-through contracts on low voltage level does however not seem to be an optimal solution. The limited volume of a residential household often does not outweigh the labor intensive process that has to be carried out by the supplier for the settlement of the residential customer. These type of contracts are also hard to reconcile with typically risk averse customers, and might be prohibited or strongly regulated by customer protection regulation.

An integrated service would not suffer from most of these conflicts, and should therefore create more overall value to be shared with a customer.

2.2. For households to participate in flexibility services

2.2.1. Minimal requirements

When a customer wishes to participate in flexibility services with residential assets such as electric vehicles (EVs), home batteries, or heat pumps, they must adhere to various requirements set by entities like the TSO, DSO, suppliers, and regulators. One key prerequisite for participation is the installation of digital meters in the customer's home. Although a digital meter may not be central to every flexibility service, it is indispensable for enabling customer participation in these services, as well as facilitating their connection under the SMR 3 regime[2]. The SMR3 regime needs to be activated by the customer since 15 min data are required for a correct settlement. This means that the system takes into account any deviations in their offtake or injection in that time frame. In Belgium most households are still settled on a yearly basis (analogue meters) or a monthly basis (most digital meters). Many households or small businesses that are settled on a 15 minute basis have a dynamic contract. This might also make most sense for suppliers with customers active in flexibility provision.

While these meters are required, their role extends beyond just facilitating flexibility services. Digital meters also capture data from other energy-related activities, such as self-consumption, PV production, and general energy management. This multi-purpose data collection, while beneficial for comprehensive energy monitoring, introduces complexities in accurately capturing the energy data, particularly when it comes to low-voltage flexibility services.

For instance, in scenarios involving asymmetrical flexibility services like mFRR or aFRR, the activation of these services can cause monthly peaks in energy usage, which might affect i.e. grid fees and the capacity tariffs. Even with symmetrical products like FCR, there is concern that while digital meters accurately record total energy consumption, they may struggle to differentiate between energy used specifically for flexibility services and other activities. This challenge could lead to complications in billing and financial viability for customers participating in flexibility services, as they might incur unexpected costs.

The question that arises is: *How can metering technology and flexibility-related regulatory frameworks be further developed to ensure that digital meters accurately differentiate between energy consumption related to flexibility services and other energy activities?* As low-voltage

[2] There is one exemption to the above rule: in the context of low-voltage flexibility services, participants may be temporarily exempt from the metering requirements - one example is the temporary exception limited to low-voltage FCR service: according to Article 2.3.26 of the Technical Regulations for the Distribution of Electricity in the Flemish Region, the requirement to use a digital meter remains, unless the grid user has been unable to obtain (and has not refused) a remotely readable small consumption meter through the initiative of the electricity distribution system operator. This is possible because the service is monitored on the basis of data with with high-resolution data of a few seconds, supplied by private metering devices.

VREG, Technical Regulations for the Distribution of Electricity in the Flemish Region of June 25, 2021, BS July 19, 2021 (entry into force: July 29, 2021).

flexibility continues to expand, regulators and operators are actively working to address these challenges. However, defining clear solutions remains complex. Successfully tackling these issues is crucial for the effective and sustainable integration of low-voltage flexibility into the energy system.

2.2.2. Advanced requirements

When a customer wants to optimize its participation in the flexibility market, some advanced technical requirements can be met:

- A useful upgrade of the digital meter can be achieved by installing (plug) a dongle into the digital meter so the customer and its flexibility service provider can obtain real time data.
- Implementation of an energy management system (EMS) to optimize the operation of the assets and manage the energy flow efficiently.

The EMS should support demand response capabilities and allow for automated control based on market signals.

Assets such as electric vehicles (EVs), stationary home batteries, heat pumps, and solar panels should be equipped with communication interfaces that allow integration with the EMS. Evidently assets should comply with the technical specifications and standards set by the local grid operator for connecting and operating distributed energy resources.

By meeting these technical, regulatory, and operational requirements, customers in Flanders have the basis to effectively participate in flexibility services with their assets, contributing to a more resilient and efficient energy system.

2.2.3. FlexSys webinar on contribution of residential flexibility

The partners of the FlexSys project organised a workshop as part of the European Sustainable Energy week (EUSEW) in June 2023. In this webinar[3], accessible online for free, the project partners share their experience from the FlexSys project to answer the question of how households can be directly involved in the flexible energy system of the future (e.g. how to control heat pumps and electric vehicles according to market signals and what are the possibilities and constraints for households). Some interesting findings - from the FlexSys survey on citizens' willingness to contribute to flexibility on the electricity grid - were also explained. It concluded with both practical advice for citizens and policy recommendations for governments and grid operators.

[3] https://www.youtube.com/watch?v=VgSRQI1gfF0

3. Potential flexibility offers to residential end-consumers

3.1. Overview flexibility options for end-consumers

End-consumers theoretically could participate in many different types of flexibility services. Every type of service allows for a number of types of pricing schemes to remunerate participation. We therefore start with an overview of types of flexibility that can be offered. In the FlexSys deliverable D3.3 'Report on customer value propositions for distributed flexibility', a high level calculation per value stream can be found, as well as what value streams can be combined or not.

1) **Self-consumption optimization**
   Consumers could use flexibility to improve self-consumption or improve uptake of an energy sharing scheme or PPA. In the same vein consumers could also limit their peak usage of the net.

2) **Day-ahead market price arbitration**
   Consumers could apply their flexibility to arbitrate between prices on the day-ahead market, shifting their load to times with lower prices.

3) **Real-time price signal**
   Consumers could also use their flexibility to profit from a real-time price signal, such as the imbalance prices published by TSO Elia.

4) **Participation in ancillary services: Frequency Containment Reserve (FCR)**
   Consumers could allow their flexible assets to react to voltage deviations to be used in FCR, a system service of TSO Elia. By taking part in ancillary services, end-consumers can contribute to an efficient operation of the Elia grid.

5) **Participation in ancillary services: Automated or Manual Frequency Restoration Reserve (aFRR or mFRR)**
   Consumers can take part with their flexible assets by reacting to the aFRR or mFRR steering signals of these Elia ancillary services.. Here it is worth mentioning participation in FCR cannot be combined with aFRR.

6) **Participation in capacity remuneration schemes**
   Consumers could theoretically also reserve capacity for capacity remuneration schemes, which could be seen as a form of long term flexibility. This case will not be handled in this deliverable.

The optimal (combination of) flexibility types will depend from the specific configuration of residential assets at the end consumer's dwelling, i.e. what are the technical specifications such as technology and asset size, what is the consumption profile of the household, etc.

3.2. Pricing formulas to valorize flexibility towards end-consumers

Offering new services can encourage diversification in a suppliers' pricing towards its customers. Extensive research is needed on which price formula can suit which flexibility service and under what form the benefits created by the provided flexibility can flow back to the end users. Many pricing structures can be envisaged to allow consumers to share in the profits of this flexibility. A series of possibilities of what pricing formulas could be used to valorize flexibility to the end consumer are explained below. A combination of these schemes and even different types of schemes are possible. However, giving some indication of the types of pricing formulas will help explaining how a supplier would have to prepare for such an offering.

1) Lower usage of the net brings lower costs

Certain types of flexibility can be offered today and will reduce the volume or capacity that is used by suppliers to calculate their invoices. This is mainly true for type 1 (optimizing self-consumption). Flexibility in these cases directly impacts the normal consumer bills, with no need to remunerate consumers additionally.

2) Flat fee

For most flexibility services, a potential part of a pricing scheme could be a flat fee to be offered just to sign in to the program. This flat fee could have some conditions attached to it, for example a system to be linked to the suppliers' system. It could also be related to the size of the flexible asset participating.

3) Fixed availability fee

As a variation on a flat fee, a remuneration could additionally depend on the period of time the asset is available. This could for example be relevant for electric vehicles that will only receive the remuneration for the time they are hooked to the charger. The reasoning being that the asset can only offer flexibility at times when it is available, and a flat fee could theoretically incentivize consumers to unplug their device to enjoy a fee whilst not wearing their flexible assets or reducing their comfort levels.

4) Variable availability fee

A more complex way to apply an availability fee would be to account for the flexible volume (up or down) that is available at every instance. This could for example account for the fact that a heat pump that has switched off after heating every heat buffer to the maximum can no longer reasonably offer flexibility, even when it is connected and available.

5) Activation fee

In cases of services that respond to a real-time signal (including a price signal), part of the remuneration could be attached to the volume that was activated up or downward. In the case of imbalance price steering or aFRR/mFRR this could be a percentage of the value actually captured by the supplier for this action.

6) Profit share

A supplier could theoretically calculate all profits and losses from the activations, both locally in the supply contract of the customer and on the different markets. Profits and losses could be split and invoiced separately.

7) Implicit price

One way of pricing flexibility is to offer consumers a price that reflects the opportunity to take action one way or another. This is the way a dynamic price today remunerates flexibility. It translates the opportunity on the day-ahead market to the consumer in a way that his reactions will be reflected in the electricity invoice.

Implicit prices could theoretically also be extended to different flexibility markets, forming an aggregated pricing signal or a compound signal.

It is important to note here that pricing schemes for supplying end-consumers are often subject to rules and regulations. In the case of Belgium it is for example not possible to refer to non-electricity related price indices. This could also become the case for a flexibility offering. When the flexibility is offered as a package deal with supply, and specifically when the supplier would use one aggregated price signal as a total commodity price, these restrictions will potentially limit the possibilities in a pricing scheme.

4. System requirements for supplier that offers residential flexibility services

In this section we discuss what (adjustments to) systems are needed to carry out dynamic prices, energy sharing and more explicit forms of flexibility.

4.1. System requirements for dynamic prices

As explained earlier, suppliers offering flexibility will most likely also offer dynamic contracts to their customers. Dynamic contracts could itself already be considered as contracts to offer flexibility, as consumers are intrinsically motivated by this type of contract to shift their offtake and/or injection based on the level of energy market prices. We thereby start this section with an overview of what steps need to be taken to successfully offer a dynamic price contract end-to-end to consumers.

Firstly much of the systems that suppliers use to invoice their customers are currently fitted to pricing formulas that change on a monthly basis. The logic of much of these systems is therefore one rate to be inputted for one month. This logic does not work for dynamic customers as their monthly rates differ depending on their behavior. In most cases however the systems are already working for professional customers and thus have formulas that are based on a 15 minute settlement. Household customers have some specific rights, for example in Belgium with respect to regulated tariffs if they are protected. The application of these tariffs may not conflict with the dynamic tariffs.

Basing the calculation on 15 minutes data as opposed to monthly data also dramatically increases the amount of data to be processed by the systems. Suppliers and their service providers need to take this into account when expanding the offer.

The electricity invoice also needs to undergo some changes to reconcile readability with transparency in the case of dynamic contracts. It is impossible to provide a complete overview on the invoice document itself of all hourly volumes and their price, on which the calculation is based. Therefore a summary should at least provide an average price for the month. The 15 minute values also need to be aggregated for volumes and comparisons to different periods.

For suppliers who are used to only offer a standard offering of monthly rated products, a lot of changes are also necessary on the front end. The conditions for a dynamic product should account for the specificities of this type of offer. They should for example lay out what happens if data is missing for a certain period of time. As provided in the legislation, suppliers will have to sufficiently warn customers that these types of contracts have risks, for example when a lot of offtake is situated in expensive moments. A lot of additional information should also be provided to (potential) customers, who often do not even understand the difference between a variable and a dynamic contract. FAQ's, information pages and webinars are ways to inform all potential customers.

The biggest effort in offering dynamic prices is training of customer service personnel. Customers are likely to have much more specific questions when they have a dynamic price contract as opposed to a monthly rated contract. Customer service employees should therefore understand

the offer, and be able to provide some calculations or refer to a more detailed calculation online to assist these customers. For a simple dynamic price contract that tracks the day-ahead price, this is still relatively straightforward. More complicated formulas will require increasing knowledge on the part of the customer service and will incite more difficult questions.

To empower consumers to actually take part in the dynamic contract, suppliers also need to inform consumers correctly about their opportunities in such a pricing scheme. This firstly means setting up a digital environment in which they can track their progress, check their invoices and find useful help to improve their results. Suppliers will therefore need to supplement their online customer portals with more granular and more up-to-date information and show analysis in a simple way.

To convince customers to switch to such a contract in the first place, suppliers will also need to provide (personalized) guidance as to when contracts of this type are at all useful.

4.2. System requirements for energy sharing

4.2.1. Challenges

In addition to dynamic pricing schemes, suppliers in Belgium are also having first experiences with energy sharing schemes. Sometimes these types of schemes are included in the more general term of flexibility. The reasoning is that energy sharing schemes allow for a second type of "self-consumption" of locally produced electricity. It might in that way give the receiver of the energy sharing an incentive to shift the consumption to the times where energy from the sender is available.

Suppliers have had to adapt their systems to account for such exchanges happening outside of their control. In Flanders the regular market system had just undergone major changes and it was decided not to make any modifications. The energy sharing information is therefore still being exchanged via a completely separate system, with its own logic in documentation and version control. The distribution system operator provided very little information on these exchanges, leaving it mostly up to suppliers to correctly implement the adaptations. In the first 2 years of the system many changes have been made to the structure of the documents, for example by changing the version system or by sending a bunch of updates to existing documents. Each change requires changes to the system of all suppliers that need to account for all this in their billing. As only a very small number of end-consumers is actually involved in a sharing scheme, the administrative cost per participant is very high.

At the heart of the problem is the interaction with the normal billing of the client, which still runs through the classic systems. With a system that sends periodic corrections, it gets very difficult to account correctly for the exchanged electricity on the invoice of the end consumer. Even if the timing and correction issues are taken care of, getting both pieces of information together on one invoice is quite a challenge. So much so that a recent report[4] shows most suppliers handle these exchanges through a separate second correction bill.

Even more so than with dynamic contracts, customer service faces very difficult challenges as customers involved in energy sharing request information about the adaptations made to their invoices to account for the energy sharing. In an extreme case, a customer with a dynamic contract

[4] https://www.vreg.be/sites/default/files/document/rapp-2024-10.pdf

gets part of its offtake covered by injection from another point. The roll-back of the invoice is thus based on the value of the volumes that were exchanged at the time they were exchanged. To understand and be able to explain these kinds of exchanges, customer services need to be very knowledgeable.

In the Flemish system of energy sharing, it is very doubtful whether any societal benefit is being created for the system. There is no advantage in terms of grid fee or taxes and levies or other obligations on the shared electricity. Also, consumers are required to activate 15' settlement to take part in energy sharing. This means that the exchanged electricity has exactly the same value (to the suppliers of these consumers) on the sending and the receiving side. This means that any exchange leading to a benefit for the exchanging parties, will mean an equivalent loss to the suppliers involved. This does not seem a sustainable model to incentivize people to shift their load. New regulations will also permeate the exchange in the settlement of the suppliers. BRP's will now have to forecast the impact of the energy sharing to limit their imbalance. This seems impossible, which actually will increase system costs. The exchange is thus zero sum at best, and creates an extreme amount of overhead administrative costs.

4.2.2. Possible benefits

There are a couple of ways in which energy sharing might still offer some benefits.

Firstly and most importantly, policy makers could attribute some benefits to sharing where societal benefits are created. In particular shared rooftops (from apartment buildings or from offices) are often not used or at least not completely covered by PV panels because most benefits are attributed to self-consumption (behind the meter) implicitly. A system has to be divided into smaller systems, each with their own converter, to create the same (artificial) benefit. Electrically, there will be no difference except that all these smaller systems are probably much less efficient. From a societal point of view, to reduce electronic waste and to increase PV penetration and efficiency, it would therefore make sense to at least partly extend the benefits of self-consumption to energy sharing under one roof or maybe even to other situations where a grid connection is shared. These benefits could be extended further as is the case in Brussels, where under one roof all is considered self-consumption and within a certain distance only half of the grid costs need to be paid. Policy makers should however be careful not to extend these benefits without care for the real societal gains being produced, because this will also increase costs for other market participants. It will be key to strike the right balance.

A second way in which some benefit could be created is when multi-site professional consumers, such as governments, might use energy sharing to virtually increase their self-consumption to attain certain goals set for them. They might for example install excess capacity on one site and use its injection on another site thereby clearly offsetting the offtake there. Although this does not create any additional value, it might not create too much burden as well. All sites could for example have pass-through contracts, that cover losses of the active suppliers in the exchange. The exchange could also materialize in other ways, for example when the supplier just submits the guarantees of origin of the other site to the consumption of one site. However for this to work, the supplier will need to offer this service, whereas with the energy sharing this can be done regardless. It could also just function as an incentive for the supplier to play along to avoid the burdensome energy sharing.

Thirdly and lastly, this kind of setup could bring some price stability into the contract of a customer, by co-investing or buying electricity at a fixed price over a long period of time, much like in a (corporate) PPA. It is however very hard for end consumers to properly value this trade, especially when only the simultaneous production and consumption are exchanged. Moreover the same value could – again – be obtained by contracts that don't have to involve the burdensome energy sharing scheme. Lastly, households are generally withheld from these types of contracts by consumer protection law. Suppliers for example cannot offer contracts lasting as long as these investments, let alone prevent customers to choose something else if they change their mind. In this setup however, consumers would get this type of contract through a separate scheme.

All in all not too much attention should be spent trying to categorize energy sharing as flexibility. The setup in a separate system with different documentation and exchanges however highlights the need for simple and understandable processes to enter into flexibility. More cumbersome systems require much more administrative overhead, killing any benefit by adding costs on the side of the supplier.

4.3. System requirements for suppliers to offer more explicit flexibility

Offering flexibility in addition to a dynamic pricing contract will require many of the same preparations and services from a supplier. Depending on the pricing scheme, more or less overhead will be needed to successfully translate participation into remuneration. The complexity will largely depend on the type of scheme applied here. In the next section an overview will be given of the inherent potential complexity of pricing formulas for flexibility.

A flat fee will require some extra steps in the onboarding of the consumer. A connection will have to be made between the flexible system of the consumer and the EMS of the supplier. This dramatically increases the complexity as consumers might have hundreds of different types of home systems, which the EMS of the supplier will need to support. In many cases a piece of hardware will be needed to connect locally. All these connectors and networks will have to be robust and ideally stay connected without too much support. Consumers will also have to set boundaries that have to be respected by the steering.

In case the flat fee is made conditional or variable depending on availability or capacity, the EMS and the local system will also have to exchange data continuously. This data will have to be processed, validated and translated on the invoice to the consumer. It is also important to note here that most electricity contracts are based on metering data that is validated by a meter responsible party such as in some cases grid operators. These parties are considered neutral, as they do not have an incentive to "cheat" with the data to reduce the remuneration they have to pay. This restriction might also limit the possibility of this type of scheme. In any case this data, coming from different sources with a different logic then regular market data, will have to be integrated into the billing engine. This will most likely cause similar problems than integrating energy sharing in Flanders.

In case of an activation fee, suppliers will need to be able to validate how much activation needs to be remunerated. Again as with the variable availability fee, this creates some concerns regarding the possible metering data used for this. The biggest difficulty with this type of fee is that an

activation causes the need to determine a baseline, meaning a reference volume to which the metered volume is compared to calculate the activation volume. This will be technically challenging and will again multiply complexity to reflect all this information in an invoice, make it transparent to the consumer and offer support from the customer support in case of questions.

An implicit price has the advantage of fitting into the mold of a regular pricing contract. The metered volume will just be charged the implicit price without any need for additional calculations on the billing side. Depending on the type of flexibility offered, the flexibility requesting party will require proof of activations much like those in an availability fee or activation fee. This burden of proof will oblige the supplier to make much of the calculations anyway. One advantages is that all these calculations in this case will not be consumer facing. That means that the consumer will need no further explanation to understand his invoice.

A profit sharing scheme is similar in complexity to an implicit price. Also here the consumer will not see much of the complexity, but his regular invoice will be supplemented by a (positive) fee to remunerate participation. If the supplier wants to offer transparency to the profit share, this will again increase the complexity to the highest level, as every market action and corresponding action of the consumer will have to be explained.

In the types of schemes where the supplier buys a right to activate flexibility, such as the flat fee, availability fee, the activation fee or the profit sharing, there are two options of how to activate flexibility. A first possibility is to give the consumer the responsibility to translate a signal from the supplier to a reaction from one or more assets. Alternatively, the consumer could also give access to the steering system of an asset, so the supplier can activate the steering directly. Whereas the first system requires a lot of confidence in the internal system of the customer, the second system obliges the supplier to connect to a series of systems. Systems that can't be coupled with the supplier EMS, will not be able to participate in the second scheme.

A last crucial element in the difficulty of setup will be the way in which the flexibility requesting party (the TSO, DSO or a BRP) might require to prove the functioning of the flexibility. Stringent (sub)metering requirements could easily negate all potential benefits for households. Transparency in market outcomes might on the other hand help pricing schemes for flexibility, as they might serve as a basis for a pricing scheme or might help explain to customers the potential benefits and the shared profit.

5. Residential flexibility and energy poverty

In this section of deliverable D3.5 we briefly discuss what challenges and opportunities residential flexibility can entail with regard to energy poverty. In another deliverable of the FlexSys project, D3.7 'Socially adjusted market strategy blueprints developed for distributed flexibility from underserved market segments', a more elaborate discussion can be found on the importance of inclusive flexibility.

An important aspect of the energy transition at large, and the role of flexibility specifically, is the equity with which it is applied. Equity meaning that the benefits should be shared by all, and not by a single group at the expense of another one. In particular policy makers would like to prevent that measures or actions lead to reverse redistribution, with people in (energy) poverty paying for the benefits of people with means.

Measures in the energy transition have a tendency to cause such effects. Notably subsidies for electric vehicles, renewable energy production and home insulation are often funded by levies on energy usage. This has been the case for these examples in Flanders. Households in energy poverty often lack means to make these types of investments, missing out on the returns other households or companies could expect with the subsidy. Perversely, these households also have difficulties otherwise reducing their energy usage, and thus sometimes pay disproportionately for these subsidies.

For flexibility services at least one part of this problem also occurs. Households in energy poverty often lack the sort of devices with a potential for offering flexibility services. Specifically, home batteries, electric vehicles and heat pumps are not prevalent in this demographic. If there are benefits to exploiting flexibility to the owners of these types of assets, it is reasonable to expect that households in energy poverty will not be able to obtain them since they do not have the means to invest in these assets.

A stark difference between the subsidies example and the case of flexibility, however, is that societal benefits are shared, also with those households in energy poverty. Attracting a large pool of potentially flexible assets to the flexibility market strongly increases supply in these markets. The flexibility requesters, ultimately system operators or balance responsible parties, will thus be able to procure their services at lower cost given that more parties will be able to provide them. As these costs are translated into commodity prices or grid tariffs, energy poor households will also benefit from lower procurement costs, especially those with relatively high electricity consumption.

The majority of the potential benefits, however, will clearly be collected by those holding the assets. Even though there are no outright losers in this case, it is still important to try to include energy poor households as much as possible.

A first way to achieve this is, as a supplier, to transfer part of the potential remuneration from those customers actually participating in flexibility services to those not participating. This however creates two problems. The challenge here is that this approach lowers the incentives for households with assets to take part in flexibility schemes. It might deter them from entering the scheme in the first place, with the potential remuneration being under their threshold to find an offer interesting.

With the tools present today, a supplier can also focus on raising awareness of the customer about the effect of the capacity tariff on the electricity invoice. A supplier can provide deeper insight on how the capacity tariff is calculated, if and how it can be lowered.

6. Conclusion

This deliverable highlights the main aspects that need to be taken into account from an electricity supplier's point of view when offering residential flexibility services to households. It also identifies some challenges that need to be overcome.

After gaining insight in the different market requirements and contractual obligations that suppliers need to meet, it is clear that the list of requirements and accompanying necessary adaptations in a supplier's business processes is extensive. Some requirements can be challenging to integrate in a supplier's existing processes and systems.

In this deliverable, the concept of energy sharing in relation to flexibility was addressed as well. Energy sharing in the way it has been set up in different European countries, as well as Flanders, does not constitute flexibility in itself, but could provide incentives to participants to shift electricity to share more. In general the process involves complex systems with a considerable amount of administrative overhead for suppliers. Without specific government benefits, there is also no overall benefit to engaging in energy sharing to divide between the participants. In some circumstances energy sharing could however help overcome existing barriers. Multi-site consumers like governments could for example use energy sharing to increase their self-consumption across different locations, without needing help from their supplier. Energy sharing could also offer price stability by allowing customers to co-invest in or purchase electricity at fixed prices over time, similar to corporate purchase agreements. Consumer protection laws often make such contracts difficult for small consumers. Overall however, the burden on suppliers of the energy sharing schemes could even undermine these types of solutions. Its potential as a flexibility solution will in any case remain extremely limited.

When considering possible pricing formulas to valorize residential flexibility as a supplier, it is highlighted that a combination of different schemes can lead to an optimal offer for the end consumer. This will also depend on what combination of assets are present in an end consumer's dwelling. In the FlexSys deliverable D3.3 'Report on customer value propositions for distributed flexibility', a high level calculation of these value streams are discussed as well as what value streams are compatible.

Offering flexibility services alongside dynamic pricing contracts involves significant complexity for suppliers, with the level of difficulty depending on the pricing scheme used. Setting up a flat fee requires integrating the customer's flexible system with the supplier's energy management system. This is a complicated process due to the wide variety of different systems in the market, with specific technical specification to enable connection for exchange of data. In addition, conditional or variable fees add further complexity by requiring ongoing data processing and integration into suppliers' billing systems. Activation fees necessitate determining a baseline for comparison, adding another layer of technical challenge. Implicit pricing is simpler, as it aligns with standard contracts but still requires proof of activation. Profit-sharing schemes, while similar in approach to implicit pricing, increase complexity if transparency is required, as each market action must be explained. Flexibility activation can be consumer-driven or supplier-controlled, each with its own challenges. Additionally, stringent metering requirements may undermine potential benefits, though transparency in market outcomes could help clarify pricing and profit-sharing for customers.

All of the aforementioned findings underline the importance of a transparent and simple legal and market technical framework. This will empower suppliers to develop understandable

remuneration schemes towards residential customers. The more transparent the pricing formulas can be towards end customers, the more citizens will be engaged in flexibility markets and the more inclusive the energy transition can occur.