Smart energy districts and the level playing field: Netherlands and Belgium.

Annelies Huygen
TNO/Centrum voor Energievraagstukken UvA
Delft
annelies.huygen@tno.nl

Kris Kessels
VITO (Vlaamse Instelling voor Technologisch Onderzoek) / Energyville
Boeretang 200,
2400 Mol, Belgium
Kris.Kessels@vito.be

Abstract

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Highlights

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Keywords

Smart energy districts, renewable energy, regulation

Abbreviations

AD Active Demand

1. Introduction

The business chain in the energy supply industry is changing drastically. Next to the traditional top-down systems, bottom-up initiatives are becoming popular. Among the new sustainable supply models are the low energy, or even energy neutral districts, where energy is produced, exchanged and stored at the local level (herein after called smart energy districts). New techniques are available to support these modes of energy supply. Energy districts can for example be started by active citizens or small businesses, who want to be involved in the energy supply chain of their premises. Participants of these districts often wish to use as much as possible the energy, produced in the district and to be to a certain level independent from other parties. Such smart energy districts are an example of social innovation and citizen participation in the energy supply sector.

These districts may contribute to a sustainable and flexible energy system by producing renewable energy themselves and by balancing supply and demand and thus delivering flexibility to the system. They can help to implement the future European obligation to build nearly zero-energy buildings, where energy is produced on or nearby the site, as laid down in the Energy Performance of Buildings Initiative (EPBD,2002/91/EC). Further, demand response is an important element in these districts. Demand response has gained widespread policy support in Europe. It is reflected in regulatory documents, including the the Third Energy Directive (2009/72/EC) and the Energy Efficiency Directive (EED, 2012/27/EC),

Rules affect the business cases of these energy districts deeply. These may impede the implementation of existing technical solutions and hamper innovation. This article analyses regulatory barriers for the development of energy districts. Within this paper we identify potential regulatory barriers and propose policy recommendations to overcome them. European law as well as national law has been reviewed, with a focus on the Netherlands and Belgium.

2. Scope, context and method

The scope of this article is the position of the smart energy district on the liberalized energy market. In a level playing field they would have the same chances to enter the market and to operate under the same conditions as other energy concepts, such as the traditional centralized energy supply. The method is interdisciplinary research: it combines technological and economic insights with regulatory instruments. It describes the technical concept of smart energy districts and it analyzes the need for flexibility, the existing technical solutions to supply this flexibility, the economic value of flexibility, the ways to realize this values and the accompanying business cases (as depicted in Table 1). The legal analysis focuses on possible impediments for these business cases and proposes ameliorations. Both European law as well as national law will be reviewed in light of the development of this typical smart energy concept.

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3. Background: smart energy districts, flexibility and the level playing field

This paragraph clarifies the central concepts in this Article: a smart energy district, flexibility and a level playing field.

Concept and model of smart energy district

In the smart energy district, as described above, different energy vectors are considered (such as electricity, gas, biomass, heat, cold), which can be converted between each other or stored for later use. Energy may be generated at the level of a household or a SME, a small or medium sized enterprise (e.g. heat pumps, PV installation) or at district level (e.g. district heating network fed by a CHP, wind turbine at district level) or a combination of both. Optimizing electricity production and use locally lowers the total costs of electricity infrastructures: transport costs are minimized and energy losses are diminished.

In this study, a typical smart energy district is taken as a model and a starting basis. The district is a new inner-city development with low-energy buildings with mixed use, consisting of about 100 dwellings (a mix of apartment buildings and separate houses), commercial spaces, offices and other functions spread over the district. The energy concept of this district will be based on local production and consumption of green heat and electricity. The offtake at district level - both for heat and electricity - is thus met by local production as much as possible. Overproduction of electricity is supplied outside the district to the public electricity grid, while the generated heat is supplied to heat consumers within the district via a local heat network but also to external heat consumers (residential consumers of a neighboring district). Smart control is applied to the flexible energy sources to match energy supply and demand, to decrease congestion on the grid and to enhance the opportunity for renewable energy production. The energy concept of the district thus starts from local decentralized production, local distribution, local supply and rational use - at district level - of renewable energy (heat and electricity). It is assumed that the inhabitants of the district are willing to participate.

At district level, a CHP plant which can be fed by biomass or natural gas, is installed which feeds heat into a local heat network, while electricity is fed into the local electricity grid. Moreover PV installations are applied both at apartment and at housing level. Several houses also invest in a their own heat pump for their heating.
Sometimes participants in a smart energy district want to use self-produced energy as much as possible within the district. This model of a smart energy district requires a lot of cooperation. In that case, the local electricity grid –although being part of the public grid - is designed in such a way that it is clear how much electricity which is generated locally is also consumed locally within the district and how much is injected into the public grid in case of surplus, at which time (at least quarter-hourly-measurements) and via which generation source. Moreover, the offtake from the public grid in case of shortage is also measured.

Flexibility

The provision of flexibility is in the core of the energy concept of a smart energy district. The district is characterized by a high share of renewable energy within the district, an efficient use of the local networks and the optimization of supply and demand. The intermittent nature of certain renewable sources (e.g. PV and wind) which are less predictable and non-dispatchable, leads to challenges of balancing electricity supply and demand, not only in smart energy districts but in the whole energy system. Flexibility is essential to cope with these challenges. Without flexibility, system costs will be driven up considerably. Flexibility is here defined as the extent to which a power system can modify its electricity consumption or production [IEA, 2011]. Flexibility can be delivered by (firm) production, storage and demand response. In smart energy districts, demand response is an important feature. According to the EED (art. 15 section 8) Member States should encourage demand side resources and/or aggregators to participate alongside supply in wholesale and retail markets and promote access of demand response in balancing, reserves and system services. This study analyzes also the access of participants in a smart energy district to these markets and services. Although Europe encourages the participation of consumers in all energy markets, the vast majority of them do not have access to new services, such as demand response services. In this respect, Europe lags behind the USA, where consumers currently earn over 2.2 billion Euro's from demand side programs (Smart Energy Demand Collective, p.2).

Level playing field in the electricity sector

A level playing field is here defined as an economic and legal environment in which all suppliers and service companies, irrespective of their size and financial strength, get equal opportunity to compete and follow the same rules. All parties, small or large, have equal chances to enter the markets and to operate on them. Such a level playing field guarantees an efficient outcome of the markets (Baumol, 1988).

For parties who are united in a smart energy districts, a level playing field is essential. Since they are relatively new, it may be difficult for them to enter the market. Until the end of last century, economies of scale were dominant: the larger the plants and the larger the systems, the more efficient they were. Consumers were passive. The production of electricity followed demand: nuclear plants and coal plants supplied base load, while gas plants were installed to provide peak load. All demand was fulfilled.

Due to technological progress small scale options, such as the smart energy district, are efficient too. Nowadays, small scale production is also cost effective. Moreover, consumers are no longer passive. In demand response programs, they adapt their use to the supply of electricity. This lowers peaks in demand. Since the regulatory system reflects this traditional organization of the sector it can impede the entrance of small production units and citizen participation to the markets.

The importance of flexibility and thus its economic value rise in an energy system with intermittent production. New small scale services and techniques can only develop when their providers are able to enter the markets under the same conditions as traditional suppliers.

Grids and pipes can be characterized as a natural monopoly. The costs are the lowest when there is only one grid, which is used by all parties with a connection. A level playing field requires that the costs of the grids are divided among all parties according to the so-called cost causation principle. This implies that costs of the grids, which are caused by a certain group of users, should be attributed to that group . An exact attribution of costs to users of the grid is not possible. Part of the costs are made for the collective and individualizing is hardly possible. Therefore, designing efficient tariffs for the use of the grids is extremely complicated [Bonbright, 1988]. But this does not release authorities from the obligation to design the tariffs in a manner that reflects as much as possible the costs of serving these groups.

In smart energy districts, the aim of participants is often to use the grid efficiently and to prevent congestion. In that way, new investments in the grid can be postponed. Also, avoiding peaks reduces the costs of maintenance notably.

A large roll out of smart energy districts, aiming at an efficient use of the local grids, could deeply influence the future architecture of the grids. The Lens scenarios, made on behalf of

Ofgem in Great Britain, show that extension of the high voltage grids till 2050 would not be necessary in a Microgrid scenario based on smart energy districts, where local consumers and local producers exchange a lot of energy and use the grids in an efficient manner. In a scenario a limited amount of local production and passive consumers, high voltage grids have to be doubled till 2050 [Graham 2012]. In other words, upscaling of smart energy districts could reduce the costs of the high voltage grids to a large extent. For a level playing field it is important that such cost savings can be attributed to the participants in the smart grids causing these savings. Then their efforts are rewarded and it can be part of their business case. This is a consequence of the cost causation principle. When participants in a smart energy district must pay for extensions of the grids they do not use, they have a comparative disadvantage on the market: they pay for costs of the grids that are caused by the behavior of other parties, while these parties themselves are exempted from paying costs they cause themselves.

4. Forms of flexibility in the districts and cases of utilization

Flexibility in supply and demand is key in the smart energy district. ESCOs and aggregators are intermediaries who can help to develop and trade this flexibility. An ESCO delivers energy services and/or other energy efficiency improvement measures in a user's facility or premises. He can sell this flexibility on behalf of his customers directly to other parties within or without the district or to an aggregator. An aggregator is the commercial function of pooling consumption changes (but also e.g. distributed generation changes) from customers to provide energy, flexibility, capacity and services to other actors within the system [Eurelectric 2015].

Different forms of flexibility are available in the concept of the smart energy district. These forms of flexibility can be deployed for different aims and to the benefit of several stakeholders. The various types of flexibility available within the district to optimize the energy flows are the following a) flexible local generation (e.g. a CHP can be modulated to decrease/increase its output) b) flexible loads (e.g. a washing machine or heat pump can delay its start, timing the loading and unloading Electric Vehicles); c) thermal storage (e.g. a heat pump with thermal energy storage can decouple the hot water demand from the electric power demand); d) electrical storage (e.g. a battery offers flexibility, both while charging, as while discharging). The use of flexible loads (b), thermal storage(c) and electrical storage (d) can also be defined as demand response. Table 1 gives an overview of nine different cases for which these forms of flexibility can be used. In each case, the flexibility has a specific value. The public DSO or operator of the private infrastructure, is responsible for the operation of the grid, and can use the flexibility to manage the local network (case 1), thereby avoiding capacity problems within the grid and potentially avoiding supplementary grid investments; With the integration of more local generation at district level, local balancing at district level becomes more important (case 2); The flexibility available within the district can also be used as an extra balancing option for the TSO to restore the balance between supply and demand at system level (case 3) or for a BRP (balance response party) to restore the balance within its own portfolio (case 4); Moreover, all stakeholders whose business consists of buying and selling energy can use this flexibility to maximize their margin between purchases and sales of energy (case 5[1]); Flexibility can also be used to promote the integration of local renewable generation by producers and prosumers, seeking to maximize the income from their local generation (case 6, 7), and ESCOs and aggregators, acting on behalf of consumers and producers (case 8), should be given the proper incentives and means to sell the (surplus) generation from local sources. Finally, society as a whole, will benefit from optimizing the energy flows within a district, as this will allow a higher integration of renewable energy (case 9).

Table 1: Demand for flexibility from different actors

Actor	Cases	No
DSO	Local network management	1
	Local balancing at district level	2
TSO	Balancing at system level	3
BRP	Portfolio management	4
BRP, traders	Optimization of purchases and sales	5
Prosumer	Optimizing generation, self-consumption and sales	6
Producer	Optimizing generation and sales	7
ESCO/aggregator	Offering energy services to consumers/prosumers.	8
Society	Maximum integration of RES	9

Table 1 shows that there is a demand for flexibility from different actors. This demand can be met by actors in an energy district.

Figure 2 gives an overview of the flexibility flows that originate in a smart energy district. A distinction is made between physical electricity flows (black exchanges) and the delivery of electricity between actors via an aggregator (green exchanges) and/or the direct delivery of flexibility between actors (red exchanges). The cases refer to the cases as defined in table 1.

[1] AH Is er nu werkelijk een verschil tussen case 5,6 en 7? Is case 5 niet een algemene termn voor 6 en 7? Is case 5 een aparte case?

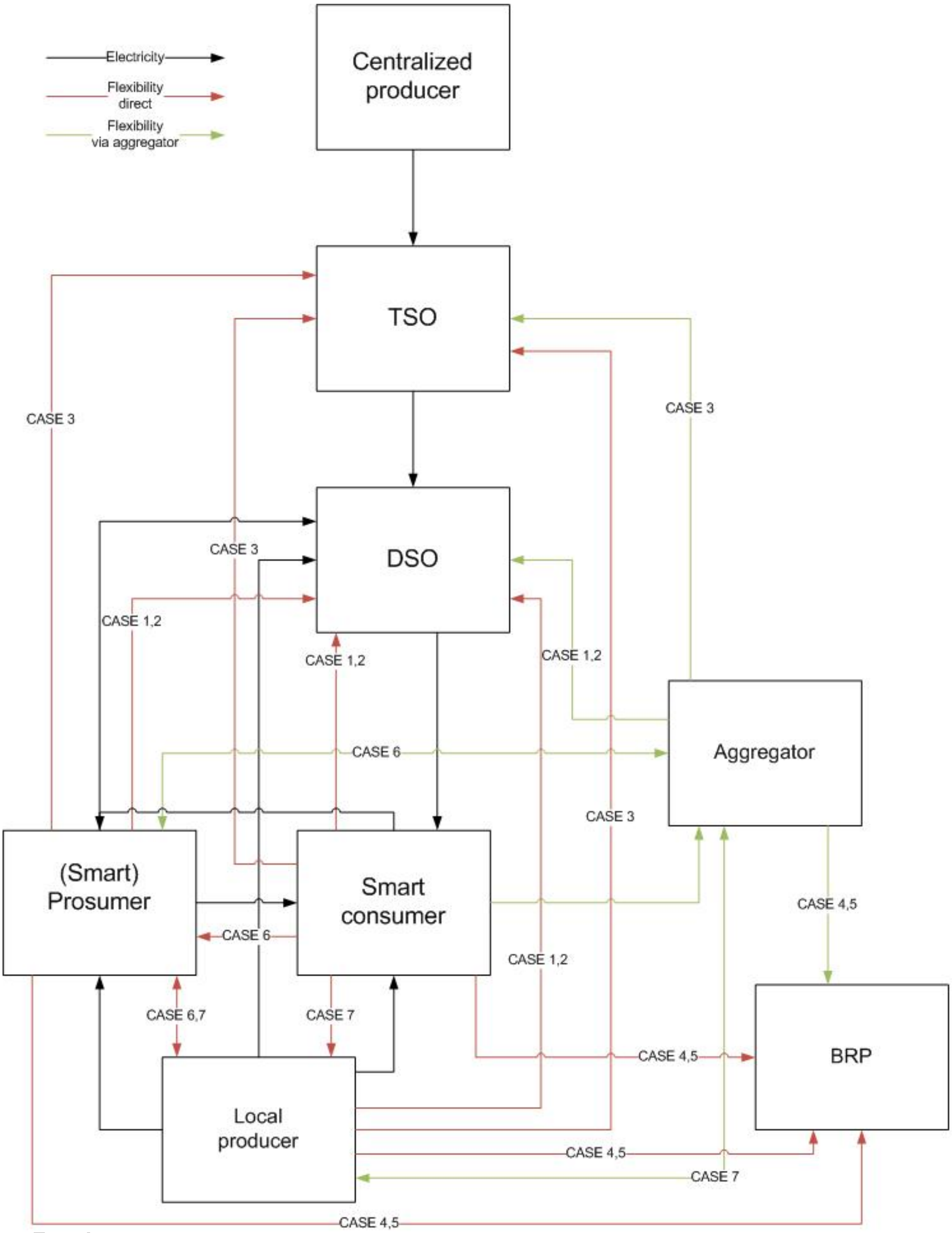

Figure 1: Electricity and flexibility flows from actors in a smart energy district.

5. Realizing the value for flexibility

It is efficient when flexibility in a smart energy district is deployed at the use with the highest value. This value depends on its use and the time of use. It is for example possible that flexibility is especially valuable for the DSO at noon, to prevent congestion on the grid. But later in the day, the highest value for flexibility may lie with a BRP to balance his portfolio. Suppliers of flexibility can only deliver their flexibility to the party paying the highest price, when they must are able to change smoothly between parties in need of flexibility. These can be commercial parties on the electricity markets or system operators (DSOs en TSOs). Advanced smart grid techniques facilitate the processes to exchange flexibility smoothly, not only for the large parties but also for new service providers such as aggregators, ESCOs and small users, including SME.

In the national systems, large consumers and producers are mostly able to offer their flexibility on a quarterly basis to the parties who value this most, for example through bilateral contracts, on the spot markets, the intraday markets and the balancing markets and with the help of aggregators. They can also deliver flexibility to TSOs. Large consumers can thus be exposed to flexible prices, in bilateral contracts or on the various markets.

Often, small consumers do not have the same possibilities as large consumers. Although they would be technically able to deliver flexibility, they cannot do so in practice due to legal and practical barriers. In order to be active at energy markets, small consumers and small prosumers need to have the same competences as large consumers. Other ways their flexibility cannot be used efficiently and the playing field is distorted. Time of use metering and the possibility to settle the bills with the various parties are conditions to realize these competences. Technological, this is possible. Often, ESCOs will support these parties.

The competences include:

- A general competence to contract against flexible prices in the markets for buying and selling electricity (cases 4,5,6,7 and 8 and 9). Flexible price schemes are necessary to reward the availability of flexibility and to stimulate demand response programs.
- A general competence to offer flexibility to system operators. This can be realized by flexible transport tariffs and by the possibility for small prosumers and consumers to enter into contracts with the DSO or the TSO in order to prevent congestion (case 1, 2 and 3), with or without the help of an aggregator. An alternative is a local grid, where production, use and transport are integrated into one system and where local production, supply and use are adjusted to the capacity of the grids.

- A general competence for smart consumers, smart producers and local producers to enter into contracts with whoever they wish, and to change supplier/buyer at a short notice and/or to have more than one supplier/buyers simultaneously (case 1, 3-9).

Flexible electricity prices

In an energy district, exchanging flexibility is key (case 4-9). To stimulate parties to deliver flexibility, prices need to reflect the value of electricity: rising prices when electricity is scarce and falling prices in times of surpluses. Varying, dynamic or flexible prices are on the basis of the business cases of demand response programs, the planning of charging electric vehicles and other mechanisms to match supply and demand.
Traditionally, large consumers and large producers can profit from price differences in the markets. They are able to conclude contracts with flexible prices or they can bid (in)directly in the day-ahead market, the intraday market and the balancing markets, where prices reflect the scarcity of electricity. Applying flexible price schemes to small consumers was difficult, since they didn't dispose of smart meters. Therefore, the so-called profiling of consumers was often the standard: the time of consumption of small consumers is assumed to follow standardized time-profiles, based on the average time of consumption of all consumers. Abolishing this practice and assigning real time of use requires new procedures between all the parties involved in the supply, metering and billing of small consumers.
Nowadays, new technologies, such as smart meters and smart billing enable small consumers to participate actively in the markets and to participate in flexible price schemes.

Flexible price schemes
For small consumers, various flexible price schemes are conceivable. Time-of-use (TOU) pricing divides the day into contiguous blocks of hours. The price of a kWh varies between blocks, but not within blocks, with the highest price for the on-peak block. Each day, the same rate structure applies. An example is higher prices at the system peak demand, for example between 17.00 hr and 20.00 hr. Critical Peak Pricing is only applied on a relatively small number of "event" days. These event days are commonly advertised by the utility a day in advance, based on their forecast of a particularly high demand. In Real Time Pricing (RTP) schemes the price may vary hourly and is tied to the real market cost of delivering electricity. Thus, the prices are not known far in advance.

To stimulate efficiency, flexible prices should not only apply to extracting electricity from the grid, but also for the feed in. The practice of net metering hinders the supply of flexibility. Net metering implies that the production of (individual) consumers in a period of time is deducted from their use. This fits within the traditional system without smart meters, in which production is often automatically subtracted from consumption. From the consumer viewpoint net metering is advantageous and often a refereed situation, since they get the all-in retail electricity price for the generated electricity, but from the viewpoint of the energy district and the energy system this causes extra pressure on the grid and no incentive to consume electricity when RES is abundant.

Flexible prices can be forwarded to consumers via smart grids and smart meters. Contracts may enable suppliers to control certain devices of the consumer, such as heat pumps, air-conditioning or the loading of electric vehicles or there may even be contracts where the supply can be limited under certain circumstances.

The complexity of the contracts between suppliers and consumers augments considerably by price flexibility. For consumers and for regulators, it will be hard to compare the various contracts and to judge the reasonability of the prices. The aims of protecting consumers and organizing an efficient electricity market may be difficult to combine. Flexible prices could rise to very high levels in winter periods without sun and wind. It is possible that regulators find those high prices too burdensome for consumers. At the same time, total system costs rise considerably when consumers do not limit their use in times of scarcity. Total costs will be higher and these higher costs will also be paid by the consumers. For regulators, it will be difficult to strike the right balance.

Legal aspects

In the Third Electricity Directive (2009/72/EG), there are no impediments to flexible prices of electricity for small producers and small consumers. As already mentioned, in most countries this requires an adaptation of the system for metering, allocation and billing, especially when profiling of consumers is the practice.

In the Netherlands, there are no clear barriers in the legal system either. Profiling of small consumers is the practice, but the parties concerned are planning to open possibilities for small consumers to billed conform their real time use.

According to the Electricity Act, suppliers of small consumers must inform the regulator of changes in tariffs (Art. 95b section 2). When the regulator deems these tariffs too high, he may prescribe maximum tariffs (Art. 95b section 3). It is not clear how the regulator judges flexible prices. Experiments with flexible tariffs per hour have started in The Netherlands recently.

In The Netherlands, suppliers are obliged to apply net metering (*the so-called salderen,* art. 31 paragraph c Electricity Act*)*: self produced electricity from small consumers, up to a

connection of 3.80 A, must be subtracted from their production. Small consumers in the Netherlands, producing more sustainable electricity than they use, must deliver this electricity to their supplier. At the end of the year (or earlier) when the meters are read, their own production is subtracted from their use of electricity. For consumers this is advantageous, since they do not pay taxes on the self-produced electricity, even when they feed it into the grid and use it at another time. Net metering is important for the business case of solar panels, since taxes on using energy are rather high in the Netherlands, sometimes more than twice the price of the electricity itself.
Consumers producing more electricity than their total use in a year deliver the surplus to their supplier against a *reasonable fee* (art.31c section 3 Electricity Act). They cannot sell it to other parties, such as the energy district or their neighbors.
Socially, changing from fixed to flexible tariffs is a big step in The Netherlands. Until now, the monthly bills of electricity for small users in the Dutch system do not reflect their real use in that month, but they are based on the average use throughout the year. Small users pay the same monthly fee in the summer as in winter, although in summer less energy is consumed. At the end of the year, when the meters are read, they have to pay extra or receive a refund. Therefore, there is no strong link between their behavior and the money they pay.

In Belgium, Art. 20 bis §2 of the Electricity Act (Wet betreffende de organisatie van de elektriciteitsmarkt, 29 April 1999) on variable contract types dictates that variable energy prices for electricity supply to residential consumers (including SMEs) can be indexed maximally 4 times per year. Dynamic pricing, such as Time Of Use pricing, is thus permitted (e.g. the current day- and night tariffs) and it is allowed to create various time intervals. The price update frequency[2], however, is in any case limited to 4 times a year, so tariff schemes like for instance real time pricing are not allowed. Moreover, the updating of prices is heavily restricted (approval needed of the proposed tariffs, publication of the methodology and parameters). Current rules therefore don't allow to take into account the dynamics of the energy system in the tariffs (e.g. availability of renewable energy system). Also in Belgium, the application of more dynamic tariffs is therefore in reality limited to a few pilot projects.

[2] AH Ik begrijp dit niet zo goed. Eerst zeg je dat time of use wel kan, maar daarna dat het niet kan? Bedoel je dat je maximaal vier keer per jaar de prijzen mag veranderen? Of bedoel je dat er maar vier verschillende tarieven mogen zijn? Aan de ene kant is er de tariefstructuur (bijvoorbeeld vaste tarieven of dag/nacht tarieven, of een ander schema) en aan de andere kant zijn er de updates, volgens mij is dat de mogelijkheid van de leverancier om de tarieven te veranderen of aan te passen? Of is een update iets anders?

In Belgium net-metering is applied for installations producing sustainable electricity with a competence up to 10 kW. In this case, an additional meter which monitors the amount of kWh generated (so as to qualify for green certificates) is installed, but these prosumers actually don't really know to which extent this generated current is being injected onto the distribution grid as there is no simultaneity requirement. Similar to Dutch case, the generated electricity is in effect subtracted from the offtake (via a backward running meter) and once a year the consumers are charged for the remaining net consumption. The consumers thus, indirectly, receive the all-in end-consumer electricity price consisting of the price components for energy, transmission, distribution and other charges. Consumers which generate more than they consume on a yearly basis, are not compensated for this surplus electricity.

Concluding it can be said that flexible tariffs for small consumers are still in their infancy, in Belgium and the Netherlands. This may hinder the uptake of smart energy districts.
To allow flexible tariffs, a redesign of the legal systems seems to be necessary, so that flexible prices are combined with sufficient protection of consumers. Prices could be regulated in another way, for example by obliging suppliers to let their customers choose between a standardized contract with fixed prices or another contract with flexible prices and to oblige suppliers to be transparent about the expected costs of the various contracts for the individual consumers and/or to send consumers with flexible tariffs a monthly bill.
Further, the practice of net metering impedes the forming of energy districts with incentives for prosumers to use the grid economically and to consume electricity when RES is abundant. From the point of view of the consumers it is however advantageous and it stimulates the business cases of PV.
Metering and billing production and use separately is a driver to relieve pressure from the grids and to use electricity when RES is abundant. However, abolishing net metering without offering consumers alternatives to receive a proper compensation for flexibility would deteriorate their position. Flexible tariffs and the possibility to buy and sell electricity on various markets should be a precondition for reforming net metering.

Flexible transport tariffs

Smart energy district aim at optimizing the use of the grid and thus minimizing the costs of the grids (case 1,2 and 3). As mentioned above, using grids in an efficient way reduces the costs of new investments and the costs of maintenance.

In general, costs of transport are lower when production and use of energy are situated near to each other. Moreover, investments in extensions of the grid can be postponed or avoided when the grids are used efficiently. For example, when there is pressure on the grid because of a peak in supply, advancing or postponing the use of heatpumps or the loading of electric vehicles helps to prevent congestion. An efficient use of the local grid within the smart energy district makes that (the rest of) the public grid is used less intensely and that less high voltage grids are needed. As is explained above, the cost causation principle requires that these cost savings are, as much as possible, attributed to the participants contributing to these savings. In that case, the private interests of the parties in the smart energy district concur with the collective interest of a low cost grid. Increasing transport tariffs in case of pressure on the grid due to a peak in demand, stimulates consumers to demand less. For producers it is the other way around. The price differences attribute to a sound business case for demand response, storage and delivering other forms of flexibility.

Traditionally, the grid is seen as a public service which has to be available at all times. Capacity should always be sufficient to meet total demand. Operators of the distribution grids are passive and transport electricity from the transmission grids to the consumers and SMEs, connected to their grids. Congestion is avoided by extending the grids. Without smart meters, there were no alternatives. Now, smart meters and other ICT-appliances enable the operators of the grid to take up an active role in integrating distributed energy resources (DER). By doing so, they transform from passive distribution network operators (DNOs) to active distribution system operators (DSOs). Ruestler et al. (2013) show that DSO regulation has to change profoundly in order to successfully integrate an increasing penetration of DER into their systems. They emphasize that grid tariffs, on top of guaranteeing full cost recovery for the network operators, should be able to convey efficient economic signals to the entire diversity of agents that may connect to the distribution grid.

Flexible network tariffs

Flexible network tariffs are an instrument to stimulate an efficient use of the grids. As is the case with electricity tariffs, various schemes are possible: Time of Use tariffs, where time of use pricing, transport prices are set for a specific time period on an advance or forward basis, typically not changing more often than once a year. Prices for transport are pre-established and known to consumer in advance, allowing them to vary their usage in response to such prices and manage their transport costs by shifting usage to a lower cost period or reducing their consumption and to use while they are producing or to store electricity; Critical Peak Pricing, where prices are higher when critical peaks are expected, which is announced in advance and real time pricing where prices reflect the load. In Europe, flexible transport prices are not common. Transport prices are often a combination of a fixed tariff (kW) and a variable tariff (kWh), or a fixed tariff.

Legal aspects

Flexible or load-based prices for the distribution of electricity fit into the European regulatory system. Art. 15 EED. Section 4, for example, stipulates that Member States ensure that incentives in the distribution tariffs that are detrimental to overall efficiency and hamper participation of demand response in balancing markets and ancillary services should be removed. Tariffs should also allow suppliers to improve consumer participation in system efficiency, including demand response. Ofcourse, price schemes must be based on objective factors and equal groups of network users must be able to enjoy the same categories of tariffs.

In practice, however, transport tariffs are mostly uniform over the whole distribution system. In The Netherlands, for example, regulation is aimed at the availability of sufficient capacity to transport electricity under all circumstances. The Electricity Act obliges system operators to award all requests to transport electricity. When a system operator refuses such a request, he must show the costs of the measures necessary to enlarge the capacity (Art. 24 Electricity Act). The system does not provide in measures to make a cost-benefit on extra transport capacity. At the time of enactment in 1998, the electricity grids were meant to be a so-called *copper plate*, where all transports had to be enabled. This was thought to be in the interest of full competition between suppliers.

In the Netherlands, there is a fixed transport tariff for small consumers (residential consumers and SME). This is a fixed monthly/yearly sum, only dependent of the capacity of the connection and independent of the use of electricity and the time of use. Within this system flexible transmission and distribution tariffs seem not possible. This capacity tariff is originally introduced to facilitate billing and settlement. In the Netherlands, the suppliers charge the transmission and distributions costs on behalf of the distribution and transmission system operators. It was thought that a capacity tariff would facilitate procedures and would simplify the bills.

However, there is an exception for experiments. A limited amount of experiments is allowed in The Netherlands, which must have the consent of the Ministry of Economic Affairs. Experimenting with flexible transport tariffs can be part of the experiment.

In Belgium, the transmission and distribution fee is based on the amount of energy consumed (€/kWh). Both the Dutch scheme (based on capacity of connection) and the Belgian scheme (based on energy consumption), don't incentivize consumers to change their behavior and thereby lower the burden to the grid at peak times. In these methods, the costs of using the grids are not sufficiently attributed to the causers of these costs. A level playing field requires that parties who attempt to fit DER efficiently into the system and to minimize the total costs of the grids, are rewarded for these efforts, so that it can be part of the business case of a smart energy district.

Vertical integration of production, transmission and consumption

A smart energy district can benefit from vertical integration of production, transmission and consumption. When decisions on (part of) new production and consumption facilities and their location are concentrated in one pair of hands, it becomes possible to optimize investments over the chain. Further, the distribution system manager may also adapt tariffs of the grid to the local needs.

In principle, European law prohibits vertical integration of system operation, production and consumption. Energy networks must be "unbundled" to ensure that network operators do not act in favor of their own affiliated interests, for example by favoring transports of their affiliated producers. However, there is also an exception to the obligation to unbundle in special cases. For a smart energy district, the so-called small integrated systems seems to be an attractive option. Integrated electricity undertakings serving less than 100,000 connected customers, or serving small isolated systems may be excepted from the obligation to unbundle (Art. 26 section 4 Electricity Directive 2009/72 EU). In these undertakings, the distribution system operator may thus remain part of the vertically integrated organization. In these systems, it is possible to efficiently optimize the whole systems and to experiment with flexible tariffs.

In The Netherlands and Belgium, the exemption to unbundle for small energy systems is not implemented in their legislation. In The Netherlands, however, the above mentioned Decision on local experiments admits a limited amount of experiments, which must have the consent of the Ministry of Economic Affairs. Experimenting with vertical integration of production and system operation would be possible in those experiments.

To sum up: European Law opens possibilities for smart energy districts to impose flexible transport tariffs and to establish small vertically integrated systems. Until now, these freedoms have not been implemented fully in the Dutch and Belgium law. To promote a level playing field, it is recommended to insert these possibilities as a standard in the regulatory systems of Belgium and The Netherlands.

Access to all other parties and all markets in the system

The flexibility in a smart energy district can be efficiently used when the participants are able to contract with all other parties within or without the district, so that flexibility can be sold to the participant bidding the most (cases 3-8). Those other parties may be other suppliers or consumers within the district (case 6,7) or the other parties outside of the district.

Large consumers are able to enter into contracts with other BRPs, suppliers, aggregators, BRPs and/or to bid their electricity directly or indirectly into the spot market, the intraday market and the balancing market. They may be BRPs themselves or outsource their BRP to other parties, for example an ESCO. Moreover, they often can have more than one supplier at the same time. In this framework, large consumers are able to trade with the party they wish.

Small consumers are traditionally bound to only one supplier, who exerts their BRP. They can choose their retailer and when the contract is ended, they can switch supplier. The retailer exerts the balance responsibility on his behalf. This fits into a system with consumers without smart meters, where consumers are profiled. With smart meters and new ICT-techniques, small consumers and producers are – just as large consumers - now able to conclude contracts with other consumers/prosumers in the district, or to bid their flexibility into the various markets for example through an aggregator. In theory, it would be possible that they buy electricity from a large supplier, that the flexibility of the charging point of their electric vehicle is managed by a lease company and that the flexibility of their heatpump is managed by the smart energy district. In practice, it is very difficult to have this organized since different parties are involved on the connection of the consumer and in one way or another, these relations must be adapted to each other. There are still many uncertainties in practice. It is difficult to foresee how the markets for small consumers will develop. When the allocation of the time of use of small consumers is no longer profiled, real time of use can be accounted for. Of course, for small consumers it is very difficult to plan their consumption, they do not know in advance how much they will use. When individual plans are made on behalf of their suppliers, their real use will probably deviate from these plans. The costs of these deviations are no longer socialized, as is the case in the profiles, but they are attributed to the suppliers, who will pass this on to the small consumers. Further, when a small consumer has a contract with different suppliers, his use has to be attributed to these suppliers. This can for example be done by submetering (charging points for electric vehicles, heatpumps) and having more BRPs with separate meters on the connection of the small consumer.

At this moment, it is not clear how the flexibility of small consumers can be unlocked in the best way. The technology is developing quickly and there are many experiments. In such circumstances, it is necessary that regulation does not interfere with the new possibilities to unlock the flexibility. Therefore, legislation should be general, without prescribing in detail how market parties should behave. When legislation attributes roles and tasks to special parties, the situation is fixed. When new technologies open new efficient solutions which do not fit in the regulatory framework, these cannot be applied.
An example, that will be described in this paragraph, is a legal obligation for suppliers to be the BRP for small consumers, such as in The Netherlands. It is conceivable that independent parties, new service providers, are able to exert the BRP on behalf of the consumers. Then, there is an extra layer in the model: the consumer attributes his BRP to the independent service provider. This service provider can conclude different contracts on behalf of the consumer, for example with a supplier and an aggregator. This service provider takes care of the contracts and the accompanying financial arrangements. He bills the consumer and pays the suppliers. Such a system gives room to many experiments and many new relationships between consumers and their suppliers. Such a system may exist next to other systems, where the supplier exerts BRP on behalf of the consumer. It is important that regulation leaves these possibilities open. An independent service provider could be useful for smart energy districts. It enables consumers to contract freely within or without the district.
At this moment, new regulatory measures for the unlocking of flexibility of small consumers are proposed. The most important is the SEDC/Usef model. This model assumes that it is mostly not in the interest of the established retailers to develop flexibility services for their customers. The business case of a retailer is based on selling large quantities of electricity and not on delivering flexibility services. SEDC (2015) notes that unbundling the provision of flexibility from the sale of electricity guarantees a focus on the consumer's willingness and ability to sell the value of his flexibility. Therefore, the entrance of aggregators, who are able to trade flexibility on behalf of the consumers, is desirable. Eurelectric (2015) defines aggregation as the commercial function of pooling consumption changes (but also e.g. distributed generation changes) from customers to provide energy, flexibility, capacity and services to other actors within the system. SEDC (2015), Usef and Eurelectric (2015) each propose new market models for the introduction of an aggregator. Central in these models is the retailer who, as to date, bears the BRP for his consumer. In the model of SEDC, the aggregator buys flexibility from the consumer and sells it into other markets. By doing so, the aggregator influences the market position of the retailer/BRP, who sells or buys less than expected. Therefore a supplementing transaction between the

retailer and the aggregator is necessary. This contracting is complicated, since the aggregator trades in electricity, which is part of the balance responsibility of the supplier and it is not in the interest of the supplier to cooperate. Therefore, in this model standard contracts and standard retributions have to be made to compensate the supplier for his losses.

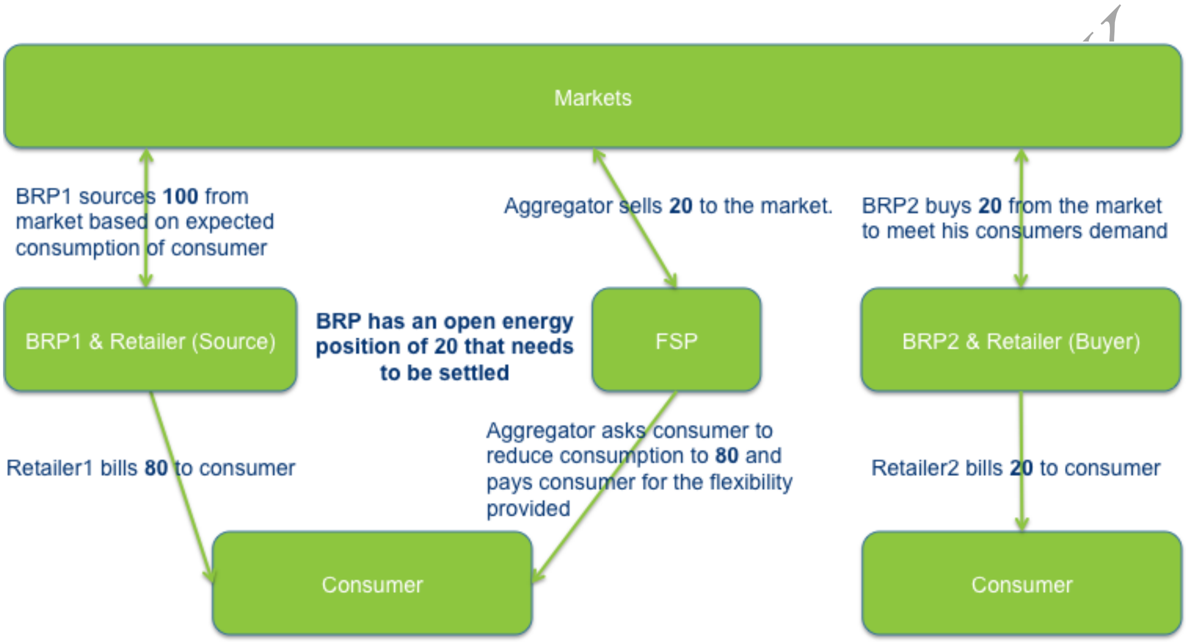

Figure 1: open energy position [SEDC, 2015, p.7]

This is a rather complicated model. It is difficult that the supplier has BRP for his customers, while third parties can interfere in his programmes, by selling or buying electricity which is part of these programmes. The model requires cooperation and contracts between parties with opposite interests and regulation is necessary to reconcile them. But in the longer term, this regulation in itself may be outdated, since new applications are available.

The proposed model, which has advantages and disadvantages, is one of the solutions to unlock flexibility in the markets. As such, it could work. But it is not the task of the regulator to choose a technology, but to take care of a flexible regulatory system, in which different solutions can be tried.

For a smart energy district, further unbundling seems to be necessary. When consumers have smart meters, it is no longer necessary that their BRP is attributed to their retailer. Their BRP can also be unbundled and assigned to other service providers. Unbundling

enables new parties to enter the market, for example ICT parties or new service companies such as ESCOs. These parties are then able to trade energy and flexibility on behalf of the consumers with whoever the consumers wishes to trade with. Suppose an ESCO exerts the BRP of a consumer. The ESCO is able to conclude contracts with (the ESCO of) other parties in the district, with an aggregator and with a supplier (all cases). For each consumer, the ESCO manages the different contracts with the suppliers and he exerts the programme responsibility. For smart energy districts, this would be an effective solution. The parties in the smart energy district are then able to contract with each other, to exchange mutually their flexibility, but they can also and at the same time choose the supplier they wish.
Consumers with a smart meter, who deliver flex to the system, are exposed to certain risks. Their bills will be setted on real time of use. When they cannot keep their promises, they may have to pay penalties. In the new market models, a balance must be stricken between the freedom to conclude contracts and the protection of the consumers.

Legal aspects
The starting point of the Third European Electricity Directive (2009/72/EG) is free competition in production and supply. This implies that all parties are allowed to contract with all other parties and that prices are the results of the market. There are no clear obstacles in the Directive for free trade. Further art. 41 section stipulates that large, non-household consumers have the right to enter into a contract with several suppliers at the same time. There is no similar provision for small consumers.
In The Netherlands, an impediment for free trade may be the obligation to have a license of supply electricity to small consumers (art. 95 a EW prohibits the supply of electricity to households and SME, with a connection of max. 3*80A without a license. The regulator ACM issues this license. Acquiring a license is rather difficult for small parties, since the license is designed for large suppliers, supplying in the whole country and not for energy districts or for individual consumers, selling electricity to other consumers. The yearly costs to have a license may be considerable. The reason to install licenses is the wish to protect small consumers and also to guarantee a sound (administrative) energy system. In order to promote experiments with energy districts the government issued in 2015 a Decision (Decision of 28 february 2015 on experiments in the energy sector) which allows a limited amount of initiatives to supply electricity to consumers without the obligation to have a license.[3]

[3] KK Kunnen we een praktijkvoorbeeld toevoegen waar dit wordt toegepast?

Small consumers or cooperatives who are not able to fulfill the conditions of the license cannot sell flexibility to other participants in the smart energy district. In effect, these rules may function as a barrier to the establishment of a smart energy district. To balance the energy streams within the district, it is necessary that electricity can be bought and sold freely between the participants of the district (case 6,7). When the requirement to have a license to supply small consumers and the conditions applied to the license impede this practice, the aims of the smart energy district cannot be reached. The only solution for this problem is having a licensed supplier on behalf of the district. This supplier can buy all the electricity from the local producers and sell it to local consumers. But in that case, all consumers in the district are obliged to be supplied by the same supplier.
Small consumers in The Netherlands are not able to effectuate BRP (or have it effectuated as they wish) on behalf of their own production or own use. The Electricity Act assigns the BRP of small users to their supplier. This supplier also has the responsibility for collecting the metering data (art. 95ca under 1), the obligation to bill on behalf of the DSO and the TSO (art. 95cb under 1). This seems to imply that small consumers are bound to only one supplier: the supplier who takes care of their BRP. In this system it is not possible for small consumers to enter into contract with several suppliers at the same time, for example the cooperative and another supplier of the last resort, or an aggregator and another supplier. This would only be possible when there are more parties with BRP on the same connection, with separate meters. It impedes small consumers to directly contract other suppliers, since it is not possible to have it billed.
While in The Netherlands, the license is needed to supply small consumers, in Belgium the license is connected to the use of the grid. Regarding the supply of energy in Belgium, the Energy decree of 1 January 2011 stipulates that a supply license, with accompanying duties and conditions similar to the Dutch case, is needed for delivery through the public distribution or transmission grid. [4]

Summing up it can be said that a sound business case for smart energy districts requires that participants are able to sell and buy flexibility to all other consumers and producers, and to bid flexibility in the various markets. As SEDC (2015) notes consumers in Europe do not have access to demand response service offerings within any market, to say nothing of the full range of balancing, reserve- and wholesale markets. This applies also to other flexibility offerings, such as production. The lack of possibilities to enter the various markets distorts

[4] AH Wat betekent dit nu? Dat in België iedereen een license nodig heeft die energie levert? M aar gelden dan dezelfde eisen voor grote verbruikers als voor kleine verbruikers? Want grote verbruikers kunnen toch meestal rechtstreeks bij producenten kopen of energie inbrengen op spotmarkten?

the level playing field. Flexibility of the participants of a smart energy district can not be traded in the same way as flexibility of large producers and consumers.

New models are under discussion to unlock flexibility from small users. In these models the BRP of these consumers rests with one supplier. There are alternatives for these models, which empower small consumers

3. Discussion

To allow new, sound business models for smart energy districts, new regulatory instruments are needed. It is a challenge to combine the possibility of contracting with all other parties in the system with consumer protection and the maintenance of a secure and sound (administrative) system. Technological developments provide new ways to protect the consumers and to secure a sound administrative system. New parties, such as energy service companies (ESCOs) and aggregators can undertake such tasks also.

4. Conclusions and Recommendations

The concept of a smart energy district, where small producers and consumers deliver flexibility to each other en to the system is rather new. From a societal perspective, these districts can contribute to efficiently integrate DER into the system, to a decrease of total system costs and the greening of the electricity supply industry. Further, it stimulates the development of new techniques to match supply and demand and for demand response and consumer participation. This Article shows that a level playing field for these districts is still lacking. Small consumers and small producers do not have the same chances to enter the markets and to sell and buy flexibility as large parties have. European Law stimulates Member States to remove the barriers te entry for demand response and participation of consumers. Changes in the regulatory systems in Belgium and The Netherlands are necessary to give small users and small producers within the district equal chances as large parties have. Flexible transport tariffs, flexible tariffs for electricity and the possibility to trade freely within the district and with other parties in the system are necessary for a level playing field. When changing the regulatory systems, the regulators have to strike new balances between consumer participation and consumer protection.

Acknowledgements

The “Energy-Hub for residential and commercial districts and transport” (E-hub) project, upon which this paper is built, has received funding from the European Union’s Seventh Programme for research, technological development and demonstration under grant agreement N° NMP2-SL-2010-260165. This funding is gratefully acknowledged. However, the sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the opinion of the European Communities. The European Commission is not responsible for any use that may be made of the information contained therein.

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