# Towards a decentralized renewable energy transition:

*Participation of incumbent and new energy actors in policy process in Wallonia*

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# Abstract

A renewable energy transition may take different forms. It could, among other possibilities, follow a decentralized pathway where renewable energy is produced on a distributed manner which inherently leads to intermittency issues and double-flow interaction with the electricity distribution grids. This infers great technical challenges that require a variety of appropriate policies and instruments touching upon production units, grid management and storage facilities. Moreover, a decentralized renewable energy transition inherently allows for citizen to become active in the energy system. Becoming prosumers or members of citizen cooperatives, they may then beneficiate from a plethora of advantages while regaining control and ownership over the system. As the entire energy paradigm changes, incumbent actors who historically dominated the system may then suffer from losses. Drawing from these insights, this research aims at shedding light on *whose interests, among those of incumbent and new energy actors, are represented in the policy-outputs that affect the renewable energy transition pathway of Wallonia.* Doing so the special interests of incumbent and new energy actors in Wallonia were explored, regarding technical, ownership and benefits distribution preferences. Five different policies were then analyzed so as to uncover which of these interests were encompassed. We touched upon the end of subsidies, regulatory framework that supports wind power development, smart metering and collective-consumption legislation inputs that concern flexibility and finally a prosumer tarification. On that account, the results showed that incumbent actors' interests reflected in the policy-outputs whereas new actors' interests barely did so. This influence did not act upon the technical development of the system as this will occur regardless of the actors' will. Nevertheless, they did act upon the ownership, control and benefits components. Finally, it was argued that the reason why the policy-outputs showed to be inclusive of incumbent actors is that policy-makers genuinely believed their pragmatic, financial and skills characteristics to be more efficient regarding a desirable societal transition whereas prosumers and cooperatives failed to prove added-value to the common good.

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# List of abbreviations and acronyms

| | |
|---|---|
| CESE | Economic, social and environmental council of Wallonia |
| DG | Distributed generation |
| DSO | Distribution system operators |
| EV | Electric Vehicle |
| FiT | Feed-in Tariffs |
| GC | Green Certificate |
| GDP | Gross Domestic Product |
| GW | Gigawatt |
| ICT | Information and Communications Technology |
| IoT | Internet of Things |
| Ktoe | Kiloton of oil equivalent |
| kV | Kilovolt |
| kWp | Kilowatt peak |
| LCOE | Levelized Cost of Electricity |
| MLP | Multi-Level Perspective |
| PV | Solar Photovoltaic |
| R&D | Research and Development |
| RES-E | Renewable Energy Source |
| RET | Renewable Energy Technology |
| TSO | Transmission System Operators |
| TWh | Terawatt hour |
| V2G | Vehicle To Grid |

# 1 Introduction

Due to ageing infrastructure, limited energy resources and diverse energy production externalities such as those concerning the environment, the energy sector will inevitably experience changes (Szulecki 2018, 21). More precisely regarding the environmental concerns, current greenhouse gas emissions must diminish over the following decades if we are to avoid a rise in global temperature by 5 or 6°C at the end of the century. Such temperature would lead to tremendous and dreadful consequences for life on earth. In order to limit the CO2 concentration in the atmosphere thus refrain global warming to 2°, renewable energy has been deployed at a growing speed (Gallo et al. 2016, 801). As put by McLellan et al. (2015, 139) "currently electricity generation contributes about 83% of global greenhouse gas emissions owing to the major reliance on coal-fired power". They hence highlight the need to shift towards a low-carbon electricity system.

A renewable energy transition is thus perceived as core to a successful climate mitigation strategy. Yet what is less often acknowledged is that such a change impacts the heart of the organization of the electricity system as we know it today. Renewable energy technologies might entail decentralized production units such as solar photovoltaic panels or wind power, and this, inherently, provides new actors with the opportunity to actively participate in the energy system. Looking beyond the mere technical components of a renewable energy transition, these new actors could get ownership and control over the system itself, as well as beneficiating from a plethora of advantages which were historically restricted to a few actors. Being inherently disruptive, one might wonder if incumbent forces attempt to hinder a renewable energy transition that would follow such decentralized pathway.

In Wallonia more precisely more than 140.000 households started producing their own electricity through solar panels and 15 citizen cooperatives, gathering 10.700 members, emerged over the past 12 years. Reflecting the renewable energy world evolution, this movement is believed to further expand over the following years. This hence infer great challenges for electricity producers, providers and distribution system operators whose role and benefits are disrupted. Acknowledging that a renewable energy transition is highly dependent of policies, including legislative and financial measures, we may wonder if these incumbent and new energy actors are affecting the policy-outputs in order to orient the transition towards a system that suits them the most?

## 1.1 Defining renewable energy transition

*Energy transition* understood in this thesis refers to a change in the overall energy system. Accordingly, "energy system" itself is to be interpreted as "the energy chain that can be regarded as an entity consisting of energy production, conversion, transmission, and consumption" (Alanne and Saari 2006, 641). This goes along with the definition provided by Grubler, Wilson, and Nemet (2016, 18) being that "energy transition is a change in the state of an energy system as opposed to a change in individual energy technology or fuel sources". Hence, an energy transition infers a structural transition that occurs in the complex multi-layered energy system as opposed to individual energy technology shift (Cherp et al. 2018). It touches upon complex interplays between several means of energy production as well as consumption behaviors and technologies.

An energy transition, and even more so a *renewable energy transition* is complex and touches upon many elements of the energy system. As developed throughout this thesis, a renewable energy transition might rely on a variety of production units, affect the role of the grid and the devices through which energy is used. On that account, an energy transition going towards renewable sources would require deeper transitions involving many different technologies at a national and global scale as well as deep structural changes in the overall energy system (Cherp et al. 2018). Such comprehensive electricity system is thus to be perceived as a complex socio-technical system that goes beyond physical infrastructures. It is influenced by social instruments and co-evolve with diverse actors and institutions (Funcke and Bauknecht 2016; Geels and Schot 2007). A renewable energy transition, consequently, relies upon deep political, economic, social and technological changes associated with the energy system (Alanne and Saari 2006).

Thereupon, transition pathways encompass several long-term transition scenarios based on the development of a wide range of technologies, from energy production technologies to distribution, monitoring devices and consumption devices. Depending on the vision and technologies that are chosen and adopted by the different and manifold energy actors, a renewable energy transition can materialize into different energy systems. One of the core discussions in the scientific literature concern the development of a decentralized renewable energy system as opposed to a centralized renewable energy system. Authors have shed light on those two contrasting – but not necessarily exclusive – pathways, both based on renewable sources but within which energy producers and consumers play different roles, leading to a different repartition of control and benefits among the two. The following section will shed light on such decentralized renewable energy transition.

## 1.2 Decentralized transition pathway

There appears to be a political and academic consensus regarding the fact that renewable energy sources (RES-E) will become the primary source of energy in the future (European Commission 2016; Funcke and Bauknecht 2016). However, strong disagreements appear when discussing the design needed to achieve such shift, with the extent of (de)centralization being central. The issue is controversial, leading to scientific and public debate on whether or not the transition should be centralized or decentralized with techno-economic advantages and governance processes at the center of the issue (Funcke and Bauknecht 2016; Lilliestam and Hanger 2016). This following section will present the core elements of a decentralized system as well as the state of play of the related academic debate.

### 1.2.1 Defining “decentralized” renewable energy transition

Energy generation has traditionally been carried out by power plants under large and centralized units (Alanne and Saari 2006). In regard to the overall willingness to decrease greenhouse gases emissions and rely less on nuclear, fossil fuels and nuclear energy sources which were dominant in the traditional energy system are ongoingly being replaced by renewable energy sources. If we wished to introduce RES-E while fitting the already-existing energy landscape, a renewable energy transition would refer to centrally regulated, large-scale power plants and balancing measures in order to achieve energy transition (Lilliestam and Hanger 2016; Funcke and Bauknecht 2016). The incumbent actors previously in charge of such centralized production, along with experts, consultancies and utilities are now encouraging large-scale deployment of RES-E. This includes large offshore wind parks and solar systems to sites in Europe and North Africa in addition to advanced Europe-wide and inter-continental transmission grid integration (Funcke and Bauknecht 2016). In this scenario, the energy production technologies change whereas the main structure and actors involved remain similar to the previously existing energy system.

As opposed to this first pathway, "decentralized production of energy" or "distributed generation" (DG) of energy – used interchangeably in the literature – can be defined as "electric power generation within distribution networks or on the customer side of the network" (Ackermann, Andersson, and Söder 2001, 195). This entails elements such as the purpose (the aim is to provide a source of active electric power) and location (with the electric generation unit being directly connected to the distribution network or connected to the network on the consumer side of the meter). In the ultimate case, it could signify that single buildings can become self-sufficient in regard to electricity (Alanne and Saari 2006). Funcke and Bauknecht (2016) suggest a more precise typology to distinguish centralized and decentralized systems based on infrastructures dimensions with. They put forward; (1) "connectivity" to the distribution grid; (2) "proximity" as production technology is located near load or resources; (3) "flexibility" between load and demand as well as storage facilities; and (4) "controllability" of infrastructure by prosumers and regional markets as opposed to national and international markets as core elements. Among the supporters of such system are private citizens, we find favorable politicians and policy-makers, environmental NGOs and local initiatives or cooperatives. They often put environmental concerns, self-sufficiency objective and regional energy structure as their overarching goals (Funcke and Bauknecht 2016).

Drawing from these first elements, two core components of a decentralized energy system stand out. First, it infers a completely new technological frame, including energy production devices as well as reliable and adapted distribution grid and storage facilities. Second, new actors are involved in the production of such renewable energy. These elements will now be defined and developed since they will be core to the following research.

### 1.2.2 Technologies for a decentralized energy system

In regard to the definition of distributed energy generation provided by Ackermann, Andersson, and Söder (2001), the technology used for distributed generation is not limited. However, it is often combined with a certain generation technology category such as renewable energy technology which is precisely the one that is focused on in this thesis.

The concept of renewable energy technologies itself is broad and encompasses a large array of technologies, going from offshore windfarms, industrial biogas plants to community-owned windmill and household-sized solar panels installation, in addition to batteries, smart grid, and so on. When looking at a decentralized energy system based on prosumers and citizen cooperatives, technologies that matter are the ones enabling consumers to self-produce, store, sell or share the energy, in addition to the ones that monitor and adjust the production and consumption (Kotilainen and Saari 2018). As summed by McKenna (2018) "integrating renewable energies require a combination of measures, for example network expansion/strengthening, increased flexibility, storage, sector coupling and intelligent control systems". Hence three main branches of technology can be highlighted when looking at decentralized RES-technologies: (1) those that are related to the ***production*** of energy itself; (2) those that deal with the ***grid***, and to a larger extent with the monitoring of the production and consumption of energy; and (3) those that concern the ***storage*** of energy. These three components will now be defined and discussed.

**Production technology**

The European Union energy system is quickly and deeply evolving, leading to a share of electricity produced by renewable energy sources rising up to 29% in 2017 and expected to reach 50% by 2030. Much of this electricity is expected to come from solar and wind sources (Gfk Belgium Consortium 2017). Although many technologies are available in regard to the micro-production of energy, McLellan et al. (2015, 139) equally argue that "the current front-runner for decentralized systems are wind and solar". Hence, technologies such as geothermal, micro-hydro and biomass will not be further addressed, and especially as those are less relevant in the Belgian context.

The wind power production has increased extensively over the past 30 years going along with an impressive development of the technology (McLellan et al. 2015). As a matter of fact, the installed wind capacity in the EU reached 168,7GW by the end of 2017, within which 153GW was onshore. Such deployment have allowed for the production of 336TWh in 2017, hence covering 11,6% of EU's electricity demand (Pineda and Pierre Tardieu 2018). As of today, standards commercialized unit have capacities of 3MW, with the maximum being 8MW. The capacity factor is 30 to 40% on good sites, with excellent turbine reliability. Due to their inherent reliability on wind, they constitute intermittent sources of energy and thus pose operational challenges within an electricity network which should be regulated through grid management and storage technologies (McLellan et al. 2015).

When it comes to solar energy, production usually encompasses different forms of technology with solar photovoltaic (PV) being central for decentralized small-scale production (McLellan et al. 2015). By 2015, almost 100GW of solar PV capacity was installed in the EU, within which 16GW were installed by households (Gfk Belgium Consortium 2017). Its price has fallen down by about 80% from 2009 to 2015. This has allowed for solar PV technology to achieve grid parity, hence cancelling out the need for subsidies and financial governmental support (excluding behavioral related incentive policies favoring prosumerism and the financial support that help covering the retail electricity price that also include grid fees) (Gfk Belgium Consortium 2017). This technology could be used so as to reach domestic self-sufficiency (through the use of batteries), yet 99% of its world capacity is grid-connected (Mclellan et al. 2015) and such as for the wind technology, the inherent intermittency of solar PV renewable energy production entails challenges for the overall energy grid system.

Although the price of renewable energy technologies has gone down, high investment were necessary in the early phase of deployment of PV panels and might remain necessary for sizable investments such as for wind technology (Kotilainen and Saari 2018). The introduction of new energy producers in the energy system has been made possible by subsidies and market schemes such as feed-in tariffs (FiT) which have enhanced their financial capacities (Funcke and Bauknecht 2016). Moreover, stable and fair support schemes seem to play a major role in promoting prosumer expansion, whereas inconsistent national subsidies appear to disrupt prosumers trust ergo inhibit further deployment (Karakaya and Sriwannawit 2015; Inderberg, Tews, and Turner 2018, 267).

**Grid, information and monitoring devices**

In a decentralized renewable energy system, the energy production technologies are often directly connected to the distribution grid instead of being connected to the transmission grid, in addition to – usually but not exclusively – being located near the consumption demand, also called load (See Fig. 2). Moreover, whereas large-scale centralized energy production rests on extensive transmission grid (also known as "supergrid" with long distance high voltage direct current) coordinated through (inter)national markets by transmission system operators (TSOs), decentralized energy infrastructures are balanced through distributed resource and demand-side management by distribution system operators (DSOs) and/or prosumers through regional markets (Funcke and Bauknecht 2016; McKenna 2018). Decentralization hence infers great changes for the distribution system operator who used to transport the electricity from one production point to several receiving points (single flow direction). With decentralized RES-E, DSOs now have to integrate electricity production at several points of entry, to be distributed to several receiving points (double flow direction). Meanwhile it has to ensure the simultaneity of these exchanges so as to ensure the stability of the grid, despite the intermittence of the RES-E sources.

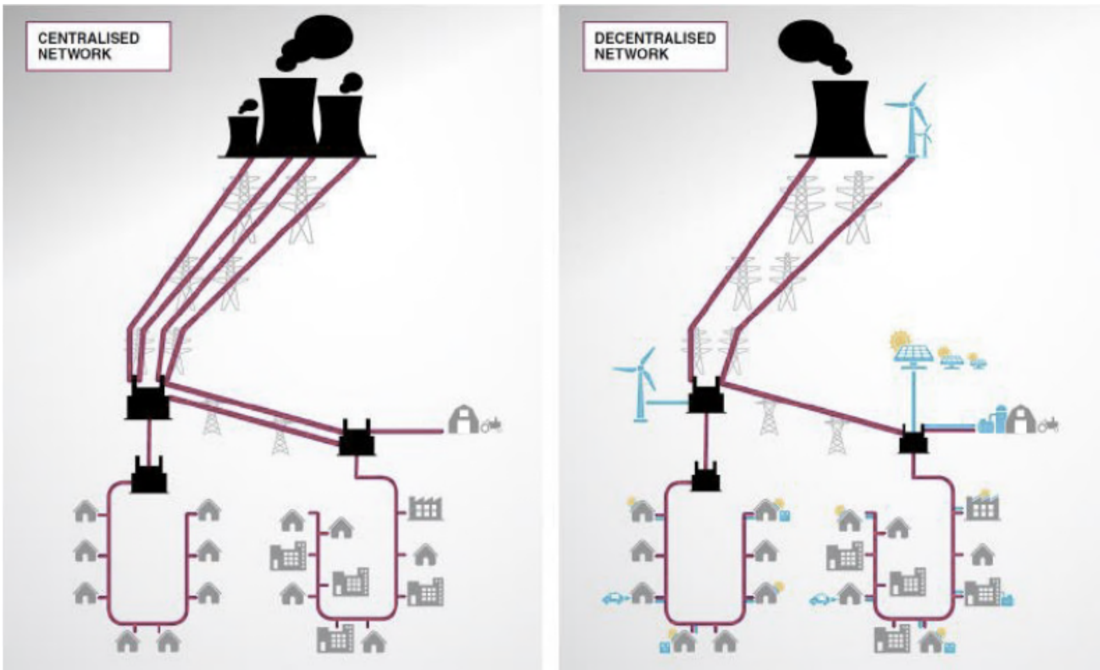


*Figure 1: Changes from centralized to decentralized energy system* (Rutovitz, Langham, and Downes 2014)

In practice, Funcke and Bauknecht (2016) call for reliable transmission grids to be combined with distribution grids so as to integrate RES-E. They consider it necessary to reduce the demand for extensive storage over time as areas with high potential for RES-E are able to provide a surplus to areas will less generative potential and higher demand (e.g. urban versus rural areas). Transmission grids will nevertheless not be considered in this study as it goes beyond the geographical scope of the research. Indeed, while DSOs operate on the Walloon region, the TSO (Elia) operates on a national scale and is highly dependent of its international context.

The most vital element when looking into decentralized energy system is for it to be flexible in regard to the generation and consumption of energy. Mateo et al. (2017) highlight challenges resulting from the integration of solar PV production onto the distribution grids with impact on voltage profiles, coordination challenges and energy losses. Although power grids are able to absorb uncertainty and intermittency from RES generation up to 10% of the system installed capacity without major technical problems nor important cost (Gallo et al. 2016), in order to reach their full potential and overcome the intermittency inconvenience, a deep renewable energy transition necessitates grid reinforcement in addition to smart grid technology which enables two-way information (i.e. reliable weather forecast in addition to load forecast) and better managed energy flow between production and consumption through load shifting for instance (Funcke and Bauknecht 2016; Michaels and Parag 2016; Kotilainen and Saari 2018; Mateo et al. 2017). Therefore, in order to allow an efficient integration, distribution system operators (DSOs) should extensively invest in the grid so as to enable it to carry the intermittent solar PV high penetration level and hence ensure safe and reliable grid operation. The authors put forward and categorize solutions to those technical challenges, solutions that can be implemented by the DSOs themselves, by the distributed producers or by the two interactively. The DSO solutions touch upon grid reinforcement, advanced voltage control, reconfiguration of the network, etc. Distributed producer similarly could modify their consumption behavior so as to fit load whereas both DSOs and prosumers, interactively, could for instance set a demand market based on price signals (Mateo et al. 2017). The European Commission follows this line of thought as it suggests the improvement of self-consumption through (1) a better energy demand management through the coordination of energy production and peak load (e.g. real-time electricity price signals); and (2) technology innovation such as smart meters (Gfk Belgium Consortium 2017).

The change from a centralized to a decentralized energy system is often believed to be possible due to the emergence of new technological solutions and business model based on widespread digitalization. Indeed, according to Kotilainen and Saari (2018, 1–2), “the integration of the Internet of Things (IoT) into the power grid has led to completely new possibilities for managing the energy system”. IoT –

network of devices which can be connected and exchange data – allows for real-time data collection, storage and analysis which eventually can lead to a better management of energy production and consumption (Kotilainen and Saari 2018). McKenna (2018) further claim that the management of such flexibility necessitates Information and Communication Technology (ICT) such as smart metering systems which are able to provide real-time information on quantity and time of consumption. Following this line of thought, Funcke and Bauknecht (2016, 72) argue that "smart meters and flexible tariffs that become available for consumers in real-time on an online market platform could incentivize load shifting". Hence, despite being costly, the development of such flexible grid as well as monitoring technologies are described as necessary in the literature, especially as the utilization of self-produced RES energy within households is limited to 20%-40% without electric batteries (McKenna 2018).

**Storage technology**

Dealing with the intermittency and uncertainty of RES generation might also be done through the use of energy storage, which can take diverse form and is highly dependent of the physical and economic potential of a country. Although further insights into the Belgian potential will be offered in the following sections, the most relevant power-to-power storage technologies will now be introduced, touching upon the "conversion of electricity into another energy form and restoring energy back to electricity" as well as power-to-gas and power-to-heat (Gallo et al. 2016, 802). We note that the storage technologies themselves might be more or less decentralized.

First, batteries can be used to store and restore electricity. Conventional batteries (such as lead-acid batteries) have been used for over a century and are widely deployed in the automotive industry and are now being often implemented for isolated PV systems. They are relatively low-cost and are characterized by a moderate efficiency of about 70-80% although some more advanced design might offer an efficiency of about 80 to 90%. Unfortunately they are also characterized by shortcomings such as low specific energy/energy density (30-50Wh/kg), poor life cycle, regular maintenance needs and negative environmental impacts due to toxicity and need for materials (Gallo et al. 2016). Despite those disadvantages, many authors have further highlighted the importance of the battery potential through vehicle-to-grid (V2G) technologies which can hence be used to balance load during peak hours

(Kotilainen and Saari 2018). According to Gallo et al. (2016, 820), V2G is highly promising since “when the electric vehicle fleet, including full electric vehicles and plug-in hybrid electric vehicles are remotely called to charge or discharge when idle connected to the grid” allows for “higher demand-response, flexibility, improved grid reliability and increased self-consumption of end-user generators”.

Although less “efficient”, using the extra production of solar PV panels to heat household water might also be interesting. This could lead to an increase of autonomy without leading to substantial costs. This is a readily available solution that can be set through the simple installation of a PV heater. This cheap mechanism detects electricity surpluses and automatically leads to the heating of the domestic water (Haveaux and Huart 2017).

Hydrogen can also play a central role in a decentralized energy system as it can be used as a storage material to further generate electricity (power-to-power) as well as being used as such (power-to-gas) (Gallo et al. 2016). Although hydrogen is currently largely produced from fossil fuels to be used in petrochemical and ammonia industries, in a decentralized energy system it could result from steam reforming or electrolysis. This technology is highly efficient and readily available, but high costs remains a barrier to its spreading (McLellan et al. 2015; Gallo et al. 2016). Another prominent challenge in regard to this technology is the safety risk inherent to compressed gas storage (Gallo et al. 2016).

Another promising yet much more prominent storage technology is pumped-hydro storage, which is the most mature and widely-installed storage technology as of today. It consists of two water reservoirs located at different heights; the energy is stored when pumping the water from the lower to the upper reservoir and is restituted when going from the higher to the lowest reservoir. This technology might store hundreds to thousands of MW, with a moderate to high efficiency of 65-85%. Although its lifetime is long (from 30 to 60 years), it requires important capital investment, is highly dependent to geographic characteristics and might lead to substantial environmental impacts (Gallo et al. 2016).

Developing these different technologies will hence require significant investment while needing to maintain an affordable and reliable electricity supply for everyone (McLellan et al. 2015). The development of such technology will require well-suited regulatory environment as it stands today as a major impediment to the development and adoption of these technologies (Gallo et al. 2016).

### 1.2.3 Decentralized energy actors

As the energy system experiences this technical decentralized transformation, it becomes interactive and allows consumers to be involved as producers of energy whereas incumbent actors see their role and influence changing to such new actors (Kotilainen and Saari 2018; Funcke and Bauknecht 2016). This decentralized system implies active citizen participation and civic ownership in the energy production, infrastructure and usage system (Szulecki 2018) which could take the shape of ***prosumerism*** or ***citizen energy communities***. As both these actors will be central to this research, they will be further developed.

**Prosumers**

In the energy field, a "prosumer" is understood as a consumer who also produces, sells, trades or stores energy (Stephenson, Whitaker, and Ford 2016). The act of prosuming thus leads to the switch from passive consumer behavior to empowered and more active participant in the energy system. A common image of prosumers is a household that produces all or part of its energy by using renewable energy technology such as solar energy panels (Kotilainen and Saari 2018). The academic literature provides different ways to understand "prosumers". In regard to the technical aspect, prosumers are linked to renewable energy sources technologies itself as well as to smart appliances and grid-related technologies. The social approach on the other hand perceive prosumers as co-creators of innovation (Kotilainen and Saari 2018). This definition encompasses both residential prosumers who produce their electricity at home and citizen-led energy cooperatives. We note however that the common and political understanding of prosumer often relate to small-scale electricity producers . In regard to Belgian standards, we will refer to prosumers as those having an installation equivalent to, or less than 10kWp. These prosumer installations often consist of solar photovoltaic (PV) panels, often related to the grid or, to a lesser extent, storages facilities.

**Community energy or energy cooperative**

Although inherently encompassing "prosumers", we will technically distinguish them from energy communities as these will consist of installations above 10kWp. Moreover, the literature defines "community renewable energy", "community renewables" or "citizen energy cooperatives" as "projects where communities (of place or interest) exhibit a high degree of ownership and control, (and are) benefiting collectively from the outcomes" (Seyfang, Park, and Smith 2013, 978). Based on several case studies in the UK, Walker and Devine-Wright (2008, 498) have identified two key dimensions that entails views of policy-makers as well as administrators, activists, projects participants and local residents on what a community renewable energy is. First, the "***process***" dimension refers to the developers and runners of the projects as it questions who is involved and whose influence matter ("who a project is developed and run *by*"). The second dimension concerns the "***outcome***" which looks into the spatial and social distribution of the economic and social outcomes ("who is the project *for*"). As they put these two dimensions together, Walker and Devine-Wright (2008) highlight different combinations of process and outcome possible with the ideal community project being at the top right of their diagram (See Fig. 2). This would consist of a project entirely driven by a group of local people that would bring collective benefits to the local community, hence being a project *by* and *for* the people.

Drawing from multiple interviews, they have developed three different interpretations of "community energy". First (A) some individuals perceive the process dimension (with high degree of involvement of local people in the planning, setting up and running of the project) as central to community projects whereas the other viewpoint (B) gives more importance to the outcome understood as the distribution of benefits. One last viewpoint (C) combines the two and thus remains open to many different forms of projects within which a plurality of combination of process and outcome are acceptable (G. Walker and Devine-Wright 2008).

The International Renewable Energy Agency (IRENA) provided a definition of "community energy" that entails the same two elements, being an "economic and operational participation and/or ownership by citizens or members of a defined community in a renewable energy project. Community energy is not limited by size, taking place on both large and small scales". In that sense, community energy is any combination of a least two of the following elements: "(1) local stakeholders own the majority or all of a renewable energy project; (2) voting control rests with a community-based organization; (3) the majority of social and economic benefits are distributed locally" (International Renewable Energy Agency 2018a, 3).

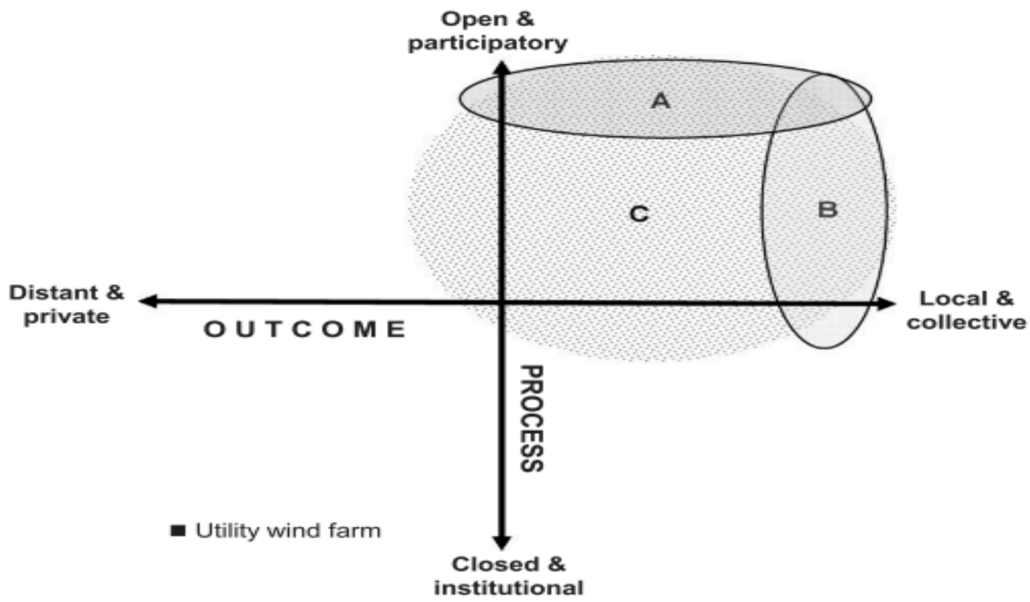


Figure 2: Understanding of community renewable energy in relation to project process and outcome dimensions (Walker and Devine-Wright 2008)

### 1.2.4 Democratic components of a decentralized renewable energy transition

Going beyond the technical changes that a decentralized energy transition infers, the literature highlights two core democratic components. First, this touches upon the ownership and control that is given to both prosumer and community members. Second, they could beneficiate from socio-economic advantages. After providing insights on these elements.

**Ownership and control**

A consistent element discussed in the academic literature regarding decentralized energy systems is that new energy actors have the possibility to take part actively in the production of the energy, as opposed to the traditional "centralized" perspective on energy transition. Such as previously discussed, decentralized renewable energy sources can be deployed by a variety of investors – including individuals becoming prosumers, cooperatives and local communities – giving these new actors the possibility to actively participate in the energy system (Szulecki 2018). As opposed to the previously dominant energy sources, renewable energy through its distributed form and enabling technologies allows for different means of ***ownership and control***. According to Burke and Stephens (2018, 79), "this approach calls for reclaiming the energy sector and shifting political power to workers, households, communities, and the public, in opposition to a centralized, corporate, utility-scale renewable energy model". The issue of governance is thus brought to the center of the debate, with decentralization opening up for an "energy democracy agenda" which entails elements of shared ownership, democratic energy decision-making (Angel 2016; Burke and Stephens 2018; Szulecki 2018b).

**Benefits**

Second, the literature recognizes that such energy system offers socio-economic benefits. Concerning prosumers, we note that they mainly access financial advantages as producing their own electricity becomes might become cheaper than purchasing it from electricity providers. In regard to energy community or energy cooperatives, a report from the British National Trust has noted several tangible benefits. They first highlighted **economic benefits** with community often using the income created by RES-E projects to fund further energy efficiency measures and micro RES-E production so as to reduce their carbon footprint or become carbon neutral. This also entails a "long term income and control over finances in areas where there might be few options for generating sustainable wealth". The size of such income will be depending of the size and profitability of the scheme. An example is one of the Talybont on Usk Hydro Scheme which delivers about 25000£ a year which were then used to provide funds to other projects in the villages. Third, such projects increase **'resilience'** since income coming from the projects "can be used to increase energy efficiency of local houses and community building" (Walton 2012, 4). They also attempt to lower fuel bills and hence fuel poverty through the "*sleeving"* of energy produced to local consumers. Sleeving is a pricing mechanism which seeks to match the energy use of a defined consumer group to the output of a specific generative group which hence "provide consumers with a more direct relationship with the source of at least some of their energy, and by reducing marketing and administrative costs enables the supplier to offer consumers a reduced rate for their energy supply" (Walton 2012, 4). Third, the **community is empowered** since such long-term project development entails the involvement of local people in a wide range of activities. It might improve the 'local economy' through the creation of employment opportunities resulting from the planning, survey and engineering parts of the projects, in addition to increasing the tourism prospects of the area (Walton 2012).

### 1.2.5 Decentralized renewable energy transition: Overview

According to the literature and political actors, a renewable energy transition is most likely to occur in the following years. A renewable energy transition could however follow different pathways. One of them consist of a decentralized renewable energy transition, where production units are spread among society. This entails physical changes, with production units (here solar PV and wind mills) being geographically spread, connected through a flexible distribution grid which coordinates electricity production and consumption as well as storage electricity facilities. We also note that this decentralization allows for new actors to participate in the energy system. Both prosumers and citizen communities might be involved, hence controlling and beneficiating from the new electricity system. These different elements can be found articulated in figure 3. In the following chapter, we will attempt to gather theoretical insights so as to map elements and understand phenomenon and interaction that might lead to a certain pathway.

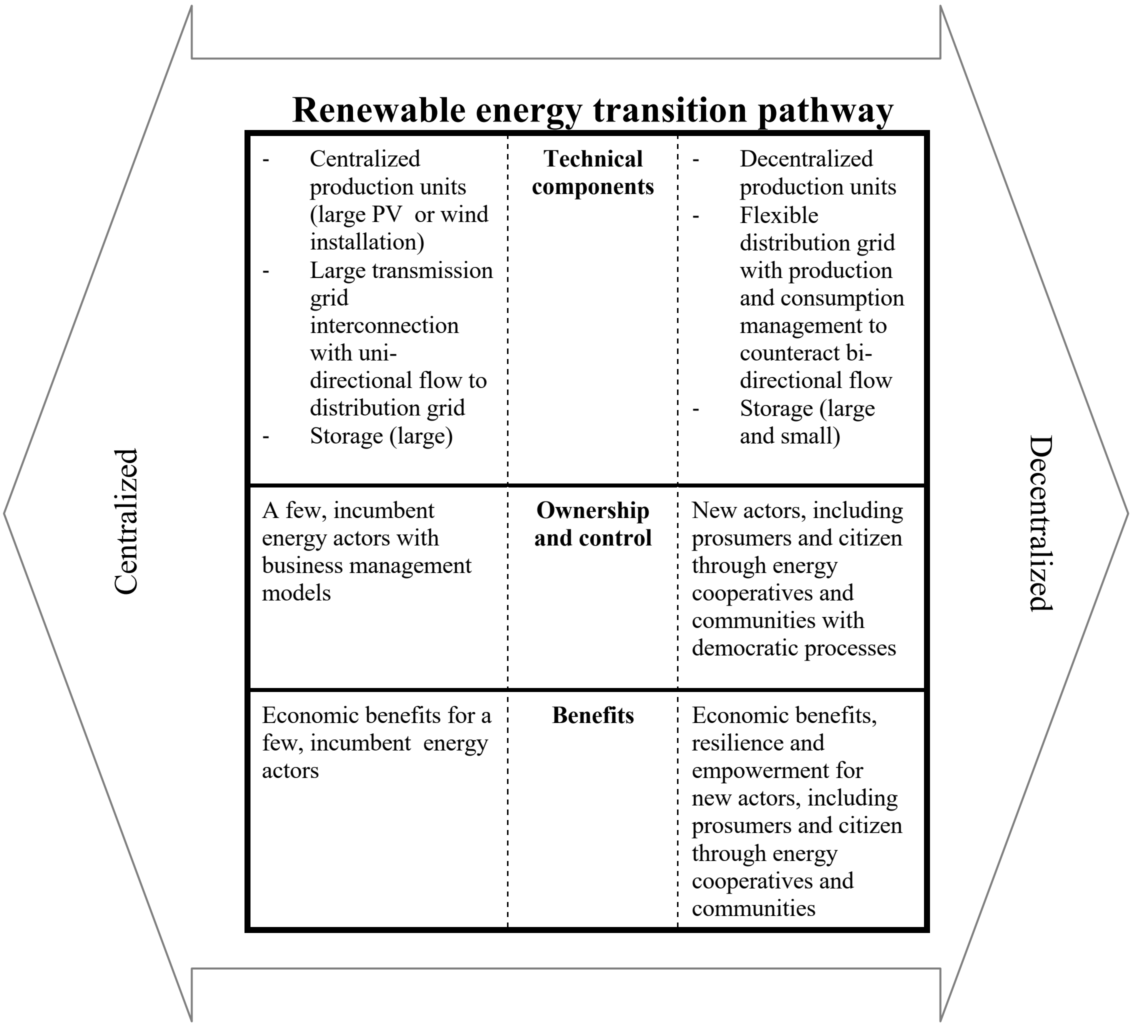


Figure 3: Renewable energy transition: (de)centralized pathway and components

## 1.3 Main research question and purpose

As displayed through the literature review provided here-above, a renewable energy transition could become decentralized. This phenomenon would steer substantial changes regarding the organization of our energy system. Actors who have been historically dominating the energy system will have to face the entrance of new energy actors who could then claim control, ownership and benefits. Such decentralization, however, requires great political will due to interrelated technical, economic and social challenges that need to be overcome through a coherent and appropriate set of policies. That being so, different actors might have developed special interests which they might wish to integrate in the policy-outputs. In order to understand the renewable energy transition pathway within a particular area, it appears important to understand the policy process from which relevant policies result. Policy process in that sense implies to consider the role and interests of the different actors, going beyond the mere policy-makers. It is based on these different considerations that a research question has been drawn, hence being: "***Whose interests, among those of incumbent and new energy actors, are represented in the policy-outputs that affect the renewable energy transition pathway of Wallonia?"***

This question serves three purposes. First, we wish to uncover the interests of the different actors; incumbent and new. What do they want in regard to the technical and democratic aspects of the renewable energy transition? Second, we aim at exposing whether or not some of these interests are integrated into the policy outputs. Third, this allows us to understand the indirect effect of special interests on the transition pathway that is experienced. Through this entire process, we will simultaneously shed light upon the energy pathway that is encouraged by policy outputs in Wallonia. Hence this is a matter of complex interplay between actors, their interests and the policy outputs which the theoretical framework will help us articulate.

## 1.4 Walloon case study and scope of the research

This particular question will be applied to the Walloon case study. Wallonia is the southern region of Belgium, located in the western part of the European Union and measures 16.844km$^2$ (55% of the Belgian territory) for 3,6 million inhabitants (31% of the Belgian population), making it a relatively dense country with 215 inhabitants/km$^2$ (similar to most western European countries) (Index Mundi 2018). In 2017, it had a GDP per capita of 25.300€, being slightly under the EU's average of 27.700€ (Brunet et al. 2018). These basic characteristics make Wallonia relatively representative of other european industrialized countries.

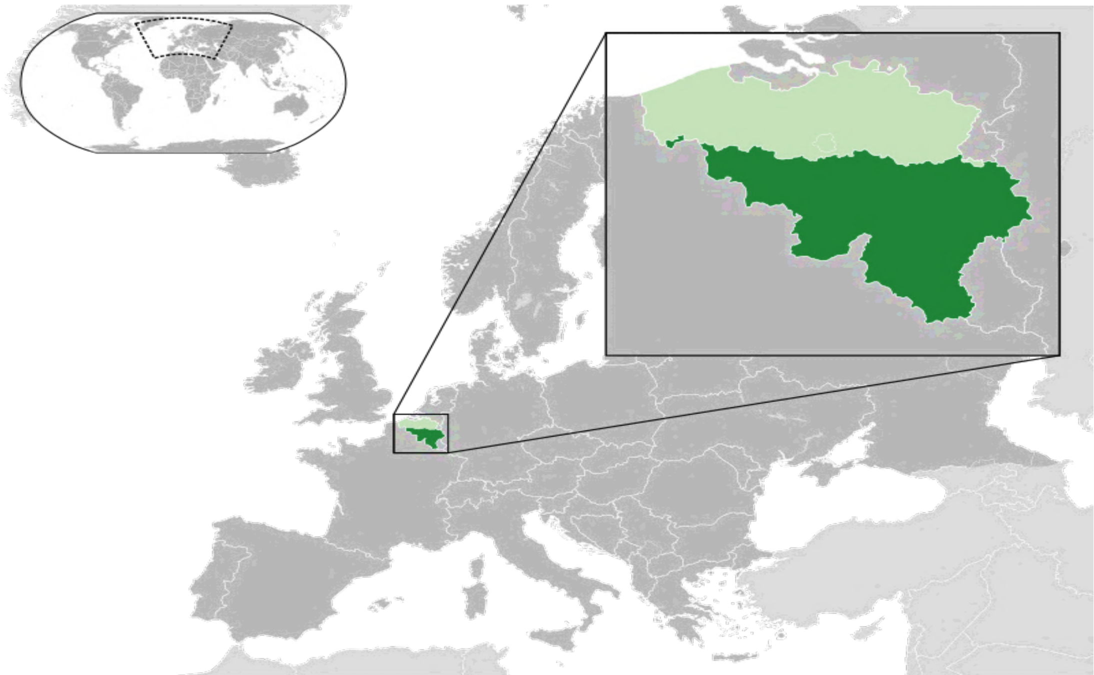

Figure 4: Situating Wallonia

In regard to the research previously presented, Wallonia appears to be a very interesting case study for several reasons. First, as opposed to mountainous regions, geothermically resourceful or sunny desertic areas, the deployment of renewable energy sources in Belgium is most likely to be decentralized. Indeed, photovoltaic and wind power are the most salient sources of energy in Wallonia (APERe 2017a) (See Appendix 1 for more details). Second, Wallonia encompasses both dominant incumbent energy actors and new energy actors. The Walloon electricity market is dominated by two main multinational companies: Engie-Electrabel (Electrabel operating in Wallonia since 1905) and EDF-Luminus (Luminus operating in Wallonia since 1978). Electrabel, as the historic energy actor in Wallonia, was also the main distribution grid system operator until 2009. Following European guidelines, it then gave its distribution system operators' missions to a separate company called "ORES". ORES now manages 75% of the electricity grid of the region and continues to expand. Moreover, the region witnessed a steep increase in citizen participation in the energy system as prosumers and citizen cooperatives started beneficiating from a green certificates subsidy scheme in 2007. Hence, the region encompasses both incumbent and new energy actors who can then be analyzed so at to shed light on the interplay of power between these categories of actors and the resulting policy outputs. Other groups of actors could play a tremendous role in regard to the transition pathway, including energy-consuming industries for instance. Yet, the focus of this research lay on the actual energy actors, hence those who directly take part in the energy system. Moreover, the research scope is limited to households; industries who start producing their energy or provide flexibility services are not included since the democratic aspects (spread of ownership and benefits) of the renewable energy transition is core to the research and assessing the democratic effects resulting from the participation of such industries would have complexified the analysis.

When looking into the policy-outputs, what is of interest are the policies which are adopted by Walloon public authorities. From a vertical multi-level perspective, the Walloon territory is affected by policies from several political entities, including international, European and national political bodies. Although the following contextualization (chapter 3) touches on the multi-level decisions that affect the Walloon policy-outputs, we only analyzed those which are adopted by the Walloon public authorities that are competent in regard to renewable energy matters: the Walloon government and the energy market regulator (Walloon Commission for Energy – CwaPE). The Walloon parliament and public administration could have been analyzed, yet it appears that they haven't initiated nor implemented relevant policies over the time frame set by this research hence they were set aside.

More precisely, the policy-outputs analyzed correspond to the different decision that were adopted within the period 2017-2019. This frame coincides with the period during which one energy minister was into power (Energy minister Crucke: July 2017-Mai 2019). This period was chosen since manifold decision touching upon the decentralization of the energy system occurred during this exercise. When relevant, background on these policies introduced previous decisions, yet these were not analyzed per se. This delimitation also has a methodological advantage: by focusing on one energy minister, changes in political ideologies do not interfere with the policy analysis. Moreover, during this period the composition of the Walloon Commission for Energy remained stable as well. The new president, Mr. Stéphane Renier, was himself chosen in May 2017.

## 1.5 Outline of thesis

In order to respond to the research question, a theoretical framework on energy transition will now be provided. An energy transition pathway is the result of complex interactions among a plethora of factors. On that account, academic authors have often made use of the encompassing social-ecological framework rendered by Elinor Ostrom so as to make sense of energy transition phenomena. This research will hence make use of this same framework in order to structure the different elements that should be taken into account when approaching a certain renewable energy transition and transition pathway. Following this theoretical framework, the chapter four on methodology will more precisely disclose how this theoretical framework will be applied to the case study. Then, the three qualitative methods used within this research will be introduced and explained before discussing the role I have played in the research and discussing some ethical consideration. Drawing from the socio-ecological framework applied to energy, the fifth chapter will provide contextual elements that are necessary to understand the following analysis and resulting pathway. Doing so, this chapter will reveal meaningful information on the case study, including technical, socio-technical and political indications. The core of the analysis will start in chapter six: The different actors will be analyzed. This will shed light upon the special interests of the incumbent and new energy actors regarding the technical transition they favor (regarding production units, grid management and storage facilities) and the distribution of ownership, control and benefits they encourage. Chapter seven will then briefly introduce the two different public authority figures that have created the policy-outputs to be analyzed. In the eighth chapter, the policy-outputs will first be contextualized before being analyzed. It will first shed light on overall impacts it has on the transition pathway before connecting it to the different actor's perspective on the issue and consequently their special interests. Through the conclusion, we will bring together these different elements so as to provide a relatively structured answer to the research question. The results themselves will hence be discussed using insights from the shallow and deep ecology dichotomy and the participative energy democracy.

# 2 Theoretical framework on energy transition

In regard to what has been previously demonstrated, the energy system is complex and entails a plurality of physical infrastructures and societal arrangements which will be modified in regard to a decentralized renewable energy transition. The literature describes the energy system as a socio-technical system that consists of physical infrastructures which are themselves strongly influenced by social structures, co-evolving with relevant actors and institutions (Funcke and Bauknecht 2016). Due to such complexity and interactions among the different core element of an energy system, theoretical frameworks on ***energy transition*** have been suggested in the academic literature in order to comprehend energy transition per se. I will now introduce the frameworks chosen to make sense of the issue here analyzed, being the understanding of a particular energy transition pathway: a decentralized renewable energy transition.

## 2.1 Social-ecological framework applied to energy

Authors in the academic literature have used meta-theoretical frameworks which draw from a plurality of academic fields in order to analyze energy transition. The social-ecological framework produced by Elinor Ostrom (2009) has put forward the interaction of multiple actors under the influence of a variety of factors to understand environmental transitions. These interactions, called “action-situation”, produce an outcome which are hence “linked to contextual variables through feedback paths” (Bauwens, Gotchev, and Holstenkamp 2016, 137). There are distinct contextual variables within these action-situations; resource systems, resource units, governance systems and actors (See Fig. 5). Accordingly, “Resource System” is used to approach the “biophysical/technical system from which Resource Units are extracted” whereas “Governance System” includes “the prevailing sets of processes or institutions through which the rules shaping the behavior of the actors are set and revised” (McGinnis 2011, 181). This framework thus allows for a comprehensive contextualization which shed light on agency (focusing on the action of the different actors regarding their power and interests) as well as structure (which entails the broader social forces and institutions that constrain the decision of the actors) in addition to the biophysical and technical boundaries (Bauwens, Gotchev, and Holstenkamp 2016). Several authors have drawn from this cross-perspective theory to make sense of energy transitions more precisely.

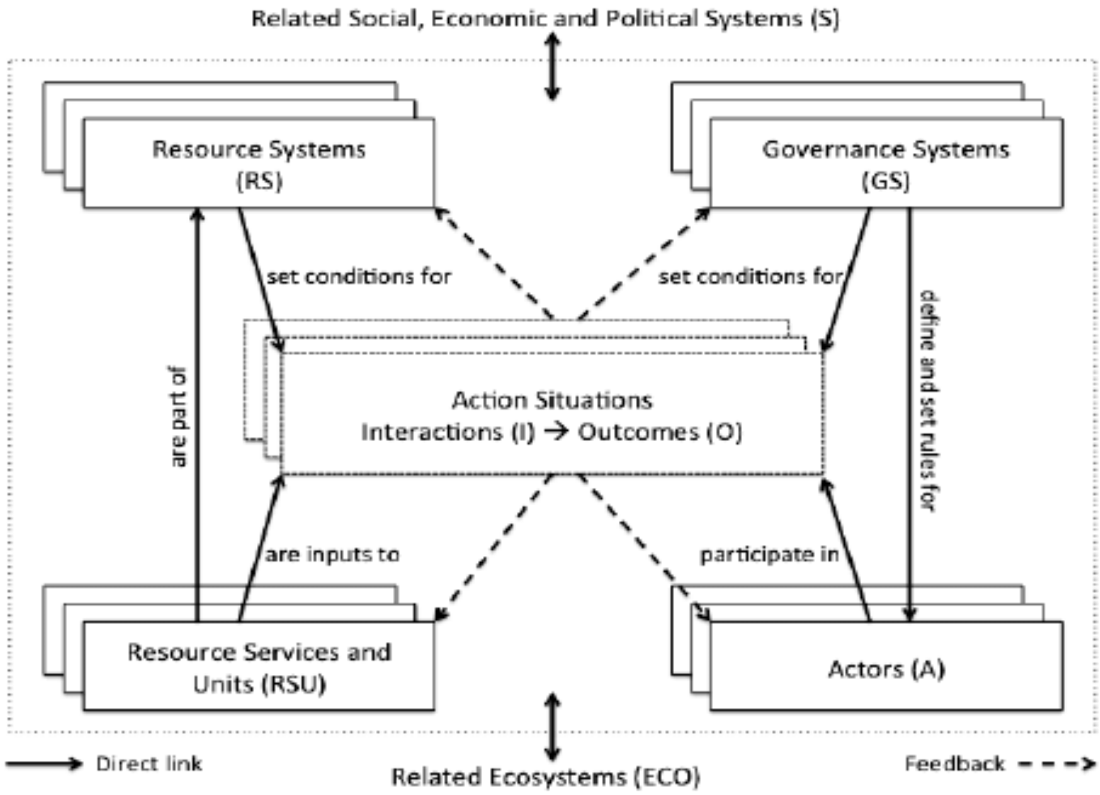


Figure 5: Graphical representation of the Social-Ecological framework (McGinnis and Ostrom 2014)

Drawing from the co-evolutionary process of the social-ecological framework, Cherp et al. (2018) suggest the existence of three sub-systems which coexist and influence one another. Accordingly, being conceptualized such as a co-evolutionary process, a renewable energy transition reflects two types of mechanisms; First, those explaining the evolution of each of the sub-systems and second mechanisms explaining links between those sub-systems (Cherp et al. 2018). Hence, historically energy transitions have resulted from changes in co-evolving and semi-autonomous systems. Considering those three semi-autonomous systems, they suggest a meta-theoretical framework to hierarchically organize and map variables and explain their interaction (See Fig. 6) which should ergo be applied to specific case studies in order to make sense of its intrinsic energy transition.

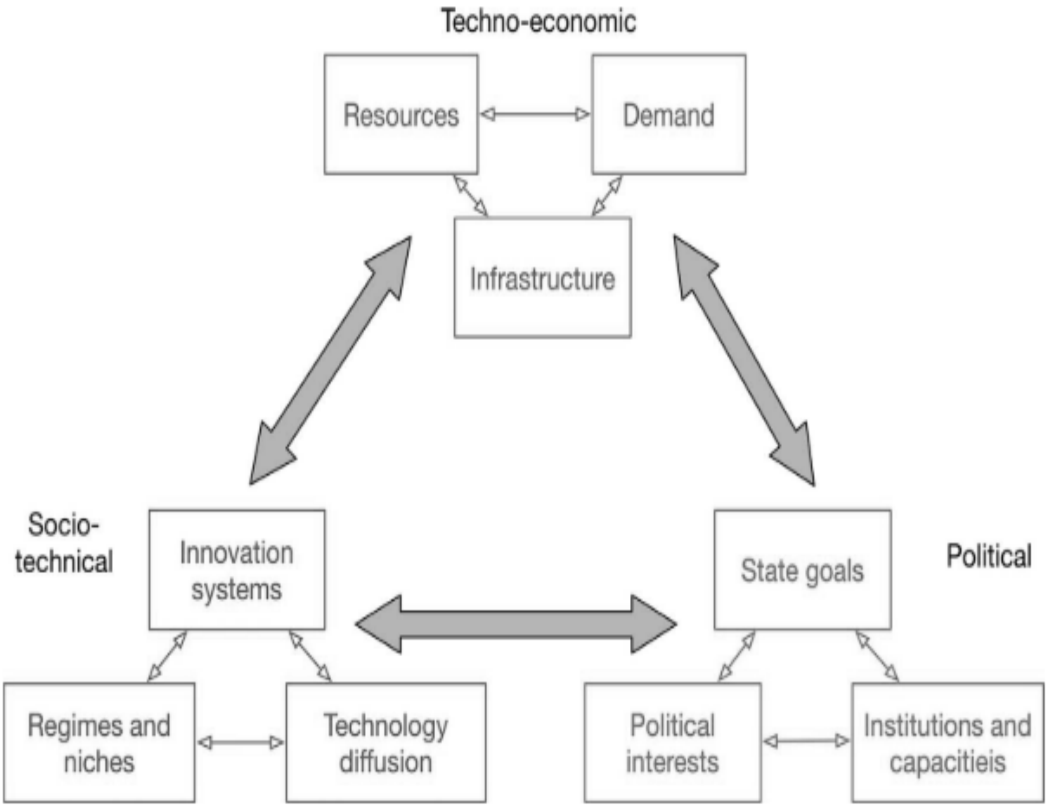


Figure 6: Top level variables associated with the three perspectives on national energy transitions. (Cherp et al 2018, 186)

### 2.1.1 Techno-economic sub-system

A techno-economic system is characterized by flows of energy associated with extraction, conversion, production and consumption coordinated by energy markets. The authors further suggest top-level and second-level variables to make sense of this sub-systems. They refer to; (1) resources (fossil fuel resources, imports, physical potential in regard to centralized and decentralized RES-E); (2) demand (type and scale of energy use, energy intensity, factors driving energy demand growth or decline, etc.); as well as (3) infrastructures (existing infrastructures in regard to fossil fuel and RES, age of infrastructure, cost of operation). Such technical and economic elements are key in order to understand whether or not a renewable energy transition will take place; and if it does which pathway will be followed regarding what is technically feasible. Accordingly, these variables will be operationalized in order to provide a consistent and necessary contextualization of the energy system within the particular Walloon case study.

### 2.1.2 Socio-technical sub-system

Moreover, energy transition pathways are also influenced by the socio-technical sub-system. This one encompasses knowledge, practices and technology related networks (such as network of developers, manufacturers and installers of solar PV panels, household practices). The top-level and second-level variables suggested to shed light on this sub-system are; (1) the innovation systems (presence of technological innovation systems and their performance); (2) technology diffusion (global maturity of relevant technology); and (3) regimes and niches (their respective structure and interaction). A niche is to be understood as a space which grants opportunity for research and learning by way of experiences. Niches are therefore the sites where radical innovations are thought through and developed, potentially threatening the current *system* in place. This current system is referred to as regime and consists in the rule-set of processes, technologies, routines and practices which are embodied in institutions and infrastructures at the meso-level. This sub-system hence relates to the multi-level perspective (MLP) on socio-technical transitions and innovation (Geels and Schot 2007; Sovacool and Hess 2017, 709). Although the multi-level perspective on energy transition could be used by itself to make sense of energy transitions, it will not be used per se and is only presented here to clarify the variables put forward in the socio-technical sub-system offered by Cherp et al (2018). This part of the contextualization applied to the Walloon case study could shed light on the extent to which technologies are appropriate in regard to a decentralized renewable energy transition and understand the role actors have played in regard to technical innovations related to production units, flexible distribution grid and storage.

### 2.1.3 Political sub-system

The author finally highlights the importance of the political action sub-system in the energy transition pathway. More precisely, this sub-system would affect the energy trajectory through the different energy policies and regulatory framework it creates. Political action here understood entails ***inputs*** such as “demands and support for certain policies from voters, parties, lobbies and bureaucracies” as well was ***outputs*** including “energy-related laws and regulations”. Variables hence would include; (1) State goals (type of goals and factors affecting those goals); (2) political interests (including party ideologies, voter's interests as well as **special interests defended by stakeholders**); and (3) institutions and capacities (institutional arrangement, state capacity, etc.). Although each of the three system is associated with its own discipline and resulting focus and theories, Cherp et al. (2018, 187) claim that this "three perspectives framework elevates the role of political science since policies might be increasingly prominent in shaping the 21st century energy transitions", hence putting forward the importance of the political variables in regard to the other elements affecting the RES transition.

Looking into the development of community energy in Europe, Bauwens, Gotchev, and Holstenkamp (2016) have also made use of the socio-ecological framework. In their analysis of energy system through this framework, they have decided to focus particularly on the governance system while the resource system and resource units is perceived as essential background factors. Doing so, they ergo decided to focus on support mechanisms and planning policies as well as actors through attitudes towards RES cooperatives and culture of local energy activism. Drawing from their results, they have highlighted the importance of issues of power and interests in the development of wind cooperatives, with power distribution being central. That being so, an important implication of their research is that "the role of power relationships, both theoretically – within the SES framework – and empirically – in the development of wind energy cooperatives – should be assessed more accurately" (Bauwens, Gotchev, and Holstenkamp 2016, 146). Academic research has, so far, mainly be focusing on techno-economic and socio-technical elements when attempting to shed light on renewable energy transition. Hence, although the social-ecological framework is able to bring essential insights onto the existence and interaction of the different components of an energy system and on contextual core elements, the political aspect should be particularly paid attention to.

## 2.2 Focus on the political sub-system

Reflecting the socio-ecological framework mentioned here-above, a plurality of explanatory factors can be used to explain the development of decentralized renewable energy transition versus a centralized one. In regard to prosumer expansion, we can mention the national background which encompasses "national structural condition and problem characteristics" and "include natural resource endowments and institutional structures, energy sources, emission portfolios, and long-term interest constellations in the electricity sector" – reflecting techno-economic, socio-technical and political sub-systems – as well as the "national policy dynamics" (Inderberg, Tews, and Turner 2018, 259). Indeed, within energy transition theories, authors in the academic literature have demonstrated that changes in policies and changes in socio-technical systems are highly interdependent while public policies play a pivotal role in sustainability transitions and energy transition pathways (Lindberg, Markard, and Andersen 2018; Geels and Schot 2007; Geels et al. 2016; Markard, Suter, and Ingold 2016). Policies, or "***public policies***", have the power to favor and protect niche innovations and guide the transition process through the financing of research and development programs, the deployment of subsidies, the constraint of previously dominant technologies and fuels, the conveying of transition targets and environmental standards and so on (Lindberg, Markard, and Andersen 2018, 2).

### 2.2.1 Outputs: Policies and instruments

Public policies are here understood as the means by which a government addresses a certain objective and is generally used to describe a series of laws, regulatory measures or actions established through a certain political process (Knoepfel et al. 2015, 40). Lascoumes and Le Gales (2007, 4) more precisely define "public policy" as a "sociopolitical space constructed as much through techniques and instruments as through aims or content" whereas a

*"public policy instrument constitutes a device that is both technical and social, that organizes specific social relation between the state and those it is addressed to, according to the representations and meanings it carries. It is a particular type of institution, a technical device with the generic purpose of carrying a concrete concept of the politics/society relationship and sustained by a concept of regulation". (Lascoumes and Le Gales 2007, 4)*

### 2.2.2 Inputs: Special interests

This set of policies, inherently contested and presupposing a particular set of values, is shown to be the result of divergent interests and struggle of actors over policy-goals and instruments (Lindberg, Markard, and Andersen 2018, 1). Different actors – representing ***special interests*** – participate in the policy-process and are thus core in the creation and implementation of policies (policy outputs). Accordingly, "policy-process" is referred to as a "political problem-solving process among constrained social actors in the search for solutions to societal problems – with the government as primary agent taking conscious, deliberate, authoritative and often interrelated decision" (Rogge and Reichardt 2016, 1625). Lindberg, Markard, and Andersen (2018, 2), highlighting the role of the different actors within the decision-making process, combine the assessment of the policies with the policy preferences of the actors. Consequently, policies and instruments might be referred to as ***"outputs"*** of policy processes which are introduced by a governing body whereas the policies and instruments themselves result from "***inputs***" into the policy-process which includes, among other things, the particular interests of the actors that have participated in the policy-process itself. One particular way to approach the inclusion or exclusion of these actors and special interest in the policy process could be through the assessment of "their degree of influence and power in decision making" (Rogge and Reichardt 2016, 1631).

## 2.3 Conclusion

Summing up, in order to understand the pathway of a renewable energy transition, it appears that both socio-technical and techno-economic consideration are to be understood jointly with policies and its inherent policy-process. The interactive and complex energy transition process implies issues of power, agency and politics, reflecting the different actors involved and their interests as well as contextual factors such as socio-economic conditions, infrastructure, resources, institutions, social behavior, and so on (Rogge and Reichardt 2016). The following methodology chapter will illustrate how these different elements will be articulated and operationalized so as to make sense of the energy transition pathway of Wallonia, Belgium.

# 3 Methodology

## 3.1 Analytical framework

The analytical framework used in this thesis directly reflects the theoretical framework previously provided. In order to understand the energy transition experienced by Wallonia, it is first necessary to have a good understanding of the overall context. This is particularly true in regard to the complexity and interplay of the different elements which characterize the energy system. To do so, the three perspectives on energy transition provided by Cherp et al. (2018) will be used, thus including techno-economic, socio-technical and political aspects so as to offer a comprehensive contextualization. Although descriptive, these elements are essential to provide a critical understanding and analysis of the policies, policy-processes and inherent special interests that will be further investigated as the focal point of this thesis.

### 3.1.1 Contextualization

The contextualization will be operationalized drawing from the elements Cherp et al. (2018) suggested (See figure 6). Techno-economic elements will first be introduced so as to shed light on the Belgian and more precisely the Walloon current energy system. Following an overview of the energy needs and energy sources covering them, information on the renewable energy potential of the country will be provided in regard to technical and economic elements such as the sun and wind energy potential and cost of infrastructure construction. I will then situate the technological potential that have emerged through niches in Wallonia and the role played by regime actors in regard to such innovation. The niche innovations might concern relevant energy production devices, smart grid and new electricity storage facilities. Lastly, I will clarify the political situation of Wallonia. This part will include elements on the energy objectives pursued by Wallonia within a vertical multi-level perspective. Being a signatory of multiple international environmental agreements as well as a member of the European Union, the decisions taken by Belgium when designing its energy system are highly influenced by external goals, which consequently impacts Wallonia. Moreover, the obstacles created by the federalist nature of the country, as well as its election-based and multi-parties political design, are to be taken into consideration before attempting to analyze the policies created and implemented in Wallonia since those components might hinder its policy capability or preferences. These stand as core elements regarding the energy trajectory so far chosen and favored by the policy-makers and the different energy stakeholders and should therefore be understood.

In regard to what has been argued until now, the political aspect should be key in transition analysis as it is of great importance in respect to the chosen policies and resulting energy pathway. Through the above-described contextualization, elements such as economic and administrative potential as well as multi-level governance realities will be introduced. Nevertheless, ***special interests*** won't be touched upon in the contextual descriptive chapter as it is the core focus of the research conducted. This thesis intends to shed light on the underlying politics of the ongoing transition which consequently involve a plethora of actors and their personal interests in the policy-making (Lindberg, Markard, and Andersen 2018; Rogge and Reichardt 2016). In order to observe such phenomenon, both policy inputs and outputs will be qualitatively analyzed.

As developed throughout the theoretical framework, all these elements evolve and interact through continuous interactions and consequently affect the policy-outputs as well as the transition pathway. Figure 6 illustrates how contextual elements will be articulated in regard to the very focus of this study being the policy-inputs (here special interests) and policy-outputs which consequently lead to a certain transition pathway. In grey are the elements that will be provided as contextual information whereas the blue components stand as the core focus of the study.

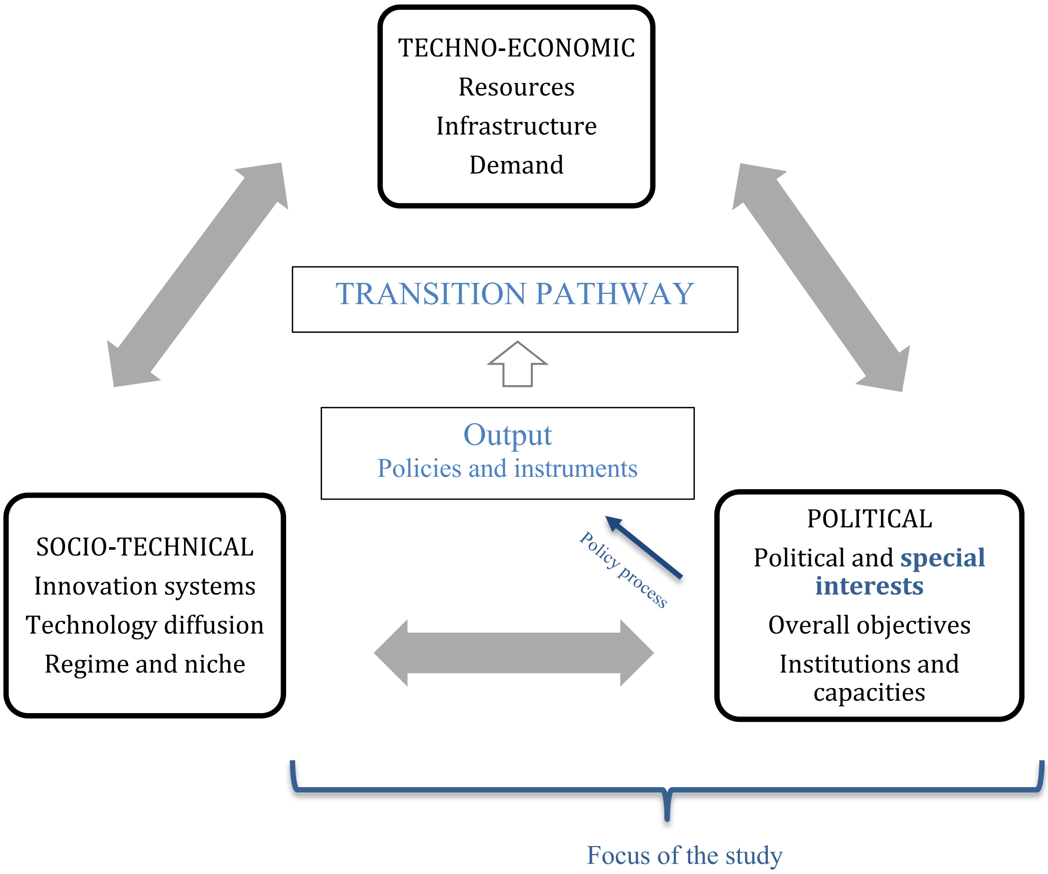


Figure 7: Three perspectives and variables on energy transition linked to policy-mix – to be applied to the case study

### 3.1.2 Policy inputs: Special interests

In order to provide the necessary insights to understand why a certain renewable energy transition pathway is followed, we first need to understand the ***special interests related to particular actors***. In regard to what has been argued in the previous chapters, two main types of actors will be substantially affected by a decentralized renewable energy transition pathway; (1) the incumbent actors which have historically been part of the energy system; and (2) the new actors – prosumers and citizen communities members – whose entrance is made possible by a change of paradigm in the energy system. After attempting to map these different actors, an analysis of their vision regarding the energy transition as well as their interests will be conducted. Information on the perceived benefits and costs that will affect them in regard to the (de)centralization will be granted. The aim is to highlight the energy transition strategic outlook of the relevant stakeholders, based on a variety of documents that is made available by them and about them as well as interviews. The different elements will be sorted so as to situate the actors in regard to the transition pathway they favor, ergo touching upon the technical transition, as well as the ownership, control and benefits components (See Fig. 3).

Having outlined the above-mentioned energy actors and stakeholders as well as their corresponding interests, this research attempts to reveal the role played by these actors in the development and adoption of the policies and instruments affecting the Walloon renewable energy transition pathway. These elements will therefore be used in the policy analysis so as to uncover whether or not they were involved in the policy-process. We hence attempt to shed light on the political interplay that is affecting the RES transition pathway.

### 3.1.3 Policy outputs: policies and instruments

In regard to the output, different ***policies and instruments that are relevant to a renewable energy transition pathway*** in Wallonia will be mapped. To do so, the different policy-makers of Wallonia will first be addressed. Then, we will discuss some of the most impactful policies and instruments they have established and/or implemented that are currently touching upon the decentralization renewable energy transition pathway. These might – simultaneously or not – affect the production, distribution and storage of RES energy as well as impacting the benefits and control of energy production.

As a reminder, the spatial boundary of these policy-outputs corresponds to the Walloon region borders. Most renewable energy matters are, as a matter of fact, the competency of regional authorities. As for the temporal boundary, policy analysis will correspond to the 2017-2019 period. To be more precise, the policies that are developed and adopted within that time period are the ones to be analyzed as opposed the policies affecting this period yet developed and adopted earlier on. This time period has been chosen as important political actors in regard to the energy transition (e.g. Energy minister or president of the Walloon Commission for Energy) were put into power at that time. Moreover, after a first review of the policy framework it appears that important decisions regarding decentralization have only recently started to emerge. Contextualization will nevertheless provide historic knowledge that will be necessary to understand decisions-processes.

Once mapped, these different policies will be contextualized before being defined, explained and analyzed. We therefore shall be able to precisely locate their effects on the renewable energy transition pathway (See Fig. 3), touching upon technical elements, benefits as well as ownership and control. Finally, we will situate the position of the actors regarding these policy-outputs. Since we will have comprehended their special interests, we will be able to expose whether one decision is beneficial or detrimental to them and the renewable energy transition pathway they fathom.

Following the analysis of the actors' interests and the policy outcome regarding the renewable energy transition pathway, it will be possible to expose whose interests are represented and supported. Eventually this analysis might demonstrate the extent to which the involvement of actors in the policy-process has hindered or encouraged the decentralization – on the broad sense – of the renewable energy system. The methods that are to be used to reach such objective will now be further developed.

## 3.2 Research methods

The research of this thesis will be conducted using a plurality of qualitative methods with policy and document analysis being central, along with interviews. Qualitative research allows for a more contextual and comprehensive understanding of phenomena, especially in regard to a case study (Moses and Knutsen 2012, 311). Hence, in regard to the complexity and interrelations between the different elements leading to a certain renewable energy transition pathway, this approach seems to be the most relevant. Moreover, as we attempt to comprehend the different actors' special interests and conduct deep policy analysis, it seems judicious and righteous to cross information through the use of several channels so as to ensure as much authenticity and precision as possible. The way these methods are used will now be developed and linked to the policy-inputs and outputs insights we are attempting to gather.

### 3.2.1 Policy mapping and analysis

As mentioned in the previous section, mapping the different policies that are relevant to the Walloon energy system and that might affect its development in the following years is of primary importance. Using different legal as well as communication platforms made available by the policy-makers of Wallonia, energy policies developed and adopted within the 2017-2019 period were taken note and reviewed so as to understand if it impacted the renewable energy transition pathway. This content is made available online by the different policy-makers of Belgium who, in addition, publish related press-releases on their official websites. Moreover, as the legal database, the website "www.wallex.wallonie.be" encompasses the different law and policies adopted in Wallonia. In that sense, gathering the different components of the energy policy framework is relatively simple. This following table contains the different policies which will be analyzed in the following chapters.

| Title | Decision by |
|---|---|
| End of Qualiwatt | Energy minister |
| Pax Eolienica | Energy minister |
| Smart metering decree | Energy minister |
| Shared auto-consumption decree | Energy minister |
| Prosumer tarification | CWaPE |

Table 1: Table of the Walloon policies and instruments analyzed in the research

Policy analysis is a technique used in political science and public administration that allows the examination and the evaluation of the policies and programs in regard to chosen criteria. Keeping in mind that a policy is designed as a response to a problem that is perceived by the policy-makers (e.g. the need for decarbonization of the energy system), the core of policy analysis is to shed light on what the problem is and how the policies and instruments are responding to it (Walker 2017; Knoepfel et al. 2015). This research aims at highlighting the objectives which were pursued when deciding on and implementing policies and instruments and ergo look at the resulting consequences. Such analysis will allow us to thoroughly situate the policies in regard to the disruption level (decentralized/centralized). As a reminder, in regard to the latter the objectives pursued could be touching upon; (1) the technology devices enhanced by the policy/instrument; (2) the role played by the actors; and (3) the way outcomes are divided among the actors. In order to conduct such policy analysis, interviews will be used besides the analysis of the available documentation.

### 3.2.2 Document analysis

Other documents will consist of content published by the different energy actors themselves. I went through each of the actors' websites and used the different documents they published so as to uncover the necessary information to assess their special interests.  These might take the form of official mid-term or long-term strategic plans or business guidelines, web articles or (un)formal opinions or memorandum written by the different actors and shared publicly. Document analysis as used in this thesis refers to a qualitative research method which makes use of documents in order to pursue content analysis (Prior 2008). The content analysis will hence be conducted in regard to the three elements characterizing the renewable energy transition pathway we intend to shed light on. Hence, these documents will be used to locate the policies and energy actors on the disruption axis based on the type of RES energy production they favor, their position on control and ownership and their stands on benefit distribution. These documents will be referenced and can be found in the bibliography.

### 3.2.3 Interview analysis

Furthermore, the materiel includes 10 interviews which were conducted in a semi-structured and somewhat conversational manner. The questions first touched upon the energy pathway they believe *will* take place in Wallonia, along with the pathway they believe *should* take place. There were asked how they were impacted by the decentralization and what positive and negative impacts it exerted on them. The interviewees were further asked to explain their position in regard to distinct energy policies and political decision developed and adopted in Wallonia between 2017-2019 and which are believed to have an impact on the energy system (hence the policies analyzed within the thesis). I would sometime reorient the dialogue when I felt that precise information could be drawn related to the control, ownership or benefits elements of a transition. Finally, questions on the participatory aspect of policy-making were asked; pertaining to their own involvement in the policy-process as well as the participation of the other actors (with an introduced dichotomy between incumbent and new actors). A translated and simplified version of the interview guides are displayed in the Appendix (Appendix 3). However, the interview often digressed.

The interviews encompassed in this thesis should ideally reflect the plurality of actors that is touched upon within this thesis. Hence, we sought to obtain a spread in the type of interviewees. First, we interviewed three incumbent actors, including the main distribution system operators and the two most important electricity providers of Wallonia. Moreover, opinions and insights from new energy actors such as one representative of the interests of energy prosumers and cooperatives (APERe) as well as RES citizen groups were collected. Lastly, one family of interviewees consists of the different policy-makers and actors competent in regard to energy in Wallonia. This will consist of a representative of the Energy minister cabinet, the public administration (SPW - DGO4) as well as the Regulatory commission of Energy in Wallonia (CWaPE). The interviewees are not to be named as they represent the opinion of the entities for which they were interviewed. Their function will however be stated to demonstrate the relevance of their opinion. The following table provides an overview of the different interviews which were conducted (Table 3).

| Function | Company / association | Role of the interviewee |
|---|---|---|
| Political | Energy Minister Cabinet | Deputy chief of staff - Energy |
| | CWaPE | President |
| | SPW DGO4 | Responsible of the Renewable Energy directorate |
| Electricity providers | Engie-Electrabel | Head of regulatory and public affairs |
| | EDF-Luminus | Manager regulatory affairs |
| System distribution Operator | ORES | Responsible Public Affairs |
| Association for the promotion of RES | APERe | President |
| Citizen Cooperative | Courant d'Air | Engineer |
| Citizen technical association on RES | Les compagnons d'Eole | President |
| | Compagnons Energie Renouvelable | Manager |

Table 2: Table of interviews conducted in the research

# 3.3 My role during the research

Drawing from a constructivist approach, I acknowledge that as the observer and author, I might insert some of my personal construct into the analysis I further conduct hence into the results I gather. Accordingly, constructivists "recognize that they do not just experience the world objectively or directly: our perceptions are channeled through the human mind – in often elusive ways" (Moses and Knutsen 2012, 9). I admit that I myself have political stands and beliefs that might affect my perception regarding a desirable energy transition. This is particularly true as I have led this research in my own region. This could also have affected the interviews I conducted. Yet, the strength of such approach is to be aware that my personal opinions might affect the methodology and results. This reflectivity should, to some extent, reduce the interference I might have exerted. This stands as coherent regarding the analytical framework and methodology I have here-above developed. Indeed, the suggested thorough contextualization of the transition, of the actors' stands and of the policies should allow the capture and understanding of the meaning behind the complex political phenomenon, regardless of my stands. As opposed to a naturalist approach, I am not intending to uncover a singular truth but rather to "embrace the particular (…) to expand (…) our political understandings" (Moses and Knutsen 2012, 11) through a descriptive and contextualized approach. Moreover, as prosumers have spread in the region over the past years, I have been acquainted with several individuals who might be directly affected by the policy decisions that are adopted and implemented. Yet I have not myself be concerned with conflicts of interests related to prosumerism during the research process.

## 3.4 Ethical considerations

The renewable energy transition is much of a hot topic as environmental concerns rise all over the country. Furthermore, the political decisions that touch upon RES-E have been very controversial, often brought to Appeal Courts by citizens or associations. This is a very polarized and complex issue which is vividly criticized. Consequently, the different interviewees might be affected by the revealing of their perspective regarding the issue. For this reason, although their "special interests" are introduced, those are highly contextualized. This grants the reader with sufficient insights so as to understand that a perspective is not inherently wrong or bad. Through their interviews and publications, each actor has genuinely argued in favor of what they thought was the most coherent transition in regard to criteria they valued and according to their particular context. In that respect, the coming information is not meant to be displayed in a hurtful manner. I am grateful that these actors have given me of their time to honestly and comprehensively respond to each of my question. It is with much respect that I intend to make use of the information they provided so as to shed light onto a complex political phenomenon and change of paradigm, without faulting any of the involved actors.

## 3.5 Conclusion

Through this research, we attempt to shed light upon the underlying political phenomenon behind the renewable energy transition pathway followed in Wallonia. In order to do so, we will first provide a comprehensive contextualization based on the three perspectives on energy transition. We will then more precisely map the special interests of the incumbent and new energy actors, regarding the renewable energy technologies they foresee, as well as the spread of benefits and ownership they fathom. The methodology used will mainly consist of document and interview analysis. Following an overview of the policy-makers and their competencies, we will map the adopted policies that will affect the renewable energy transition pathway. Drawing from the previous results on special interests, policy analysis as well as document and interview analysis, we will attempt to uncover the actor's interplay with such policy-outputs. We will once more situate these policies regarding the technical, ownership and benefits elements of the RES transition pathway. Through this analytical framework and methodology, we should be able to expose the relationship between actors and their interests, policy outcomes and the RES transition pathway.

# 4 Contextualization: the three perspectives on energy transition

In order to understand the decentralization of the electricity system in Wallonia, it is important to comprehend some basic elements regarding the overall energy system as well as the renewable energy potential. This first section will intend to disclose the main elements of such system, touching upon the demand for energy and electricity, the resources and existing infrastructures. Because the continuous spread of decentralized production units is being felt, the need for more flexibility is now advocated for. Consequently, niches are starting to emerge regarding new technologies and new storage potential. This will be discussed through the second section. Finally, we will discuss the political context. Indeed, both multi-level governance perspective and inherent institutional characteristics greatly infer with the development of a decentralized system.

## 4.1 Techno-economic

### 4.1.1 Demand

**Type and scale of energy use**

In 2016, the final energy consumption in Belgium was of 42,1Mtoe (primary energy consumption of 56,5Mtoe), this consumption being covered by a variety of energy sources (FPS Economy 2018). Oil products has been the dominating source of energy of the country over the past decades, followed by natural gas and electricity to a much lesser extent. The different sources of final energy consumption have remained stable over years although electricity is believed to become a larger source of energy in the future since its production is known have a lesser impact on greenhouse gases emissions (FPS Economy 2018; Service Fédéral Changements Climatiques 2013).

Moreover, the amount of energy consumption and sources differ in regard to sectors (Appendix 5). Industries had been the largest consuming sector in Belgium in 2013 (final consumption of 19 Mtoe representing 47,5% of the final energy consumption) due to its very energy-demanding petrochemicals and chemicals sector. However, since 2015 the industrial sector is surpassed by the residential sector in terms of final energy consumption (see Fig. 8; IEA 2016). As a matter of facts, the final consumption of the residential sector equaled 12Mtoe in 2014 (IEA 2016) and 13,6Mtoe in 2016 whereas the industrial consumption fell to 10,9Mtoe in 2016 (FPS Economy 2018). In 2016, the residential and industry consumption of energy have been respectively covered by natural gas (34,9% and 40,7%), electricity (29,8% and 26,7%) and petroleum products (17,1% and 26%) whereas the transport sector has been exclusively dominated by petroleum (93,2%) (FPS Economy 2018).

| Sector | Mtoe |
|---|---|
| Residential and equivalent | 13.6 |
| Industry | 10.9 |
| Transport | 9.1 |
| Non-energy use | 8.5 |
| **Total** | **42.1** |

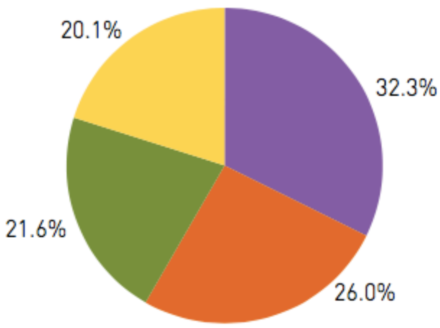


Figure 8: Final energy consumption in Belgium in 2016 per sector (FPS Economy 2018)

What we hence conclude is that the residential sector is highly energy-demanding and mostly rely on polluting energy sources. This demonstrates of the relevance of the delimitation of this study, which only touches upon the residential sector. In order to have an idea the amount of electricity that would need to be produced to cover this sector, we shall note that 13,6Mtoe approximately equals 158.168GWh[1].

**Factors driving demand growth and decline**

According to IEA (2016), the increase of energy consumption in the residential sector reflects the changing of space-heating need. This has however been

[1] Conversion base being 1Mtoe = 11630GWh

somewhat counterbalanced by an increase of energy efficiency. In regard to final energy consumption, this has improved by 25,6% between 2000 and 2015. This seeking for more energy efficiency was partly driven by the European Energy Efficiency targets (directive 2012/27/EU, Art 3 of the EED) which set the Belgian target to 18% reduction in primary energy consumption by 2020 (Odyssee-Mure).

**Energy intensity**

Energy intensity might be calculated as the energy consumption per capita, hence being of 4,8Toe per capita in 2014. This makes Belgium the 8$^{th}$ highest energy intense country among the IEA members (IEA 2016). Moreover, we shall note that energy is the main sources of emission in Belgium, with 57,1Mt $CO_2$ eq. being released in 2014. This represents a share of 48,8%. That same year, RES production has led to a net savings of GHG emissions of 11,4Mt $CO_2$ equivalent (Banja et al. 2017). This further demonstrates the needs to orient the countries towards renewable energy sources as to response to climate change matters.

### 4.1.2 Resources

**Fossil fuel types, resources, reserves and extraction cost**

In 2018, there was no proved reserves of natural gas, coal or crude oil available on the Belgian territory (EIA 2019). De facto, the last coal mine was closed in 1992 (FPS Economy 2018).

**Production, import and export of energy and electricity**

Hence, in order to cover its primary energy consumption of 56,5Mtoe, Belgium is heavily relying on fossil fuel imports. Belgium's total own primary energy production equaled 15,3Mtoe in 2016 (27% of total primary energy consumption), 73,9% of which came from nuclear production. From 2015 to 2016, nuclear energy production had increased by 67%. It is important to acknowledge that although statistically perceived as domestic, such nuclear energy is produced from imported uranium (FPS Economy 2018).

The national Transmission Grid Operator (ELIA) has further noted that from 2017 to 2018, the nuclear production of energy had decreased whereas renewable energy production expanded by 18%. Imports of electricity from neighboring countries had increased in order to cover the nuclear decline (Elia 2018a). That being so, during the year 2018 Belgium imported close to a quarter of the electricity consumed within its border. This was an important leap from the year before which was characterized by an 8% electricity import (Rubinstein 2019). These changes are illustrated by the following figure (Fig. 10):

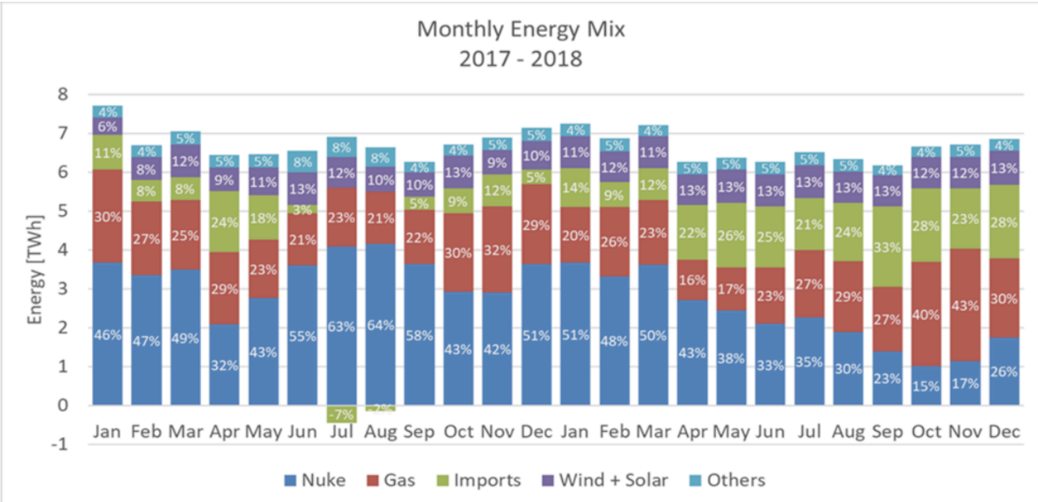


Figure 9: Belgian monthly energy mix in 2017-2018 (Elia 2018a)

**Type and potential of renewable resources**

According to Banja et al. (2017) overall renewable energy contribution to gross final energy consumption was of approximately 8% in 2014 and 2015. In the electricity sector more precisely, the RES share reached 13,3% in 2014, 15,42% in 2015 and is expected to reach 20,9% by 2020. The EUCO27 scenario projection points to the renewable electricity consumption of 2020 (19630 GWh) being dominated by wind (61,1%), followed by solar photovoltaic (20,4%), biomass (16,6%) and hydropower (1,9%) (Banja et al. 2017, 3:44). Indeed, Belgium has high potential in regard to wind and solar energy: 2,5% of the Belgian territory (800 $km^2$) equipped of solar PV or 10% of the territory (3000$km^2$) with 5 windmills/$km^2$ could cover the entire electric Belgian consumption (80TWh/year) (APERe 2017b). With ambitious investments, RES production could cover 58% of electricity consumption by 2030 (with an electricity consumption of 85TWh/year) according to the following scenario (Fig. 11) (Van Dyck et al. 2016, 14):

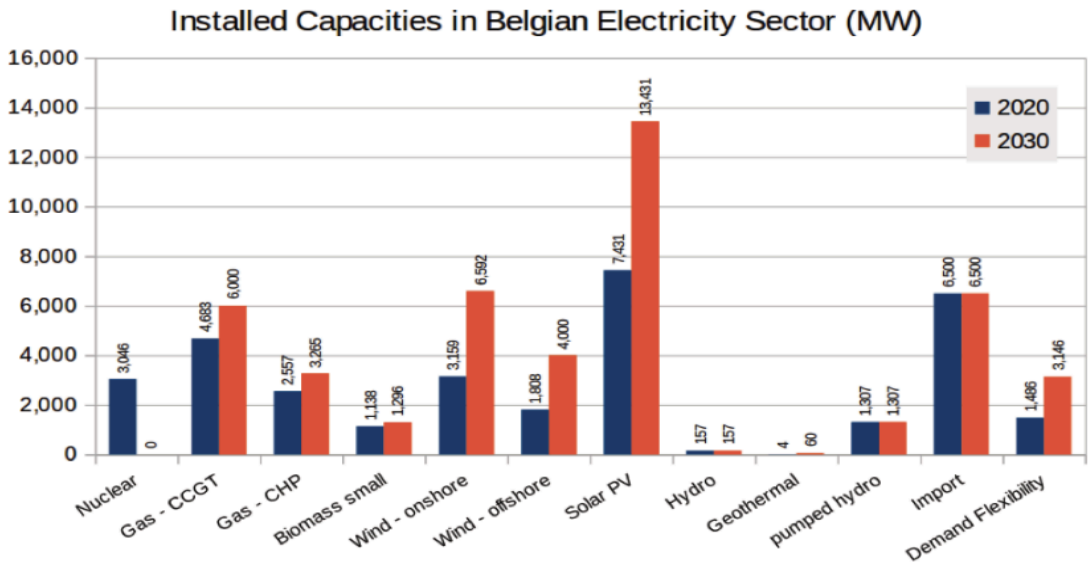


Figure 10: Installed capacity in Belgium following "Notre avenir énergétique" scenario (Van Dyck et al 2016)

The energy sources that are mainly advocated for in Wallonia are hence solar PV as well as wind technology, including onshore and offshore. Although offshore wind and hydropower will still be part of the energy system (hence being somewhat decentralized), as put by Elia (2017, 8) and (Edora 2019b, 7), a renewable energy transition in Wallonia would inherently lead to a decentralization of the system.

### 4.1.3 Infrastructures

**Existing infrastructures and age**

Most of the Belgian energy production originate from nuclear facilities. There are 7 nuclear reactors in Belgium which are spread in two main areas; Tihange in the Walloon region and Doel in the Flemish region. These reactors are exploited by Engie-Electrabel which holds a share of 100% of 2 of the reactors and a share of 90% of 4 other reactors, with EDF-Luminus having a share of 10% of those 4 reactors. The seventh nuclear reactor is shared equally between Engie-Electrabel and EDF Luminus. These two private companies are hence the two most important electricity producers and providers of Belgium and the Walloon region. These reactors account for a 6000MW installed capacity and have covered half of the electricity demand since the 1980s. Hence, nuclear have played a central role in the energy production in Belgium. These infrastructures are now facing major technical challenges as they are becoming obsolete, which explains that the nuclear energy production has decreased since 2018 (Van Dyck et al. 2016). As will be discussed further, this has led to political decisions that support the closure of the nuclear facilities by 2025. Yet, three of the nuclear installations (Tihange 1, 3 and Doel 4) do not suffer from microcracks and are still conform to the seismic norms and could hence, according to the Belgian energy expert Damien Ernst, still be used past 2025 (Verset 2017). Some energy experts in Belgium advocate for the development of new gas power plants as a short-term solution in order to cover the 3600GW which Belgium will be needing with the closure of the nuclear reactors (Lambrecht 2019).

Other and complementary scenarios predict a decrease of nuclear production which is then to be counterbalanced by further investments in renewable energy. However, this requires a proper future-oriented policy plan to enhance the development of the necessary RES structures, including production technologies as well as grid enhancement and flexibility measures (Van Dyck et al. 2016). Belgium has experienced a first increase in renewable energy production within its borders. Primary energy production based on wind and sun has experienced the most important improvement as it increased by 332,7% from 2010 to 2016 (FPS Economy 2018). We count about 130 000 households with solar PV installations (APERe 2019c) and 383 onshore windmills in Wallonia (APERe 2019b). The lifespan of the solar PV or windmills installed in Wallonia stand around 20-25 years. If windmill need repowering, they might have access to additional subsidies; yet there hasn't been requests on this as of 2018 (Haveaux and D'Hernoncourt 2018). Here are the renewable energy capacity and generation numbers per year from 2008 to 2017 based on a report from IRENA (Table 3) (IRENA 2018a):

| | | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total RES | MW | 1193 | 2011 | 2938 | 3610 | 5057 | 5797 | 5976 | 6355 | 6594 | 7507 |
| | GWh | 4418 | 5439 | 6494 | 8377 | 10458 | 11675 | 12213 | 14454 | 14168 | / |
| Hydropower | MW | 1418 | 1417 | 1425 | 1426 | 1427 | 1429 | 1431 | 1422 | 1425 | 1486 |
| | GWh | 1757 | 1757 | 1668 | 1423 | 1659 | 1704 | 1462 | 1418 | 1489 | / |
| Pumped storage | MW | 1307 | 1307 | 1307 | 1307 | 1307 | 1310 | 1310 | 1310 | 1310 | 1310 |
| | GWh | 1347 | 1429 | 1356 | 1227 | 1302 | 1324 | 1170 | 1100 | 1119 | / |
| Wind | MW | 324 | 608 | 912 | 1069 | 1370 | 1792 | 1930 | 2176 | 2260 | 2837 |
| | GWh | 637 | 996 | 1292 | 2312 | 2751 | 3665 | 4615 | 5574 | 5436 | / |
| Onshore wind | MW | 324 | 577 | 716 | 873 | 989 | 1084 | 1222 | 1464 | 1548 | 1960 |
| | GWh | 637 | 914 | 1102 | 1603 | 1897 | 2125 | 2399 | 2961 | 3046 | / |
| Offshore wind | MW | / | 32 | 197 | 197 | 381 | 708 | 708 | 712 | 712 | 877 |
| | GWh | / | 82 | 190 | 709 | 854 | 1540 | 2216 | 2613 | 2390 | / |
| Solar PV | MW | 62 | 386 | 904 | 1391 | 2581 | 2922 | 3027 | 3122 | 3300 | 3571 |
| | GWh | 42 | 166 | 560 | 1169 | 2148 | 2644 | 2883 | 3053 | 3086 | / |
| Bioenergy | MW | 696 | 907 | 1004 | 1031 | 986 | 965 | 899 | 945 | 919 | 923 |
| | GWh | 3329 | 3949 | 4330 | 4700 | 5202 | 4986 | 4423 | 5509 | 5276 | / |

Table 3: Renewable Energy statistics for Belgium in capacity (MW) and generation (GWh) (IRENA 2018)

In regard to the grid infrastructure, the high voltage transmission grid is about 8500km long and is managed by the company ELIA (Elia 2018b). The electricity distribution grid is then divided among 7 different distribution system operators, with the most important one, ORES, being responsible for 49 000km of the electricity grid, covering 193 out of the 267 Walloon municipalities (ORES 2015). We also note that these grids need punctual maintenance. For instance, ORES invests about €250 million annually to ensure the general maintenance of the grid sector, and will invest €1,15 billion for the period 2018-2022 to further maintain, but also develop and digitalize the electricity and gas distribution grids (ZoneBourse 2018).

Touching upon storage facilities in the Walloon Region, we note that there are 2 pumped-storage hydropower facilities. The Coo hydro power station, being owned by Engie-Electrabel, has a total capacity of 1164MW (Engie-Electrabel 2015) whereas the Plate Taille hydro power station, owned by Lampiris, has a total capacity of 140MW (Lampiris 2018). Both are used to increase the flexibility of the energy system as of today. This is further combined with other flexibility methods, such as gas stations or flexibility contracts with industry consumers. For the winter 2016-2017 for instance, there was 3490MW of gas or fuel flexibility potential (Elia 2016, 20).

**Manufacturing, import and export of equipment**

There are several manufacturers of PV panels in Belgium, including Issol Pro, Evo Cells, Finale24. A representant from the latter claimed in an interview from 2015 that this sector was becoming profitable and that they expected the manufacturing industry to grow as the RES energy continues to take place (UCM 2015). Nevertheless, the country has low national shares in the manufacturing and in the production of all the components of solar PV panels (EY 2017).

In regard to wind deployment in Belgium, up to 2010 there weren't many manufacturers delivering the necessary services. Hence the country had been dependent of other European and worldwide businesses (Deloitte 2012). However, today, different manufacturers are settling in Belgium and offer competitive services, including XANT – Wind power made easy, Turbowinds, Fairwind, Hadda International Group (xprt energy 2019).

Investing in renewable energy technologies may lead to a rise in non-delocalized employment opportunities, mainly in the construction sector (Van Dyck et al. 2016). In Europe, 150 000 people are now working in the wind sector and another 368 000 new jobs should be created by 2020 to cover demand resulting from renewable energy transition (Charouk and Haveaux 2008). More precisely in Belgium, the wind industry has historically created a fair amount of indirect employment, hence touching upon a wide range of sectors in the economy. The economic sector that are indirectly benefiting are mainly transport, construction, electric and electronic equipment, fabricated metal products and basic metal. In regard to the direct employment impact, from 2007 and 2010 the wind sector went from encompassing 1806 jobs to 2722 (Deloitte 2012). In regard to solar PV employment, the full time equivalent (FTE) jobs per year was of 2068 in 2008, 2338 in 2016 and is believed to reach 2687 in 2021.

**Cost of operation and construction of infrastructure**

Despite being dependent of import regarding the renewable energy technology, the price of wind and solar PV technologies are both going down, making solar and PV energy profitable to produce (Van Dyck et al. 2016). Indeed, in 2017 onshore wind and solar PV became the cheapest sources of energy with wind turbine reaching an average cost of 0,06$ per kWh and solar PV 0,10$ per kWh (IRENA 2018b). Hence, despite necessary investments wind and solar RES-electricity generation becomes cheaper than fossil fuel within a few years (Fig 12).

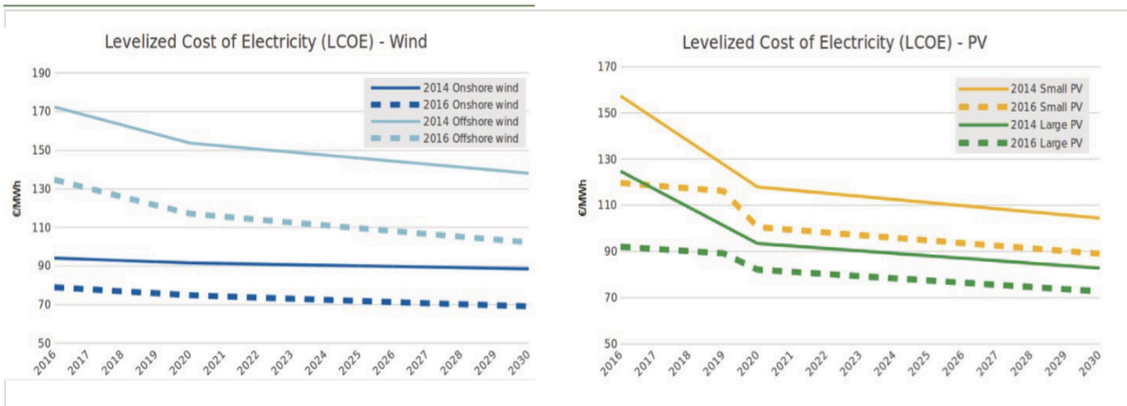


Figure 11: Evolution of the LCOE cost for PV and Solar energy until 2030 (Van dyck et al 2016)

According to APERe, in Belgium the cost of a 3500kWh PV installation (covering the need of a household in Wallonia) went from 25 000€ to 5000€. Studies have also shown that the profitability of the installation is of 7,7% over 20 years, hence cancelling out the need for subsidies (L'écho 2018). In regard to wind energy, the cost of the windmill itself represents about 75% of the total investment which is thus to be added to feasibility studies, installation, maintenance, accordance to grid, transportation and other costs. The total cost of a 1kW installation will stand between 10 000 et 15 000 euros (taking into consideration that an installation of 5kW is necessary to cover a 3500kWh household consumption). A 20kW windmill installation would therefore approximately cost 70 000€ (Les énergies renouvelables 2019).

# 4.2 Socio-technical

## 4.2.1 Innovation systems and diffusions

As previously described, renewable energy production technologies have spread over Wallonia. Due to available technologies and strong supports from the public authorities (including a major Green Certificates Scheme starting in 2007), both solar PV and onshore wind production units have been installed widely and haven't failed to produce renewable electricity (see Fig. 12). Technologies regarding grid management and storage have, on the contrary, recently and only scarcely been developed and will thus be considered as niche. This section will be structured regarding the suggested technologies mapped based on the literature review on decentralization. We will report on the maturity of the technology as well as the role played by the actors (incumbent and new) in regard to the development of such technological niche.

## 4.2.2 Maturity of the technology, regime and niche interactions

**Smart meters**

Industrial actors as well as policy-makers start to support the development of smart, following neighboring countries such as France and Germany. As a reminder, smart meters are able to measure the electric consumption of households as well as the production of their own RES installation on a quarter of hour basis. Moreover, it is able to transmit the information it collects and receive information, which might consequently allow a better management of the consumption and production of electricity. We note however that such development is highly controversial, with civil society organizations and consumer federations opposing the development of this "niche" for safety, privacy and financial reasons (Lismond-Mertes 2018).

Industrial actors on the contrary are in favor of such development and are themselves actively taking part in its technological development.

The DSOs ORES, Tecteo (today known as Nethys), Régie d'électricité de Wavre, l'AIEG and Galsewest started pilots project around the year 2010-2011, leading to the installation of around 1500 smart meters by 2012 (Capgemini consulting for the CWaPE 2012, 11). Although not yet regulated, the distribution system operator ORES believed in the installation of smart meters starting in 2020 (ORES 2018b, 1). They were working on the deployment of "linky" smart meters which are used in France and are developed by Enedis, part of EDF-Luminus. This technology was based on a grid transmission of the data collected. Yet when the Walloon authority finally legislated on the issue in summer of 2018, they decided that the technology developed should use the wireless network to transmit the information (Moniteur 2018). Although this infer new costs for the DSOs, the company Enedis has already developed this type of meters (GPRS) for industrial actors and is supposed to install 5 million of those in India in the following 18 months. The director of Enedis Marie-Line Bassette has thus claimed that despite the disruptive legislation, (translate from French): "we are still interested in the Belgian market" (Belga 2019b).

**Smart grids**

Pilot projects have also been led in regard to smart grids, including MerydGrid and E-Cloud. The core idea behind these projects is to work on the optimization of the management of the electricity produced and consumer via digital tools. These studies are led on micro-grid on a delimited industrial geographical sector. Because micro-grids are not allowed in Wallonia, such projects received derogations in regard to the article 21 of the tarification decree (Gouvernement Wallon 2017). The projects were directed by DSOs (Nethys, Resa, ORES, etc.) in collaboration with universities and with the support of the Walloon regulator (Cluster Tweed 2018a; ORES 2017). As of today, they mainly concern the management of electricity for the industrial sector, but the technology might eventually be used for the general distribution of electricity in Wallonia. Hence this remain a niche technology, developed by incumbent actors themselves. It doesn't seem to be leading to much reaction from consumer and general citizens as it doesn't disturb the current regime.

**Batteries**

A study from McKinsey has revealed that storage pricing was decreasing due to a higher demand for electric vehicle (EV) and electronics which has led Asian, European and American actors to develop this sector. Battery pack would now cost 230$ per kWh in 2016 compared to 1000$ per kWh in 2010 (Frankel and Wagner 2017). A Tesla Powerwall 6,4 kWh battery would, for instance, cost around 7000 to 8000€ (material and installation) and allows for 250 to 300 cycles of charging/discharging (Engie-Electrabel 2018c).

Yet, the performances of batteries should still be enhanced in terms of energy density its power, its stability and its durability. Research and development remain necessary. This was acknowledged by the Innovation and networks executive agency of the European Union who had created a "Building a low-carbon, resilient future: next-generation batteries" call for project proposal. This call makes available €114 million euros for different battery sector, including in transportation and in the residential sector (ncp Wallonie 2019). Industrials (including car manufacturers) are those who invest the most in this technology. In this case many civil actors support the creation of batteries, including prosumers who wish to be independent from the grid.

**Hydrogen**

The use of hydrogen stands as a very interesting way to store energy since the transportation sector, the industry and the buildings will most likely continue to require combustible materials. This could respond to the intermittency created by renewable energy sources. Hydrogen projects have emerged all over the world. Belgium joined this movement in 2018 with a first project led by Fluxys, Eoly and Parkwind. Wallonia appears as an active actor in regard to this sector since it has invested €8 million over three years. A plurality of energy actors in Wallonia support the deployment of several projects in Wallonia over the coming years. In this regard once more hydrogen has a great potential but is not yet fully mature (Cluster Tweed 2018c).

**Pumped-storage**

As noted earlier, there are 2 pumped-storage hydropower facilities existing in Wallonia for a total capacity of 1304MW installed (Engie-Electrabel 2015; Lampiris

2018). We note that Engie-Electrabel could invest in additional capacity in “COO 3” but this hasn’t been done. As argued by Engie-Electrabel in regard to the construction of this project which would cost 600 000 000€ and allow for more flexibility in regard to the electricity system, a stable regulatory and economic framework is necessary, yet it does not exist as of today. According to them, a lack of clarity on, for instance, grid tarification hinder the development of such projects. Moreover, they wish for the politicians to have a clearer and more precise perspective on the flexibility needs for the future (Engie-Electrabel 2015).

Moreover, recent research has shown that old mines tunnels and quarries could be used for such pumped-hydro storage, which could hence lead to greater potential for electricity storage in previously mined, non-mountainous areas such as Wallonia. However, this would require further studies so as to assess geologic challenges and thus requires R&D investments (Daily Science 2017). This observation has led to the SmartWater project. This project studied the specific capacity that results from the use of underground tunnels to store electricity through the pumped-storage system. The research attempted to produce insights onto proper socio-jurisdictional, economic, and technical system that would be favorable for the underground pumped storage development in Wallonia. It was partially financed by Wallonia (subsidies of 3 681 278€ through the Energinsere research framework), by private actors such as Engie-Electrabel and several universities. They have found that the global storage potential reaches 4GW, spread into 76 different sites throughout Wallonia. 18 of these sites could be used in the near future, for a total of 823MWh that could be stored. However, the author note that the legislation was not yet suitable for such development. Indeed, at the time of the study the storage status was not recognized by the Walloon legislative system which mean that the projects would be subject to heavy taxes. The development of this facilities would hence not be profitable (Cluster Tweed 2018b).

In total, 65 actors were active in research and projects regarding the storage of energy in Wallonia and Brussels. This includes enterprises, research and development centers, etc. The sector of research is very diversified and large, which can be directly linked to the demand created by the intermittency of the renewable energy units which are spreading in southern Belgium. However, these projects are in the developing phase and are not yet mature (Huart and Cech 2017). They require a proper and stable legislative framework that recognizes their service, provide them with a special status meanwhile shedding light on the future of the energy system. Moreover, they need research and development support.

# 4.3 Political

## 4.3.1 Goals

**International perspective**

As a scientific consensus was found on the cause of global warming in the 1980s, the international community has come together time and again with the common objective to reduce greenhouse gases. The necessity to prevent dangerous anthropogenic interference with the climate system was first and foremost discussed in 1992 within the United Nations Framework Conventions on Climate Change (UNFCCC). This convention, signed by Belgium, aimed at stabilizing the anthropogenic greenhouse gases emissions in the atmosphere in order to prevent the climate from experiencing dangerous changes. It is under this convention that the Kyoto protocol was designed in 1997, this time fixing clear and obligatory targets for Annex 1, "industrialized" countries, hence including Belgium which signed the protocol in 1998 and ratified it in 2002. In Belgium, emissions had to decrease by 7,5% in 2012 as compared to 1990. During the Doha summit in 2012, the Belgian objective was raised to 18% by 2020 in regard to the 1990 GHG emissions. Still under the UNFCCC, the 21$^{st}$ COP took place in 2015 and led to the adoption of the Paris Agreement by 195 countries. This agreement created a strong political basis for international and national climate change ambition through the limitation temperature rise by 2°C. The agreement was ratified in Belgium the 6$^{th}$ of April 2017. Hence, Belgium has had strong political incentives on an international level to decrease its carbon footprint ergo to promote a carbon neutral energy system. Nevertheless, the means to reach such objective are left to the discretion of the States and consequently these international momentums do not approach the decentralization of the energy system per se.

**European perspective**

Following this international momentum, the EU has attempted to become a climate change leader and is now often seen as the only frontrunner in global climate policy at the present (Bernauer, Gampfer, and Kachi 2014, 134). The article 194 of the Lisbon Treaty specifies since 2009 that the EU's energy policy should "*promote energy efficiency and energy saving and the development of new renewable form of energy"* through the ordinary legislative procedure according to which the European Parliament and the Council, in accordance, shall establish measures necessary to achieve this objective (Debelke, Klaassen, and Vergote 2016, 52). The same year, based on the European Commission's proposal, the parliament and the council of the European Union adopted the 2020 Climate and Energy package in order to respond to this worldwide decarbonization ambition through a common EU frame. The core of the package comprises three main targets being (1) the reduction of EU GHG emissions; (2) the enhancement of efficiency in order to lower primary energy use; and (3) an increase of renewable energy in the EU energy consumption (European Commission - objectives 2020).

In regard to this last objective, the European institutions agreed on the binding "Renewable Energy Directive" (Directive 2009/28/EC). A directive is a legal act of the EU which requires every Member States to achieve a particular result without imposing the means (Commission a, 2016). Accordingly, this RE directive established an overall policy and a common set of rules to encourage the production and promotion of renewable energy, requiring the integration of renewable energy source for at least 20% of the total EU energy consumption by 2020. This binding-overall goal was then divided among countries through binding "national target" which took into consideration financial aspects as well as technical feasibility. In regard to this national target, countries had to provide a national action plan where they described their policy strategy and yearly objective intentions. The directive has applied since June 2009, States thus had to incorporate it into national law and, according to Article 4 (Directive 2009/28/EC) submit their National Renewable Energy Actions Plans (NREAPs) by 2010. The binding Belgian objective under this directive is to reach a share of renewable energy share of 13% by 2020 (Official Journal of the European Union 2009).

Thereafter, the EU adopted the 2030 Climate and Energy framework in 2014 which was then revised in 2018. The European objectives are accordingly set for a 32,5% energy efficiency binding target, 32% share of RES in the energy consumption binding target as well as a 40% decrease of GHG emission in regard to 1990 binding target. It is believed that these objectives would lead to a decrease of GHG emissions by 80 to 95% by 2050. Under this new package, the objectives are binding in a European perspective, but the percentage assigned to States individually are not binding themselves. Member States are however obliged to adopt an integrated "National Climate and Energy plan" with draft a roadmap to be submitted by the end of 2019 (European Commission - objectives 2030).

These two previous European legislations have encouraged the general deployment of renewable energy. As we have seen, this inherently means for Wallonia to promote decentralized production of RES to a certain extent since an important part of its potential relies on it. The European Directive 2009/72 also strongly encourages the digitalization of the grid as well as a more active participation from the consumers regarding the management of electricity. This is often mentioned as the reason why Wallonia has been politically encouraging the smart deployment of smart meters (Capgemini consulting for the CWaPE 2012, 6–7). Going beyond the technical aspect of the transition, the European legislation also provide some more indication into the RES transition pathway it encourages regarding the benefits and control criteria. A key element of the Climate and Energy Package is the willingness to empower European consumers by encouraging them to become fully active in the energy transition as they become producers (Commission - Clean energy for all Europeans). Moreover, the European Union states through the resolution 23/06/16 (2016/2041) states that:

> *"Member States are, on the basis of public participation, to develop a Citizen and Community Energy strategy and describe in their national action plans how they will promote small and medium-sized renewable energy projects and energy cooperatives and factor them into their legislative framework, support policies and market accessibility; Calls for the introduction of a new Citizen and Community Energy chapter under the revised Renewable Energy Directive to address the main market and administrative barriers and provide a more conducive investment environment for self-generation and self-consumption of renewable energy" (European Parliament 2016, §36-37).*

To conclude, we can argue that the European Union favors the recognition and deployment of decentralized production, on a technical point of view as well as on a control and benefits point of view since prosumer and cooperatives are to be included.

**Belgian perspective**

Resulting from these above-described European obligations, Belgium has agreed on a federal standpoint on what the Belgian decarbonization and energy transition should be. In December 2017, the four ministers (three regional and one federal) competent in regard to energy met and agreed on the Federal Energy Pact which would give the main energy and climate guidelines for 2030 and 2050 (Ellipse 2018). This pact, officially approved by the federal government since March 30th, 2018, has now to be agreed on by every governments and parliaments and should be finalized by the end of 2019. This document included goals and objectives which were thought through to be coherent with the European objectives previously mentioned. Hence, the Energy Pact touched upon four main central elements which will be summarized here (Fig. 13).

**Belgian Interfederal Energy Pact**

(1) Developing a low-carbon production, consumption and supply of energy;

i. Enhancement of energy efficiency

ii. Transformation of the production park with the closure of nuclear facility by 2025, share of RES production in final consumption of 40% in 2030 and 100% in 2050 with installed capacity of 8GW for solar PV, 4GW for offshore wind and 4,2GW for onshore wind

iii. Enhancement of flexibility through biomass/biogas cogeneration, geothermic power, centralized and decentralized stockage

iv. Evolution of transport and distribution with international interconnexion, micro-grid and smart grids

(2) Decarbonization of the heating and cooling sector

i. Better energy performance of the real estate

ii. Enhancement of energy efficiency in industry

iii. Transfer of the electricity financial charges towards fossil fuels

iv. Conversion towards less carbonated sources

v. Adapted infrastructures

(3) Decarbonization in the transportation sector

(4) Importance of research and innovation

Figure 12: Summary of the Belgian Interfederal Energy Pact - 2017 version approved by the four energy ministers of Belgium

In regard to the energy system, the main goals originated from the desire to exit nuclear production by 2025. Indeed, the federal level passed a law on January 31st, 2003, on the progressive exit of nuclear energy in regard to industrial production of electricity, modified in 2012 and 2015, now confirming the turning off of the last nuclear reactor by 2025. Following this decision, the energy system should be (1) ensuring energy supply; (2) respecting the Paris accord on decarbonization objectives; (3) maintaining an affordable price for households and enterprises; and (4) ensuring security of installation (Belgian Interfederal Energy Pact 2017).

This pact was then to be adapted for the three regions of the country which consequently have to produce an "Energy and Climate Plan". In Wallonia, the regional government approved the draft plan, called "Projet Plan Wallon Energie-Climat 2023-2030" the 18th of December 2018. The main goals of this plan are; (1) the decarbonization of Wallonia, with a target of 37% less GHG emissions (excluding the emissions covered by the EU Emission Trading System – ETS) compared to 2005; (2) a share of RES reaching 23,5% of the final consumption of energy in 2030; (3) better energy efficiency (ETS and non ETS); (4) Market integration including higher local flexibility and consumer protection; and (5) more research and innovation. In regard to the technical perspective, this plan highlights that PV is profitable without financial supports, yet the regulatory framework has to be improved to favor the spread of wind production installations. It also approaches the need for flexibility through the deployment of smart metering, increased auto-consumption as well as storage facilities. Yet this regional plan doesn't discuss matters of control and benefits regarding the renewable energy transition (Région Wallonne 2018).

Moreover, the 2030 Climate and Energy EU framework above-mentioned fosters Member States to provide a national plan to the EU Commission, illustrating the way predefined goals would be reached. Accordingly, the "Plan Wallon Energie Climat" was then re-integrated into the "National climate energy plan 2021-2030" (PNEC), itself approved by the Walloon Government in February 2018 and now submitted to the European Commission. There was hence an interaction phenomenon between the different level of powers so at the fix the regional overarching goals to be followed in regard to decarbonization.

## 4.3.2 Institutions and capacities

**Institutional arrangement: Federal State**

Belgium is a federal entity which accounts for 3 regions and 3 communities (see Fig. 14) and a total of 6 governments and parliaments; including a federal government and parliament (with the Flemish Region and Flemish Community being represented by the same government and parliament). Over the last decades, the constitution has been reformed 6 times, with additional competencies going from the federal State to the federated entities.

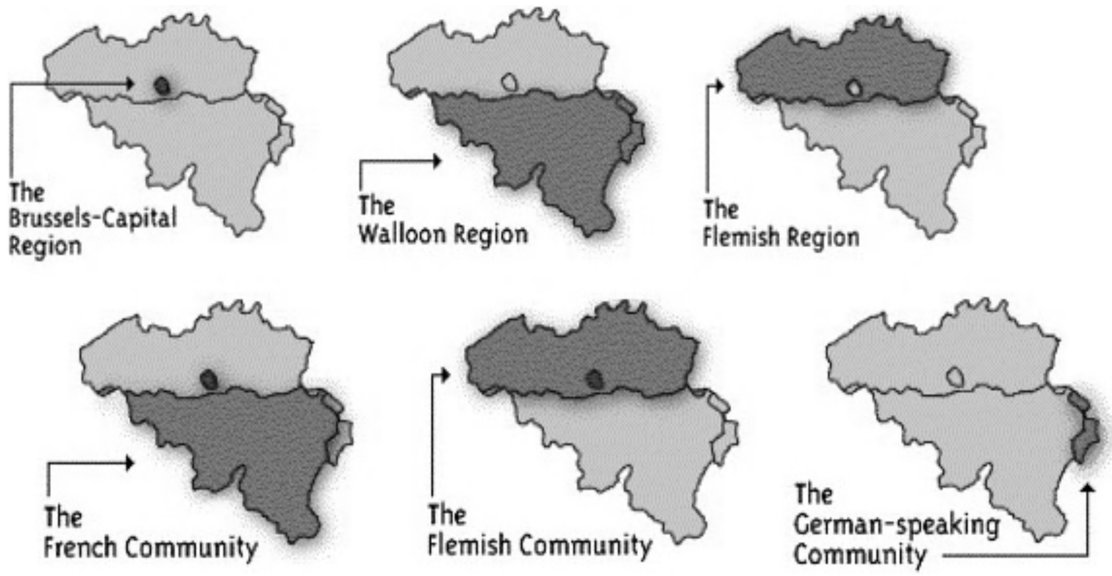


Figure 13: Federated entities of Belgium

Along with this regionalization, energy became a regional competence with the Special Law of August 8, 1980. However, the federal State remained competent for what requires technical and economic indivisibility. Accordingly, nuclear production and facilities, storage, high voltage transmission grid, taxes on energy and security of supply remain the federal areas of competence. On the other hand, regions are responsible for distribution transmission grids for gas and electricity as well as new sources of energy, including renewable energy (since 1987). This institutional complexity is often perceived as impeding a coherent energy political strategy within the country. As an illustration, the decision to get out of the nuclear is a federal competence which directly impacts the RES transition, being itself a regional competence (Van Dyck et al. 2016). This hindering phenomenon was also observed by Dekleermaker (2018), according to which the federal characteristics of Belgium has obstruct the climate change mitigation ambition of the country. This has shown through the Paris Agreement where the opposed and confronting claims of the different federated entities made it difficult to agree on a common agreement that had to be brought to international negotiations.

This spread of competencies has required cooperation between the federal and regional governments competent in regard to energy. A concertation group – called CONCERE in French, ENOVER in Flemish – was therefore created and formalized in a cooperation agreement signed the 18th of December 1991. This concertation group brings together delegates from the four administrations and cabinets responsible for the energy policies as well as representatives of SPF Foreign Affairs. This concertation groups hence encompasses several missions, including the concertation among the State and the Regions, ensure internal coherence in energy policy, centralize information on legislative adaptation touching upon energy matters, collect data to be shared with international organizations and provide energetic assessment, arrange the Belgian delegation to international organizations and ensure a common stand to adopt within international bodies. As demonstrated earlier in regard to the Paris Agreement, this concertation body often struggles to fulfill these different missions.

**Institutional arrangement: Government system and stability**

Belgium is a representative democratic and constitutional monarchy. Hence, the head of the State is the King Philippe of Belgium, while the prime minister is the head of government. The executive power is exercised by the government whereas the legislative function is exercised by the parliament. Belgium is also a multi-party system requiring coalitions in order to form a government. From 2009 until today, there has been three Walloon governments. From 2009 to 2014, the coalition was formed by the Socialist Party, the Green Party and the Catholic Party. The Minister-President was Rudy Demotte from the socialist party whereas the Minister of Energy, Housing, Public Office and Sustainable Development was Jean-Marc Nollet from the Green party. The next mandate, from 2014 to 2017 was composed of the Social Party and the Catholic Party, with Paul Magnette (PS) being the Minister-President and Paul Furlan (PS) being the Minister of Local Government, City Policy, Housing and Energy. On the 26th of January 2017, the Minister of Energy Paul Furlan resigned following a corruption scandal (Publifin Affair). He was followed by another energy minister from the socialist party, Christophe Lacroix, from January

2017 to July 2017. Regardless of elections (since this was still within the 2014-2019 legislative period), a new government had to be formed when the Catholic party announced the end of their collaboration with the socialist party. The following government was composed of the Liberal Party (MR – 25 seats) and the Catholic Party (13 seats), forming a very narrow majority (38 seats out of 75 seats). This majority was lost on the 18th of March 2019 when the deputy Patricia Potigny (cdH) left the coalition, making difficult the adoption of law and policies passed that date. The Minister-President is Willy Borsus (MR) and the Minister of Budget, Energy and Airport is **Jean-Luc Crucke (MR).** As shown here, the role of energy minister has been given to three different parties and ideologies from 2009-2019 and there were 3 different energy ministers for the period 2014-2019 only. This instability is known to have impacted the way political decisions have unfolded regarding the renewable energy system of Wallonia since the governing system doesn't allow for the policy-makers (here ministers) to create and enforce their strategies in a medium term.

### 4.3.3 Political interests

Although the political aspect is not to be studied per se we shall provide some insights onto the political ideology of the minister that created the policy-outcome studied in this research (Energy Minister Crucke for the period 2017-2019). Other core policy-maker – the energy regulator CWaPE – is also to be studied but is supposed to be neutral in regard to political interest.

As previously said, the energy minister Crucke belongs to the traditional liberal party (MR). The overall perspective of the party is to combine energy transition with economic development. The liberal party encourages a "blue ecology" (blue being the liberal color in Belgium): the more a society develops itself economically, the more it is able to fight against pollution thanks to its scientific capabilities, its technological and financial instruments. The party opposes the "green ecology" defended by the green parties which are said to be hostile to the market economy, to cars, to consumerism societies, and more generally to the standards of living of the middle class. They consider this perspective to be a restriction to freedom and of using a moralizing approach (Clarinval and De Salle 2019). This quite radical approach was however put into perspective by the Energy Minister Crucke as he shared during an interview that (translated from French): "Business-asusual is not sufficient to win (against the climate change). On the contrary, we need to change the paradigm and act concretely, proactively and voluntarily". Nevertheless, such transition cannot occur in an "economic desert", "we need to focus on research and innovation, financing and changing individual and collective behaviors" (Belga 2019a).

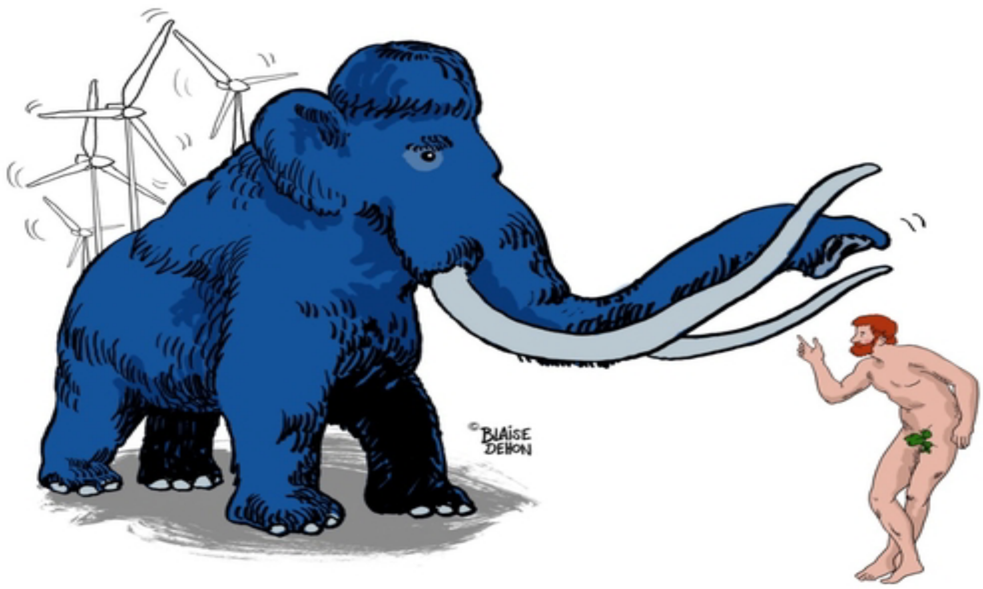


Figure 14: An illustration by Dehon Blaise on the position of the MR party on climate change actions as opposed to the "radical" green approach

In regard to ecology politics, we might associate this perspective with a mainstream shallow ecology movement such as perceived by Arne Naess, as opposed to a deeper ecology movement which "stresses extensive changes in values and practices, especially in industrial nations" (Drengson and Devall 2010, 52). We note that over the past years and even more so since recurrent climate marches have drawn further attention into the ecological crisis – a few months before the political elections – almost all parties have started to take stronger stands regarding climate change (De Muelenaere 2019). Their position as to how the transition shall take place is, nevertheless, strongly depending on the core ideology of the party.

## 4.4 Conclusion

This contextual chapter has provided a global perspective of the energy system in Belgium and more precisely in Wallonia. Through this information we observe that Belgium has a significant carbon footprint that can be related to its residential energy consumption. This energy is mostly fossil fuel based and relies on imports. Yet, the country has great potential regarding renewable energy sources and mainly with regards to solar and wind production. This potential could be developed on a decentralized manner as fathomed by important energy actors such as the renewable energy federation Edora or the transmission system operator Elia. We also observe that the spread of production units such as solar PV or windmill are economically coherent as these technologies have become highly profitable. As for the flexibility mechanisms, including grid management and storage technologies, there seems to be growing in importance. Indeed, many different actors support their development and actively participate in research and development. Nevertheless, these technologies are not fully mature yet. Finally, the political context demonstrates of a strong international ambition regarding decarbonization. The European Union more precisely advocates for the deployment of a decentralized RES system and approaches both technical elements and democratic characteristics (benefits and control). Inherent institutional issues in Belgium (as a federated and multi-party State) might hinder the adoption of policy-outcomes related to the decentralization of the system and should be kept in mind. Nevertheless, the scope of this research which focuses on the RES policies of the period 2017-2019 (one single energy minister on competences that are exclusively his) allows us to somehow limit these influences. Moreover, we took note of the political stand of this minister so as to distinguish this inherent ideology from the influence of the incumbent and new actors which is the focal point of the research.

# 5 Mapping energy stakeholders in Wallonia

The core focus of this study being the role of the incumbent and new energy actors within the policy-making process, we will now map the different actors involved in the energy sector that are or would be impacted by the de/centralized pathway of the Walloon energy transition. Referring to the methodological chapter, the mapping of the actors, their special interests as well as their perspective on the RES transition will allow us to shed light on the political phenomenon behind the energy transition pathway experienced in Wallonia. These elements will provide a general picture of the different actors and their position whereas the following chapter – policy-analysis – will provide a deeper analysis of their position regarding policy-outputs that affect the energy sector. We will then observe which of these interests are supported through the policy outputs. We shall keep in mind that the main elements we try to uncover relate to the form of renewable energy production they encourage as well as the division of ownership and benefits they favor.

## 5.1 Incumbent electricity actors

In regard to the theoretical framework provided beforehand, we understand incumbent energy actors as those which have had an active role in the electricity system when this one was centralized. With regards to the Walloon context and referring to the typology of centralized and decentralized energy system by Funcke and Bauknecht (2016, 69), this encompasses energy producers and providers as well as the distribution system operators.

### 5.1.1 Providers

There are nine main electricity providers in Wallonia; Engie-Electrabel, EDF-Luminus, Essent, Poweo, Zeno, Lampiris, Octa+, Mega and Eneco. These might produce or purchase the electricity commodity which they further sell. In regard to this research, we have decided to focus on the two most important providers; Engie-electrabel and EDF-luminus which own 66,8% of the market share (see Fig. 16).

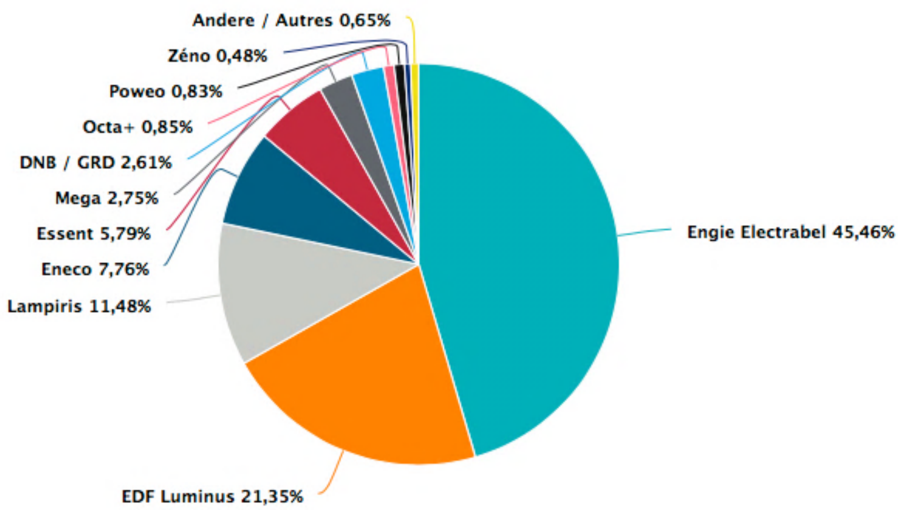


Figure 15: Share of the walloon electricity market by providers (CREG 2018)

We will also look into one smaller yet historic energy provider called Eneco which is, according to Greenpeace (2019), grandly oriented towards a renewable energy transition. These three providers also happened to be producers.

We will provide more details on their commercial activity, their perspective on a renewable energy transition and hence shed light on their position regarding a prospective decentralized energy transition. Although not approaching the integrality of providers, through such approach we believe to provide a sufficient array of information to map the interests of incumbent providers. The documents used in order to draw such information (balance sheets, reports as well as commercial strategies which are available on their websites) will be referenced and can be found in the bibliography. Moreover, information will be drawn from interviews that were conducted.

**Engie-electrabel**

Engie-Electrabel is a Belgian-based corporation and stands as a subsidiary of the French multinational utility Engie. It is the most important energy producers in Wallonia, owning 90% of the nuclear production parks of Belgium which accounts for a power accumulation of about 5320 MW (SPF economie 2018). In regard to renewable energy, Engie-electrabel has a power capacity of 645MW in 2018, out of which 285MW come from biomass, 22MW from run-of-river and dam hydroelectric power plants, 7MW from solar energy and 331MW from wind energy, spread into 38 onshore and offshore parks (Engie-Electrabel 2018b). It also owns the main storage facility, being the pumped-storage hydro facility of Coo which has a maximum capacity of 1164MW (Engie-Electrabel 2015).

Beyond being the main energy producer of Belgium, Engie-Electrabel is also the main provider as it possesses 45,46% of the market share (CREG 2018). Its operating profit was of 857 million € in 2017 – also including gas activity. According to the semi-annual financial report, we further note that in Belgium and Luxembourg, the turnover decreased by 2,5% which can be explained by two main factors; First, the nuclear facility closure and inherent challenges; and second, the lesser income from the energy prices collected. As a matter of fact, the sale of electricity decreased by 3,2TWh over the first semester of 2018 (Electrabel SA 2018). During interviews and public appearances, Engie-Electrabel has been transparent about the fact that the decentralization of electricity production units, with citizens starting to produce their own energy, consists of a challenge for the income of the company. Indeed, on average in Wallonia, 25% of the consumer electricity bills goes directly to the electricity providers (CREG 2019), hence if Walloon households produce and consume their own energy, the energy providers' income are directly affected. Nevertheless Engie-Electrabel does not oppose this transition. As put by Engie-Electrabel:

*"Energy generation and consumption will be different in the future. The energy of the future will be even more carbon neutral, more green, more efficient, more digital, more local, more decentralised and cleaner. Engie- Electrabel is getting ready for this and is guiding its customers through this energy transition in which it strives to serve as a key stakeholder in Belgium." (Engie-Electrabel 2019)*

Accordingly, the head of public affairs of Engie-Electrabel during the interview highlighted that this change of paradigm will unconditionally occur. Therefore, they aim at playing an active role in such a change. Pinpointing that securing affordability for all as well as ensuring security of supply in an electricity system as complex as a decentralized one will be the core challenges, Engie-Electrabel believes to have a central role to play as a facilitator. This is especially true in regard to the manifold skills and experiences they have gained over their past years of electricity services. These newly designed functions might vary regarding whether it consists of solar decentralization or wind decentralization, as will now be further investigated.

In regard to decentralized photovoltaic production, they intend to adapt and create for themselves adjusted roles. First, as of 2015 Engie-Electrabel started to sell, install and repair solar PV production units in Belgium. Second, they intend to act upon residential flexibility. This is particularly relevant as solar PV units require a comprehensive system that ensures coherence between electricity production and consumption, through consumer behavior, grid development, storage and so on. As the complexity of the system increases with citizens sharing the electricity they produce and a variety of storage forms such as the vehicle-to-grid technology, the electricity "puzzle" will be such that the help of facilitators – which Engie-Electrabel wishes to become – will be essential. According to them, this role is contingent to smart technologies, including smart meters, which should provide information on a quarter of hour basis. The company hence aims at providing services that will integrate this decentralization ergo benefits the entire system. In this regard, ***the type of renewable energy technology*** promoted are decentralized and highly digitalized, while the ***control and the benefits*** of the decentralized electricity production is shared among the "facilitators" – here Engie-Electrabel – and the newer actors which would assumedly need exterior expertise in regard to the complexity of the system. Although they believe to have the potential to offer such services, they acknowledge that they do not fully have this capacity as of today. These skills are being developed notably through their research center Engie Laborelec and with pilot projects being tested. They often refer to such transition as ongoing, with missions to be accomplished in the following years as opposed to the immediate future. We note for instance their need for smart meters to accomplish such flexibility services, with those to be installed starting from 2023. Moreover, drawing from the head of public affairs, decentralized flexibility technologies such as V2G make a lot of sense, nevertheless they remain conceptual and are not to be implemented on a short-term perspective. They mainly highlight technical elements as reasons to explain slow changes, although this could be overcome by market demand or political incentives.

Concerning wind energy, we have first noted that they own a few wind parks. Furthermore, following the emergence of public wind cooperatives in Wallonia in the early 2000s, industrial groups such as Engie-Electrabel decided to open their own windmill projects to citizen finances. In this context, Engie-Electrabel founded SCRL CoGreen in 2013 which is a structure that allows citizens to invest in windmill projects (Electrabel CoGreen 2019). More precisely, they own 24 windmill parks which offer public shares for about 2500 people all over Belgium, within which four parks are located in Wallonia (Frasnes-Lez-Anvaing 2013, Lincent 2017, Ecaussines and Soignies 2019). According to their annual report of 2018, the CoGreen structure has had an annual profit of 192.665€. Citizen stakeholders must have an established residency located near the wind park and might own a maximum of 20 shares, each being worth 125€. The dividend may not exceed 6%; For Frasnes-Lez-Anvaing, this dividend was of 6,68€ per share and 4,92€ for Lincent in 2018. Co-Green does not directly exploit the sites as this is done by Electrabel (Electrabel CoGreen 2018). As noted by Vanwelde (2018), they haven't created such system to cover financing needs but rather to favor social acceptability of wind project, with the Not In My Backyard (NIMBY) phenomenon and the perceived unfairness regarding the distribution of costs and benefits being targeted. As asserted by several interviewees including the head of Public Affairs of Engie-Electrabel, the citizen opposition to windmill projects have led to many challenges, including appeals to justice which are notably hindering the development of wind projects and slowing down the delivery of permits. Consequently, sharing the benefits with the citizens to some extent would reinforce social acceptability and lower the opposition risks. We note that the awareness campaign made around these projects touch upon societal acceptability more than the energy transition per se. In regard to the citizens who take part in those cooperatives, it appears that the financial benefits stand as core motivation, and that the stability of these societies allows for reinsuring and safe investments (Vanwelde 2018). Drawing from these insights, the ***type of renewable energy production*** stands as technically decentralized (although to a lesser extent compared to households PV), being fully owned and ***controlled by*** the parent company Engie-Electrabel, but with some of the ***benefits*** (dividends) going towards the citizens through CoGreen. The company highlights the inappropriate legislative frameworks that slows down the development of such projects.

To conclude, the head of public affairs of Engie as well their representant during the EU PVSEC 2018 noted that a centralized production of energy will remain a reality (nuclear, offshore windmills, etc.), yet this will go along some more decentralized production. Regarding the latter, Engie-Electrabel intends to play an important role. Their main approach to such decentralized transition is to have the possibility to adapt to and integrate this new system, keeping some form of control and sharing the benefits with the new actors, including prosumers and members of cooperatives. In the following chapter, we will see how this general objective unfolded in regard to the political decisions that were adopted.

**EDF-Luminus**

EDF-Luminus has a similar profile to Engie-Electrabel. It is the second main provider in Wallonia, with a market share of 21,35% (See Fig. 16) and is main shareholder is the French parent company "Electricité De France" (EDF). It owns the remaining 10% of the Belgian nuclear capacity, hence equaling a total capacity of about 600MW. With 189 windmills installed all over Belgium, it has a wind capacity of 450MW and aims at reaching a capacity of 700MW by 2022. It also owns run-of-river and dam hydroelectric power plants for a capacity of 67MW (Demaret 2018). Just like Engie-Electrabel, the Manager of Regulatory Affairs of EDF-Luminus noted that the decentralization of the electricity production is inevitable; the electricity system will evolve towards an increasing participation of citizens in the energy production. This challenges their historical role and makes it necessary for them to reorient their functions and services.

Through the analysis of the interview with the Manager of Regulatory Affairs and their websites, we observe that these changes are similar to the ones described above for Engie-Electrabel. In regard to solar PV, they first offer installation services, but also would like to provide flexibility services in regard to the complexity of the upcoming system. As for wind energy, following the development of cooperatives all over Belgium, EDF-Luminus has launched a cooperative society "EDF-Luminus Wind Together" which works on the same basis as Electrabel CoGreen with citizens having the possibility to obtain shares ergo dividends up to 6% whereas the ownership and control belongs to EDF-Luminus (Luminus 2016; Vanwelde 2018). Hence their overall perspective is coherent with what has been discussed for the previous main historic producer and provider of energy: the renewable energy transition will be both centralized and decentralized, and they intend to adapt their services so as to be involved in both.

**Eneco**

Eneco is the 4th most important energy provider in Wallonia, with a market share of 7,76% (see Fig. 16). It is of Dutch origin and made its way into the Walloon market when it purchased Eni Gas & Power in 2017. Eneco aims at delivering the consumers with green energy only, but as they bought Eni – which is a traditional provider with a grey mix –, this has lowered their share of green energy commercialized. Eneco is now investing so as to convert Eni to green energy as well. Accordingly, they have a production capacity of 1671MW in wind onshore, 427MW in wind offshore, 291MW in solar production, 56MW in biomass and 522MW in conventional energy (Eneco 2019). This information demonstrates that Eneco is willing to head towards a renewable energy transition in a quite ambitious manner. It is now of interest to look into the degree of de/centralization that this provider is encouraging.

According to their 2018 Annual Report (Eneco 2018b, 20) and public interventions, they believe in a decentralized production system, being simultaneously democratic and digital. But doing so, and mirroring the thoughts of the other providers, Eneco highlights the need to adapt and offer new services. Accordingly, in 2018, the manager of ENECO (Christophe Degrez) – after having merged with another energy provider – has argued that eventually there will only be three energy providers in Belgium.

*"This is because the complexity (of the future energy system) is such, with three regional regulations and an economy model where electricity only represents 23 to 30% of the bill whereas the providers takes all the risk, including those of non-payment from the consumer, that they need to gain a size that will be sufficient to develop new products and new services" (L'Echo 2018a).*

In regard to prosumers Eneco now offers solar panels and domestic batteries. Their 2018-2020 strategy also mentions their wish to grow their services to customer, including energy management (flexibility) services. Moreover, they allow citizen participation in wind projects. That being so, Eneco avails itself of the financing support from citizens. In 2018, they for instance gathered 300 000€, coming from 337 local citizens and other investors through a crowdlending system. Those citizens would beneficiate from a fixed rate of return of 4% for 6 years once they invested for a minimum of 250€. As put by the CEO of Eneco Wind, Miguel de Schaetzen, about this project (translated from French):

*"Eneco believes in a renewable energy system that is durable. We are today the pioneer of this energy transition and we want to make it with the citizens and the enterprises. This financing participative cooperation is one concretization of such vision. With the objective to federate locally around our wind project, the citizens of Neufchâteau and Léglise (the concerned towns) have had the opportunity to invest in*

*priority in this project before becoming open to the public. We can now, together, build this project" (Eneco 2018a).*

Like for the cooperatives set by CoGreen Electrabel and EDF Luminus Wind Together, being financially part of this project does not imply citizens' participation in the exploitation process or in the decision-making regarding the project.

Hence, this renewable oriented provider might be perceived as more ambitious regarding the renewable energy transition in itself and its speed of change, yet it does not seem to significantly differ from the more traditional actors when it comes to sharing the benefits or the control of the transition.

### 5.1.2 Distribution System Operators

In Wallonia, distribution system operators have the responsibility to distribute electricity to the consumer through low voltage grids (between 3 to 50kV). More precisely, the DSOs have to ensure the quality of the infrastructure through construction and maintenance and are responsible to transport the electricity from the transmission grid (Elia) or from local producers to the final consumers. They are in charge to distribute electricity for specific areas which are designated by the public authority. Public authorities are controlling DSOs mainly as to ensure that they serve grid users (including electricity providers) in a non-discriminatory way.

As of today, there are 5 electricity distribution system operators; AIEG, AIESH, RESA, Reseau d'énergie de Wavre and ORES. The latter stands as the most important, covering 75% of the Walloon municipalities (See Fig. 17). We also note that they are represented by the Belgian federation of electricity and gas operators: "Synergrid". Due to its core importance in the sector and since they are all relatively similar in their functioning, ORES will be the DSO studied in this research.

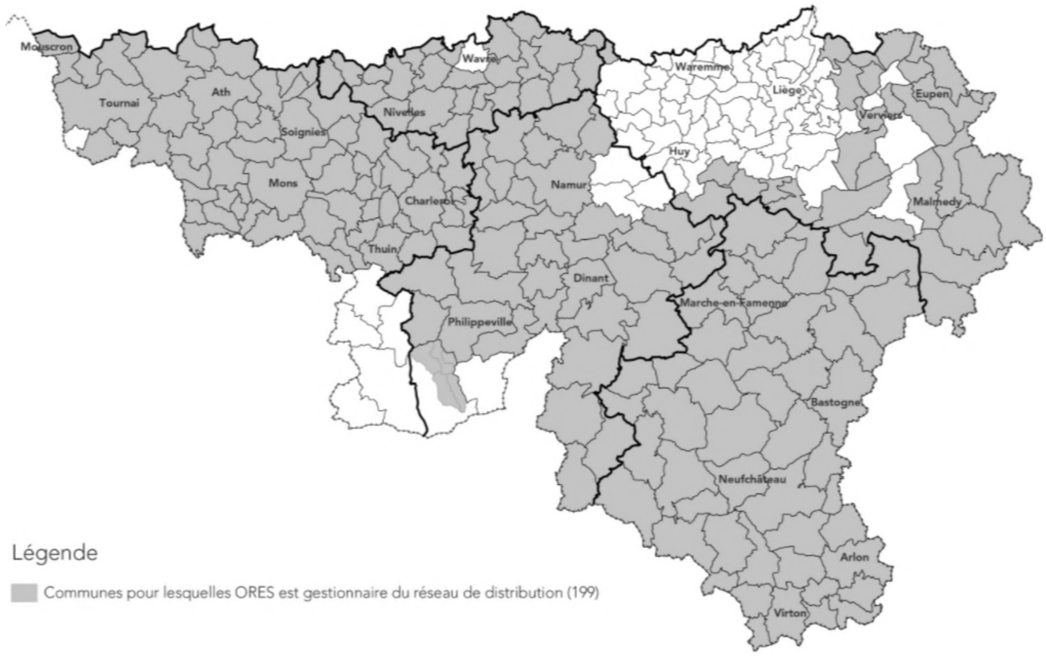


Figure 16: ORES as main Electricity Distribution System Operator (ORES 2019)

We note that Walloon DSOs are intermunicipal structures, meaning that there are intercommunal enterprises that provide a service to several municipalities. In that sense, the shareholdings belong to municipalities as well as to pure inter-municipal financing companies (or “intercommunale pure de financement”, IPF). More precisely, ORES belongs to the municipalities it deserves as well as seven IPF (Idefin, IPFH, Finest, Sofilux, Finimo, IPFBW and IEG) which regroup the municipalities in groups that loosely correspond to provinces. Being the shareholders of the company, these municipalities and IPF are also the ones received dividends based on the company’s profits (ORES 2018c). To give an illustration of what it means, the city of Charleroi has received more than €3 million of dividends in 2017, €3,7 million in 2018 (See Appendix 8). Drawing upon a statement made by the financial director of the City of Wavre (which has its own DSO – “Réseau d’énergie de Wavre”), it appears that DSOs provide sizable revenues to the municipalities which might consequently be putting pressure on them so as to ensure benefits hence dividends. This thought was also shared by the president of APERe during an interview.

As we have previously discussed and will now be further developed, the distribution system operators face notable challenges resulting from the intermittence of renewable energy production and even more so when this production is decentralized. Drawing upon the interviews, including the one with the Responsible of Public Affairs of ORES and from their "Strategic Plan 2019-2025" (ORES 2018a), it seems that this transition would infer two main challenges for the DSO; (1) additional costs as they must adapt the grid and their role with respect to the decentralized production of electricity ; and (2) lesser income due to the spread of prosumers. Approaching these stakes will help us understanding the perspective of DSOs and more precisely ORES regarding a decentralized renewable energy transition. Once again, the aim of this chapter is to provide insights into the interests at stake for this category of actors and therefore see how this delivers in the policy-process.

First, starting from the observation that a decentralized RES production leads to bidirectional flux of electricity in the grid as opposed to a centralized unidirectional system, the distribution grids inherently plays another role in the electricity system, including one of storage and of integration of electricity at various entry points. Despite these intermittent and varying sources, the power grid needs to be stable and thus maintain a constant voltage. To approach this matter, DSOs can either invest in the physical grid infrastructure itself or encourage better management through, for instance, smart metering and smart grids. According to their strategic plan 2019-2025, in order to integrate the RES transition, the grid needs to be transformed, modern and intelligent. Hence, their strategy mainly relies on digitalization and big data management and more precisely refer to smart meters, smart grids, internet of things (of energy), blockchain, and so on (ORES 2018a, 12). They further provide an implementation strategy. By 2022, their financial and logistical management would be optimized, making it possible for them to conduct physical improvement on the client side of the grid (smart meters) by 2023 and finally start optimizing the grid by 2024. Between 2020 and 2023, they would be preparing such digitization of the grid through the modernization of their data system (SCADA) and enhancement of their grid electricity flux accounting processes. They also ambition to find a system that manage congestions of the grid efficiently. This transformation would infer additional cost which would, according to the president of the administration council, be carried by the tarification period 2019-2023 that has set around €1,3 billion to be invested in the development of the electricity distribution grid (ORES 2018a, 23). According to the chief executive officer of ORES, Fernand Grifnée, the cost of this development should not be supported by the consumers through an increase of the energy bills (ORES 2018a, 5). They want this grid transformation to be as neutral as possible for the tarification, hence they will rely on internal optimization and efficiency to cover the costs (ORES 2018a, 13).

The second matter at stake for the DSOs – which is not mentioned in the strategic plan provided by ORES although being stated during political discussions and put forward in several interviews – is their loss of income due the decentralized production of electricity. As for the electricity providers, the fact that consumers provide themselves with electricity has a direct impact on their income. Indeed, around 33% of the electricity bills goes to the transmission and distribution system operators (Appendix 7). According to the head of public affairs at ORES, losses of financial incomes due to the expansion of prosumers would actually be transferred onto the other consumers if political decisions are not undertaken to cover this loophole. In their memorandum, ORES and RESA pinpoint for public authorities to conduct an encompassing reflection on a new tarification structure which integrates decentralized renewable energy production and consequently spur social, environmental and economic changes. Simultaneously, they wish for the public authorities to diversify the financial incomes of the companies that offer public services that are both affected and necessary for the renewable energy transition (ORES and RESA 2019, 5). Moreover, as argued during the interview, they do not wish people to fully disconnect from the grid either, through the installation of individual storage facilities for instance, or through private and close grid. This would be considered as unnecessary investment as the public grid already exists.

In conclusion, we observe that the DSOs are not opposed to a renewable transition that will most certainly be ***decentralized*** to a certain extent. Yet, despite not being intrinsically opposed, this infers great changes as well as costs for them. They wish to offer quality services in regard to their incumbent role of electricity distributor and grid manager, yet they are facing important needs for grid investments meanwhile their income decreases. Consequently, one of their objectives is to ensure revenues that covers the transition as well as the shareholders claims. This might, however, affect the prosumers' ***benefits*** and/or other citizens' contributions. As for ***control***, DSO have a monopoly on the grid management thus such role is not to be changed by the RES transition. On the contrary it is most likely to be reinforced regardless of the new roles to be played by prosumers and cooperatives. This is unless private grids and storage facilities appear which they do not favor.

## 5.2 New actors

The renewable energy transition introduces new ways to produce energy. Especially in regard to the resources available in Wallonia, the energy system is transforming towards a decentralized system that includes photovoltaic panels and onshore windmills. Consequently, production units might belong to actors historically known for being mere consumers. Becoming simultaneously producers, we refer to these new actors as “prosumers” or “citizen cooperatives”. The first term embraces private ownership while the second is used to refer to collaborative ownership of the production units. In this section we will now introduce these actors and shed light on their main interests and perspective regarding the transition pathways. First, we will investigate the perspective of the citizens that could eventually become prosumers or take part in cooperatives. Second, we will approach the existing PV prosumers. Third, we will look into wind citizen cooperatives and related providers. Finally, we will introduce the association of renewable energy (APERe) which promote an inclusive transition through the deployment and thrive of both prosumers and local cooperatives.

### 5.2.1 Public opinion

As previously discussed, the renewable energy transition might lead to the decentralization of the energy system with citizen, historically being consumers, having the possibility to become energy producers themselves. This can occur through privately owned or shared wind and solar electricity production units. One way to approach the interests and claims of these new actors is to look into the citizens’ perspective on what the transition pathway should be as they might themselves be the new or become the future energy actors. This will be done based on an open public consultation which was launched in autumn 2017 and involved around 34 000 individuals in the context of the inter-federal pact on energy. In an attempt to integrate democratic legitimacy into this pact, a public consultation was launched and interrogated the Belgian citizens on a plurality of matters touching upon the energy transition. The result of this consultation is available and consequently provides information on the perspective and claims of citizens regarding renewable energy prosumerism and energy cooperatives. The graphs from which we draw these insights will be provided in the Appendix 5.

Two main shortcomings might be noted ahead of such analysis. As for every voluntary public consultation, there is a participation bias as only those involved or interested in the topic discussed are likely to take part in the questionnaire. This is particularly true as there wasn't much transparency regarding the fact that this consultation was available. The second bias relate to the fact that this is a national public consultation, thus the results also treat the perspective of the citizens from the Flemish and Brussels region (respectively 54% and 12% of the answers) which might vary from the Walloon perspective (34% of the answer) due to quite different socio-economic and political contexts. Hence the conclusion drawn from this consultation are to be used carefully.

In a more general perspective, when asked how they perceived the energy mix of the future, 81% of the respondents have cited renewable energy as part of it (mostly solar and offshore/onshore wind) and 42% have highlighted higher level of flexibility. To a much lesser extent, nuclear was cited by 24% of the respondents, fossil fuel by 23% (mainly natural gas) and imports through interconnexion by 14%. In regard to the role they believe the public authority should have in this transition; 67% of the respondents believed public authority should encourage the deployment of RES production, whether through rewarding (48%) or obligations of investments (19%). When asked again in another question if they are in favor of rewarding citizens and enterprises who invest in RES or in efficiency, 86% were somewhere between in favor to very much approving. Another question highlighted that many believe that renewable energy should be stimulated through rewards such as subsidies and grants and should not be prone to pricing regarding the use of the distribution grid to store energy. When asked if the public authority should support citizen cooperatives regarding the energy transition, 48% were absolutely agreeing, 23% are certainly approving and 17% are quite approving, resulting in a total of 88% encouraging such support.

Touching upon the citizens' own contribution, when asked if they would like to personally contribute to the energy transition, 48% of the respondents were absolutely agreeing, 26% were certainly agreeing and 17% were quite agreeing, for a total of 91% in favor of such participation. More precisely, 90% of the respondents were agreeing to being more flexible in regard to their energy consumption, 86% were interested in investing in renewable sources at home and 78% were interested in participating in a renewable energy cooperative (shared PV, wind, renovating projects, etc.).

Nevertheless, at several occasions the respondents put forward their concern in regard to the economic changes and justice imbalances such transition could introduce. For instance, although being generally in favor of more flexibility, in regard to dynamic pricing that could enhance flexibility by synchronizing production and consumption through economic incentives, 59% of the respondents were in favor whereas another 20% believed that only a part of the population would benefit from this change. Moreover, 37% of the respondents believed it would be too fastidious and would increase disparity among consumers. Hence, we can conclude that justice challenges remain an important concern among the citizens, despite being highly in favor on a renewable energy transition involving decentralized technologies and ownership.

To conclude, an important part of the population that participated in this questionnaire stands in favor of ***a decentralized production***, within which solar and wind energy is substantial. Although the inherent ***benefits*** of producing its own energy is not directly addressed, they strongly encourage the State to provide advantages to renewable energy producers. Likewise, it appears that citizens would be interested in ***owning*** energy production installation yet not much is said about the ***controlling*** of these private and cooperative installations. .

### 5.2.2 PV prosumers

Now that we have gained insight into the general perspective of the citizen within which existing or future energy producers might be represented, we will now more particularly approach the already existing PV prosumers who exists in Wallonia. Doing so, we will also attempt to shed light on some of their interests and claims towards the public authorities.

As of 2018, there were 141 512 decentralized PV production units under or equal to 10 kW (units of capacity installed) for a total of 3 624 377 inhabitants (CWaPE 2018b). These so called small, or residential installations represent about 84% of the photovoltaic installed capacity, with the other 13% belonging to commercial production and 3% to industries (Neubourg 2018; Huart and Neubourg 2017). As mentioned earlier, the installations of these solar panels in Belgium have increased over the past years, with a peak around the year 2012 – due to a generous support system – and a calmer but steady increase since 2015 (APERe 2018).

In their early start in 2007, cost of the PV panels stood around 4000€ for 1kWc, keeping in mind that an average family of four would require an installation of about 4kWc so as to produce the necessary 3,5kWh per year. The cost of the PV panels alone would be of around 15 000€. As of today, panels for 1kWc would cost between 1400 and 1800€ (Engie-Electrabel 2018a) while a complete installation in 2019, including workforce, inverter and grid connection for a family of four would cost around 7500-9500€ (Guide Panneaux Photovoltaïques 2019). Over the lifespan of the PV panels (around 25 years), an installation of 5kWc would allow savings up to 18 752€. This was calculated excluding subsidies schemes and adding grid tarification, as this would be the case in Belgium as of January 1st, 2020 (Wikipower 2019). This shows the profitability of such investment as compared to traditional electricity billing, with a return on investment believed to occur within 7-10 years. Although lesser well-off citizens might be unwilling or unable to acquire these production units due to the needed investment at first hand, we could conclude that owning solar panels could be of great economic benefits for these so-called prosumers and is becoming a possibility for more and more people as years go by. To highlight the Walloon potential, we also highlight that the National Bank of Belgium (2019) has noted that in January 2019, €270 billions rested on savings account.

In regard to aggregated interests and claims pursued by the prosumers, the president of APERe has noted that prosumers are not consolidated through a federation, hence their interests are neither gathered on a macro level, nor defended through a legitimate body. We can however draw insights on what such interests and claims might be through additional sources of information. Although the PV prosumers have not engaged through a federation per se, two different organizations and associations have attempted to defend the interest of prosumers. As of today, their missions consist of protecting the rights and interests of smaller producers of renewable electricity (under or equaling 10kWc) in regard to decisions adopted by public authorities including the government and the regulator; Walloon Commission for Energy (CWaPE).

**TPCV**

First, a non-profit organization called "touche pas à mon certificat vert" (TPCV) (which can be translated by "don't touch my green certificate") encompasses more than 18 000 prosumers. It has emerged as an opposition to the end of green certificate subsidies in 2014. The end of subsidies had retroactive effects for small installations since it was then decided that prosumers would benefit from green certificates for 10 years instead of 15. This decision was taken due to unexpected and wrongly managed economic consequences from the subsidy scheme. Ergo the primary objective of TPCV was to defend prosumers against this political decision which they believed to be unfair. They further evolved as they started defending prosumers in regard to all decisions taken by public authorities.

Going beyond this primary and core motivation, the content provided through the website of TPCV might be used to draw some insights on additional prosumer interests and claims to the public authorities. Available documentation, including the videos of their general assembly of 2017, (fully available online: ASBL TPCV 2017) have been analyzed and have shown that they are strongly opposed to the digitalization of the grid or to prosumers' financial contribution to the grid. They are, however, often putting self-sufficiency (through individual batteries for instance) forward as a solution to avoid being affected by costs that would be imposed to them from public authorities while beneficiating from their own production. Hence in regard to the ***technical elements***, they encourage decentralized production units and small storage facilities, yet they are reluctant regarding an overall flexible grid with flexible and comprehensive tarification and digitalization. We observe that their main concern is to secure financial ***benefits*** to prosumers. These benefits might be related to the profitability of their production, to subsidies or for them to participate to a lesser extent in the financing of the electricity system. They wish to ***own and control*** their production installations.

**GPPEV**

Second, an association of small producers of green energy (GPPEV) was created in 2013. Their objective is the promotion, defense and valorization of the decentralization of renewable energy production. Concretely, they tend to group small producers of green energy and offer services to its members, including juridical support, information on the RES sector and representation towards the public authorities. Reflecting the action of TPCV, they have mainly opposed the retroactivity aspect of the end of subsidies (they appealed to a judicial court).

To conclude, the existing prosumers federations have clear claims and demand the political sphere to take their opinions on the energy transition in consideration. Mostly, they encourage the public authorities to not disrupt the previously-adopted decisions on economic subsidies and pricing that would affect their investment in a retroactive manner. Nevertheless, and as noted by the deputy chief of staff of the current energy minister, current prosumer associations such as TPCV have mainly based their claim on criticism and opposition to measures, whereas they do not often succeed in providing concrete and encompassing recommendations. Accordingly, their core focus is to ensure financial incomes for the prosumers and oppose retroactive political decisions that would affect these predetermined financial claims.

### 5.2.3 Citizen cooperatives

In Wallonia, there are 16 citizen cooperatives which work on renewable energy production projects (See Table 4). Moreover, there is a cooperative-based electricity provider which delivers the electricity produced by those cooperatives to consumers. Most of these cooperatives and their common providers are then part of a federation which aggregate and protect their interests with regard to the other energy stakeholders and policy-makers. We will now map the different cooperatives and associated provider as well as their core values and missions. We will also explore the federation that represents them and draw their general political claims.

**Citizen cooperatives in Wallonia**

The first energy cooperative emerged in 2001, followed by 7 cooperatives around the year 2007-20012 where green certificates were an important form of subsidies for wind projects. There are now 16 Walloon cooperatives which might produce their RES energy independently or in collaboration with other cooperatives. For instance, Vents du Sud, Lucéole and Férréole for instance conjointly own (respectively 76%, 12% and 12%) and exploit a 2MW windmill since 2015. Vents du Sud was created in 2012 by 33 citizens and account for 500 cooperators as of today. This cooperative aims at stimulating the renewable energy transition through the exploitation of the resources that are available on the Walloon territory. Doing so, they wish to promote an alternative, ethical and inclusive energy system around the decentralization of the production of energy, with a relocation of the profits and inclusive democratic processes.

| NAME | PROJECTS | CREATION | COOPERATORS | SHARED CAPITAL |
|---|---|---|---|---|
| Allons en vent | Solar, wind, hydro, biomass | 2001 | 935 (2018) | 206 200€ (2018) |
| Champs d'énergie | Solar and wind | 2013 | 725 (2018) | 875 000€ (2018) |
| Clean Power Europe | Wind | 2016 | 30 (2016) | 30 000€ (2016) |
| Clef | Wind and hydro | 2008 | 1055 (2017) | 2 478 500€ (2017) |
| Vent du sud | Wind and hydro | 2012 | 573 (2018) | 700 000€ (2018) |
| BocagEn | Solar | 2017 | 24 (2018) | 80 000€ (2018) |
| Condroz Energies Citoyennes | Hydro and biogas | 2014 | 136 (2018) | 92 500€ (2018) |
| Coopeos | Biomass | 2015 | 154 (2019) | 395 750€ (2019) |
| Courant d'air | Wind and hydro | 2009 | 1618 (2017) | 3 336 250€ (2017) |
| Emission zero | Wind, solar, biogas, hydro | 2007 | 1745 (2018) | 3 057 340€ (2018) |
| Eolie-lien | Wind | 2013 | 219 (2017) | 274 500€ (2017) |
| Férréole | Wind and solar | 2012 | 354 (2019) | 176 000€ (2019) |
| Gaume Energie | Solar and biomass | 2014 | 35 (2017) | 55 700€ (2017) |
| Lucéole | Wind and hydro | 2010 | / | / |
| Hesbenergie | Wind, biomass and hydro | 2013 | 769 (2019) | 786 250€ (2019) |
| Nosse Moulin | Wind | 2011 | 358 (2017) | 417 500€ (2017) |

Table 4: RES Walloon citizen cooperatives (Coop à la carte 2019)

Concretely, through the decentralized energy production (from wind, solar but also biomass, biogas and hydro), citizens are given a central role in the energy production. Being projects cooperators, they control and jointly take decisions on the management of the projects as well as the production and provision of electricity.

This is done with regards to decisions that are taken during General Assemblies that occur once a year, where all cooperators are invited, and each has a voice regardless of the amount of money they invested. Beyond the democratic control of the projects, they also beneficiate from two economic advantages. First, they obtain a dividend of maximum 6% (the maximum being imposed by the law on cooperatives) and a reduction on the pricing of the energy they purchase (if purchased from their affiliated provider Cociter). As put by Vanwelde (2018), the perspective of economic dividends and benefits is of great importance when citizens decide to invest in wind cooperatives. Coopeos also adds to their objective the creation of local, sustainable and respectful job opportunities as indirect economic advantages (Coop à la carte 2019). To sum up, the three main axes of objectives are related to the protection of the environment through the spread of renewable energy production, democratically inclusive functioning and economic benefits. Every Walloon cooperative has cited those elements as their core missions and values. Moreover, we note that a few cooperatives, including Clef and BocagEn, also intent to raise awareness on 'sustainable development' and on the rational use of energy through their projects (Coop à la carte 2019).

Drawing from the goals they bring forward, most cooperatives seems to vividly encourage a decentralized transition, with a spread of ***decentralized production units***. They do not particularly address the development of the grid nor storage facilities. In regard to the control and benefits, their position is very clear and is fundamentally linked to their origin: they want the ***benefits*** of decentralized RES to go to citizen and wish to democratically manage their installations hence sharing ***ownership and control***.

**Cooperative provider: Cociter**

Cociter is a provider that delivers renewable electricity produced by 12 of the cooperatives here-above mentioned to 3500 Walloon households (Greenpeace 2019). The core idea is to provide the electricity produced by the RES projects to the members of the cooperators. Their tarification is designed so as to cover real operating costs although those being members of the cooperatives benefit from an advantageous tarification; They encourage citizen to become the producers of their own energy through the participation in the cooperatives. That being so, Cociter is a not-for-profit structure that promotes a "social economy" aimed to be ethical and sustainable. Through such task, they seek the re-appropriation of strategic skills and abilities related to the distribution of electricity on a regional scale. We can read on their website (translated from French):

> *"Cociter wishes to re-appropriate the complex and strategic skills of producing and delivering electricity, which has progressively been left to multinational and big groups." (Cociter 2019)*

As for the cooperatives with which they collaborate, Cociter's core values encompass the democratic participation and financial contribution of all members. They wish to promote autonomy, independence as well as a community feeling, education, formation and information regarding electricity production and consumption.

As it encompasses the citizen cooperatives previously mentioned, Cociter unsurprisingly mirrors their objectives and values. Cociter encourages the development of ***decentralized renewable energy production*** that is simultaneously ***benefitting*** citizens as they lower the cost as much as possible for those participating in the cooperatives (nevertheless the cost might stand as superior than traditional providers under certain circumstances) and promote citizen's participation in the decision processes (***ownership and control***).

**The federation: REScoop**

The federation REScoop brings together 15 cooperatives for a total of 29MW installed, 10 700 cooperators and €15,4 million. In 2018, they produced 40 million kWh and produce electricity for 11 500 households. As for the cooperatives it represents, REScoop is open to citizen participation and its management is based on democratic processes. The objectives are to regain the control of the energy we consume, favor the energy independence of the country and promote a social and ethical economy. Through such aggregation, they intend to ensure the quality of the projects and the respect of citizens and biodiversity, oppose the purchase of the installation from multinational companies, and wish to offer completely green energy to its consumer (REScoop 2019). They have however not published clear stands on the overall energy transition (including smart grids and batteries).

### 5.2.4 APERe

APERe is an association that promotes a sustainable and socially inclusive renewable energy transition. Doing so they pursue two core missions. First, they aim at educating citizens, schools, municipalities, professionals, institutions and medias regarding the transition and its potential. Second, in order to facilitate the RES transition, they address suggestions regarding the legislative and regulatory framework to public authorities. They more precisely support local actors, cooperatives and prosumers in regard to the transition. Therefore, they encourage a decentralized transition where the benefits and control are given to citizens. Although not being legitimate since they are not a federation per se, this association defends the interests of the “new actors” which a decentralization might allow, while keeping in mind the overall added-value to society as a whole. In regard to their expertise and their socially oriented values and missions, we will also take their claims and political advises into consideration to analyze whose interests are represented throughout the policy-outputs.

Though their website and the interview analysis, we observe that they vividly promote ***renewable energy technologies*** which include decentralized solar and wind units owned by prosumers and cooperatives and connected through a flexible grid that is able to encourage auto-consumption. The ***control*** of the production units should be left in the hands of the citizens which become actors of the energy system. In regard to the ***benefits***, they deeply encourage a transition that provide benefits to each citizen, promoting an encompassing tarification that reflects and beneficiate each and every producer and consumer. Moreover, they encourage a regulatory framework that allows the sharing of renewable energy production so as to regulate intermittency ergo enhance grid flexibility (APERe 2019a). As cited in their memorandum (translated from French):

*“The costs of photovoltaic and wind electricity have reached such a level that there are the cheapest forms of energy, even without subsidies if that energy is auto-consumed. Means exist today so as to capture their economic values and ensure that their environmental and financial added-value benefit the most people with equity”.*

## 5.3 Aggregation of actors

In an attempt to influence the policy-makers, these different actors come together under groups or platforms. These are often mentioned by the interviewees when asked through which ways energy actors were represented and active with regards to the policy-process. Although we won't go into details as they do not represent interests that differ from those previously discussed, it is important to acknowledge their existence as they are the main link between the previously-described actors and the policy-makers.

**Edora**

Edora stands as the "federation for renewable energy". Both incumbent actors (including EDF Luminus, Engie-Electrabel for instance, but not the DSOs) and new actors (different cooperatives and APERe) are members of this association, as well as experts, RES industries, and so on (Edora 2019a). The type of renewable energy they defend are broad and includes wind and solar PV which they consider as important, along with biomass. In their reports and memorandum, they often highlight the need for a decentralized, flexible and sustainable energy system. Hence, they argue in favor of a legislative and regulatory framework which encompasses local RES community, collective auto-consumption, new tarification that coherently affect electricity consumption behavior, smart grids, etc. (Edora 2019b). In regard to the type of renewable energy produced they enhance; we can argue that it very much corresponds to a decentralized type. As for who would claim the benefits and the control of this production, it is much less comprehensible. As seen previously, the incumbent actors could aim at integrating this new scheme of production while gaining benefits and control. Although they support economic benefits and local employment when arguing in favor of this decentralization (Edora 2019b, 12), the manager of a citizen technical association on renewable energy has mentioned during an interview that those who contributes the most in the federation tend to have a bigger voice and be more represented in their political claims. Consequently, we cannot situate Edora in regard to control and benefits and will hence be let aside in the policy analysis despite being an influential actor towards the policy-makers.

**CESE Wallonie**

The "Economic, Social and Environnmental Coucnil" of Wallonia (CESE) is a consultative regional assembly that brings together all the representants of the environmental, labor and employer representatives. This group is bringing opinions and recommendations on matters that concern the development of the Walloon Region. Doing so, they allow a concertation between the Walloon government and the social and environmental actors (CESE Wallonie 2019a). It is divided into several thematic poles, including one on energy (called "Pôle energie") which brings together representants of social interests and public assistance centers, of residential and industrial consumers, local public authorities, environmental association, actors of the energy sectors (centralized, RES, prosumers, and so on), DSO and providers (CESE Wallonie 2019b). Hence this is the main platform that allows the different actors, which we have previously discussed, to defend their interest and claim towards the policy-makers. They try to integrate the different actors in a platform that reaches the policy-makers and provide them with comprehensive insights.

## 5.4 Conclusion and overview of the actors' interests

Throughout this chapter we have argued that incumbent actors do not oppose the decentralization of the renewable energy system, principally because these changes will occur regardless of their will. Yet, this change of paradigm profoundly affect their incomes and the services they provided as of today. Being aware of this transition, providers and distribution system operators attempt to adapt and secure as much control and benefits as possible. They fathom, for instance, providing flexibility services. New actors, on the contrary, don't seem to be fully aware that this change of paradigm is occurring and that they have the opportunity to reclaim part of the energy system for their own. Prosumers keenly defend their financial benefits on an opposition basis whereas cooperatives struggle to enter a market that is extremely complex. These different interests are summarized in the following figure. We will further see how these evolved in regard to the particular policy-outputs.

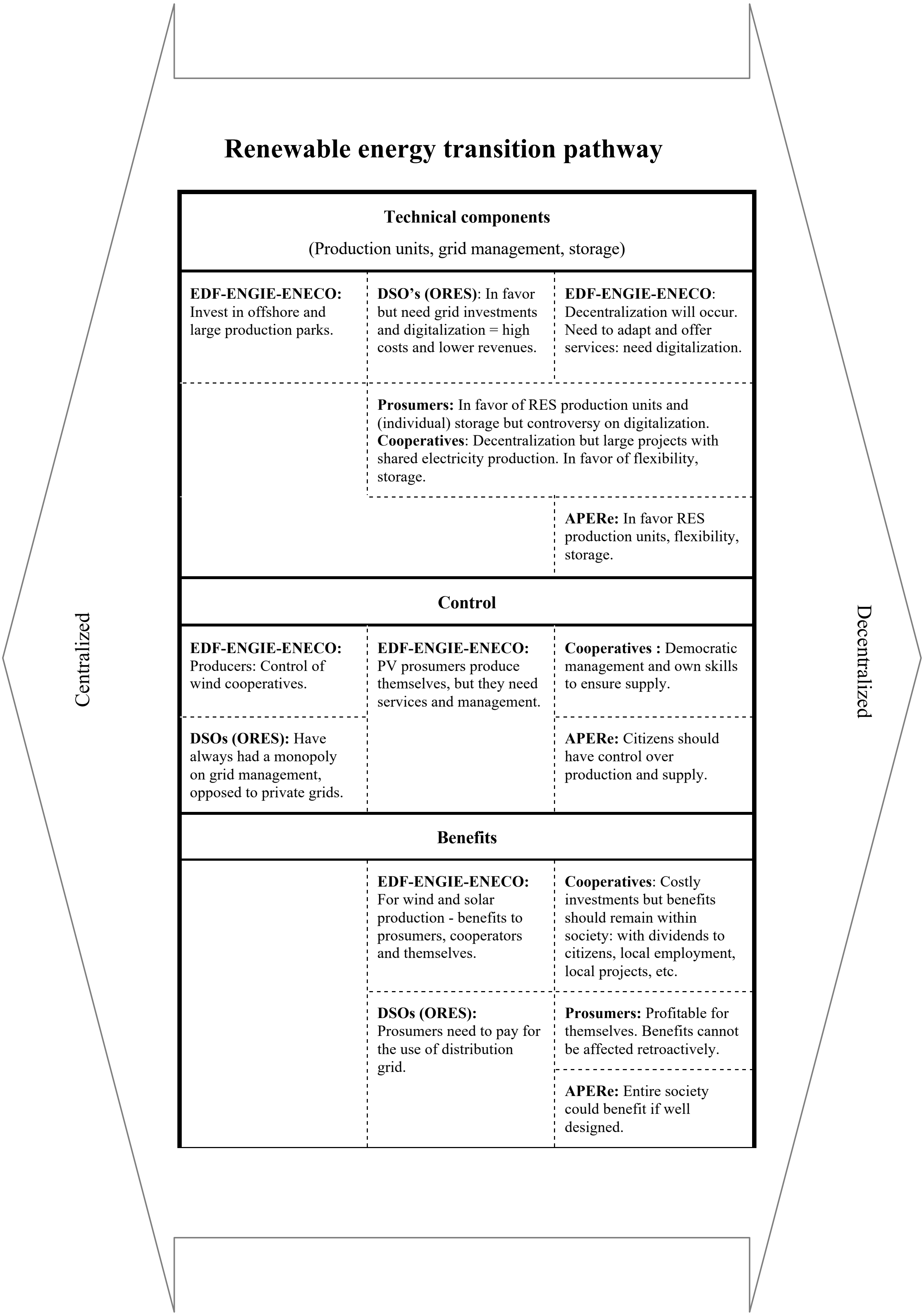


Figure 17: Actors' interest on the renewable energy pathway axis

# 6 Walloon energy policy-makers

Drawing from the previous chapters we now have an understanding of the Walloon energy system, its potential regarding a renewable energy transition as well as insights into the political elements that might affect such transition. Furthermore, we have situated the different actors' interests hence position regarding a decentralized renewable energy transition pathway. Consequently, we wish to see how these interests might have affected the policy-outputs that influence the pathway that is to be followed. In order to do so, we first need to uncover which public authority figure is responsible of creating such policy-outputs. The electricity market of the Walloon Region is organized in the decree from April 12, 2001. This decree mentions the different public actors of the energy sector and their competencies in regard to the electricity market. It will hence be addressed.

## 6.1 Energy minister

In the Walloon Region, a public policy would be referred to as a decree which has to be voted by the parliament and executed by the competent Minister. Before being voted by the parliament, the decree might be proposed by the Parliament itself (hence called a proposal of decree, or "proposition de décret") or by the Minister and will then be called "draf decree", or "projet de décret". Such proposal or draft must be officially introduced before being analyzed by the relevant Commission of the Parliament within which ten deputies sit. These deputies might also use the help of experts in their parliamentary analysis. This Commission has the opportunity to amend part of the text before presenting their report in front of the plenary session of the parliament, bringing together the 75 deputies. The Commission then present their report and allow for other deputies to amend the official text. At the end of the session, if a majority of the deputies vote in favor of the text, this one is adopted and is to be executed and implemented by the competent Minister and his or her cabinet through the publishing of a Ministerial Orders ("arrêté ministériel") which entails policy measures and instruments.

In regard to the decentralized production units installed, the energy minister is responsible to decide on the subsidy scheme (to be applied to Walloon region, municipalities might also offer grants and subsidies). It also has the power to decide on administrative procedures, but these often requires the respect of conditions often set by the European Union directives. For instance, in order to decide on environmental "guidelines" regarding windmill installations, it requires for the policy-maker to first conduct an environmental assessment. Through decrees, if approved by the parliament, the energy minister and the government have the power to reorganize the energy sector, define the role of the (incumbent and new) actors and shed light on the future orientation of the region in terms of flexibility and storage targets. We further note that the Regions are competent in terms of scientific research in regard to their own competencies, hence including RES energy in Wallonia (Loi 08 août 1980, article 6bis). Decrees and Orders can touch upon most of the elements that were brought forward regarding the decentralization system.

In addition to the possibility of initiating a law, the competent minister has been attributed a diversity of tasks and competences touching upon the energy market per se. In regard to the 12/04/2001 decree on the organization of the electricity market in the Walloon Region, the distribution system operators are strongly controlled by the Government, hence the Energy Minister. Accordingly, the government might fix complementary conditions related to the composition and decisional processes of the DSOs (Article 7), provide clarification regarding the rules on the transparency of the DSOs accounting information (Article 8 §2bis). Alienation of the distribution grid made by the DSO should be approved by the Government following inputs from the regulator (CWaPE) (Article 8 §4). The Government further sheds light on the missions to be followed by the DSOs, having to ensure exploitation, maintenance and development of the distribution grid while being reasonable in regard to social, technical and economic criteria (article 11). Hence, the Minister is responsible to provide the general guidelines to be followed by the DSOs.

## 6.2 Walloon commission for energy (CWaPE)

The regulator, the Walloon Commission for Energy, was created on the 12th of April 2001 by the here-above mentioned decree. It is the official organization which has the responsibility to secure the effective operation and good performance of the electricity and gas market in the Walloon region. Since the liberalization of the energy market in the early 2000s, the energy sector of the Walloon region involves many actors, including electricity providers, flexibility actors and distribution system operators as well as an important number of regulations. The CWaPE as the official regulating organ has a monopoly on the control and surveillance of the energy actors, especially distribution system operators, in regard to the Walloon regulations.

In order to accomplish this mission, the CWaPE has first a duty of transparency and protection towards the consumers, especially in regard to the providers' tariff. They also pursue a general control and surveillance mission towards the distribution system operators (gas and electricity). Accordingly, the CWaPE verifies that the DSOs respect the ministerial decrees and orders. Moreover, it offers a service of mediation or conflict resolution between the different actors and embodies an adviser role to the public authorities. These missions arise from the objectives set in the article 43, §1er bis of the 12/04/2001 decree relating to the organization of the regional electricity market, and were further divided into specific tasks in the Article 43, §2 of the 12/04/2001 decree (See Appendix 6) (Région Wallonne 2001). More precisely, the CWaPE has the obligation to (translated from French);

(1) Promote a competitive and reliable market as well as an effective opening to the market for all clients and providers within the European Economic Area and guarantee appropriate conditions for the grid to function in an effective and reliable manner, taking into consideration long term objectives;
(2) Contribute to the implementation of reliable, safe, well-functioning, to the non-discriminatory access to the grid, to the amelioration of the energy efficiency as well as the development and integration of electricity from renewable energy sources and quality co-generation electricity and give new production capacity access to the grid, including through the elimination of obstacles that could hinder new actors in the market;
(3) Ensure that system operators and users of the electricity grid, including private closed grid and professional close grids, are inclined, in the short and long term, to enhance the efficiency of the grid and favor the market integration;
(4) Contribute to the insurance of a public and universal, high quality service in the electricity provision sector, and contribute to the protection of the clients and to the compatibility of the needed

mechanisms of data exchanges for the clients to be able to choose their electricity providers;

(5) **Promote the access and facilitate the participation of flexible resources.**

The 4 first missions were added through a modification of the 2001 decree dating from the 11th of April 2014. The 5th mission was added through a modification of the 2001 decree dating from the 19th of July 2018 which touched upon the methodology of pricing by the DSOs in the perspective of deployment of smart meters and flexibility.

Drawing from the article 43§2 of the 2001 decree, we will now unfold some more precise missions that the organization has to pursue in regard to the developing RES energy system. We highlight that these are not the mere competencies of the Walloon Commission for Energy but are the core elements to acknowledge in order to grasp the functioning of the renewable energy system in Wallonia. First, the CWaPE ensures that the DSO are fulfilling their own responsibilities (ensuring security of supply, safety for and development of the grid). Second, the CWaPE approves of the rules, contracts and general conditions imposed by the DSO on the electricity providers and users of the grid once one has been granted access to that grid or such access was modified. Third, this organization attributes the licenses to become an electricity providers or provider of flexibility services. Fourth, it has to approve the contract – or modification of the contract – between the DSOs and the providers of flexibility services. Fifth, the **CWaPE is entitled to decide of the pricing methodology for the DSO and approve the pricing decided by the DSOs.**

The Energy Commission exerts its authority to pursue these missions as an autonomous public organization being one distinct legal entity from the Region. Hence, it is not directly under the supervision of the government as it holds no tutorship. However, some control was applied through the presence of some government commissioners and through the designation of the executive committee by the government (12/04/2001 Decree, Article 47). This slight control of the government regarding regulatory duties should however soon be executed by the parliament in order to attune to the European guidelines which promotes the reinforcement of the energy commission neutrality (Preliminary draft decree from 19/07/2019 and Government decree from 04/04/2019 in CWaPE 2018).

Moreover, the CWaPE has been executing “non-regulatory missions” aimed at promoting green electricity, such as decided by the parliament and government. This mission consisted of delivering green certificate, subprime and guarantee of origins to renewable energy producers and responding to complaints regarding those subsidies. As a result from the governmental decree from 04/04/2019, following May 1st, 2019, this mission will be accomplished by the public administration (SPW DGO4), once more in response to the European Guidelines which encourages independence in regard to such processes (CWaPE 2019b).

## 6.3 Conclusion

To sum up, we have shown that the Walloon Commission for Energy has duties and competencies which are particularly relevant in regard to the renewable energy pathway to be followed. The regulator is an important adviser to the regulator and legislator in regard to the different decrees and orders that are to be adopted and implemented. It also has a central role in controlling the DSOs and impact the tarification system. The minister on the other hand might affect the plethora of elements that compose a decentralized energy system. It is however subject to restrictions, first in regard to the parliament who has to approve the decisions, second concerning European restrictions and third in regard to competencies that are left to the independent regulator, including grid tarification. Moreover, these two actors often interact regarding their policy-outputs. In the following chapter, we will shed light on the way incumbent and new energy actors have positioned themselves regarding the transition pathway.

# 7 Analysis of Walloon policies on renewable energy

As we discussed in the previous chapters, a renewable energy transition might take several forms. The energy system might become decentralized, with electricity production units being spread among citizens hence becoming active prosumers and cooperators. This could consequently grant the citizens benefits from the energy system and even have some agency on it. A decentralized renewable energy transition makes it possible for the energy system to become democratic, encompassing shared benefits and control among citizens. This would affect incumbent actors which historically beneficiated from these advantages. We hereby approach a deeper transformation of the society, with social, environmental and economic transitions being implied. In order to happen, a set of policies is necessary, touching upon technological and socio-economic stakes which would push forward a spread of production units, more flexibility in regard to the grid as well as storage facilities. These policies would also clarify the roles these actors will embody in regard to new missions created by the decentralization of the system.

We have previously mapped the interest of the incumbent and new actors, which has allowed us to situate them in regard to a (de)centralized pathway axis. We will now look into policy-outputs which are directly affecting the type of pathway the renewable energy transition of Wallonia is currently facing in regard to production units, share of benefits and control. Through such analysis, we will attempt to highlight which of the previously discussed interests are represented by those policies which ergo define the pathway being followed. As discussed with the three perspective on renewable transition pathways, many elements might affect this transition. Although we focus on the special interests of the new and incumbent actors, other techno-economic and socio-technical elements might be of importance. The contextualization previously provided grant us with sufficient knowledge to take these into consideration hence be critical of their possible effect.

In this chapter, we will first analyze policies that affect the number of production units being installed, referring to solar PV and onshore windmills. We will then analyze economic and regulatory instruments touching upon grid management. More precisely during these analyses we will contextualize and explain the policy-outputs before shedding light on the related position of the incumbent and new actors. Based on these elements and the interviews, we will see which actors were involved in the policy-process hence how the special interests of these actors might have influenced the transition pathway of Wallonia. Policy-outputs related to storage will finally be discussed despite not being analyzed regarding the actors' interests.

## 7.1 End of financial support regarding renewable energy installations

### 7.1.1 Background

**Net metering system**

There have been several financial support schemes regarding decentralized energy production units. First, the **net metering system** in place supports the solar PV production units. When households own photovoltaic installations two types of exchanges occur with the grid; (1) if they produce more than they consume, the electricity will be exported to the grid; and (2) when local production is insufficient to cover the household' consumption, they import from the grid. As of today, the energy billing reflects the consumption minus the production, hence net imports on a yearly basis. In that sense, the prosumers use the grid as a storage facility when they do not auto-consume their electricity, yet they do not contribute to the grid financially and are not facing the physical reality of the production and consumption of electricity. This might be considered as a hidden economic support to solar PV.

**Green Certificates**

Second, renewable energy installations have been promoted through apparent supportive mechanisms as soon as 2008. The most important was a system of **green certificates**. Under this scheme, 7 green certificates were attributed for each MWh produced from a certified renewable source. These green certificates were then traded on the market, but with a price floor at 65€ and price ceiling at 100€ which led to an estimated direct support of 588€ per MWh produced (Gautier and Jacqmin 2018, 5). In 2011, this support was considered as too generous for **small installations** (<10kWc), and the end of the support as it existed was publicly announced. This has led to a boom of installation in 2012 and consequently to an economic bubble that reached up to a debt of €2,5 billion. The economic support was hence modified in a retroactive manner (GC to be granted for 10 years instead of 15) for installations below 10kWa, upsetting those who had invested in solar PV technologies believing they would benefit from such subsidies for a period of 15 years (Haveaux Christophe 2018a). This has profoundly affected the citizens faith in policy-makers which are now perceived as inconstant and unreliable.

The green certificates mechanism for **installations above 10kWc** (hence concerning cooperatives and RES industrial producers) continued to be a reality although being diminished. The logic behind such decision was that substantial investments are required for large scale installations; hence subsidies are still necessary. Through these subsidies, producers might gain 40€ to 100€ per MWh produced.

**Qualiwatt**

Following this profoundly instable green certificate system, a new subsidy scheme started on January 2014 for smaller produced (<10kWc), called Qualiwatt. This premium would be attributed yearly, for a period of 5 years to a pre-determined number of installations which are below 10kWc. This premium varied between 290€ and 628€ (Dauvister 2018).

### 7.1.2 End of Qualiwatt (<10kWa)

On September 2017, the Minister of Energy Crucke has appointed the Walloon Commission for Energy to provide an examination on the Qualiwatt subsidies scheme. In December 2017, the CWaPE has published their notice, highlighting that the installation under 10kWa are economically profitable without subsidies. PV installation are now 30% less expensive and more performing that in the past. Consequently, the rate of return for PV installation <10kWc lies between 7,3% and 8,4% without subsidies. After pointing out to the liberal perspective of the energy minister' political party, the deputy head of cabinet during an interview has claimed that (translated from French) "we will not support a sector that doesn't need to be supported". The CWaPE nevertheless raised concerned about the psychological effect that the end of such subsidies could have on the potential prosumers (CWaPE 2017, 13). This insight was sharply criticized by the deputy head of cabinet who found inappropriate for the regulator (CWaPE) to take psychological concerns into consideration. Thus, regardless of that warning plea, the energy minister decided on December 2017 that subsidies under the Qualiwatt scheme shall end as soon as the 30th of June 2018, guaranteeing non-retroactivity for those having installed solar PV beforehand. Indeed, the ministry insisted strongly on the need to avoid retroactivity as opposed to the green certificate's controversy.

### 7.1.3 Diminution of green certificates (>10kWa)

In regard to bigger RES installations, there are still to be supported by the green certificate scheme. However, this support has decreased over the past years and is likely to further diminish as the government has, on the 31st of January 2019, approved a project affecting the number of green certificates to be allocated. The legality of such decision is now being analyzed by the Council of State (Di Antonio 2019).

### 7.1.4 Actors' perspective

**Incumbent actors**

The deputy head of cabinet noted that most actors were agreeing with the decrease of subsidies regarding renewable energy production and more particularly with the end of Qualiwatt, precising that the "pole energy" had a relatively approving stand on the issue (following a few arrangements made with the construction actors).

Both the head of public affairs of Engie-Electrabel and EDF-Luminus accordingly agreed that as soon as a sector is profitable without subsidies, there is no need to further support it with public money. Nevertheless, they mentioned that the other lesser apparent form of subsidy (compensation scheme through the net metering system) is much less coherent than a visible form of subsidy such as Qualiwatt. They have both highlighted the inappropriateness of the net metering system, with the head of public affairs of EDF-Luminus also highlighting that the net metering negatively impacts providers financially. Engie-Electrabel mentioned that they would have encouraged the keeping of subsidies such as Qualiwatt if other invisible subsidies (compensation system) were taken to an end, pointing out to the non-virtuous prosumer behavior encouraged by this mechanism. They themselves still beneficiate from subsidies for large projects.

As for the DSO Ores, they have stated that they did not wish to intervene in discussion on subsidies as they are "political stakes". In the case of Qualiwatt premiums, DSOs were nevertheless involved as they are the ones assigned with the administrative tasks of providing prosumers with the premiums, yet they claim to not have had a strong opinion about it.

**New actors**

The president of APERe equally argued that such subsidies was needless as the project have become profitable without additional support. The barriers to investment are minor as the cost of a middle-sized installation went from costing 35 000€ to 5 000€ in 10 years. However, the communication around solar PV is quite negative among prosumers. Although the Energy Minister attempted to have a positive communication strategy – not through particular policies but personal communication of the ministry –, the overall perception in society is that benefits of solar PV are unstable. This would also be due to the fact that the federation TPCV ("don't touch my green certificates") dominate the prosumer perspective. In that sense, their movement (regardless of the legitimacy of their claim) is starting to have negative repercussions. As mentioned by the deputy head of cabinet, the prosumers federation "TPCV" criticized the minister decision to put an end to the Qualiwatt subsidies. Although this decision does not have retroactive effects, this further exacerbate the unstable support to prosumers which worries and outrage them. During a political debate, TPCV further expressed their skepticism regarding the fact that consequent subsidies (green certificates) were still given to bigger installation when premiums are now refused to them (A votre Avis 2018). What is more, during the general assembly of 2017, the president of TPCV demonstrated a certain opposition to the possible end of the net metering system (ASBL TPCV 2017).

As for the citizen cooperatives which are still beneficiating from green certificates, an engineer at Courant d'Air has noted that the support mechanism was sufficient as of today, although it could be financially improved to facilitate cooperatives in Wallonia (through a modification of taxes scheme for instance). A green association called "Inter-Environnement Wallonie" has nevertheless noted that the lowering and shortening of the financial support for wind production is negatively affecting the citizen cooperatives which are lacking cash whereas bigger operators and producers are favored (Inter-environnemt Wallonie IEW 2019).

### 7.1.5 Results

It appears that the decentralized renewable production units should not be affected too negatively by this policy-output as it remains financially coherent to invest in PV and wind installations. Although several actors seem to have participated to the political discussion regarding this decision (through the pole energy for instance), the decision was taken based on a liberal perspective: “something that is profitable should not be subsidiarized”. This decision did not provoke massive opposition from the different actors as all of them, other that the federation TPCV, considered that decision to be coherent. TPCV further reflects the “benefits” component of the transition pathway, as they solicit greater financial profits. The “control” element is not relevant regarding this political decision. What we might also conclude is that the communication aspect is core in the effect of such decision with the different actors reflecting on transparent and non-transparent ways to subsidy, citizen trust issues, psychological effects of the end of support despite profitability, etc.

# 7.2 Regulatory support for wind development

## 7.2.1 Background

A ministerial order dating from the 13th of February 2014 was first adopted on the “sectorial conditions related to the wind parks with a capacity equal or above 5MW”. This order was first and foremost adopted so as to clarify regulations on the acoustic standards which were often use by opponents of wind projects to judicially appeal against wind permits. These appeals to the Council of State inferred high costs for the wind projects as well as investment insecurities that hinder the development of wind installations. On August 2018, 24 projects (355MW) were on standby due to appeals (D’Hernoncourt 2018b). We note that the ministerial order was itself attacked by the association called “Vent de Raison” et “Eolienne à tout prix”. According to the European Law, these sectorial conditions should have been preceded by environmental impact assessments as well as a public survey. This Ministerial Order was hence cancelled by the Council of the State, yet it is to remain on application for a period of 3 years starting on the 24th of November 2017. Starting from that date, the Walloon government has three years to settle new sectoral conditions if they want to avoid further jurisdictional uncertainty regarding the delivering of permits (Gouvernement Wallon 2014).

### 7.2.2 Pax Eolienica

As a response to the lack of clarity in regard to the normative framework around the onshore wind production and in an attempt to bring citizen opponents and the public authorities together around this matter, the Walloon government has approved, on the 28th of February 2019 a "Pax Eolienica". This Pax was consequently designed so as to enhance the development and spread of wind production units. According to the deputy head of cabinet of the energy minister, the objective pursued with this Pax Eolienica was to gather the different elements that hinder the development of the wind production in one singular document. They have consequently identified 15 measures to counteract those barriers, in concertation with different actors. Quoting the deputy head of cabinet, they have involved "EDF-Luminus, Engie-Electrabel, FEBEC[2], EDORA, etc." and no other actors brought new elements or revendications once the documents was finished. As most of those barriers concern uncertain legal and regulatory elements which are used by wind projects' opponents to appeal to the Council of State, this Pax Eolienica would benefit both industrial and citizen cooperatives wind installations. Therefore, we won't go into details regarding these relatively technical measures. We shall however more precisely look into the 13th measure which touches upon the integration of citizens and municipalities/cooperatives and consequently particularly address the "new actor" category. Within this measure, the current energy minister claim to be willing to organize a workshop (at the end of the year 2019, hence after the political elections) on the creation of wind project in municipalities. Different themes should be discussed, including (translated from French):

*"a higher implication of local authorities and citizens in the projects, as well as the integration, in each new wind project, of a citizen and local cooperative with social purpose. Following a government proposal, the parliament has adopted a project decree-program on the 17th of July 2018. Several dispositions discussed the mechanism called "convention of ecological transition". This mechanism aims at constituting a new instrument, more flexible, faster and resting on a collective dynamic that allows the mobilization of different actors (...). Concretely, they suggest dispositions that favor the association of the public sector, including the organisms representing the municipalities and the associative sector as well as representatives of consumers".*

[2] Belgian federation of the main industries

When asked how these measures and ambition regarding the involvement of citizens and cooperatives in wind projects would be unfolding, the deputy head of the energy cabinet responded in an interview (translated from French):

*"There were two possibilities. We could have either forced, through a decree, that every wind project, or RES project in general, would be hybrid, hence involving both private and public actors. We didn't choose this possibility since there is a paper, called Belgian Constitution that highlights freedom of association. So, a decree on this would be a constraint, it would be constraining citizens, shareholders, citizen to get together. This is anti-constitutional and a freedom-destroying law. Although it was encouraged by other political parties. So instead we oriented ourselves towards a more virtuous shareholding partnership. (…) One windmill is 3 million euros, a wind park is 6 windmills, so a total of 20 million euros. It is not with citizens around the table that you find this amount of money. You need to put industrial actors around the table, and then you can add public holdings, citizens, municipalities, and so on ".*

Hence, there seem to be some ambiguity in the way the energy minister wishes to involve the citizen. It seems that they mainly wish to integrate citizens and cooperation in a way to avoid citizen opposition to hinder the project meanwhile they encourage the control and benefits of wind renewable energy production to be kept by main industries. This reflects the stands of producers (Engie-Electrabel and EDF-Luminus) regarding the transition pathway they encourage.

Moreover, through the last measures the government reaffirm its willingness to gradually put an end to subsidies (green certificates) which are perceived as becoming unnecessary for the development of wind production.

### 7.2.3 Actors' perspective

**Incumbent actors**

More precisely, regarding the Pax Eolienica, the head of public affairs of EDF-Luminus and Engie-Electrabel both agreed that the measures were good and relevant as the wind projects have been facing strong oppositions from citizens which have had negative impacts on investments. When such citizen opposition leads to judicial appeal to the Council of the State, they are themselves negatively affected in regard to their projects. Hence, they plead for the jurisdictional insecurity to be overcome as ambitioned through the Pax Eolienica. When more precisely asked what they thought of the cooperative aspects included in the $13^{th}$ measure, Engie-Electrabel highlighted that cooperatives were very "trendy" and helped combat the

NIMBY effect. The representant of EDF-Luminus further claimed that they would most gladly collaborate with cooperatives on wind projects and create a partnership. They however have some issues when cooperatives wish to lead a project on their own, hence fully evicting them from the project.

**New actors**

Having explored the different websites of the cooperatives as well as their provider and federation, no published perspective regarding the Pax Eolienica could be found. Nevertheless, ensuring a safe investment context for wind projects would be positive as new actors' projects would be safeguarded from opponents' appeal (D'Hernoncourt 2018a).

### 7.2.4 Result

In regard to the number of RES production units installed (here wind units), we note that the energy minister attempted to act upon the regulatory elements based on which opponents of wind project act in order to appeal and make projects obsolete. Although the measures suggested are praised by everyone, it appears that the one touching upon the citizen, cooperative and municipality participation is relatively weak and hasn't led to further action. This reflects the special interests promoted by the traditional energy producer and providers. It nevertheless sheds light on the "capital" argument, as the participation of main industrial actors is said to be mandatory if we are to experience a renewable energy transition. Means to favor and facilitate citizen investments are, however, not discussed in the Pax. On the contrary, they mention the decrease of green certificates for wind projects which, as previously discussed, would hinder cooperatives investments as opposed to the main producers (Inter-environnemt Wallonie IEW 2019).

## 7.3 Legislative decision on grid flexibility

### 7.3.1 Background

As argued throughout this research, the decentralization of the electricity system infers great changes for the grid. The need for flexibility and better load and demand management is necessary so as to ensure the integration of RES. This new model opens up for a struggle between the actors. It becomes necessary to clarify what role the different actors will have. As put by Francis Ghini, president of the

CWaPE between 2002 and 2017, the role of the principal actors used to be clear (producers, providers, distributers, DSOs,…) yet as the need for flexibility increases (beyond the industrial sector), new missions appear. The following legislation hence needs to fill a completely new area: define the different roles related to flexibility (Cech 2017). It is to face these new challenges that decrees on flexibility and collective auto-consumption were adopted.

### 7.3.2 Smart metering decree

On the 19th of July 2018, a project decree by the Energy minister Crucke was adopted by the Walloon parliament. It aimed at encouraging the deployment of smart meters and flexibility contracts. A smart metering system measures the consumption of electricity, gathers more information than a classic meter and might transmit and receive information and orders from away. The decree's goal aimed at framing the integration of this smart metering system and took into consideration multiple actors. The policy-process involved the Pole Energie, Synergrid, the CWaPE as well as the Commission for Private life protection.

Based on this decree, starting on the 1st of January 2023 the installation and activation of a smart meter will be systematic when technically feasible and reasonable. As of January 1st, 2029, DSOs must have installed smart meters for 80% of those who; (1) have a consumption of 6000kWh or more; (2) have a potential of electricity production off 5kWa or more; and (3) offer recharging terminal to the public. This smart meter should provide the grid user with real time information on the electricity consumed and injected on the grid. The CWaPE might eventually suggest the government to introduce measures that allow the combination of these meters with new services developed by the market. The development of smart meters is then to be assessed by the regulator and the distribution system operators should put in place a monitoring committee with representatives of consumers, union representatives, political parties (proportionally to the parliament) and electricity and services providers (article 35). Moreover the meter should provide information to the consumer who could access to its load history and corresponding tarification (article 35bis) (Moniteur 19/11/2018).

### 7.3.3 Decree on collective auto-consumption

After three readings, a decree on collective auto-consumption was agreed by the government on March 2019. It was then definitely adopted by the Walloon parliament on the 1st of Mai, 2019. According to the decree, several entities (natural of legal person) will be able to mutualize and synchronize their production and consumption of electricity within a defined geographical area. Several combinations are possible. For instance, one household with solar panels that produce more electricity than what is necessary might be able to associate with other households to cover part of their electricity needs. A residential building could install – in agreement with some of its residents and/or owner – solar panels and spread the production among the residents. Several enterprises could associate so as to spread their production and consumption during the day hence favor auto-consumption. A local authority could also install solar panels and allow  social tenants to beneficiate from low-cost electricity. Many more arrangements are made possible through this decree. According to the Walloon government, the objective pursued by the minister through this decree are to save investments that would be necessary to enforce the grid and to lower the consumer financial contribution to its development, to allow a better integration of renewable energy which are inherently intermittent, and finally; to favor the digitalization of the grid as smart metering will be necessary to participate in such association (Gouvernement Wallon 2019).

The legislation also clarified the role of the actors. Accordingly, the DSO will remain the depositary of the data and will eventually distribute it to the participants; the manager of the community, the community itself or residential electricity providers as they will need the information provided by the smart meters. During the third reading of the decree, it was also decided that DSOs could not manage such auto-consumption collectivities as this service should remain on the open market. According to one interviewee, during stakeholders' consultation on the matter, incumbent providers strongly lobbied to exclude the DSOs from this task meanwhile they attempted to be involved in the accounting activity, claiming that as liberalized actors they would work "faster, be more innovative and be less expensive".

Consequently, both these legislative decisions favor the technical decentralization of the electricity system, through an enhancement of flexibility and load management. Based on the insights provided by the interviews and different documents published by the stakeholders, we will now attempt to map the perspective of the different actors.

### 7.3.4 Actors' perspective

**Incumbent actors**

Drawing from their willingness to start offering services in regard to RES installations, the heads of public affairs at both Engie-Electrabel and EDF-Luminus introduced "intelligence" and "digitalization" as the prerequisite for flexibility services. Net metering are fundamental tools that are lacking as of today, hence they highly encourage and support the net metering and flexibility decree. It is necessary to be able to measure what is happening in terms of consumption and production of electricity. The smart metering which offers information per quarter of hours consequently empowers them in regard to flexibility services. As flexibility services provider, they will incentivize their clients to diminish or increase their consumption at certain moment in time through tarification changes for instance. Moreover, the shared auto-consumption decree will accelerate this decentralization at a retail level, which was impossible until today. We note that the collective auto-consumption decree allows for providers to become manager of the auto-consumption collectivities, which, of course, they fully endorse.

The responsible of public affairs at ORES further noted that electricity accounting is one of their core missions and is of great importance since it is used to calculate billing amounts. The current "yearly" accounting service lacks precision, therefore a transition to a more detailed accounting system is beneficial to them. In regard to the renewable energy transition, this smart metering system enables tarification measures that could also induce consumers into shifting their consumption regarding the availability of RES electricity, thus relieve the grid from intermittency stresses. Furthermore, smart meters and resulting data could be used to better understand and manage the grid as they might eventually find out where investments should be made or avoided. Accordingly, ORES stands in favor of the flexibility and smart metering decree. However, they had started to research and invest on smart meters and grids prior to legislation and some specific and technical decisions included in the late-coming decree negatively affected their previous investments. In order to manage the extensive amount of data in accordance with the other actors, they also need to operate on a new platform (Atrias project) which ORES believes to be available at the time of the smart meters' installation (2023) – according to the interview. The year 2020 was mentioned in the first decree of project regarding the installation of smart meters, but the year 2023 as decided through the 3rd lecture seems more adequate regarding this DSO.

The auto-consumption decree was also well received by DSOs. The responsible of public affairs at ORES expressed their encouragement in regard to this decree (translated from French):

*"we could even say we initiated it. We had a pilot project called E-cloud (...) we also felt the demand from our clients, they wanted to pool their electricity production. The distribution grid could not respond to this demand because the legislative framework didn't exist. There was a temptation towards close micro-grids which we first opposed. Then we thought about it and told ourselves we shouldn't oppose it, but it makes no sense since clients are already connected, we just needed to put something in place, a new market model that allows the clients to share their electricity while being connected to the distribution grid".*

As we see here, this decree is beneficial for the DSOs in the sense that it prevent their clients to disconnect from the grid they manage.

Through these new decrees the relationship between those incumbent actors are also changing. The DSOs happen to be excluded from being the manager of auto-consumption collectivity, yet they are the ones having access to the big data and making it accessible to the providers. Both the DSOs and the providers during the interviews praised the clarification of their role and highlighted their willingness to collaborate; the DSO as data repository and the providers as new management actors although during the stakeholder consultations they had lobbied in favor of a larger role for themselves.

**New actors**

Associations of citizens and prosumers strongly oppose the deployment of smart meters. They argue that the cost of such installation (€2,23 billion) should be invested in the enhancement of energy efficiency regarding the Walloon real estate, and that the prosumers would only be affected by disadvantages (incl. installation charges and changes in electricity bills). Even if the installation costs are partially covered by DSOs as, drawing from a report from the CWaPE a citizen defense association (CSCE) argued that the cost would eventually impact the tarification hence the final consumer billing. Furthermore, they raise concerns about health impacts and the possible threat to privacy. They further argue that such investment have shown to realize little to none energy savings in other countries with similar contexts, even if consumer have access to their load information (ASBL TPCV 2017; Lismond-Mertes 2018).

According to the president of APERe, smart meters themselves do not offer advantages to households. He acknowledges that citizens, associations, professionals and some politicians consider it as being intrusive and expensive – although these arguments might be counteracted. He asserts that smart metering is a tool which is not inherently good or bad but if we do present smart technologies as the actual objective, the confusion it infers for citizens is understandable and legitimate as it doesn't appear to offer them advantages. Smart meters are just a tool, what matters is how they are used and such use benefits. APERe argues that (translated from French):

> *"smart metering is a simple device, which should open up for new economic model, to the benefice of citizens" and this could be done through collective auto-consumption (Wilkin 2018).*

Accordingly, the collective auto-consumption would be beneficial for prosumers and eventual prosumers-to-be as they would produce energy and collectively beneficiate from electricity that is cheaper than on the market. We note however that many ministerial orders will need to be passed in order to ensure inclusive and efficient collective-auto consumption projects. Addressing the political candidates for the May 2019 political elections, APERe through the 6th measure of their memorandum states that elected candidates shall:

> *"Ensure that the role of manager of an auto-consumption collectivity remains open for every type of actors, any natural or legal person, being public or private, including to municipalities, public service commission, schools, etc." (APERe 2019a).*

The president of APERe during an interview noted that many actors could enter this "new game" as the electricity paradigm completely changes through. Although many could perform these new tasks, so far it seems that only incumbent actors are aware of this and struggle to be recognized by the legislation as the new core actors meanwhile citizen cooperatives such as COCITER grapples to sustain itself in an activity with very little economic margin. Current and future prosumers seem to not have realized the gigantic role they could be playing in this new paradigm; they mainly stand as opponents instead of evolving into active actors. We note that in other countries where such projects are already implemented – such as

Germany or France, they might be led exclusively by citizen cooperatives (Gaiddon and Joos 2016).

### 7.3.5 Results

Both the metering and the collective auto-consumption decree seem to be favorable for incumbent energy actors. Beyond being intrinsically beneficial to them, they also entail elements that are more precisely suiting their capacity. Indeed, as the decentralization occur and new electricity services emerge, both need digitalization to meet their new duties. Since it was presented as an intrinsic goal without insights on the benefits it could bring to the citizens and prosumers, prosumers oppose their deployment, referring to cost, safety and privacy issues. The collective auto-consumption decree could associate this technology with a fair and inclusive system. This is yet to be materialized through additional policy-outputs. Yet it appears that benefits might mainly be spread among incumbent actors which have a dominant position, as opposed to new actors that are not yet aware of the transformation that is occurring. More precisely, the incumbent actors (providers and DSOs) have both lobbied to increase the extent of the role they could embodied within this decision. The decree has made clear that the providers could become managers while the DSOs could not, whereas DSOs safeguard the access to production and consumption data which can then be shared to other actors.

## 7.4 Grid tarification

### 7.4.1 Background

As previously argued, the tarification system in place in Wallonia is based on net metering system; one is billed as a result of his/her consumption minus his/her production, regardless of the use made of the grid. We also outlined that households were billed regarding the energy they purchase from a provider. Since prosumers purchase none or little electricity from the providers, their contribution to the grid as well as to the State diminish as well. Indeed, about 24% of the bill goes to the providers, 33% to the grid operators, and 42% to the State (CREG 2019). As we have previously mentioned, the expansion of prosumers entails financial losses to the grid operators, including DSOs. In order to offset such deprivation and in line with the tarification rules which were jointly agreed with the CWaPE, the other consumers would be additionally contributing.

Moreover, many argue that deficient tarification system encourages a non-virtuous circle where prosumers are not aware of using the grid as a storage facility ergo they do not attempt to auto-consume at the time their installation abundantly produce electricity. A research has attempted to uncover whether or not Walloon consumers adapt their behavior once they have installed PV panels. It appears that 55% of the people interrogated produce as much or more electricity than what they consume. In case of surplus, 24% decided to acquire new electrical devices (mainly heating systems) while only 40% attempt to synchronize their consumption to their production of electricity. Hence, they have concluded that owning solar panels didn't necessarily infer virtuous consuming behavior – especially due to the fact that injecting electricity into the grid is exempted of pricing. In regard to the necessary flexibility, the research was advocating in favor of a different tarification that would reflect the service offered by the grid and hence encourage prosumers to auto-consume more in a synchronous manner (Gautier 2018).

### 7.4.2 Prosumer tarification

In order to counteract with this prosumers' non-virtuous behavior and to counterbalances the losses encountered by the DSOs while protecting the other consumers, the CWaPE has introduced a "prosumer tarification". This was included in the tarification methodology for the period 2019-2023, decided in July 2017 by the regulator (CWaPE). According to this new decision, every Walloon prosumer will have to financially contribute to the grid as soon as the 1st of January 2020. The tarification could materialize into two different terms of payment. In case of a simple meter, the prosumer would be assigned an annual cost depending on the capacity of the installation, hence this is called "capacity tarification" and is based on the assumption that a prosumer auto-consume 37% of its electricity as argued by the DSOs (Appendix 10) (CWaPE 2019a). If the prosumer has a double flow meters such as smart meters, the tarification could be proportional to the use made of the grid. We note that the DSOs were in favor of a capacity tarification, yet after a decision from the Justice Court of Liège, the tarification could only be enforced if prosumers have the technical possibility to install smart grids and beneficiate from a proportional tarification. Hence as soon as 2020 this tarification shall apply to every prosumer, regardless of the date of installation of their photovoltaic panels if the DSOs are able to provide such consumers with a double flow accounting system (such as smart meters) if requested (L'Echo 2018b). This is hence earlier than the 2023 date of installation prescribed by the smart metering decree.

In opposition to the "retroactive" effect of this decision, the energy minister Crucke has introduced a project of decree so as to exclude already existing installations from this tarification (MR 2019). According to the minister, the prosumers have acquired rights which shouldn't be disregarded. This project of decree had been transmitted to the parliament which then rejected it (Crucke 2019). Opposition deputies included the socialist and the green party. The European Directive 2009/72 set the regulator (CWaPE) as exclusively competent when it comes to deciding the tarification of the grid (including such prosumer tarification), hence such decree cannot be taken by the government (ASBL TPCV 2019) whose only competence regarding tarification is general guideline settings (Interview with ORES). According to the Deputy chief of staff of the energy minister, although the CWaPE as the regulator is an independent structure, this doesn't mean that it should act in a bureaucratic manner regardless of democratic appreciation. The cabinet wished some form of democratic control could be exerted on the regulator. They recall that both the 'electors' and the FEBEC members wish to have a stable climax which would favor investments. Therefore, such decision is perceived as highly unfortunate. Moreover, the cabinet does not perceive the prosumer tarification as a good solution in regard to the auto-consumption matter; they claim that it will just incentivize prosumers to overconsume even when not necessary in order to not inject electricity on the grid.

### 7.4.3 Actors' perspective

**Incumbent actors**

According to the deputy chief of staff of the energy minister, the prosumer tarification has been a long-lasting demand from the DSOs who will now be beneficiating from €50-60 million per year. Reflecting what has been previously argued, ORES stresses that this amount of money would have been raised regardless of the tarification; this amount would have been imposed on the other grid users. They hence belabor that this is not a measure that favors them but rather a measure necessary to ensure social justice. However, the head of public affairs of ORES did admit that this "increasing billing" to electricity consumers has created a negative atmosphere in regard to their other clients which they deplore. He also stated that the regulator's decision was taken following concertation within the "energy pole" within which they participated like every other actor and provided some more technical advices to the regulator, yet they claim not to be the instigator of this prosumer tarification.

The head of public affairs of producers Engie-Electrabel and EDF-Luminus consider the prosumer tarification as coherent since the prosumer is injecting and drawing from the grid freely, hence beneficiating from a service they do not contribute to. However, Engie-Electrabel do not believe the prosumer tarification to be the most coherent form regarding the objectives. The net metering itself (also called compensation) is deleterious, yet we keep it and add an additional cost for the prosumer. Hence their opinion is that it is coherent, yet completely wrongly designed. They further mention that it will not motivate a virtuous behavior which a more comprehensive, non-compensatory tarification could provoke. The head of public affairs of EDF-Luminus stated that this decision satisfies the DSOs and the other consumers, but the other part of the tarification system should also be taken into consideration. The underlying argumentation touches upon the fact that they are themselves impacted by the deployment of prosumers (translated from French):

> *"we understand this gesture which satisfies the needs of the DSOs so we think it was a good thing but they should have gone further and also change the other part of the billing system, which is ours".*

This further reflects the fact that to provide further flexibility services, ergo expend their role in regard to the decentralization, the tarification model has to be redesigned.

**New actors**

According to the president of APERe, the decentralized production today is so profitable that a margin could be used to invest in the grid and still remain profitable. Moreover, a contribution to the grid makes sense: the grid is necessary for a solidarity transition and is beneficial to the system as a whole as it integrates decentralized renewable energy production. Nevertheless, they argue that it is the net metering system that is wrongly designed and shoud be modified to make prosumers fairly contribute to the grid. This compensation scheme is inherently unsustainable and should be modified instead of adding such "pricing" to it. Although a contribution to the grid makes sense, the prosumer tarification is a "*plaster on a wooden leg*" whose only function is to maintain the viability of the current system and the industrial actors. It was designed to compensate losses experienced by DSOs. What is needed is a proper, comprehensive new tarification system based on a new market which acknowledges the services provided by the grid AND prosumers and would actually encourage virtuous behavior by prosumers. As discussed in their newsletter, APERe stated that a prosumer tarification designed by the regulator would lead to three perverse effects; (1) future prosumers could decide to install less PV panels than what is physically possible, or even decide to take off theirs; (2) prosumers might use more electricity than they need in order to avoid injecting in into the grid; and (3) this could create an even bigger divide between DSOs and prosumers when actions and collaborations are needed for an efficient decentralized transition (Wilkin 2016).

As for the prosumers which are directly concerned by this decision, they are vigorously opposed. The TPCV federation has appealed to the judiciary court which has decided, on the 23rd of October 2018, that the prosumer tarification would enter into force once the DSOs will be able to provide the prosumers with double flow or smart meters (Haveaux Christophe 2018b). We note that TPCV had already appeal to the court of Liege in 2015 in regard to a decision taken by the CWaPE regarding the 2017 tarification. Already then, the regulator had attempted to introduce a tarification on the electricity withdrawn from the grid by prosumers. TPCV won the first trial. The CWaPE then appeal to the Court of Cassation of Brussels which broke the first decision from the Court of Liège (Cour de Cassation de Belgique 2018) which consequently led to the prosumer tarification as we know it today. As we observe, the opposition of TPCV and prosumers regarding such tarification has been strong and long-lasting. Moreover, the president of TPCV argued, during their 2018 General Assembly that citizens have paid for the grid all throughout its installation since it was financed by municipalities which had consequently used taxes to invest in it. They note that this investment had already led to a 200% return on investment for municipalities. Ergo, they strongly opposed having a role in financing the grid once more because of a decentralized RES transition. What's more, TPCV strongly oppose retractive decision which the prosumer tarification is considered to be (ASBL TPCV 2017).

### 7.4.4 Results

Policy instruments should be put in place so as to encourage more coherent behavior regarding the electricity production and consumption of prosumers. One financial instrument designed to respond to such challenge was the prosumer tarification. Through the net metering/compensation system currently in place, prosumers do not pay for the “storage” service that the grid provides. One study has shown that prosumers do not necessarily attempt to auto-consume once they install PV panels. Moreover, this has a side effect: as prosumers stop consuming electricity, they stop contributing to the grid. Because DSOs needs income, the bills of their other clients increase, hence leading to social injustice. In order to respond to both these issues, the CWaPE, in accordance with the DSOs, has decided to set a prosumer tarification which would affect all existing and prosumers-to-be, ergo in a retroactive manner. Beyond the DSOs who obviously beneficiate from greater income and prosumers through the TPCV federation who publicly opposed such decision since they will financially contribute, we observe that one general stand appears. Most believe that the prosumer tarification makes sense in regard to the losses and the use made of the grid, nevertheless a more comprehensive tarification should be designed so as to actually integrate the overall decentralized production’s advantages and inconvenience. This policy output hence doesn’t serve its role. It doesn’t lead to a fairer tarification that benefits simultaneously DSOs, prosumers, overall citizens and providers. Both the President of the CWaPE and the head of cabinet of the energy minister have mentioned the lack of time to concretize a proper new tarification which should be designed for the following tarification period – 2024-2029. In regard to the transition pathway, we note that this decision hardly encourages the spread of decentralized units nor a proper gestion of the grid. The amount of RES electricity injected might decrease – due to lesser installation of PV units and perhaps unnecessary consumption. It might also ensure a longer subsistence of the grid as it exists today, hence this does not encourage further flexibility nor enhanced grid management. Furthermore, the benefits are simply oriented towards the DSOs meanwhile the prosumers and other electricity consumers are stripped from the benefits a proper market and adapted tarification could bring. The control of the grid remains in the hands of DSOs. Nevertheless, as a response to this tarification prosumers might be willing to disconnect from the grid and become self-sufficient through the use of batteries.

## 7.5 Storage facilities

As demonstrated during the contextualization chapter, storage technologies are still immature. Support from Wallonia hence mainly consist of financial aid through call for projects. There are different financial instruments that promote the development of energy and environmental projects, including SRIW, SOGEPA and SOWALFIN. They endorse small, medium and large enterprises, depending on the quality of the projects. However, they do not necessarily support strongly innovative and hazardous investments (such as those required for storage R&D). To overcome this shortcoming, the Walloon government on March 2019, has decided to encourage the creation of a European Bank for Climate and to create a working group that would more precisely define the need for investments in Wallonia (Dreze and Crucke 2019).

Moreover, the Public Administration of Wallonia (SPW) finances R&D projects based on funds from the government. There have been 14 different calls for projects in energy sector from 2000-2016. Regarding batteries, they financed projects for a sum of €1 billion in 2004, €1,8 billion in 2011, €1,3 billion in 2013, €4 million in 2015 and €9 million in 2016. They also financed hydrogen projects for a total of €2,5 billion in 2013 and €8 million in 2015 as well as one pumped-storage projects for €3,6 billion in 2013. These projects have mostly been attributed to university research centers (SPW 2018).

Furthermore, the current energy minister has launched calls for projects regarding car charging stations (which could consequently encourage V2G although not being sufficient per itself) for a total amount of 768.517€ in 2018. Such call for projects will occur every year until 2022 in order to cover the supposedly electric car deployment in Wallonia.

Apart from the R&D support, there hasn't been changes in the legislative or regulatory measures regarding storage facilities. Through the interviews and analysis of the different actors' websites and published documents, it doesn't seem that strong stands evolved around policy-outputs regarding storage. Therefore, policy-outputs regarding storage will not be analyzed in regard to the actors' interests.

## 7.6 Overview of the policy-outputs analysis

Five distinct policy-outputs have been analyzed in this chapter, four of them coming from the energy minister and one from the market regulator. First, we have observed that putting an end or diminishing subsidies seemed coherent for most of the actors as renewable energy has become profitable on its own. Prosumers, (through their represented by TPCV), are the most affected and are opposed to this decision since their profits decrease. Nevertheless, the policy-maker had paid strict attention regarding the fact that this decision should not be affecting prosumer retroactively. The decision was hence taken on a liberal, profitability logic which was not controversial among the energy actors.

Second, we looked into Pax Eolienica. Its core aim is to favor the development of wind facilities through the establishment of a clear regulatory framework that would scale down legal proceedings against wind projects. It consisted of 14 measures, 12 of which related to the administrative and technical aspects of wind development and were praised by incumbent and new wind actors. The 13$^{th}$ measure however touches upon the involvement of cooperatives, citizens and municipalities into these projects. Although it came from benevolent intentions, it appears that in practice the involvement of citizen cooperatives is only encouraged so at to overcome the citizen opposition, regardless of democratic potential (spread of control and benefits). This perspective coincides with the incumbent providers' view on the matter. We also note that the 14$^{th}$ measure recall their wish to gradually decrease subsidies as production becomes profitable. However, citizen cooperatives would be more affected than industrial wind companies due to cash flow issues regarding investments. Cooperatives have highlighted their wish for fiscality arrangements that would ease their investments.

Third, the smart metering decree set obligations of installation for distribution system operators, starting from 2023 (instead of 2020 as was primarily suggested). Both DSOs and incumbent providers welcome this decision since this should ease the grid and provide them with the necessary information to enhance flexibility through tarification incentives, for instance. Prosumers on the contrary dread this decision as they point to economic, health and safety shortcomings. As demonstrated by the literature review, smart metering (leading to smart grids) is a great way to integrate decentralization production into the energy system. According to APERe, although smart metering could lead to more desirable system, it might not necessarily be the case. Because smart meters are only an instrument, what matters is what it is used for.

This brings us to the fourth policy-outputs: collective auto-consumption. According to APERe, this appears to be a good way to promote virtuous self-consumption behavior among a group of energy producers and consumers. It is hence positive in regard to prosumers and citizen cooperatives. It is also well-perceived by DSOs and electricity providers who are recognized by this decree as important actors; incumbent electricity providers might become manager of these collectivities meanwhile it reassures the DSOs regarding the fact that prosumers will not be disconnecting from the public grid which they own and auto-consumption should relieve some of the technical pressure that the grid experiences due to the intermittency of RES.

Fifth, the prosumer tarification was discussed. This was a direct response to the net metering system in place whereby prosumers use the grid as a storage system when they do not auto-consume without financially contributing to that service. In order to compensate the consequent DSOs financial losses (that would otherwise be attributed to the other consumer) and incentivize prosumers to auto-consume more, they decided to impose a tarification on prosumers. Prosumers are rationally opposing such decision, and even more so since it has "retroactive" effects which they absolutely disguise. All the other actors consider the decision to be rational, although the design of it is improper. Instead, they would encourage the development of a comprehensive tarification that actually reflect the services brought by all actors, including prosumers and DSOs. This stand was also shared with the head of the energy cabinet who acknowledged not having had the time, within their two years of activity to design such a large and disruptive tarification.

In the following figure (Fig. 19) we provide a summary of the different actors' interests together with the effect these policy-outputs had on them. Some elements of the policy analyzed go in favor of the special interest of the actors (in which case it is preceded of a "✓") whereas other elements might affect special interests' negatively (it will then be preceded by a "✕").

## Renewable energy transition pathway

Centralized ⟵⟶ Decentralized

| **Technical decentralization**<br>(production units, flexible grid and storage) | | |
|---|---|---|
| **EDF-ENGIE-ENECO:**<br>Invest in offshore and large production parks.<br>✗ Diminution Solwatt (affects less than cooperatives)<br>✓ Pax Eolienica (stability) | **DSO's (ORES)**: In favor but need grid investments and digitalization = high costs and lower revenues.<br>✓ Prosumer tarification | **EDF-ENGIE-ENECO**:<br>Decentralization will occur. Need to adapt and offer services, need digitalization.<br>✓ Smart metering<br>✓ Collective auto-consumption (as manager) |
| | **Prosumers:** In favor of RES production units and (individual) storage but controversy on digitalization.<br>✗ Smart metering<br>✗ End of qualiwatt<br>**Cooperatives**: Decentralization but large projects with shared electricity production. In favor of flexibility, storage.<br>✗ Diminution Solwatt (affects more than industrials)<br>✓ Collective auto-consumption<br>✓ Pax Eolienica (stability) | |
| | | **APERe:** In favor RES production units, flexibility, storage.<br>✓ Smart metering (but needs to be used so as to beneficiate society, not necessarily the case)<br>✓ Collective auto-consumption (good in association with smart meters) |

| **Control** | | |
|---|---|---|
| **EDF-ENGIE-ENECO:**<br>Producers: Control of wind cooperatives.<br>✓ Pax Eolienica (13th measure only theoretical) | **EDF-ENGIE-ENECO:**<br>PV prosumers produce themselves, but they need services and management.<br>✓ Smart metering (as manager)<br>✓ Collective auto-consumption (have access to data and might offer flexibility services) | **Cooperatives :** Democratic management and own skills to ensure supply.<br>✗ Pax Eolienica (13th measure only theoretical) |
| **DSOs (ORES):** Have always had a monopoly on grid management, opposed to private grids.<br>✓ Collective auto-consumption (prosumers have to remain on the public grid to share their electricity)<br>✓ Smart metering (They have access to and control data) | | **APERe:** Citizens should have control over production and supply.<br>✗ Pax Eolienica (13th measure only theoretical)<br>✓ Collective auto-consumption (citizens could manage it themselves) |

| **Benefits** | | |
|---|---|---|
| | **EDF-ENGIE-ENECO:**<br>For wind and solar production - benefits to prosumers, cooperators and themselves.<br>✓ Collective auto-consumption (as manager)<br>✓ Smart metering (have access to data and might offer flexibility services) | **Cooperatives**: Costly investments but benefits should remain within society: with dividends to citizens, local employment, local projects, etc.<br>✓ Collective auto-consumption (benefits could remain within participants) |
| | **DSOs (ORES):** Prosumers need to pay for the use of distribution grid.<br>✓ Prosumer tarification (prosumer participate and PV still profitable for them) | **Prosumers:** Profitable for themselves. Benefits cannot be affected retroactively.<br>✗ End qualiwatt (not retroactive but less income)<br>✗ Prosumer tarification (retroactive) |
| | | **APERe:** Entire society could benefit if tarification well designed.<br>✗ Prosumer tarification (makes sense but not well designed) |

Figure 18: Actors' interests and policy-outputs in regard to the renewable energy transition pathway

# 8 Conclusion and discussion

*"While the transition away from fossil-based resources is an important component of the fight against climate change, what is often overlooked is the centralized ownership and control of electricity generation by corporate and state actors. This ownership scheme overwhelmingly favors electricity generation for the sake of profit and growth instead of human and ecological realities. Meanwhile, those who are most directly impacted by the destructive elements of the electricity sector, namely community members and workers worldwide, are excluded from ownership and circles of decision-making. This lack of democracy in the economic and political realms is produced and reproduced daily by capitalistic social relations." (Mcmurtry and Tarhan 2016, for the CIRIEC congress)*

Renewable energy production has increased all over the world, as it did in Belgium over the past decade. Drawing from the literature, I have argued that such transition could follow a decentralized pathway, shedding light on technical and democratic components. Accordingly, decentralized renewable production units could be installed all over a particular territory so as to produce energy, and in this case more precisely electricity as we focus on wind and solar PV. This however implies that a grid that was conceived to distribute electricity on a unique and stable direction flow basis now needs to integrate electricity from intermittent sources at several entry points. This double-flow new scheme infers great challenges for the stability of the grid which then needs to adapt by means of grid reinforcement, load and demand management through digitalization and tarification, and so on. Storage facilities might also be developed and installed so as to limit the stability shortcoming created by intermittent renewable energy sources. Throughout the thesis, these are hence perceived as the technical components of a decentralized renewable energy transition pathway.

Moreover, such decentralized production also means that citizens who used to be mere recipients of the electricity commodity may now become producers themselves. This, by itself, leads to a complete shift of paradigm with new actors having the possibility to own and benefit from the energy system. These citizens could do so individually (prosumers) or jointly with a group of other citizens (citizen cooperatives or energy communities). We might wonder how the incumbent actors situate themselves regarding this shift of paradigm. In point of fact, a group of actors including electricity producers and providers as well as distribution system operators have been part of this system and beneficiated from it over the past decades.

Therefore, I wished to uncover where these new and incumbent actors situated themselves in regard to a decentralized renewable energy transition that touches upon technical elements, control and ownership as well as benefits components.

Drawing from the literature on energy transition, a certain transition pathway would be the results of the interaction between several elements, including technical, socio-technical and political elements. Accordingly, special interests as those of the incumbent and new actors might be exerting influence on the political sphere which would then affect the transition pathway to be followed. The political component is of core importance since the policy-outputs have a direct effect on which technologies will develop and be deployed as well as on the overall functioning of the system. Hence, by applying this theoretical perspective onto a precise case study (Wallonia), the aim was to shed some light upon the power interplay between actors hence explain some of the factors that hinder or encourage a particular pathway.

Before drawing a connection between the actors' interests and the policy-outputs, it was first necessary to have an overall understanding of the energy system from a technical, socio-technical and political point of view. Belgium is very dependent of fossil fuel imports to cover its energy needs. It also produces part of its electricity through nuclear production which is owned and managed by the two main energy producers and providers in Belgium: Engie-Electrabel and EDF-Luminus. A political – legislative – decision has however decided to put an end to such production by 2025. Hence, Belgium could benefit from producing electricity through its own resources, using solar PV and wind power production units. Both sources are now economically coherent as their levelized cost of energy has proven them to be cost-effective. As for the grid management related technologies, they now seem to be available, yet they are still to be implemented and improved. Storage technologies on the other hand are still either "niches" technology that are not mature or require further research ahead of being installed and implemented on a larger scale in Wallonia. The related R&D is however supported by manifold actors, including those belonging to the existing "regime". Such insights are necessary so as to understand why certain policy-outputs have been adopted, regardless of the influence of the incumbent and new actors. Moreover, the perspective of the actors might themselves be affected by the availability of such technology as will be demonstrated by the DSOs perspective on smart meters.

We then highlight that the development of renewable energy sources is highly exhorted on an international and European level. More precisely, the European Union encourages the deployment of decentralized sources of production and endorses a redistribution of ownership and benefits regarding such production. They encourage Member States to acknowledge and support cooperatives and citizens' role regarding the transition. Hence, the international political context doesn't seem to negatively hinder a decentralized transition pathway, on the contrary. The inherent complexity of the Belgian institutional design has, on the other hand, a negative influence on it. First, the federalist nature of Belgium inherently complexifies the decision-making process as climate change mitigation strategies have to be agreed in collaboration with other federated and federal actors. Regardless, the competencies of renewable energy belong to the regional entities which still has, at the end of the day, the power to decide on the renewable energy transition guidelines and legislation. Hence the negative consequence of the federalist nature of the country is mitigated. Second, the multi-party nature of the government and parliament strongly influences the adopted policy-outputs. Although this political aspect is not the focus of this research, opposition among parties have led to some controversies and modification in the policy-outputs. Moreover, we note that most of the policy-outputs analyzed originate from a liberal party which naturally affect their inherent logic.

Once having understood the overall landscape regarding the renewable energy transition, incumbent and new energy actors were analyzed. The first underlying and fundamental observation was that a renewable energy transition will occur, and the production units will be decentralized regardless of the interests and wishes of the different actors. This was conveyed by all actors interviewed and all documents analyzed. What remains to be defined is the way the intermittency nature of the renewable energy sources will be dealt with, and how the ownership and benefits will be distributed among the actors. *Reflecting on the interests of the actors, which policy-outputs were adopted and how do they eventually influence the transition pathway?*

Being aware that this renewable energy transition will occur in any event and that it will negatively impact their income, incumbent producers and providers of energy want to adapt. They want to provide services that are adapted to the new energy paradigm. This for instance includes flexibility services and management of shared production facilities. In that sense, even if they do not fully own the production infrastructures (domestic infrastructure), they still play an active role in its functioning. In regard to industrial energy cooperative they remain owner and manager. This brings up elements of “skills” and “capacity”. The energy system is known to be complicated, and a renewable energy system will be even more so. Hence, incumbent energy providers wish to provide services that citizen cannot or don’t want to accomplish themselves – according to the providers. In this system, they beneficiate from benefits along with the citizens. We can conclude that incumbent actors do not oppose the technical decentralization of the renewable energy system as they recognize that this phenomenon will occur regardless of their will. Hence, they aim at securing participation and benefits in this new system through the different policy-outputs that are adopted. These interests are first integrated by the smart metering and collective auto-consumption decree that make possible for incumbent providers to become core actors in the flexibility market-to-be. These decisions would appear to be coherent regarding the decentralized transition which would be favored by the skills, experience and capital that this category of actors has.

The distribution system operators’ stand on the matter lies in the fact that the decentralization requires them to fully modify their modes of operation. They need to invest massively in the development of the grid in order for it to integrate the intermittent renewable energy production. Meanwhile, they are affected by losses of income resulting from prosumers not being billed for the grid – although they use it to store their renewable energy production. Hence, their posture is paradoxical. They favor digitalization which will help the management of grid, yet the deployment of smart meters creates additional cost and reinforce the complexity of the system. Moreover, they don’t support the disconnection of prosumers from the grid, yet they are in favor of storage facilities that relieve the grid. They encourage virtuous shared auto-consumption behavior, but they don’t want private/parallel grids to be installed. Their stand is highly complex. They want to develop their services sufficiently for decentralized producers to be satisfied and remain on their – stable – grid meanwhile this leads to extensive costs, which should then be financed by decentralized energy actors to some extent – decentralized actors who then wish to disconnect from the grid.  The prosumer tarification emerged as a consequence of this.

Individual prosumers (often related to small PV installations) reveal their interests and claims through federations that emerged as opponents to losses of financial benefits that affected them. Indeed, as public subsidies decreased and were abducted from them in a retroactive way, they became vividly attached to defending their income. In that sense they oppose every decision that is or could increase their bills or decrease their direct or indirect profits. They dislike decrease of subsidies, are skeptical regarding smart metering that entails additional costs for them due to the installation and to changing energy tarification and are strongly against contributing to the grid. Hence, both the smart metering decree, the prosumer tarification and the end of Qualiwatt subsidies (although to a less extent since non-retroactive) upset the prosumers. Other prosumers might be thinking otherwise, yet they are not represented publicly in any ways. For instance, drawing from a public study, it appears that most respondents were in favor of adopting flexible behaviors so as to facilitate the development of renewable energy sources.

Citizen cooperatives on the other hand seem very much in favor of a decentralized system, in regard to technical but also democratic elements. Through the spread of large solar PV, wind and other form of technologies, they wish to develop citizen ownership and democratic control, reappropriation of the energy system and distribute benefits equally among participants, being citizens. This is also what the organization APERe promotes. This organization is however not "legitimate" in the sense that it is not representing citizens/prosumer or cooperatives per se, it is not a federation. Nevertheless, they are involved in the policy-process and argue in favor control and benefits being distributed among citizens. Citizens cooperatives as opposed to incumbent actors, are known to lack resources and be relatively weak, hence they pain at defending these interests on a macro level. This, once again, brings us to a discussion on capacities: They may not have the skills nor capital to lead a deep renewable energy transition. We observe that they are not directly affected negatively by policy-outputs other than through the decrease of green certificates subsidies. What is most obvious, however, is that nothing was put in place to encourage or reinforce them either. The 13$^{th}$ measure of the Pax Eolienica illustrates this claim perfectly, as well as lack of financial scheme that reinforces them as opposed to incumbent, cash flow resourceful actors.

Hence in regard to the research question "*Whose interests, among those of incumbent and new energy actors, are represented in the policy-outputs that affect* *the renewable energy transition pathway of Wallonia*?", three main findings can be drawn. First, the interests of the incumbent actors transpire from the policy-outputs whereas it is not the case for the new actors' interests. Second, the renewable energy system heads towards a technically decentralized transition regardless of the actors' interests. This change seems to be propelled by other factors, including international pressure, the end of nuclear production and the economic profitability of renewable energy sources. The *speed of the change* however might be hindered by path-dependency effects, yet this was not included in the research. Third, consequently the incumbent actors acted upon the distribution of ownership and benefits.

Theoretical insight might be used to discuss these findings. In regard to incumbent actors, we observe that the reason why they are so influential hence favored through some of the policy-outputs is that they are considered as resourceful actors. Accordingly, incumbent actors possess capital, skills and knowledge as opposed to citizens who are neither capable nor willing to accomplish the energy "missions" themselves. We note that this view corresponds to the liberal ideology and shallow ecology perspective of the minister that adopted these decisions, as discussed in the contextualization. The policy-outputs were decided pragmatically, without considering the inherent democratic contingencies of a renewable energy transition. As opposed to this stand, we did observe that citizens cooperatives wish to intervene, develop their own skills and gather aggregated citizen investment capital so as to be involved in the energy sector and consequently distribute benefits among citizens rather than to multi-national industrial actors. They relate to a deeper ecology position, with a restructuration of the current energy system (Naess 1973). Yet they aren't sufficiently resourceful so as to demonstrate or defend the merit of such perspective. Paradoxically, policy-outputs should start beneficiating and empowering these citizen-led initiatives so as to strengthen them hence allow them to show their capabilities. Through my research I do not wish to normatively assess these two perspectives, I do note however that the decisions reflected the shallow transition pathway, hence not contributing to a spread of ownership and benefits among the actors beyond what is inherently imposed by the technical transition, the underlying reason being that society as a whole will beneficiate from the incumbent actors action. We may then reflect on the combability of those two systems. Some authors who have brought governance issue in the center of the centralized-decentralized controversy have insisted on the incompatibility of the two pathways;

as the centralized path aims at satisfying growing energy demand through technological progress, the decentralized path demands for constraints and shared energy governance with direct citizen ownership control. According to such perspective, the transition is not characterized by technical choices but rather socio-political structure of the energy system (Lilliestam and Hanger 2016; Stirling 2014; Mitcham and Rolston 2013).

Drawing from this observation, we may now wonder whether or not policy-outputs that actively involve new actors and consider the interests of prosumers and cooperatives would favor a decentralized RES transition, with benefits and control going to all citizens. This opens up for a discussion on energy democracy in a broad sense, where citizen would actually play a role in the policy-process so as to promote a new energy system they fathom. We now need to distinguish citizen cooperatives – who allegedly encourage a spread of benefits and control to the benefits of society as a whole – to prosumers who are, as of today, only represented by federations that oppose decisions that infer losses for them, regardless of the impact it has on the overall society. In that sense, involving prosumers would not necessarily mean that a decentralized pathway (technically and democratically) would be favored. This could shed light on another structural issue: the lack of positive communication towards prosumers who do not necessarily perceive the broad and overall potential of a decentralization. For prosumers to be actively involved in the policy-process, this could mean having to reorient their discourse towards constructive critique and suggestions and embody societal interests in addition to theirs. This is also the discourse adopted by the incumbent actors who assert that they act on behalf of the common good by pursuing a renewable transition, even if they exert benefits from it.

To sum up, the renewable energy pathway followed (technically decentralized with benefits and ownership remaining partially or totally in the hand of incumbent actors) is not the mere results of special interests lobbied into policy-makers. It is rather the results of a complex interplay of actors that have attempted to demonstrate, with a pragmatic rationale that this was the most viable way to reach a renewable energy transition, with regards to technical and financial aspects. The new actors on the contrary did not manage to fully integrate their interests in the policy-outputs. In regard to prosumers, it appears that their interests weren't sufficiently oriented towards a renewable system that beneficiate the overall society. By remaining in negative criticism and defending their own interests regardless of the common good, they were set aside during the policy process. As for the citizen cooperative who actually encourage a deep technical and democratic renewable energy transition, they weren't sufficiently vocal nor resourceful so as to convince of the added value of a "deep ecology" based transition. Paradoxically, in order to become sufficiently powerful, they would need to be supported by policies-outputs.

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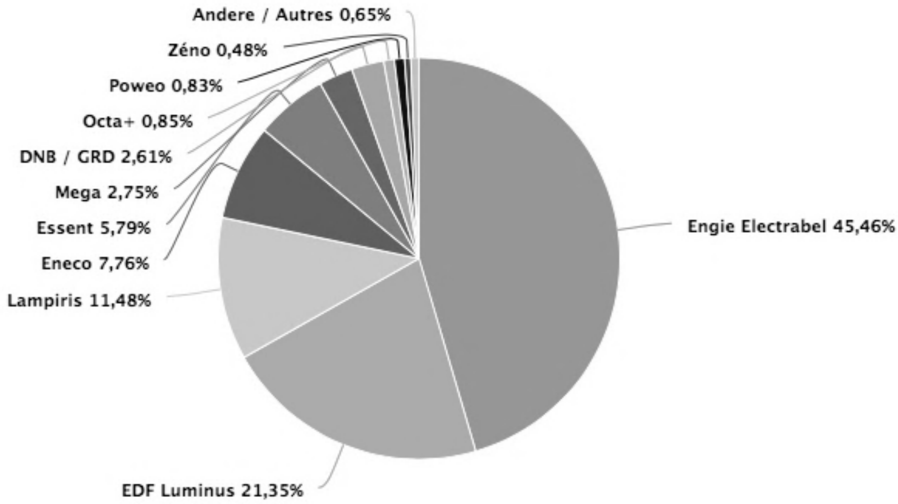
# Appendix

### Appendix 1: Renewable energy potential in Wallonia

| Source | Ressource énergétique annuelle primaire | Ressource énergétique annuelle finale issue de technologies actuelles |
|---|---|---|
| Soleil | 1 000 GWh/km² Variabilité: cycle jour et saison | Chaleur (basse t°): 100 - 500 $GWh_{th}$/km² Electricité : 50 - 200 $GWh_{e}$/km² |
| Vent (terre) | Dépend de la hauteur où est situé le rotor et la rugosité du sol Variabilité : cycle météorologique (dépression – anticyclone) | Electricité : 20-40 $GWh_{e}$/km² |
| Vent (mer) | | Electricité : 30 - 60 $GWh_{e}$/km² |
| Cours d'eau | Spécifique aux bassins versants Variabilité selon régime des pluies (régularité et intensité) | Electricité : 350 - 600 $GWh_{e}$ (Territoire belge) |
| Courants marins et vagues | A l'étude (Courant marin : 800 GWh/km²) (Vague 4-5 MW/km) | A l'étude (Elec - courant marin: 50-100$GWh_{e}$/km²). (Elec - vague: facteur de charge de 6%). |
| Chaleur naturelle (milieu ambiant : air, eau, sol) | Réservoir de chaleur renouvelée par le soleil et dérivés (vent, pluie) | Dépend de la taille de l'échangeur de chaleur, de la t° demandée, la t° de la source et de sa capacité de renouvellement. |
| Chaleur naturelle géothermique | Réservoir de chaleur renouvelée par un flux de conduction thermique des roches du sous-sol ≈ 0,110 W/m² (1 GWh/km²) | A l'étude |
| Biomasse | 6 GWh/km² (Energie stockée par photosynthèse dans conditions moyennes belges) | Chaleur (haute t°) : 3 - 5 $GWh_{th}$/km² Electricité : 1 - 2 $GWh_{e}$/km² |

Source: (APERe 2017a)

### Appendix 2: Share of the Walloon electricity market by providers




Source: (CREG 2018)

## Appendix 3: Interview guidelines

Producers/Providers/DSOs

- Wallonia seems to be experiencing a renewable energy transition. How do you foresee such transition? In regard to production units, grid development and storage?
- And more precisely, what do you think of a decentralized renewable production?
- How does this change influence you?
- Will you have to adapt to this new system? If yes, how?
- Are there barriers to the fact that you start accomplishing these new missions?
- What is your opinion on:
    - End of Qualiwatt, less subsidies
    - Prosumer tarification
    - Collective auto-consumption decree
    - Smart metering decree
    - Pax Eolienica
    - Recharging terminal, V2G, storage
- Do you feel involved in the policy process?

Public authorities:

On:

- End of Qualiwatt, less subsidies
- Prosumer tarification
- Collective auto-consumption decree
- Smart metering decree
- Pax Eolienica
- Recharging terminal, V2G, storage

- Why were these decisions adopted?
- Were there actors from the civil society with strong stands on the issues?
- Were actors from civil society involved in the policy process

New actors:

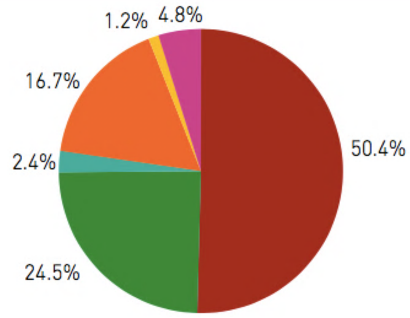
On:

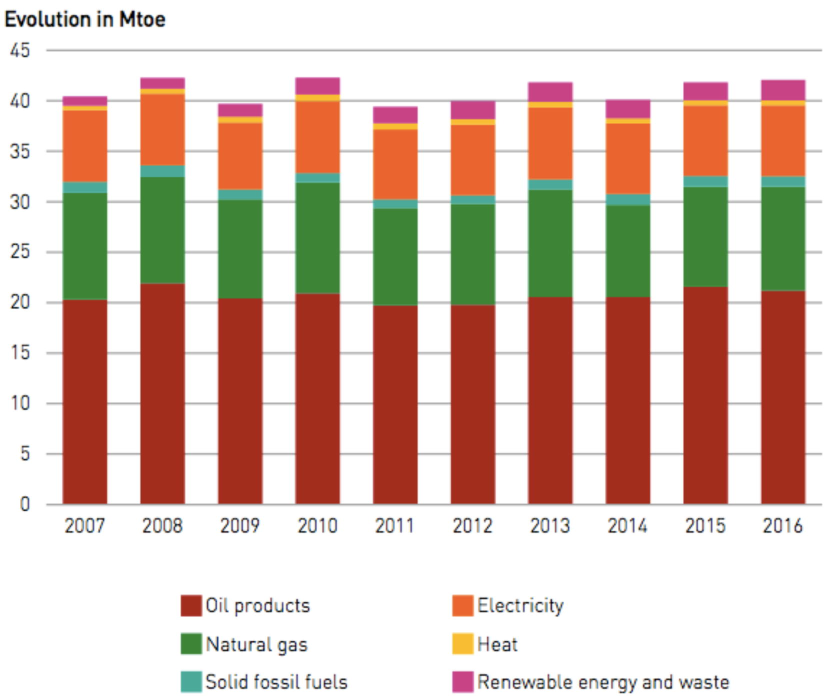
- End of Qualiwatt, less subsidies
- Prosumer tarification
- Collective auto-consumption decree
- Smart metering decree
- Pax Eolienica
- Recharging terminal, V2G, storage

- Is that decision in your interest/in the interest of prosumers and citizens cooperatives?
- Did the prosumer/cooperative get involve in the policy process?
- What do you think of these decisions? In terms of technical and democratic potential

## Appendix 4: Final energy consumption in Belgium in 2016 per energy source

| Energy source | Mtoe |
|---|---|
| Oil products | 21.2 |
| Natural gas | 10.3 |
| Solid fossil fuels | 1.0 |
| Electricity | 7.0 |
| Heat | 0.5 |
| Renewable energy and waste | 2.0 |
| **Total** | **42.1** |



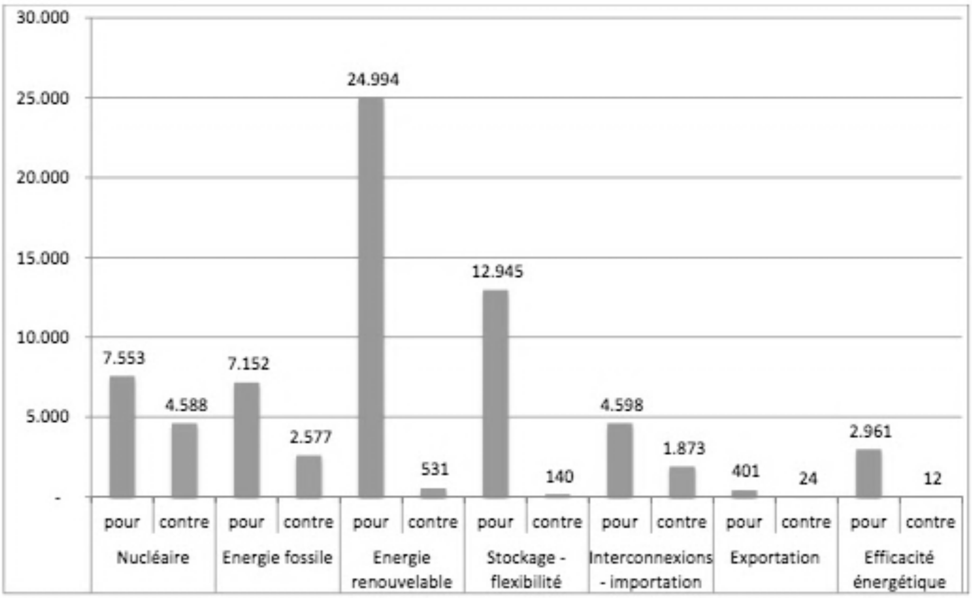

Source: (FPS Economy 2018)

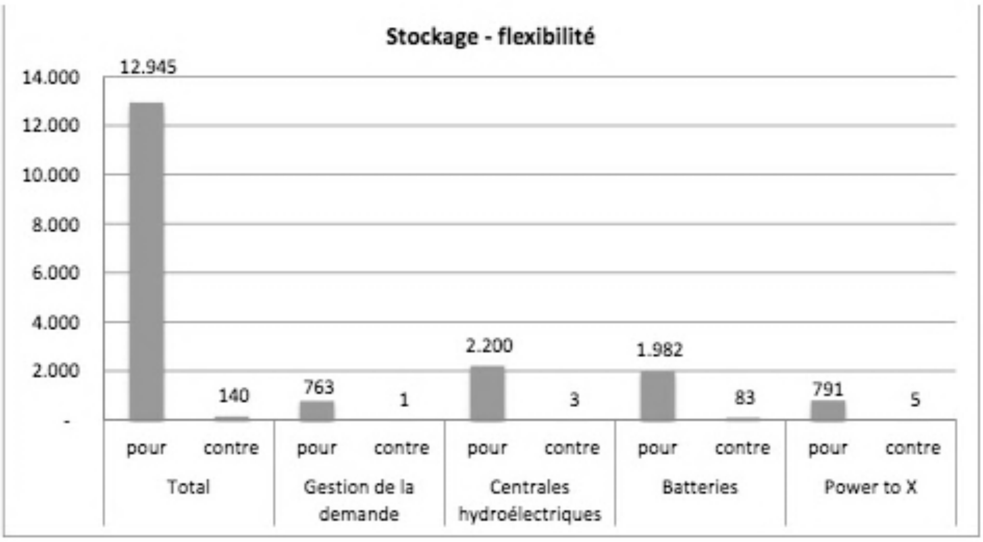
**Annex 5 : Public concertation on renewable energy transition for the Federal Energy and Climate pact**

QUESTION 3 : AUJOURD'HUI, ENVIRON 50% DE L'ÉLECTRICITÉ EST PRODUITE À PARTIR D'ÉNERGIE NUCLÉAIRE. LA LOI DE SORTIE DU NUCLÉAIRE MET UN TERME À LA PRODUCTION D'ÉNERGIE NUCLÉAIRE D'ICI 2025. L'ACCENT EST MIS SUR LES ÉNERGIES RENOUVELABLES ET LA FLEXIBILITÉ, MAIS POUR ASSURER LA SÉCURITÉ D'APPROVISIONNEMENT, DIFFÉRENTS CHOIX SONT NÉCESSAIRES. COMMENT CONCEVEZ-VOUS LE MIX ÉNERGÉTIQUE IDÉAL (EX. CENTRALES AU GAZ, IMPORTATIONS, PLUS D'ÉNERGIE RENOUVELABLE, STOCKAGE,...) ?

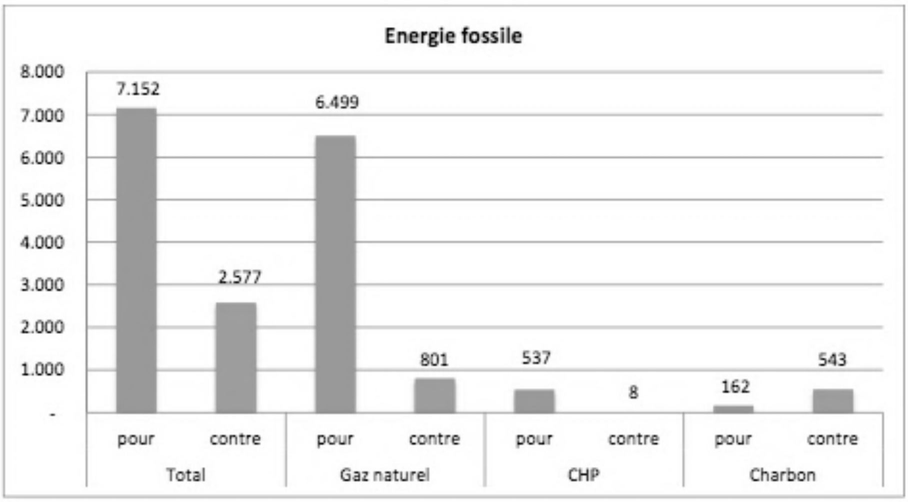
A cette question, 30.680 participants ont formulé une réponse. Les résultats sont repris ci-dessous.

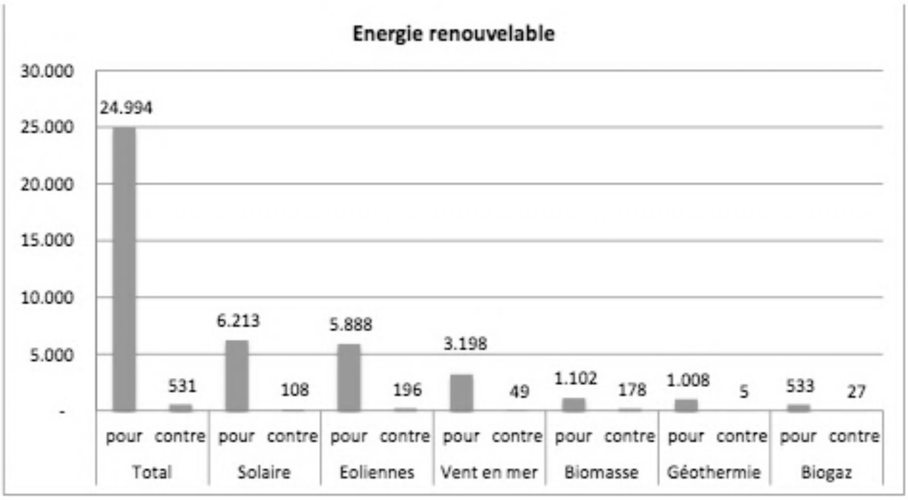
Nombre de fois qu'un thème a été cité :



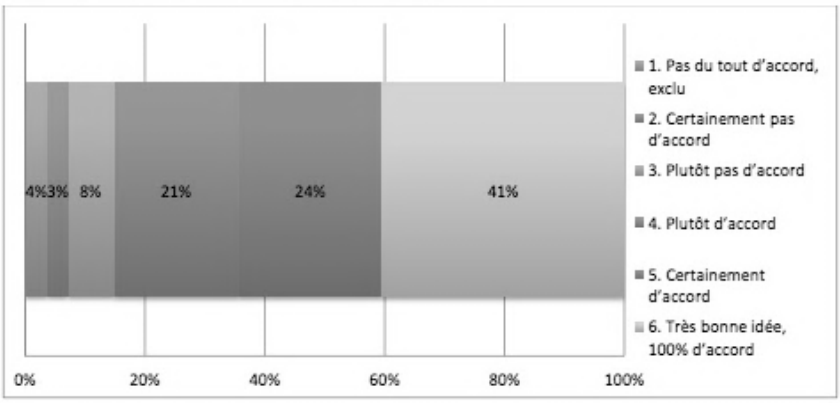
Certains thèmes ont été subdivisés en termes plus spécifiques. Le détail est repris ci-dessous :




## QUESTION 10-13 : DANS QUELLE MESURE ÊTES-VOUS D'ACCORD AVEC LES AFFIRMATIONS SUIVANTES ? LES POUVOIRS PUBLICS DOIVENT RÉCOMPENSER LES CITOYENS ET LES ENTREPRISES QUI INVESTISSENT DANS L'ÉNERGIE RENOUVELABLE ET LES MESURES D'ÉCONOMIE D'ÉNERGIE

Quelle est la répartition des réponses au niveau national ?



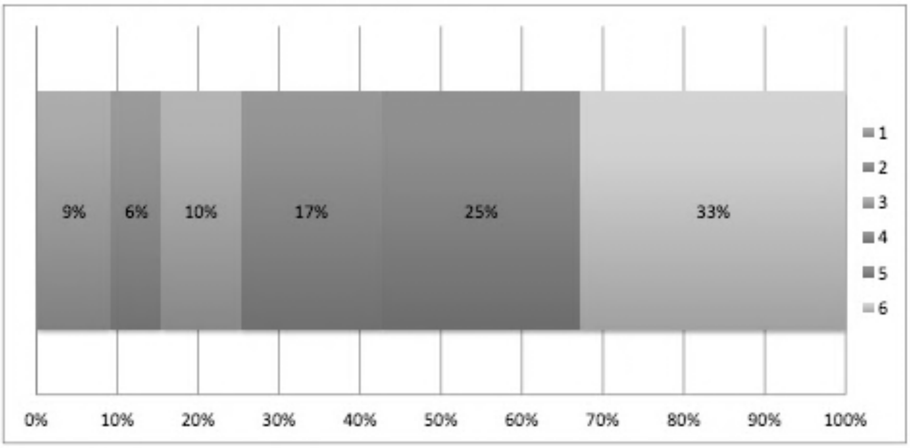

Nombre de réponses reçues : 30.828

## Question 4 : La vitesse de la transition énergétique est un enjeu considérable. Une vitesse plus élevée implique des coûts initiaux plus importants.

Indiquez sur l'échelle suivante la vitesse de la transition énergétique que vous préférez:

> Transition progressive (1): les investissements et les coûts augmentent progressivement, mais les bénéfices (en termes d'emplois et d'environnement) se feront un peu plus attendre
>
> Transition rapide (6): les investissements et les coûts sont élevés à court terme et permettent de profiter rapidement des bénéfices

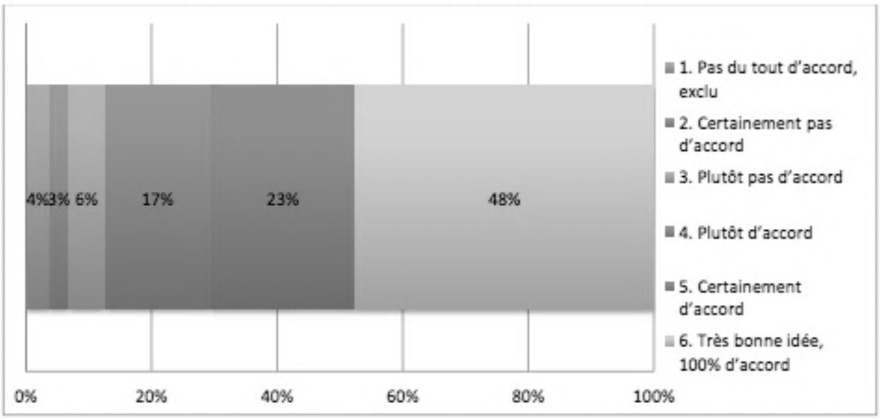
Quelle est la répartition des réponses au niveau national ?




Nombre de réponses reçues : 32.093

## Question 10-14 : Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes ? Soutenir les coopératives citoyennes relatives aux enjeux de la transition énergétique (ex. renouvelable, rénovation de quartier,....)

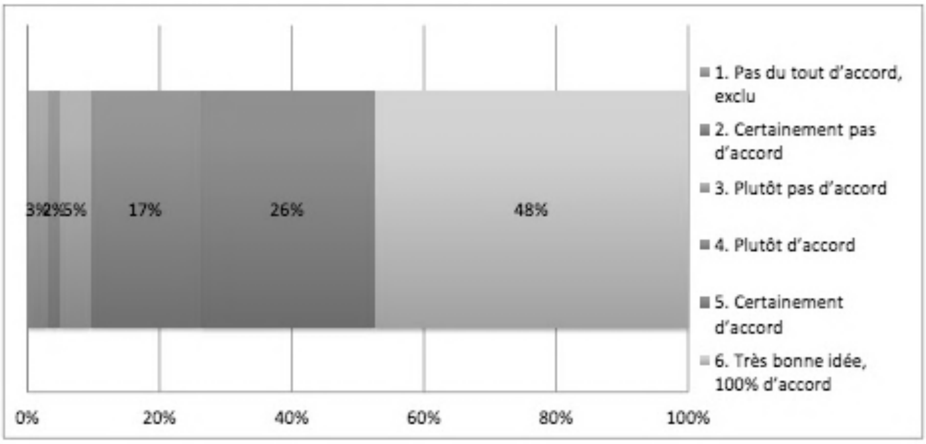
Quelle est la répartition des réponses au niveau national ?




Nombre de réponses reçues : 30.826

## QUESTION 11-01 : DANS QUELLE MESURE SOUHAITEZ-VOUS CONTRIBUER À LA TRANSITION ? JE VEUX AUSSI PARTICIPER PERSONNELLEMENT À LA TRANSITION ÉNERGÉTIQUE

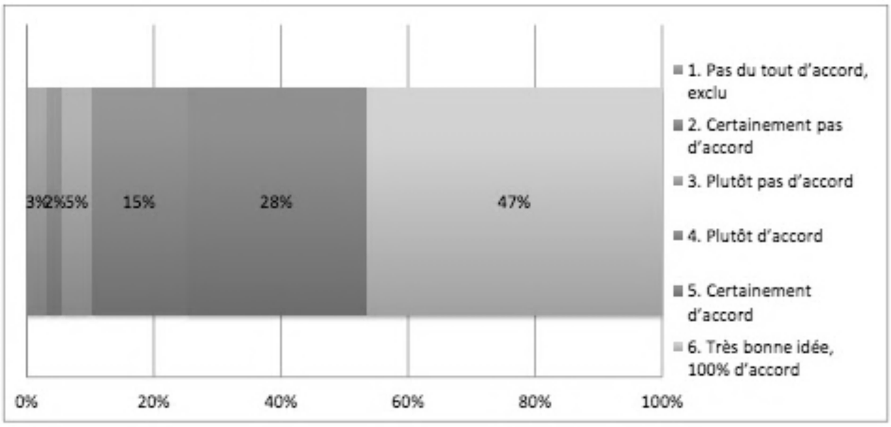
Quelle est la répartition des réponses au niveau national ?




Nombre de réponses reçues : 30.752

## QUESTION 11-04 : DANS QUELLE MESURE SOUHAITEZ-VOUS CONTRIBUER À LA TRANSITION ? JE SUIS PRÊT À GÉRER PLUS ACTIVEMENT / DYNAMIQUEMENT MA CONSOMMATION ÉLECTRIQUE

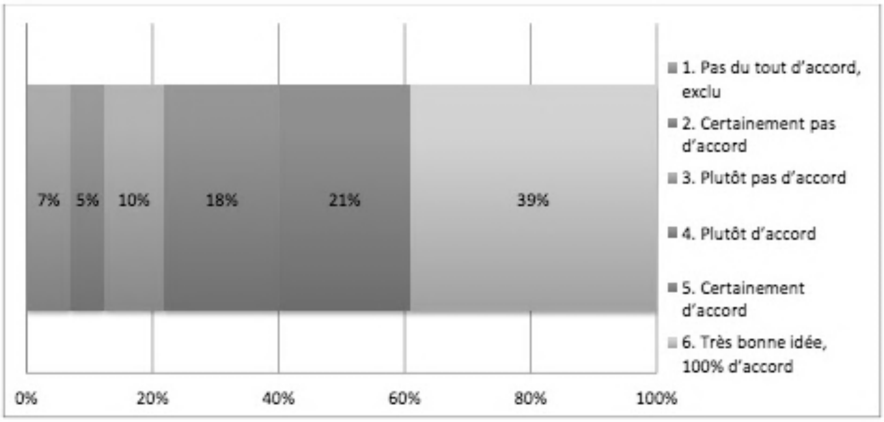
Quelle est la répartition des réponses au niveau national ?




Nombre de réponses reçues : 30.814

## Question 11-07 : Dans quelle mesure souhaitez-vous contribuer à la transition ? Je souhaite investir dans des projets d'énergie renouvelable dans le cadre de coopératives (panneaux solaires sur le toit d'un bâtiment scolaire, éoliennes, projets de rénovation)

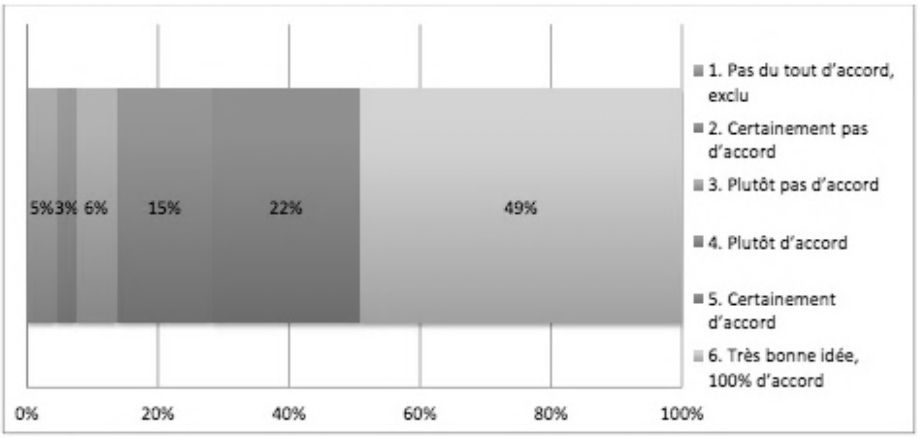
Quelle est la répartition des réponses au niveau national ?




Nombre de réponses reçues : 30.709

## Question 11-06 : Dans quelle mesure souhaitez-vous contribuer à la transition ? Je souhaite investir dans des projets d'énergie renouvelable dans ma propre habitation (panneaux solaires, chauffe-eau solaires)

Quelle est la répartition des réponses au niveau national ?

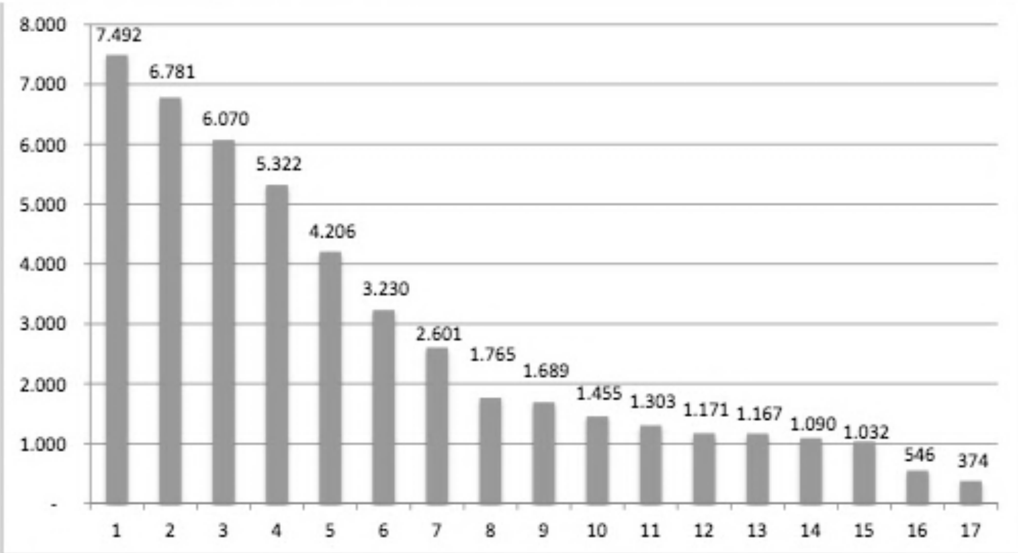



Nombre de réponses reçues : 30.693

## QUESTION 12 : QU'EST-CE QUI, POUR VOUS, DOIT IMPÉRATIVEMENT ÊTRE TRAITÉ DANS LE CADRE DE CE PACTE ÉNERGÉTIQUE?

A cette question, 23.470 participants ont formulé une réponse. Les résultats sont repris ci-dessous.

Nombre de fois qu'un thème a été cité :




| | | |
|---|---|---|
| 1 | **Sortie du nucléaire, énergie nucléaire, calendrier nucléaire, centrales nucléaires, nucléaire, centrales au thorium** | **7.492** |
| 2 | **Caractère abordable, prix, compétitivité, mesures fiscales, accises, subsides, le consommateur paie, mesures de soutien** | **6.781** |
| 3 | **Sources d'énergie pauvres en carbone, sources d'énergie renouvelable, énergie solaire, panneaux solaires, vent, éoliennes, offshore** | **6.070** |
| 4 | **Transfert de mobilité, véhicules électriques, rouler moins, transport en commun, tarification routière, voitures de société, voitures au gaz ou à hydrogène** | **5.322** |
| 5 | **Objectifs et vision à long terme (CO2), objectifs 2020, objectifs 2030, objectifs 2050, objectifs européens, accord de Paris, taxe carbone, trajet, approche, plan par étapes, planning ou vision réaliste, choix clairs** | **4.206** |
| 6 | Informer, sensibiliser le consommateur, changer les comportements, crowdfunding, participation dans l'économie, coopérations | 3.230 |
| 7 | Efficacité énergétique, appareils efficaces, isolation, PEB, norme énergétique, appareils intelligents | 2.601 |
| 8 | Réseau(x), micrograds, indépendant, production locale, production décentralisée | 1.765 |

Appendix 6: 2001 Law on the energy Market. Chapter related to the CWaPE

**CHAPITRE XI. - Commission wallonne pour l'énergie.**

**Art. 43.§ 1er. Il est créé une Commission wallonne de régulation pour l'énergie. La [3 CWaPE]3 est un organisme autonome ayant la personnalité juridique et ayant son siège dans l'arrondissement administratif de Namur.**

**[4 § 1erbis. Dans le cadre de ses missions, la CWaPE poursuit les objectifs suivants :**
**1° promouvoir un marché régional de l'électricité concurrentiel, compétitif sûr et durable et une ouverture effective du marché pour l'ensemble des clients et des fournisseurs de l'Espace économique européen, et garantir des conditions appropriées pour que les réseaufonctionnent de manière effective et fiable, en tenant compte d'objectifs à long terme;**

**2° contribuer à la mise en place de réseaux électriques sûrs, fiables, performants, à un accès non- discriminatoire au réseau, à l'amélioration de l'efficacité énergétique ainsi qu'aux développement et à l'intégration des productions d'électricité à partir de sources d'énergie renouvelables et de la cogénération de qualité et faciliter l'accès au réseau des nouvelles capacités de production, notamment en supprimant les obstacles qui pourraient empêcher l'arrivée de nouveaux venus sur le marché;**

**3° faire en sorte que les gestionnaires et les utilisateurs des réseaux d'électricité en ce compris des réseaux privés et des réseaux fermés professionnels soient incités, tant à court terme qu'à long terme, à améliorer les performances de ces réseaux et favoriser l'intégration du marché;**

**4° contribuer à assurer un service public et universel de qualité dans le secteur de la fourniture d'électricité, et contribuer à la protection des clients protégés et à la compatibilité des mécanismes nécessaires d'échange de données pour permettre aux clients de changer de fournisseur.]4**

**[6 5° promouvoir l'accès et faciliter la participation des ressources flexibles.]6**

**§ 2. [1 La CWaPE est investie d'une mission de conseil auprès des autorités publiques et d'une mission générale de surveillance et de contrôle. Elle exerce ces missions tant en ce qui concerne l'organisation et le fonctionnement du marché régional de l'électricité qu'en ce qui concerne l'application du présent décret et de ses arrêtés d'exécution. Dans ce cadre, outre les missions qui lui sont confiées par d'autres dispositions du présent décret, la CWaPE assure les tâches suivantes :**

**1° le contrôle du respect, par les gestionnaires de réseaux, [4 les gestionnaires de réseaux privés et les gestionnaires de réseaux fermés professionnels,]4 de leurs obligations imposées par le présent décret et ses arrêtés d'exécution,**

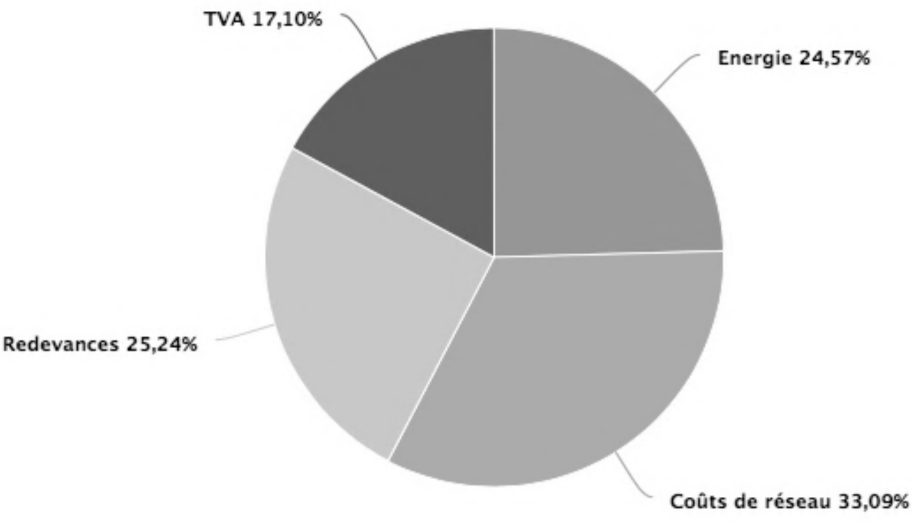
**notamment [7 le règlement technique; si les gestionnaires de réseaux]7 ont confié l'exploitation journalière de leurs activités a une filiale, conformément à l'article 16, § 2, le contrôle de la CWaPE s'exerce également sur cette filiale;**

**[4 1°bis la surveillance de la gestion de la congestion des réseaux, y compris des interconnexions, et la mise en oeuvre des règles de gestion de la congestion;]4 2° l'approbation des règlements [7 , contrats et conditions générales imposés par les gestionnaires de réseaux aux fournisseurs, aux utilisateurs du réseau et aux détenteurs d'accès à l'occasion, en raison ou à la suite d'un raccordement, d'un accès au réseau et de leurs modifications;]7**
**3° [6 le contrôle du respect des conditions à remplir pour être reconnu fournisseur ou fournisseur de services de flexibilité et pour pouvoir conserver cette qualité ainsi que l'octroi des licences de fourniture d'électricité et des licences de fourniture de services de flexibilité]6 4° le contrôle et l'évaluation de l'exécution des obligations de service public par les gestionnaires de réseaux [4 , les gestionnaires de réseaux privés et les gestionnaires de réseaux fermés professionnels]4 et les fournisseurs, si les gestionnaires de réseaux [4 , les gestionnaires de réseaux privés et les gestionnaires de réseaux fermés professionnels]4 ont confié l'exploitation journalière de leurs activités a une filiale, conformément à l'article 16, § 2, le contrôle de la CWaPE s'exerce également sur cette filiale; 5° l'établissement, le cas échéant, par voie réglementaire, de la méthode de calcul des coûts réels nets des obligations de service public et la vérification des calculs effectués par chaque entreprise concernée conformément à cette méthodologie; 6° le contrôle du respect des conditions émises pour les autorisations délivrées en vue de la construction de nouvelles lignes directes en vertu de l'article 29; 7° la détermination des informations à fournir par le gestionnaire de réseau [4 et, le cas échéant, les gestionnaires de réseaux privés et les gestionnaires de réseaux fermés professionnels]4, en vue notamment de l'élaboration des bilans énergétiques et [4 de l'élaboration des bilans énergétiques et des obligations de rapportage de la Région wallonne auprès de l'Union européenne en matière d'énergie]4;**
**8° le contrôle du respect des dispositions en matière de promotion des sources d'énergie renouvelables et de la cogénération de qualité;**
**9° l'octroi des certificats verts conformément aux modalités et à la procédure visée à l'article 38;**
**10° la détermination et la publication annuelle des rendements annuels d'exploitation des installations visées à l'article 2, 30, et des émissions de dioxyde de carbone d'une production classique conformément à l'article 2, 50;**
**11° la tenue d'une banque de données dans laquelle sont enregistrés les renseignements relatifs aux certificats de garantie d'origine des unités de production d'électricité à partir de sources d'énergie renouvelables et/ou de cogénération, ainsi qu'aux labels de garantie d'origine et aux certificats verts octroyés à ces unités de production, moyennant l'approbation du Gouvernement, la CWaPE peut déléguer la gestion de cette banque de données, le Gouvernement détermine le contenu de la banque de données, après avis de la CWaPE;**
**12° la coopération et la concertation régulière avec les autres régulateurs [4 au**

**niveau fédéral, régional et européen][4] des marchés de l'électricité, notamment en vue de vérifier l'absence de subsides croisés entre catégories de clients, ainsi qu'avec [[4] l'ACER et][4] toute autre autorité ou organisme belge, étranger ou international;**
**13° le développement de toute étude, outil ou démarche visant à améliorer le fonctionnement du marché de l'électricité, à faciliter l'exercice, par le client final, de son éligibilité et à tenir informé le Gouvernement du comportement des acteurs du marché et des consommateurs;**
**14° l'approbation des tarifs des gestionnaires des réseaux de distribution [[4] ainsi que, conformément aux articles 15bis et 15ter, les conditions de rémunération des réseaux privés et des réseaux fermés professionnels][4];**
**[[5] 14°bis l'exercice des compétences tarifaires, notamment la fixation de la méthodologie tarifaire et la surveillance et le contrôle de la mise en oeuvre des plans d'adaptation des gestionnaires de réseau, conformément à l'article 15, §§ 4 et 5;][5]**
**15° l'exécution de toutes autres missions qui lui sont confiées, par décret ou arrêté en matière d'organisation du marché régional de l'électricité.][1] [[4] 16° lorsque le GRD, ou la filiale désignée conformément à l'article 16, réalise d'autres activités que la gestion des réseaux électrique ou gazier, la CWaPE est habilitée à vérifier qu'il n'y a aucune subsidiation croisée entre les activités de gestion des réseaux électrique et gazier et les autres activités, à cette fin le gestionnaire ou la filiale est tenu de répondre à toute question ou demande de documents émanant de la CWaPE.][4][[6] 17° l'approbation des contrats type d'accès de flexibilité entre les gestionnaires de réseaux et les fournisseurs de services de flexibilité, de même que leurs modifications.][6]**
**§ 3. [[4] Pour le 30 juin au plus tard, la CWaPE communique au Gouvernement et au Parlement wallon][4] un rapport sur l'exécution de ses missions et l'évolution du marché régional de l'électricité. [[4] La CWaPE présente son rapport annuel au Parlement. Le rapport est publié sur le site internet de la CWaPE.][4].**

**(1)<DRW 2008-07-17/53, art. 58, 008; En vigueur : 07-08-2008, à l'exeption de l'art. 43, § 2, 14°, qui entre en vigueur : indéterminée>**
**(2)<DRW 2008-07-17/53, art. 59, 008; En vigueur : 07-08-2008> (3)<DRW 2008-07-17/53, art. 1,1°, 008; En vigueur : 07-08-2008> (4)<DRW 2014-04-11/23, art. 48, 020; En vigueur : 27-06-2014> (5)<DRW 2014-04-11/23, art. 48,10°, 020; En vigueur : 01-07-2014> (6)<DRW 2018-07-19/38, art. 25, 032; En vigueur : 16-09-2018> (7)<DRW 2018-07-17/04, art. 139, 033; En vigueur : 18-10-2018>**

**Appendix 7: Composition of the electricity price for households in Wallonia**




Source: (CREG 2019)

# Appendix 8: Financial exercice of the City of Charleroi 2019

CHARLEROI
DIRECTION FINANCIÈRE

**EXERCICE :** 2019

CIC: VFP002
**No I.N.S. : 52011**

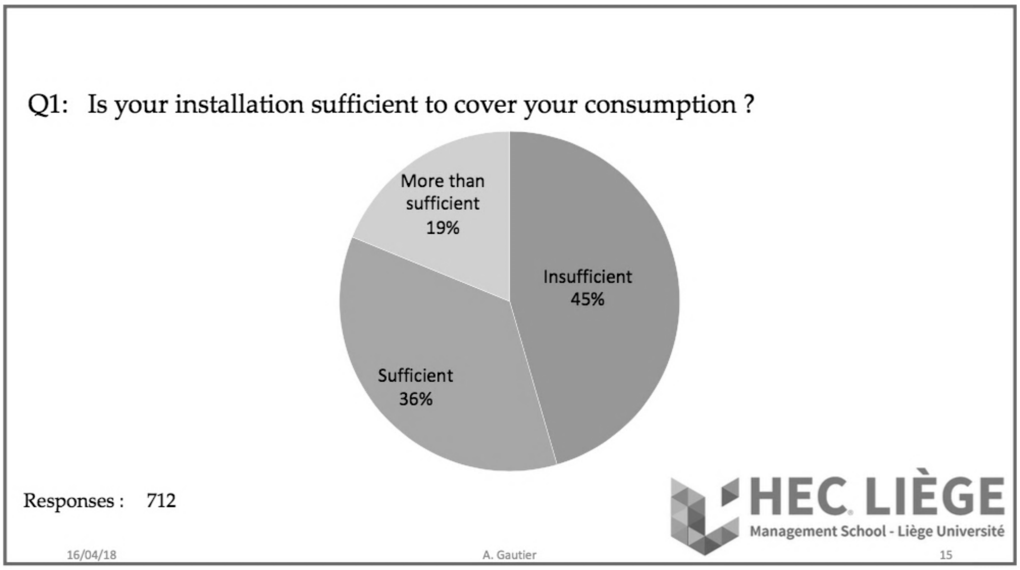
**EXERCICE PROPRE-RECETTES**
COMMERCE-INDUSTRIE

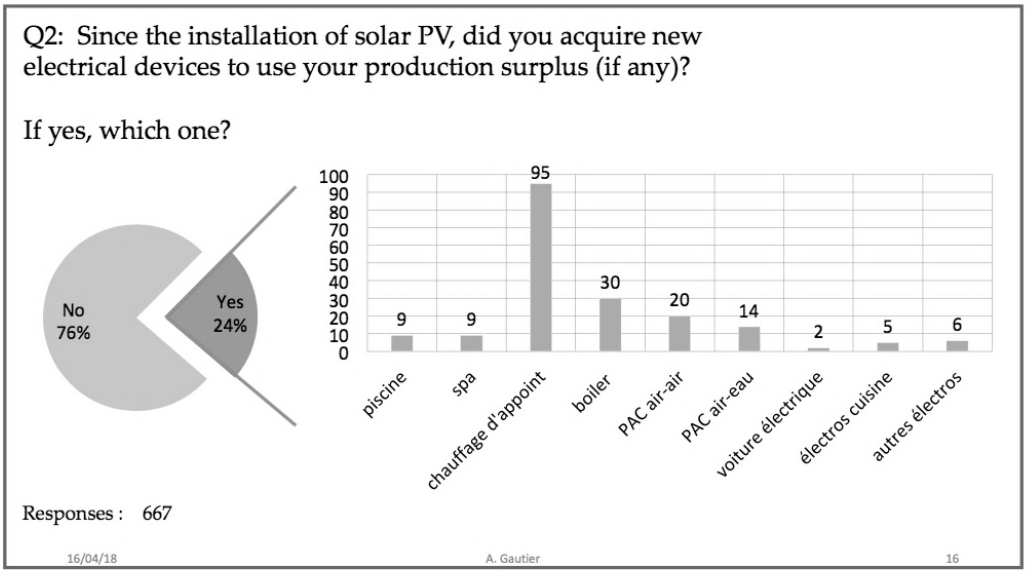
**FONCT : 5**

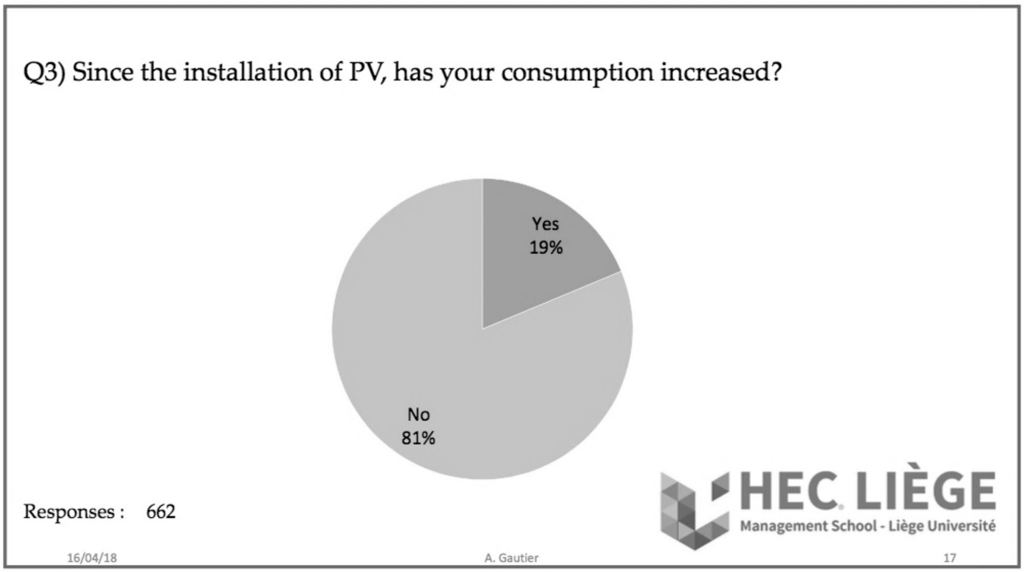
| ARTICLE | COMP GEN | FSER | LIBELLE | COMPTE 2017 DR. CONST. | BUDGET 2018 | BUDGET 2018 (+MOD BUDG) | ESTIMATION 2019 |
|---|---|---|---|---|---|---|---|
| 61 | | | R.O. TRANSFERTS | | | | |
| 0561 /465.05/001 | 73405 | 031 | Contribution de l'Autorité supérieure pour le personnel contractuel subsidié | 188294,49 | 189631,72 | 175945,58 | 175945,58 |
| 0561 /465.05/006 | 73405 | 031 | Récupération de l'ONSS pour le personnel contractuel subsidié | 105447,21 | 107779,12 | 105691,16 | 107935,03 |
| 599 /000000/61 | | | TOTAL | 362383,10 | 377923,09 | 386374,28 | 383042,86 |
| 62 | | | R.O. DETTE | | | | |
| 0521 /271.01/001 | 75711 | 083 | Participation dans les bénéfices de la Régie des Marchés Publics | 362711,71 | 0,00 | 0,00 | 0,00 |
| 0551 /272.01/001 | 75711 | 002 | Dividendes de participations dans les intercommunales pour le secteur "Gaz" | 4548783,70 | 4770872,72 | 4770872,72 | 4770872,72 |
| 0552 /272.01/001 | 75711 | 002 | Dividendes de participations dans les intercommunales pour le secteur "Electricité" | 3063720,98 | 3780890,49 | 3780890,49 | 3780890,49 |
| 599 /000000/62 | | | TOTAL | 7975216,39 | 8551763,21 | 8551763,21 | 8551763,21 |
| 68 | | | R.O. PRELEVEMENTS | | | | |
| 0552 /998.01/001 | 66622 | 030 | Utilisation des provisions pour risques et charges | 500000,00 | 0,00 | 0,00 | 0,00 |
| 599 /000000/68 | | | TOTAL : | 500000,00 | 0,00 | 0,00 | 0,00 |
| 599 /000000/63 | | | TOTAL R.O. | 13196039,52 | 11821225,37 | 11885461,22 | 11857318,99 |

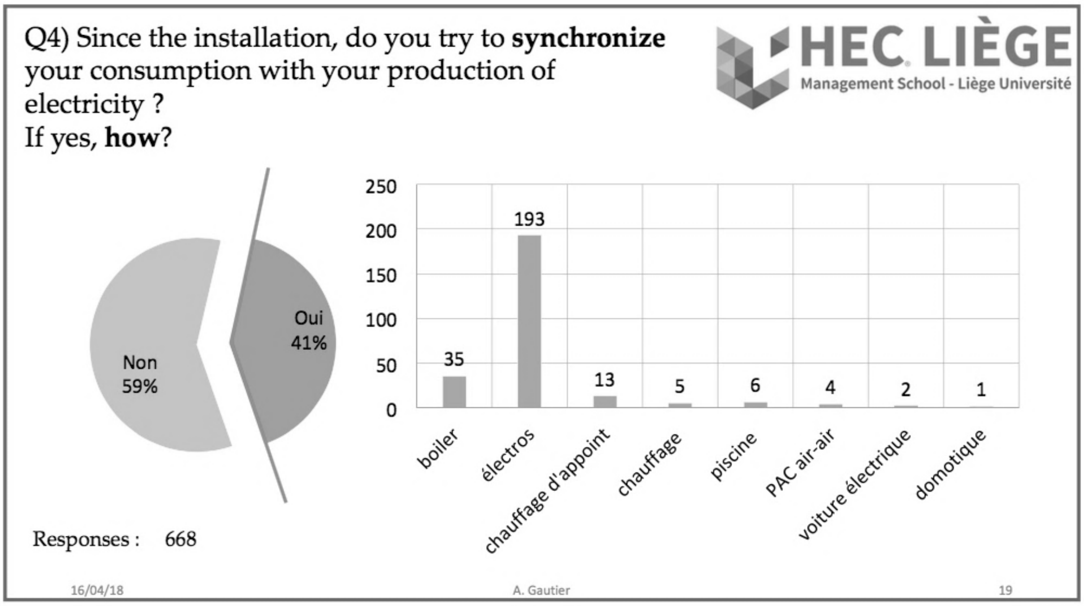
118

## Appendix 9: Results on auto-consumption






Source: (Gautier 2018)

## Appendix 10: Prosumer tarification: capacity tarification for the year 2020-2023

| Tarif prosumer capacitaire TVAC | | | | |
|---|---|---|---|---|
| *exprimé en €/kWe* | 2020 | 2021 | 2022 | 2023 |
| AIEG | 66,87 | 67,43 | 67,27 | 65,50 |
| AIESH | 85,29 | 86,34 | 86,50 | 86,91 |
| ORES NAMUR | 87,41 | 88,16 | 88,50 | 88,21 |
| ORES HAINAUT | 85,78 | 85,47 | 85,95 | 84,86 |
| ORES EST | 98,63 | 99,39 | 99,26 | 98,53 |
| ORES Luxembourg | 89,54 | 90,29 | 90,63 | 91,63 |
| ORES VERVIERS | 98,84 | 98,79 | 99,07 | 97,08 |
| ORES BRABANT WALLON | 78,62 | 79,24 | 79,51 | 79,52 |
| ORES MOUSCRON | 78,81 | 79,67 | 80,31 | 82,26 |
| RESA | 76,04 | 77,06 | 76,87 | 77,19 |
| REW | 89,46 | 90,75 | 92,10 | 88,67 |

Source: (CWaPE 2019a)