1. The Flemish Energy Market: Generation, Retail and Regulation

The Flemish energy market is a traditional liberalised market with the typical stakeholders as shown in Figure 1**.** It allows competition in both electricity generation and energy supply. The Flemish energy market supplies 300 municipalities and has 3.5 million electricity connections [1].

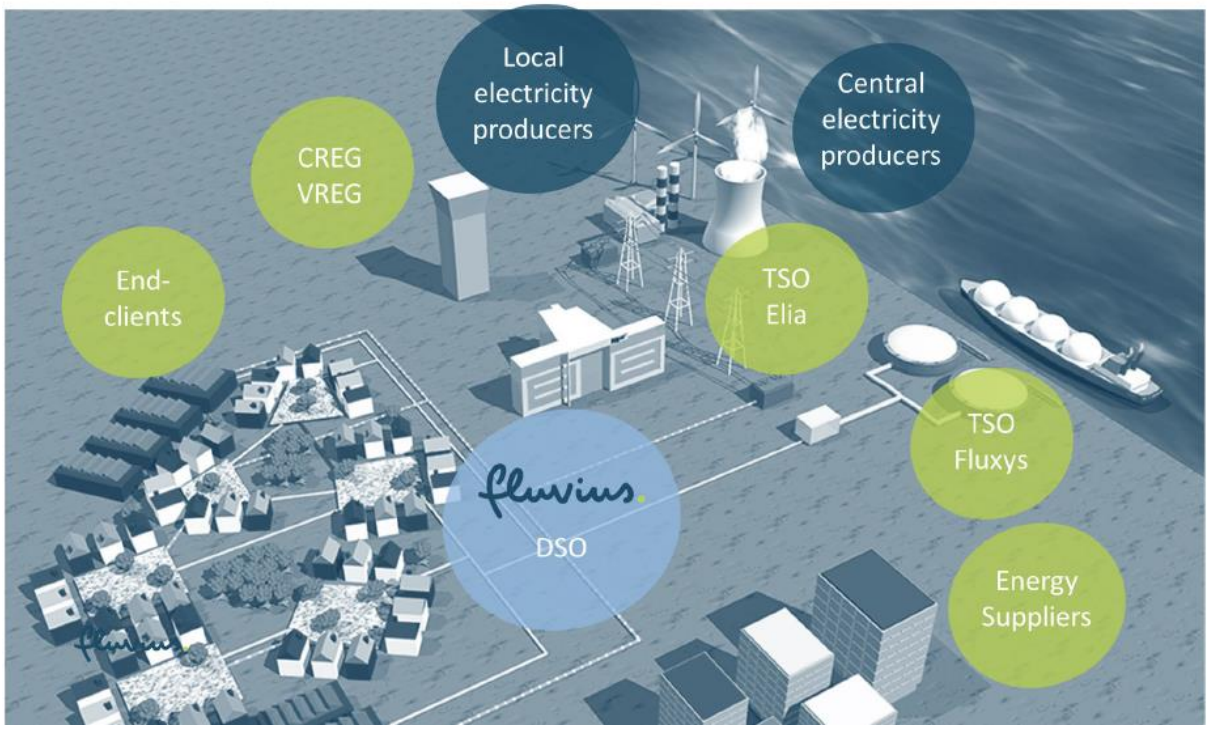

Figure 1: Who's who in the Flemish energy market [1]

The energy suppliers have two main roles: (1) ensuring that end users (both households and companies) receive energy and (2) bill electricity usage. In Flanders, customers can freely choose their electricity supplier. Most of the energy suppliers in Flanders are not electricity producers; instead, they buy their electricity from a producer or on the power markets. The Belgian electricity market is still dominated to a high extent by Electrabel/Engie (GDF Suez) for both generation and supply. However, its market position for supply has fallen recently, in Flanders. Other key generating companies operating in Belgium include EDF and E.ON. In the supply sector, in addition to Electrabel/Engie, some of the large players include EDF, Eni and Lampiris.

The electricity is distributed via a network of cables to the houses and businesses. Operating this network is the main activity of the distribution system operators (DSOs). They provide new connections to the network and are responsible for reading the customer's electricity meters. In Flanders, Fluvius is the only DSO and therefore, customers cannot choose their DSO. Fluvius is the overall name for 11 Flemish intermunicipal utility companies and their operating company Fluvius System Operator (FSO), and some other related entities. Fluvius System Operator is the operating arm of, and is 100% owned by, 11 intermunicipal companies that are themselves 100%

owned by the 300 Flemish municipalities. These intermunicipal companies are public law companies, but do not have a commercial character, thus the Belgian bankruptcy law is not applicable. Each intermunicipal DSO holds monopoly for the area covered by its network and owns its proper grid infrastructure. However, each intermunicipal DSO is appointed by the energy regulator for a renewable term of 12 years: ownership of the network or rights to use. Furthermore, Fluvius FSO has 3 consolidated subsidiaries, namely *de stroomlijn, Atrias and Synductis.* In addition, Fluvius is, not only, responsible for the distribution of electricity to the end-clients but is also responsible for the distribution of gas, operating the sewerage network and powering and maintaining the public lighting infrastructure.

The Transmission System Operator (TSO) is responsible for controlling and operating the transmission grid. The transmission grid, the high voltage electricity grid, comprises of voltages levels 30 to 400kV. The responsibly of the TSO also includes monitoring and controlling the current grid topology and the voltage in all parts of the transmission grid. Furthermore, the TSO also maintains the security of the electricity supply in Flanders. Hence, if the consumption exceeds the local production, it is the TSO's task to buy extra energy from suppliers to re-establish the balance between supply and demand, i.e., procuring up-regulation. In the same context the TSO is also responsible for procuring down-regulation. Naturally, this comes with a cost, this is financed by all grid users via grid fees collected by the TSO. The current TSO in Flanders is the Elia Group, which has a legal monopoly as Flanders's sole electricity TSO. However, its license is valid for 20 years and can be renewed. It operates 8,781 km of high-voltage lines and is not only responsible for onshore infrastructure but also the offshore infrastructure.

Due to the Belgian federal state structure, there are four energy regulators. The regulators responsible for Flanders are the federal regulator, the Commission for Electricity and Gas Regulation (CREG) and the Flemish regulator, the Flemish Regulator of the Electricity and Gas market (VREG).

2. Overview of the regulatory landscape in Flanders

As stated above, due to the Belgian state structure, there are four energy regulators, namely federal regulator, the CREG, and three regional regulators: CWaPE, BRUGEL and VREG [2].

The CREG consist of 3 main bodies:

- Committee of independent directors;
- General counsel;
- Dispute settlement body.

The directors committee is responsible for the operational management. The general counsel is composed of representatives of the federal government and the energy sector.

The objectives of the regulators include giving advice on energy issues to the authorities, monitoring the energy market, ensuring compliance with legislation, settling disputes and imposing sanctions [2]. The regional regulators, in Flanders this is the VREG, also have many objectives, including monitoring compliance with

regional Acts, granting supply licences and green certificates and advising authorities on energy issues.

Each region oversees the promotion of renewable energy and is therefore in charge of protecting the environment. However, the North Sea offshore renewable energy sources, e.g.: offshore wind farms, fall under the federal authority.

The VREG's main responsibilities are:

- Supervise electricity suppliers and DSOs in its region;
- Regulate the use and access to the distribution grid;
- Oversee the free energy market;
- Digitalisation in the energy market;
- Monitor prizes of the DSOs.

3. Review of P2P blockchain projects in Flanders

This section lists all the Peer-to-Peer (P2P) blockchain projects in Flanders, to the best of the authors' knowledge.

Flexible heat and power (FHP) [3]
In the FHP project the objective was to secure mitigation of renewable energy source curtailment in the electric distribution grid by dynamic coalition of power-to-heat resources.

Flemish partners: VITO, KULeuven.

P2P blockchain usage: the Flexibility Trading and Dynamic Coalition Manager concepts for the coordinated community level control of building-level flexibility to save energy costs and offer flexibility services to local grid operators and market parties. A multi-Agent System implementing these concepts has been demonstrated in a Swedish pilot.

Antwerp Circular South [4]
The aim is to encourage more efficient use of energy, water, waste and materials by the citizens of the New South district of Antwerp through an innovative community-driven approach.

Flemish partners: Kringwinkel, Pantopicon, Imec, EnergieID, Vito, Ecopower, Digipolis.

P2P Blockchain usage: the participants could earn a virtual currency, "circular coins", using blockchain technology.

Buurzame Stroom

4. The Regulatory Framework for BC4P

Very recently, mid 2021, the Flemish government issued a decree, “Energiedecreet”. The full extent of this decree can be found in articles: 4.4.2; 7.2.1; 7.2.2 §2; 4.8.1; 4.8.4 of the Energy decree and articles 3.3.1, 3.3.2 of the decree “Energiebesluit”. [5]

Energy sharing, peer-to-peer energy trading and energy communities is made possible by the above mentioned articles of the Flemish Codex.

- Active consumers
  An active consumer is defined as an individual, a legal entity e.g.: local government, SMEs to large enterprises, that not only consumes but also produces energy. The regulation allows the surplus energy produced, that would otherwise be injected on the grid, to be sold to another individual or legal entity. For residents of a collective building e.g.: appartement buildings, shared office spaces and the like, there are also opportunities. Energy produced by the collective investment of the inhabitants can be redistributed a ratio of each induvial investment. If there is an imbalance, between the investment ratio and energy use, the energy can be sold.

  Every individual or legal entity with an official connection to the distribution grid can be an active consumer. However, their active consumer role cannot be their main commercial or professional activity.

- Energy Community of civilians
  An energy community is a group of active consumers that form a legal entity whose main activity falls into the following category:
  - Produce energy;
  - Produce and consume energy;
  - Store energy;
  - Provide grid support;
  - Charging station activities for electric vehicles.

  Aside from above mentioned activities it is also allowed to share the produced energy between the members of the energy community. As with the inhabitants of the collective building, this energy sharing must be free of charge, a ratio of each individual investment of the collective. When energy is sold to two or more end consumers the seller must obtain a distribution licence from the Flemish Regulator of the Electricity and Gas market (VREG).

  Several conditions have been imposed on the energy communities. They must be a legal entity in which everyone can participate (citizens, local authorities, SMEs as well as large companies) but control over the energy community is limited to natural persons, local authorities or small companies. The small enterprises should not be involved in large-scale commercial activities and their main commercial activity should not be in the energy sector. SMEs or large companies can therefore in no way, exert a decisive influence on the energy community. In an energy community, citizens, local authorities and small businesses are thus in control.

The energy communities also carry out activities related to energy, i.e. electricity or heat, green or grey. Furthermore, they must pursue an ecological, social or economic (for their members or the region where they operate) goal. Making a profit is of secondary importance to this main objective.

Energy communities are obligated to create an agreement between their members and to report to the VREG.

5. References

[1] K. Schelkens, “Investor Presentation Fluvius System Operator cv,” 2021.
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