Adequacy & Flexibility study 2022-2032

Reaction by COGEN Vlaanderen

November 27th 2020

Zwartzustersstraat 16, bus 0102 - 3000 Leuven

016 58 59 97 | info@cogenvlaanderen.be | www.cogenvlaanderen.be

0 Context of this document

On October 30th, Elia has launched a public consultation on the methodology, the basis data and scenarios that will be used for the study regarding the adequacy and flexibility needs of the Belgian power system, which must be carried out every 2 years. This consultation aims at receiving any comment from market participants on these data and the methodology and any suggestions on possible sensitivities on the central scenario.

COGEN Vlaanderen proposes to analyse three sensitivities linked to the development of Cogeneration as a concept.

1 First sensitivity : Heat pump development partially replaced by small-CHP development

The dataset for the development of electricity demand, assumes a growth linked to electrification of heat based on the WEM-scenario (With Existing Measures) and WAM-scenario (With Additional Measures) in the NECP. As input for the study, the penetration of heat pumps is seen as a growth from 0.7% in 2020 to 4.5% in 2032, gradually moving from the WEM scenario to the WAM scenario.

COGEN Vlaanderen believes that the suggested development heat pumps is too early in time, especially if ambient air would be the heat source of these heat pumps (i.e. air/air and air/water HP). Due to the closure of nuclear power plants (even if 2 GW would remain operational), marginal electricity production during the heating season will remain based on CCGT using natural gas, at best with electrical efficiency of 55% (on low heating value = LHV = MWh_i). We believe that market situation during cold winter days, with low wind and limited hours of sunlight, will create highest stress on achieving adequacy in Belgium. France might be also looking for strong imports to achieve adequacy during such periods. To support our concern on heat pump development, we want to demonstrate following reasoning during winter (cold spell) situation:

- We assume that marginal electricity production results in a conversion of 2 MWh_i or more of natural gas upstream per MWh_e delivered at the connection of the buildings using heat pumps (taking into account transport and distribution losses). Situation could be worse if only old gasfired power plants would be the marginal unit (efficiency of <48%) and even worse if OCGT would be the marginal technology (@< 40 % net).
- During cold winter spells, periods where heat demand is maximum, air/air and air/water heat pumps will operate at lower COP due to low ambient temperatures. We assume that the current development of heat pumps results on average in 2 MWh_{th} usefull heat per MWh_e at input during cold winter days.
- Combining the two assumptions above, we conclude that the development of heat pumps is equivalent to using the electricity sector to transform 1 MWhi of natural gas into 1 MWh of useful heat. This is equivalent to a condensating boiler, the technology currently used in buildings.

Therefore, growth linked to air/air and air/water heat pumps will only marginally contribute to the European Climat Change objectives during the period 2022-2032. Political attention point is that such growth could be perceived as transfer of emissions from the non-ETS segment (emissions from condensating boilers) to the ETS segment (emissions linked to centralised electricity generation). Development of heat pump will in first instance be a logical development at places where a low temperature heat source is available (ground, water, low temperature waste heat).

COGEN Vlaanderen supports the development of heating systems using the cogeneration concept. Micro CHP (0,8 - 50 kW) and small CHP (50 - 200 kW) show higher efficiencies in transforming natural gas into heat for buildings when taking into account the synchronous production of electricity :

- Small CHP, supplying heat at the same temperature as heat pumps, have an electrical efficiency of 30-37% but an overall efficiency of 100% (on LHV). For each 100 MWh_i of natural gas at input, 30-37 MWh_e is produced at low tension grid level, combined with 70-63 MWh_{th} of useful heat. Cold ambient temperature have no (or even a positive) impact on the performance. New developments linked to fuel-cell CHP (800 – 2000 W) even increase the performance up to 50% electrical efficiency without lowering the overall efficiency.
- Development of low temperature heating networks allows to use CHP installations with 45% electrical efficiency while keeping 100% overall efficiency (on LHV).
- Note : when combining small cogeneration with heat pumps (boosting the remaining waste heat from the cogeneration unit to a useful temperature) a very efficient heating system is obtained. It also allows sufficient capacity for heating during cold spells and a heat supply system that can cope with periodes of strong wind.

Based on above arguments, COGEN Vlaanderen suggests that an alternative scenario is studied linked to Power-to-Heat :

- Growth of Heat Pumps according to WEM scenario instead of WAM.
- When moving from WAM to WEM scenario, the suggestion is to assume that the “Heat not served with heat pumps” is produced by small-CHP with 35% electrical efficiency and 100% overall efficiency. This results in a synchronous production (!) of 0,54 MWh_e per MWh_{th} of heat supplied (= 35/65). This is to be compared with 0,5 MWh_e consumption (!) per MWh_{th} of heat supplied in case air/air or air/water heat pumps would be installed.
- Additional gain on adequacy is obtained due the fact that injection is at low tension level, thus avoiding losses linked to transport and distribution of electricity (6% ?)
- If we assume that the natural gas allocated to heat is 1 MWh_i of gas per MWh of heat (i.e. displacement of heat from a condensation boiler) and if we assume a CHP with an overall efficiency of 100% (on LHV), the marginal cost of the electricity produced is the price of natural gas, expressed in €/MWh_i. However, we can assume that cogenerations will bid at even lower levels into the day ahead market as additional value is created through reduction on grid costs (local generation is at least avoiding the tariff linked to grid losses).
- Note that such CHP’s (35% electrical efficiency) using 100 MWh_i of natural gas, displaces 35 MWh_e of central generation (corresponding to consumption of 70 MWh_i or more natural gas) and 65 MWh_i of natural gas in a condensation boiler. Primary energy savings (natural gas) are thus 35 MWh_i. Versus a “heat-only” and “electricity-only” solution, this represents 35/135 = 26% reduction, supporting the objective of CO2 emissions.

2 Second sensitivity : +1000 MW of cogeneration

EU Green Deal and revision of the European Energy Efficiency Directive (EED) should favour the sector coupling of heat and electricity through cogeneration, either decentral (per building) or through low temperature heating networks, as this represents a primary energy saving of around 30%.

As developed item 1, a cogeneration unit that focusses on space heating, could produce 0,54 MWh_e per MWh_{th} of heat demand. However, the capacity of a cogeneration will not be based on the maximum capacity of heat demand but be based a "baseload" in heat demand.

When assessing the potential for additional cogeneration, a figure of around 1000 MW was put forward. This combines "process driven" and "heating driven" cogeneration. Process driven cogeneration supplies an almost continuous demand for high temperature (e.g. steam) and low temperature heat. Full load hours is in excess of 5000 hours, often even higher than 7000 hours. These cogenerations are operating at full load during all days of high electricity demand as they are linked to economic activity. Technical potential for process driven cogeneration is exceeding 500 MW.

Annual natural gas consumption in the residential sector amounts 41 TWh (High Heating Value) consumption for 2,8 million households (average around 15 MWh per year per household). SME (including tertiary sector) of gas consumption amounts 26 TWh.

- We can assume that at least 85% of this gas consumption is linked to space heating. Assuming only condensation boilers (100% efficiency on LHV), this means an annual heat demand of 67*0.9025*0.85= 51 TWh.
- Improving building insulation and renovation and impact of climat change will further reduce this consumption by 2032. If we assume 35% reduction (Current EU CO2 reduction target for Belgium), we still reach 33 TWh of heat demand per year
- If we look at cogeneration, providing only for heat demand in building sector during 3000 hours (most of them during winter), 400 MW_e additional capacity seems feasible : these installations would serve 400MW_e/0.54*3000= 2.2 TWh_{th} of heat demand.
- Taking 400 MW_e of additional cogeneration into account translates in an assumption that a little bit less than 7% of the heat demand in 2032 would be satisfied through cogeneration. Modern installation also include a heat buffer which allows buildings to operate the cogeneration at full load during most days in winter.

COGEN Vlaanderen suggest that in the adequacy and flexibility study includes a sensitivity of +1000 MWe of cogeneration is made :

- If we take into account that natural gas allocated is heat exceeds 1 MWh_i of gas per MWh of heat (displacement of heat from a condensation boiler or steam boiler) and we see that the marginal cost of the electricity produced will be equal or lower that the value of natural gas. Here again, we can assume that cogenerations will bid at lower levels into the day ahead market as additional value is created through reduction on grid costs (local generation at least avoiding the coverage of grid losses)
- Due to heat buffering and possibility to reduce power, these 1000 MW of cogeneration can be seen as flexible.

3 Third sensitivity : 1000 MW of cogeneration leaving the market

The input data linked to individually monitored, gas driven CHP (CIPU) shows 970 MWe, not taking into account Zandvliet power. A large part of this installed power is up for renewal (technically and contractually) during the next 10 year. Also in the non-CIPU segment, a large part of the cogeneration units will have to renew the cooperation with the heat consumer and make investments to continue operations. As mentioned on input data file, the technical potential for the CHP's is not at risk (heat demand remains present) but the loss of support mechanism might introduce a switch to a "heat only" solution, i.e. investments in gas boilers, stopping the CHP-installation.

COGEN Vlaanderen suggests that impact (versus the central scenario) of losing 1000 MW of installed cogeneration capacity in Belgium is studied.

Hans VANDERSYPPE
General Manager
+32475200576