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CVPP REPORT ON THE ESTABLISHMENT OF THE CVPP

PARTNER RESPONSIBLE: ENERGENT

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Project acronym: cVPP

Project full title: Community-based Virtual Power Plant (cVPP): a novel model of radical decarbonisation based on empowerment of low-carbon community driven energy initiatives

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1 GENERAL INTRODUCTION

In this report Energent describes the main aspects of the community-driven Virtual Power Plant that was assembled during this first phase of the project. We start with the definition of this cVPP and reflect from what was described in the projectproposal as approved in 2017. Followed with all aspects that finally were put in place in this project. This report also mentions future developments Energent has planned to continue developping the established cVPP, as well as changes in legislation that are under development.

2 DEFINING COMMUNITY-BASED VIRTUAL POWER PLANT (CVPP)

For the exact definition of a cVPP we refer to the paper published by Luc van Summeren & Anna Wieczorek, 'Defining a community-based Virtual Power Plant'. The authors state that a cVPP is a portfolio of community-owned distributed energy resources aggregated and coordinated by an ICT-based control system, adopted by a (place-based, interest- based, virtual or sectoral) network of people (and organisations), who collectively perform a certain role in the energy system. What makes it community-based is not only the involvement of a community, but also the community-logic under which it operates (Van Summeren et al., 2018).

3 PORTFOLIO OF DISTRIBUTED ENERGY SOURCES

3.1 INVESTMENT PORTFOLIO IN THE PROJECT PROPOSAL

In the initial project proposal following investment portfolio was proposed :

- CHP
- 200 kWp PV
- Residential
- SME
- School
- 200 kWh Battery Storage

- 5 EV stations

Ones implementation started and all aspects of above described investments were studied in detail, EnerGent concluded that some of those investments were not viable (anymore). We explain the main reasons why.

3.1.1 CHP

In the middle of the project area we count with the Groot-Begijnhof St-Elisabeth. This is an area where formerly nuns were living. It consists out of 80 individual houses, 10 convents (bigger houses which are actually used by small profit and non-profit companies as office), a church and a community center. The whole area is private property and owned by a non-profit organisation that’s responsible to manage the site. They own their own medium voltage transformator and have a private low voltage grid in the whole area. Based on this situation during the pre-feasibility study that was carried out prior to this project, A CHP was proposed as an economically viable investment in this area, building a heat-network and providing all houses with heat, while the generated electricity could be distributed through the private grid towards all connected customers. By the time the project started, the DSO did not agree with the existing situation. The DSO argued that following EU legislation, all renters of the site should have freedom to choose their own electricity supplier. This could only be established by handing over the privately owned grid to the DSO. As a consequence the generated electricity of the CHP would only be valorised behind one specific electricity meter (so in one house or convent where the CHP would be established), concluding in the loss in income from most of the generated electricity (as the amount of electricity that would be injected in the grid, is very little valorised). So EnerGent decided not to build this CHP anymore, loosing a valuable asset in the foreseen cVPP concept at the level of generation as well as on the level of generating flexibility.

3.1.2 EV stations

Initially the project planned to work with partago, a cooperative that organises chaired EV vehicles. Partago however decided to work with the EU funded Wisegrid project, and not to join the cVPP project. As hardly no other EV are present in the project area this made it difficult to establish EV stations. The project also looked to install 2 charging stations at the parking lot of the Siklos site, which might be connected directly to a project PV installation, but this concluded to be technically not viable..

3.2 IMPLEMENTED INVESTMENT PORTFOLIO

At the level of generation the project focusses on Solar installations, this at all levels. We briefly mention the different implemented generators below, a more detailed discussion on this aspect can be found in the report I3.3.1 Selection of the cVPP investment portfolio.

3.2.1 Residential PV installations

- Participants invest in their own PV installation through Gent Zonnestad

- Third party investment in residential PV installations through EnerGent for socio-vulnerable groups
- Organisation of investment in residential PV installations by house owners, in mutual agreement with their tenants
- Organisation of investment in PV installations in the case of apartments, through third party by EnerGent of investment carried out by the VME (organisation of home owners), this mainly for electricity that is commonly used.

3.2.2 Third party investment in PV installations for Schools, public buildings, SME's

As described in the report about business models, EnerGent organises third party investment in PV installations on bigger roofs. Such installations only are viable in the case where electricity consumption is big enough and where auto consumption on site on a quarter hour basis amount minimally 60% of the produced solar electricity. This auto-consumption can be increased through the investment in short term battery storage, except for schools, which are entirely closed during summer holiday. In this case seasonal storage through hydrogen production f.e. could be evaluated.

3.3 Portfolio to be investigated for future development in this cVPP area

As the enlarged project area is situated on the southern side of the port of Ghent one could imagine to include a windturbine in this cvpp concept. Companies developing windturbines in Flanders actually face a lot of resistance from surrounding inhabitants, who only face the nuisance of those projects such as noise and drop shadow. Developing a turbine on a cooperative and participative way, where cvpp members could benefit from their own financed and managed turbine could turn the more negative aspects of wind development more acceptable.

Depending on how EU legislation on Citizens Energy Communities will be translated in Flemish legislation, aspect such as 'zonnedelen' might become feasible and could be developed in the project area as well.

4 Demand Side Management – Controllable loads

During the first year of the project we made an inventory of intresting available assets in the core project area with all participants of the project. Based on this inventory, some evaluation of successfull Demand Side Management projects such as for example the linear project and the test goals we defined in our project, we decided to focus on homebatteries and (hybrid) heat pumps.

4.1 HOME-BATTERIES

We decided to start with a standardised solution at the level of homebatteries, using one single brand, already integrated with an inverter brand we will be able to communicate with, through the EMS system to be developed. After some market inquiry we decided to select the BYD batteries, standardly connected to SMA inverters. The minimal capacity of those BYD batteries was 6,4 kWh, which is a quite high compared to the type of residential pv installations that are present or being build in the residential urban setting of our project area (an average of 3 kWp/Pv installation). In a following phase, other brands and types op batteries will be connected to the EMS system.

4.2 ELECTRIC BOILERS

Electric boilers are interesting assets for demand side management as well, as they implicate some electric power and some flexibility can be organised by heating the water to a higher degree at convenient moments. Unfortunately not one of the participants of the pilots has a functioning electrical boilers in his house, as most houses in the area are connected to the gas grid and use a gas boiler for sanitary hot water. So the functionality of incorporating this type of assets by an on/off plug was developed in the EMS, but not put in practice.

4.3 (HYBRID) HEAT PUMPS

Heat pumps form an interesting asset as well, as they use 2-3kW of electric power and combined with a water storage a thermal buffer can be organised. As gas is very cheap compared to Electricity in Flanders, very littly heat pumps are installed and we did not find any in the project area. As a project we decided to organise a pilot with a hybrid heat pump ourselves. In this case a small heat pump (4-6kWth) with a thermal buffer is installed in parallel with the existing gasboiler. The pv production is optimized through thermal storage. The heat pump as well can be used in a cVPP concept to optimise collective self consumption.

The hybrid system is constructed in such a way that no lock in is organised. So in case the house owner continues to improve its energy efficiency of his house, he can reduce his gas usage until he only needs the heat pump for heating.

As in flanders the ratio between residential gas price and electricity price is very high (respectively ca 6c€ versus 28c€) almost nobody is shifting towards electrification for residential heating in Flanders.

In a following phase more (hybrid) heat pumps should be installed and additional communication protocols should be developed in order to be able to manage other types of heat pumps within the EMS system. In this fase communication with a Viessman and a Daikin heat pump was developed.

4.4 EV

As no EV's were present in the project area during the start of the project and we did not succeed to set up a cooperation with the EV sharing cooperative Partago in Gent (as they were engaged in another EU project), the cVPP project did not integrate EV assets in this fase of the cVPP development. This definitely should be done in the future and further development of the EMS system.

4.5 Residential white goods.

In Flanders the Linear project was organised by a huge consortium of companies, being the first project testing demand side management at residential level. An important conclusion in this project was that demand side management with 'white goods' (being washing machines, dish washers, dryers, etc) were very little efficient, had a lot of impact on the comfort level of the beneficiaries and had little impact on energy demand shifts. So taking this conclusion into account we decided not to include those assets in the cVPP concept.

5 Energy Management System

5.1 Objective of the EMS

The Energy Management System has following objectives:

- Set up communication with all connected assets, being all distributed energy sources, as well as all assets being used for demand side management.
- Collect all data of production and consumption of the connected assets
- Elaborate steering algoritms to manage connected assets depending on the objectives defined.
- Visualise collected data, algoritms towards participants
- Visualise collected data, algoritms, results etc in a active dashboard for the cVPP manager.

5.2 Tender of the EMS and evaluation criteria

Prior to tendering this EMS system, Energent organised a thorough market analysis. We discussed with several companies active in this field of the IT energy market. As this is a very new development in the energy market, most of the players are start up companies with little track record.

From the consulted companies and the gained insights of the developed EMS systems, Energent decided to define following evaluation criteria in the tendering process:

- Price
- Open source aspect of the EMS: as this phase of the cVPP is only an initial step towards a further developed CVPP, a lot of further IT development will need to be done in following years. This depending on new legislation, new business models, new assets, changing roles in the energy

market. The tender should be organised in such a way in order to prevent future lock ins, at the level of EMS partner company, at the level of the software and at the level of the hardware.

- Low cost hardware at residential level operating with open source hardware. Margins in the electricity market are thin, so realistic business models will have to create added value within those thin margins. The use of low cost plug and play hardware will be fundamental.

5.3 Initial development of EMS at start of implementation

The EMS was developed and tested in laboratorium circumstances were communication with the inverters used in this phase of the project could be set up and tested. The developed algorithm that could be tested in laboratorium setting, were tested here as well. Some of the steering algorithms depend upon live data, so could not be tested beforehand.

In a following phase 2 clusters of beneficiaries were selected were all of the participants installed pv on their roof and got a home batterie installed in their house. In this phase of the project we decided to use one type of inverter (SMA brand) in order to set up the communication and test the functioning of the EMS system.

As a lot of aspects of this project are totally new for all actors involved a lot of communication needed to be organised. For each inverter the installer company needed to enter the correct setpoints internally in the inverters. Another company installing the EMS communication hardware needed all network information of the participant in order to make communications between the assets and the EMS platform working.

A lot of lessons were drawn from this test pilot, which was a time consuming process. Finally all equipment got installed and communication between all aspects got organised.

After this initial phase addional assets were connected to the EMS. Other brands of PV inverters such as Fronius and Solaredge were connected. As mentioned above a pilot with (hybrid) heat pumps was set up and communication with Viessman and Daiking heat pumps was developed. Specific steering algoritms for thermal buffering based on pv production was developed for this pilot.

5.4 Future development of EMS for following phases

The EMS will continue to be developed with:

- Additional assets at production level
- Additional assets at demand side management level
- Additional steering algoritms depending on bussines models that will be implemented.

6 COMMUNITY OF THE cVPP

6.1 WHO IS THE COMMUNITY IN THIS PHASE OF THE cVPP AND WHAT'S ITS ROLE

At the start of the project a lot of time was spent discussing the roles of all participants in a cVPP concept. In the belgian pilot some focus group discussion were organised and an online survey was organised to define the value propositions of a cVPP. The final conclusion was that a cooperative was best fit to represent the participants in a cVPP. A cVPP requires quite some investments and technical, juridical knowlegde to get everything organised and up and running. A professional cooperative, with cVPP participants as active cooperants seems to be a a good platform to start this exercise. Energent as existing cooperative took up this role in the belgian pilot.

The role of the cooperative can be diverse and here choises need to be made at the start, but these can evoluate in time as well. As described in the report on the 'conceptual design of a cVPP', a cVPP actor can play a lot of roles in the energy market. He can be a facilitator, esco, energy trader, BRP, retailer etc. In this phase Energent focussed in being a facilitator toward participants investing in their own generation and as investor in additional generation, storage, Heat Pumps and the EMS system.

6.2 POTENTIAL DEVELOPMENT OF THE COMMUNITY IN THIS cVPP

In following phases of the cVPP in Gent, the role of Energent will broaden. Energent is actively evaluating the feasibility to act as an aggregator and depending on how legislation at Flemisch/belgian level will be defined Energent as well might evolve towards a retailer.

7 REGULATORY INTERACTIONS AND APPROVALS

7.1 LEGISLATIVE DIFFICULTIES FACED

The project faced quite some difficulties at the start. The Belgian regulatory context is quite complex as certain legislation in the energy field is defined at federal level, while other aspects are competence of the regional level. Different levels of administration not always tend to work together, but often just hide behind their legislative framework. Frontrunner projects such as cVPP just need dynamic administrations interested in joining experiments in order to learn if and how things could be organised more efficiently in the fast changing landscape of the energy markets. This however hardly is the case in Flanders.

The Flemisch DSO as well rather takes a conservative attitude towards innovative projects and doesn't tend to experiment outside their responsibility as defined by regulatory administrations. Some examples of difficulties faced at legislative level

Request for a ‘regelluwe zone’. We asked the cabinet of the responsible minister to grant us a ‘regelluwe zone’ in order to experiment with a neighbourhood batterij. The request was denied, without mayor argumentation.

The project a building a CHP in the Grootbegijnhof was more or less counteracted by the DSO, who in rule with legislation wanted to take over the existing private grid. This could have been a great opportunity to experiment with a small scale heat net, flexible electricity production in a heritage setting where strict rules need to be respected at the level of renovation of the houses and improving energy efficiency. The only viable option to heat those houses will be with high temperature technical options, so the idea of a heatnet with a CHP would improve the existing situation.

New legislation concerning ‘directe lijnen’ was put in place in Flanders in 2018. With this legislation one can organise a pv installation on one cadastrial plot and connect to a user on a neighbourhood plot, crossing a cadastrial border. The legislation states that one should pay a certain tax for these type of projects, as a kind of compensation of avoided public grid costs. The cost of this compensation is about 6€/MWh on the medium voltage grid, while it is about 56€/MWh at the low voltage grid. So busines cases at residential level aren’t feasible, its mainly a way to support industry with these type of projects, but totally do not contribute in cVPP concepts at residential level.

Introduction of digital meters in Flanders: by the end of 2019 the outroll of the installation of digital electricity meters started in Flanders. In 2017 at the start of the project our DSO promised to install 200 digital meters in the project area, specifically for the project, in order to connect them to the EMS and to be able to read out data of injection and consumption. Finally the first phase of the project nearly reached its end when some of those digital meters were installed, so very late in the process of the project to make use of the necessary data.

7.2 FUTURE LEGISLATIVE DEVELOPMENTS THAT WILL INFLUENCE CVPP

A lot of new legislation is under development that will highly effect the cVPP concept in the Flemisch concept. There are:

The transposition of the EU directives concerning Citizens Energy Communities and Renewable Energy communities, creating a lot of opportunities for cVPP project to become a viable player in the energy market. All will depend on how Belgian and Flemisch administrations will deal with this transposition and which level-playing field will be created for prosumers to get more actively involved in the energy market.

The end of the ‘prosumententarif’ in Flanders, where all prosumers pay a flatrate tax for using the grid as a battery for their pv production. So the optimization of individual autoconsumption of pv production will play a big role in the economic viability of residential pv installations.

The introduction of a capacity tariff, which will stimulate prosumers and consumers to reduce injection and demand peaks, as they will be taxed on the amount of the size of those peaks.

The introduction of the digital meters, which will be able to measure energy production and consumption on quarterly hour basis. This data is essential in order to organise the future energy market based on renewables.

The introduction of dynamic electricity prices, scheduled for 2023-2024 in Flanders.

8 CONCLUSION

The Flemisch cVPP pilot succeeded in organising a first phase cVPP with a working EMS system. This EMS is able to communicate with assets at the level of production side and demand side. Steering algortims were organised and tested in order to fit demand closer to production an in order to reduce stress on the public grid due to injection of pv production.

We succeeded in organising an EMS on an open source basis with low cost hardware, so no lock-in has been organised and Energent has the possibility to negotiate further development with other actors engaged in the IT energy market.

With all new legislation coming up the next coming years, the cVPP concept will need to be adopted in the direction of certain busines models taking into account the values defined by the community. This new legislation needs to be defined and all details needs to be clear in order to decide which activities are viable and feasible.