Interreg North-West Europe
EUROPEAN UNION
cVPP
European Regional Development Fund

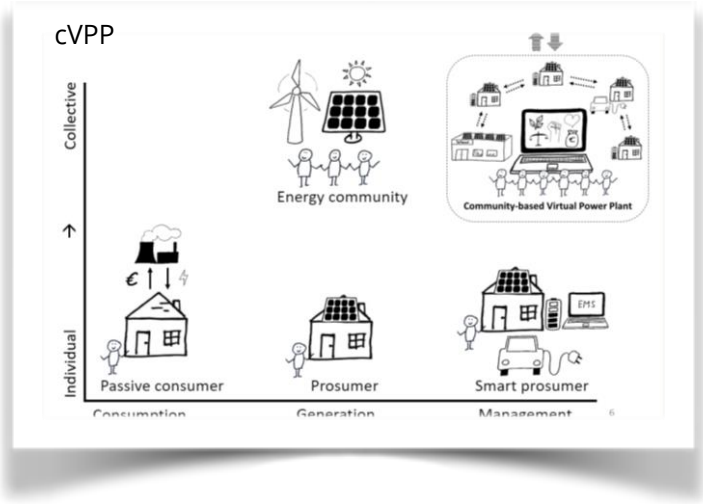
Community-based Virtual Power Plant (cVPP)

A new model for energy system organisation

Summary

In this project we develop and operationalise a concept of a **cVPP** and its **viable business model** in 3 communities of Ireland, Netherlands and Belgium. We also develop a **Mobilisation and Replication (MoRe) model** that guides 9 other communities in configuring of their own cVPPs.

A **cVPP** is a portfolio of community-owned distributed energy resources (e.g. PV on the roofs) and flexibility (available in home appliances) aggregated and coordinated by an ICT-based control system. The portfolio is adopted by a (place-based, interest-based, virtual or sectoral) network of people, who collectively perform a certain role in the energy system. What makes it community-based is not only the involvement of a community, but predominantly the community-logic under which it operates. That implies a.o. that these are community needs that drive the initiative, that community owns the various assets and the ICT platform, that members collectively make decisions and chose how they organise themselves (Van Summeren, Wieczorek, Verbong, 2019).



Being organised by a community and through the ICT platform that reacts to changing prices, energy flows and weather conditions, a cVPP can help its members participate in the energy market: they can decide when and how much of their electricity or flexibility is sold to whom and at what price and how they distribute the costs and benefits. cVPP thereby empowers prosumers and contributes to democratisation of the energy system.

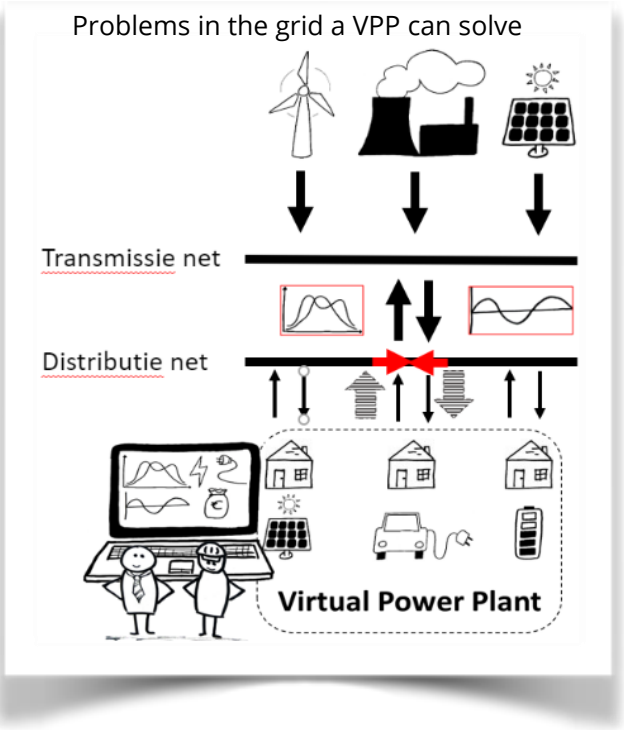
Given that not all communities are large and professional, to be a serious player in the energy market and to survive in the environment of professional and established energy companies, cVPPs need a **viable business model**. Although the number of such business models is limited in the current legal framework, the recent comprehensive update of the EU's energy policy framework, the so called Winter Package, is expected to improve the level-playing-field for prosumers and communities. In this project through the **MoRe model** we facilitate the mobilisation of communities, replication of the cVPP concept to other territories, and stimulate upscaling of low-carbon energy community-driven initiatives. The model is an online, user-friendly, interface that after testing will become available for broad public use.

Target group

Our target group are communities or groups of prosumers who already set basic energy generation infrastructure (e.g. PVs or wind mills), and who want to do more with it, either for individual or community benefit. In this project we work with (wealthy and conscious) Dutch communities of Apeldoorn, Belgian (socially challenged) neighbourhoods of Ghent, and a number of (dispersed) Irish communities of Tipperary. We demonstrate this way that an alternative, more democratic way of organising the energy system is not impossible and that regardless of national contexts, different types of communities can make meaningful contribution to the energy transition.

Originality of research for society

The research is driven by the community needs. It aims to contribute to their empowerment and thereby to changing the logic that is behind the organisation of the current energy system. Virtual Power Plant, the VPP, as such is not a new concept (see figure below). However most, if not all current applications of the VPP, are driven by the needs of the DSO or TSO (grid operators) and aim to release grid congestion and support grid balancing. This is a very technical objective that individual prosumers or communities rather do not think about when they initiate a bottom-up energy project together. Prosumers are of course involved in such classical VPPs, and sometimes, they appreciate not having to bother with the working of a difficult electricity system. However, apart from having a day-night tariff choice (in some countries not even that), they do not have any influence on how their energy and flexibility is used and traded. This project, by adding 'community-based' to the VPP, flips this logic upside-down arguing for more space and level-playing-field for prosumers and communities. It demonstrates that not only the technical 'system' needs can be satisfied but also the 'social' needs of the communities, such as: local self-consumption, local trading, energy independence, development of social cohesion in the community or support to the local economy.



The research takes the energy transition a step forward. It means that it demonstrates how to create critical mass and accelerate radical decarbonisation and democratisation of the energy system. So far, and driven by the growing concerns about CO_2 emissions, increased deployment of renewables sources was called for as a means to motivate the energy transition. In response, a significant basic renewable infrastructure has been set. The large-scale deployment of renewables however, in combination with their intermittent character, put pressure on the grid causing congestion and forcing extra balancing in the peak periods (see figure above). Lack of energy storage additionally reinforces the need for real-time demand side management (DSM). The currently popular solution has been to either add more cables, reinforce the grid or use only large flexible players. Given however the expected further growth of distributed energy sources, this not only becomes a pricy solution with diminishing returns, but it also hinders the empowerment of prosumers. The community-driven energy initiatives by aggregating a number of distributed energy resources (DER) and controllable appliances can provide such services. Aggregation can help them gain volumes that facilitate the level playing field with the large incumbents. It can thereby make the current efforts around renewables and energy communities significantly more meaningful and relevant for the energy transition.

The research develops tools that are immediately tested in the societal context. That means that the innovative ideas are not experimented in a protected environment of a lab but are exposed to the harsh environment of the dominant centralised and fossil-fuel-based regime. Apart from the basic concept of a cVPP, one of such tools is the Mobilisation and Replication (MoRe) model. The model is generic in nature, which means it can be used by various communities (rural, urban, wealthy, poor) but it also has a degree of context specificity, which implies that it takes into account the regulatory framework of specific contexts where cVPP is deployed. The recently comprehensively updated EU energy policy framework (Winter Package, 2017), after transposition into national laws in 2019, is expected to bring further, considerable benefits for environment and economy and facilitate significantly better opportunities for prosumers and communities in the dynamic energy market. The cVPP and the MoRe model are tools that prepare communities for that moment. By being tested in a number of contexts and used as training material, the tools are actively applied and do not lay idle on the shelf.

The research is trans-disciplinary by design. That means that it meaningfully involves a variety of actors and their values and frames in a co-creative process. Without the strong trans-disciplinary collaboration and especially the science-practice interface, many of the TRL7+ type of projects like this one, are often developed intuitively by non-academic partners. Here we combine the experience and intuition of practitioners with the academic excellence, providing a workable but scientifically well underpinned solution of a very high societal relevance. One of the preconditions for such a trans-disciplinary collaboration is the development of common language and agreement on terms. The development of the common language was the first and longest phase in this project. Through a number of discussions, literature research and by gathering experience from the implementation of cVPP in three contexts, the team went through an iterative process of determining what is meant by cVPP, community, replication, upscaling or how the ICT platform should look like. One of the key outcomes of this process has been the specification of what makes an energy project community-based and the (flexible) definition of a cVPP. Being flexible, the definition gives sufficient space for a variety of projects to consider themselves as either already being cVPPs or having a good basis to become one. So far there was no such common definition and no consensus in either academic or policy world. These definitions not only help us as a team to move on but are also highly appreciated by the funder and the communities themselves.

Extra dissemination efforts

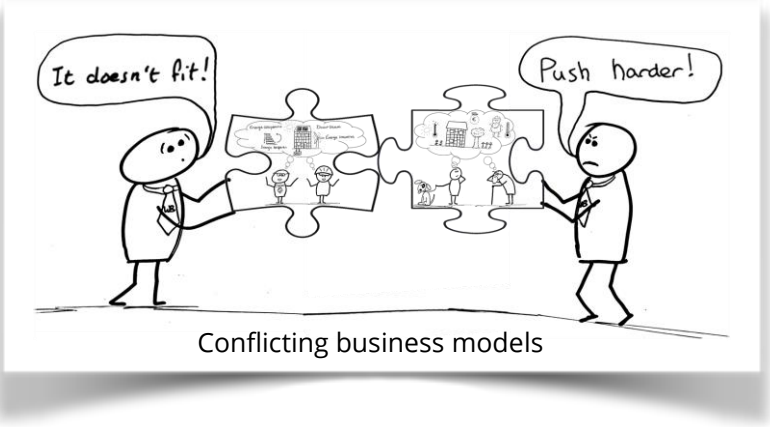
Dissemination activities are an important element of this research. We activate and engage relevant actors in a variety of ways (see Appendix for more details and examples).

In Belgium we organised 3D (Dream, Dare, Do) Days to show new communities in the entire province of Antwerp what cVPP is and how it can benefit communities. During a series of the '**inspiration meetings**' the knowledge about deploying effectively the renewable energy was brought closer to the citizens. Communities could listen to the experts, hear about good examples and visit the realised projects. The series of meetings provided insight into common concerns, helped communities develop a step-by-step plan towards a cVPP and learn how to organise themselves around generating, using, storing and distributing their own energy. In the Netherlands, the Municipality of Apeldoorn, who is a partner in the project, is connecting to other municipalities, companies and local energy cooperatives. In Ireland, the partners carried out a school-competition, activating schools, parents, youth and even the national politics.

The project is actively advertised in the **media**. Examples include: the RTE (national broadcaster) broadcasted on national television a short story on Tempeldary wind farm and our project; our partners commented on the launch of the International Energy Agency 2019 Review of Irish Energy Policies; the RTE radio (Drivetime) interviewed our project about Microgeneration and Community

Power; our Irish partners commented following a high level stakeholder event on Climate Disruption hosted by the Minister for Communications Climate Action and Environment; the project was quoted twice by The Irish Times and in Green News, both in the context of subsidies and the micro-generation bill. We also showed up on the Dutch TV and recorded a number of you tube films. Following the meetings with the communities, the partnering countries will organise **competition** for the new communities to configure their own cVPPs. The competition will end with an award of 2000 euros and is broadcasted by regional media: TV, radio, press, social media and with involvement of regional governments (see press release link below).

Every partner is also involved in a variety of networks. We produce **scientific and policy articles**, give **talks** and organise **workshops** about cVPP. Examples include: Power Summit in Prague, Sustainability Transition Conferences in Ottawa and Lisbon, the Interreg Impact meeting, two WTMC workshops, EU regions and Cities meeting in Brussels, etc. In that we make use of easy to convey material, often taking a form of pictures made by Luc van Summeren (the PhD candidate in this project) like the one below representing the conflicting business models of the communities and the system at large, which is the essential struggle in the energy transition.



Conflicting business models

Being based at an educational institution, TUe team has an unusual opportunity to disseminate the results among the young generation of students. The concept of cVPP is discussed and used as a practical example in several **bachelor and master-level courses**. About 8 **master theses** have been produced under the supervision of the research team and in collaboration with outside actors such as Tennet, Aliander, Enpuls, Termovault. The master students advance research on satellite questions related with the project conceptualisation and implementation.

We also search **synergies with existing projects** at the university - e.g. Scalings which is about scaling of co-creation and where cVPP is used as a case study. We reach out to Delft University and Wageningen University to discuss with groups who do similar research and build on each others' findings. We collaborate with BOKU Viena on legal aspects of cVPP and the potential implications of the Winter Package for national renewable and electricity laws.

On a more practical front we are in **discussion with** RESCOOP.eu, the European federation of renewable energy cooperatives of 1,500 European energy cooperatives and their 1.000.000 citizens who are active in the energy transition. The aim of these discussions is to establish a cVPP Working Group at RESCOOP and initiate use of our cVPP concept and the MoRe model by the RESCOOP cooperatives.

Societal relevance for: education, social organisations, policy and business

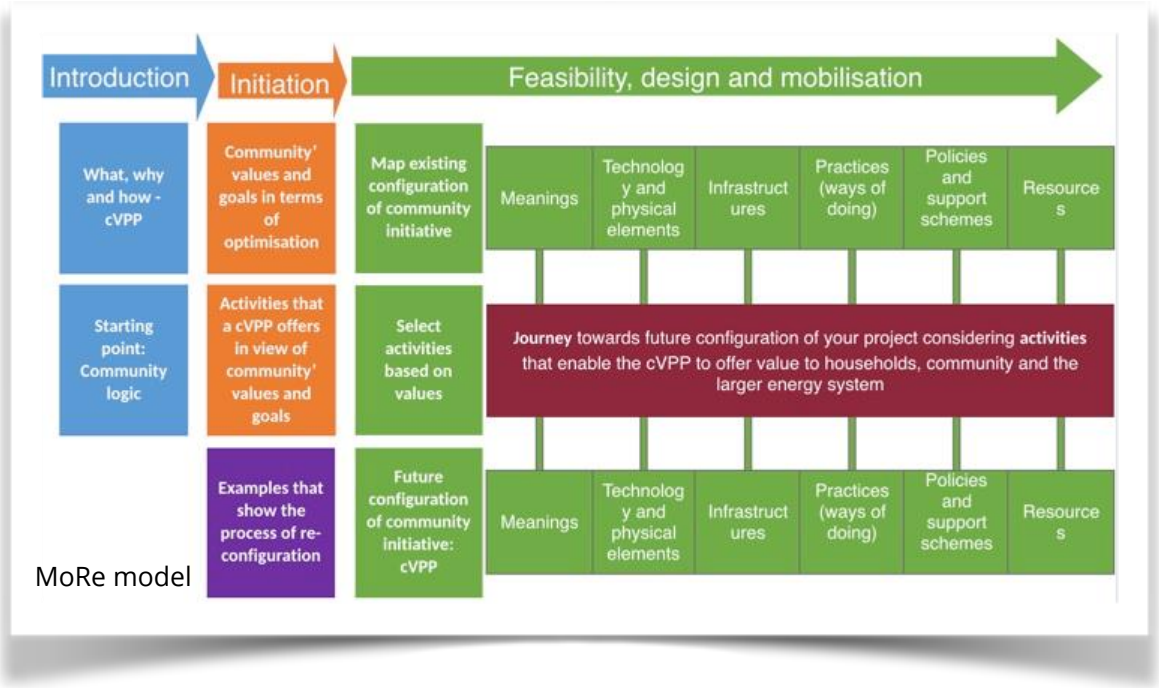
By contributing to the energy transition through empowerment of a variety of communities (rural, urban, with social challenges, dispersed) and by preparing them to play an important role in the changing electricity market, the project is of high relevance for a variety of actors.

Particularly, by clarifying what community is, what cVPP implies and how communities can configure their own cVPP in a specific national context using the MoRe model, the project shows that an alternative way of organising the energy system is possible. It also helps **social organisations**, in this

case communities, to realise that they have a strong card to play in the process of negotiating their way into the large market. They have flexibility and distributed generation, which the incumbents need in order to operate the existing infrastructure in the changing context. More effort and lobbying is needed however to make the **policies** work in the true advantage of active community members. By showing what works and how community energy projects can function and what they have to offer for the system at large, we make a strong case for a change of policy. A good basis is also laid by the Winter Package but much will depend on how the it is transposed into the national regulatory contexts and what space Member States will decide to give to their citizen initiatives. This is when the real impact of the cVPP will be tested.

For **businesses** such as energy utilities and network operators, this research shows how the energy system is transforming, what the dynamics is and what new challenges and opportunities arise. The current solutions to the growing intermitted renewable energy discharge to the grid are too expensive. The upcoming operationalisation of the European law will also change the conditions under which the communities operate. They are expected to become new actors in the market offering valuable flexibility. This means new business opportunities and new partnerships. Particularly SMEs can profit by partnering with communities and creating synergies with their energy initiatives. They can, e.g. offer roof space for the deployment of extra generation capacity and additional flexibility in amounts that are not available at the community level. That can give even more boost to the communities empowerment.

Regarding **education**: the MoRe model (see figure below) is encompassing a great degree of complexity, not all communities are in a position to use it easily for their own case. The complexity however is necessary to stay as close to reality as possible. To deal with it and to bring it closer to the citizens, we are translating the model into an easy-to-use manual with examples, pictures and links under which users could easily learn more about implications of taking specific steps. The MoRe model in its original form however is used as training material for energy ambassadors and other intermediary organisations (e.g. RESCOOP.eu, HierOpgewekt and Sustainable Energy Agency Ireland), whose job is to support the communities with a variety of energy related issues. This way, we prepare ground for a greater deployment of the large scale community energy aggregation. The MoRe model serves as a vehicle to achieve it.



MoRe model

Adoption rate in relation to the nature of the research

The essence of this project is a socio-technical innovation based on aggregation of distributed generation and flexibility and revision of the logic based on which current energy system functions: away from fossil fuel, dominated by large companies towards a more distributed generation where citizens and communities play an important role. This way cVPP provides a more democratic way of organising the energy system. Through its specific characteristics, and as explained above, it allows for another step in the energy transition. So far significant basic infrastructure was set by local projects in the form of PV or wind mills and it is increasing, but doing more of the same, as much as critical for transition, will not be enough. Smart combination of existing ICT technologies and their new way of deployment allows for moving towards a large scale upscaling.

In this project we test cVPP in three contexts and prepare 9 new communities, by means of the MoRe model, to configure their own energy aggregation. New partnerships are also explored with e.g. network operators, which also help create the critical mass. In that sense the adoption rate and a move towards carbon reduction is high. It is expected that by the end of the project, it will reduce 1,9kT CO2, leverage 8,6M euro of funds and create 165 jobs. However, the technology underlying the cVPP, the EMS system, still needs further work and testing. There are also only few cVPPs consciously set, but a number of existing projects are on a good way to become one, regardless of whether they call themselves cVPPs. We were invited to extend this project by another 2 years and 1,2 M euro to further test and capitalise our results.

Unique aspects

Although led by a University and an academic project leader, this research defies the linear model of innovation. The linear model of innovation suggests that innovations originate from research and are taken up by the market. The linear model suggest that more funds need to be allocated to R&D to make sure more innovations are created for the benefit of society. This project, however, by being trans-disciplinary, demonstrates a different mode of innovation: it manifests that innovations can be co-created by a variety of societal actors. By involving users (in this case - communities), they have higher chances of being relevant and having greater societal utility. By reaching out to decision makers we can create the necessary space for ‘new ways of doing things’. By involving academics, we makes our research less abstract and disconnected from reality.

The scholarly network of sustainability transitions where we are embedded as researchers and where we aim to contribute to, makes strong appeals for a radical change of the way we provide human needs, such as energy. This research however is highly academic, conceptual and theoretical. Hardly any researcher, who is a member of that network, factually implements such radical innovations in practice. This project aims to factually accelerate the energy transition by mobilising the wealth of scientific insights to design and set radical innovations in practice rather than studying past innovations or innovations implemented by others.

In that sense it is a unique initiative that does what others only write about.

Anna J. Wieczorek
Eindhoven, 27 November 2019

Appendix

All our materials are digitalised. We do not produce any paper flyers or newsletters. Information is spread in our networks via online channels. Below: selected examples of dissemination activities.

Project website:
https://www.nweurope.eu/projects/project-search/cvpp-community-based-virtual-power-plant/

Recent newsletters:
https://www.nweurope.eu/media/5504/cvpp_project_newsletter_3.pdf
https://www.nweurope.eu/media/8392/cvpp-nieuwsbrief-november-2019.pdf
https://www.nweurope.eu/media/7777/cvpp_project_newsletter_4.pdf

Selected you tube films:
https://www.youtube.com/watch?v=F27lqCSU5no
https://www.youtube.com/watch?v=FWq-5HqREMI
https://www.youtube.com/watch?v=uvLVRONZzwo
https://www.youtube.com/watch?v=SqDXfP2GlNE
https://www.youtube.com/watch?v=OKaFuq_Fzyw
https://www.youtube.com/watch?v=uM-8hYX3Lus

Use of cVPP in education:
https://www.nweurope.eu/projects/project-search/cvpp-community-based-virtual-power-plant/news/students-have-immersed-themselves-in-the-subject-of-cvpp/
https://www.youtube.com/watch?v=lIPRcz7-Wxg&feature=youtu.be

Example master thesis:
https://www.nweurope.eu/projects/project-search/cvpp-community-based-virtual-power-plant/news/siddharth-raghav-murali-who-recently-graduated-with-a-master-s-thesis-titled-community-based-virtual-power-plants-aligning-technical-functions-with-social-motivations/

Example talks:
https://energy-days.com/previous-editions/
https://www.pintofscience.nl/eindhoven-sustainable-science
http://europeanpowergeneration.eu/files/Power_2019_Onsite_Agenda_All_Days_Combined_opt.pdf

Example media contribution:
http://www.nweurope.eu/media/4514/rvo-brochure_interreg-klimaat_-oktober-2018.pdf

Example flyers:
https://www.nweurope.eu/media/4587/cvpp_flyer-apeldoorn.pdf
https://www.nweurope.eu/media/7300/community-power-flyer-220719.pdf

Project poster:
https://www.nweurope.eu/media/3710/cvpp_a3-projectposter_def.pdf

Press releases:
https://www.nweurope.eu/media/8407/persbericht-kampc.pdf
https://www.nweurope.eu/media/4411/cvpp_kamp-c_persbericht-1.pdf
https://www.nweurope.eu/media/4586/persbericht-liandon-ec-en-translyse-winnen-eu-aanbesteding-cvpp-20181012.pdf

Scientific article examples:
https://doi.org/10.3390/proceedings2019020025
https://research.tue.nl/en/publications/defining-community-based-virtual-power-plant