D4.2 IMPACTS OF PVP CONCEPTS ON GRID SYSTEM – THE NETHERLANDS

Concept and guidelines

PVP4Grid

D4.2

Internal note

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Summary

The recent Clean energy for all Europeans package (CE4AE Package) introduced a comprehensive update to the EU energy policy. Along with other important changes, the new rules facilitate individuals and collectives to become energy prosumers i.e. to produce, store or sell their own energy from renewable sources. The PVP4Grid project explores photovoltaic (PV) energy prosumer concepts, particularly in terms of energy communities, by carrying out qualitative analysis and quantitative simulations and testing of PV prosumer concepts in eight different EU countries, with the overall objective to gain better understanding of those factors that can potentially enable or hinder the process of consumers becoming PV prosumers in economically viable and system-friendly manner.

This report looks at the PV prosumers concepts and their implications for electricity grid system and its actors in the Netherlands. The so-called “grid actors” include the most relevant stakeholders such as regulatory bodies, Distributed System Operators (DSOs), Transmission System Operators (TSOs), electricity commercialisation companies, energy service companies (ESCOs) energy communities, consumers associations, aggregators, etc. The emergence of prosumers and energy communities proposes new challenges in terms of technical requirements for the network system and its management, changes in business models, and regulatory challenges to set the optimal framework conditions. The report presents the key results of the simulation and testing of several prosumer concepts conceived in the project in the Netherlands as well as stakeholder views and perceptions discussed at the PVP4Grid workshop organised in Utrecht on 19 December 2019.

The report is structured as follows:

- The first chapter describes the grid system and its actors providing a snapshot of the current landscape in the Netherlands. Then a summary of the new EU regulatory framework is provided.
- The second chapter presents the key results and conclusions of the quantitative simulation and testing of PVP4Grid concepts in the Netherlands.
- The third chapter collects the key findings of the workshop, summarising the stakeholder views on PVP4Grid concepts, as well as the related benefits and challenges.

1 Introduction

1.1 Description of the grid system landscape in the Netherlands

1.1.1 Definitions and roles of different actors

The liberalisation process of the electricity market and the directives for non-discriminatory access to the network, implemented in Europe [1], have contributed significantly towards the creation of competitive markets and a restructuring of the electricity sector. In Europe, each control area of the interconnected power system [2], is operated by the associated Transmission System Operator (TSO), the legal institution that monitors the transmission network, ensures the connections with other control areas, and organises the markets for operating reserves and cross-border capacity and exchanges. The Netherlands is operated as a single control area, and TenneT TSO[1] is the responsible authority to ensure security of supply and to facilitate electricity markets operation. A single control area might involve one or more Distribution System Operators (DSO), but every regional distribution system is associated to a single DSO company that operates as a natural monopoly. DSO companies connect individual system users to the transmission network, and provide the distribution of electricity through medium voltage (MV) and low voltage (LV) networks, which subsequently feed a large number of system users at the LV distribution level. There are currently 8 DSOs active in the Netherlands, while 3 dominant DSOs manage 95% of all customer connections, i.e. Enexis, Alliander (Liander/Endinet) and Stedin (Eneco)[2].

The Dutch electricity market has been fully open to competition since July 2004, and TenneT recognises Balance Responsible Parties (BRPs) as the market parties that can nominate energy at the wholesale level. Other main stakeholders in the Dutch power market are the regulator, i.e. the Authority for Consumers and Markets (ACM)[3], and the European Power EXchange (EPEX)[4] which is a power exchange providing trading and clearing services for the wholesale market in Germany, France, the United Kingdom, the Netherlands, Belgium, Austria, Switzerland and Luxembourg. Furthermore, the association Energie-Nederland[5] represents energy producers, traders and supply companies in the Netherlands. An overview of the main actors (and their roles) involved in the Dutch Energy Market, is provided in **Table 1**. Terms and roles have been aligned with those used in [3], and by ENTSO-E [2], [4].

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1 www.tennet.eu
2 Updates on DSO service area, as per Jan. 1, 2016, can be found herein: Enexis Holding N.V. Investor Presentation (Oct. 2015). Available online: https://www.enexisgroep.nl/media/1188/enexis_holding_nv_investor_presentation_201510.pdf
3 Autoriteit Consument & Markt: https://www.acm.nl/nl
4 In 2015, EPEX SPOT integrated with former APX Group: www.apxgroup.com
5 http://www.energie-nederland.nl/

Figure 1. Overview of Dutch DSOs.

1.1.2 Current grid system landscape

In the Netherlands, the transmission grid (>110 kV) is operated by the TSO, TenneT, whereas the distribution grids (<110 kV) are operated by DSOs. Cross-border connections encourage free-market operation in the energy sector, and the Dutch power system is highly interconnected (within the ENTSO-E area), as follows:

- Continental cross-border connections with Germany and Belgium.
- Undersea cross-border connections with Norway (NordNed, since 2008) and the United Kingdom (BritNed, since 2011).
- Cobra cable undersea connection with Denmark (with Energinet, since 2019).

Grid operators, i.e. TSO and/or DSOs companies, are potential users of flexibility services, through the procurement of ancillary services, to perform their core tasks, to defer network reinforcements and investments, and to reduce grid losses [6].

Table 1. Main Actors and Roles in the Dutch Energy Market **[5]**.

Actors/Roles	Description	Relevant Dutch Stakeholder
System user	System users are the natural or legal persons that supply, or are being supplied by, a transmission or distribution system [2]. The system users are all the producers and consumers of electricity that own and operate within their premises any generation unit, load and/or storage device.	All consumers/producers connected to the Dutch grid
Balance Responsible Party	A BRP carries the role of energy nomination at the wholesale level [2], and is responsible for balancing supply and demand for its portfolio.	A full list of registered BRPs in the Netherlands can be found at the TenneT BRP Register[6].
Balancing Service Provider (BSP)	The term Balancing Service Provider is used for the market participant that provides balancing services to its connecting TSO or in case of the TSO-BSP model, to its Contracting TSO [4].	A BSP is a market party that submits bids to TenneT and from which TenneT activates power for its balancing task, for Frequency Containment Reserves (FCR), automatic Frequency Restoration Reserve (aFRR) and manual Frequency Restoration Reserve (mFRR) products BSPs[7].
Supplier	The role of the supplier is to source, supply, and invoice energy to its customers. The supplier and its customers agree on commercial terms for the supply and procurement of energy [3]. The supplier must be assigned the metering points of the customer it supplies [4].	The number of energy suppliers in the Netherlands quadrupled since liberalisation[8]: "Before deregulation there were only 12 suppliers for electricity, based in different parts of the country. Now, there are. In total, 35 companies offer gas and electricity for consumers. The remaining 12 only offer energy contracts to businesses and multinationals. Thirty-one out of the 47 companies offer energy from renewable sources".
Transmission System Operator	A party that is responsible for a stable power system operation (including the organisation of physical balance) through a transmission grid in a geographical area [2].	TenneT TSO B.V. is the responsible authority to ensure security of supply and to facilitate electricity markets operation.
Distribution System Operator	A natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution network in a given area and, where applicable, its interconnections with other networks and for ensuring the long-term ability of the network to meet reasonable demands for the distribution of electricity [4].	There are currently 8 DSOs in the Neterlands, i.e. Liander, Enexis B.V., Stedin B.V., Enduris, Endinet, Westland Infra, Cogas Infra & Beheer B.V., and N.V. RENDO. [9]

[6] BRP Register (TenneT, 2019):"https://www.tennet.eu/electricity-market/dutch-market/brp-register/
[7] Imbalance Pricing System (TenneT, 2019):
https://www.tennet.eu/fileadmin/user_upload/SO_NL/ALG_imbalance_pricing_system.doc.pdf
[8] https://www.dutchnews.nl/features/2018/07/number-of-energy-suppliers-in-the-netherlands-quadrupled-since-liberalisation/
[9] The market share of electricity DSOs in the Netherlands in 2016 and 2017:
https://www.statista.com/statistics/878534/electricity-dso-market-share-in-the-netherlands/

TenneT organises single-buyer markets for Ancillary Services[10]. Specifically, for the provision of primary reserves:

- The provision of reserves for primary control used to be a mandatory, unpaid service for controllable generators in the Netherlands.
- On April 2013 the Dutch regulator ACM agreed a proposed change in the system code related to the procurement of primary reserve.
- The change came into effect on January 2014 and stipulates that TenneT has to procure the primary reserves in a market-based manner, by joining the German platform for weekly auctions (regelleistung.net).
- The requirements for primary contributions are determined annually by ENTSO-E in proportion to the total production volume in the control area.
- In 2019 the frequency bias setting for the Netherlands is 3,7%[10]. This means that an outage of 3000 MW (reference incident) anywhere in the synchronous grid of continental Europe, should result in a Dutch FCR contribution of 111 MW.

TenneT also organises a single-buyer-market where market parties can offer regulating and reserve capacity, i.e. capacity that they can produce or consume over or under the amount reported in their energy program (e-program) per ISP with a dispatch time of ≤15 minutes. Furthermore, regulating and emergency capacity is contracted by TenneT to cope with uncertainties during significant contingency events.

An extensive review of available products for ancillary services in the Netherlands can be found in [7], including the main characteristics of the operating reserves for balancing that are currently traded in the Netherlands, as well as other ancillary services (black start and transmission services).

1.1.3 Grid system and prosumers – current state of play

Recent developments in distribution grids, environmental policy, and the energy market liberalisation process, have opened up several opportunities for the provision of market-based products and services from distributed energy assets through aggregators [7].

In recent years, TenneT has updated ancillary services product specifications for balancing and processes have been streamlined (e.g. allowing shorter bid periods), which enable a broader range of flexible assets to play a role in this market. Furthermore, TenneT has initiated pilot

[10] Ancillary Services (TenneT, 2019): https://www.tennet.eu/electricity-market/ancillary-services/

projects for FCR delivery with aggregated assets[11], and aFRR provision focused on aggregators and decentral energy assets[12].

Regarding congestion management, a coherent approach by TSO and DSOs is important to manage congestion and to enable access to flexibility for that use where it is most valuable, and the GOPACS[13] (Grid Operator Platform for Congestion Solutions) project was initiated early 2019 in cooperation with grid operators and the Energy Trading Platform Amsterdam (ETPA[14]). Based on up-to-date information, the grid operators determine where and when congestion can be expected. To solve congestion at a certain part of the grid, electricity production/consumption needs to be adjusted. The congestion situation is entered into GOPACS, and market parties with a connection in the affected area can then place an order on the platform. However, the balance in the electricity grid at a national level is not to be disturbed. This is why an adjustment in the congestion area is combined with an opposite order from a market party outside of the congestion area.

The above-mentioned pilot projects and initiatives by the grid operators open up opportunities for prosumers and aggregators to participate actively in ancillary services markets.

Regarding self-consumption, the Dutch government has decided to maintain the net-metering scheme, which was originally scheduled to be replaced in 2020, with its current conditions for residential Photovoltaic (PV) systems until the end of 2023, with plans to gradually phase it out by 2031. At current cost for PV installations, economic payback time for residential PV systems is about 7 years. The gradual reduction of the net-metering scheme is planned to ensure that this remains at 7 years. With the net-metering scheme in place, there is currently no financial incentive for prosumers to store the surplus of PV generated electricity. By the moment that the scheme will be abolished, PV energy is expected to have reached marginal cost levels comparable to the fossil-fuel based power plants now in place, whereas the gradual phase-out is also expected to create opportunities for energy storage technologies by encouraging self-

[11] End report FCR pilot – TenneT 2018. Available online: https://www.tennet.eu/fileadmin/user_upload/SO_NL/FCR_Final_report_FCR_pilot__alleen_in_Engels_.pdf

[12] TenneT: continuing with Blockchain after successful (FRR) pilots, Jan. 29, 2019. Available online: https://www.tennet.eu/news/detail/tennet-continuing-with-blockchain-after-successful-pilots/

[13] Dutch grid operators launch GOPACS: a smart solution to reduce congestion in the electricity grid, Jan. 29, 2019. Available online: https://www.tennet.eu/news/detail/dutch-grid-operators-launch-gopacs-a-smart-solution-to-reduce-congestion-in-the-electricity-grid/

[14] ETPA is a recent development, started in April 2016, which lowers the market entry thresholds. Furthermore, ETPA enables market parties to trade energy in blocks of 15 mi.n., one hour, one day, one weekend, or one week. TenneT has a share of about 40% in ETPA [11]

consumption. Residential PV installations supported by the net-metering scheme have accounted for about 550 MW (38% of the solar market in 2018) [8].

1.2 The new EU Regulatory Framework for Self-Consumption and its Grid related Provisions

A recently adopted new set of EU rules – the so-called "Clean Energy for All Europeans" Package[15] - is aiming to further develop one of the EU's major long term policy initiatives, namely the EU Energy Union.[16]

Major objectives of this Union include, among others, to place renewable energy and energy efficiency into the centre of a new internal energy market and put citizens at the core of the Energy Union. It includes European-wide targets, inter alias, to increase the share of renewables in the EU energy mix to 32% by 2030.

The new framework shall enable citizens to actively participate on a level playing field across the market and to benefit from Europe's energy transition. It aims at empowering and protecting consumers through better information on energy consumption and costs and helps issuing a tighter safety net to addresses energy poverty and vulnerable consumers. In addition, energy labels and eco-design measures are directed to increase cost savings and energy-efficient behaviour. Also, consumers are given more choices in their homes, making it easier to play a more active role and engage as self-consumers – or "prosumers" - in electricity markets, by investing in renewable energy, most obviously solar panels, and then consume, store or sell the energy they produce, and benefit from functioning and organized electricity markets.

The necessity to further decarbonise the world's economies to counter climate change and the ambition to make Europe become the first climate-neutral continent should be further endorsed by what the incoming President of the next European Commission, Ursula von der Leyen, chose to call the "European Green Deal" – a set of new policy initiatives announced for the new legislation period 2019 to 2024 "to reduce emissions further and faster, and by at least 50% for 2030".

In parallel, each EU Member State must transpose the new EU rules into national law and reflect them in their national energy and climate plans.

[15] Clean energy for all Europeans package, https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans
[16] Energy Strategy, https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union

Such an ambitious trajectory will need citizens and cooperatives to play an increased role in the take-up of renewables through self-consumption. To give support to the upcoming policy-making in this respect, the PVP4Grid project results and recommendations can be used to address and reduce barriers beyond existing regulatory frameworks across the EU.

1.2.1 The new EU Regulatory Framework for Self-Consumption

Although self-consumption is not a new concept, and individual self-consumers are relatively widespread across Europe, the EU now obliges its Member States to adopt enabling legislative frameworks in this respect until the end of 2019 – and demonstrates its vision that consumers shall participate in energy markets as equals among all market players. By introducing new provisions and its corresponding definitions, the EU for the first time formally recognises self-consumers, as “renewable self-consumers” and “active customers”, entitled to generate, store and consume electricity from *renewable* sources but also to carry out activities beyond the self-consumption, such as the participation in flexibility or energy efficiency schemes. Hence electricity, produced either individually or collectively, can be fed into the grids and in return make self-consumers receive remuneration that reflects market value. Nevertheless, this is not supposed to represent one’s primary commercial or professional activity. Electricity behind the meter is not being charged, although exemptions are foreseen for installation larger than 30 kW, for electricity that benefits from support schemes, or if there’s system risks resulting from increasing amounts of the electricity fed into the grid (from 2026 onwards). Such active participation in energy markets is further enhanced by facilitating power-purchase agreements, peer-to-peer trading and demand response schemes.

Furthermore, the new provisions aim at tackling barriers related to over-burdensome bureaucracy by preventing consumers from being subject to disproportionate technical and administrative requirements and procedures. For instance, self-consumers owning energy storage facilities have the right to a grid connection within reasonable time.

1.2.2 The Grid related Provisions

From a macro-economic perspective, the most pressing challenge results from integrating renewables into the electricity networks, and in particular at distribution level where more than 90% of RES are connected. The overall system costs need to be allocated among all network users while striking a balance for pursuing the two overarching – and potentially conflicting - principles of sustainability and affordability. Sustainable, because incentivising active customers and renewable self-consumers (as well as consumer engagement in other forms, such as citizens' and renewable energy communities) increases the RES share in the EU's energy mix and contributes to achieving the EU's decarbonisation targets. And affordable, because most of Europe's network costs are still socialised among all system users and paid in form of network tariffs to ensure the network operators' revenue stream. When now an increasing number of consumers gain a higher energy autonomy and in consequence contribute less to the network and the overall system costs - while in most cases remaining connected to the distribution networks for times without sun or wind. The "passive" consumers or those without means or access to renewable self-consumption will need to afford a higher share of the system cost and might face increasing energy bills. The new EU rules acknowledge and address the need to outbalance this conflict of interests:

- Network charges need to be cost-reflective and contribute to the overall cost sharing of the system, and account separately for electricity consumed from the grid and electricity fed into the grid, phasing out net metering schemes beyond 2023, to make sure that self-consumers pay the full cost of service to use the grid and do not shift their share of the costs onto customers without renewable self-consumption.
- Principles for network charges and tariffs - such as for connecting consumers to the networks – according to which citizens shall not be discouraged from becoming self-consumers. Also, distribution tariffs may be differentiated, based on the system users' consumption or generation profiles.
- Active customers are financially responsible for the imbalances they cause in the electricity system but can delegate their balancing responsibility to market actors offering such services (so-called "aggregators"). Regarding demand response, consumers have to pay a compensation to other market participants or their balancing responsible party that are directly affected by their demand response activity.

Many of the new provisions in this respect are kept at rather general level, as the cost allocation and financing of accessing and using energy networks differ to large extent across the EU. Much depends on how Member States will proceed and transpose the new EU rules into national legislation, while more legal clarifications are expected to be defined in a Network Code on demand response, including aggregation and energy storage - which is likely to further develop also the framework for active customers and renewable self-consumers. Network Codes are legally binding European Commission implementing regulations to govern all cross-border electricity market transactions and system operations.

From the perspective of the electricity network, the increasing decentralisation of Europe's energy system has a major impact on how to operate networks in an affordable, sustainable and secure way. Large shares of renewable energy sources, including electricity produced by self-consumers, are connected at medium and low voltage level and integrated by the DSOs into the networks. Therefore, the EU has assigned new roles and responsibilities to DSOs who in their function as regulated monopolistic entities (there is no parallel electricity grids, for good reasons) shall become “neutral market facilitators” and will need to carry out more active system management, but without interfering in existing and functioning markets. While not explicitly referring to active customers and renewable self-consumers, this is reflected in the new EU regulatory framework for DSOs and designed to incentivise the further development of “smart, flexible and digitalised” networks - a prerequisite for connecting and integrating self-consumption. This entails, in particular for intermittent electricity, the use of flexibility for shifting loads and matching generation and demand (electricity networks must be in balance at all times), access to storage facilities, rules for congestion management (in times with lots of sun or wind), data exchange and management models, the further roll-out of smart meters and a better cooperation between TSOs, operating high voltage and long distance networks, and DSOs, as well as the interaction with market parties.

All in all, with the new EU framework on self-consumption, the principles on network charges and tariffs, as well as for the new rules for the operation of electricity distribution networks, the EU is trying to establish a fair balance between customer and the electricity system needs – which the Member States will now need to reflect when implementing the Clean Enery for All Europeans Package into national legislation.

2 KEY IMPLICATIONS OF PVP4GRID CONCEPT TO GRID SYSTEM

In this section, a quantitative analysis of improved PVP4Grid concepts is described, focusing on both cost and CO_2 emission reduction potential.

2.1 Economic optimization PV and Battery instalment

This part of the research was conducted by TU Wien; the complete report will be available online from March 2020 [9].

2.1.1 Methods

The optimization model HERO^{community} was used to calculate the optimal generation and storage mix. In the model, the prosumer optimizes the costs of energy consumption (heat and electricity). In short, the decision variables are grouped in two categories, i.e. investment and operational decisions. They are:

Investment decisions

- Processes: photovoltaic capacity in kWp
- Storages: battery capacity in kW and kWh

Operational decisions

- Energy flows within the renewable energy community (REC) in kWh per unit of time
- Charging and discharging of storages in kWh per unit of time
- Buying and selling from the grid in kWh per unit of time

Constructed time series of electricity demand, heating demand, hot water demand, electric vehicle charging (EV) demand and solar irradiation were used as input for the optimization model. The provision of energy can be provided either by PV, storage, or by buying electricity from the grid. Additionally, the prosumers are able to trade within the renewable energy community (REC). The model is able to picture energy trades within the same building (i.e., group 2[17], Figure 2) or from neighbouring buildings (i.e., group 3, Figure 3).

[17] For a definition of groups, see Deliverable D2.1

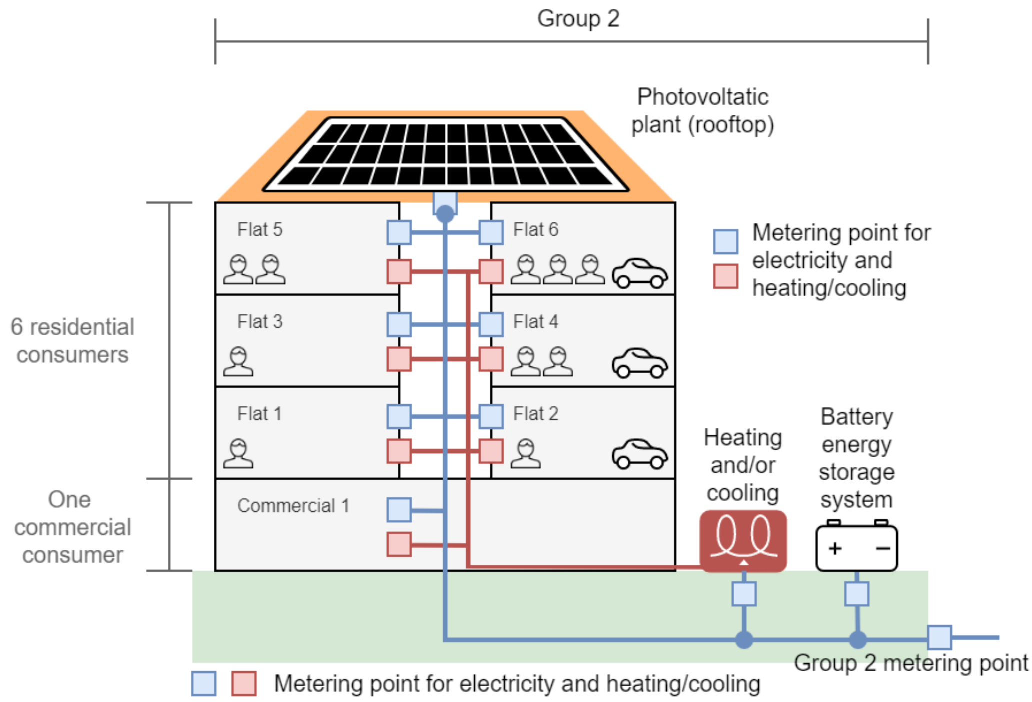

Figure 2. Schematic of group 2.

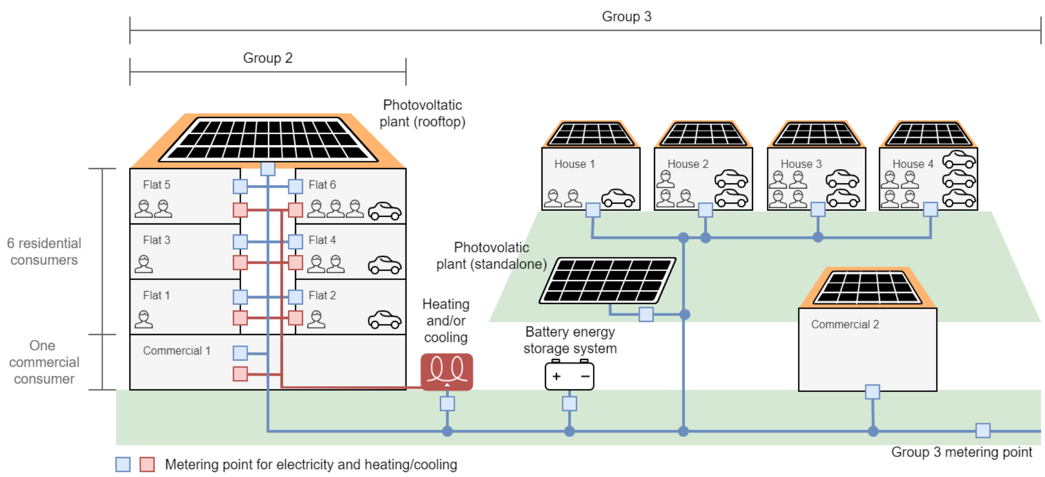

Figure 3. Schematic of group 3

Table 2 shows the three scenarios that were considered both in Group 2 and in Group 3; Grid consumption, No community and community. In the case of energy sharing, consumers would save the retail electricity price (assumed to be 21 €ct/kWh), but would still need to pay 7.1 €ct/kWh as grid fee. Two demand scenarios were analysed: a 'Baseline' scenario (natural gas boiler heating and no EV) and a 'Future' scenario (all-electric, including EVs).

Table 2. Overview of the community scenarios.

Community scenario	Metering point	Investment options	Energy sharing
Grid consumption	Individual metering (per household)	None	No
No community	Individual metering (per household)	PV and BESS	No
Community	Group metering	PV and BESS	Yes

2.1.2 Results

In the Future (all-electric) scenario of group 2, both in the Community and in the No Community scenario 30 kWp of PV was installed, which was the maximum of the available roof space. In group 3, a total of 98 kWp was installed in the No Community scenario, and 95 kWp in the Community scenario. Figure 4 shows that installing PV leads to cost reductions compared to the Grid consumption scenarios. Although the amount of PV installed in the No Community scenario and the Community scenario is roughly equal, the advantage of an energy community can be found in the economic results. Figure 4 shows the results of the economical optimal configuration for Group 3. Here, the community scenario clearly achieves costs savings compared to the No Community scenario. This can be explained by the lower installation costs and higher benefits because of the possibility of selling electricity to the neighbours.

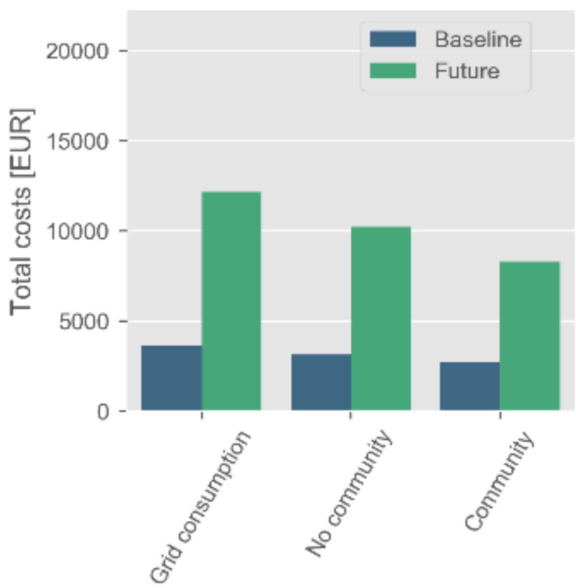

Figure 4. Total yearly energy costs of the renewable energy community.

The impact on the grid is shown in Figure 5. Evidently, the all-electric scenario ('Future') leads to higher peaks than the baseline scenario. Peak consumption and peak feed-in are similar for the Community and the No Community case.

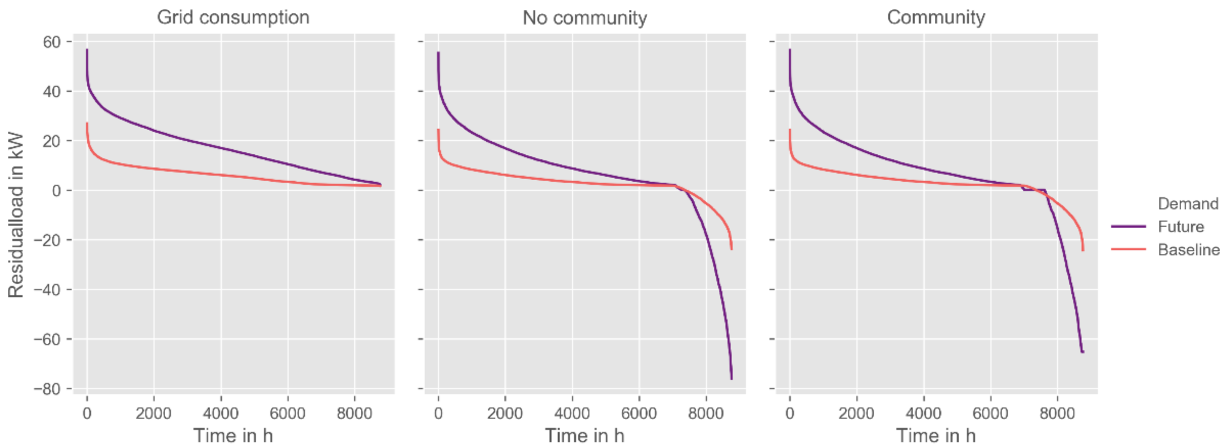

Figure 5. Load duration curves of energy communities.

2.1.3 Greenhouse Gas Emission Reduction Potential of Energy Communities

This research is based on the publication that can be found in [10]. The impact on Greenhouse Gas (GHG) emissions was calculated for the all-electric scenarios of the energy communities, with the same configuration as Figure 3. Assumed installed PV capacity was 124.6 kWp for the Energy sharing (Community) scenario and 113.9 for the No Energy Sharing (No Community) scenario. Furthermore, battery capacities were assumed to be 24.3 kWh and 16.4 kWh for the sharing and no sharing scenario, respectively. Hourly emission profiles were constructed to account for process emissions, while life-cycle emissions of the manufacturing of the PV system, batteries, heat pump and EVs was taken from the Ecoinvent v3 data base.

Figure 6 shows the GHG emission reduction potential for the energy communities in total, and specified and normalized per technology. Energy communities can have a large impact on the GHG emissions of the community. Every kW of installed PV leads to an emission reduction of 8%. Because of the PV installed in the community, the impact of switching from a vehicle with an internal combustion engine to an EV is relatively high; substantial parts of the EV charging demand is covered by onsite PV-generated electricity.

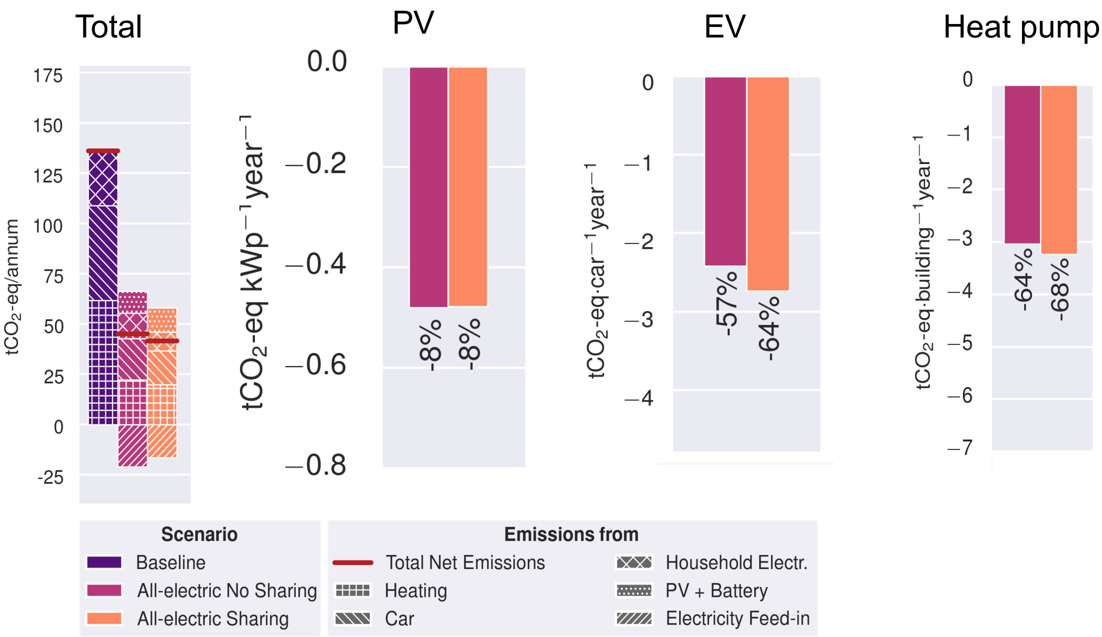

Figure 6. Overview of GHG emission reduction potential of energy communities.

3 KEY BENEFITS AND CHALLENGES FROM THE PERSPECTIVE OF THE GRID SYSTEM, RESULTS FROM THE DSO WORKSHOP

The national workshop “The impact of PV prosumer concepts on the electricity grid” (in Dutch “de impact van PV prosumenten concepten op het elektriciteitsnet”) with national DSOs and other relevant stakeholders has taken place on Thursday 19 December 2019, in Utrecht, at the offices of the association Holland Solar at Arthur van Schendelstraat 550 in Utrecht.

The purpose of the workshop was to

- gather technical input from national stakeholders for the project report on the implications of PV prosumption (PVP) concepts on grid systems (D4.2, this report)
- enhance understanding of the country context and challenges related to PVP concepts from the perspective of grid system
- involve of most important stakeholders at national level

In total nine persons representing all relevant stakeholders in the Netherlands (DSOs, associations on solar and on renewable energy, energy consultants, funding bodies) attended the workshop (see Deliverable 3.3). The PVP concepts have been presented as well as the new legislation of the EU energy union. In addition, a case study on prosumers in Amsterdam was presented. Finally, a SWOT analysis has been made,

Attendees commended on the work done regarding the PVP concepts and the timeliness of the results in relation to the new EU legistations regarding prosumer involvement. In their opinion, this will assist national policymakers in formulating new, more prosumer directed, legislation needed to realize the greenhouse gas emission reductions nationally and Europe-wide.

Attendees agreed that PVP concepts were not at the forefront of attention of policy makers in the Netherlands, as at the moment other sectors have higher potential in greenhouse gas reductions, which is central in the national Climate Agreement, and as the Netherlands is short on reaching the national targets in greenhouse gas reductions that have been agreed between member states of the EU. In the national Climate and Energy Exploration (nationale Klimaat en Energie Verkenning) 2030/2050 flexibility is not even mentioned. This is a great shortcoming. Perhaps this may have to do with the PBL (Netherlands Environmental Assessment Agency) models not having high enough spatial resolution to account for local energy management and flexibility.

It seems that in the Netherlands the built environment is not really treated seriously in relation to the potential greenhouse gas emission reduction, as the industrial and agricultural sectors emit considerably more greenhouse gases. The lobby to the government in the interest of prosumers is mostly missing, but lobby efforts may be intensified as net metering will be abolished at the end of the decade. The national consumer association (Consumentenbond) and the Homeowners Association (Vereniging Eigen Huis) should be more active in this, as well as social housing organisations. Perhaps it should be made clearer that if prosumerism is not recognized as potentially assisting grid stability, customers will be paying more for the electricity they consume due to higher networking cost.

Nevertheless, in the national Climate Agreement district heating, energy savings and electrification of the built environment are measures identified to be needed to realize greenhouse gas emission in the built environment. In the EU Clean Energy package, the role of consumers is mentioned though, and the Dutch government should take that much more seriously.

Abolishment of net metering will start from 2023 with a gradual, linear decrease to a zero settlement price in 2031. This start coincides with the moment that large-scale smart meter roll out is expected to have been realized. Abolishment of net metering is expected to negatively influence the residential PV market, while it may also lead to increased selfconsumption as batteries will become cheaper in that period. We do note, however, that in many Dutch pilots with PV/storage it is found that the battery storage is full even before the PV peak that occurs at noon. Proper energy management is required.

Many pilot projects on energy management in local grids, including PV/EV/V2G are being performed, however lessons learnt could be shared in a better way. Also, integral approaches are needed. Research and innovation funding will be modified for that. A difficult situation will be the ‘dunkelflaute’ days/weeks in winter, without wind and solar energy, while heat (pump) demand will be high.

A steady increase in the number of energy communities in the Netherlands is observed, due to the postal rose policy scheme, experiments with peer2peer trading, and in the framework of the so-called experimental arrangement (experimenteerregeling) that allows bypassing regulations in testing out new ideas/technologies. This societal movement has been growing and in new legislation even local ownership or participation will be required of about 50%.

PVP concepts can provide flexibility to the local grid to address congestion, which DSOs need to be able to handle, but probably only to a limited extent. One of the solutions could be peer2peer trading between prosumers. Physically this is possible on the same cable/transformer (any surplus at the moment will be injected in the grid anyway and is settled based on the net metering policy in force), but it is economically not interesting due to double taxation: exporting surplus energy requires that one pays energy tax, and someone else importing will also need to pay energy tax. Grid fees also apply, but that is making sense, as one uses the grid.

However, peer2peer trading will not help in addressing congestion, and perhaps it may lead to local increased power fluxes that go beyond cable capacity. Proper management is required, but it is unclear who will do that. DSOs are involved as grid manager, but legally DSOs presently are not allowed legally to act as peer2peer facilitator. An aggregator may need to step in for this, and/or legislation need to be adapted for that.

Presently, most DSOs plan new or extensions of distribution grids based on the needed capacity on a winter day, not taking EVs and heat pumps into account (yet). In the future, flexibility is deemed to be necessary, but this will require energy management at the LV level. It is yet unclear how that will happen. Flexibility will help DSO in managing congestion, while peer2peer trading does not necessarily alleviate congestion. Other, perhaps more visionary DSOs may already take future developments into account in new grid design.

It was also mentioned that perhaps flexibility may not be *the* solution, while the built environment must contribute to flexibility (services) in some way. On a local level, the potential of flexibility may not be large, but on a higher system level (HV grid) it certainly is.

The effects or prosumption on costs/revenues for the DSO are not clear. Neither on state level, however, if the tax regime is changed, the state will see a decrease in tax-based incomes. Question is to find the optimum for the whole society, which requires a societal cost/benefit analysis. Increased selfconsumption, be it individual or within a community, would lead to lower demand, thus helping to prevent congestion. DSOs are supportive of this, but it is not their core business.

Finnaly, the following SWOT analysis of PVP concepts in relation to DSOs was made:

Strengths: • Local generation leads to potential lower demand and peaks at medium voltage grids (and to a lower extent at the low voltage grid • Lower costs for prosumer and DSO • Influence of electricity consumer on cost is enlarged	Weaknesses: • Not urgent • Not visible • Impact is low (short term) • Not on radar of policy makers
Opportunities: • New businesses for SME, regarding flexibility services • Peer-to-peer trading (smart)	Threats: • Grid extension/reinforcement • Peer-to-peer trading (smart) • Available personnel (human capital agenda)

4 References

[1] The European parliament and the council of the European Union, “Directive 2009/72/EC of the European parliament and of the council concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC,” Brussels, 13 Jul. 2009.

[2] ENTSO-E, “The Harmonised Electricity Market Role Model, Version: 2015-01,” European Network of Transmission System Operators for Electricity (ENTSO-E), Brussels, Belgium, 2015.

[3] Universal Smart Energy Framework (USEF) Foundation, “USEF: The framework explained,” ISBN 978-90-824625-0-0, 2015.

[4] ENTSO-E, “The ENTSO-E Metadata Repository Glossary,” 2016. [Online]. Available: https://emr.entsoe.eu/glossary/bin/view/Main/. [Accessed Mar. 2016].

[5] I. Lampropoulos, M. van den Broek, W. van Sark, E. van der Hoofd and K. Hommes, “Enabling Flexibility from Demand-side Resources through Aggregator Companies,” in *Smart Cities in the Mediterranean - Coping with Sustainability Objectives in Small and Medium-sized Cities and Island Communities*, Cham, Switzerland, Springer, 2017, pp. 333-353.

[6] Expert Group 3 (Regulatory Recommendations for Smart Grids Deployment), “Regulatory Recommendations for the Deployment of Flexibility,” European Commission Smart Grids Task Force, Jan. 2015.

[7] I. Lampropoulos, M. van den Broek, E. van der Hoofd, K. Hommes and W. van Sark, “A system perspective to the deployment of flexibility through aggregator companies in the Netherlands,” *Energy Policy,* vol. 118, pp. 534-551, 2018.

[8] E. Bellini, “Netherlands to maintain current net-metering conditions until 2023,” 30 Oct. 2019. [Online]. Available: https://www.pv-magazine.com/2019/04/26/netherlands-to-maintain-current-net-metering-conditions-until-2023/.

[9] A. Fleischhacker, J. Radl, F. Revheim, G. Lettner, D. Schwabeneder and H. Auer, “Quantitative Analyses OfImproved PVP4Grid Concepts And Report On Testing.,” Technical report, Deliverable D3.2 of the projectPVP4Grid, 2019. http://www.pvp4grid.eu/impact-analysis/. Available March 2020, 2020.

[10] W. Schram, A. Louwen, I. Lampropoulos and W. van Sark, “Comparison of the Greenhouse Gas Emission Reduction Potential of Energy Communities,” *Energies,* vol. 12, no. 23, pp. 1-23, 2019.

[11] TenneT TSO B.V., “Press release: TenneT to support development of flexible energy trading platform for private sector,” TenneT Holding B.V. 2017, 30 Mar. 2016. [Online]. Available: http://www.tennet.eu/news/detail/tennet-to-support-development-of-flexible-energy-trading-platform-for-private-sector/. [Accessed 11 Dec. 2019].