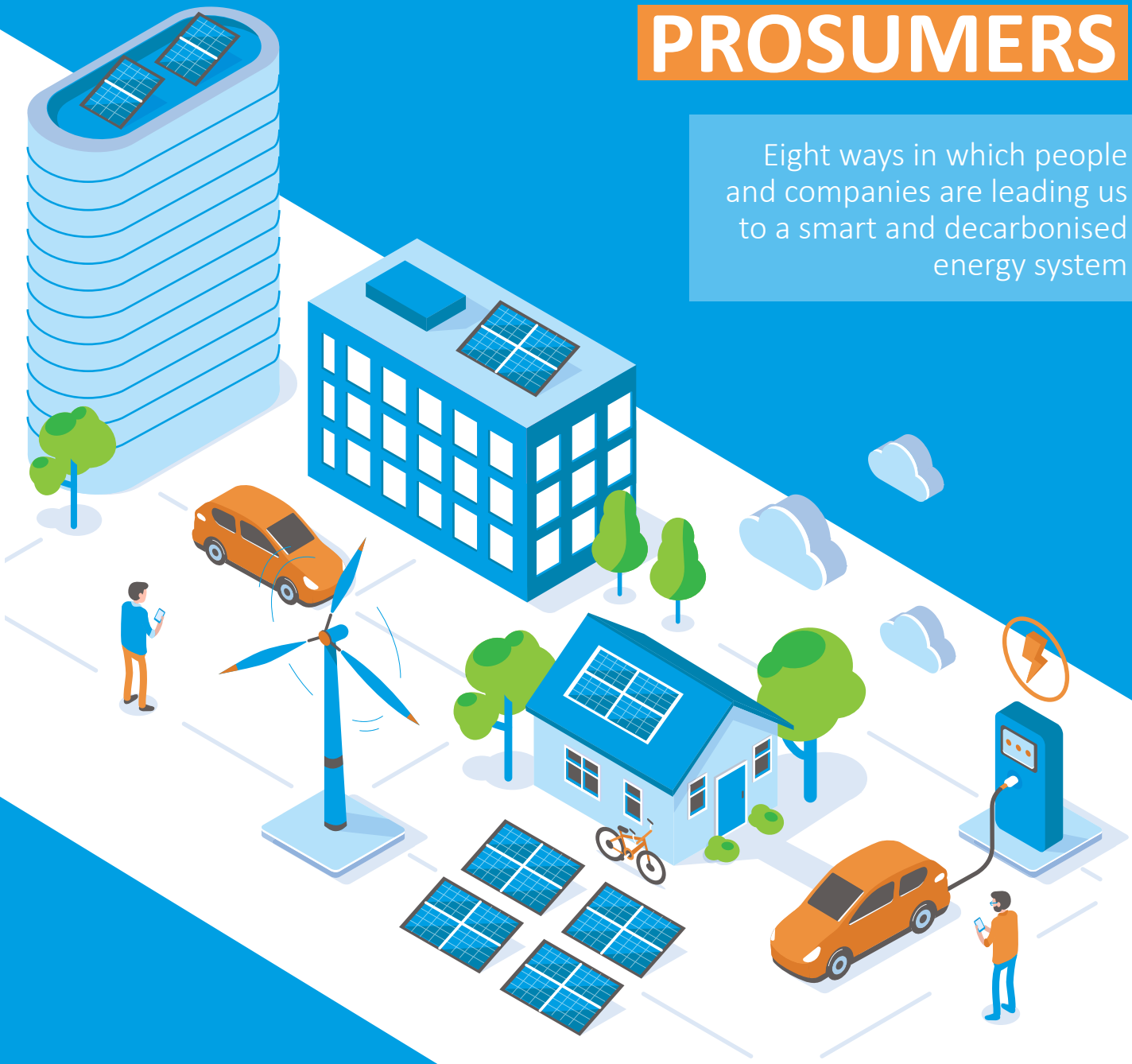
SMART ENERGY PROSUMERS

Eight ways in which people and companies are leading us to a smart and decarbonised energy system



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List of acronyms:

CEC = Citizen Energy Community
DER = Distributed Energy Resource
DSO = Distribution System Operator
EV = Electric Vehicle
GO = Guarantee of Origin
PPA = Power Purchase Agreement
PV = Photovoltaic
REC = Renewable Energy Community
TSO = Transmission System Operator

Lead author: Layla Sawyer, smartEn

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Summary

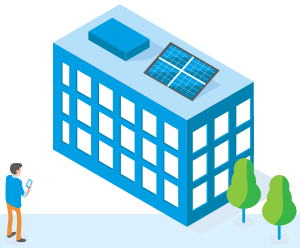
When we think of prosumers, we should not only think of a single house with a solar panel, but of a wide range of actors including households, commercial and industrial players. This report identifies eight different smart prosumer models, and identifies what the financial and non-financial factors driving these models, as well as the benefits these prosumers are bringing to society as a whole.

1. Grid-connected households with onsite PV, storage, and/or flexible load
2. Grid-connected households with offsite DERs
3. Off-grid Households
4. Commercial buildings with onsite DERs and flexible load
5. Industrial prosumers with onsite DERs and flexible load
6. Green Corporate Sourcing
7. Virtual Energy Communities
8. Virtual Communities based on grid proximity

Across all these models, we discover several recurring financial and non-financial drivers to become a prosumer. Financial drivers are often based on specific regulatory frameworks, such as existing feed-in-tariffs, the regime of taxes and network charges, and access to markets for aggregated and flexible loads. As for non-financial drivers, themes such as participation in the energy transition, autonomy, resilience, and the importance of showing climate leadership become apparent.

In addition to the benefits of being a prosumer, it is important to highlight the benefits prosumers are bringing to society. In terms of the energy system, they have an important role in decarbonisation, keeping overall system costs low, as well as increasing energy security and resilience. In broader terms, they also play a role in raising awareness, making the energy system more inclusive, as well as increasing competition and innovation.

Finally looking forward, it is important to consider what will make these prosumer models more sustainable. We know prosumers are creating a considerable amount of value for the energy system, and in an ideal situation this would be directly reflected in price signals and revenue streams. However, since is not currently the case, we are left to consider how prosumers can monetize their value in the short term. It is also important to consider are whether prosumers have access to information needed to make decisions and how to communicate about the value they are bringing to the system.



Introduction

Europe is now entering a new era in which energy prosumers of all shapes and sizes are taking over the wheel. A record number of houses and buildings are now sporting PV installations and combining this with home storage systems, EV charging stations, and smart energy management systems to optimise the use of the different assets according to price signals and grid requirements.

Coinciding with developments in technology, energy service providers and platforms are paving the way for prosumers to participate in energy markets, many of which are only just now opening up to aggregated, flexible load. These services are empowering a growing number of prosumers to generate new revenue streams from their existing assets, and are providing an impetus to invest in new Distributed Energy Resources (DERs).

Industrial prosumers are also going to new lengths to participate in the energy transition, both by investing in DERs and optimizing their flexibility on site and by driving the demand for clean energy through corporate PPAs and purchasing Guarantees of Origin.

Yet as the various types prosumers become more mainstream, there is also a growing need to look at what is driving households, communities, buildings and industry to make choices regarding their energy use, and to the overall impact these choices have on the energy system.

This paper will have a closer look at what the drivers are for the current prosumer models, and how sustainable these models are. How dependent are they on the current support in the form of feed-in-tariffs or net metering? How dependent are they on the current regime of taxes and network charges, and will this regime still hold water if the number of prosumers continues to grow at the pace needed to reach the EU's 2050 goals? What is needed to develop long-term sustainable prosumer models, in which customers remain at the centre of the energy system?

This report starts out by looking at the most common prosumer models out there, and by analysing what is driving the business case for each model. These driving factors will feed into a final discussion on what is needed for prosumer models to be sustainable in the long-term, and in this way aim to trigger a larger policy debate on future prosumer models.

- Scoping: what prosumer business models are out there?
- Case studies

Scoping

- Analysis: what is driving the current models?

Driving factors

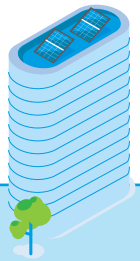
- Reflection: what is needed to develop long-term sustainable prosumer business models?

Future business models

Overview of models

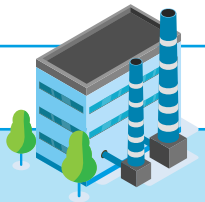
HOUSEHOLDS

- Grid-connected households with on-site PV, storage, and/or flexible load
- Grid-connected households with offsite DERs
- Off-grid Households



COMMERCIAL BUILDINGS

- Commercial buildings with onsite DERs and flexible load
- Green Corporate Sourcing



INDUSTRY

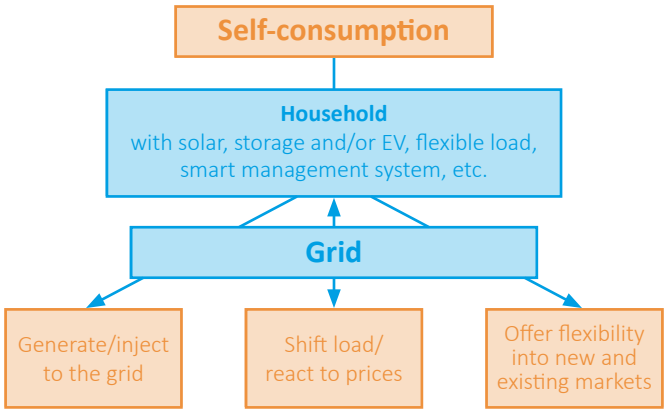
- Industrial prosumers with onsite DERs and flexible load
- Green Corporate Sourcing

COMMUNITIES

- Virtual Communities (based on membership)
- Energy Communties (based on grid proximity)

Households

Grid-connected households with onsite PV, storage and/or flexible load



OVERVIEW

There are many different ways in which a household can save money on their electricity bill or receive payments through its interaction with the grid, but essentially they come down to the following three activities: shifting electricity consumption based on price signals, installing generation capacity, or actively offering their flexibility through an aggregator. Each of these activities can be undertaken separately, or in various combinations, depending on the possibilities of the household, as well as the national regulatory framework.

Although grid-connected households can usually feed their surpluses back into the grid (depending on the national regulatory framework), home systems are usually sized to optimally match self-consumption. Residential PV has been most popular in countries with favourable Feed-in-tariffs or net metering regulations, while residential Demand Side Flexibility has been popular in countries where markets are most open to aggregated flexible load, and implicit flexibility is most feasible in countries with high level of electrification and strong price signals (e.g. through dynamic price contracts).

Electric vehicles and smart charging open up important new opportunities for households, because they consume a significant amount of energy, and can be used for all the above-mentioned purposes (including vehicle-to-grid injections, load shifting, participating in markets, etc.)

INVESTMENTS AND REVENUE STREAMS

Various revenue streams are available to grid-connected households, depending on the national regulatory framework. For households with onsite generation, such as solar PV, an important source of revenue is self-consumption, i.e. savings on the monthly energy bill due to avoiding the cost of purchasing electricity delivered through the grid. In countries without a feed-in-tariff or net metering scheme, this is in fact the only source of revenue. In countries with feed-in-tariffs or net metering schemes, selling the surplus energy back to the grid is another important revenue stream.

Adding flexible load into the mix opens up additional opportunities. It allows households to strategically use electricity when it is cheaper. This is particularly interesting if there are large price differences, e.g. with a dynamic pricing contract. If there is sufficient flexible load, it may also allow the household to bring down its peak, and thus minimise its capacity charge (if applicable). In addition, flexible load can allow the household to maximise its self-consumption, thereby further enhancing this revenue stream.

Finally, households are able to offer their flexibility into various markets through an aggregator. Many European balancing markets for example are now open to aggregated loads, and this allows households to participate in these markets (see for example The smartEn Map European Balancing Markets Edition).

TAXES AND CHARGES

The different kinds of taxes and network charges have an enormous influence on the payback period of any DER investment, and therefore on which kinds of models will be adopted in a certain country or region. If taxes and charges are largely volumetric, this encourages households to maximise self-consumption (e.g. by storing self-generated PV for later use). If charges depend mainly on the overall capacity size, this will encourage households to reduce their peak load.

BENEFITS

Although the economics of the model need to work for people to make such investments to their home, a large number of prosumers are likewise motivated to participate in the energy transition in order to contribute towards environmental goals, to benefit the overall energy system, and to increase their own autonomy over their energy supply. Smart energy management systems can even increase the comfort levels in the home and create a healthier living environment.

PROSUMERS IN PRACTICE

HOMES PROVIDING SERVICES TO THE FRENCH ELECTRICITY GRID

The Smart Home Energy Management System developed by tiko allows prosumers to connect all types of electrical devices, such as heating systems, coolers, PV systems, batteries and EV charging stations, independent of their brand, and to manage them through apps and web-based applications. As part of this system, French utility Direct Energie was able to offer tiko's plug-in control device as an extra service to their customers. This allows their customers to have a better understanding of their use of electricity and to increase their comfort by controlling the temperature in different rooms. At the same time, this comes at no extra cost to the customer, because they are selling Frequency Containment Reserve (R1) to the French grid operator RTE.

MILLIONS OF APPLIANCES PARTICIPATING IN ALL ELECTRICITY MARKETS

On request from interested households, Voltalis sends an electrician to install a box at home, thus making it smart and interconnected with others. Flexible appliances are monitored and controlled remotely in order to reduce and optimise the consumption of each home individually and globally, taking into account the needs of the grid. The solution is totally transparent for the consumer: he may take back control any time using an ad hoc button on the box, and he can monitor his consumption and participation in real time via his personal account on the platform. Voltalis provides its solution free of charge and recoups its costs by selling flexibility in all electricity markets, such as wholesale day ahead or real time balancing and frequency control services to grid operators. 100,000 households and buildings have been installed in France, hence one million appliances operated in real time for several years; the EIB and EC recently decided to support the roll out of another 150,000. Voltalis started in France and develops this offer in Europe and abroad.

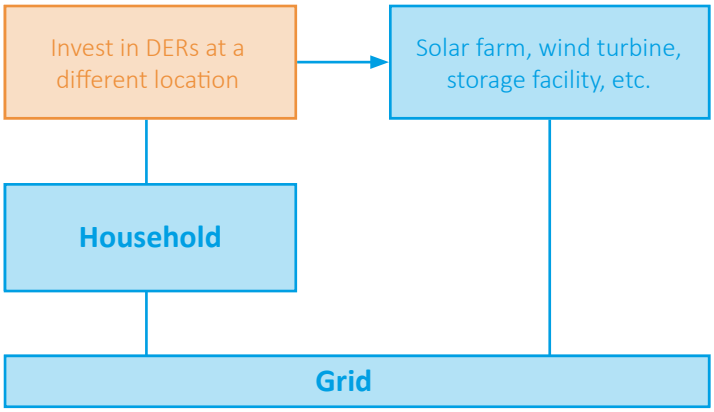
SMARTLY HEATING HOMES IN THE NORDICS

The majority of Nordic homes are all-electric, which means heating can cost up to €3,000 per year. In order to bring this cost down, geo has developed the Cosy system, in which the heat in each room/zone is smartly controlled from an app. Users first decide how warm they want their rooms to be at which times, and the system then carries this out by calculating the time it needs to heat the room, while also taking Nord Pool spot prices into account. Since Nordic homes are usually well insulated and good at retaining heat, the system can heat the room when prices are low or when the grid isn't overloaded. Initial analysis, excluding spot pricing, shows that homes can on average save around 15% on their energy bill. Modelling suggests that including spot prices could deliver a further savings of 10%, resulting in a total savings of around €500- €750 per year. Payback is currently estimated to be around 2 years, but is expected to be reduced significantly as volumes build and installation is simplified. In addition, if grid operators introduce peak pricing, for example because the increasing number of electric vehicles requires more strategic grid management, limiting peak loads from homes will add further benefits to the consumer and the grid.

A SIMPLE SUBSCRIPTION TO OFF-PEAK CHARGING

In Austin, Texas, drivers of electric vehicles now have a simple way to reduce the cost of charging their vehicle, while minimizing the impact of their electric vehicle on the electricity grid. Through their EV 360 subscription with Austin Energy, EV drivers pay a flat monthly fee of 30 dollars, for which they can unlimitedly charge their car during off-peak hours (all hours, except 14.00-19.00 on weekdays). Upfront costs include the installation of the sub meter at home in order to differentiate between electricity consumed for other purposes. In addition to charging at home, the subscription includes unlimited charging on public chargers owned by Austin Energy in and around the city, at any time of day. Trial results have shown that more than 99% of drivers with this subscription charge their car during off-peak hours.

Grid-connected households with onsite PV, storage and/or flexible load



OVERVIEW

When it is not possible to invest in DERs on their own property, many European citizens are now investing in DERs at other locations. This could be by buying a share in a wind turbine (see also the section on Communities for collectively owned DERs), or crowdfunding a large solar PV installation. In addition to solar and wind, we would also expect to see an increasing number of investments in offsite storage installations, as business models for storage become more viable (see the LEAFS project for example).

Sometimes these offsite investments can be considered a financial investment entirely unrelated to the household's onsite energy consumption and are in no way reflected on their energy bill (see the Dutch platform Zonnepanelendelen). Other times, when investments are facilitated through the energy retailer, the electricity generated from the offsite DER is removed from the electricity component of the energy bill (see the German retailer Enyway). In some cases, these investments can even benefit from measures similar to those reserved for onsite generation, and can be referred to as 'virtual net metering'[1].

INVESTMENTS AND REVENUE STREAMS

Investments can be as small (<100 euros) or as large as the facilitating organisation/platform can accommodate. If it is a purely financial product, there isn't likely to be a limit in the amount you can invest. If it is linked to the energy bill or a virtual net metering arrangement, there is likely to be cap on investments in direct relation to your own consumption. Likewise, the revenue stream for the investing prosumer also depends entirely on the legal structure of the project and the arrangements made by the platform/organisation. For a financial product, it may be paid out on a yearly basis, while for an agreement with a retailer it may be measured in savings on the energy bill.

[1] See the Greek case or the Flemish pilot Zonnedelen

TAXES AND CHARGES

If it is structured as a financial product unrelated to the energy bill, it will in no way affect the taxes and charges on the energy bill, but instead count towards wealth taxes, depending on the country's regulatory framework. If it is facilitated by a retailer, it may affect the taxes and charges on the bill. If it involves virtual net metering, this also reduces the taxes and charges paid for each unit of energy, and thus improve the business case.

BENEFITS

Such models are a very easy way to participate in the energy transition, regardless of living situation or financial income. The major benefit of this model is that there is a very low threshold for participation on all fronts. It doesn't matter how and when you consume energy, which direction your roof is facing, or whether your landlord has given permission.

PROSUMERS IN PRACTICE

DUTCH PLATFORM ZONNEPANELENDELEN

On the Dutch platform, Zonnepanelendelen, shares of large solar projects are issued in the form of 25 euro bonds. Throughout the project, investing prosumers will receive a return on investment of 2.5-5% each year, based on the performance of the solar project. The initial investment will either be paid out linearly or returned in one go at the end of the project (usually around 15 years).

GERMAN RETAILER ENYWAY

Another way to organize offsite DERs is through the facilitation of the energy retailer. For example in Germany, Enyway allows you to invest in a portion of a solar panel (the size of a pizza box or a ping pong table), and in return you receive your electricity at purchase price for two years (during which time you save between 100-200 euros on your energy bill).

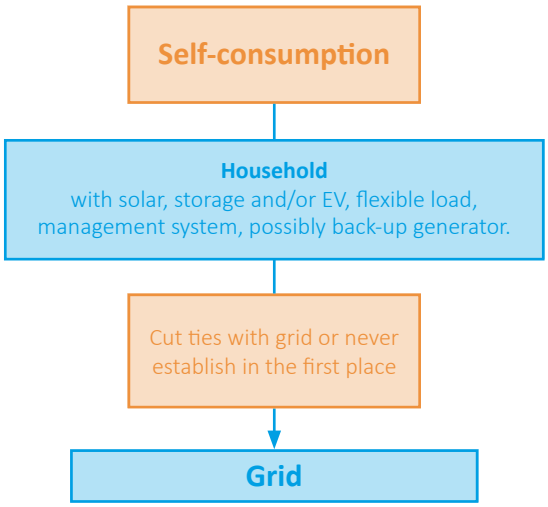
COMMUNITY ENERGY STORAGE

In the Austrian village of Heimschuh, a consortium of partners including Energienetze Steiermark has installed a large storage system (100kW), which is operated by the local energy supplier. The system is serving 10 prosumers, each of whom has 10% of the storage system at their disposal to maximise the use of energy from their own solar panels.

At the same time, the storage system is able to provide voltage control services to the DSO, which allows a larger number of PV installations to be installed in this community. If the business case allows it, it is also possible for the storage system to provide market services, such as participating in the spot market.

The local energy supplier owns the storage system, and as this is still in a trial phase, the DSO is currently paying 100% of the leasing cost. In the future, this cost should be shared by the prosumers. Of course this approach requires that the storage system is placed in a location where it is of value to the DSO.

Off-grid households



OVERVIEW

Going off-grid has long been seen as something for outside of Europe, where grids have not yet reached certain remote areas, or the grid is highly unreliable[2]. However, EY has suggested that even in Europe going off-grid may reach grid parity by 2022[3]. This means that the cost to self-generate and store power and the cost of purchasing it from an energy provider will be the same.

Of course this is primarily appealing in remote areas where connection to the grid is difficult and/or costly. In order to ensure access to electricity is consistent year round, such installations often require a back-up diesel generator. However, if there is a grid connection that can still be used a few times a year, a back-up generator may not be needed. As storage becomes cheaper, this may eventually be able to replace diesel generators – yet long periods without onsite electricity production may still pose a problem.

INVESTMENTS AND REVENUE STREAMS

There is a large upfront investment cost, because the entire system needs to be purchased in one go (unless there is a third party willing to finance it and thus help spread out the upfront investment over the lifetime of the system). The benefit is that once the system is in place, the use of electricity is free for the lifetime of the system (with the exception of maintenance and the occasional fuel cost of the back-up generator). However, there is also a risk of overcapacity. Surplus generation cannot be sold back to the grid, and no revenues from flexibility are possible.

[2] https://www.pv-magazine.com/2019/03/05/off-grid-solar-could-bring-electricity-to-740-million-people-by-2022/
[3] https://www.ey.com/en_gl/news/2018/01/europe-to-reach-off-grid-energy-parity-up-to-20-years-ahead-of-the-us

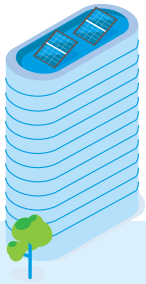
ROLE OF TAXES AND CHARGES

The national regime of taxes and charges is very important in this model. High fixed charges make models like this more appealing, particularly if there is a high initial cost to connect to the grid. If you are building a new house for example, it may be cheaper to build your own system than connect to the grid, if the upfront cost of connecting is very high. Without high taxes and charges, it would not be very appealing to go off-grid, at least from an economic perspective. By staying connected, prosumers could still occasionally use the grid.

BENEFITS

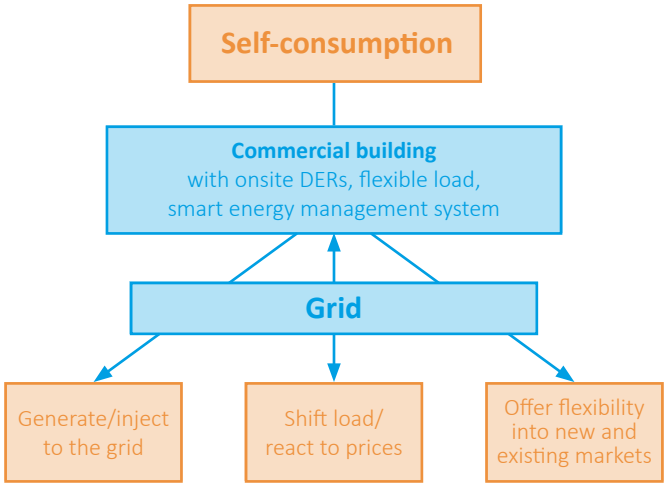
An increased sense of autonomy is an important driver for this model. There is a certain appeal for households to take complete responsibility for their own entire system. Resilience and price security are other important components. Off-grid households are immune from rises in electricity prices, and unaffected by black-outs.

On the other hand, going off grid can also be perceived as lacking in solidarity. While it can be understood in a remote area (simply due to the high cost of connecting to the grid), as this becomes more and more technologically feasible, this could start posing a problem to the solidarity of the grid system. This is sometimes referred to as the utility death spiral. Not everyone can afford the investments needed in order to go off-grid, and this will make the electricity grid much more expensive for those remaining.



Commercial

Commercial Buildings with onsite DERs and flexible load



OVERVIEW

These are buildings used for commercial purposes such as offices, retail, commercial centres, etc. They can either be owned by one company or by multiple companies (such as in a shopping centre). Energy management systems play an important role in this model. A combination of different types of renewable energy, storage, and flexible load can help maximize benefits.

INVESTMENTS AND REVENUE STREAMS

It is important for a building to decide whether it is going to prioritise self-consumption versus grid-injection. Because of considerable daytime use, these buildings can often consume 100% of the electricity they generate. However, sometimes it can be more profitable to sell the electricity through a feed-in-tariff, and then purchase it more cheaply from the grid. Of course, if the electricity price is higher than the feed-in-tariff, it's more profitable to self-consume your own electricity. This means that the self-generated electricity needs to be integrated into the building's technical systems.

Commercial buildings have a significant capacity to serve the electricity system with their flexibility. In many cases, they can provide ancillary services without too much effort, and this can even increase the comfort levels of a building[5].

TAXES AND CHARGES

In general, commercial buildings have more capacity and fixed charges than residential prosumers[6], which cannot be reduced by rooftop PV. However, including storage and smart energy management systems can help commercial buildings make the business case more profitable[7].

BENEFITS

Commercial buildings represent a considerable amount of energy usage, and by becoming prosumers can make a significant difference to the energy system. At the same time, it is increasingly important for companies to show leadership in climate and sustainability. It also has the added benefit of increasing resilience in the case of power outages and adding to the security of supply.

PROSUMERS IN PRACTICE

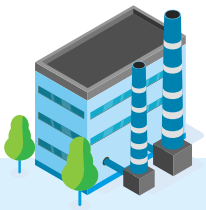
OPTIMISING ENERGY USAGE ONSITE

Finland's First Smart Industrial Energy Management System for a Distribution Centre

In 2019, Lidl a European grocery store chain built a new 60.000 m2 distribution centre in Järvenpää, Finland. The challenge was to build a flexible, future-proof, environmentally friendly and energy-efficient new logistics centre, that optimizes heating and cooling, connects to Finland's demand response market, and significantly reduces the energy consumption over the life-cycle of the building. Schneider Electric delivered the first industrial microgrid of this scale in the country.

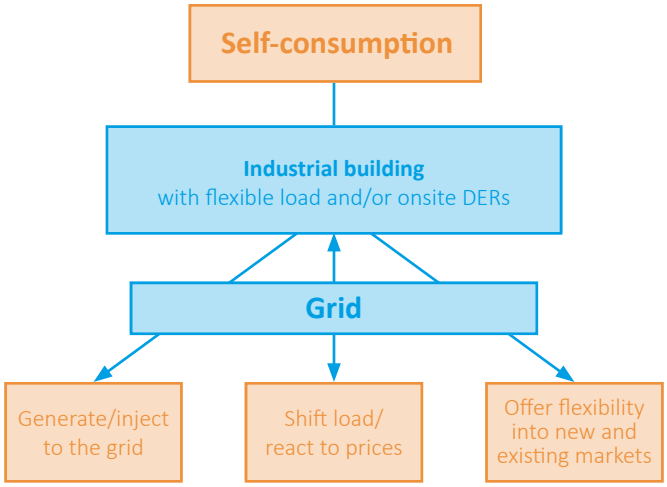
The distribution centre can operate 100% on renewable energy. A 1600-panel solar power plant on the building's roof generates solar electricity which can be utilized in the cogeneration of heating and cooling. The comprehensive solution, built by Schneider Electric, integrates microgrid and building automation management systems, and operates on the cloud-based EcoStruxure architecture. Smart energy solutions, such as heat recovery, allow Lidl to save significantly on energy costs and reduce the carbon dioxide emissions of the distribution centre. The system monitors utilization rate, price, consumption of electricity and weather in real time. CO2 emissions were cut by 40%, and the logistics centre uses 50% less energy than the current two operational centres.

[5] https://infoscience.epfl.ch/record/210518/files/Postprint.pdf
[6] https://iea-retd.org/wp-content/uploads/2016/08/RE-COM-PROSUMERS-Report.pdf
[7] https://blog.se.com/building-management/2017/07/26/power-up-your-building-with-these-renewable-energy-technologies/



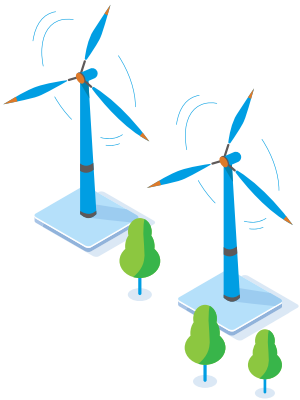
Industrial

Industrial Prosumers with onsite DERs and flexible load



OVERVIEW

Due to their energy intensity, industrial prosumers are important players in the energy transition. Their existing assets often already have a significant amount of flexibility, and installing DERs onsite (e.g. renewables, storage) can further help their business case.



INVESTMENTS AND REVENUE STREAMS

Offering flexibility in existing markets (ancillary services, balancing, capacity, etc.) can be particularly interesting, because very little capital investment is usually required on the part of the prosumer. The most important part is to determine where their flexibility lies, and to make adjustments to internal processes in order to valorise that flexibility.

Whether it is also interesting to invest in generation onsite depends largely on whether it makes sense at that location. For a large data centre for example, there may be some space to put solar panels on the roof, but this does not begin to cover the amount of energy the data centre needs. If the data centre is committed to powering itself on renewable energy (such as Microsoft, Google), they are much more likely to purchase it elsewhere (see section on Green Corporate Sourcing). However, if there happens to be a suitable location adjacent, it might still be interesting to install generation capacity onsite.

Revenues from onsite DERs are based on minimizing the capacity charge and by responding to time of use prices. If there is sufficient storage capacity for example, it could also be used to purchase electricity when it is cheaper, and sell it back to the grid when it is more in demand.

ROLE OF TAXES AND CHARGES

In the UK, there is such a thing as the triad response, in which the costs of using the energy system are determined during three half-hour periods of peak demand between November and February. An important driver for industrial prosumers is to minimize grid charges by avoiding these charges.

Higher volumetric network tariff increases the incentive to maximise self-consumption, while high share of fixed charges blunts price signals. High demand charges on the other hand can limit possibilities to participate in flexibility markets.

BENEFITS

As is the case for commercial buildings, green leadership is increasingly important for industry. Other benefits included an increased resilience and security of supply.

PROSUMERS IN PRACTICE

FLEXIBLE ALUMINIUM PRODUCTION IN THE ALPS

Electricity is the highest single cost component in the production of aluminium, comprising approximately 30-40% of the cost. This means that any cost-saving in the field of electricity can have a large impact on the competitiveness of aluminium. This is why Trimet and EDF are working together in Saint-Jean-de-Maurienne, in an aluminium factory located in the Alps, in order to bring costs down and to help balance the grid. They have installed a load management device which can bring down peak demand, and can offer the flexibility in production into existing markets, such as Rapid Reserves and Primary Reserves.

DUAL APPLICATIONS FOR DATA CENTRES

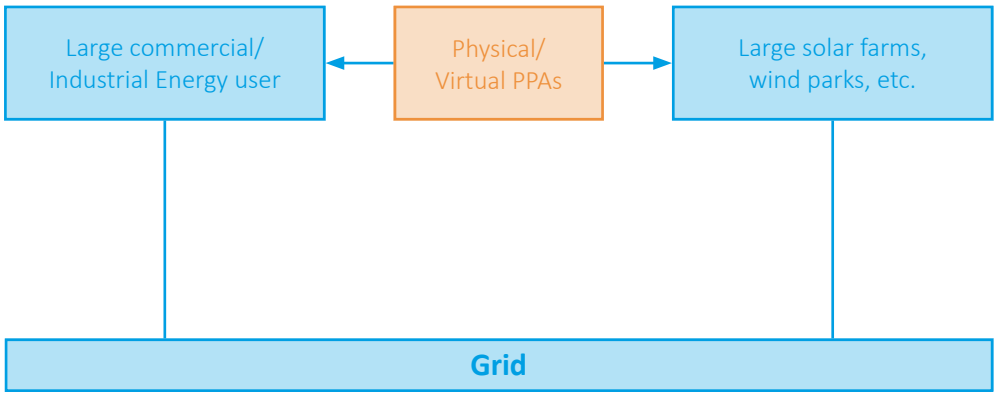
Microsoft's Virginia data centre provides a good example of the way in which DER integration can enable system-wide benefits. The Virginia data centre has behind-the-meter battery storage for backup power and power quality. In recent months, Microsoft has piloted an advanced uninterruptible power supply system with capability to support both critical load and grid services applications. Through this pilot in partnership with Eaton, Microsoft has demonstrated the application of a behind-the-meter customer-sited battery resource providing frequency regulation to PJM while also supporting critical load. By focusing on dual use of a single resource, the project also demonstrates the potential for a DER commitment framework to delineate between dual applications for customer resiliency and grid services.

CONVERTING DATA CENTRES INTO ENERGY FLEXIBILITY ECOSYSTEMS

In the Catalyst H2020 project, a consortium of partners has been investigating the role that data centres could play in the energy transition. Not only can data centres deliver ancillary services, they are large producers of waste heat which could be used for District Heating and Cooling networks. By contributing to both the electricity and thermal grids, this could increase the flexibility revenue streams for data centers.

Furthermore, the project is developing a pioneering multi-commodity marketplace allowing a wide range of prosumers (not only data center) to act as traders of their own thermal and electric flexibility offered in coupled networks.

Green Corporate Sourcing



OVERVIEW

For corporations with significant electricity needs, renewable generation onsite does not make much of a dent in their energy demand. Because of the growing public concern about renewable energy, many corporations have started purchasing their electricity directly from renewable energy projects through power purchase agreements (PPAs). This can be done through sleeved/physical PPAs, or financial/virtual PPAs.

INVESTMENTS AND REVENUE STREAMS

A commitment to 100% renewable energy is a considerable investment for a corporation, both in terms of time and resources. Although setting up a PPA is becoming more and more streamlined, there is still a certain amount of transaction cost for each deal. It is also not necessarily the cheapest way to purchase electricity, as the corporation pays the difference between the price on the open market and the price agreed in the PPA. However, if structured properly, PPAs can hedge against the risk of rising electricity costs in the open market.[8]

Corporations can also choose to further hedge price risk, as the power output of renewable projects is not always consistent, and the demand of the corporations is not necessarily flexible. This can be particularly important, because when the renewable project is not producing enough electricity to cover the demand of the corporation, the price on the open market is also higher. When the project is producing more than needed, the price on the market is usually relatively low. A volume firming agreement, such as the one developed by Microsoft and REsurety, can help mitigate these risks.

It is also very important for corporations who have made such a commitment to be able to transparently report on where their energy is coming from, ideally by purchasing the Guarantees of Origin directly from the developer.

ROLE OF TAXES AND CHARGES

In a virtual/financial PPA, the corporation still pay for the transmission and distribution of electricity according to their actual energy use.

BENEFITS

There is a huge amount of public pressure for corporations to show green leadership, as demonstrated for example in the RE100, in which more than 100 companies have committed to 100% renewables. This also gives corporations a competitive edge and a license to operate.

Although PPAs are providing an important impetus to continue developing bigger and better renewable energy projects, they are doing very little to enhance system flexibility, which becomes increasingly important as we decarbonise. From a societal perspective, corporate PPAs are filling a gap where feed-in-tariffs are being phased out.

[8] https://blogs.microsoft.com/on-the-issues/2018/10/16/buying-renewable-energy-should-be-easy-heres-one-way-to-make-it-less-complex/

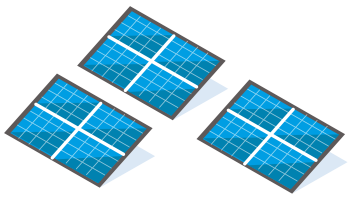
MATCHING SUPPLY AND DEMAND THROUGH GUARANTEES OF ORIGIN

Once an energy source has been converted to electricity and injected into the grid, it is no longer possible to tell whether the electricity originally came from the sun, wind or any other source of energy. In order to prove to consumers that their electricity came from renewable energy, the 2009 Renewable Energy Directive established a framework for Guarantees of Origin (GO), defined as '*an electronic document which has the sole function of providing proof to a final customer that a given share or quantity of energy was produced from renewable sources*'. This meant that a supplier, even if it had purchased renewable energy from the producer, also needed to have the corresponding GO in order to make sure it was counted only once. However, it remained possible to separately purchase GOs, while continuing to purchase electricity derived from fossil fuels.

As public awareness about climate change grew, companies started incorporating renewable energy purchasing into their sustainability strategies. Under the RE100, 189 companies have so far committed to purchasing 100% of their energy from renewables. In order to make such claims, companies must have the GOs to back it up. But more than simply purchasing GOs from the open market, the most progressive corporations are purchasing their renewable energy directly from the producers through PPAs, along with the corresponding GOs.

However, in some Member States it is not possible to get the corresponding GOs, if the renewable energy project is already benefiting from a support scheme (such as a feed-in-tariff or premium), because this would be considered an extra benefit to the project on top of the support scheme. This is the case in Germany for example, where GOs are not issued for projects that benefit from a support scheme (which in Germany is more than 90% of renewable energy). In other countries, such as France and Italy, the GOs go directly to the government, and it is hoped that the income from auctioning off the GOs will bring down the cost of the support scheme. Other countries, such as The Netherlands for example, have an open tendering system and producers need to already take the market value of the GOs into account when they participate in the tendering procedure. In this way, it also brings down the cost of the support scheme, while simultaneously allowing the buyer to have access to the corresponding GOs when they set up a PPA. In fact, the GOs are such an essential part of these transactions that there are hardly any (corporate) PPAs in countries where companies are not able to get the corresponding GOs. Companies showing sustainable leadership want to be able to transparently communicate about the source of the energy they are consuming.

Some companies are taking this transparency even further, and instead of purchasing the GOs on an annual basis, are matching the purchase of GOs to their actual consumption of energy. This could encourage companies to better match their load profile with the availability of renewable energy. Microsoft and Vattenfall for example have piloted a solution that matches GOs on an hourly basis with the consumption data from smart meters at Microsoft's headquarters in Sweden.



Communities

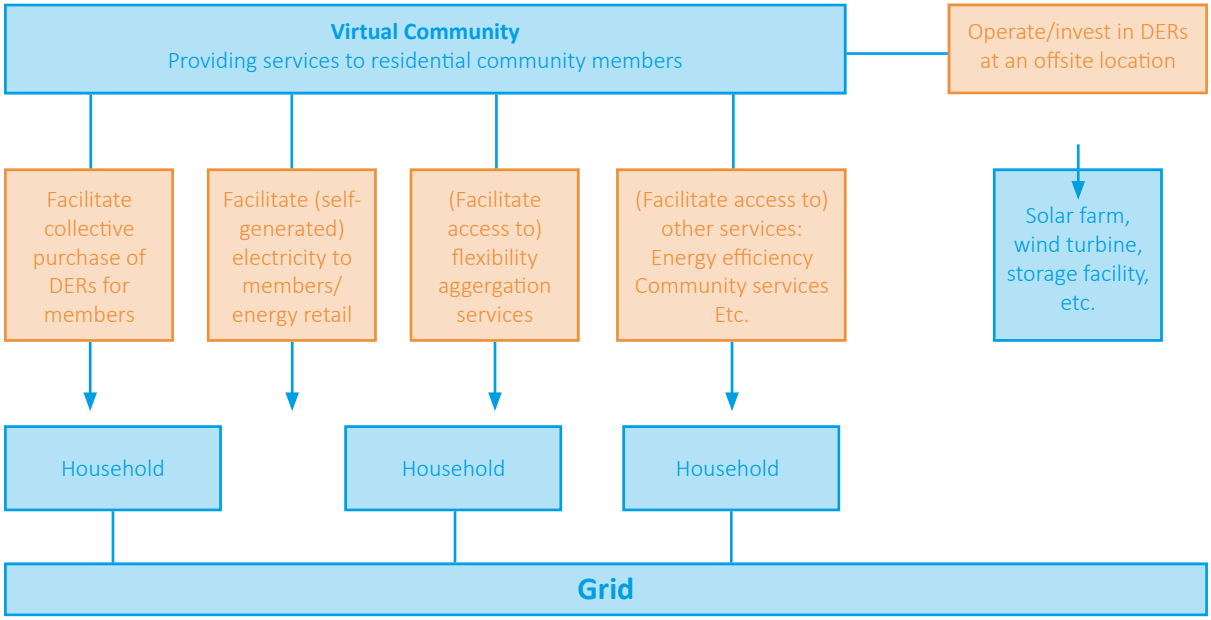
The term 'community' is used as a catch-all phrase for when a group of energy users decides to act collectively instead of individually. This term has been debated extensively, because it can refer both to innovation in the new commercial energy offers (e.g. Sonnen Community), as well as to two new legal concepts which present new organisational ways to address energy challenges.

'Citizen energy community' (CEC) and 'renewable energy community' (REC) have been defined in respectively the Electricity Directive and the Renewable Energy Directive. CECs and RECs are legal entities based on open and voluntary participation and effectively controlled by their shareholders or members who are citizens, SMEs and/or local authorities and whose primary purpose is to provide environmental, economic or social community benefits for their members or the local area members.

These two concepts have been set up to enable the participation of the civil society into the provision of energy services, where profit is not the main goal (e.g. cooperatives, association, etc.). These forms of social innovation can be supported by innovative energy companies.

The term 'virtual communities' addresses the business models based on services to a group of consumers, in which consumers enjoy the benefits of their pooled or collective assets. In order to create a distinction, this first section will cover virtual communities in which individuals are bound together because they are members of the same collective service (aggregation, collective self-consumption, etc.). The next section will discuss energy communities, in which individuals and/or companies are bound together because of their proximity to one another (e.g. a grid-connected micro-grid or a multi-family dwelling).

Virtual communities based on shared membership



OVERVIEW

Decentralised energy service providers (aggregators, ESCOs, assets managers, etc.) are at the forefront of innovative services for communities of (potential) prosumers.

Their services can range from facilitating the collective purchase of DERs for individual use (e.g. rooftop PV), to installing and operating DERs (e.g. wind, solar, storage), selling electricity back to the grid (through feed-in-tariffs or PPAs), and serving as an energy retailer to community members to enable energy sharing.

Market actors are offering new opportunities to join a Virtual Community to enjoy the benefits of collective self-consumption or aggregation. Civil society actors (citizens, local authorities and SMEs) are also playing an increasing role in facilitating access to these services. Citizen Energy Communities (e.g. in the form of energy cooperatives) have been engaging citizens in the energy transition for many decades and have been a major driving force for installing local renewable energy. Cooperatives and other CECs are now buying the services of innovative energy companies to offer similar services.

INVESTMENTS AND REVENUE STREAMS

nvestment for collective self-consumption services or aggregation of collective assets have a similar structure as for individual homes (see section 1) except when they require negotiating among a collective of prosumers e.g. an apartment building, or a CEC for a whole neighbourhood.

As the European energy mix incorporates an increasingly large percentage of variable renewable energy, it also becomes more interesting to look at how existing energy communities can contribute to the overall flexibility of the energy system. This could be by assisting their members to individually unlock the value of their implicit and explicit flexibility (see also USEF's White Paper on unlocking the value of CECs[9]), or by themselves serving as a flexibility aggregator. The opportunities for additional flexibility revenues are still underdeveloped and there is a lot of room for CECs to explore this.

[9] https://www.usef.energy/app/uploads/2019/02/USEF-White-Paper-Energy-and-Flexibility-Services-for-Citizens-Energy-Communities-final-CM.pdf

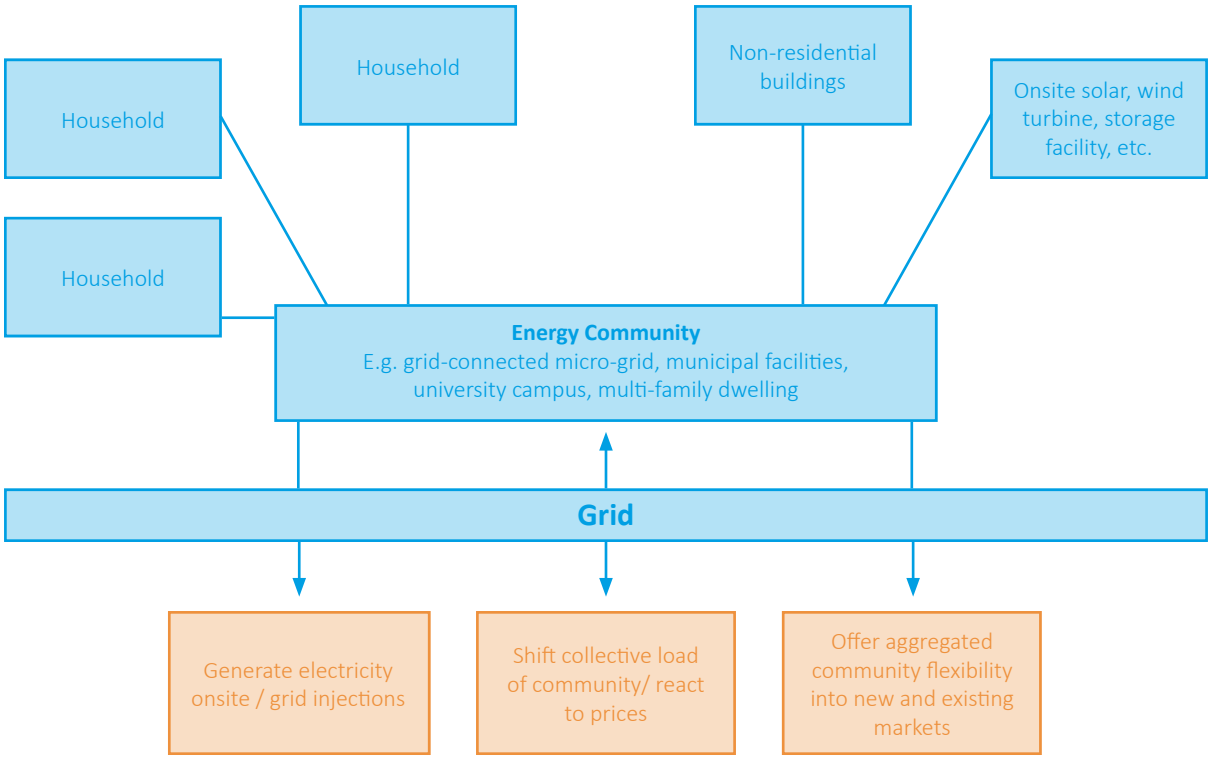
TAXES AND CHARGES

Virtual community members pay taxes and charges on their electricity bill based on the energy use on their own premises. If the community-owned DERs are installed elsewhere, this means the household still pays taxes and charges on the electricity purchased from these DERs, and cannot take part in net metering schemes. Of course if the participating household also has their own DERs onsite, they will still be able to take part in advantageous net metering schemes, or save taxes and charges on electricity consumed behind the meter.

BENEFITS

Organising in a Virtual Community can help prosumers achieve an economy of scale, and have access to the same benefits as an individual household. While services providers can offer these aggregation services directly to consumers (see section 1), they can also work with a Citizen Energy Community. As mentioned before, Citizen Energy Communities themselves are not primarily driven by profit, but by increasing their autonomy and furthering environmental or social goals. CECs help citizens participate in the energy transition, by providing a means to organise themselves and pool their resources. Profits made by the CEC are usually reinvested in the community.

Energy Communities based on grid proximity



OVERVIEW

Energy communities that are based on proximity or that share a part of the grid, could share all the same features as virtual community described in the previous section, but have even more possibilities to unlock value. In a multi-family dwelling for example, particularly if this includes electric vehicle charging, there is a value to shifting the load profiles in order to keep the peak capacity of the overall building to a minimum. The same goes for grid-connected micro-grids, campuses, commercial or industrial sites, or any other area where energy users are sharing grid facilities.

INVESTMENTS AND REVENUE STREAMS

In addition to investing in DERs that can be used for flexibility, much investment in terms of time and knowledge development is needed for communities to unlock this collective value. In addition to all the revenue streams from individual households or that can be obtained through Citizen Energy Communities, energy communities based on grid proximity are better able to match their collective load profile based on system needs, and to keep the overall capacity charge as low as possible. A mix of residential and commercial load patterns can complement each other, and increase the revenue streams.

TAXES AND CHARGES

The most important aspect to consider is whether the grid is considered a public grid or a private grid. In most cases, such an arrangement would have to be the object of a specific agreement with the DSO. In specific cases where the grid is private (closed energy network) or integrated in a utility (<100 K customers), this can be negotiated with private actors.

LOCALLY BALANCING ENERGY WITHIN THE BRUNNTHAL ENERGY COMMUNITY

In a municipality close to Munich, GreenCom Networks, has launched an energy community where residents are able to share their surplus electricity in the community and vice versa receive electricity when they do not produce enough.

The community enables members, either prosumers or consumers, to share energy with each other. For instance, where one household has a surplus of electricity through solar generation, and another is charging an electric vehicle, the supply and demand between the two is optimised to increase independence from outside supply and reduce costs. GreenCom has also pledged that communitymembers get a cash bonus per each kWh used in balancing the community's electricity supply and demand. Any residual electricity imported from outside the community originates from 100% renewable sources.

The assets owned by the members of this community are connected through GreenCom's Energy IoT platform, called eibp. Yet, they are also acting locally to reduce the costs of the grid, and further facilitate the integration of an increasing share of renewables and electric vehicles.

Driving factors

Overall, the driving factors from all prosumer models can be briefly summarized in the following table.

FINANCIAL DRIVERS

- Remaining feed-in-tariffs and net metering schemes
- Offsetting electricity bill through increasing rates of self-consumption
- Avoiding/minimising taxes and network charges
- Time of use/price arbitrage
- Participation in new and existing markets
- Long-term price stability

NON-FINANCIAL DRIVERS

- Enhanced capabilities and performance
- Contribution to clean energy transition
- Climate and energy leadership
- Increased autonomy and independence
- Security of supply, resilience

Going forward:
Sustainable Prosumer Models

VALUE

What value are prosumer models creating for society?

Decarbonisation: While there are many benefits to becoming a prosumer, the reverse is also true. Prosumers greatly benefit society by contributing towards decarbonisation. The complete decarbonisation of our society simply cannot take place without a growing number of prosumers, contributing to the energy system in a smart and efficient way.

Lowering the system cost: Investing in a more flexible electricity system will bring down the cost of integrating renewables significantly. UK scenarios put together by Nera and Imperial College show that reaching a target of 50g of CO2 emissions per kWh corresponds to savings of 7.1-8.1 billion pounds per year.[10] According to T&E, in the switch to renewables, electric vehicles can save 4.1 billion euros per year in France, Italy, Spain and the UK alone.[11]

Energy security and resilience: If there is a power outage, prosumers that have their own onsite installations may be able to go for some time in islanded mode before they run into problems. At the same time, the whole of Europe is vulnerable due to the high level of energy imports. A strong prosumer base can help reduce this vulnerability.[12]

Increased competition: The more prosumers there are in the market, the more competition there will be on markets for system services, leading to an overall more liquid market.

Awareness and engagement: By taking more control of their energy production, consumption and purchase it can be expected that both people and companies will become more aware of how they are using energy and how it affects the system around them.

Innovation: As the number of prosumers grows, this will encourage the market to come up with better offers and more innovative solutions to meet their needs.

Inclusiveness: By becoming prosumers, people and companies all have the opportunity to become an integral part of the energy transition, and have a stake in the future energy system.

[10] Nera and Imperial college study, 2015
[11] https://www.transportenvironment.org/press/electric-cars-will-save-four-eu-countries-over-%E2%82%AC4bn-year-switch-renewables
[12] https://www.iea.org/publications/freepublications/publication/so_contribution.pdf

MONETISATION

How can prosumers monetise the value they are bringing to the energy system?

While prosumers create a huge amount of value in the transition to a decarbonised energy system, the business case is now often based on reducing taxes and network charges, without necessarily reducing the overall cost of operating the grid. In general, actions that don't benefit the system as a whole should not be over-incentivised. For example, it can be good to use a storage system to optimise self-consumption from onsite renewables. However, if at any given moment this storage system can be put to better use in providing system services, this should be properly rewarded. Prosumers should be encouraged to use their assets to add as much value to the system as possible.

In an ideal world, the value that prosumers bring to the energy system would be properly reflected in price signals and revenue streams. However, a true reflection of this value is not likely to happen spontaneously in the timeframe needed to achieve our 2050 decarbonisation targets. This leaves us with a number of fundamental challenges for how prosumers can monetise their value.

How can net metering and feed-in-tariffs be phased out without undermining the business case for prosumers?

While net-metering and feed-in-tariffs have been essential for the development of the renewables industry, they are not necessarily conducive to a smarter energy system and eventually need to be replaced by more sustainable alternatives. Any phase-out should be accompanied by credible alternatives that ensure a continued business case.

INFORMATION

Do potential prosumers have access to all the relevant information?

At the moment, prosumers do not always have access to all the information they need in order to make investment decisions. Particularly because the future revenue streams from decentralised energy resources are not always clear. In order for prosumers to invest, particularly in the case of industrial prosumers, a higher level of price certainty will be needed in order to justify the investments needed.

COMMUNICATION

When (onsite) prosumers inevitably need to consume electricity from the grid, how will they know where their electricity is coming from at that particular moment?

Unless they have disconnected from the grid altogether, even prosumers that have onsite DERs (e.g. rooftop solar, electric vehicles, storage systems etc.) need to use electricity from the grid on a regular basis. Even if they have a contract with a supplier of renewable energy, that electricity could still have been produced at any moment throughout the year. Apart from the price, if they have a dynamic pricing contract, there are no indicators for prosumers on where their electricity is coming from, and what their real time contribution to the grid is. The same is true for large energy users who are purchasing renewable energy through PPAs. All prosumers should be able to have insight into where their electricity at that moment is coming from, and be rewarded for matching their demand to when there is a lot of renewable energy in the grid.

Annex:
Financial drivers and revenue streams

	HOMES	VIRTUAL COMMUNITIES	COMMERCIAL BUILDINGS	INDUSTRY
Onsite Generation	▪ Self-consumption ▪ Net metering ▪ Feed-in-tariff ▪ Avoiding volumetric taxes and charges	▪ Collective self-consumption ▪ Avoiding volumetric taxes and charges ▪ Feed-in-tariffs/ PPAs	▪ Self-consumption ▪ Feed-in-tariffs/ PPAs ▪ Avoiding volumetric taxes and charges	▪ Self-consumption ▪ Feed-in-tariffs/ PPAs ▪ Avoiding volumetric taxes and charges
Shifting electricity use	▪ Increase self-consumption ▪ Time-of-use/ energy arbitrage ▪ Minimizing capacity charge	▪ Increase collective self-consumption ▪ Minimize collective capacity charge	▪ Increase self-consumption ▪ Time-of-use/ energy arbitrage ▪ Minimizing capacity charge	▪ Increase self-consumption ▪ Time-of-use/ energy arbitrage ▪ Minimizing capacity charge
Flexibility products	▪ Individual participation in various markets (through aggregators): wholesale, capacity, local flex, balancing, etc.	▪ Collective participation in various markets (through community flexibility aggregator): wholesale, capacity, local flex, balancing, etc.	▪ Participation in various markets (through aggregators): wholesale, capacity, local flex, balancing, etc.	▪ Participation in various markets (through aggregators): wholesale, capacity, local flex, balancing, etc.
Purchasing elsewhere	▪ Income from DER investments elsewhere ▪ Cheaper retail energy ▪ Virtual net metering	▪ Cheaper retail energy from collectively owned DERs ▪ Collective energy purchasing schemes	▪ Long-term price security	▪ Long-term price security

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- Intersolar Europe – The world's leading exhibition for the solar industry
- ees Europe – The continent's largest and most international exhibition for batteries and energy storage systems
- Power2Drive Europe – The international exhibition for charging infrastructure and e-mobility
- EM-Power – The exhibition for intelligent energy use in industry and buildings

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