Briefing
November 2016

European Parliament

Electricity 'Prosumers'

SUMMARY

Active energy consumers, often called 'prosumers' because they both consume and produce electricity, could dramatically change the electricity system.

Various types of prosumers exist: residential prosumers who produce electricity at home – mainly through solar photovoltaic panels on their rooftops, citizen-led energy cooperatives or housing associations, commercial prosumers whose main business activity is not electricity production, and public institutions like schools or hospitals.

The rise in the number of prosumers has been facilitated by the fall in the cost of renewable energy technologies, especially solar panels, which in some Member States produce electricity at a cost that is the same or lower than retail prices.

Profitability depends partly on the share of the electricity produced that prosumers can consume themselves. But while this can reduce their bills, it can create problems for traditional energy generators and grid operators.

The EU has no specific legislation on prosumers, self-generation or self-consumption, nor a common definition of prosumers. But the Energy Efficiency Directive, the Renewable Energy Directive and Guidelines on State Aid include provisions which relate to small-scale electricity producers. The European Parliament has called for a common operational EU definition of prosumers and for new energy legislation to provide measures for encouraging investment into self-generation capacity.

In this briefing:

EPRS | European Parliamentary Research Service
Author: Nikolina Šajn
Members' Research Service
PE 593.518

EN

Introduction

As the European Union sets new renewable energy targets, it expects that they will be partly delivered by prosumers – energy consumers who also produce energy. In 2015 the Commission set out a vision of an Energy Union 'with citizens at its core, where citizens take ownership of the energy transition, benefit from new technologies to reduce their bills, participate actively in the market, and where vulnerable consumers are protected'.

Prosumers could dramatically change the energy system. The International Energy Agency (IEA) considers that solar photovoltaics (PV) in particular could turn into a 'disruptive' technology, 'which could revolutionize the utility sector just as personal computers and cell phones changed their respective industries'.

On the one hand, prosumers who invest in renewable energy technologies could help the EU finance the energy transition, increase the share of renewable energy sources (RES), and under certain conditions, reduce the costs for the system. At the same time, by generating their own electricity, they could lower their bills, benefit from a sense of empowerment, and help introduce elements of 'energy democracy' (which is why they are sometimes referred to as 'energy citizens').

On the other hand, the emergence of prosumers brings challenges, notably for incumbent players such as electricity producers and grid operators, who might lose revenue as prosumers start buying less energy from the grid because they are producing their own. This could result in lower levels of investment in the grid and could affect consumer bills for those not producing their own power. The functioning of electricity markets in the EU is the subject of a separate EPRS briefing.

What are electricity prosumers?

'Prosumer' is a relatively new term that, in the energy field, most often denotes consumers who both produce and consume electricity. They **'self-consume'** some of the electricity they produce, and sell the excess to the grid. But when their production falls short, they also buy power from the grid, which makes them both producers and consumers. Examples of prosumers include:

- **residential prosumers** – citizens who produce electricity on their property, mainly by installing solar PV panels on their rooftops or through micro combined heat and power (micro-CHP);
- **community/cooperative energy** – citizen-led renewable energy cooperatives ('Res Coops'), housing associations, foundations, charities, which are not commercial actors, but produce energy meant for self-consumption, mainly by solar PV panels and wind turbines;
- **commercial prosumers** – SMEs, department stores, office buildings, industry and other business entities whose main business activity is not electricity production, but which self-consume the electricity they produce, mainly with rooftop PV panels and CHP, leading to significant cost savings;
- **public prosumers** – schools, hospitals and other public institutions that self-generate electricity.

Self-generation, however, is not always considered a defining feature of prosumers.[1] A wider understanding of the term covers all consumers that not only passively consume energy, but are also actively participating in the market, thereby generating value for themselves or for other players in the energy market. Prosumers can, for instance,

'produce' energy savings – through energy efficiency measures and demand-side response (i.e. shifting energy demand to a time when supply is more plentiful). Such reduced demand has a value on the market, including in helping to balance the electricity system, for which prosumers could be compensated. They could also sell surplus electricity from their energy storage.

Prosumer energy in the EU

The past decade has seen a drastic reduction in cost of RES technology and an explosion in the number of citizens producing their own energy in the EU. This has in particular been the case for photovoltaic (PV) panels, which are, according to the European Commission's Joint Research Centre (JRC), currently the cheapest new technology for energy production available. The JRC research shows that in the most competitive markets, the prices of residential PV solar systems have fallen by over 70 % from 2008 to 2014. The target of 84.4 GW of installed PV systems, which Member States laid out in their 2020 national renewable energy action plans (NREAP), was reached and even exceeded by 2014.

Thanks to the fall in prices, PV panels have, in a number of Member States, achieved **grid parity** (also known as socket parity). This means that, when all costs incurred over their lifetime are taken into account,[2] they produce electricity that costs the same or less than the electricity from the grid. Achieving grid parity for residential consumers has been helped by high retail electricity prices in the European Union, which poorly reflect the wholesale prices of energy.[3] Grid parity is therefore more difficult to achieve for commercial prosumers, due to lower electricity prices for industry.

Research by the International Energy Agency's Renewable Energy Technology Deployment (IEA-RETD) programme on residential and commercial prosumers shows that a decision on whether to become a prosumer is not influenced only by economic factors, but also behavioural factors (desire for greater autonomy and environmental protection, whether the PV panels are considered stylish, technological factors (new trends and development such as electric vehicles or storage) and national conditions (roof space available for PV, the share of building owners vs. tenants, electricity grid conditions). Studies claim that grid parity, while representing an important psychological milestone, is not enough for citizens and businesses to decide to become prosumers. The price of electricity from PV panels has to fall well below grid parity to be worth the financial risk and overcome inertia.

Self-consumption

The profitability of prosuming partly depends on the share of electricity produced that prosumers can consume themselves, as this directly reduces their bills. Self-consumption could also be beneficial to the electricity system, as it can reduce transmission losses and peak demand and thus save costs in the long term. But to achieve this, prosumers would need to self-consume at the time of demand peaks, which is often not the case.

Residential prosumers with rooftop PV self-consume only about 30 % of their production because most of their production takes place when there is plenty of sun (during the day, when they are often not at home, and during the summer), while, according to the IEA Technology Roadmap: Solar Photovoltaic Energy, electricity demand in Europe peaks on average in winter and in late afternoon or early evening. That is why, according to the IEA, in wintertime PV production in most European countries contributes little to lowering

peak system demand. The self-consumption ratio is better in warm and sunny countries, where electricity can be used for air conditioning at the same time as it is produced.

Wind power is a better match both with daily and seasonal demand, enabling a better self-consumption rate for community projects based on wind power. Larger residential prosumers, such as apartment buildings, are also better at self-consumption.

Commercial prosumers can achieve high rates of self-consumption because they more often need energy during the day, at the time when they produce it. This is especially the case with those companies that need considerable levels of energy over seven days a week, such as hospitals, supermarkets, and businesses with big freezers. These industries have the potential to self-consume a lot, in the region of 50 %-80 %. Some commercial and manufacturing buildings in Germany and Spain already achieve self-use ratios of 75 % to 100 %.

Demand-side response and energy storage

Self-consumption can be improved by shifting the time of consumption through demand-side response (e.g. running the dishwasher at a time when the sun is shining so solar power can be used) or by storing the electricity for later use, by means of energy storage. According to the Commission's staff working document on renewable energy self-consumption, this could potentially raise the self-consumption rate to 65 %-75 %, although an Insight Energy brief warns that figures about the real potential of demand-side response and energy storage differ widely between studies. Furthermore, demand-side response is contingent on the roll-out of smart meters and availability of real-time electricity price signals, while the prices of decentralised energy storage are still prohibitively expensive.[4]

Some definitions of the term prosumer consider demand-side response and energy storage to be resources that can be traded in themselves. Especially during demand peaks, prosumers could sell the energy they had previously stored in their decentralised energy storage, or could lower their consumption and thus help 'shave off the peaks'. Since these actions have value for the energy system, they could be sold on the balancing or reserve markets. This could be done by **aggregators**. They could bring together individual prosumer loads, which are likely to be too small to place on the wholesale market, and offer them as one larger bid.

A study on the effective integration of distributed energy resources for providing flexibility to the electricity system, conducted for the Commission by the engineering consultancy company Sweco, describes business models for demand-response by aggregating energy savings from space heaters in Austria, ventilation systems in Finland and heat pumps in Sweden. Aggregators remotely operate a large number of appliances, synchronise their switching off for short periods of time, and thus bring demand down without compromising the comfort of clients. The study, however, notes that the obstacles to massive deployment of demand-side response include a lack of flexibility in markets, lack of access for aggregators and lack of energy price signals.

Some projects look at ways of using batteries of electric vehicles as energy storage. The vehicles could be charged at times of lower demand (and lower prices) and the electricity sold at times of higher demand (and higher prices). This vehicle-to-grid (V2G) concept already functions on a small scale in the United States, Denmark and the United Kingdom. Alternatively, owners could use their vehicles to power their homes.

Integration of prosumer energy in the energy system

Like other electricity from renewable energy sources, prosumer energy is variable – it depends on whether there is enough sun or wind power available – and therefore requires more reserves to balance the system in case there is no wind or no sun. On the one hand this creates the problem of handling the grid when there is too much power, and on the other hand requires back-up generation capacity when there is too little. This could mean that investments in improved information and communications technology (ICT), smart meters and more flexible distribution mechanisms may be necessary. But it may lead to fewer electricity lines and power stations being built if energy savings can be achieved and energy demand becomes more balanced. Challenges of integrating renewable energy into the electrical system are discussed in detail in an EPRS analysis on promotion of renewable energy sources in the EU (June 2016).

A rise in the number of prosumers creates challenges for the traditional business model of legacy generators, distribution service operators (DSOs) and transmission service operators (TSOs). If indeed self-consumption does not reduce maximum system demand, as suggested by the IEA-RETD study, this means that the traditional utility companies will have to maintain the same capacity but prosumers pay less for it, leaving grid operators in particular unable to recover their costs. This could become especially problematic if the number of prosumers rises significantly, since grid charges in the EU are most often embedded in the price by kWh of electricity consumed. This could raise the price of electricity for everybody, and creates the problem of 'cross-subsidies', whereby consumers unable to produce their own energy (e.g. because of high costs or because their home is not suitable for PV panels) in effect subside the cost of system upkeep for those who can.

Leaving the grid and utilities death spiral

The rise in electricity prices, due to grid costs being divided among a smaller number of consumers, creates incentives for more and people to become prosumers. This may eventually lead to a vicious circle, the 'utilities death spiral', as more and more people decide to produce electricity for themselves. This would especially be the case if people and companies start to leave the grid in large numbers and stop paying for the grid altogether. However, leaving the grid completely for now does not seem to be a very likely option: a study on the example of Spain shows that for the majority of the population, leaving the grid will not be the best economic option, even in the future. Still, about 50 % of EU households could produce renewable energy by 2050 and about 83 % could provide demand response and energy storage, according to a study by the CE Delft consultancy.

A solution could be to change the way grid tariffs are calculated. A fixed tariff (per year or per month) is possible, but would not encourage the saving of energy nor reflect usage because those who consume little pay the same as those who consume a lot, and it could present an unfair burden on poorer consumers. Similar problems exist with 'capacity charges', a model in which grid charges are based on the maximum capacity of the connection. Another solution, which is favoured by the IEA, is time-based pricing, which would more accurately reflect the cost for the grid but is also contingent on the deployment of smart meters.

Nevertheless, the IEA warns that cross-subsidies cannot be completely avoided and the decision on whether a cross-subsidy is acceptable is ultimately a political one.[5] An Insight Energy paper warns that this challenge goes even further: since the prices by kWh in the EU also include taxes, RES levies and sometimes even social transfers, reduced consumption could strain public budgets and RES programmes as well. Some countries, for instance Germany, Spain and Belgium, therefore require prosumers to pay at least

part of the taxes and charges on the electricity system from PV generation that they self-consume. However, this may reduce the incentive to become a prosumer.

How prosumers are paid

There are several models by which prosumers are remunerated, which can also affect the amount of the costs that the grid operators can recover from prosumers.

Net-metering

Under this model, prosumers feed excess electricity into the grid and consume it later when they need to, paying only for the net difference. The period in which the excess production can be consumed (the netting period or the rolling credit timeframe) can be an hour, a day, a month or a year. Since this model does not differentiate between the price of electricity at peak and non-peak periods (i.e. both production and consumption are valued at the same fixed price), a longer netting period means lower consumer bills.[6] It basically enables prosumers to use the grid as their energy storage. This does not encourage self-consumption, while at the same time it causes a reduction in DSO incomes. According to a study on the impact of net metering on cross subsidies, a longer netting period causes a bigger fall in DSO incomes[7] and larger cross subsidies.

Feed-in tariffs (FiTs)

In this model, prosumers pay the retail price for the power they consume from the grid, but are offered long-term contracts, typically of 10 to 25 years, by large energy providers at an above-the-market price. The FiTs are technology-specific and usually fixed, or may be designed to decrease as a technology becomes more mature.

FiTs are attractive for investors because they offer predictability and security of their investment. However, they can lead to extra profit for prosumers, as well as to cross subsidies that raise the price of electricity for everyone, as most FiT schemes are paid for by RES levies raised through the price of kWh on the electricity bill. The IEA therefore recommends that feed-in tariffs include rapid and decreasing rate changes or yearly quantitative limitations, either in terms of capacity or (preferably) in financial support.

Feed-in premiums (FiPs)

Feed-in premiums are a form of remuneration for RES production preferred by the IEA and the European Commission, as they introduce short-term market exposure of RES electricity. Like feed-in tariffs, feed-in premiums imply technology-specific long-term contracts, but take the form of a bonus added to the current market price.

The premium can be fixed (which can lead to over-compensation if market prices are high, or under-compensation if they are low) or sliding (which usually means that they close the gap between the market price and the feed-in tariff).[8] In both cases, the feed-in premiums encourage RES producers to produce electricity when and where it is needed, as well as to make their production more efficient.

Competitive auctions and requests for tenders

This is not a necessarily a remuneration model in itself, but a way to decide on the allocation and the level of FiTs and FiPs. In an auction, bidders compete for compensation for producing a certain volume of electricity or capacity. Germany, for instance, intends to use auctions to decide the level of sliding feed-in premium from 2017 (pilot projects for PV premiums started in 2015).

While auctions help expose renewable energy production to the markets, they often entail high transaction costs and are not well-tailored to small-scale projects. The

Commission's staff working document suggests that one solution might be aggregators, which could pool the power produced by small producers to put it on the market, in order to reduce administrative costs and achieve a better price.

EU policy

The EU has no specific legislation on prosumers, self-generation or self-consumption, nor has it a common definition of prosumers. However, existing energy legislation does include some provisions applicable to this field. The 2009 Renewable Energy Directive requires Member States to provide either priority or guaranteed access to the grid system for all renewable electricity production, big and small. The only concession 'for small projects and for decentralised devices' is that Member States should ensure 'simplified and less burdensome authorisation procedures, including through simple notification if allowed by the applicable regulatory framework'. Similar provisions are included in the 2009 Electricity Directive. The 2012 Energy Efficiency Directive introduces a similar requirement for small scale and micro-combined heat and power (CHP). It also requires Member States to encourage participation of demand response in wholesale and retail markets and, when necessary, to include aggregators.

The 2010 Energy Performance of Buildings Directive does not introduce special provisions for prosumers, but creates a need for them and for self-consumption. It introduces the concept of 'nearly zero-energy buildings', which are supposed to become the requirement for all new buildings from 2021, and for new public buildings from 2019. The nZEB should cover the little energy they need largely from renewable sources 'including energy from renewable sources produced on-site or nearby'.

The European Commission's 2015 communication on Delivering a New Deal for Energy Consumers sees the combination of decentralised generation and storage options with demand-side response as the way forward. It warns that consumers are currently not properly rewarded for active participation in the energy market, and are sometimes prevented from self-generation and self-consumption. Collective and cooperative self-generation schemes are also mentioned as enabling better energy deals for consumers, with the help of energy service companies, aggregators and brokers.

Guidelines on State Aid for environmental protection and energy 2014-2020 exempt most prosumer energy from market exposure when it comes to compensation for the electricity they feed into the grid. Installations with installed capacity of less than 1 MW are exempted from the competitive bidding process for feed-in premiums (FiPs), and those with installed capacity of less than 500 kW can still be awarded feed-in tariffs (FiTs). Most residential prosumers will be well below these limits, but Member States can choose to set lower limits.[9]

Position of the European Parliament

In its resolution of 26 May 2016 on Delivering a New Deal for Energy Consumers the Parliament called for a common operational EU definition of prosumers. It said individuals, households, cooperatives, communities and local authorities should be encouraged to become energy producers and suppliers, and that their active participation should include energy efficiency and demand response measures. The Parliament called for the introduction of net metering schemes and called for more support for energy efficiency and self-generation to be targeted at energy-poor consumers.

The Parliament repeated its request for an EU definition of prosumers in its resolution of 13 September 2016, Towards a new energy market design. The Parliament asked the European Commission to include a new chapter on prosumers in the revised Renewable Energy Directive, which would 'address the main barriers and boost investment in self-generation and self‑consumption of renewables'.

In its resolution of 15 December 2015 on Making Europe's electricity grid fit for 2020, the Parliament said that when deciding on electricity infrastructure, prosumers have to be taken into account, and smaller suppliers, in particular prosumers, should be able to access the grid.

The European Parliament resolution of 12 September 2013 on Microgeneration called for measures that would encourage prosumers to self-consume the electricity they produce, as this can lead to lower costs for the system. However, it noted that increasing microgeneration capacity in the EU could be very costly, as it would make new investments in distribution and transmission systems necessary. It stressed that increasing microgeneration should not undermine the security of supply or artificially increase energy prices.

Stakeholders' views

European Environmental Bureau calls for an EU-wide right to self-generate, self-consume and store electricity for all consumers, including when they act collectively. It says the new Renewable Energy Directive should facilitate access to finance for prosumers and ensure they are adequately rewarded for fed-in power. It suggests the Commission should propose guidelines or best practices for rate design, which would include a combination of low fixed charges for grid costs and time-varying rates for energy supply.

Eurelectric calls for the removal of barriers to prosumers, and sees them as a possible business opportunity, for instance, the electricity industry could offer services such as forecasting, balancing, back up or aggregation to prosumers. Eurelectric also favours exposing prosumers to market signals, for instance, requiring them to sell their surplus energy at a 'fair market price', and argues in favour of phasing out price regulation as well as the obligation to purchase electricity from renewable sources, and proposes to avoid FiTs and net-metering schemes.

The non-profit environmental law organisation, Client Earth, calls on the Commission to adopt a legal definition of prosumers in future legislation, which would distinguish them from all other market actors and enable them still to be protected as consumers. It suggests that prosumers should be legally defined as 'active consumers'. The definition should include individuals, collective initiatives and small enterprises and should cover generation, storage and supply of renewable energy as well as demand-side response and possibly other activities. Client Earth calls for the revised Renewable Energy Directive to require Member States to find ways for energy-poor households to participate in community energy projects.

The European consumer organisation BEUC calls for more stability in national regulatory frameworks for prosumers, especially when it comes to support schemes, as well as for adequate remuneration for electricity fed into the grid. It also calls for a framework to enable citizens living in multi-apartment buildings or rented properties to become prosumers, and for vulnerable customers also to benefit from self-generation. It suggests that Member States include long-term strategies for small-scale self-generation in their

energy and climate plans, while their reporting obligations should include the amount of electricity produced and self-consumed by households, as well as their installed capacity.

Solar Power Europe says that the post-2020 legislative framework should ensure that self-consumption is allowed and supported, and community energy projects facilitated by dedicated legal, technical and financial measures. It argues that self-consumed electricity should not be subject to specific taxes and that prosumers should not be discriminated against when it comes to grid costs. It suggests that prosumers should pay for the grid based on their impact on it: if they use it as energy storage, for instance by using net metering, grid charges they pay should be higher; if their self-consumption is adjusted so that it does not overburden the grid, then charges should be lower. Solar Power Europe also calls for the new legislation to encourage building renovations with on-site RES solutions.

Next steps

According to the New Deal for Energy Consumers communication, the revised Renewable Energy Directive, Energy Efficiency Directive, and the New Electricity Market Design will all include provisions for prosumers, including the possibility of collective schemes. A regulatory framework for new market actors, such as aggregators, should also be established in this package of legislation. The new legislative proposals are now expected to be adopted by the European Commission towards the end of 2016.

Main references

Fraunhofer Institute, Recent facts about photovoltaic in Germany, 2016.

IEA-RETD, Residential prosumers: Drivers and policy options (Re-prosumers), 2014.

IEA-RETD, Tapping the potential of commercial prosumers, 2016.

International Energy Agency, Technology roadmap: Solar photovoltaic energy, 2014.

Joint Research Centre, PV status report 2014, 2014.

Pyrgou, A., Kylili, A., Fokaides, P.: The future of the Feed-in Tariff (FiT) scheme in Europe, Energy Policy, Vol 95, pp. 94-102, 2016.

Roberts, J., Prosumer rights: Options for an EU legal framework post-2020, ClientEarth, 2016.

Rosa Luxemburg Stiftung, Angel, J., Strategies of Energy Democracy, 2016.

Self-consumption of electricity from renewable sources, Insight Energy, 2015.

Endnotes

[1] See for instance A Prosumer Oriented Energy Market and Prosumer Rights: Options for a legal framework post-2020.

[2] This 'levelised cost of electricity' (LCOE) takes into account initial investments, operations and maintenance, cost of fuel and cost of capital.

[3] According to many commentators, including the European Commission, high retail prices are in large part due to differing taxes and levies in energy bills that fall disproportionately on households. However, these taxes and levies are often used to subsidise the costs of RES generation, so to some extent the rise of prosumers may be causing high retail prices for others.

[4] This could change in the future, with the most promising efforts for now coming from Tesla.

[5] The European Commission notes that subsidies for electricity for the industry (or its exemption from RES levies, for instance) can also result in cross-subsidies.

[6] In California, where the netting period is one year, schools with a large amount of rooftop PV panels sometimes end up paying for no electricity at all, because they produce a lot of it in the summer, when there are no classes, and then use it during the school year.

[7] The example of Spain shows that a daily netting period in combination with per kWh DSO charges would reduce DSO income per household by 69 %. The DSO income would be reduced by 77 % with a monthly netting period, while a yearly netting period would mean zero income for DSOs.

[8] The sliding feed-in premium is the approach taken in the new German Renewable Energy Act, according to which feed-in tariffs remain for projects up to 500 kWH contracted before 1 January 2016 but only up to 100 kWh for projects contracted after that. Other renewable electricity producers can receive only feed-in premiums.

[9] The new German Renewable Energy Act sets the limit at 100 kW.

Disclaimer and Copyright

eprs@ep.europa.eu
http://www.eprs.ep.parl.union.eu (intranet)
http://www.europarl.europa.eu/thinktank (internet)
http://epthinktank.eu (blog)