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Published in:
Energy Law, Climate Change and the Environment

DOI:
[10.4337/9781788119689.IX.61](https://doi.org/10.4337/9781788119689.IX.61)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2021

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Diestelmeier, L. (2021). Regulating residential prosumers. In M. M. Roggenkamp, K. J. De Graaf, & R. C. Fleming (Eds.), *Energy Law, Climate Change and the Environment* (pp. 729-740). (Elgar Encyclopedia of Environmental Law series; Vol. 9). Edward Elgar. <https://doi.org/10.4337/9781788119689.IX.61>

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IX.61 Regulating residential prosumers

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Abstract

This chapter explains how legal frameworks determine the role of residential prosumers in the electricity sector. The focus is on remuneration mechanisms for surplus electricity and distribution network structures. The chapter focuses on residential prosumers and mainly draws upon insights from the European Union (EU) context and the integration of prosumers in the electricity sectors in the Member States. The legal issues discussed are, however, also relevant for a broader context and applicable to other jurisdictions beyond the EU.

Keywords

Prosumers, renewable energy, remuneration, network tariff, demand-side flexibility, distribution grid, smart meter, active customer

Contents

- IX.61.1 Introduction
- IX.61.2 Residential prosumers and resulting legal issues
- IX.61.3 Regulating prosumers
 - IX.61.3.1 Market integration
 - IX.61.3.2 Distribution network tariffs
- IX.61.4 Conclusion

IX.61.1 Introduction

Prosumers are commonly understood as energy consumers who start generating energy, primarily for their own use and on their own premises. Prosumers have traditionally been more visible in the industrial and commercial sectors, though they are becoming increasingly important at the residential level.¹ The development of the latter category (residential prosumers) has accelerated with the emergence of small-scale production technologies running on renewable energy sources (RES). Households and small enterprises, which have previously been exclusively electricity consumers, install small-scale generation technologies – typically photovoltaic (PV) panels – on their premises behind the metering point (‘onsite generation’).² However, prosumers are not fully self-sufficient, and remain dependent on electricity provided by a supply company, thus

¹ Generally, prosumers can be put into three categories: residential, commercial, or industrial. The exact definition of each category depends on the jurisdiction and may, for example, refer to the connected capacity or the purpose of generation, which could be either private or commercial. Regarding commercial prosumers, see: Rickerson and others (2016).

² Inderberg, Tews and Turner (2016) 72.

fulfilling a dual role of producer and consumer. The term *prosumer*, a portmanteau of *producer* and *consumer*, suggests that prosumers do not comfortably fit within existing definitions of electricity sector legislation.³

Prosumers are often not explicitly defined in legal frameworks. Moreover, the factors that motivate people to start producing energy are often far more complex than legislators understand them to be.⁴ Nonetheless, electricity sector legislation *is* responsible for determining the role of prosumers, often utilising economic carrots or sticks to convince or dissuade consumers from generating electricity for their own use.

At the core of determining the role of prosumers are the remuneration mechanisms for the surplus electricity, and the network tariffs applicable to prosumers. Prosumers often generate surplus electricity due to the variable (or intermittent) character of RES, which does not coincide with the demand patterns of prosumers.⁵ The resulting regulatory question thus is whether prosumers are allowed to sell surplus electricity – and if so, what conditions should be attached? As prosumers use the grid in a different way to conventional consumers (*i.e.* less consumption and feed-in of surplus electricity), the resulting regulatory question of how network tariff structures can reflect this differentiation comes to the fore.

The aim of this chapter is to outline the main regulatory approaches affecting the development of residential electricity prosumers and to discuss their potential role in the electricity sector. The chapter mainly draws upon insights from a European Union (EU) context, looking to the integration of prosumers in Member States' (MSs) electricity markets. The legal issues discussed in the chapter are relevant in a broader context and are applicable to other jurisdictions. The chapter is structured as follows: section IX.61.2 describes prosumers and introduces resulting legal issues; section IX.61.3 outlines main remuneration mechanisms for surplus electricity and different network tariff structures and how these affect prosumers; and section IX.61.4 concludes on the potential roles of prosumers in the electricity sector.

IX.61.2 Residential prosumers and resulting legal issues

The development of residential prosumers raises regulatory questions regarding their position in the market. Prosumers are not producers, neither are they merely consumers, hence prosumers do not comfortably fit into existing classifications in electricity sector legislation.⁶ The difficulties in classifying the phenomenon of prosumers in a universal definition can best be understood by sketching a functional description of their most common activities. Following on from this, it is possible to outline the different options of how prosumers could participate in the electricity sector. Residential prosumers are primarily producing for their own consumption and not for commercial purposes. The variability of RES has two implications for the activities of prosumers. First, electricity generation does not necessarily coincide with the consumption profile of the prosumers: this means that they remain dependent on electricity from a supply company for times

³ For the first use of the term *prosumer*, see: Toffler (1980).

⁴ GfK Belgium Consortium (2017) 32; Kotilainen and Saari (2018) 17; Palm (2018) 2; Schaffer and Brun (2015) 221; Schelly (2014) 186.

⁵ Khalilpour and Vassallo (2015) 217.

⁶ Lavrijssen and Carrillo Parra (2017) 4.

when no electricity is being produced at their home. Second, the generated surplus electricity is fed back into the grid. Prosumers are thus using the grid in two ways, as an exit and an entry connection.

It is necessary to emphasise that roles of *self-consumer* and *small-scale renewables producer* only clarify the physical electricity flows. Core legal issues with prosumers concern the regulation of self-consumption and surplus electricity. For example, questions relating to self-consumption include whether prosumers have the right to connect a generation installation to the grid and consume a part of the generated electricity, and whether self-consumption implies any benefits or costs for the prosumer (for example additional charges for network use). Questions regarding surplus electricity include whether the prosumer ought to receive a revenue for the surplus, and if so, whether the value of remuneration is fixed or market-based, or calculated using a hybrid model incorporating a price floor. If remuneration is in place, this raises the question of applicable timeframes for the remuneration (for example, yearly, monthly, daily, 15 minutes or even in real-time).⁷

How these issues are regulated will essentially determine the role of prosumers in the electricity sector. For example, when prosumers are remunerated for surplus electricity at a flat-rate, in a time-independent manner, they are not incentivised to consider market prices or network congestion. They simply generate and consume at their convenience. If subject to dynamic market pricing for surplus electricity and additionally to dynamic cost-reflective network tariffs, prosumers are incentivised to consider these market signals, and to invest also in other complementary technologies, such as batteries.⁸

The above issues illustrate the extreme difficulty in finding and providing a universally valid definition for the concept of prosumers. While some descriptions of prosumers consider autonomy and market integration as inherent features,⁹ others classify prosumers more narrowly as ‘consumers who start producing electricity’.¹⁰ Depending on the role of prosumers, and more specifically, their level of market integration, different market models are conceivable for prosumers. In peer-to-peer market models prosumers can directly enter into transactions as autonomous market participants. In more centrally organised models, prosumers can offer either surplus electricity or grid services to a central actor, for example, the supplier or the system operator, or aggregators.¹¹ The following section elaborates further on this by focusing on two issues, namely the market integration of prosumers, and the effect of network tariff regulation on prosumers.

IX.61.3 Regulating prosumers

Regulation affecting prosumers mainly concerns the remuneration mechanism for surplus electricity and the network tariff. Both can be designed in different ways, with the design shaping the role of prosumers in the electricity sector. The following two sections explain both components and identify the consequences and possible challenges for the development of prosumers.

⁷ Lettner and others (2018) 8; Banet (2018) 188.

⁸ Eid and others (2016) 242.

⁹ Jacobs (2017) 525; Morstyn and others (2018) 94; Shandurkova and others (2012) 36.

¹⁰ Ford, Whitaker and Stephenson (2016) 5; GfK Belgium Consortium (2017) 28; Cretu and Mumovic (2018) 3.

¹¹ Parag and Sovacool (2016) 2.

IX.61.3.1 Market integration

Economic benefits are one of the main incentives for consumers to start generating electricity. That prosumers are indeed carrying out an economic activity from a legal perspective has been established by the European Court of Justice.¹² However, the nuts and bolts of remuneration for this economic activity can be organised in different ways, with implications for the integration of prosumers into markets.¹³ Remuneration mechanisms for surplus electricity generated by prosumers can be divided into two main categories – regulated remuneration and market-based remuneration.

Regulated remuneration includes fixed compensation for surplus electricity generated by the prosumer. This regulated compensation typically applies in a time-independent way, meaning that the moment of generation does not influence the remuneration. The aim is to provide a large degree of financial certainty and to shield producers from fluctuating market prices. The most prominent examples of such schemes are the many support schemes for electricity generated on the basis of RES, and net-metering schemes, which offset surplus electricity with the consumption of the prosumer.¹⁴

Support schemes themselves can take various forms, as RES proponents aim to reduce the level of investment required to stimulate RES electricity generation.¹⁵ Typically, support schemes provide a predetermined tariff for electricity generated on the basis of RES. For example, under a feed-in-tariff support scheme, prosumers would receive a fixed remuneration per kWh of generated electricity. Germany is an example of a country which initially established a rather generous feed-in scheme. Originally, prosumers in Germany made a windfall gain, as their self-consumed electricity was exempted from surcharges for the energy transition (essentially, the feed-in tariff), which had been levied on consumed kWh. This resulted in an inequitable distribution of costs and benefits among consumers and prosumers.¹⁶ Legal reforms changed this system to also integrate prosumers, and in particular self-supply, into the cost scheme.¹⁷

Net-metering involves using surplus electricity generated to offset metered electricity consumption. It is thus a billing agreement, usually between the supply company and the prosumer, to settle the difference over a specified timeframe (typically annually or monthly).¹⁸ This allows the prosumer to contractually calculate all their generated electricity as self-consumption, regardless of the moment of generation. The Netherlands is an example of a country that established net-metering as a remuneration mechanism for prosumers.¹⁹ One of the main criticisms regarding net-metering is that it does not take into account the actual price of electricity at a specific point in time, as it simply offsets on an annual basis. With increasing amounts of RES connected to the distribution grid

¹² Case C-219/12 *Finanzamt Freistadt Rohrbach Urfahr v Unabhängiger Finanzsenat Außenstelle Linz*, in the presence of: Thomas Fuchs, ECLI:EU:C:2013:413, paras 18, 38.

¹³ Hughes and Bell (2006) 1534; Moura and Centeno Brito (2019) 820.

¹⁴ Ossenbrink (2017) 239; Poullikkas (2013) 1.

¹⁵ Battle, Pérez-Arriaga and Zambrano-Barragán (2012); Huntington and others (2017) 476.

¹⁶ Inderberg, Tews and Turner (2016) 16; Winter and Schlesewsky (2019) 345; Lang (2018) 149.

¹⁷ Lang (2018) 145.

¹⁸ Eid and others (2014) 246.

¹⁹ Diestelmeier and Kuiken (2018) 154.

and the need for flexibility in the system, this particular issue looks set to gain greater relevance. Currently, the Dutch net-metering scheme is being reviewed, and will be progressively phased-out as of 2023 until 2031.²⁰

For regulated remuneration, the time element in metering is less relevant, as remuneration is based on fixed amounts per kWh, which are compensated or offset, for example, on an annual basis. By contrast, market-based remuneration for surplus electricity generated by prosumers requires metering at more precise time intervals, ideally in real time. Metering which is more precise in time intervals is usually referred to as *smart metering* or *advanced metering*.²¹ In contrast to conventional analogue meters (which typically measure only consumption over a period of time), smart meters are digital, and communicate meter readings of consumption and also production between prosumers, supply company, DSOs or aggregators. Universal smart metering would expose prosumers to market forces to a larger extent, potentially influencing their choices of when to consume or to feed electricity into the grid according to the market price, or even incentivise them to invest in storage technologies.²²

While, as well as enabling their initial emergence, regulated remuneration aims to incentivise prosumers to produce by providing financial certainty, it does not facilitate their further development as market actors. Further market integration may become necessary in time, in part due to the increased integration of variable RES-generation at distribution system level. Variable generation (without adequate storage) necessitates more flexible consumption at the residential level, which can be incentivised by harnessing market forces.²³ Exposing prosumers to a market-based remuneration for their surplus electricity would shift the business case of prosumers. Instead of merely producing, using the majority and feeding in the excess, prosumers would seek to maximise profits by enhancing their ability to react to market signals – perhaps through purchasing batteries or participating in demand-response systems. This would again require a more elaborate understanding of prosumers than *consumers that generate electricity*, for example by including market participation as a feature. The reformed EU directive on the rules of the internal electricity market²⁴ includes a definition of prosumers (although the term ‘active customers’ is preferred). They are defined as follows:

[...] a final customer, or a group of jointly acting final customers, who consumes or stores electricity generated within its premises located within confined boundaries or, where permitted by a Member State, within other premises, or who sells self-generated electricity or participates in flexibility or energy efficiency schemes, provided that those activities do not constitute its primary commercial or professional activity.²⁵

²⁰ Letter from Wiebes E (Minister of Economic Affairs and Climate Policy, Netherlands) and Snel M (Secretary of State for Finance, Netherlands) to Arib K (Speaker of the House of Representatives, Netherlands) (25 April 2019).

²¹ Erlinghagen, Lichtensteiger and Markard (2015) 1250.

²² Eid and others (2016) 239.

²³ Lund and others (2015) 788.

²⁴ Directive (EU) 2019/944 on Common Rules for the Internal Market for Electricity [2019] OJ L158/125.

²⁵ *ibid* art 2(8).

This definition foresees a broader role of prosumers than consuming and generating electricity. By including participation in flexibility or energy efficiency schemes, the EU can be seen as steering prosumers towards market integration. It remains to be seen how this provision is transposed at MS level, and how this will affect the (re)design of remuneration mechanisms.

IX.61.3.2 Distribution network tariffs

The network tariff structure determines how DSOs can recoup their costs by specifying the calculation of network tariffs.²⁶ Two main objectives for network tariff design are, *inter alia*, cost-reflectivity (ensuring the network tariff reflects the actual costs incurred by a system user) and non-discrimination (applying the same network tariff structure to system users considered to be of the same category).²⁷ Whereas in an electricity sector with only conventional consumers the network tariff structure can incorporate the consumed electricity as its main cost component (volumetric tariff, meaning $\text{€}/\text{kWh}$), in an electricity sector with prosumers, the determination of cost components becomes more complex.²⁸ Prosumers are using the grid in two ways, as an entry and an exit connection. There are multiple ways of regulating network tariffs – for the purpose of this chapter, it is sufficient to distinguish between more conventional tariffs and dynamic network tariffs.

Typically, network tariffs consist of three main elements: a fixed charge ($\text{€}/\text{period}$, *i.e.* independent of consumption), volumetric costs ($\text{€}/\text{kWh}/\text{period}$, *i.e.* proportional to the energy consumed), and capacity charges ($\text{€}/\text{kW}/\text{period}$, *i.e.* dependent on the maximum power capacity used).²⁹ Various combinations of these elements are possible. This also implies that the policy objectives of network tariff structures are reflected to different extents.³⁰ Generally, there is a distinction between a volumetric charge, a network tariff which is to a larger extent based on the volume of energy consumed; and a capacity charge, a network tariff which is to a larger extent based on the fixed capacity of the connection. The design of network tariff structures is highly complex, with a trade-off between economic efficiency and equity at its core.³¹

The majority of EU MSs deploy distribution network tariff structures that are, to a large extent, based on a volumetric charge – meaning a large part of the network tariff is based on the volume of the energy distributed (kWh).³² This structure stems from electricity sectors with conventional customers who induce system costs by consuming electricity. In an electricity sector with only electricity consumers, a volumetric tariff structure generally fulfills the criteria of cost-reflectivity and non-discrimination.

²⁶ Picciariello and others (2015) 371.

²⁷ Rodríguez Ortega and others (2008) 1713.

²⁸ Schittekatte, Momber and Meeus (2018) 484.

²⁹ Picciariello and others (2015) 371.

³⁰ Nijhuis, Gibescu and Cobben (2017) 638.

³¹ Borenstein (2016) 5.

³² Per AF-Mercados, REF-E and Indra (2015) 2: 'In the electricity sector the energy component applied to households is on average 69% of the total network charge. This situation is common in most countries apart from three (The Netherlands, Spain and Sweden) where the energy charge weights between 21% and 0%'.

Prosumers, however, cause additional grid costs which need to be reflected in the network tariff structure. Volumetric tariffs based on consumption are thus no longer sufficient for recovering costs induced by prosumers. In some EU MSs a trend towards capacity-based tariffs can be observed, *i.e.* in the Netherlands, Spain, Sweden, and Italy.³³ While a larger capacity charge provides DSOs with greater certainty of cost recovery, it does not incentivise system users (consumers or prosumers) to adjust their grid usage or energy consumption according to constraints in the network or the availability of RES.³⁴ As expected, this becomes of greater relevance with increasing amounts of decentralised generation on the basis of variable RES.

Besides these two conventional forms of network tariff structure stands dynamic network tariffs, which incorporate a variability element. Dynamic tariffs aim to incentivise a more flexible use of the grid, reducing network constraints.³⁵ Some EU MSs already deploy more than one energy component depending on the timing, aiming to incentivise a more efficient use of the grid.³⁶ For example, *time-of-use tariffs* determine time blocks with different prices, with *critical peak pricing* setting higher prices for predetermined critical peak moments, and *real-time pricing* setting prices (as close as possible) to real-time values, in accordance with current network constraints. As prosumers are using the grid more extensively by also feeding in electricity, dynamic network tariff structures are possibly a way of ensuring more accurate cost-reflectivity and non-discrimination between consumers and prosumers. However, the exact design of such tariffs is the subject of discussion, as it always implies a trade-off with other policy objectives, for example cost-reflectivity and predictability.³⁷

In conclusion, distributing the costs for grid usage becomes more complex with the integration of prosumers. Rather than setting only energy or capacities as the cost determining components, network tariff structures need to reflect the different usage patterns of consumers and prosumers. One innovative approach suggests charging consumers and prosumers for specific services they require based on their deployed technologies, *i.e.* generation and/or other technologies enhancing their flexible usage such as batteries.³⁸ This approach may be further developed by adding a peak-pricing component and fixed charges in order to improve cost-recovery for system operation.³⁹ This would certainly increase the complexity of network tariff structures, but improve cost-reflectivity and non-discrimination. Moreover, dynamic network tariffs would ideally also incentivise more efficient use of the grid.

IX.61.4 Conclusion

This chapter aimed to outline the main regulatory approaches affecting residential prosumers in the electricity sector. The regulation of residential prosumers depends on the wider vision for the electricity sector, be it incentivising RES electricity generation

³³ AF-Mercados, REF-E and Indra (2015) 114.

³⁴ Kolokathis, Hogan and Jahn (2018) 4.

³⁵ Abdelmotteleb and others (2018) 816.

³⁶ AF-Mercados, REF-E and Indra (2015) 113.

³⁷ Nijhuis, Gibescu and Cobben (2017) 640.

³⁸ Brown, Faruqui and Grausz (2015) 148.

³⁹ Faerber, Balta-Ozkan and Connor (2018) 217.

behind the meter, or the efficient use of RES and the network. Accordingly, the structure of remuneration for surplus electricity as well as network tariffs can be designed to coerce prosumers to produce and feed in at any time, or to consider market signals and network constraints via dynamic pricing schemes. There is more than one way to skin the prosumer cat, each with different implications for the future role of prosumers in the market – with the largest distinction being whether they are positioned between regulated actors, or whether they can act autonomously as market participants in their own right.

Generally, with increasing amounts of RES connected to the electricity system, the flexibility of system users becomes of greater relevance. This shift towards flexibility needs to be reflected in the remuneration schemes and the network tariff structures. In turn, this would require the role of prosumers to develop from ‘consumers who start producing’ for the benefit of regulated remuneration, to more autonomous market actors whose role is not only producing, but also offering flexibility.⁴⁰ The EU legislation introduced a new actor category, active customers, which is indeed characterised by more features than only ‘producing’. It remains to be seen how the MSs will align their national legislation with this approach, and which legal issues will emerge.

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⁴⁰ Jacobs (2017) 575.

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