Access to solar

A legal framework for tenants in multi-storey buildings to obtain solar energy

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Contents

1. Executive summary

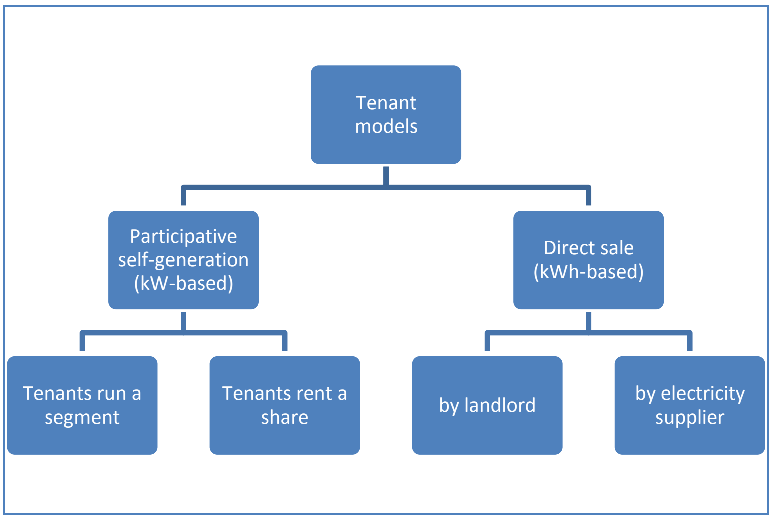
Our energy supply is becoming cleaner and less centralised. This is due in large part to a fall in the investment costs of renewable self-generation technologies, such as solar photovoltaic (PV) installations. Detached home-owners have been the first to take up, and benefit from, solar electricity self-generation, in particular where public incentive schemes have been set up. But other parts of society have so far been unable to access this source of energy, including tenants in multi-storey buildings. As many as around 150 million Europeans, 30% of the population of EU28 in 2014, are tenants.[1] Many of them live in multi-storey dwellings. The EU is currently looking into ways to empower consumers to become more active energy market participants through its Energy Union strategy. But tenants seem still to be the blind spot of solar PV policies. The European Commission would do well to make it easier for tenants who live in multi-storey buildings to benefit from solar electricity that has been generated on their buildings' premises. We consider this a potential contribution to combat energy poverty.

A broad definition of self-generation & self-consumption for tenant models

In this paper, we extend the definition of self-generation to any model that allows tenants to participate in solar electricity generation. Self-consumption is also defined broadly as any model giving tenants direct access to the use of electricity that has been generated on premises, in other words behind the grid connection point of the building (see *chapter 2 and 3*). This paper assesses four models (*chapter 4*) where tenants would be able to access and consume the solar electricity that has been produced on the rooftop of the multi-storey dwelling they live in:

1. **Segmented self-generation**: Tenants rent and run a segment of a solar power plant on their own.
2. **Shared self-generation**: The shared use of the solar power plant is part of the lease for the flat the tenant is renting.
3. **Direct sale by the landlord or by a contractor**: Tenants are offered an in-house solar electricity tariff.
4. **Direct sale by an electricity supplier**: Tenants are offered solar electricity and electricity imported from the grid in one single retail electricity tariff.

The first and second model depend exclusively on the installed capacity, the kilowatt (kW) of the solar panel. They require a relatively high level of involvement by the tenants and can be classified as participative self-generation. The two other direct sale models resemble normal retail electricity tariffs since tenants receive a bill based on the kilowatt-hours they've consumed.



[1] Eurostat: Housing statistics, http://ec.europa.eu/eurostat/statistics-explained/index.php/Housing_statistics, 11 May 2016.

Direct sale models are simpler and less risky for tenants – but provide less control

The assessment from a consumer perspective (*chapter 5*) shows that direct sale models generally bear a lower risk for tenants. The contractual framework provides a higher level of transparency with regard to costs and benefits. Moreover, the administrative burden for the tenant tends to be much lower. However, in legal terms, a broader definition of self-generation and self-consumption is required to include these models.

The following table summarises the assessment of the tenant models and ranks their consumer-friendliness under specific angles.

Overview of tenant models' principles and assessment of their consumer-friendliness

	Segmented self-generation	**Shared self-generation**	**Direct sale by the landlord or by a contractor**	**Direct sale by an electricity supplier**
Who's the owner of the power plant?	Landlord (or tenants) or third party	Landlord or third party	Landlord or contractor or third party	Landlord or third party or supplier
Who's responsible for the technical operation of the power plant?	Tenant	Landlord	Landlord	Supplier or landlord
How are tenants invoiced?	Use of their segment through a monthly rent + individual retail tariff by supplier	Use of their share included in rent + individual retail tariff by supplier	In-house solar electricity tariff + individual retail tariff by supplier	In-house retail electricity tariff by supplier only
Can tenants actively participate in operations and management decisions?	yes	yes, but in a more abstract manner	only passively by adjusting consumption, if information and appropriate tariff is provided	only passively by adjusting consumption, if information and appropriate tariff is provided
Self-consumption rate	Disadvantageous	Advantageous	Good if many tenants opt in	Good if many tenants opt in
Uncertainty on tenants' cost and benefits	Depending on irradiation and consumption	Depending on transparent cost allocation, irradiation and consumption	Low	Low
Tenants' administrative burden	High	Average	Average	Low
Level of tenants' risks	High	Average	Low	Low

Tenants are the blind spot of self-generation policy

Tenants seem to be the blind spot of all solar self-generation policies in EU Member States. We analysed how the four tenant models fit with national legal frameworks in Germany. It is clear that project developers, contractors, cooperatives, social housing companies or other landlords do not have an appropriate legal framework that would welcome tenant models. At the moment, tenants' access to solar self-consumption is, legally-speaking, almost a no man's land. The fact that self-generation policies are mainly designed for owners of detached houses makes it hard for tenants to access this solar electricity.

Tenants should not be discriminated against

In order to remove the 'grey zone', this paper develops a set of recommendations (*chapter 6*). Most importantly, the technical potential of the premises should be what determines whether tenants can access solar self-generation and not inappropriate support schemes that are designed for other consumer groups.

The European Commission's legislative proposals should work for tenants

The upcoming new Energy Market Design Initiative of the European Commission and the revision of the Renewable Energy Directive offer a window of opportunity for tenants to access solar electricity generated on their premises and for innovative business models to emerge.

In a nutshell, the most important legal requirements to provide tenants with access to solar self-consumption are:

- **Prohibiting any direct or indirect ban on self-generation or self-consumption**, e.g. by technical rules, contracts or by support schemes that require solar power plant operators to fully export the generated electricity into the grid;
- **Keeping free of charge the consumption of solar electricity produced on premises;**
- **Providing a stable and reliable framework** of simple and fair energy law and avoid stop-start policies;
- **Granting priority grid access and dispatch** to excess electricity to be fed into the grid and provide **appropriate remuneration for it**;
- **Ensuring these tenant models reflect existing consumer rights and integrate consumer protection in new contract schemes**.

Add a social dimension to the Energy Union strategy

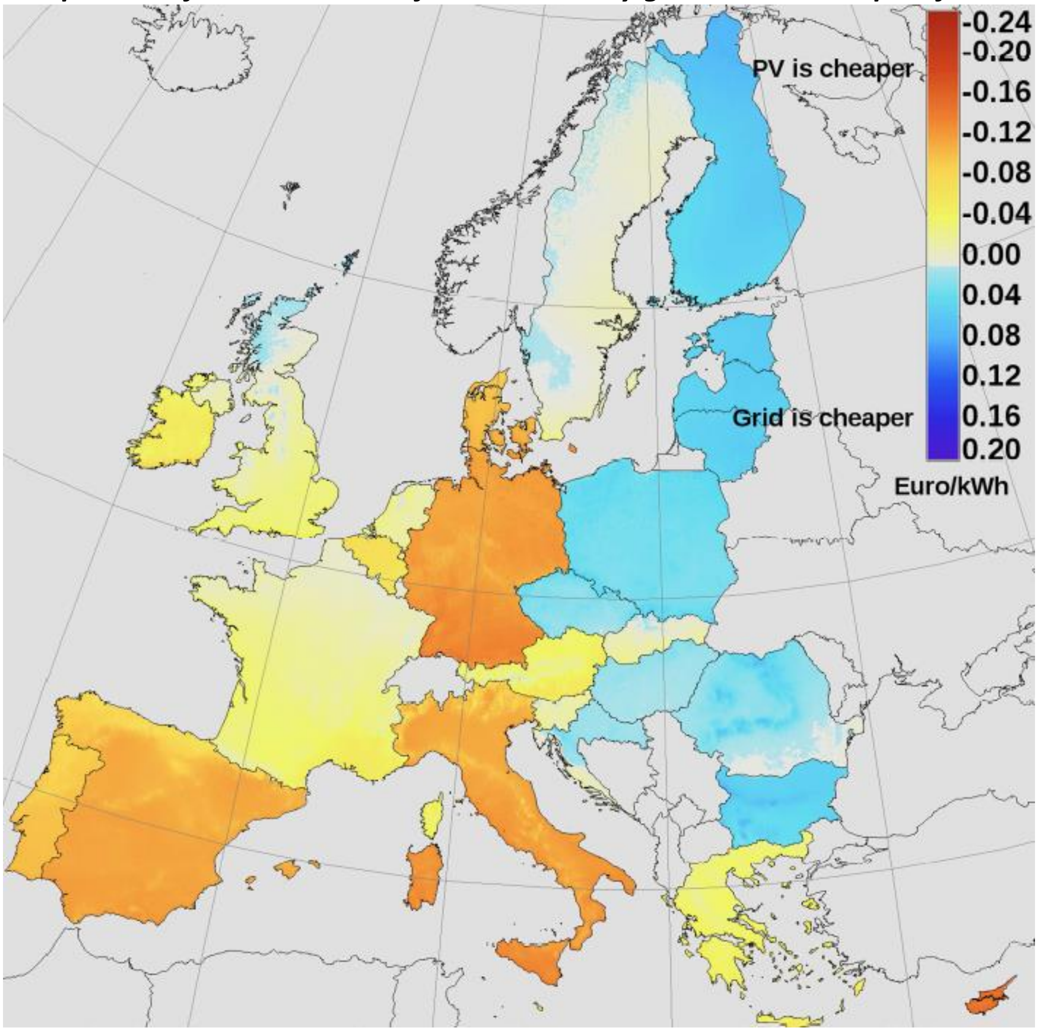
Tenants' access to solar self-consumption is not only a question of equal footing with home-owners. It is also an important contribution to combat energy poverty if tenants are able to cut their bills by participation in concepts for low-, zero- or plus-energy-housing with access to cheap locally generated solar electricity. This would give the Energy Union strategy a social dimension.

2. Scope and content of this paper

This background paper explains concrete ways in which tenants can benefit from self-generation and on-site generated electricity directly. We will analyse existing or expected hurdles and work out proposals for improvements in future legislation so that these ideas can work. To keep it simple, this paper will focus on solar PV installations only, given that they are the most widespread renewable self-generation technology in the electricity sector. However, other renewable self-generation technologies such as micro wind turbines as well as cogeneration units could also significantly cut costs for tenants. These technologies struggle with problems similar to those of self-generation.

Four out of five Europeans live in a region where generating solar electricity on their rooftop is cheaper than importing it from the grid. When the cost of solar kilowatt-hours equals the average retail electricity price, this turning point is called grid parity.

***Comparison of levelised costs of solar electricity generation vs. import from the grid*[2]**



[2] For 80% of EU households, self-generation of solar electricity would be cheaper than buying it from the grid. Joint Research Centre (JRC): Cost Maps for Unsubsidised Photovoltaic Electricity 2014, September 2014. Assumptions: 1,400 euro/kW system price plus national VAT rate, levelised cost of electricity generation with 20 years payback, 5% p.a. interest, 2%/year maintenance. The actual spread between the retail price on the one hand and the levelised generation cost of solar PV electricity may differ because the JRC model applied EU average data and did not take into account any eventual public support granted (e.g. tax exemptions) that could increase or decrease retail prices respectively generation cost.

All households should be able to benefit from the lower cost of solar electricity generation, and not just homeowners, but also tenants especially in social housing. While investment costs for solar PV continue to decrease, self-consumption for tenants cannot take off by itself.[3] Limiting policies to owners of detached houses would exclude millions of consumers: 30% of the EU28 population in 2014 were tenants, 40% of the EU28 population lived in a flat. The EU's leading solar PV market, Germany, is at the same time the EU's largest nation of tenants with 47.6% of the population being tenants. In two other big countries with early grid parity and established solar PV markets, the share of people living in multi-storey dwellings is very high: Spain is the EU leader in terms of population living in flats with 66.5%. In Italy, 50.8% live in flats.[4] This paper focuses on the conditions for tenants, mostly living in such flats in multi-storey dwellings.

To some extent, the tenant models that we describe could also be adapted to homeowners living in multi-storey dwellings. For instance, tenants and/or homeowners could set up a cooperative that owns and/or operates the PV power plant as a third party. We will, however, not touch upon such cases here.

Solar electricity: from the rooftop to the tenant

In order to illustrate the specific challenges of tenant models, we take the scenario where we have solar panels that are installed on a multi-storey dwelling rooftop. Referring to the physical flow of electrons, if someone generates electricity on site, any tenant living in the same building consumes at least part of the solar electricity produced: Once fed into the internal building grid, solar electricity from the rooftop of the multi-storey dwelling will take the shortest way through the power line to the next consumers, namely to the tenants. But in the case of a multi-storey-dwelling, this does not have the same cost-reducing effect that homeowners enjoy when self-consuming solar electricity in a detached house. In financial terms, unlike homeowners, tenants regularly receive that electricity as electricity delivered via the grid. Their electricity is purchased, delivered and billed by an electricity supplier. This situation does not value the fact that, speaking in physical terms, the use of the grid is spared thanks to solar self-consumption. Nor does this situation allow tenants to adjust their electricity demand to availability of the locally produced solar electricity. Speaking in financial terms, this means that tenants do not get the opportunity to consume cheap solar electricity – although they physically already do it automatically.

Keeping tenants away from self-consumption could mean that roofs of multi-storey dwellings suitable to generate solar electricity are only used by external investors for selling solar electricity to the grid. But given that many Member States do not provide sufficient support schemes for solar electricity fed into the grid, this currently does not pay off in the EU. Low wholesale market prices alone cannot pay off the initial investment. It needs self-consumption to make solar PV projects economically viable. The more expensive import of electricity at retail prices from the grid is substituted, the faster the project can be amortised. **But if self-consumption is not allowed in financial terms, roofs of multi-storey dwellings would remain unused, despite being a potential source of cheap electricity.** This is even more paradoxical when bearing in mind that:

[3] BEUC gathered expertise on solar self-generation with its mapping report 'Current practices in consumer-driven renewable electricity markets', published in January 2016. Policy recommendations are summarised in the policy paper 'A welcome culture for consumers' solar self-generation', published in February 2016.

[4] Eurostat: Housing statistics, http://ec.europa.eu/eurostat/statistics-explained/index.php/Housing_statistics, 11 May 2016.

- Tenants, as potential consumers, live right under the location of a potential PV power plant, often paying relatively high retail electricity prices;
- In case public support schemes like feed-in tariffs are in place, tenants who self-consume solar electricity reduce exports of excess electricity to the grid, thus reducing the volume of financial support to be allocated to PV power plant operators.

In a nutshell, tenants could be in a position to make investments in PV power plants economically viable and, to some extent, make financial support schemes for solar electricity superfluous.

Definition of self-generation and self-consumption

We understand self-generation as the combined activity of consuming the electricity that has been generated on premises and of feeding electricity into the grid. Self-generation is not limited to electricity generation but can also include heat generation and consumption on the premises, although the heating and cooling sector is not covered in this paper.

Often, consumers who engage in such activities are described as 'prosumers'. We see prosumers as energy consumers, actively engaging in energy markets, be it as house-owners or tenants, institutions or small businesses. Self-generation and self-consumption are typical prosumer activities, besides storage and participation in demand response or in energy efficiency schemes. Prosumers can act either on their own or collectively through aggregators, for instance energy service companies, contractors or cooperatives, through social enterprises or through other local community energy projects.

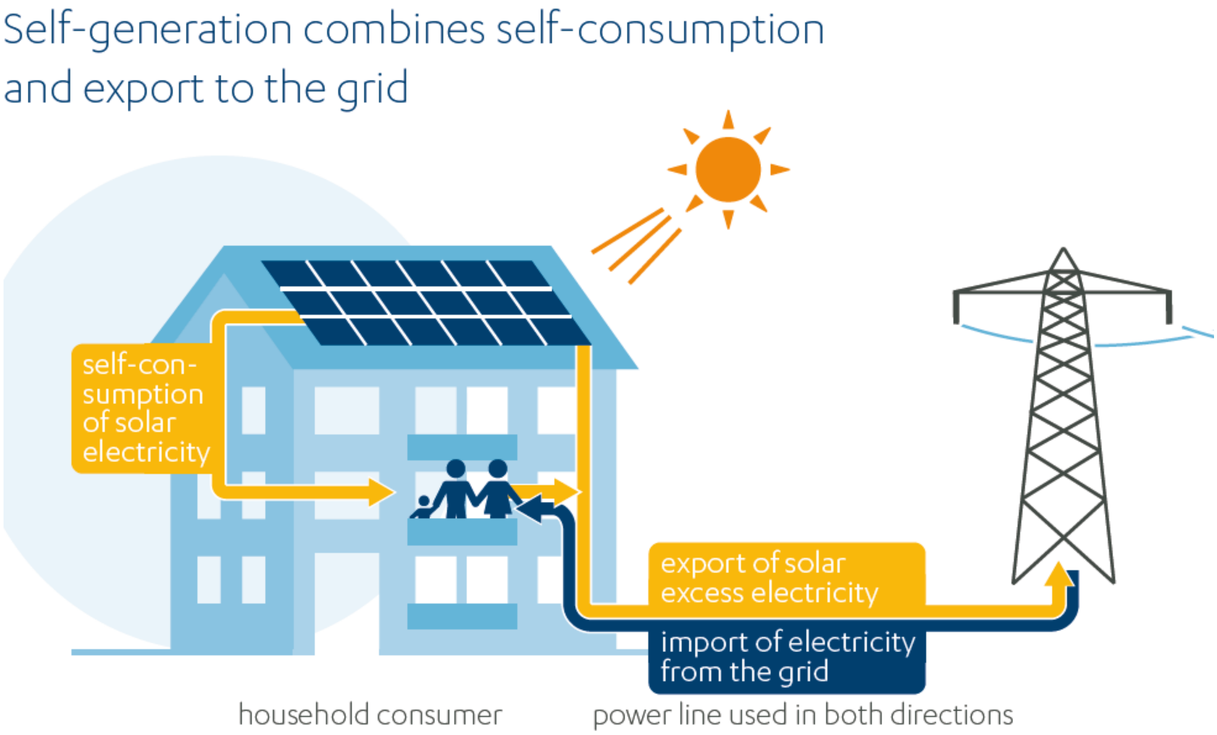
Limiting the scope of tenants' participation in electricity generation and consumption to a narrow understanding of self-generation by homeowners living in detached houses is not consumer-friendly. It excludes tenants who cannot invest in solar panels or who cannot operate their own separate power plant. Therefore in this paper we understand 'self-generation' in a broader sense, including any model of participation in self-generation.

The term 'self-consumption' however might be misleading to some extent because any electricity imported from the grid and supplied to a tenant is 'self-consumed' by the tenant in the verbatim sense as well. By using the term in this paper, we refer to electricity that is generated and consumed on-site, within a multi-storey dwelling and without grid transmission, i.e. consumed within the building where it is 'self-generated' in a broader understanding.

3. General challenges for tenants' solar self-consumption

3.1 Self-generation combines self-consumption and export to the grid

A tenant can consume his self-generated electricity without extensive technical issues if a suitable PV power plant is installed on the roof and the electricity is physically fed via a direct cable into his part of the customer installation. If the produced electricity exceeds the consumption in the customer installation, the excess is supplied to the grid.



No self-consumption without grid connection

For any scenario of self-consumption where the electricity is locally produced by one household on the premises, the supply of excess electricity to the grid is essential. A household will seldom have sufficient and steady energy consumption during strong sunlight hours to use the full capacity of a PV power plant. Although it is possible to store the produced electricity in batteries until it is needed, this form of storage is still relatively expensive and does not necessarily pay off yet.[5] Furthermore, transport of excess electricity to other consumers demanding power at the same time is usually much more efficient and economical than local storage. Therefore, currently, and in the future, the grid is needed to share the excess electricity with other consumers. Self-generation should therefore not be seen as a concept of isolation from the grid, but as a concept of contribution to the overall electricity supply like a pond feeding a bigger lake nearby.

[5] Solar Power Europe: Ahead of the pack. Solar, the new Gateway to the decentralised Energy System. May 2016.

Self-generation needs an appropriate framework for grid integration

There are technical requirements and regulations to prevent any negative effects resulting from the power plant likewise any other installation being connected to the grid. This is not only a matter of metering, which can be solved by bidirectional meters. In the same way a backflow of water from a sampling point into a supply basin might overflow or soil the basin, the backflow of distributed solar self-generation might increase voltage and frequency or affect other technical qualities of the electricity in the grid, which would have negative effects if not managed properly.

When it comes to grid integration, we have to differentiate between big power plants designed to supply and sell 100% of their power to the grid on the one hand and small-scale solar installations with self-consumption on the other hand. The difference lies in the responsibility for the management of the energy flow: in the case of the big power plants, the supply into the grid is to be handled by the electricity supplier purchasing the energy through an accounting system. The supplier has to balance supply (purchase) and withdrawal (sale) of the electricity in his account at any time. Neither tenants nor small-scale self-generators normally have the knowledge or infrastructure to participate in this system.

Self-generation needs appropriate management and remuneration

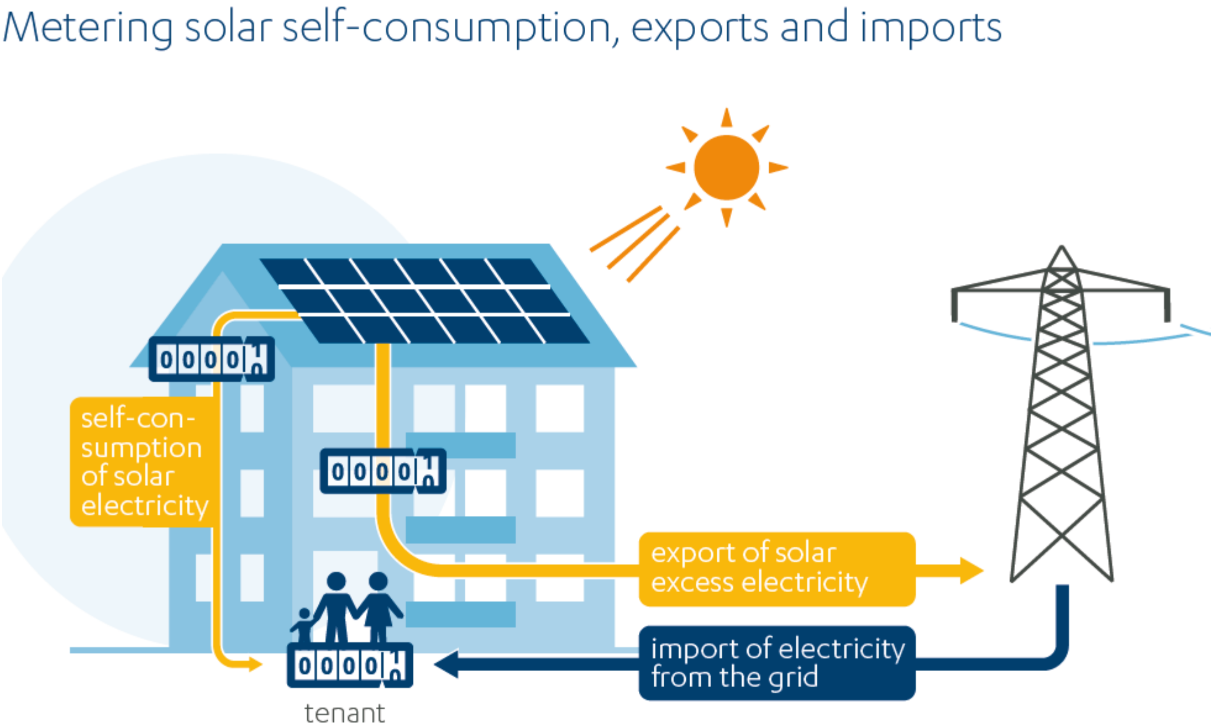
Several Member States require grid operators to provide priority grid access to renewable power plant operators. Different schemes are in place to remunerate small-scale self-generators for their electricity which is fed into the grid. Legislation in some Member States offers a fixed tariff or a premium for every kilowatt-hour. Some Member States allow net metering which means that the amount of kilowatt-hours fed as excess electricity into the grid is deducted from the bill of the owner of the power plant during a certain period in time. Without these types of solutions for flexible, small-scale electricity supply into the grid, single households either require small, uneconomical sizes of PV power plants, expensive batteries or extensive operating and administration efforts.

3.2 How to meter tenants' self-consumption correctly

Obviously, it is more complicated to manage and meter self-generation on premises in a multi-storey-building with a number of tenants who want to consume solar electricity from their rooftop than to handle self-consumption in a detached house for one single homeowner. The metering and accounting has to be designed not only to meter, manage and account the total amount of electricity imported from the grid or exported to it, but also any small amount of electricity going from the grid and from the PV power plant into each tenant's home.

Each tenant needs to be able to track kilowatt-hours consumed and/or generated

In such a model, the electricity imported and consumed from the grid has to be distinguished from the self-generated and self-consumed electricity. This differentiation on the technical and on the financial level is crucial because tenants might have different tariffs and/or different electricity suppliers. To keep the access to external suppliers open, however is a crucial matter of consumer rights. Liberalised access to retail electricity offers is an achievement protecting tenants from overpricing. Therefore, whenever a tenant participates in one of the following models, this has to be done on a voluntary basis. Consumers shall not be tied to a supplier just because a PV power plant is installed on their rooftop. Consumers always must be given the opportunity to opt for a retail electricity offer only, without any self-consumption. Thus, the metering system must be able to distinguish supply to tenants participating in a tenant model and others not participating.



Self-consumption for tenants fails without accurate metering

In multi-storey dwellings, it's laborious to differentiate between each tenant's solar self-consumption and the electricity imported from the grid by dividing the distribution into different powerline systems. However, with digital meters that provide certain minimum functionalities, the challenge of differentiation can be met with the help of smart metering. Smart metering allows a computing of the distribution of the self-generated electricity to the tenant's appliances by monitoring generation and consumption within a particular time period. The remaining amount counted on each tenant's meter is the amount of electricity taken from the grid.

Such metering systems, however, are not yet in place in most cases. Therefore, if more than one tenant is to consume electricity produced on the roof, the metering system of the whole building normally needs a general review and – most likely – major technical changes. Without installing these types of metering systems, or at least the appropriate regulations for their roll-out in multi-storey dwellings, for the issue of tenants' self-consumption fails at the question of metering.

3.3 Making tenants' self-consumption contractually viable

Apart from technical issues, there are contractual matters to be addressed when energy produced on the premises is used by tenants. While the use of a central or self-contained heating system is usually included in the lease agreement and only the costs of its operation are billed to the tenants, the use of electricity produced on premises has no such history.

There are two general ways to address any on-premises generation, participative self-generation and direct sale:

3.3.1 Participative self-generation

One possibility would be to allow consumers to participate in the usage of all energy systems, including the solar power plant, through the monthly rent. If maintenance is billed separately, this amount would be a part of the utility costs. Only the operating costs of the power plant are billed in addition to the fixed rent. As the power plant in this concept is regarded as a part of the building, like a central heating, the revenue for the investment into it is already included in the rent of the dwelling. This means that tenants refinance the investment in the PV power plant through their monthly rent, just like the landlord's investment in the building itself is refinanced by the overall rent of all tenants.

If electricity generation is included in the lease in this way, the fixed rent has to be higher, but the tenant will save on the costs for an extra purchase of electricity. The model therefore is closer to a house-owner's investment in a PV power plant for self-generation than to electricity purchase. However, the landlord (or a third party) makes the full one-time investment into ownership. Tenants engage only through their pro-rata payment for the time of usage.

If the use of the power plant is meant to be optional, it might be subject to a separate agreement, in addition to the lease agreement for the flat. However, this does not change the fact that the rent for the power plant would be a fixed rate and the operating costs would be shared.

In this model the landlord has the obligation to maintain the power plant and pay for repairs. Operation of the power plant however could be considered a joint venture, because both the tenant and the landlord bear the risks and opportunities. Apart from downtimes for maintenance and repair, there may be a variation of up to 15% over or below a competently calculated projection of the yearly output of a solar power plant because of differences in yearly irradiation.

The benefit of the tenants' pro-rata payment for the usage of the power plant therefore will vary depending on irradiation and operation. Hence, the electricity generated and consumed in such a 'participative self-generation' scenario does not have a fixed price per kilowatt-hour. Tenants do not pay a 'flat rate' but pay for the participation in the use of a device. Participating in such models has risks for tenants, but provides also for advantages regarding the operation of the power plant. From a consumer perspective, transparency of these risks, and influence on the operation of the power plant and the use of the generated power, are crucial.

In the course of this paper this way of participating in usage is referred to as 'participative self-generation' because the tenant pays for participation in the usage of the energy system. The tenant himself participates in the generation and shares the output, but does not purchase the electricity. The paper will discuss two models in detail, see chapter 4.1 on segmented self-generation and 4.2 on shared self-generation.

3.3.2 Direct sale

The other way to go about on-premises generation is for the landlord or a third party to directly sell the electricity to the tenant, by operating the power plant himself or purchasing the electricity from the power plant operator. The power plant does not make up part of the fixed rent or the utility costs. The same applies to potential self-consumption of solar electricity in heat pumps, in air conditioning or other appliances for joint use in a multi-storey dwelling. As a consequence, the fixed rent can be lower than in a participative self-generation model. The tenant pays for the investment not through his rent, but through consumption-based billing, as is usually the case for electricity.

In this model, the power plant operator is *de facto* acting as an electricity supplier to the tenants. Acting on the retail electricity market however exposes the power plant operator to regulations targeted to large utilities. This might entail certain duties for the operator, and it might also imply taxes and levies to be charged on top of the electricity sold. A private landlord or a traditional housing company might probably not have the expertise to take on this new role unaided in order to offer solar electricity to their tenants.

In this paper, we discuss two direct sale models more in detail: Direct sale by the landlord or by a contractor (chapter 4.3) and direct sale by an electricity supplier (chapter 4.4).

3.4 Making tenant models pay off

Apart from the aforementioned general questions, any particular model for self-consumption needs to pay off. Grid parity has been reached in most Member States. Despite this fact, the economic viability of local self-consumption can be questioned by the extra costs introduced for metering, handling and administration. Moreover, several Member States introduced charges or taxes on self-consumed electricity.[6]

From the point of view of tenants, these extra costs might make self-consumption financially unattractive: If they pay more for self-consumed electricity than for the electricity traditionally imported from the grid, most tenants will refrain from local self-consumption models. From an investor's perspective, these costs can make the profit margin unattractive.

Tailor-made support remains essential to tap self-generation potential in a cost-effective way

Where national legislation provides an adequate support scheme for solar electricity fed into the grid, the investor is still likely to prefer selling and supplying 100% of the electricity to the grid instead of engaging in complex self-consumption models with tenants. If support schemes are not sufficient, options for solar PV electricity generation on multi-storey dwellings are likely to remain unused, not due to generation costs, but due to the administrative burden, legislative uncertainties, taxes or charges. **Only if the margin of on-site-consumption for the investor is more attractive than feeding the electricity into the grid, and if the price leading to this margin is lower than the retail price of electricity imported from the grid by the tenant, are the business models likely to succeed.**

[6] BEUC: Current practices in consumer-driven renewable electricity markets. January 2016.

After having explained these general challenges, we will now analyse in greater detail the conditions for the four different concepts in a comparative approach.

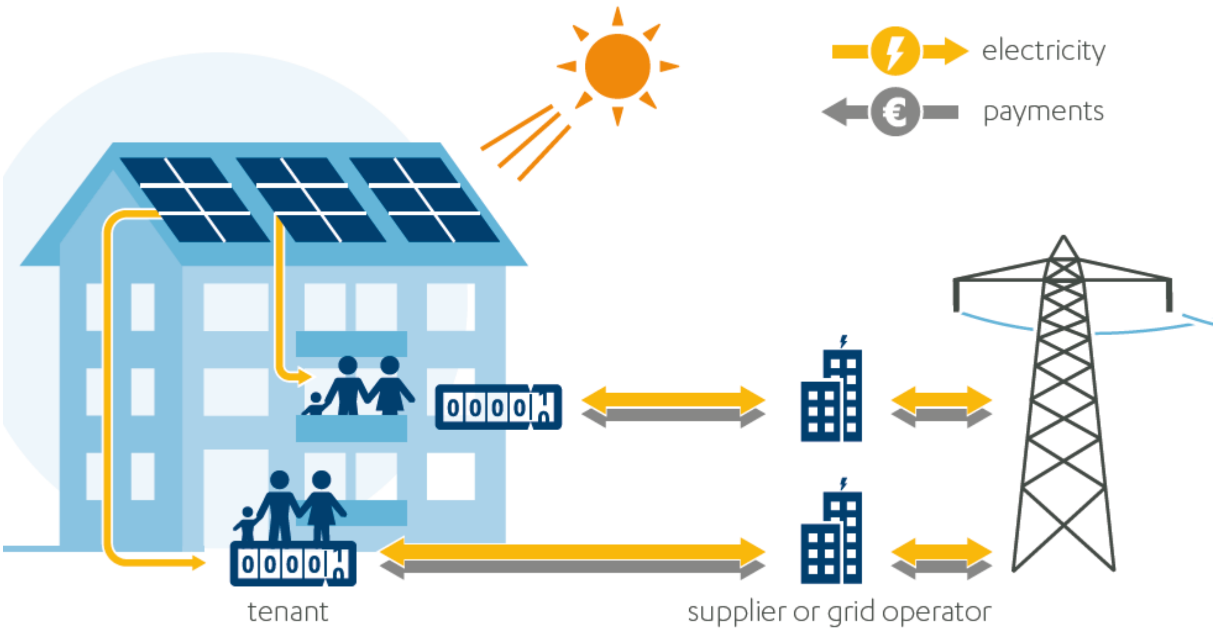
4. Presentation of different tenant models

4.1 Segmented self-generation

4.1.1 How this model could work for tenants

The easiest way to make self-generation work for tenants is to rent one stand-alone segment of the PV power plant on the roof to participating tenants. For instance, a 20 kilowatt (kW) installation could be split up into 20 segments of 1 kW to allow 20 tenants to become the operator of 'their' power plant. Technically each segment has to form a standalone PV power plant with a separate inverter connected to the tenant's appliances. Each participating tenant needs a bidirectional meter to measure electricity imported from the grid while the PV power plant's output is insufficient to cover all the tenant's electricity needs. Vice versa it must measure electricity exported to the grid if self-generation exceeds self-consumption.

Segmented self-generation: Tenants run a segment



The power plant might also be owned by the tenant, who only rents its space. However, this is only practical for smaller, mobile PV panels. Otherwise a tenant who leaves would have to sell his segment to the tenant who will replace him or her once he or she decides to move. More likely, the PV power plant is installed by the landlord (or a third party) and included in the lease of the flat, or the segments are leased separately to tenants interested in using them as a PV self-generation unit.

This model is a participative self-generation model. The tenant himself becomes the operator of his segment of the power plant and has to take into account his self-consumption, his electricity exported to the grid, the requirements for it as well as remuneration and administrative issues. The self-consumption rate as well as the degree of self-sufficiency tends to be relatively low: during some hours of the day, solar electricity generation largely exceeds the single household's demand while the limited segment of the power plant alone cannot cover the household's demand during other hours.

4.1.2 Potential and challenges in Germany

Under German law this model has advantages as small power plants according to the Renewable Energy Act (Erneuerbare-Energien-Gesetz, EEG) are entitled to a feed-in tariff, i.e. fixed remuneration for the export of electricity to the grid by the grid operator. At the same time the grid operator is also the administrative counterpart for most issues regarding grid connection, metering and management. The feed-in tariff (€0.1071 – €0.1231/kWh for small power plants up to 100 kW in 2016) is close to the cost of generation (€0.09 – €0.11/kWh for small power plants up to 100 kW[7]) and well below the national average electricity retail price of €0.298/kWh[8].

In order to pay off the investment, it is essential to substitute the particularly high German retail price through cheaper self-consumption. The incentive for the operator of the power plant (i.e. the user entitled to the earnings of generation) to increase self-consumption is high, for example by making behavioural changes that aim to better match consumption and generation.

Tenants and landlords using this model in Germany however face a highly complicated and ambiguous legal situation. Apart from additional registration issues with the national regulatory authority, the Federal Network Agency, and electricity tax and general tax issues, the main problem is the Renewable Energy Act itself. It treats tenants far worse than it does owners of small-scale PV power plants on the rooftops of detached houses.

One hurdle is that distinct self-generation units on the same roof are not recognised as small separate power plants. This prevents such models from receiving the higher feed-in tariff which is granted to small separate power plants with up to 10 kW of installed capacity. As a consequence, 20 segments of 1 kW would still be regarded as one single 20 kW power plant.

Furthermore, if the overall capacity of the segmented PV power plants on one roof exceeds 100 kW, the power plant is no longer entitled to a fixed feed-in-tariff. Instead of the feed-in tariff the power plant operator receives a market premium from its grid operator. This amount is paid on top of the revenue gained previously by selling excess electricity to the wholesale market. In theory, the wholesale market price and the market premium add up to the level of the feed-in tariff. However, for traders who think in megawatts and not in kilowatts, it is not yet profitable to market a 100 kW power plant and they are even less interested in aggregating a high number of tiny little segments.

In addition, the landlord might be subject to the levy on any retail electricity delivery ('EEG-Umlage'). This levy is collected by grid operators for any electricity consumption in order to cover the high feed-in tariffs and the market premiums for renewable electricity fed into their grid. In 2016, the levy amounts to €0.063/kWh. This levy is also collected from self-consumption of solar electricity on premises, although it is limited to 40% of the full levy charged on self-consumed renewable electricity from newly installed power plants with more than 10 kW. Requirements on who pays this reduced levy and under which conditions are unclear. Rental of a power

[7] See Fraunhofer ISE Recent Facts about Photovoltaics in Germany, Dec. 2015, figures on p. 9 and 29, https://www.ise.fraunhofer.de/en/publications/veroeffentlichungen-pdf-dateien-en/studien-und-konzeptpapiere/recent-facts-about-photovoltaics-in-germany.pdf.

[8] Eurostat: Electricity prices per type of user, http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_pc_204&lang=en, 28 April 2015.

plant might be considered retail delivery of electricity by the landlord or lessor.[9] If so, the landlord or lessor owes the full levy to the grid operator, without regard to the size of the power plant.

If the electricity consumed by tenants from their little segments would be considered as self-consumed, the tenant owes the levy to the grid operator. Moreover, and what is often more incriminating, the tenant has the administrative burden around balancing this. The charges add a substantial factor to the costs described in chapter 3.4 above. Only small power plants up to 10 kW are exempted.

4.2 Shared self-generation

4.2.1 How this model could work for tenants

Another way to make self-generation work for tenants is to rent the PV power plant on the roof to the tenants as a shared device. The rent may be included in the lease agreement for the flat or may be a separate, optional agreement.

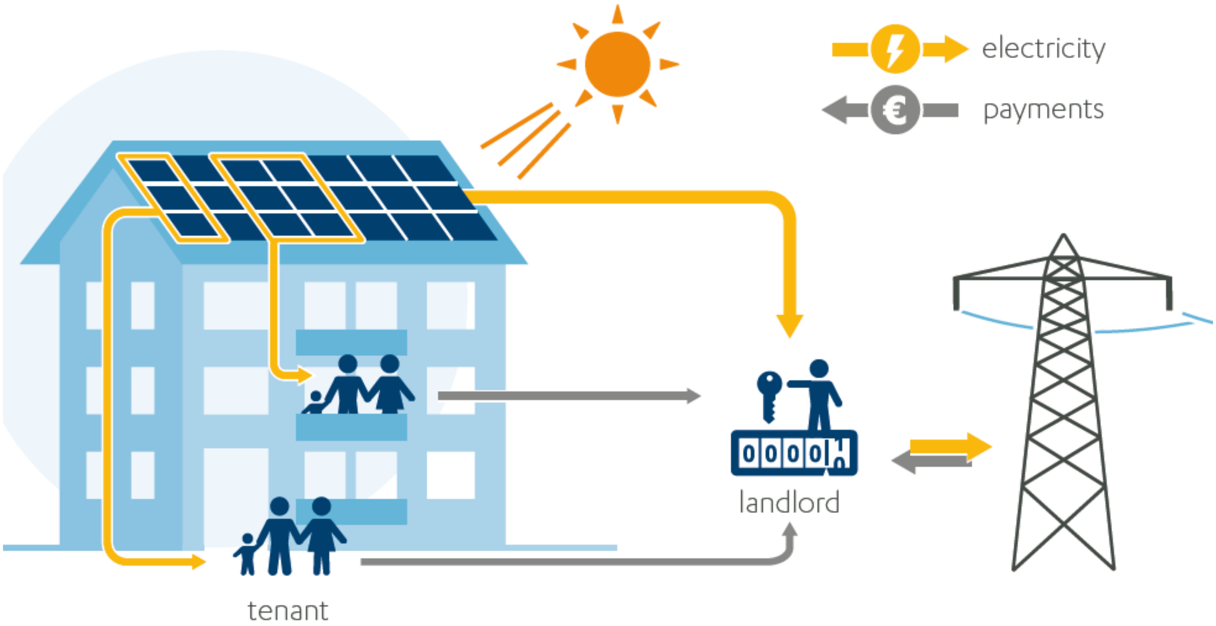
Technically, the power plant feeds the whole internal grid of the multi-storey dwelling. Each tenant shares its usage to the extent he consumes solar electricity during production time. Only the remaining electricity demand is imported from the grid. The metering system therefore has to distinguish the amount of solar electricity that has been self-consumed by each tenant from the amount of electricity that has been imported from the grid, as described in 3.2 above.

The cost of self-consumed solar electricity, however, is already covered through the rent. So there is no consumption-based billing for the self-consumed solar electricity. The operation costs of the power plant amount only to a fraction of the costs of solar electricity generation. They might be shared proportionately to tenants' usage.

In contrast to segmented self-generation (4.1) this model maximises the self-consumption rate of the overall solar electricity generation in the entire multi-storey dwelling (see info box 1). Since the self-generated electricity can be delivered flexibly to a large number of households with different consumption patterns there will be less excess electricity fed into the grid. One household might intermittently use 100% of the production while the others do not consume any. At another moment in time the whole production instantly might be self-consumed by several tenants.

[9] There is some ambiguity about the distinction of self-consumption from the sale of electricity in regard to the lease of a power plant: A draft guideline of the German national regulatory authority, the Federal Network Agency, backs the approach of lawyers not regarding consumption of electricity out of a leased power plant as self-consumption, as the lessor shall be regarded the operator of the power plant not the lessee, concerning risks and responsibility for the plant. This is opposed by other lawyers who argue that the transfer of the operation is the function of a lease and includes the operation results (risk and chance). The remaining risks for the lesser were the risks out of the ownership, not out of the operation. The crucial fact in this discussion is that the lease of a PV power plant for self-consumption might cause extra costs of approximately € 0.04 to 0.08/kWh compared to ownership, depending on the size of the unit.

Shared self-generation: Tenants rent a share



The excess is supplied into the grid and needs to be remunerated adequately. This revenue has to be reflected in the lease agreement. Since the tenants pay a rent for the shared use of the power plant, its benefits should also be shared. The power plant operator who receives the remuneration for exported excess electricity must allocate this revenue in a fair way to the tenants. In the lease agreement for the tenant's particular share of the power plant, the revenue from the export of excess electricity must be reflected.

4.2.2 Potential and challenges in Germany

Under German law this model has advantages as the excess electricity of the power plant according to the Renewable Energy Act (EEG) gets either a fixed feed-in tariff or a market premium (see 4.1.2) when it is exported to the grid. The market premium and the administrative requirements are better manageable if managed by one person responsible for the whole PV power plant, e.g. the landlord or a third party. The shared self-generation model is better adapted to tenants than the segmented self-generation model described under 4.1. An assembly of tenants could organise the technical operation and fair allocation of revenues from excess electricity exported to the grid, if this part is not left to the landlord or a third party.

The remuneration for excess electricity obtained through the feed-in tariff or through the market premium is lower than the retail market price and close to, if not lower than, the costs of solar electricity generation. It will be economically viable if the tenants are able to extract much of the profit from the self-consumption activity. As long as self-consumption is more profitable than solely exporting solar electricity to the grid, the incentive to extend self-consumption is high, for example by better aligning supply and demand of electricity supply.

A disadvantage of this model under German law is that the national regulatory authority and the grid operators do not foresee any room for a legal definition of shared self-generation models. They require the power plant operator and the consumer to always be the same, meaning that according to their understanding of self-consumption, one person or entity must always take on both of these roles.[10].

As a result, a single power plant operator who produces the electricity that is self-consumed on premises has to be identified. This power plant operator risks being charged with the full levy ('EEG-Umlage') of €0.063/kWh for each kWh not consumed by himself or herself personally. The shared use of all other tenants is likely to be considered as a retail electricity delivery to consumers where the levy would have to be charged[11]. In that case, the power plant operator cannot claim the reduced levy on self-consumed solar electricity as in the case of segmented self-generation models (see 4.1.2). The full levy will probably have to be paid. However, this is still a highly disputed and unclear matter.[12]

Even if the tenants were assumed to be 'sharing' power plant operators, they would have to claim the reduced levy and file accounts to pay that lower level. The unclear legal situation, administrative costs and payment of the levy massively hinder this model. In addition, for bigger-scale projects, electricity tax may apply.[13] This substantially reduces the economic advantages of this model.

4.3 Direct sale by the landlord or by a contractor

4.3.1 How this model could work for tenants

Another way to make self-generated solar electricity accessible to tenants is for the landlord or contractor to directly sell it to the tenants. In this model the power plant feeds the whole internal grid of the multi-storey dwelling. Each tenant automatically consumes the solar electricity from the rooftop provided during production time. Only the electricity demand going beyond the self-generated supply is covered by imports from the grid. Excess solar electricity is exported to the grid and needs to be remunerated adequately.

The metering system has to be capable to distinguish the amount of solar electricity delivered to each tenant from the amount of electricity imported from the grid. The imported electricity is metered and then billed by the tenants' individual electricity supplier. In contrast, the self-consumed solar electricity is billed separately by the landlord or by a contractor.

Tenants shall not be obliged to buy solar electricity for self-consumption. If a tenant would opt for a complete coverage of his demand by his individual electricity supplier, this has to be handled by metering and billing. The solar electricity generated on the rooftop of the building would still - but only physically – be delivered to the

[10] Bundesnetzagentur (Federal Network Agency): Leitfaden Eigenversorgung. Konsultationsentwurf (Guidelines on self-generation, draft for consultation), 16 October 2015, p. 17 ff, http://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Energie/Unternehmen_Institutionen/ErneuerbareEnergien/Eigenversorgung/Entwurf_Leitfaden_151016.pdf?__blob=publicationFile&v=3.

[11] See Higher Regional Court (OLG) of Karlsruhe, judgement of 29 June 2016 – 15 U 20/16.

[12] See footnote 9.

[13] Currently self-consumption from power plants of up to 2,000 kW on premises is exempted from the German energy tax. But according to the draft revision of the Electricity Tax Act (Stromsteuergesetz), this tax exemption for renewable self-consumption shall be limited to 20,000 kWh per year only, corresponding to the average annual electricity production of a 20 kW PV power plant; see Bundesfinanzministerium (Federal Ministry of Finance): Entwurf eines Zweiten Gesetzes zur Änderung des Energiesteuer- und des Stromsteuergesetzes, 16 May 2016, http://www.bundesfinanzministerium.de/Content/DE/Gesetzestexte/Referentenentwuerfe/2016-05-19-Energiesteuer.html.

respective tenant. Legally it would not be considered as self-consumed on the premises but as being exported into the grid.

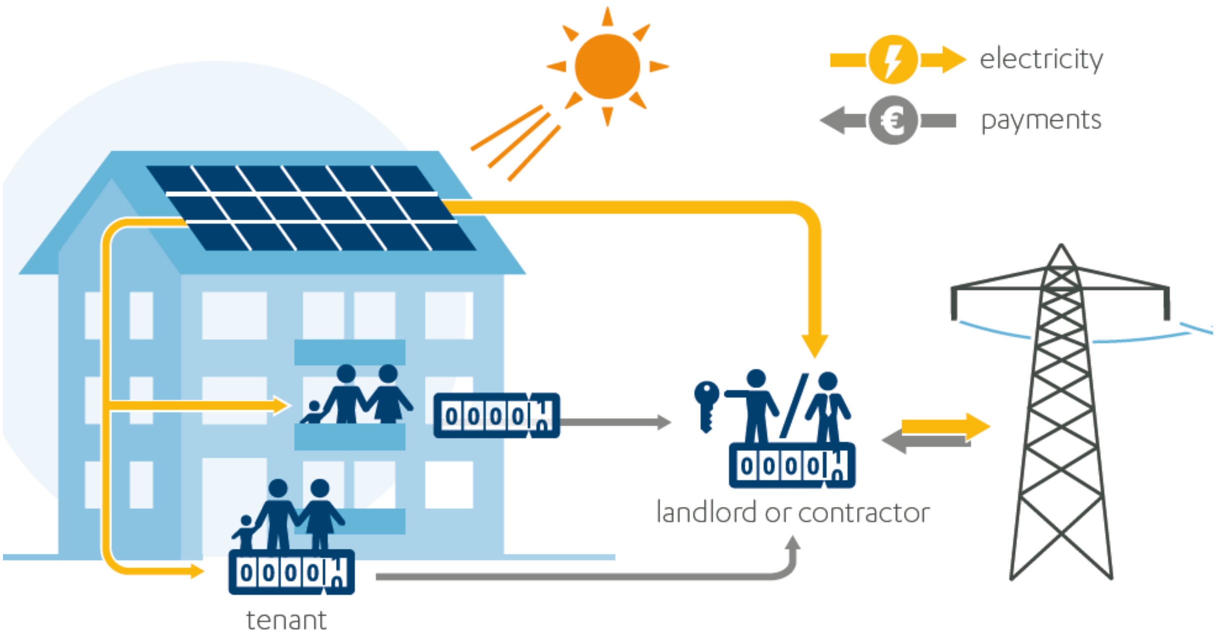
Those tenants who opt for being supplied with self-generated solar electricity by the landlord or by a contractor will still need an individual electricity supplier, but only for covering their additional demand, not covered by the PV power plant. As a consequence, this supplier needs to accept that its customers buy electricity from the landlord or a contractor in addition. Many electricity supply contracts yet exclude the purchase of electricity from a third party.

Therefore, direct sale by the landlord or by a contractor of self-generated electricity should generally be allowed in addition to a supply of electricity from the grid.

A direct sale model requires additional efforts in metering, administration and billing by the participating tenants. They would receive two bills for their electricity, one from their individual electricity supplier for kilowatt-hours imported from the grid and one from the landlord or contractor for self-consumed solar electricity under the direct sale model.

The extra costs must be integrated into the consumption-based price per kilowatt-hour of solar electricity. A standing charge will probably not be accepted under a direct sale model as the tenants normally already pay a standing charge under the retail electricity tariff billed by their individual electricity supplier.

Direct sale by the landlord or by a contractor



The double billing can be avoided in case the landlord or the contractor buys all the electricity imported from the grid for his tenants participating in the direct sale model. If electricity in general is supplied exclusively by the landlord or contractor to the tenants, without any distinction between self-consumed solar electricity and additional electricity imported from the grid, smart metering as described above (see 3.2) can probably be avoided. The distinction between self-consumed solar electricity and electricity imported from the grid would no longer be required.

The sale of electricity imported from the grid through the landlord or a contractor however raises other problems. In this case, the landlord or contractor no longer purchases electricity as the average final customer. They become electricity resellers. This entails legal consequences for the electricity supplier that sells to the landlord or to the contractor: The electricity supplier is, by changing the role of the customer, also changing his or her own role. Unintended or not, the electricity supplier becomes a wholesale supplier. This has unwanted consequences regarding Regulation (EU) 1227/2011 of 25 October 2011 on wholesale energy market integrity and transparency (REMIT) which requires registration, publications and reporting to monitor market participants in the wholesale market. The aim of the regulation is to prevent large-scale insider transactions. However, in the case of direct sale models by landlords or contractors, the above-mentioned scenario would be a transaction to a small-scale unit, usually limited to one single building.

4.3.2 Potential and challenges in Germany

A power plant operator who sells solar electricity to tenants on-site under a direct sale model is not entitled to the feed-in tariff or to the market premium under the Renewable Energy Act (EEG). The operator is however charged with the full levy (‘EEG-Umlage’) for those amounts of electricity delivered on site. The levy is collected by the grid operators. As the national regulator’s understanding of self-generation does not include any sale on premises,[14] no exemptions or reductions apply. The full levy of €0.063/kWh is charged. Some other taxes may apply when electricity is sold to tenants, in particular the electricity tax whose expansion to small-scale self-generation is currently being discussed.[15]

If the landlord or the contractor takes over the complete electricity supply of tenants to reduce administration and billing costs, problems stemming from the co-existence of two contracts for each tenant are avoided. Yet the landlord or the contractor then becomes not only a power plant operator and a retail electricity supplier, but also a local energy trader. As long as this is handled within one single multi-storey dwelling, i.e. behind one single grid connection point and its metering point, the German Energy Act (Energiewirtschaftsgesetz, EnWG) releases the landlord or the contractor operating the power plant from the usual requirements conferred upon the electric power industry.

Practical problems do occur however. The grid operators and the electricity suppliers treat the landlord as a customer, while the Energy Act and in particular the Renewable Energy Act address him as an electricity supplier, for example regarding his or her duty to pay the levy ('EEG-Umlage’). As a consequence, the practical handling of that hybrid role becomes complicated.

In addition, there are some problematic duties conferred upon electricity suppliers that apply to direct sale: Consumers have the right to know where the electricity they buy comes from, including information on the environmental impact of the fuels used to produce electricity. While established retail electricity suppliers have

[14] Bundesnetzagentur (Federal Network Agency): Leitfaden Eigenversorgung. Konsultationsentwurf (Guidelines on self-generation, draft for consultation), 16 October 2015.
[15] See footnote 13.

disclosed their fuel mixes for years now, it is still unclear how landlords running a direct sale model have to calculate and communicate their fuel mix.

A number of uncertainties and the complexity of Germany's energy legislation therefore prevents landlords from using these models. Without these burdens, in particular without the levy ('EEG-Umlage') on the direct sale prices, this model would be profitable.

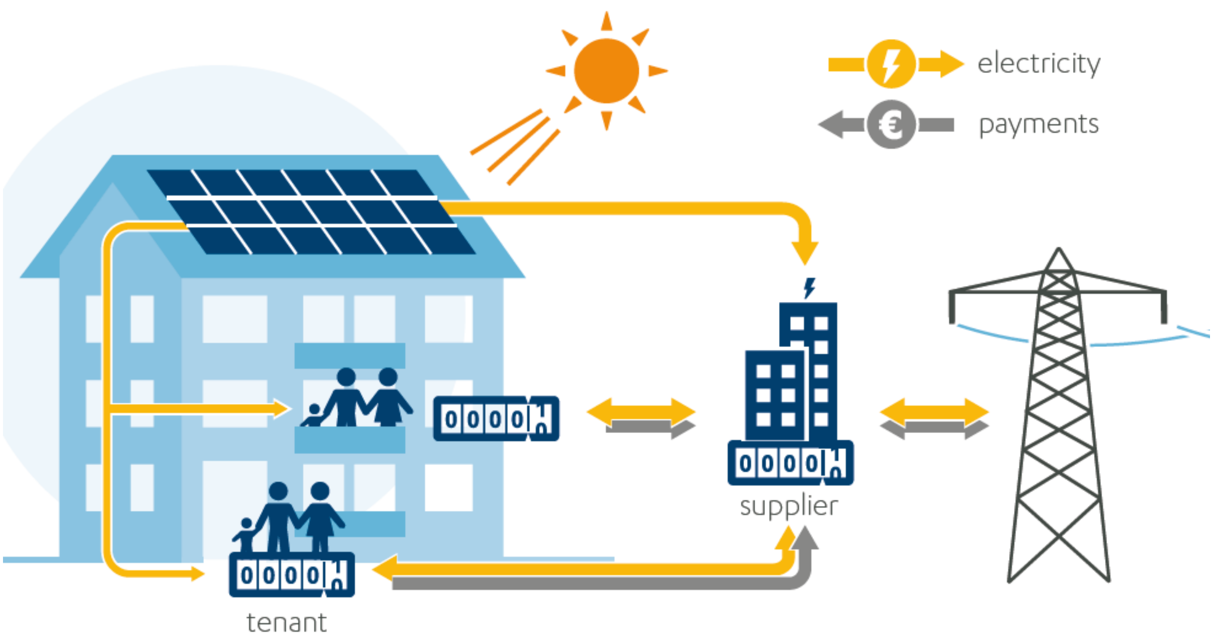
4.4 Direct sale by an electricity supplier

4.4.1 How this model could work for tenants

In this model, direct sale is not organised by the landlord (4.3) but by an external retail electricity supplier. The grid-based supplier buys all the self-generated electricity from the landlord or any other operator of the PV power plant. The supplier physically always exports the entire solar electricity production to the grid but legally delivers the electricity right back. The supply, even if legally regarded as grid-based, is physically done on the premises. The grid is spared since the physical transport of electricity through the grid to the tenants is reduced.

Tenants are offered a dedicated tariff by the supplier. They physically receive the self-generated electricity from the power plant, complemented by electricity imported from the grid. The supply, billing and service would not substantially deviate from any other retail electricity tariff.

Direct sale by a retail electricity supplier



Such a direct sale by a supplier bears the potential to overcome drawbacks of the direct sale model run by the landlord. By being the power plant operator only, but not the electricity supplier, the landlord (or any other operator) is relieved of the duties of contracting, billing and distribution after selling the self-generated electricity to the supplier.

A licensed retail electricity supplier could also take care of local distribution and the sale of exported excess electricity, for instance to neighbours. Such activities may require permits or registrations that might only be accessible to recognised electricity suppliers but not necessarily to landlords or contractors.

4.4.2 Potential and challenges in Germany

The direct sale by electricity suppliers might be preferable in Germany not only because electricity suppliers can use experience and resources for the supply and administration which landlords and tenants do not have. The purchase of the self-generated solar electricity by the supplier is also supported by the feed-in tariff or by the market premium under the Renewable Energy Act if the electricity is fed into the grid. This guarantees a revenue of between approximately €0.10 and €0.123/kWh (June 2016, plus VAT) to the operator of a small-scale rooftop PV power plant. If the electricity sold to tenants is formally fed into the grid, purchased by the supplier and then re-imported from the grid, however, all taxes and charges on retail electricity delivery apply (see 4.2.2 and 4.3.2).

All in all it could economically be more attractive to export all solar electricity to the grid. It would then only be redelivered to tenants on the balance sheet. This would be regrettable however:

- Technically, it would give away a potentially better balanced supply and demand on the local level, helping to stabilise the electricity grid.
- Financially, it would unnecessarily require public support (feed-in tariff/market premium) while self-generated solar electricity on site is already profitable when marketed under a direct sale model.

5. Assessment of tenant models from the consumer perspective

The four tenant models that have been summarised here (4.1 to 4.4) will now be assessed from the point of view of viability for household consumers. We will analyse to what extent tenants' access to solar self-consumption could be facilitated.

5.1 Segmented self-generation

From a tenant's point of view, the first model of segmented self-generation would suggest a feeling of security: the tenant is in full control of his 'own' solar PV installation as well as of its operation. Thanks to the clear separation of ownership of the PV installations, the model at the one hand is relatively simple. It guarantees technical and economic transparency in terms of output, consumption and revenues.

High control, but low self-consumption rate despite large effort

On the other hand, the model has some obvious drawbacks when it comes to a cost-benefit analysis: compared with the three other models, the segmented self-generation probably requires the most effort from the tenant to administrate and operate 'his' power plant. At the same time, the potential to reach the optimum self-consumption rate remains limited. Although living in a multi-storey dwelling where the overall solar electricity generation could technically be distributed evenly amongst all tenants, reaching the optimum self-consumption rate will not be possible because the tenant's consumption patterns often do not match the solar electricity generation from his segment. In other words, the average tenant often is not at home to consume the electricity when being generated (see info box 1). This leads in principle to a higher amount of excess electricity to be fed into the grid than in the case of the shared self-generation model. If there is no adequate remuneration for large quantities of excess electricity exported to the grid, this model will not pay off within a reasonable time period. Since the tenant would run his segment separately, he would meet the same problems as a household that has installed a PV power plant on a detached house.

Little flexibility and little self-sufficiency

The size of the segment could be reduced in order to avoid excess electricity. Adjusted to the demand of one household, the installed capacity would be very low. However, solar electricity production will always be too small when the sun is fading and a high amount of electricity is needed. It will be too large at peak hours when the sun is shining while the tenant is not at home. An investment in batteries would give the tenant the possibility to store excess electricity in order to overcome the disparity between generation and consumption times of the day. However, this would increase investment costs massively. Batteries can be avoided if the electricity one tenant wants to store for later use could instead be used immediately by another tenant.

5.2 Shared self-generation

In general, the shared self-generation model reduces the export of excess electricity to the grid. It brings about an optimised share of self-consumed electricity because the total generation can be distributed flexibly amongst all participating tenants in the building. So tenants can increase the value of self-generated electricity by substituting their costly imports of electricity from the grid.

Higher self-consumption rate for smaller administrative efforts

Shared self-generation also has the advantage that it entails a centralised administration and technical operation of the power plant. This effectively relieves the tenants from important burdens. Instead of acquiring a detailed expertise to run a PV power plant on their own, they can leave this task to the landlord or a third party that operates the power plant.

High uncertainty with regard to tenants' costs and benefits

Sharing the use of a solar PV power plant however raises the question of the exact benefit each tenant will gain through the rental. The household is not charged for a defined amount of kilowatt-hours but only for the possibility to consume a share of the total solar electricity. This does of course require that the tenant's electrical devices are actually running at that moment in time when solar electricity is available. In order to absorb a maximum of it for self-consumption, certain adaptations are advisable.

A calculation of this benefit can only be an estimate based on a projection of the solar PV power plant's production as well as of the electricity demand of each tenant, the so-called load curve. Such projections will remain complicated and vague, even when calculated and communicated to the tenant. When a tenant changes his consumption patterns this will change the estimate even if the calculation was correct initially. The tenant's actual benefit of his share in the power plant might drastically differ from the estimate once his actual load curve differs from the load curve initially estimated.

Allow adjusted estimation to compensate for mismatch with real consumption

The problem of differences with tenants' actual demand might be addressed through flexible shares. Tenants could be allowed a contractual adjustment. Such a compensation mechanism would take effect in case real consumption differs substantially from the initial estimation.

The necessity of calculating a certain lump sum for the rent remains a disadvantage of this model because the calculations themselves, and the underlying assumptions of self-consumption and export of excess electricity into the grid, might remain dubious and opaque for tenants. Transparency could however be provided by competent institutions such as energy consultants, environmental auditors, tenant unions or consumer organisations certifying the appropriate worth of the rented fractional use of the PV power plant. Such certification would include a preliminary review by an independent expert.

Need to thoroughly assess and negotiate specific conditions

A lump sum constitutes an advantage for the investor of the power plant: being refinanced for the investment through a fixed rent paid by all tenants for the entire period of their tenancy is an investment with lower risk than investing in a PV power plant and then trying to sell the electricity directly to a customer base that is limited to the tenants. If the tenants do not show interest in the solar electricity offered under a direct sale model, the investor can only feed the surplus into the grid at what are much worse conditions. However, avoiding this risk from the investor's point can be turned into a benefit for the tenants as well. Tenants can negotiate from a privileged position, given that the investor depends on their willingness to consume his solar electricity. Under certain conditions, they could reach a fair long-term deal with a low average price compared to rising retail electricity prices that are offered by grid-based electricity suppliers. The margin for the investor may be low – but acceptable due to lower risks.

Differences appear between tenants in consumption patterns. For example one is using electricity only at night and another using electricity mostly at noon. This might be solved by calculating a part of the rent from the metered self-consumption, thus mixing it with direct sale models. Besides a higher administrative burden this consumption-based approach yet would open up the possibility that part of the rent is considered to be energy sale[16] with the consequences described in this paper.

5.3 Direct sale models

In these models, tenants remain clients of one or two electricity suppliers which normally should be an easy understandable contractual relation, compared to segmented self-generation and shared self-generation models. Pricing and billing is comparable and transparent as long as it complies with existing minimum requirements that have been established in retail electricity markets.

High level of simplicity, but less control for tenants

The disadvantage of all direct sale models is that they cancel the benefits of shared self-generation: being a customer in a direct sale model, tenants do not participate in its operation and miss the potential of long-term low electricity prices offered in shared self-generation models. Exposure to rising retail electricity prices tends to be higher.

Although direct sale models in the long term might also guarantee a low price per kilowatt-hour, tenants can find attractive retail electricity tariffs that provide a comparable, or even better, protection against price increases. The landlord, contractor or supplier offering the direct sale tariff might have a particular interest in keeping the tenants as consumers of his self-generated electricity and might therefore keep the prices comparable to grid electricity prices. However, if the lessee changes or after a specific term, the landlord, the contractor or the supplier is as free to raise the price as any other retail electricity supplier.

Need to thoroughly compare and negotiate prices

It tends to be difficult to legally cap such price increases. In the case of segmented or shared self-generation, a specific limit for the claimed rent might be imposed on the base of national legislation on rent control. However, limiting electricity prices for landlords or contractors in direct sale models while the market prices are rising is without precedent. Nevertheless, the direct sale model is much easier to understand. Comparing the prices is much more consumer-friendly than in the case of segmented or shared self-generation.

[16] This is, however, correctly treated in two different ways: If the rent would be calculated as a price per kWh, it is clearly similar to the sale of electricity, as the price refers directly to the amount 'delivered'. If calculated as a part of a total rent for the power plant, depending on the share of usage, it is still a (flexible) rent. The amount of electricity drawn from the power plant would not directly correlate with the rent, as production might be higher or lower than initially assumed.

5.4 Overview of tenant models' consumer-friendliness

While participative self-generation should be considered an option under certain conditions and expectations, the direct sale model should be seen as the easiest and most transparent way to provide tenants with direct supply from PV power plants on site. If a grid-based electricity supplier is however involved the tariff could from a consumer perspective be perceived as being comparable to existing 'green electricity' tariffs. Such tariffs are already offered by retail electricity suppliers in the majority of EU Member States. BEUC has found misleading offers because of problems related to transparency of the fuel mix.[17] The difference between direct sale models and common retail electricity tariffs without self-consumption becomes marginal.

Overview of tenant models' principles and assessment of their consumer-friendliness

	Segmented self-generation	**Shared self-generation**	**Direct sale by the landlord or by a contractor**	**Direct sale by an electricity supplier**
Who's the owner of the power plant?	Landlord (or tenants) or third party	Landlord or third party	Landlord or contractor or third party	Landlord or third party or supplier
Who's responsible for the technical operation of the power plant?	Tenant	Landlord	Landlord	Supplier or landlord
How are tenants invoiced?	Use of their segment through a monthly rent + individual retail tariff by supplier	Use of their share included in rent + individual retail tariff by supplier	In-house solar electricity tariff + individual retail tariff by supplier	In-house retail electricity tariff by supplier only
Can tenants actively participate in operations and management decisions?	yes	yes, but in a more abstract manner	only passively by adjusting consumption, if information and appropriate tariff is provided	only passively by adjusting consumption, if information and appropriate tariff is provided
Self-consumption rate	Disadvantageous	Advantageous	Good if many tenants opt in	Good if many tenants opt in
Uncertainty on tenants' cost and benefits	Depending on irradiation and consumption	Depending on transparent cost allocation, irradiation and consumption	Low	Low
Tenants' administrative burden	High	Average	Average	Low
Level of tenants' risks	High	Average	Low	Low

[17] BEUC: Trustworthy 'green electricity' tariffs. Policy recommendations for more transparency, better choice and environmental benefits. BEUC-X-2016-002, January 2016; http://www.beuc.eu/publications/beuc-x-2016-002_jmu_trustworthy_green_electricity_tariffs.pdf.

6. Legal requirements for a better access of tenants to solar self-consumption

6.1 Requirements for all described models

6.1.1 Preventing legal or contractual bans

Tenants' access to solar self-consumption is blocked, if contractual or legal bans apply or regulations on technical issues or support schemes have a similar effect.

Policy-makers can refer to contractual or legal provisions setting requirements for PV power plants on a technical basis, with the objective to prevent negative effects of self-generation on the grid.[18]

Contractual clauses of retail electricity suppliers which state an exclusive delivery by the supplier, as well as prohibiting any energy purchase from third parties as well as self-generation, also ban any self-consumption. These clauses are commonly used.

Even on the level of public support schemes, legal provisions hinder self-consumption. Renewable electricity generation can still be excluded from financial support if the produced electricity is not exclusively fed into the grid.[19]

EU law should ensure that legal and contractual terms prohibiting or restricting self-generation and self-consumption of renewable electricity are limited to those provisions which are technically required and appropriate.

In this context it is essential for tenants' access to self-generation that self-generation is not understood in a narrow sense, which would limit the scope of self-generation to homeowners of detached houses or to commercial consumers. The tenant models described in this paper require a wider understanding of self-generation and self-consumption. **Self-consumption, either of electricity self-generated by the tenant or generated by a third party on premises, should be included in such provisions and treated in the same way.**

6.1.2 Discharge from levies

Inappropriate levies on generation and consumption of renewable energy on site, i.e. the self-consumption by the operator as well as the consumption of the electricity by third parties having the same grid connection point, limits self-consumption on site. Unnecessary financial burdens, such as taxes and fees on self-consumed electricity, are common in many Member States.[20] Some have even been introduced retroactively.[21] These

[18] The German Renewable Energy Act (EEG §14) for instance requires appliances for feed-in-management by the grid operator. Grid operators established requirements for the management of reactive current in their general terms for grid connection. See for instance Westnetz: Technische Anschlussbedingungen Niederspannung. Version 1.1, Januar 2013; https://www.westnetz.de/web/cms/mediablob/de/1756724/data/1768324/7/westnetz/netz-strom/netzanschluss/niederspannung/allgemeine-und-technische-anschlussbedingungen/TAB-NS-Westnetz.pdf.

[19] An example for such provisions are the German conditions for the support scheme on ground-mounted PV power plants (according to § 21 (1) no. 2 FFAV) and prospective provisions on the support scheme for PV power plants with more than 750 kW of installed capacity in the revised Renewable Energy Act (EEG) 2017.

[20] An example for such discrimination is the levy charged not only on each retail electricity tariff but as well on self-consumed solar electricity in Germany ('EEG-Umlage', see 4.1.2). The levy collects funds mainly from small consumers to refinance the higher feed-in tariffs and market premiums for renewable electricity that is fed into the grid. The electricity consumed on premises is explicitly excluded from this support scheme. In effect, self-consumption is treated worse than

kinds of charges discriminate against the self-consumption of renewable electricity in favour of importing electricity from the grid. Disproportionately high network tariffs for self-consumers neither reflect their real grid use nor reward their contribution to grid stability.

EU law should ensure that legal and contractual terms do not impose inappropriate levies on self-generation and self-consumption of electricity from renewable energies. Self-consumption, either of electricity self-generated by the tenant or generated by a third party on premises, should be included in such provisions and treated in the same way.

6.1.3 Reliable framework of simple and fair energy law

A framework of simple and fair rules on the generation of renewable energies or the consumption of such electricity generated on premises by the operator of the power plant as well as third parties, in particular tenants, should be provided and explained to the public, for example with the help of one-stop shops. The framework, once it is set, has to be reliable and should not be subject to frequent changes.

The framework should be limited to simple rules that are appropriate to the situation. In parallel, the models described above need to be integrated into this framework. For this purpose, self-generation and the consumption of renewable electricity generated locally[22] behind the same grid connection point should be exempted from any requirements and obligations applicable to grid-based electricity suppliers.

This framework should include:

- **Treatment of all local supply, behind the same grid connection point, as self-consumption and not as a delivery.** This will have the effect that such delivery will not change the status of the landlord, contractor or supplier with regard to energy law. Neither the landlord, the contractor nor the supplier who is selling solar electricity to tenants change their status in relation to any other retail electricity supplier delivering to that grid connection point. When running a tenant model the landlord, contractor or supplier should remain a consumer from the point of view of any other grid-based retail electricity supplier. Such delivery to the grid connection point would remain retail delivery and not be considered a wholesale market transaction.

  This provision would not only secure continuity in the roles but also unburden self-consumption under tenant models from obligations in energy law. Until now, rules mainly address grid-based retail electricity suppliers and not small-scale transactions on site.

  Doing this would also avoid modifying the role of the grid-based supplier from a retailer to that of a wholesaler. If not, the scenario would entail inappropriate consequences with regard to registration,

consuming electricity imported from the grid, although a higher self-consumption rate reduces the need to fund feed-in tariffs.

[21] See for instance the prohibitive network tariffs and other hurdles in Belgium and Spain in BEUC: Current practices in consumer-driven renewable electricity markets. BEUC mapping report, 6 January 2016, BEUC-X-2016-003, http://www.beuc.eu/publications/beuc-x-2016-003_jmu_current_practices_in_consumer_driven_renewable_electricity_markets.pdf.

[22] When discussing 'local supply' and 'local consumption' or 'locally generated renewable electricity', we refer to the broader definition of self-consumption that goes beyond the idea of having one single owner and operator in one single building. The local use implies that in the neighbourhood, several consumers should be able to participate in self-consumption models. We presuppose that this always happens behind the same grid connection point, for instance in a micro-grid.

publications and reporting linked to the monitoring of market participants in the wholesale market. This stems from the REMIT regulation's aim to prevent large-scale insider transactions.

Finally, this provision is key to exclude that ownership alone defines who is entitled to self-consumption. A self-consuming PV power plant owner would then legally be on an equal footing with a landlord offering a share of his or her power plant or selling solar electricity to tenants.

- **Exemption from registration requirements for retail electricity suppliers.** In case a landlord, a contractor or a third party offers solar electricity for self-consumption to tenants, the established registration or licensing procedures that apply to retail electricity suppliers are inappropriate. The landlord, contractor or third party only run a local tenant model behind one grid connection point with a limited size. They normally do not intend to become a nation-wide retail electricity supplier delivering electricity to thousands of customers.
- **Exemptions from procedures, taxes, fees or levies**, if the administrative burden is inappropriate for the amount payable.

6.1.4 Priority grid access and appropriate remuneration for feeding excess electricity into the grid

As long as batteries are relatively expensive any model of self-generation – if not limited drastically in its size - needs to feed relevant amounts of excess electricity into the grid during peak generation times. As explained in chapter 4, the economic viability of tenant models is in question without adequate revenue from selling excess electricity. For this reason, priority grid access and dispatch is key. **Provisions in the Renewable Energy Directive with regard to accommodation of renewable electricity in the grids[23] should be strengthened. Tenant models should be able to make use of a simplified grid connection procedure and be protected from delays or restrictions.**

Maintenance and expansion of the electricity grid are refinanced through network tariffs paid by all consumers. Under tenant models, tenants remain consumers, meaning that they import electricity from the grid. Thus tenants keep paying for network tariffs that are charged on imported electricity, be it directly or indirectly. **Tenant models have the potential to spare the grid from some transmission of electricity through a high self-consumption rate and internal load shifting behind their grid connection point. In order to trigger this flexibility the network tariffs should reflect the real grid use.** By doing so, graded network tariffs could reward responsiveness with regard to grid stability. While the consumption-based component of a network tariff could vary in time, depending on peak or off-peak periods, the capacity-based component could be differentiated dependent on the size of the grid connection.

Speaking in financial terms, substituting electricity imports from the grid with self-consuming solar electricity alone does not allow the operator to pay off an investment in a PV power plant, be it under a tenant model or in a model where a homeowner has PV panels on the roof of his detached house. Regardless of the solar PV technology and local potential, even with a high self-consumption rate, current wholesale markets fail to provide sufficient revenue. Moreover, any solar self-generation is at a disadvantage because the electricity of

[23] Directive 2009/28/EC on the promotion of the use of energy from renewable sources, 23 April 2009, art. 16.

established, non-renewable large power plants appears to be cheaper. This is because the external costs like environmental damages, health costs and subsidies are not priced in. **Tenant models, as with other small-scale self-generation projects, need stable safeguards for integrating their excess electricity into existing markets under current conditions, including a remuneration scheme.**

6.2 Fair contractual framework for self-generation by tenants

Tenants who join participative self-generation projects remain consumers who possess the same consumer rights as customers of a retail electricity supplier. Several consumer rights need to be highlighted against the backdrop of the specificities of segmented self-generation (see chapter 4.1) and shared self-generation models (see chapter 4.2). Fair rules and transparency for self-generation established in connection with the lease of a flat or house for private use must be provided.

We recommend obliging the landlord

- On the occasion of the installation of the PV power plant, **to abstain from setting a disproportionally high rent (or rent increase) that exceeds the value of the tenant's share in the power plant, regarding his or her personal use of electricity**. If in doubt, the landlord or lessor should be obliged to provide evidence.
- **To provide a clear calculation of the prospective benefit** for the tenant of the PV power plant based on a projection of the PV power plant's estimated electricity production as well as of the electricity demand and load curve of the tenant.
- **To provide clear and fair conditions**, in particular provide clear and fair rules
  - on the term of contract,
  - on the structure of the rent for the power plant and the calculation of surcharges, if regular use goes over what was originally estimated, or rebates, if undercut,[24]
  - on fees or costs incurred in addition to the rent, in particular any maintenance costs not included in the rent but claimed from the tenants,
  - if applicable: duties of the tenant in regard to the operation of the power plant,
  - on metering and invoicing and
  - on delay of payment,

  As well as **clear and sufficient information** on

  - the necessity to have a retail electricity supplier for the additional electricity,
  - the tenant's liability and need for insurance for the operation of the power plant,
  - the terms and consequences in case of underperformance of the power plant (warranty information),
  - terms and consequences in case of repair and
  - terms and consequences of interruption of supply.

[24] This could be, for example, a higher or lower share in utility costs, calculated on the base of the solar electricity consumption of each tenant, or a flexible rent, depending on the actual share of the production the tenant uses.

The obligations described above have to be harmonised with the existing level of protection of tenants set in tenancy law, in particular where the PV power plant would be included in the lease agreement and not leased separately, all on a voluntary basis.

6.3 Fair contractual framework for direct sale to tenants

Direct sale to tenants, either by the landlord, a contractor or an electricity supplier resupplying solar electricity to the tenants, has significant differences with the supply of electricity via the grid, based on a retail tariff.

Fair rules and transparency for the direct sale of solar electricity generated on premises to tenants must be provided. General consumer protection regulations should apply to the landlord, contractor or supplier acting under a direct sale model. As a seller they have to comply with rules applicable to retail electricity suppliers in the field of consumer right.

This touches upon

- the term of contract,
- clear and fair structure of tariffs and fees or costs incurred on top of the regular tariff,
- conditions for switching,
- transparency on metering and invoice, fair terms on delay of payment and
- prohibition of interruption of supply and
- fair conditions in general terms.

As shown above, electricity sold on premises should not be considered electricity sale in terms of energy law.

EU law should provide a particular role for sellers under tenant models. Although exempted from certain duties that relate to energy market rules landlords, contractors or retail electricity suppliers that offer electricity under a direct sale model fully have to respect consumer rights for existing retail electricity markets.

Another challenge is the correct disclosure of the tariff's fuel mix. National tracking schemes for the share of renewable electricity in the fuel mix normally are based on Guarantees of Origin (GOs). They need to make sure that no double-counting is allowed with self-consumed solar electricity on premises. A simple disclosure based on the metering of self-consumed solar electricity on site might safeguard transparency and veracity. This could better prevent misleading practices and with less effort than using GOs for internal transactions behind one grid connection point. **EU law therefore should allow exemptions for direct sale of electricity on site from rules on transparency of the fuel mix.[25] In parallel it should provide for different rules ensuring that the electricity sold is generated as claimed. One solution could be to simply disclose how much renewable electricity has been metered as 'generated on site'.**

The landlord or contractor only selling electricity generated on site, or purchased from the grid operator delivering to the customer installation, should be treated as a customer under energy-law and from the electricity industry's perspective. Such an approach avoids unnecessary requirements and limits the

[25] Directive 2009/72/EC concerning common rules for the internal market in electricity, 13 July 2009, Art. 3, 9.

administrative load on small-scale and projects. At the same time it saves the operator of direct sale models from wholesale market requirements like REMIT[26] obligations. **EU law therefore should generally exempt operators of local, limited direct sale models from energy law obligations in case they only import electricity from the grid, but do not deliver via the grid to third parties. Even if there is a resale to tenants or other local redistribution, such interaction should not be regarded as a retail sale.** This should include a regulation that any contractual provision binding a consumer to one single electricity supplier and prohibiting the purchase of electricity from a second supplier should not prevent the customer from buying electricity generated on premises, in addition to the electricity imported from the grid.

[26] Regulation EU/1227/2011 on wholesale energy market integrity and transparency, 25 October 2011.

Glossary

Contractor: An energy service company, acting as an aggregator; in this paper offering an in-house solar electricity tariff under a direct sale model to tenants.

Degree of self-sufficiency: The higher the share of self-generated solar electricity in the overall annual electricity consumption of a household, the higher the degree of self-sufficiency. A level of 100% self-sufficiency is achieved in case the PV power plant on average fully covers a household's electricity demand over the period of one year.

Electricity supplier: A commercial or public power company that delivers electricity via the grid connection point to final customers under a retail electricity tariff; in this paper acting either in addition to segmented or shared self-generation, either in addition to direct sale by the landlord or a contractor, or acting as the unique supplier of solar electricity *and* imported electricity from the grid under a direct sale model.

Grid: The network for feeding in electricity, transporting electricity and delivering electricity; in this paper referring to the low voltage distribution system since small-scale PV power plants on residential buildings are mainly connected at this grid level.

Grid operator: A company charged with maintenance and expansion of the electricity network; in this paper normally referring to the Distribution System Operator (DSO).

Homeowner: Any household or legal person that possesses a property.

Landlord: Any private homeowner or a private or public housing company who offers a property for rent.

Lease agreement: A contract under tenancy law, establishing a tenancy agreement; in this paper for renting a flat in a multi-storey dwelling.

Network tariffs: A fee to be paid by all electricity consumers to grid operators for maintenance and expansion of the electricity networks. It is charged on the sale of electricity, normally as a part of retail electricity tariffs. In most Member States, network tariffs consist of a fixed capacity-based component, mainly depending on the size of the grid connection point, and on a variable consumption-based component, depending on the amount of kilowatt-hours consumed. This cost component can also vary in time.

Power plant operator: The user of a power plant, responsible for operation and maintenance, entitled to earnings.

Self-consumption rate: The share of the overall annual electricity production which is not exported as excess electricity to the grid but consumed on premises. A 100% self-consumption rate means that electricity demand on premises matches with electricity production of the power plant on-site; in this paper it refers to the share of solar electricity used by tenants.

Self-generation: Combined activity of producing electricity (or heat) and self-consumption on premises with export of electricity (or heat).

Tenant: In this paper referring to a household having a lease agreement, living in a rented property.

Utility costs: The costs for the maintenance of the house utilities, such as central heating, water, garbage collection etc.