PV PROSUMER GUIDELINES FOR EIGHT EU MEMBER STATES

European Renewable Energies Federation (EREF)

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PVP 4Grid

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INTRODUCTORY REMARKS

PVP4Grid is an EU funded project that aims to increase the market share and market value of PV by enabling consumers to become PV prosumers in a system-friendly manner.

Following a summary of the key issues regarding the latest EU legislation developments, these guidelines compile summaries for national regimes on the photovoltaic (PV) prosumer guidelines in Austria, Belgium, France, Germany, Italy, the Netherlands, Portugal and Spain.

THE EU FRAMEWORK

In 2015, the European Union (EU) approved the Paris Agreement. With the approval, it promised to '*keep the increasing global temperature well below 2°C above pre-industrial levels*', to '*limit the increase to 1.5°C since [that] would significantly reduce the risks and impacts of climate change*' and concludes that '*global emissions must peak as soon as possible*' and '*undertake rapid reductions thereafter in accordance with the best available science*'.

In this context, the EU adopted the Clean Energy for All Europeans (CE4AE) legislative package effectively revamping European energy policy for the next decade. The CE4AE package cements the EU's energy objectives to transform and decarbonise its energy supply, reduce Europe's dependency on energy imports and ensure its security of supply. The package includes new European legislation for the next decade from 2020 onwards such as a new Renewable Energy Directive, a new Governance Regulation, a directive and regulation on the design of the new European electricity market, a new regulation on risk preparedness and new rules for the Agency for the Cooperation of Energy Regulators (ACER).

The package also sets three important targets for the renewable energy and efficiency sector to be achieved by 2030:

- Renewables must make up at least 32% of the EU's energy mix,
- 32.5% of energy efficiency must be achieved and
- Emissions from Greenhouse Gasses (GHG) must be reduced by 40%.

Sub-targets for renewable Heating & Cooling (H&C) and transport were also adopted. The H&C sub-target is indicative and increases by 1.3% per year and 40% of the target is expected to be met by waste heat flexibility. Renewables must power at least 14% of transport by 2030 with additional sub-targets for different types of biofuels.

For the first time ever, the EU has established a right for energy consumers to both produce and consume (*prosume*) their own electricity, and obliges its

Member States to adopt a legislative framework to enable prosumers to exercise this right.

Consumers now have the right to produce their own electricity (individually or collectively) without being subject to over-burdensome or discriminatory conditions. They are entitled to generate, consume and store their renewable electricity as well as sell any excess to the grid.

The new Renewable Energy Directive generally foresees and exemption from charges for the consumption of self-generated electricity which is produced and used locally. Member States may only apply non-discriminatory charges where there is either an effective support in place, the installations concerned are larger than 30 kW or – from 2026 – where the installed self-consumption capacity exceeds 8%.

Important for small and medium-sized renewable generators, is that the package maintains priority dispatch for small renewable plants of up to 400 kW (and up to 200 kW as of 2026).

With sound support systems and a fall of technology prices for small operators encouraging decentralized production from renewable sources, half of all European Union citizens could be producing their own electricity by 2050, meeting 45% of the EU's electricity demand.

Solar PV will play a key role in the energy transition from a centrally based system with large conventional utilities producing and transmitting electricity to a large number of consumers, to a more decentralised system with a multitude of scattered independent renewable energy producers.

A report drafted by the CE Delft[1] counted nearly **6 million** "energy citizens" in the EU and estimated how many could exist by 2030 and by 2050, providing that the right legislation is in place. The report showed that 7 million EU citizens could be producing their own electricity by 2030 and over **264 million EU citizens** (half its population) by **2050**. Accordingly, these energy citizens could be producing 611 TWh of electricity by 2030 and 1,557 TWh by 2050. Therefore, by 2030, energy citizens could be delivering **19% of the EU's electricity demand**, and **45% by 2050**. This is a significant contribution to achieving the EU's 2030 renewable energy target and moving towards a 100% renewable energy system.

The report also shows the potential of different types of self-producers and consumers. In 2050, collective projects and co-operatives could contribute 37% of the electricity produced by energy citizens, while micro- and small businesses could contribute 39%, households 23% and public buildings 1%.

[1] CE Delft, 2016. The Potential for Energy Citizens in the European Union, available at bit.ly/energy citizen study

These results clearly demonstrate that energy citizens are capable of delivering a large share of the renewable energy needed to decarbonise Europe's energy system. However, this cannot be achieved without active and diligent participation by national and regional governments.

National and regional governments must implement the CE4AE package into their national laws in the short-term and in an ambitious way in order to maximise the deployment of renewable energy. Still, it should be highlighted that this will only happen with the active engagement from EU citizens who must demand action from their authorities and policy makers.

Austria

LEGAL FRAMEWORK

Section 16a of the Austrian Electricity Industry and Organisation Act (*Elektrizitätswirtschafts- und -organisationsgesetz – ElWOG*) entitles all users of distribution grids to operate a shared electricity generation plant. The electricity generated in the shared plant is thereby allocated to the participating parties to the extent the self-generated energy is not transmitted through facilities of the grid operator. The electricity drawn from the grid is reduced by the quantity of electricity which is generated and consumed simultaneously. Energy which is not consumed by a participating party is injected into the grid.

The implementation of this model requires at least two participants to form a community. They may operate the shared generation plant themselves or designate an operator, who must be notified to the grid system operator. In case the operation of the plant is assigned to an operator, the law requires the operator to be contractually bound and lays down provisions that must be included in the installation and operating contract.

The distribution system operator is responsible for installing adequate metering devices (according to sec. 17 Para. 2 ElWOG) and measuring the generated and consumed electricity as well as the additional electricity imported from the grid by the participants. The energy values of the shared generation plant are balanced on the basis of quarter-hourly time slots with the respective consumption values in accordance with a distribution key agreed upon between the participants. The resulting values are used as a basis for accounting to the participants and must be made available to suppliers and the operator of the shared generation plant.

Regarding the mentioned distribution key, the participants must contractually agree upon how the generated electricity is allocated by the distribution system operator to each participant. The energy shares may be allocated either statically or dynamically.

Participants are further required by law to conclude a purchase agreement with an electricity trader for the remaining energy which is fed into the public grid. Each individual participant retains the right of free choice of supplier regarding the consumed electricity that is not covered by the shared generation plant.

Besides the requirements laid down in the ElWOG. It may also be necessary to apply for certain legal permits required for instance by building law, or trade regulations. It is also possible to receive national or regional funding for generation plants. Various model contracts are available.

TECHNICAL ISSUES

The surface area and roof of the building on which the shared generation plan is to be installed must meet the necessary requirements. The project may require the installation of smart metering devices.

ECONOMIC FRAMEWORK

Investors may include the building owner, an association, a contractor or energy supplier. The investor may also function as the operator, who is responsible for offsetting the electricity generated in the shared plant. This requires a clear definition of which party has which share in the electricity produced in the shared installation and how it is accounted for. In static allocation, a fixed portion of the electricity generation is reserved for one participant. If the share is not consumed within the quarter of an hour, it is considered to be surplus fed into the grid and sold to the electricity trader. The advantage of this distribution lies in simpler accounting, however it also tends to lead to a reduced overall quota of on-site use of the electricity generated. In case of a dynamic method, the effective allocation key can vary over time. For example, if a participant needs less energy, the remaining share could be proportionally distributed to other participants with a higher demand. This increases the amount of on-site use of electricity generated, however the billing is more complex.

Careful planning, assigning all necessary roles and proper dimensioning of the shared plant is essential for the economic success of such a project. Online tools are available to calculate the correct dimensions of a plan according to household size (http://pvaustria.at/sonnenklar_rechner/ (PV Austria, 2018), however at this point these tools are not capable of representing the cash flow of a shared plan community.

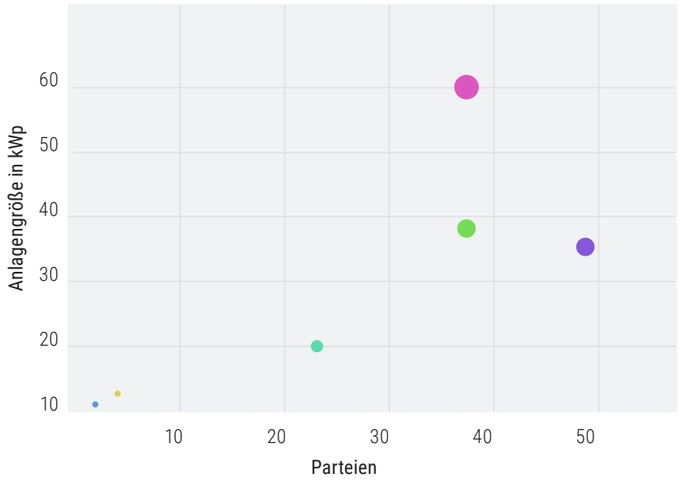
Besides this, it should be noted that it is difficult to base investment costs on pre-existing models and must be determined and adjusted specifically to each individual project.

PROJECT EXAMPLE(S)

Seven different implementation projects are listed on the information platform www.pv-gemeinschaft.at. The listed projects include:

- Multi-party house in Dreihackengasse,
- Geidorf Center in Scheidtenbergergasse (Graz),
- Multi-party house in Reichenauer Straße (Innsbruck),
- Solar.Top in Dorfwerfen,
- Multi-party house in Wagna,
- „GWS Wohnen“ in Hart near Graz and
- Lavaterstraße 5 in Vienna.

The illustration shows an overview of the plant size, number of participating parties, operator role and distribution mechanism of the listed projects.



Source: Bundesverband Photovoltaic Austria et al., 2018 and Dallinger, et al., 2018

Belgium

SINGLE DIRECT USE IN THE RESIDENTIAL SECTOR

In all three regions of Belgium, PV systems with a capacity of up to 10 kW (5 kW in Brussels) are allowed with net-metering. Consumer electricity bills are reduced depending on how much is consumed and produced from the PV system. Brussels still provides financial support for residential PV installations through green certificates. However, this will only remain until the new MIG 6 Regulation enters in to force, predicted for 2020. Flanders has implemented an additional prosumer grid tariff which reduces benefits for prosumers. Although prosumers have the choice until October 2020 to choose between two schemes:

- Net-metering + prosumer grid tariff and benefits from it for 15 years
- Self-consumption scheme without tariff.

After 2020, every new prosumer will be forced to adopt the self-consumption scheme.

Third-party investment has declined significantly. In Brussels, thanks to the green certificates, third parties can offer free PV installations to residential customers.

IMPLEMENTATION OF SINGLE DIRECT USE IN THE RESIDENTIAL SECTOR

Step 1: Assess the conditions of the rooftop (i.e. size, orientation and sunlight availability) and select an adequate PV system.

Step 2: Verify with the municipality whether authorization is needed prior to installing the system.

Step 3: Select a contractor to install the system. This can be an individual installer, a third-party investor or a collective buying group.

Step 4: Inform the local DSO that solar panels will be or have been installed. Depending on the region, the meter might have to be changed.

- In Brussels, an A+/A- electronic meter is required. The DSO must be consulted before its installation. Until 2020, prosumers benefit from net-metering on an annual basis.
- In Flanders and Wallonia, there is no need to change the existing meter. In Flanders, the prosumer may install an A+/A- meter in order to avoid the prosumer tariff. They will then no longer benefit from net-metering but instead from a pure self-consumption scheme.

- In all three regions, prosumers may go above the fixed limit for net-metering, but this is not often the case due to grid costs and the profitability of projects between 10 and 30 kW.[2]

Step 5: Once the system is installed, a certified company will verify the installation before the PV system can enter into operation.

PROFITABILITY OF SINGLE DIRECT USE IN THE RESIDENTIAL SECTOR (CASH FLOW MODEL)

Revenues:
In the three regions, self-consumption for household PV below 10 kW (5kW in Brussels) is incentivized by net-metering. Compensation is given yearly based on production and consumption. For every unit of excess electricity injected in to the grid, prosumers can consume a unit of electricity from the grid and pay only the net difference: revenue therefore comes from electricity bill savings. Although, if prosumers feed more than they consume on an annual basis, they do not get additional credit. Due to that limitation, the size of systems has always been linked to annual consumption, which leads to a waste of solar potential.

Costs:
In Flanders a "prosumer tariff" must be paid to the local DSO. In 2019, it ranged between € 80 and € 113 per kW. Prosumers can avoid this payment by installing an additional bidirectional meter. However, by doing so, they lose their eligibility for net-metering and switch to self-consumption.

A prosumer tariff has been discussed in Wallonia as well but is not scheduled to be implemented before January 2020. VAT is paid on the PV installation and offset by savings on electricity.

BEST PRACTICES

Until now, the net-metering scheme is the only scheme used for residential prosumers. Only few alternatives are available. PV installations are also disconnected from energy efficiency products. In some cases, heat-pumps have been proposed to prosumers, but this remains marginal.

there have been recent legal proposals to move towards self-consumption and collective self-consumption through energy communities.

The progressive shift towards self-consumption, especially in Flanders, offers new opportunities for batteries, demand side management and more smart energy management in buildings.

Wallonia retroactively changed its payment policy for green certificates, reducing payments for existing installations from 15 to 10 years. The Walloon government is now looking for options to return

[2] Note that the revision of the synergrid C10/11 is proposing to move this limit from 10 to 30 KW. This still has to be accepted by the regulators.

to 15 years of payments while avoiding additional burdens for electricity consumers. As of yet, no governmental plan has been published. This has also triggered the creation of a powerful prosumer's association which brings together more than 19.000 prosumers (out of around 120.000) which many hope will lead to more prosumer friendly policies in the coming years.

IMPLEMENTATION OF *SINGLE DIRECT USE IN THE COMMERCIAL AND INDUSTRIAL SECTOR*

Step 1: Assess the conditions of the rooftop (i.e. size, orientation and sunlight availability) and select an adequate PV system.
Step 2: Verify with the municipality whether authorization is needed prior to installing the system.

Step 3: Select a contractor to install the system. This can be an individual installer, a third-party investor or a collective buying group.

Step 4: Consult with the DSO for an assessment of the technical and financial conditions before connecting the PV installation to the grid. If the conditions are accepted, a contract can be concluded between the DSO and the prosumer. For larger PV installations (>250 kW or > 1.000 kW depending on the DSO), these contracts include flexibility clauses allowing the DSO to manage congestion issues with a remote monitoring equipment.

Step 5: Depending on the region, a prosumer must inform the region/regulator in order to receive green certificates.

- In Flanders, below 750 kW, support is fixed and the applicant can inform the regulator after installation. Over 750 kW, the prosumer needs to inform the regulator before getting financial support.
- In Brussels, the prosumer can inform the regulator after installation.
- In Wallonia, a prosumer must submit an application to the administration to receive green certificates.

PROFITABILITY OF SINGLE DIRECT USE IN THE COMMERCIAL AND INDUSTRIAL SECTOR (CASH FLOW MODEL)

Revenues:
For industrial and commercial installations, self-consumption generates revenue through savings in the electricity bill and from electricity sales at wholesale market prices. Depending on when the PV system is installed, a different amount of green certificates are received per MWh produced.

Costs:
In addition to investments costs and the cost of the mandatory DSO assessment, there are yearly costs. For large PV installations in Flanders, the injection tariff

plus the yearly costs can range from 0,3 c€/kWh to 1,2 c€/kWh depending on the size of the systems and the amount of energy injected into the grid. For Wallonia and Brussels, there is no injection tariff but only yearly costs linked to the DSO's imposed equipment which reduce the profitability of the PV plant.

BEST PRACTICES

Energy cooperatives allow installations with participation from multiple parties. The situation for collective self-consumption varies from region to region.

In Flanders, "Zonnedelen", a Flemish initiative, is currently testing co-investment in PV systems where residential electricity consumers who don't have the means to finance their own installation, can co-invest together with other similar consumers (in installations between 10 and 250 kW – typically the commercial & industrial sector). Each investor then gets a share of the energy produced according to its share in the PV installation. That share is then deducted from their electricity bill thanks to communication with the DSOs and the energy providers. This initiative began with industrial consumers who had higher margins and larger roof sizes. The aim of this initiative is to further develop small PV installations and possibly even BIPV systems in the coming years.

In Wallonia, a new decree allowing collective self-consumption has been adopted early March 2019.

France

SELF-CONSUMPTION

Since France's electricity prices are lower than its neighbouring countries, self-consumption arrived relatively late. However, due to the decrease in the costs of PV electricity production, self-consumption is becoming more and more attractive for residential consumers as well as commercial, industrial and agricultural consumers. It presents benefits for consumers (residential and commercial) as well as for energy collectives by giving them autonomy over their electricity systems and producing savings in their electricity bills.

INSTALLING A PV SELF-CONSUMPTION SYSTEM

In France, PV self-consumption installations up to 100 kW are authorised (there are specific tenders for bigger systems). Depending on the size of the installation, investment aid may be available and the price of the sale of the electricity will vary. Installations with capacity under 100 kW can claim a feed-in tariff, but self-consumption becomes possible by selling excess electricity.

The different steps to installing a PV installation are:

Step 1: Assess the conditions of the rooftop (i.e. size, orientation and sunlight availability) and select an adequate PV system.

Step 2: Verify with the municipality whether authorization is needed prior to installing the system (not necessary if the installation has a capacity below 3 kW).

Step 3: Request the DSO (*Enedis* in most cases) to be connected to the grid in order to be able to sell excess electricity. The DSO will then offer the consumer a proposal for a contract that defines the available investment aid that will be split over 5 years.

Step 4: The PV system is then installed and linked to the grid. All self-consumption installations require the building to be fitted with a smart meter.

Step 5: Certification by the national authority of the installation. Once done, the installation may enter in to operation.

Step 6: The contract for the sale of electricity can be downloaded online, signed and resent. After readings from the meters are lifted, billing is done online.

PROFITABILITY OF SELF-CONSUMPTION

Revenue:
By definition, self-consumption reduces consumers' electricity bills if they do not change their consumption habits. The electricity produced by the PV system which is consumed in real-time does not need be bought from electricity suppliers.

All excess electricity which is not consumed is injected in to the grid and is subject to a feed-in tariff, calculated depending on the size of the installation. For installations with capacity below 9 kW, the electricity is bought at 10 c€/kWh. For installations with capacity between 9 and 100 kW, electricity is bought at 6 c€/kWh.

Installations below 100 kW are able to receive investment aid which is given over 5 years but decreases every quarter depending on the amount of PV grid connection requests. The aid is given at rates of:

- 0.39 €/Wc for an installation < or equal to 3kWc
- 0.29 €/Wc for an installation between 3 and 9 kWc
- 0.19 €/Wc for an installation between 9 and 36 kWc
- 0.09 €/Wc for an installation between 36 and 100 kWc

If the consumer chooses to not consume their own electricity produced but to sell directly to the grid, the tariff is imposed at rates of:

- for an installation < or equal to 3kWc = 18,72 cts€/ kWh,
- for an installation between 3 and 9 kWc = 15,91 cts€/ kWh,
- for an installation between 9 and 36 kWc = 12,07 cts€/ kWh,
- for an installation between 36 and 100 kWc = 11,19 cts€/ kWh.

Costs

The cost of installation will depend on the chosen system. The fixed costs of the electricity bill will continue to be paid as if there were no PV system, but the former will decrease in case of self-consumption (19.8 €/ year for P ≤ 36 kVA and 413.76 €/year for P between 36 and 250 kVA) and (20.88 €/year for P≤36 kVA and 294.72 €/year for P between 36 and 250 kVA).

The grid use tariff (TURPE, acrynomed from '***T**arif d'**U**tilisation des **R**éseaux **P**ubliques d'Electricité*') is determined according to the size of the installation (measured in capacity at the point of connection to the grid) and is made up of 2 elements: The annual counting component (…) and the annual management component for prosumers (…).

Finally, annual care and maintenance costs can be added as well as a subscription to a monitoring service which will enable the prosumer to track the performance of the installation.

SELF-CONSUMPTION IN ENERGY COLLECTIVES

'Collective' self-consumption (in energy cooperatives) is a fairly recent development in France. A 2017 French law allows several prosumers to invest together in PV installations and share the produced electricity. This could be implemented, for example, on a building with several consumers recording their production and consumption.

Electricity, produced by one or several producers, is supplied to one or several end consumers, all of whom are grouped in one legal entity and whose grid extraction and injection points are located downstream of the same public station transforming high-voltage electricity to lower voltages. The legal entity is charged with distributing the produced electricity between the different consumers. Every 30 minutes, total production and consumption are measured in order to determine the group's real-time rate of self-consumption. All excess electricity is injected in to the grid.

IMPLEMENTATION OF COLLECTIVE SELF-CONSUMPTION

The usual actors in collectives are consumers, residing near to each other, who choose to commonly produce PV electricity. In order to reduce costs, their PV installation will be large scale and installed on the ground as opposed to atop buildings which means reduced installation costs. The installation could just as easily be located atop buildings who are not the end consumers (e.g. solar panels installed atop a bus hangar, supplying electricity to the neighbouring school).

Energy collectives are authorised in French law as long as production and consumption is managed by a central legal entity and the common PV installation is located on the same low-voltage grid as the consumers. In order to optimise the installation, the involved parties must calculate their common electricity demand and choose for a system with appropriate capacity.

Step 1: All potential consumers who wish to join the energy collective must calculate their common electricity demand. Once that is defined, their patterns of consumption must be evaluated with regard to future solar availability. This will allow the consumers to determine how much of the electricity produced will actually be consumed on site and thus choose for a system with appropriate capacity.

Step 2: The consumers group themselves within a single legal entity and submit a request to their distribution grid operator. They will check whether the project is feasible and fulfils the requirements described above.

Step 3: Consumers without an adequate meter must request the distribution grid operator to install one.

Step 4: The consumers must authorize their grid operator to measure their load curve and provide such to the central legal person.

Step 5: An *ex ante* study of the grid connection point and the intended PV system.

Step 6: The consumers sign a collective self-consumption agreement.

Step 7: The installation enters in to operation.

PROFITABILITY OF COLLECTIVE SELF-CONSUMPTION

Revenue
In all cases, self-consumption reduces the energy bills of end consumers. In the case of collective self-consumption, savings are made through the contributions of the common PV installation to the consumption of the different participants in the energy collective.

Additionally, all the excess electricity can be vsold at market price.

Costs
The costs of a collective self-consumption system are identical to those of a private self-consumption system, described above. These are:

- The initial costs of investment
- The fixed costs of the electricity bill
- The TURPE
- The annual counting component
- The annual management component
- Annual care and maintenance costs

BEST PRACTICES

The project in Marmagne *village is one of the most advanced projects in terms of energy cooperatives.*

PV systems with total capacity of 220kW were installed atop 7 public buildings and supplies electricity to the public buildings while any excess supplies neighbouring buildings. In order to complement the installation, a 120 kWh battery was added. The financial conditions of the system allow it to produce cheaper electricity than public suppliers, for the public buildings as well as for the 61 residents who chose to participate in the project.

Germany

LEGAL FRAMEWORK

The legal framework of combined e-mobility, photovoltaics and storage solutions is to be determined by the different parts of regulation for each of these individual sections. One therefore has to distinguish between (1) the installation and operation of a PV system as such, (2) its combination with a storage system and (3) the construction and integration of charging infrastructure.

INSTALLATION OF A PHOTOVOLTAIC SYSTEM

Concerning the installation of a PV system, the EEG (**German Renewable Energy Act**) regulates the technical and organisational requirements of the operation as well as its marketing options. In the EEG, the entirety of all modules in a PV system are considered a renewable energy system. Grid operators are obligated to connect renewable energy systems to the public grid and to purchase the generated electricity with priority. At the same time, PV system operators are obligated to report and register their renewable energy system. A PV system operator is defined in the EEG as somebody who – regardless of ownership of the system – uses it for the generation of electricity from renewable energy sources.

In case of self-consumption, PV system operators need to comply with more regulatory principles: Because there are no grid utilisation charges for the on-site produced and consumed electricity, all levies and fees normally charged by the grid operator are avoided. PV systems with a capactiy of less than 2 MW are exempt from the tax on electricity, but in general have to pay **the EEG levy**. An **exception** is possible for in-house consumption, if:

- the end consumer is also the system operator (personal identity of both market roles),
- there is no transit through a public grid and
- the consumption takes place at the same location.

If those requirements are met and the installed performance is lower than 10kW, it is free from the EEG levy; all other on-site systems are to pay a reduced EEG levy of 40%.

In consequence, being considered a system with on-site consumption is essential for charging electric cars because it can drastically lower the electricity costs.

1 Combination with a storage system
Storage systems are also subject to different regulations. Focusing on the use for the *prosumption* of PV electricity for e-mobility solutions, storage systems allow for charging cars during the evening or overnight, which is essential

when using only PV electricity. For *prosumption*, EEG levy is omitted when the PV system as well as the storage system has a capacity of less than 10kW and both are operated by the same legal entity on the same location. To fulfil the operator requirement in that sense, the legal entity has to:

- bear the entrepreneurial risk,
- determine the mode of operation and
- have direct access to the installation.

As the usage of storage systems means that the public grid is not used, all commodity price-related network charges, grid-related levies and concession fees are fully omitted.

2 Construction and integration of charging infrastructure

As far as the PV and storage systems are integrated in a charging infrastructure, different legal frameworks apply.

The German **"Law on Energy Management"** (EnWG) applies because charging stations in Germany are seen as an energy facility. Great relevance is given to the operator of the charging stations, who is defined as a legal entity who bears the economic risk of the charging infrastructure and determines the mode of operation. The operator role could be filled by the company itself or by a service provider. Because of Article 3 no. 25 EnWG, the operator is treated like an end consumer. In consequence, the operator is not classified as an energy company in the terms of the EnWG, although such classification could become necessary with regard to other legal requirements based on the EEG.

As long as the operator company owns the PV system, the storage system and the charging infrastructure, there is no obligation for notification and registration as an energy company. The produced energy in this scenario can be used to charge cars without additional EEG levies (Article 3 no. 19 EEG). If third parties use the charging stations, the supplied energy could be qualified as an electricity delivery and hence be charged with the EEG levy. A charging infrastructure that is used by the operator itself as well as by third parties needs to be set up with a metering device to meter the supplied energy quantity to third parties in intervals of 15 minutes (so-called "cascade measuring"). The same principle applies for the storage system. As an operating company, one should make sure to develop a well thought out metering concept in order to ensure exemption from EEG levies.

Next to EnWG and EEG, the German **Regulation for Charging Stations** (*Ladesäulenverordnung*) will be applicable. It mainly contains the basic requirements for the standards of charging plugs, the construction and the operation of publicly accessible charging stations.

The general German **road traffic law** also influences the e-mobility sector, mainly by determining the requirements of labels for electric cars. Differences are made between electric vehicles, hybrid electric vehicles and fuel cell vehicles.

Electric vehicles are also tax-favoured by the German **tax law**. For example, a company car is exempt from the taxation of non-cash benefits if it is an electric car. As mentioned before, an exemption from the obligation to pay electricity tax is possible for charging system operators who use PV electricity exclusively (Article 9 *StromStG*). If an electricity mix is used, the exemption for electricity tax only applies when certain criteria are met (capacity of less than 2 MW and use of electricity in direct spatial context).

The construction of e-charging infrastructure is also subject to **building and planning law** as well as **property law**. For example, a tenant is not entitled, without the consent of his property owner, to make structural changes to the leased object which is necessary for the construction of charging infrastructure. Although politicians are currently working on removing the legal obstacles by means of changes in tenancy and housing law, a corresponding bill by the Federal Council has not yet been passed.

Concerning planning law, the charging infrastructure is understood as a structural facility within the meaning of § 29 *BauGB*. However, it does not have to fulfil the requirements for a filling station within the meaning of the *BauNVO*, but is treated as a secondary facility within the meaning of § 14, para. 1, *BauNVO*. Building regulations are the responsibility of the federal states and may therefore vary from region to region.

TECHNICAL REQUIREMENTS

Traders, who wish to charge electric vehicles with PV electricity they have generated themselves and provide the corresponding charging infrastructure, should consider certain technical requirements in order to achieve the best possible integration into the existing customer network with PV storage systems.

Concerning the integration into existing systems, an electrically powered vehicle is to be considered a flexible power consumer with high power consumption. The electric vehicles are connected to the electrical network of the tissue plant (customer plant) via a charging infrastructure (charging station, wall box) as electricity consumers. The charging circuit for an electric vehicle is a final circuit which may not contain any connection points for other electrical appliances. Interruptible or disconnectable consumption devices, which have a separate metering point, offer the possibility of saving network charge costs (see § 14a EnWG).

There are certain advantages of charging electric cars with your own PV electricity, such as:

- With self-produced solar electricity, prosumers can fill up an electric vehicle in an environmentally friendly and cheaper way than with household electricity from the socket.
- Charging the electric car with self-produced PV electricity increases the share of consumption and thus, the current economic efficiency of the PV system.
- An electric car can be charged directly with locally produced PV electricity during the day, in the evening or overnight via a PV storage system.
- The proportion of solar electricity is higher when the car is charged during the day (in sunshine). Another factor that influences the proportion of solar electricity is the size of the PV system and the charging capacity of the electric vehicle.
- A small charging capacity of the electric car causes longer charging times, but the usable solar power share increases, as the PV system can more often provide sufficient charging capacity.

Concerning metering of the PV electricity it should be noted that elaborate metering concepts may be required due to the application of the mentioned legal framework.

The technical requirements are otherwise based on the known technical standards such as VDE-AR-N400, DIN VDE 0100, DIN EN 61851-1, ISO 15118 and others.

ECONOMIC FRAMEWORK

The combination of a PV system, battery storage and charging station pays off in Germany, especially for PV systems up to 10 kW, as they do not have to pay the EEG levy for their own supply. The self-generated electricity is half the price of the electricity from conventional grid connection at 10 to 12 cts/ kWh. However, the costs of storage must also be taken into account.

Systems up to 10 kW are therefore a good investment option, for example for smaller commercial companies (private care services, courier services), even if storage costs are added).

PROJECT EXAMPLE: CHARGING INFRASTRUCTURE AND E-MOBILITY OF GP JOULE AT THE *REUSSENKÖGE* SITE

GP JOULE is a renewable energy company from Northern Germany. GP Joule aims to promote not only renewable power generation but also the consumption of this clean and cheap power in other areas such as power conversion to hydrogen or mobility. Therefore, GP Joule wanted to gradually complete the

conversion of the company's fleet to electric vehicles, and in special cases, to plug-in hybrid vehicles at the company's 120-strong headquarters in *Reußenköge* in Schleswig-Holstein, which is rich in wind and solar energy. Since suitable charging solutions for large vehicle fleets with a high degree of integration into the operating and power supply environment were not yet available on the market in 2015, GP JOULE took over the development itself.

The biggest challenges were seen in maintaining the mobility and working capacity of the employees. The task was to develop an intelligent load and energy management systems for the sites. It was also necessary to create charging solutions for employees at home and in addition to these challenges, the actual objectives of the e-fleet solution system i.e. emission and cost reductions.

In the meantime, 40 e-vehicles are regularly on site and charge at 50 charging points. In the medium term, up to 120 electric vehicles are expected per day. With an holistic planning approach of electrifying the mobility and charging infrastructure via integration of generation plants and other consumers, high automation of billing and embedding into corporate mobility and scalability of the system, GP JOULE created a powerful system that creates a high level of acceptance among employees and minimises additional costs due to changes in mobility and energy consumption behaviour.

At the energy level, it has been possible to adapt the charge load curve to the existing grid connection by effectively avoiding peak loads that occur during uncontrolled charging. The existing capacity is always fully utilised. In the meantime, approx. 50% of the expected electro mobility at the site has been converted into reality.

Italy

LEGAL FRAMEWORK

The best incentive to become a *prosumer* is to save energy. Although the Italian "Conto Energia" subsidy programme expired a few years ago, many still use a PV system to generate and consume their own electricity.

The current regulatory restrictions in Italy, however, limit the full potential of *prosumers*: According to current legislation, it is not possible to operate so-called collective self-consumption. That means, that in an apartment building, the electricity generated by a PV system may not be used in the individual apartments, but only for shared use (e.g. elevator, lighting in the stairwell etc.). This restriction also applies to the tertiary sector (e.g. the various users of a shopping centre) and the industrial sector (e.g. the various plants in a production area).

These regulatory restrictions are contrary to European Union policy which, particularly through the recent CE4AEPackage, has made it clear that Member States should take measures to promote self-consumption and consumer participation.

The PV solution is particularly interesting for two market segments:

- **Private users** who benefit from the possibility of a tax deduction for part of the investments made and who can save money with domestic production compared to the expensive electricity tariffs.
- **Individual commercial or industrial** users of medium to large size whose self-consumption is regularly high during periods when the sun is shining.

The incentives in the old promotion model ("Conto Energia") were easy to understand: Monetary revenues were mainly linked to the energy produced so that it was not necessary to analyse the details of the later use of the energy produced when drawing up a business plan. The current model, on the other hand, is based on energy savings through solar energy and refers to two key parameters that must now be taken into account:

- Costs for the kWh of electricity drawn from the grid
- The level of captive use

Self-consumption can be defined as the amount of electricity produced by the PV system that is consumed directly by the consumer in relation to the total value of the electricity produced by the PV system. The degree of self-consumption essentially depends on how well the user's consumption trend overlaps with the PV production curve, which in turn is linked to the hours of sunshine.

TECHNICAL ISSUES

Since the PV system must capture solar radiation, ideally it is placed on a roof. In order to achieve maximum energy production in one year, the modules of the photovoltaic system should face south and be inclined at an angle of about 30°.

Interested parties should also clarify some technical questions with their supplier. It is advisable to find out what the consequences are if your roof does not have the optimal inclination and orientation. Or how the shadows of trees and buildings can affect power generation. It may also be important to know how long the PV system takes to install and how often maintenance is required.

In order to use as much of the solar energy generated as possible for their self-consumption, prosumers should try to shift as many loads as possible into sunny times, for example by starting the washing machine at a time when the sun is shining. Of course, so-called smart home systems, which can be linked to sunshine times, can also be used for this purpose. It is also possible to couple the PV system to a battery storage system in order so use the generated electricity later on.

ECONOMIC FRAMEWORK

The economic efficiency and profitability of a PV system depends on many individual factors. Two analyses of different prosumers were carried out as examples: a private user and a commercial user:

1 Private user of a PV system
For a **private user**, the analysis assumes a system with a size of **3 kWp** (kiloWatt peak, term for the electrical output of solar cells). The costs of the PV system are thus between **4500 and 6000 €**. There is the possibility of a **tax deduction of 50%** of the costs incurred. Such a PV system can generate between **3300 and 3900 kWh/year**, depending on the solar radiation at the installation site. Assuming that the share of the **self-consumption** is about **35 %**, a **total savings of between 350 € and 600 € per year** can be achieved. The system pays for itself after about **5 to 9 years**.

2 Commercial users of a PV system
For a commercial user, the analysis assumes a plant of **100 kWp** in size. The costs of the PV system are thus between **120000 and 150000 €**. A tax deduction is not possible for commercial users. Such a PV system can generate between **110 and 130 MWh/year**, depending on the solar radiation at the installation site. With an expectable rate of self-consumption of about **90 %**, between **15000 € and 19000 € per** year can be saved. The system pays for itself thereby after approximately **6 to 10 years**.

PROJECT EXAMPLES

YSY AGRITURISM by Paolo Chistolini
In April 2018, an agritourism with gastronomy and accommodation installed a PV system with an output of 18.6 kWp on an area of 102.3 square metres. The modules, installed at an inclination of 17° in the horizontal plane and facing almost perfectly south, are part of the PEIMAR SG300 monocrystalline silicon model. The plant is also organized in four electrical strings and equipped with two ABB inverters of 8.5 kW each.

The expected energy production of the plant is about 20,000 kWh/year, of which 28% will be consumed by the users themselves, and the cost of electricity from the grid is 0.27 €/kWh. The system was designed and built by *ERiM* S.r.l.

Agricultural Company located in Valle Intelvi (CO)
In August 2018, a farm equipped with livestock breeding, cheese dairy, restaurant and accommodation installed a PV system with a rated output of 10.8 kWp, consisting of 40 VIESSMANN Vitovolt 300 modules of 270 W each, made of polycrystalline silicon. The plant, designed and built by *EQUA* S.r.l., has an expected production of 13,500 kWh/year on an area of 70 square metres. It was installed on the roofs of the barn and stable.
The system is equipped with two Fronius inverters of 5 kW each, one of which is a "hybrid" type and manages the storage system. The special feature of this system is that the PV modules are coupled with batteries to store the energy produced. It is a FRONIUS SOLAR BATTERY 4.5 ferrophosphate-lithium-ion storage system with a rated output of 2.4 kW. The storage tank has a rated output of 4.5 kWh and a net output of 3.6 kWh taking into account a discharge depth of 80%.

Thanks to the use of batteries, the system was able to achieve an own consumption of between 80% and 90% and an economic payback period of around 8 years, if the electricity costs from the grid of 0.26 €/kWh are taken into account.

The Netherlands

LEGAL FRAMEWORK OF INDIVIDUAL SELF-CONSUMPTION

Individual self-consumption or direct own use of solar energy is permitted in the Netherlands and has been common practice for a long time. This leads to a net annual electricity consumption for a household with a PV system that is lower than the consumption of the same household without a PV system. The price for purchasing electricity from energy suppliers (~ 0.23 € / kWh) is the same as the financial benefit of feeding electricity into the grid (so-called "netting"). At the same time, this actually means that there is no reward for self-consumption over the return of electricity to the grid. However, the Dutch government intends to phase out the feed-in subsidy gradually from 2021.

Offsetting is allowed for small consumers. Homeowners therefore invest in PV systems that can generate the annual demand for electricity, so that no electricity is consumed on an annual basis. In the Netherlands, no building permit is required to install PV systems at home, which simplifies the installation procedure. However, a PV system must be notified to the grid operator. As offsetting is sometimes seen as a hidden subsidy because it causes the treasury to lose out on energy tax, a review of the offsetting system is underway. Offsetting will then be replaced by a feed-in tariff, which will gradually decrease, but will keep the economic payback time at about seven years.

LEGAL FRAMEWORK OF COLLECTIVE SELF-CONSUMPTION

In many cases there is not one personal owner of a roof, but it is shared e.g. in apartment complexes where homeowners are obliged to participate in an Association of Owners. In apartment buildings in which homes are owned by private individuals, four solutions for personal consumption are possible:

- Firstly, PV energy can be used for collective services in the building, such as lifts and lighting. In general, this solution is not considered as collective self-consumption, as the consumer is only one entity, namely the Association of Owners. In this case, all owners will benefit from a reduction of the electricity bill because they are (obligatorily) members of the Association of Owners.
- In the second option, individual apartment owners actually own part of the entire PV installation on the roof and are directly connected to the apartment. Strictly speaking, this is not shared 'own consumption', because the extra energy produced by the PV part of an owner cannot be used by other owners.
- Thirdly, a combination of both options involving some hardware distributor.
- The fourth option is a special case of the so-called *Postcoderoos* (Postal

Code Rose) scheme, where anyone living in one postcode can invest in a PV system in and directly around the postal code area in which he/she lives. The advantage consists of an exemption for energy tax on one's own energy bill. This advantage is lower than the current feed-in compensation in the case of an investment on a roof of which one is the owner. In recent years, the number of postal code projects has increased rapidly and is usually started by local energy cooperatives or organisations such as *EnergieU* in Utrecht.

TECHNICAL ISSUES

1 With individual self-consumption
As mentioned, offsetting is allowed for small customers. PV systems are used by "small customers" when they have a maximum capacity of 15 kWp (about 50 standard solar panels), with a grid connection limited to 80 A (three phases) and where the electricity must be supplied to the same connection. However, if the amount of PV electricity produced is higher than the annual consumption, the system owner receives a much lower remuneration from the energy suppliers. This fee usually amounts to 5-7cts/kWh.

2 With collective self-consumption
For investments in PV systems larger than 15 kWp, a fee per kWh produced can be requested under the SDE+ scheme (The Dutch Subsidy for Renewable Energy Scheme, so-called "Subsidie Duurzame Energie"). These installations may not be linked to the limitation of 3x80 A. There are two categories: PV power between 15 and 1000 kWp, and PV power greater than 1000 kWp. This is based on the assumption that investment costs of larger PV systems will be lower per Wp than smaller ones. Typically, applications for support are organised in phases per year, with fees depending on the phase, usually the later in the phase of the year, the higher the fees. These fees are corrected on the basis of how electricity is used, i.e. whether or not it is delivered to the electricity grid.

ECONOMIC FRAMEWORK

1 For individual self-consumption
In general, it can be said that homeowners decide on making an investment in a PV system on the basis of their preference. An independent portal for solar panels was developed a number of years ago. This web-based portal contains guidelines for investing in solar panels, including a calculation aid that allows a rough estimate of the financial advantages and disadvantages.

Homeowners must also take action themselves and request quotations from installers and/or suppliers. This is seen by many homeowners as a difficult task, because of the large and diverse supply. Various organisations and municipalities are active in collective purchasing actions, whereby these organisations carry out an extensive quality check on the suppliers.

With an average PV system size of about 3-5 kWp in the Netherlands and an average household demand of 3500 kWh per year, *prosumption* is estimated at about 30% per year. This varies and is modelled by research institutes (e.g. UU). With current market prices of 1-1.5 €/Wp for a 3-5 kWp PV installation, the economic payback time is about 5-7 years.

If you have received a quotation from a PV installer, divide your total costs by the system size in kWp. The starting point here is a system price of 1.2 €/Wp, or € 4800 for the system size of 4 kWp. The cost price for electricity is then 15cts/kWh and varies linearly with the system price. This cost price is therefore considerably lower than the price that you currently pay for electricity as a consumer (as mentioned above approximately 23cts/kWh).

In general, the system is used for 20 years. Costs for replacing components with a shorter lifespan (inverters, batteries) are already included in the calculations. Quality modules have a lifespan of 25 years.

2 For collective self-consumption
The financing of a PV system is supported by the National Energy Saving Fund, which makes it possible for the Associations of Owners to take out a long-term loan on relatively favourable terms. This scheme is only open to Associations of Owners with more than ten apartments, but the recent climate agreement expresses the ambition to also open this scheme to Associations of Owners with six to ten apartments.

The hardware-based energy distributor called **'Herman**' sequentially links the PV installation on the roof of the apartment building to individual households, so that each apartment can benefit from offsetting, albeit at different times.

Finally, various housing corporations in the social housing sector are experimenting with models that allow tenants to take full advantage of adding PV systems to apartment buildings. This would be possible by using *Herman* or by setting up (local) energy companies or cooperatives. Housing corporations can own the PV system and depending on the connection to the apartment, the system costs can be part of a (possibly) increased rent. The housing costs of tenants are then lower as a result of PV generation (savings on the electricity bill). Housing associations can also enable tenants to invest collectively or individually in a system on the roof for an annual fee (which can as well be zero).

A recent amendment to the Electricity Act offers consumers the possibility of closing contracts with several energy suppliers, with the intention of facilitating

new market models that could accelerate the energy transition. Each contract requires to install a separate electricity meter. It would therefore be possible to have a separate contract for household consumption, another for selling PV energy and another for charging an electric vehicle.

Portugal

The **production** and **consumption** of your own electricity has several advantages such as reducing greenhouse gas emissions and creating savings on energy bills. In order to best integrate these prosumers in to the Portuguese grid, the self-production/consumption system has to be carefully designed in a way that the most amount of energy possible is consumed on-site since any excess electricity produced and sold back in to the grid is sold at a low price (90% of market price).

In particular, commercial consumers who operate during the daytime can greatly benefit from a self-production/consumption system due to the fact that their consumption of electricity aligns perfectly with the cycle of photovoltaic production: when the sun is strongest, the most is electricity is produced.

THE SINGLE *PROSUMER*

In Portugal, any consumer who has a contract for consumption of electricity has the right to install a self-production/consumption system (or UPAC according to Portuguese law). This right does not depend on the type of entity – be they private households, commercial entities, agricultural or industrial operators – all have the right to become *prosumers*.

Law-Decree 153/2014 defines three levels of UPACs. The rules and conditions for each depend on their installed capacity.

- Level 1 – Systems with a capacity of up to 200 W may be installed and connected to onsite grid without any kind of authorisation or registration.
- Level 2 – UPACs with capacities between 200 W and 1500 W can be installed and connected to the onsite grid without previous authorisation but must be registered in the online governmental portal (SERUP).
- Level 3 – Systems with capacities between 1500 W and 1 MW must be previously authorised and are subject to a technical inspection after their installation. Only after receiving a certificate of use can they be put in to operation.

IMPLEMENTATION OF A SINGLE UPAC

The steps to follow when implementing a UPAC are usually the following:

- Registration in the online SERUP portal as user
- Installation of the System:
  a) For a Level 1 UPAC, the system can be installed and operated without any additional procedures
  b) Level 2 UPAC can be installed and operated after registration on the SERUP portal. The *comercializador de último recurso* (CUR, energy supplier for the end costumer) will then alter the configuration of the meter in order to adapt it to the altered conditions (in case the property is equipped with an

electronic energy meter); in properties still equipped with a mechanical energy meter, he will substitute it with an electronic one.
c) Level 3 UPAC must obtain authorisation after registering on the SERUP portal. After this, the system may be installed but may not begin operating.

- In order to validate the registration of the system, the *prosumer* must pay a fee.
- A request for a technical inspection must be made with along an indication of the onsite meter as well as the SIM card number thereof.
- A test reading will be taken from the electronic meter.
- After the inspection (or in the case of no inspection takes place within period of 10 days after the request for such), the *prosumer* will receive a certificate of use which will allow the UPAC to begin operating.

PROFITABILITY OF A SELF-PRODUCTION/CONSUMPTION SYSTEM

A UPAC's profitability should be evaluated in light of the following three factors:

- Its savings in the final energy bill, calculated per unit of energy (kWh) consumed from your own produced energy. Currently, industrial consumers save about 9 cts/kWh while private consumers save around 23 cts/kWh.
- The sale of excess electricity back in to the grid at 90% of the Spanish & Portuguese market price (MIBEL).
- The costs of the initial investment and of operating the system.

It is important to note that the costs of production are usually higher than the profit earned from selling excess energy. A system should be chosen which aims to produce the most amount of energy that will be consumed on-site while limiting the amount of excess energy to be sold.

It is also permitted to install a battery which could store any excess energy produced during the day to then be consumed during the night. However, this increases the initial investment costs so the installation of a battery would have to depend upon the type of system chosen

RECOMMENDATIONS

The administrative procedures for authorising a UPAC are fairly easy since everything can be done *online* but some aspects could be improved. Since UPACs with a capacity of at least 1500 W need to have electronic meters installed, this can increase the initial investment costs of the installation by up to 10-20%. Since this metering is only for the collection of statistics on the consumption of renewable energy in the country, alternate means of collection have been put forth.

It is difficult for a private consumer to conclude contracts for the SIM card of the *modem* of the meter. Telecommunications companies sell pre-paid SIM cards but a call must be placed with these cards at least every 3 months or it is automatically deactivated.

It is also worth mentioning that the market for self-production/consumption systems could significantly expand if models 2 (and in particular) 3 of the PVP-4Grid projects are authorised. Model 3, which sees groups of consumers jointly produce and consume energy, could have a large impact in Portugal. This model could be of particular use in large convenience stores such as supermarkets or shopping centres.

In the future, a tax on UPACs (which is foreseen in legislation) could limit the growth of the market. Consequently, this possible rise in prices should be closely monitored.

Finally, the VAT tax should be reduced back from 23% to 6%. Photovoltaic installations not only offer less carbon-intensive energy than conventional energies, but their development would also create jobs and raise the GDP. A strong financial signal should be sent for these investments by lowering the VAT tax. The current higher VAT tax rate affects mainly private consumers since industrial and business consumers can deduct the VAT in their accounting.

Spain

In Spain, the models for self-consumption, according to newly approved legislation, covered in this document will be:

- Self-consumption without surplus (when a device blocks any excess electricity from being injected back in to the grid)
- Self-consumption with surplus (when the installation allows for the consumption of one's own produced electricity and its injection back in to the grid)

On 5 October 2018, new legislation on self-consumption was adopted in Spain. This new legislation eliminates the 'sun tax' (self-produced and consumed energy that did not pass through the grid still was subject to grid charges). With new measures such as improving the rate of return during specific time windows, the new legislation dispels much of the fear that had gathered around self-consumption in Spain.

WHAT IS A *PROSUMER*?

A *prosumer* is an electricity consumer who produces his own electricity with a photovoltaic (PV) installation. Their installation is connected either directly to his internal grid or through a direct line. Any surplus electricity produced can (or not) be injected back in to the grid. *Prosumers* can either be isolated or connected to the grid.

IMPLEMENTATION OF SELF-CONSUMPTION WITHOUT SURPLUS

Self-consumption installations without surplus must install a device to block any surplus from being injected in to the grid. Royal Decree-Law 15/2018 does not specify which type of the certificate the device must have, but a certificate must be provided by the manufacturer attesting to the 'no-injection' of the installation. For these installations, there is no cap on the capacity that can be contracted as well on the installed capacity. Systems with a capacity equal to or lower than 100 kW will be subject to specific regulation (Since these will be connected through the distribution grid, they are governed by the law on low-voltage installations).

Installations will be fitted with means of measurement (meters) which permit them to be billed correctly. Bi-directional meters are preferred, installed at both the point of connection to the grid and at the consumption meter. The use of storage systems such as batteries is permitted.

Owners of these types of installations are exempt from paying grid charges for all electricity which they produce themselves. In energy collectives, in case surplus electricity is injected in to the grid, the exact amount must be calculated in order to calculate the cost of the charges for use of the grid.

The *prosumer* can delegate to the installer of the PV system, the requirement to undertake the necessary administrative processes in their place.

Administrative Procedures
The main processes that must be undertaken are for adaptations to urban planning requirements, an application must be made for a minor building permit through a simplified procedure or by means of a 'responsible building' declaration and finally, the necessary fees must be paid.

Many local authorities are granting tax breaks to such installations from the 'real estate' tax (IBI, *Spanish acronym*) and the 'constructions, installations and works' tax (ICIO, *ibid*). Spanish law allows for reductions of up to 50% of the IBI and 95% of the ICIO. During the planning of your project, consult with your local authority to verify whether any such reductions are available.

Access and Connection to the Grid
Self-consumption installations without surplus do not need to request additional authorisation for access and connection to the grid for their PV system as long as the consumer already has one for consumption from the grid.

Local Authorisation of the Installation
No authorisation must be granted by the local authorities for installations without surplus as long as the system has been inspected by the competent local authority which attests that the installation meets the requirements of the law on low-voltage installations.

Registration
Once it has been established that your installation meets the requirements of the low-voltage installations law, your chosen installer will have to notify the local authority (Autonomous Community) of the installation by means of a bulletin. The local authority will then register the installations within the registry of national self-consumption of the Ministry for the Ecological Transition so that the latter may monitor the national levels of self-consumption of electricity.

Penalty for Infringement of the Regulation on Self-Consumption
10% of the annual turnover for electricity consumption or 10% of the annual turnover for energy discharged into the grid will be charged from any party who infringes this law.

Profitability of Installations without Surplus
Considering that the laws which govern self-consumption have recently changed in Spain, there are, as of yet, no figures on the profitability of self-consumption installations under the new law. What is known however is that the economic payback period will be shortened as compared to under the previous legal framework, and that technical and

administrative requirements are simpler and less costly.

Self-consumption without surplus is especially used in single-family households, small businesses and industries who consume electricity mostly during daytime, and in the future, multi-family buildings. Most Spanish citizens live in multi-family building blocks which highlights the fundamental importance of the development of self-consumption in Spain.

Despite the fact that administrative procedures are simpler for installations without surplus as compared to those with surplus, the fact that installations without surplus will not profit from the sale of excess electricity in to the grid means that it will take significantly longer for a prosumer to recover his initial investment for the installation. This is especially true for private residential households who opt for this type of installation.

Furthermore, due to the fact that electricity production from PV installations is strongest during the day when families are away from their homes, electricity storage emerges as an attractive option for installations without surplus. However, batteries have high upfront costs but do also exponentially improve the profitability of the installation and significantly reduce the time it takes to recover the initial investment.

BEST PRACTICES

'*Oleada Solar*', launched by *Ecooo* in 2017, helps consumers reduce costs of ordering PV installations by grouping a large of number of interested consumers and ordering the installation in bulk at a lower price rather than individually. Additionally, a common PV installation is currently being developed with input from all involved parties. Within 6 months of the start of the project, an increase of 35% in the number of buildings with self-consumption systems was noted.

Some regional authorities have organised 'self-consumption round tables', which provides a forum for discussion between different sector stakeholders (businesses, associations, distributors and local/regional authorities) in order to voice any doubts and conflicts in applying the legislation and resolve them as quickly as possible.

SELF-CONSUMPTION WITH SURPLUS

Implementation of Self-Consumption with Surplus

Self-consumption installations with surplus may produce electricity for the *prosumer's* own consumption as well as inject any excess electricity in to the transmission and distribution grids.

Identically to installations without surplus, there is no cap on the capacity that can be contracted as well on the installed capacity for installations with surplus. These installations will also be fitted with means of measurement (meters) which permit them to be billed correctly. Bi-directional meters are also preferred, installed at both the point of connection to the grid and at the consumption meter. The use of batteries is also permitted.

Again, identically to installations without surplus, electricity consumed from the self-consumption system will not be subject to grid charges but all surplus energy will be subject to the same treatment as the energy produced and injected into the grid and will be subject to grid charges.

Simplified compensation mechanisms will be developed for surplus from installations with a capacity of less than 100 kW. These mechanisms have yet to be regulated.

As previously mentioned, if they wish, the *prosumer* can delegate the requirement to undertake the necessary administrative procedures to the installer of the PV system in their place.

Administrative Procedures

There are several procedures to be undertaken with the local administrations to get the installation permission. In addition, certain specific regional authorities require, for non-residential households, special authorisation for the sale of excess electricity to be considered a commercial activity. During the planning phase of the installation, it is necessary to consult with local authority to check whether such authorisation is necessary.

Deposit

For installations with capacity larger than 10 kW, a deposit of 40 EUR per kW of installed capacity is required.

Access and Connection to the Grid

In urban areas, installations with an installed capacity lower than 15 kW, which are not yet registered, are exempt from having to request authorisation for access and connection. All other self-consumption installations with surplus will have to request, from its distribution system operator (DSO), a new connection or a modification to its existing one.

Article 4 of Royal Decree 1699/2011 governs installations with capacity be-

tween 15 kW and 100 kW. The DSO has 1 month to notify the proposed conditions of access and connection to the interested *prosumer.* The *prosumer* has 3 months to accept the conditions of the distributor. If the connection is refused, if he fails to reply within the time limit or does not agree with the conditions, he may submit complaint with the competent administration. Once accepted, the DSO then has 15 days, if the connection is made in BT, to send the economic and technical specifications of the access and connection project. The final step is for the *prosumer* is to accept these conditions.

A simplified procedure for installations with capacity below 10 kW is identical to the procedure for installations without surplus.

Request for Authorisation from the Local Authority

In order to request authorisation for installations with an installed capacity between 10 kW and 100 kW, the following documents are required:

- Installation plan signed by a competent technician
- Installation certificate with relevant user information in annex
- 'Construction management' certificate signed by a competent qualified technician
- Connection point and access granted by the DSO
- Certificate of compliance with Royal Decree 1699/2011, of 18 November, issued by the installer or competent technician as appropriate
- Certificate of favourable initial inspection issued by an approved Control Body.
- Certificate of commissioning of utilization facilities
- A deposit in cases where a deposit is required (PV systems with capacity higher than 15 kW with grid connection).

In cases of a connection to the transmission grid, regardless of the contracted capacity or for installations above 100 kW, the provisions of Royal Decree 1955/2000 apply.

Request for formalization of the technical contract for access, connection and first verification

Once the previously mentioned documents have been obtained, the *prosumer* must sign the technical contract for access to the distribution network and the connection of the installation and the first verification.

Normal Procedure (Installations with capacity between 10 kW and 100 kW)

The *prosumer* must request the DSO to sign the technical contract of access to the network, once he has presented a certificate which attests to their passing of the certification tests and that the technical and economic conditions of the connection have been accepted.

The *prosumer* must sign a technical access contract with the DSO to supply auxiliary production services directly or through a marketing company, or modify the existing contract in accordance with the applicable regulations. Within the following month, the *prosumer* and the DSO must sign the technical access contract.

The DSO is then formally requested to connect the installation to the distribution network and has 1 month to make the connection. This request can be made together with the subscription of the technical contract with the distributor, or at any time after signing it. The DSO may conduct an inspection of the installation unless it has a certificate guaranteeing compliance of the installation with the provisions of the low-voltage or high voltage laws, as appropriate.

Procedure for installations with capacity greater than 100 kW

For these installations, the provisions of Royal Decree 1955/2000 and Decree 50/2008 apply.

Simplified Procedure (Installations with capacity below 10 kW)

Once the PV system has been installed, the installation is connected to the grid, accompanied by the technical access contract and an installation certificate.

The DSO has a period of 10 working days to formalise the technical access contract, verify the installation and connect the production facility to the distribution network. Inspection is not required should the *prosumer* produce a certificate proving that the installation complies with the provisions of the low-voltage or high voltage laws, as appropriate. In the case of installations in urban areas with capacity below 15 kW, it is not necessary to ask for access and connection permits.

Subscription or Adaptation of the Contract for Supply Access

The consumer and the producer, for ancillary services, may purchase the energy either as direct consumers on the production market or through a trading company. In the latter case, the supply contract may be to the market or in through any of the models provided for in Royal Decree 216/2014.

Registration of Electrical Production Facilities

For installations with surplus with a capacity greater than 100 kW, registration in the administrative register of electrical production installations is mandatory. The *prosumer* applies for registration with the body responsible for energy, which is usually the Directorate General for Industry or Energy of the Autonomous Community. Installations with capacity below 100 kW are exempt from registration.

Sale of Surplus Electricity
The owners of installations with surplus can sell their surplus electricity on the electricity production market.

Sanctions for infringement of regulations
The penalties for infringement are identical to those for installations without surplus.

Profitability of Installations with Surplus
Before the legal framework changed, installations with surplus generally had shorter investment recovery periods than installations without surplus. This was due to the fact that these installations are located on commercial premises, schools, universities or other organizations that consume a large part of their electricity during the day, which coincides with the production cycle of photovoltaic solar production. In addition, any surplus is bought at market prices.

BEST PRACTICES

Alongside the previously mentioned tax breaks and the stakeholder forums, some regional administrations are also offering subsidies to small and medium-sized enterprises (SMEs). With this, they intend to help SMEs to reduce their energy and economic costs and, in this way, increase their competitiveness.

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