European Commission

CITIZEN ENERGY ADVISORY HUB

A Guide to the Electricity Grid and Selling Electricity

Guidance Document 5

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Appendices

1. INTRODUCTION AND BACKGROUND

1.1 Document purpose and content

This guidance document supports active customers* and energy communities* in **understanding how to connect renewable energy installations to the electricity grid* and how to sell excess electricity**. As more citizens, small and medium-sized enterprises (SMEs), and local initiatives engage in renewable energy production, accessing the grid and participating in electricity markets has become a key step in enabling meaningful participation in the energy transition.

Although European Union (EU) legislation grants clear rights to generate, consume, and sell electricity, the practical processes to exercise these rights (such as grid connection procedures, technical requirements, and remuneration pathways) can be complex and vary across Member States. This guidance aims to provide a clear and accessible overview of these processes, highlight common challenges, and present effective practices from across the EU, helping actors navigate the system with greater confidence. Moreover, it contributes to the broader CEAH goal of **empowering citizens, communities, small organisations and SMEs** to participate meaningfully in the energy transition by producing, consuming, and sharing renewable energy.

Technical terms marked with an **asterisk (*)** are explained in the **glossary** provided in Annex 1. The glossary can be consulted throughout the document for further information on the main actors, processes and technical concepts related to grid connection and electricity selling.

This document combines a high-level **explanation of the electricity grid** with **practical guidance** on grid connection and electricity selling. It is structured as follows:

- **<u>Background and Context</u>**: **introducing the electricity grid**, its key actors and functions, the EU legal framework, and explains why grid access and electricity selling matter for citizen energy.
- **<u>Technical and Practical Guidance</u>**: providing **step-by-step guidance** on understanding the grid connection process, navigating technical requirements, and identifying practical pathways for selling electricity.
- **<u>Case Studies and Practical Applications</u>**: presenting **real-life examples** from across the EU that illustrate simplified, transparent, and replicable approaches to grid connection and market participation.
- **<u>Recommendations and Call for Action</u>**: outlining **targeted actions for key stakeholders** to improve accessibility, transparency, and efficiency in grid connection and electricity selling.

1.2 Background and context

1.2.1 Introduction to the electricity grid and its relevance to citizen energy

<u>What is the grid?</u> The electricity grid is the backbone of the energy system. It **enables electricity to be transported from where it is generated to where it is consumed.** The grid consists of an interconnected network of infrastructure (including transmission lines, distribution networks, substations*, and control systems, see Figure 1: The levels of the electricity grid), which ensures that electricity is delivered reliably and safely to end users. A key characteristic of the electricity grid is that it operates in real time.

The grid must keep supply and demand balanced at all times to maintain system frequency and avoid disruptions. If too much or too little electricity is produced compared to demand, the system frequency can deviate from its standard level, which can damage equipment or, in extreme cases, lead to outages. Maintaining this balance, therefore, requires continuous monitoring and adjustment by system operators. This makes the grid both a physical network and a highly coordinated operational system. The importance of the grid extends beyond its technical function. It is essential **for ensuring access to electricity** for households, businesses, and public services. In addition, it also acts as the platform through which electricity can be traded, enabling market participation and the exchange of energy across regions.

<u>How is it evolving?</u> The role of the grid is becoming increasingly important as the energy system undergoes a profound transformation. Historically, electricity systems in Europe were highly centralised, relying on large-scale power plants and one-directional flows of electricity from producers to consumers.

Today, this model is evolving towards a more **decentralised system**, characterised by the rapid growth of small-scale renewable energy installations. In this new model, electricity is often produced closer to where it is consumed, enabling higher levels of self-consumption* and local use.

However, the grid remains essential to balance supply and demand across locations and over time. This shift is fundamentally changing how the grid operates. Electricity flows are becoming bidirectional*, as increasing numbers of consumers also produce and export electricity. At the same time, digital technologies such as smart meters* and advanced data systems are enabling more dynamic and efficient management of the network.

Figure 1: The levels of the electricity grid

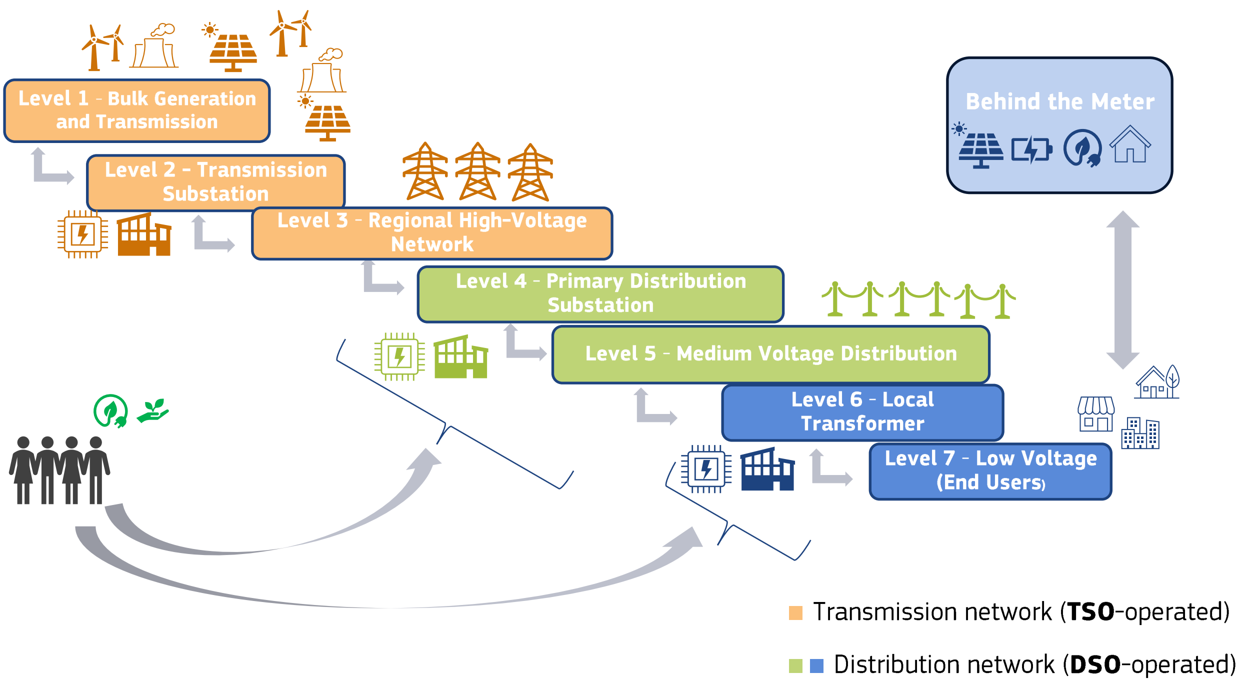


Figure 2: The path of electricity

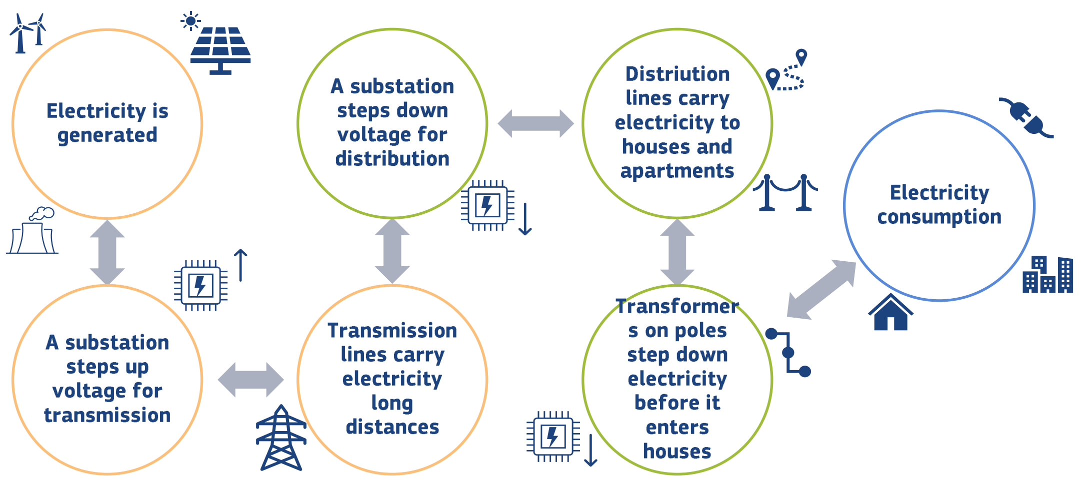


Figure 1 presents the different levels of the electricity system, from large-scale generation and high-voltage transmission down to low-voltage networks* and on-site energy systems. It shows how the grid is structurally

organised into distinct levels, each with a specific function. At the top (**Levels 1-3**), electricity is generated and transported over long distances through the transmission network*. At the intermediate level **(Level 4-5**), substations transform voltage and connect transmission to distribution. At the lower levels (**Levels 6-7**), electricity is distributed locally to end users, with Level 7 representing households, businesses, and on-site energy systems where most citizen energy is located.

"Behind the meter" * refers to the electricity generation, consumption, and/or storage that takes place on the end user's side of the electricity meter. The meter acts as the boundary between the internal installation (e.g. rooftop solar panels, batteries, heat pumps, or EV chargers within a building) and the wider electricity grid. Electricity generated behind the meter can be consumed directly on-site, stored locally, or exported to the grid if surplus electricity is produced. For energy communities covering several buildings, generation and consumption may take place behind different meters, while electricity shared between members is measured and allocated through the wider grid. For many citizen energy projects, this is the primary level at which energy is generated and used.

Error! Reference source not found. complements this by illustrating the functional perspective, that is, how electricity flows through the system. In a conventional model, electricity flows in a top-down manner: from centralised generation, through transmission and distribution networks, to final consumption. This representation is useful for understanding how the system has historically operated and how electricity is physically delivered across the grid. However, this linear pathway does not fully reflect how modern electricity systems function.

With the rapid expansion of decentralised renewable energy, **electricity flows are increasingly bidirectional**. Many users are no longer only consumers but also producers. Households with rooftop solar panels, small businesses, farms, and energy communities can generate electricity locally and either consume it directly, share it with nearby users, or export surplus energy to the grid.

As a result, **electricity can enter the system at multiple points, not only the top levels shown in Figure 1**. Most small-scale active energy producers are connected at the low-voltage or medium-voltage* levels, meaning that electricity is often injected into the grid closer to where it is consumed. This fundamentally changes the dynamics of the system, requiring greater coordination and flexibility to manage flows in multiple directions. The exact distinction between small- and large-scale installations varies across Member States and technologies. In many cases, locally generated electricity does not need to travel far at all. It can be consumed directly within a building (behind the meter), shared among users within the same site, or exchanged within a neighbourhood or community. In these situations, the role of the wider grid shifts from long-distance transport to enabling balancing, providing backup supply, and facilitating access to broader energy markets when needed.

What is the relevance of the grid for citizen energy? For citizen energy actors, the grid plays a more specific role. It enables households, small businesses, and communities not only to consume electricity but **also to actively participate in the energy system.** Renewable installations do not always generate electricity when it is needed. The grid therefore allows surplus electricity to be exported and provides electricity when local generation is insufficient. It can also enable locally generated electricity to be shared or sold. Access to the grid expands the scope of citizen energy projects beyond on-site consumption and increases their financial and environmental benefits.

Why does selling electricity matter for citizen energy? The ability to sell electricity is a central element of citizen participation in the energy system. While self-consumption allows individuals and organisations to reduce their energy bills, selling surplus electricity* significantly enhances the economic value of renewable energy investments. From a financial perspective, selling electricity creates an **additional revenue stream**. This improves the overall return on investment and can shorten the payback period for installations.

Beyond individual benefits, the ability to sell electricity has broader systemic importance. It incentivises the deployment of renewable energy technologies by making them more financially attractive. It also ensures that surplus electricity is not wasted but instead, contributes to the wider energy system, increasing efficiency and **reducing reliance on fossil fuels**.

Furthermore, selling electricity enables citizens and communities to become **active participants** in energy markets. This opens the door to new business models, including sharing electricity among community members or utilising price differences throughout the day and adjusting electricity consumption, storage or generation accordingly. In this sense, well-functioning systems for selling electricity to the grid are essential to enable wider market uptake of renewable energy, particularly for small-scale actors and community-led projects.

1.2.2 Key actors in the electricity grid

The electricity system is shaped by a range of **actors, each playing a distinct role** in ensuring that electricity is generated, transported, managed, and traded effectively. Table 1 provides an overview of these actors and their respective roles within the electricity system.

While the electricity system involves many actors, citizen energy participants will not interact equally with all of them. For most customers and small energy communities, the Distribution System Operator* (DSO) is typically the main counterpart throughout the grid-connection process. Electricity suppliers, aggregators*, and service providers usually become relevant at different stages, especially when designing the project and when electricity is sold or market participation is considered. Regulators and Transmission System Operators (TSOs)* generally operate in the background, mainly shaping the overall framework rather than interacting directly with individual projects.

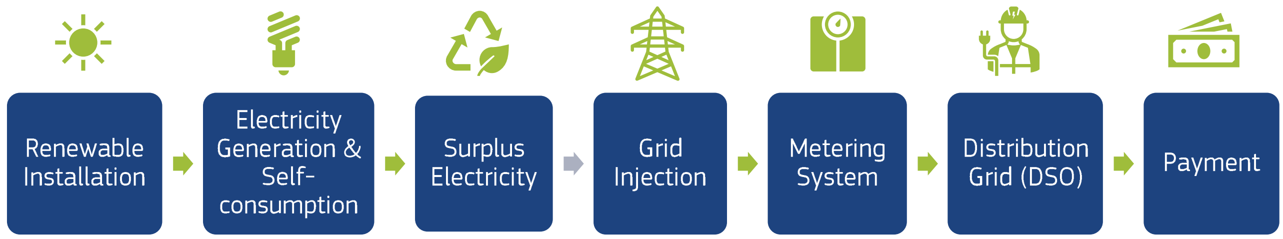
Table 1: Key actors and their roles in the electricity system

Actor	Role in the electricity system
Transmission System Operators (TSOs)	They manage the high-voltage transmission network and are responsible for maintaining system-wide balance and stability across large geographic areas.
Distribution System Operators (DSOs)	They operate the local distribution networks that connect end users to the grid. DSOs play a particularly important role for citizen energy actors, as they are responsible for processing connection requests, assessing local grid capacity, and ensuring that new installations comply with technical requirements.
Active Customers/Prosumers	Produce, consume, share, and potentially sell electricity, generally investing in renewable installations. They also participate in energy markets at small-scale.
Energy Communities	Collective actors that jointly produce, manage, and share energy. Energy communities enable local participation and the democratic governance of energy systems.
Electricity Suppliers	They purchase electricity and sell it to consumers; they may also buy electricity from prosumers under different contractual arrangements.
Regulators/Public Authorities	Regulators and public authorities establish the rules governing grid access, tariffs, and market participation, ensuring fairness, transparency, and consumer protection.
Aggregators/Service Providers	They facilitate participation of small producers in energy markets, bundle production or flexibility services, and provide technical and administrative support.
Local and Regional Authorities	Their role is to support local energy planning, facilitate projects, and integrate energy into spatial and community development strategies. They may also own land and public buildings suitable for renewable energy projects, may become partners in projects, set planning and permitting rules that affect project timelines, and, in some cases, operate municipal energy agencies or one-stop shops providing advisory support.

1.2.3 How renewable energy installations connect and interact with the grid

For citizens and communities, participation in the electricity system typically begins with the installation of a renewable energy system, such as rooftop solar panels. However, generating electricity is only one part of the process. To fully realise the value of renewable energy, it is necessary to understand how these **installations interact with the grid**. This interaction can be understood as a logical sequence of steps, from electricity generation to potential remuneration. Figure 3 illustrates this process in a simplified way.

Figure 3: From RE generation to grid injection and payment



The process begins with an installation, which generates electricity based on available resources such as sunlight or wind. This is first used on-site to meet local demand, a process known as **self-consumption**. When production exceeds consumption, **surplus electricity** is generated. This excess can be exported to the grid through a process known as **grid injection***. At this stage, the installation must be properly connected to the distribution network*, and technical components.

Smart meters play a critical role in this process by accurately measuring both the electricity consumed and the electricity exported. This data is used to determine **how exported electricity is paid for** and ensure transparency in billing. Once electricity is injected into the grid, the DSO ensures that it can be safely integrated into the network, considering local capacity constraints* and system stability. Capacity constraints arise when a part of the network cannot safely carry additional electricity, much like a road that can only accommodate a certain amount of traffic at a given time. Finally, the exported electricity is sold in a way that may vary depending on the regulatory framework.

1.2.4 EU legal framework and policy developments for grid access and citizen participation

The increasing role of citizens and energy communities in the energy system is underpinned by an evolving EU policy framework. At its core, the Renewable Energy Directive and the Electricity Market Directive establish the right of individuals and collective actors to generate, consume, share, and sell electricity, as well as to access the grid under objective, transparent, and non-discriminatory conditions. These provisions mark a fundamental shift in the energy system, recognising **citizens not only as consumers but as active market participants.**

Building on these rights and regulations, recent initiatives have focused on closing the gap between legal frameworks and practical implementation. The 2025 European Grids Package prioritises **faster and more transparent connection processes, improved planning, and more efficient use of existing infrastructure**. In particular, it emphasises the need to accelerate connections for renewable projects, including those led by energy communities, and to reduce bottlenecks in connection queues. Supporting measures promote better queue management*, digital procedures, and clearer information on available grid capacity. The 2026 Citizens' Energy Package emphasises the **need to simplify administrative procedures, promote energy sharing, and provide accessible support** to enable broader citizen participation. At the same time, the rapid expansion of renewable energy has brought increasing pressure on electricity networks. This is due to a growing number of local installations connecting at distribution level, more variable production patterns of solar and wind energy, and the increasing need to manage electricity flows to and from consumers, making grid access a central challenge to overcome.

1.2.5 Key barriers and challenges

Many actors encounter significant barriers when attempting to connect to the grid and sell electricity. These challenges can arise at different stages of the process and often interact with one another, increasing overall complexity. Table 2 provides an **overview of the main types of barriers** encountered by citizen energy actors and their consequences.

In practice, administrative and technical barriers tend to be particularly significant for households and small-scale projects, especially during the early stages of project development and grid connection. Financial barriers often become more prominent for larger or more complex installations, particularly where grid reinforcement or advanced market participation is required. Several of the case studies presented later in this document illustrate practical approaches that have been implemented across Member States to reduce these barriers through simplification, digitalisation, transparency, and organisational support.

Table 2 : Barriers and consequences to grid connection and electricity selling

Barrier Type	Description	Challenges that it poses
Administrative	Complex procedures, unclear documentation requirements, long approval timelines (queue management*)	Delays projects, increases uncertainty, discourages participation from new entrants.
Technical	Limited grid capacity, complex technical requirements, uncertainty around connection conditions (congestion/hosting capacity limits).	Limits ability to connect or export electricity, creates risk of project infeasibility.
Financial	High or unpredictable connection costs, grid reinforcement costs, upfront investment needs, and additional costs linked to electricity suppliers or intermediaries (e.g. for metering, billing, and administrative handling of electricity sales).	Affects economic viability; unexpected costs can stop projects entirely.
Market Access	Difficulty accessing remuneration schemes, complex contracts, limited market knowledge and access to data.	Prevents actors from realising financial benefits, reduces incentives to invest.
Social and Organisational	Lack of expertise, coordination challenges (especially for communities), governance complexity.	Slows down collective projects, limits scalability and inclusiveness.

2. TECHNICAL AND PRACTICAL GUIDANCE

This section provides practical guidance on how to engage with the electricity system, focusing on three key aspects:

- Understanding the **grid connection process**, including the main steps and actors involved.
- Navigating **technical requirements**, such as equipment standards, metering, and connection conditions.
- **Selling electricity**, outlining the main pathways through which surplus energy can be remunerated.

2.1 Understanding the grid connection process

Connecting a renewable energy installation to the grid is a structured process involving a sequence of technical and administrative steps. While specific procedures, timelines, and requirements vary across Member States, the overall logic of the process is broadly consistent across the EU. Depending on the size and complexity of the installation, the process may take anywhere from a few weeks for simplified small-scale systems to several months for larger projects requiring detailed technical assessments or grid upgrades.

This section provides a clear, step-by-step overview of how to connect to the grid, outlining what actions need to be taken and which actors are involved at each stage. In practice, some stages are driven primarily by the applicant (such as initial planning, submitting documentation, and installation), while others depend largely on the DSO (such as grid-capacity assessment, issuing the connection offer*, and final commissioning). While the steps presented here are generic, they offer a practical framework that can help prosumers and energy communities understand what to expect and how to approach the process in their specific context.

1. Initial planning and information gathering

Before formally initiating a grid connection request, it is important to **define the project and assess its feasibility**, including an initial understanding of local grid conditions. This step may be naturally preceded by a separate permitting process.

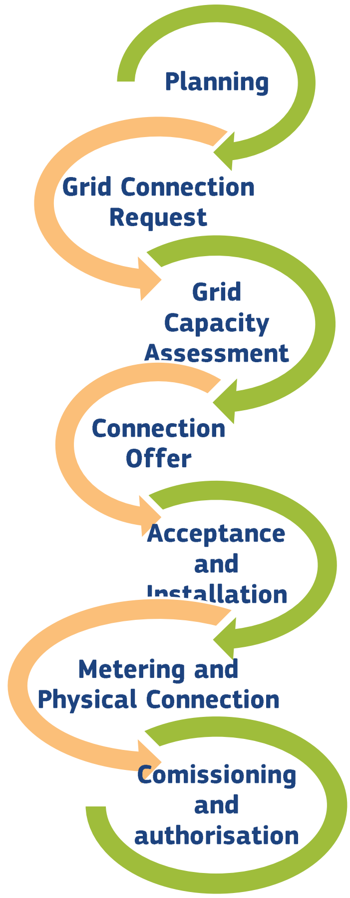
At this stage, the prosumer or energy community defines the main characteristics of the installation, including its technology, planned capacity, and location. This **initial definition** helps determine the scale and complexity of the connection process. At this stage, it is also important **to determine whether a new or upgraded grid connection is required**, or whether the installation can be accommodated within an existing connection point*, as is often the case for small-scale rooftop PV systems. This distinction has important implications for the complexity, cost, and duration of the connection process.

A key element of this step is carrying out a **preliminary assessment of the local grid.** Increasingly, DSOs provide publicly available information (such as hosting capacity maps, connection guidelines, or online portals) that allows users to estimate whether the local network can accommodate additional generation/feed-in of electricity, which is especially relevant in the planning of larger renewable energy installations. Reviewing this information is a useful first step and can help identify potential constraints early on.

In parallel, it is advisable to **consult installers or technical advisors** to assess the technical feasibility of the installation and refine project parameters. Many Member States also provide support through **one-stop shops, municipal energy offices, or national information platforms**, which can guide first-time applicants through the process. Early engagement with both publicly available information and relevant experts can significantly reduce the risk of delays or unexpected costs.

▲ **Check early:** Consult available DSO capacity maps, connection guidance or online portals before finalising the location and size of the installation.

Figure 4: Grid connection process



2. Submitting a grid connection request

Once the project has been defined, a **formal application** must be submitted to the relevant DSO. The prosumer or energy community provides the technical and administrative information required to assess the proposed connection. Although requirements vary across Member States and DSOs, applications typically include the location, technology and planned capacity of the installation, technical information on the equipment and connection, and details of the applicant and installer. In many Member States, this process is facilitated through standardised forms or digital platforms, which streamline submission and improve transparency.

▲ **Avoid delays:** Check the documentation and technical information required by the DSO before submitting the connection request.

3. Grid capacity assessment

Following submission, the **DSO evaluates whether the local grid can accommodate the proposed installation**. At this stage, the applicant typically awaits the outcome of the DSO's technical assessment and may need to provide additional information if requested. The DSO assesses factors such as existing grid capacity*, current and projected demand, and the cumulative impact of other connected or planned installations. This evaluation determines whether the installation can be connected under existing conditions or whether additional measures are required.

Possible **outcomes** include:

- Direct approval of the connection.
- Connection subject to technical conditions (e.g. limits on electricity export).
- The need for grid reinforcement* or upgrades before connection.

▲ **Understand the outcome:** If the connection is subject to conditions or grid reinforcement, ask the DSO how these requirements may affect the project's design, cost and timeline.

4. Connection offer

Based on the results of the assessment, the **DSO issues a formal connection offer**. The applicant receives and reviews the connection offer, which outlines:

- The technical conditions for connection, such as the connection point and permitted export capacity.
- The scope of any required works, such as changes to cabling, metering or protection equipment.
- Connection costs.
- Expected timelines.

- Any limitations or operational constraints, including restrictions on the amount of electricity that can be exported.

This step represents a key decision point. The applicant must assess whether the proposed conditions are acceptable and whether the project remains economically viable. In some cases, it may be necessary to adjust the project design (e.g. reducing capacity) in response to the conditions outlined.

> ▲ **Review before accepting:** Check how the connection costs, required works, timelines and any export limitations affect the project's technical and financial viability.

5. Acceptance and installation

If the connection offer is accepted, the project moves into the **implementation phase**. The applicant formally accepts the connection conditions and proceeds with the installation of the renewable energy system. This includes installing generation equipment (e.g. solar panels), inverters*, and protection systems in accordance with the technical specifications provided by the DSO.

Ensuring compliance with these specifications is essential to guarantee the safe and reliable operation of the installation within the grid. At this stage, coordination between the project owner and the installer is particularly important. The DSO confirms the connection requirements and relevant milestones, while the installer ensures that the installation is designed and completed accordingly.

> ▲ **Coordinate responsibilities**: Before installation begins, ensure that the project owner, installer and DSO have a shared understanding of the technical requirements, responsibilities and connection milestones.

6. Metering and physical connection

Before the installation can begin operating, **appropriate metering and physical connection** to the grid must be completed. A key requirement is the installation or configuration of a smart meter capable of accurately measuring both electricity consumption and electricity exported to the grid. This is **essential for billing, monitoring, and remuneration purposes**. The installation is then physically connected to the distribution network.

> ▲ **Clarify responsibility**: Check early whether the DSO, electricity supplier or applicant is responsible for installing or upgrading the meter.

7. Commissioning and authorisation

The final stage ensures that the installation meets all technical and safety requirements before entering operation. The system undergoes testing and verification to confirm compliance with applicable standards. This may include **checks on safety systems, grid compatibility, and overall performance**. Once these checks are completed, the installation is formally authorised to operate. The prosumer or energy community can then consume electricity generated on-site and export any surplus to the grid. Depending on national rules and the project configuration, self-consumption within a single site may follow different requirements from energy sharing between buildings or members connected through separate meters. The applicable arrangements should therefore be clarified with the DSO before operation begins.

- ▲ **Confirm before operating:** Check with the DSO when self-consumption, grid export and, where relevant, energy sharing between users connected through separate meters may begin.

2.2 Navigating technical requirements

When connecting a renewable energy installation to the grid, meeting the technical requirements set by the DSO is a fundamental part of the process. These requirements are designed to **ensure that the installation operates safely and does not negatively affect the stability or reliability** of the wider electricity network. While the specific standards vary between Member States, the core principles are broadly consistent across the EU. As such, the list below provides some general directions on the key requirements for grid connection processes.

Detailed technical requirements are typically published by DSOs on their websites or connection portals, often in the form of technical guidelines or connection codes*. In practice, these requirements are usually **implemented by certified installers or engineering professionals**, who ensure that the installation complies with applicable standards.

- **Inverter and protection systems:** For solar photovoltaic installations the inverter is the **central technical component**. It converts the direct current produced by solar panels into the alternating current used by the grid.

Inverters must comply with applicable standards (such as EN 50549[1] in Europe) to ensure they respond correctly to changes in grid frequency and voltage and disconnect safely in the event of a fault. **Protection systems**, including anti-islanding protection, prevent the installation from continuing to export electricity to the grid during a power outage.

▲ **Check equipment compatibility**: Ensure that the installer selects an inverter and protection systems certified for use under the applicable DSO requirements.

- **Metering requirements:** A smart meter capable of **measuring both consumption and export** is a prerequisite for grid connection in many Member States. This bidirectional metering enables accurate recording of how much electricity is exported to the grid, directly shares this information with responsible entities, and forms the basis for any payment received.

  ▲ **Clarify responsibility:** Check whether the DSO, electricity supplier or applicant is responsible for providing, installing or upgrading the meter, and confirm that it can measure electricity flows in both directions.

- **Connection point and cable sizing:** Depending on the capacity of the installation, the connection may be made at the low-voltage or medium-voltage level of the distribution network. For most residential and small commercial installations (typically up to 10-15 kW), a low-voltage connection to the existing household supply point is standard. Larger installations may require a dedicated connection point (that is, a separate physical connection to the network where the existing connection cannot safely accommodate the installation) and appropriately sized cabling. The **DSO's connection offer will specify the technical parameters** of the connection, including any limitations on the maximum export capacity permitted.

  ▲ **Check the connection conditions:** Confirm whether the existing connection can accommodate the installation or whether a dedicated connection point, additional cabling or other works will be required.

- **Export limitations and dynamic operating modes:** Where the local grid cannot safely accommodate all the electricity produced, the **DSO may limit the amount that can be exported**. The remaining electricity must be consumed when it is generated, stored for later use, or not produced.

  ▲ **Check the financial impact:** Ask the DSO whether export limitations* may apply and assess whether increasing on-site consumption, adding storage or adapting the installation size could keep the project viable.

- **Certification and compliance:** All equipment used must typically be **certified and meet applicable European or national product standards.** Installers should be appropriately qualified, and in many Member States, only certified professionals are permitted to carry out the electrical connection work. Keeping documentation of equipment certifications and installation records is advisable, as these may be required during the DSO's commissioning inspection.

  ▲ **Keep the documentation:** Retain equipment certificates, installer declarations and installation records, as these may be required before the installation is authorised to operate.

2.3 Selling electricity and other remuneration pathways

Once an installation is connected to the grid and surplus electricity begins to be exported, the question of **how that electricity is remunerated** becomes central. In addition to direct payment or compensation for exported electricity, citizen energy actors may also obtain value by participating in energy sharing, aggregation or flexibility services, depending on national regulation, metering arrangements and market design. The most appropriate option will depend on national regulation, the size and type of the installation, and the actor's capacity to engage with more complex market arrangements.

[1] EN 50549 is a European standard specifying the technical requirements for connecting generating installations to distribution networks, including rules related to voltage, frequency response, protection systems, and safe operation.

Pathway	How it works	Main targets	Complexity	Key advantage	Key limitation
Net metering/ Net billing*	Surplus is discounted against the bill. Net metering offsets in kWh; net billing credits in € (price-based)	Households and small prosumers	Low	Simple and accessible entry point, reduces payback time	Not available in all countries; credit value depends on national design (often lower than retail price)
Feed-in tariffs/ Premiums*	Export remunerated at a fixed tariff (FiT) or market price + premium (FiP)	Small to medium installations, some community projects	Low-Medium	Stable and predictable revenues	Schemes are being reduced or redesigned in some countries
Power Purchase Agreements (PPAs) *	Long-term contract with a buyer (or supplier) at an agreed price/structure	Medium to large projects, communities with legal/contracting capacity	Medium-High	Revenue certainty over longer periods	Requires negotiation and administrative capacity
Wholesale market participation*	Electricity is sold directly on energy markets. Small actors typically access via aggregation/supplier arrangements	Large producers or aggregated small actors	High/Low (if done through an aggregator)	Access to market-based revenues.	Requires forecasting, scale, and market expertise
Energy sharing through an energy community*	Electricity is shared among members of the community, reducing their bills	Energy communities	Low-Medium	Maximises local value of electricity and can include tenants/non-owners	Requires organisational structure and enabling regulation
Peer-to-peer (P2P) energy sharing*	Platform-enabled allocation/sale between individuals (often local), with national rules determining how electricity is measured, allocated and reflected in participants' bills or payments	Prosumers in pilots or advanced frameworks	Medium-High	No need for a separate legal entity; Potentially higher value	Still emerging; often limited in who can participate
Flexibility services*	Participants are rewarded for adjusting consumption, storage, generation or export in response to price signals or grid needs. This is often done via an aggregator or flexible retail contract.	Prosumers and energy communities	Medium-High	Creates additional value beyond exported electricity and can reduce congestion and system costs	Requires smart meters, data access, aggregation or suitable contracts. Also, availability of these services varies across Member States.

3. CASE STUDIES AND PRACTICAL APPLICATIONS

The following case studies present **concrete and transferable examples of how grid connection and electricity-related procedures can be simplified in practice.** While the specific arrangements may not apply in all countries, they illustrate how grid-connection procedures can be made more accessible and efficient. Each case includes practical points for citizen energy projects to check whether similar tools, procedures or support are available in their own context.

The cases cover:

1. **Aggregating grid connections through energy communities** – Belgium (Ecopower) and Spain (Som Energia)

2. **Simplifying grid connection through digital portals and capacity information** – France "Enedis Connect" and Estonia "Elektrilevi"
3. **Improving planning through grid capacity maps** – Austria (Österreichs Energie)
4. **Fast-track connection for small-scale installations** – Germany (Plug-in Balcony PV) and Portugal (Simplified UPAC Regime)

3.1 Aggregating grid connections through energy communities – Belgium (Ecopower[2]) and Spain (Som Energia[3])

In a nutshell: Energy communities in Belgium and Spain have developed **organisational solutions to manage grid-connection procedures collectively**, acting as a single intermediary between citizens and the DSO.

Key challenge: For community-based projects, the main challenge is not technical feasibility but repeatedly **navigating complex and resource-intensive procedures** for multiple small installations.

Context and key actors: The case focuses on cooperatives such as Ecopower (Belgium) and Som Energia (Spain). The key actors are:

- **Energy communities** acting as project developers and intermediaries.
- **Individual citizens** participating as members.
- **DSOs** processing grid-connection applications.

Actions taken: These cooperatives have **centralised and professionalised the grid-connection process,** submitting applications on behalf of their members and using standardised documentation. Over time, they have developed structured and stable working relationships with DSOs, allowing for smoother and more predictable interactions.

Figure 5: Community Energy Project

Source: Tierra.org

Outcome and results: This model **reduces administrative complexity by aggregating demand and building procedural expertise.** It lowers the burden on individual citizens while also benefiting DSOs, who interact with a single experienced counterpart instead of multiple one-off applicants.

Replication potential: The approach is particularly relevant in contexts where procedures remain complex. Its **replication depends on the presence of strong intermediary organisations**, highlighting that organisational capacity can be as important as regulatory reform in enabling citizen energy.

▲**What to check in your context:** If grid connection is difficult to navigate, citizen energy projects should check whether an established energy community, cooperative, energy agency or other intermediary can provide technical or administrative support. They may also consider cooperating with nearby projects or energy communities to share expertise, coordinate relevant steps where appropriate and engage more effectively with the local DSO.

3.2 Simplifying grid connection through digital portals and capacity information – France "Enedis Connect" and Estonia "Elektrilevi"

In a nutshell: France and Estonia provide examples of how digital tools can simplify grid-connection procedures for small producers. In France, Enedis allows applicants to submit and follow connection requests through an online account. In Estonia, Elektrilevi provides a self-service portal for producer connections and an available-capacity map to support early project planning.

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[2] Investing in renewable energy together · Ecopower

[3] Som Energia. Esto no va de luz.

Key challenge: Grid-connection procedures can be difficult for non-expert users when requirements are unclear or too complex. This can lead to incomplete applications, delays and uncertainty. Digital portals and upfront capacity information help reduce this by making the process more transparent and standardised.

Context and key actors: The case combines two DSO-led examples: Enedis in France and Elektrilevi in Estonia. The key actors involved are:

- **Enedis** and **Elektrilevi** as the DSOs responsible for processing connection requests.
- **Citizens and small producers** (e.g. rooftop PV owners) submitting applications.
- **Public authorities** setting the regulatory framework within which the process operates.

Actions taken: In France, Enedis provides an **online connection account** where users can submit and follow their request for connection to the public electricity network. For production installations, applicants can create a connection account, submit the required documents online, receive the technical and financial proposal through the account, and proceed towards commissioning once works and compliance documentation are completed. In Estonia, Elektrilevi similarly allows producer-connection applications to be submitted through a **self-service portal** and classifies producers according to size, with different procedures, charges and indicative timelines. Elektrilevi also provides a map of available capacities, allowing applicants to check areas with more than 200 kW of available capacity before applying.

Outcome and results: These approaches improve **transparency and predictability** for applicants by allowing them to submit documentation and track the connection process more easily. In Estonia, the categorisation of producers also helps make procedures more proportionate. For example, Elektrilevi indicates a four-business-day connection offer for nano-producers and 30 days for certain small producer categories, while larger or more complex cases may require longer assessment and additional costs.

Replication potential: The model is **widely replicable** because it relies primarily on process digitalisation and better access to information rather than on major changes to the physical grid. The examples show that user-oriented digital platforms can reduce administrative burden and make grid access more accessible for non-expert users.

▲**What to check in your context:** Citizen energy projects should check whether their DSO provides an online portal through which connection requirements can be reviewed, applications submitted and progress tracked. National guidance, DSO websites, one-stop shops and energy agencies may also provide information on the documentation, timelines and costs applicable to different types of installation. Where digital tools are available, using them from the outset can help avoid incomplete applications and identify potential constraints early.

3.2 Improving planning through grid capacity maps – Austria (Oesterreichs Energie)[4]

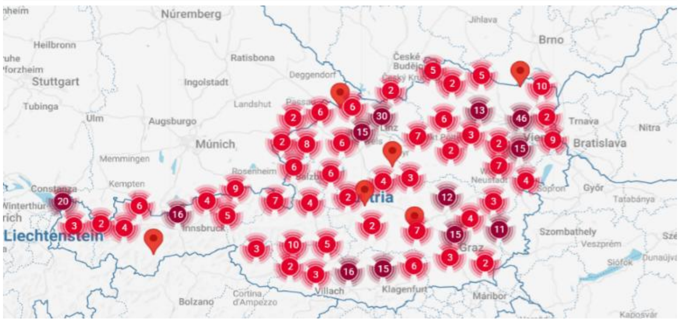
In a nutshell: Austria has introduced a **publicly accessible grid-capacity map**, allowing users to assess the likelihood of connection before submitting a formal request.

Key challenge: Applicants often **lack upfront information on grid capacity**, leading to speculative or unsuccessful connection requests and unnecessary administrative burden.

Context and key actors: The case takes place in Austria and focuses on distribution-level capacity. The key actors include:

- **DSOs** providing and updating capacity data.
- The **industry association** (Oesterreichs Energie) coordinating the initiative.
- **National legislators** mandating transparency requirements.

Figure 6: Screenshot of grid capacity map



Source: Oesterreich Energie

[4] Service: Grid operators publish map of free grid capacities: Oesterreichs Energie

Actions taken: A national **grid-capacity map was developed and made publicly available**, showing indicative available capacity at substation level and updated regularly. This provides users with early-stage information before initiating a formal connection request.

Outcome and results: The map **improves project planning and decision-making**, reducing the number of unviable applications and improving the overall efficiency of the connection process. It benefits both applicants and DSOs by lowering uncertainty and administrative workload.

Replication potential: The approach is **broadly replicable**, provided there is legal backing for transparency and clear communication of data limitations. It demonstrates that access to information is a key enabler of more efficient and user-friendly grid access.

⚠ **What to check in your context:** Citizen energy projects should check whether the relevant DSO, regulator or national energy authority publishes a grid-capacity or hosting-capacity map. Where such information is available, it should be consulted early when selecting the project location and size. Projects may be able to adapt their location, capacity or design to reflect available network capacity, but the applicable conditions should always be confirmed with the DSO before final investment decisions are made.

3.3 Fast-track connection for small-scale installations – Germany (Plug-in Balcony PV[5]) and Portugal (Simplified UPAC Regime[6])

In a nutshell: Germany and Portugal have introduced **simplified connection regimes for small-scale installations**, allowing very small systems to connect through notification or light registration procedures rather than full approval processes.

Key challenge: Traditional **grid-connection procedures were not proportionate to the scale** and impact of small installations, creating unnecessary administrative burden and slowing down deployment.

Context and key actors: This case focuses on small self-consumption systems in Germany and Portugal. The key actors include:

- **Citizens** installing small-scale PV systems (e.g. balcony or rooftop installations).
- **DSOs** responsible for maintaining grid oversight.
- **National regulators** designing and implementing simplified frameworks.

Actions taken: Both countries introduced clear capacity thresholds that determine the level of administrative requirements. **In Germany, plug-in PV systems can be connected through a simple notification** process without prior approval. **In Portugal, a graduated regime applies**, where installations are subject to exemption, notification, or registration depending on their size. These approaches explicitly recognise that very small systems have limited impact on the grid and do not require full technical assessment.

Figure 4: Balcony PV installation in Germany

Source: Euronews

Outcome and results: These measures have **significantly reduced connection times and administrative effort** for small actors, while allowing DSOs to focus their resources on more complex cases. They have also enabled rapid uptake of small-scale PV, particularly in the case of plug-in systems in Germany, where over 1.2 million units are in use.

Replication potential: The approach is **highly replicable**, if regulators define appropriate thresholds and accept proportionate risk management. It shows that regulatory design can be as important as technical capacity in enabling citizen participation, and that simplifying procedures for low-impact installations can unlock large-scale deployment.

⚠ **What to check in your context:** Citizen energy projects should check whether simplified, notification-based or fast-track procedures apply to installations below specified

[5] Federal Network Agency - Homepage - Balcony Solar Systems

[6] Energy Production for Self-Consumption | E-NETWORKS

capacity thresholds in their Member State. They should assess whether the planned installation falls within these thresholds and whether its size or configuration could reasonably be adapted to benefit from a simpler procedure. Any adjustment should continue to reflect the project's expected generation, consumption needs and financial viability.

4. RECOMMENDATIONS AND CALL FOR ACTION

Building on the practical guidance and case studies presented above, this section **translates key insights into targeted actions for the main actors** involved in grid connection and electricity market participation. The recommendations focus on **what each actor should do at different stages of the process** - from early project planning to connection and electricity selling - to reduce administrative complexity, improve transparency, and enable broader participation in citizen energy.

Prosumers and Energy Communities

To successfully connect installations and access remuneration, prosumers and energy communities should take a proactive and informed approach throughout the process:

- At the **planning stage**:
    - **Consult** grid capacity maps and publicly available DSO data before selecting a site or defining project size.
    - **Clarify** early whether the installation can be connected through an existing connection point or requires a new one.
    - **Seek** guidance from installers, energy agencies, or one-stop shops to assess technical and financial feasibility.
- When **applying for a connection**:
    - **Use** digital portals and standardised procedures where available.
    - **Ensure** that applications are complete and accurate from the outset to avoid delays.
    - **Make use** of simplified or fast-track procedures for small installations where applicable.
- During **installation and connection**:
    - **Work** with certified installers familiar with DSO requirements.
    - **Ensure** compliance with technical standards (e.g. metering, inverter settings, protection systems).
    - **Coordinate** timelines closely with DSO processes.
- When **selling electricity**:
    - **Select** remuneration schemes that match the scale and complexity of the project.
    - **Consider** working with aggregators or service providers to access markets.
    - **Evaluate** administrative and contractual requirements before engaging in more complex arrangements.

Distribution System Operators

As the main interface for grid connection, DSOs play a central role in enabling or constraining access. Prosumers and energy communities should be able to expect:

- At the **planning stage**:
    - **Publication** of hosting-capacity maps or equivalent grid information.
    - **Pre-application guidance** explaining procedures, timelines, indicative costs, and technical requirements.
    - **Contact points** for early-stage enquiries and clarification.
- During **application and assessment**:
    - **Digital platforms** for submitting and tracking applications.
    - **Standardised** documentation requirements and harmonised procedures where possible.
    - **A single point of contact** for each application to facilitate communication.

    - **Clear** timelines, milestones, and decision points throughout the process.
    - **Proportionate** treatment of small installations, avoiding unnecessary administrative burdens.
- During **connection and operation:**
    - **Technical specifications** presented in a clear and user-friendly format.
    - **Streamlined** inspection and commissioning procedures.
    - **Predictable timelines** for connection works and meter installation.
    - **Transparent** communication regarding export limitations, dynamic operating modes, or reinforcement needs.
- For **market integration**:
    - **Access** to metering and consumption/export data.
    - **Increasing** use of digital tools and flexible connection approaches where appropriate.

<u>Regulators and National Authorities</u>

Regulators have a key role in ensuring that frameworks are proportionate, transparent, and enable participation. Prosumers and energy communities should expect:

- On **connection procedures**:
    - **Transparent** and accessible connection procedures.
    - **Simplified** and proportionate requirements for small-scale installations, including notification-based regimes where appropriate.
    - **Monitoring** of DSO performance on timelines, transparency, and user accessibility.
- On **planning and transparency**:
    - **Publication** of usable and regularly updated grid-capacity information where feasible.
    - **Standardisation** of procedures across regions and DSOs.
    - **Guidance** on remuneration schemes, energy sharing, and market participation pathways.
- On connection, **electricity selling and participation**:
    - **Transparent** and cost-reflective connection charges.
    - **Reasonable** timelines for application processing and physical connection.
    - **Requirements** (administrative/contractual) adapted to the capacities of small actors.
    - **Predictable** remuneration frameworks for exported electricity and flexibility services.

<u>Aggregators and Service Providers</u>

Aggregators, suppliers, installers, and other service providers act as intermediaries that help small-scale actors navigate requirements. Prosumers and energy communities should expect:

- **Accessible support** for market participation and compensation.
- **Clear and transparent** contractual conditions adapted to small-scale actors.
- **Aggregation models** that reduce the administrative and technical burden of direct market participation.
- **Support** in understanding technical requirements and data management obligations

<u>Local and Regional Authorities</u>

Local actors can play an important supporting role in facilitating projects and coordinating stakeholders. Depending on their competences and available resources, relevant actions may include:

- **Integration** of grid-capacity considerations into spatial planning, SECAPs, and local energy and climate plans.
- **Alignment** between local permitting procedures and expected grid-connection timelines.
- **Access** to local advisory services such as energy agencies, one-stop shops, or municipal facilitation services.
- **Support** in coordinating with DSOs and other local stakeholders where relevant.
- **Information** on available support schemes, procedures, and local energy opportunities.
- **Availability** of municipal data (e.g. rooftops, land use, public buildings) that can support project development and planning.

Annex 1 – Table of Technical Terms

Term	Definition
Active customer/ prosumer	An electricity consumer who also generates electricity (e.g. via rooftop PV), self-consumes part of it, and may store, share or sell surplus electricity.
Aggregator	A market actor that combines multiple small-scale consumers and producers to enable participation in electricity markets or provision of flexibility services.
Behind the meter	Electricity generation, consumption, and storage occurring on the customer's side of the meter, prior to any exchange with the grid.
Bidirectional flows	Electricity flows that move both from the grid to users and from users back to the grid, reflecting decentralised generation.
Capacity constraint	A limitation arising when part of the electricity network cannot safely accommodate additional electricity consumption or generation.
Connection codes	A set of technical rules and requirements established by the relevant system operator or authority that an installation must meet to connect to and operate safely within the electricity grid.
Connection offer	A formal proposal issued by the DSO specifying the technical conditions, costs, required works, and timelines for connecting an installation.
Connection point	The physical interface where an installation is connected to the electricity network.
Connection requirements	The technical conditions defined by the DSO that installations must meet to connect safely.
Connection requirements	The technical conditions defined by the DSO that installations must meet to connect safely.
Distribution grid/network	The medium- and low-voltage network that delivers electricity to end users and connects decentralised generation.
Distribution system operator (DSO)	The entity responsible for operating, maintaining, and developing the distribution network, and for managing most grid connections for small and medium installations.
Electricity grid	The interconnected system of transmission and distribution networks, including lines, substations, and control systems, that transports electricity from generation to consumption.
Energy community	A legal entity through which citizens, SMEs, or local authorities collectively engage in energy activities such as generation, sharing, or supply, with a focus on local benefits.
Energy sharing	The allocation of electricity produced by one or more installations among a group of users, typically to maximise local use and reduce energy costs.
Export limitation	A restriction imposed by the DSO on the maximum amount of electricity that an installation can export to the grid, usually because of limited local network capacity.
Feed-In Premium (FiP)	A support mechanism where electricity is sold at market price with an additional premium payment.
Feed-In Tariff (FiT)	A support scheme providing a fixed price per kWh for electricity exported to the grid, typically guaranteed over a defined period.
Flexibility services	Services that adjust electricity generation or consumption in response to grid needs, helping maintain balance and avoid congestion.

Grid capacity	The estimated additional generation capacity that can be connected at a given location without breaching technical limits.
Grid capacity assessment	The technical evaluation performed by the DSO to determine whether and how a new installation can be connected.
Grid congestion	A situation where network capacity is insufficient to accommodate additional electricity flows without constraints or upgrades.
Grid injection	The export of electricity from a generation installation into the network.
Grid reinforcement	Physical modifications to the network required to increase capacity or maintain reliability.
Inverter	A device that converts direct current (DC) electricity into alternating current (AC) and ensures compliance with grid requirements.
Local transformer	Equipment that reduces voltage from medium to low levels for distribution to end users.
Low-voltage network	The final layer of the distribution system supplying households and small consumers.
Medium-voltage network	The part of the distribution network supplying larger users and feeding local transformers.
Metering system	The equipment used to measure electricity consumption and export for billing and settlement purposes.
Net billing	A scheme where exported electricity is compensated financially, typically at a predefined rate.
Net metering	A scheme where exported electricity offsets consumption on an energy basis (kWh).
Non-firm (flexible) connection	A grid connection allowing access under certain conditions, where export may be limited or curtailed instead of requiring immediate grid reinforcement.
Peer-to-peer (P2P) energy sharing	Direct exchange or sale of electricity between users, typically enabled by digital platforms.
Power purchase agreement (PPA)	A contractual arrangement for the sale of electricity at agreed terms, often over a long duration.
Queue management	The process used by system operators to organise, assess and prioritise grid-connection requests when several projects seek access to limited network capacity.
Self-consumption	The use of electricity generated on-site to meet local demand before exporting any surplus.
Smart meter	A device capable of measuring electricity flows in both directions and enabling detailed consumption and export data.
Substation	A facility that transforms voltage levels and manages electricity flows within the network. A step-up substation increases voltage so electricity can be transported efficiently over long distances, while a step-down substation reduces voltage before electricity enters the distribution network and is supplied to end users.
Surplus electricity	Electricity generated in excess of on-site consumption and available for export or sharing.
Transmission network	The high-voltage network transporting electricity over long distances.
Transmission system operator (TSO)	The entity responsible for operating and maintaining the high-voltage transmission network and ensuring system-wide balance.
Wholesale market participation	The sale of electricity through organised markets, typically requiring aggregation for small actors.

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