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*International Smart Grid Action Network (ISGAN)*

# Concepts of flexibility provision by local resources

## Working Group 9: Flexibility Markets

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Electrification of energy demand (particularly in heating and mobility) alongside the rapid proliferation of distributed generation (especially rooftop PV) is presenting significant challenges to distribution system operators (DSOs). Most distribution grids were not typically designed to accommodate the increased, and especially the bidirectional, power flows. To reduce the need for costly and extensive network extensions and to gain planning time by deferring them, new approaches that actively involve end users are being introduced. These concepts work by utilizing the flexibility of end-user resources, either directly or indirectly, by managing network loading (e.g., branch currents) and ensuring operational feasibility through measures such as voltage regulation. Belgium has introduced innovative variable (Wallonia) and capacity-based (Flanders) tariffs at lower grid levels, aiming to better align energy costs with real-time usage and capacity demands; this is also foreseen in Austria with a new, currently pending, electricity law. In Switzerland, various utilities are developing and progressively introducing tariff schemes that motivate their customers to reduce their peak power withdrawals and injections and/or shift them in time. At the same time, Peer-to-Peer (P2P) energy sharing is gaining momentum, allowing individuals and communities to trade energy directly. In Austria, the rise of energy communities is empowering local groups to generate, consume, and share energy autonomously. In the United Kingdom and the Republic of Korea, flexibility programs (demand response programs and renewable energy curtailment schemes are in place, "flexible connection agreements" cannot yet be considered institutionalized) are becoming increasingly popular. These initiatives enable consumers to adjust their energy consumption in response to grid signals, enhancing grid stability and optimizing the use of existing infrastructure. Parts of Canada have adopted variable tariff structures to better use grid resources, e.g., reducing demands during peak periods and encouraging overnight charging of electric vehicles (EVs) and heating. Japan has so far mainly maintained a grid reinforcement–centered policy approach; VPP and demand response demonstration projects are also being actively pursued. These diverse approaches underscore a global trend toward more adaptive and sustainable energy systems.

On the one hand, some countries prioritise user engagement through open market mechanisms, which, in principle, allow the most efficient solutions to prevail in a non-discriminatory manner. In the European context, regulations (2019/943) explicitly call for the adoption of market mechanisms to procure flexibility from network customers, where feasible. On the other hand, since violations[1] at the distribution grid level are often highly localised, the liquidity of generic market mechanisms can pose a challenge, since specific grid violations can be resolved by a limited number of connected customers.

The concept of a "local flexibility market" for local congestion management is gaining significant attention and interest within the energy sector. In this document, we aim to examine and classify various mechanisms for local flexibility provision by relating them to the broader and more generic concept of a "local flexibility market".

To accurately categorise and understand the various existing concepts of flexibility provision, particularly when defining the terms "flexibility market" or "local flexibility market", several key aspects must be carefully considered.

A **market** is traditionally understood as any structure that allows buyers and sellers to exchange any type of goods, services, and information. Another common definition describes it as *"the meeting of supply and demand, through which prices are established in the case of a trade"*[2]. We consider this rather broad definition to apply to all existing concepts in Table 1, including tariffs, where the "good"[3] being exchanged can be understood as the right or ability to use the grid for transporting purchased energy. When many consumers seek to use the grid simultaneously, the increased demand for grid capacity drives up the price of this "good", which can be reflected in (variant) capacity-based tariff components but also variant energy-based charges. In this way, tariffs can be seen as part of a market-like structure that responds to supply and demand dynamics. However, the extent to which tariffs function as market mechanisms depends heavily on their design. Key factors such as temporal or spatial granularity play a crucial role. Poorly designed tariffs may inadvertently lead to demand synchronization¸ where many users respond in the same way at the same time, leading to new peak loads rather than smooth market-based responses.

[1] A violation ocurre when the operating conditions (eg. voltage, current, or power factor) exceed their permissible limits. These indicate parts of the grid that are running outside safe or regulatory standards. This can potentially affect reliability and power quality.

[2] https://en.wikipedia.org/wiki/Price_mechanism

[3] A „good" can be either a sevice or product

*Table 1: Flexibility concepts and their categorization*

| Mechanism/Type of Flexibility Market | Price (customer perspective) | Triggers explicit or implicit flexibility | Voluntary or involuntary participation | Amount | Local or national |
|---|---|---|---|---|---|
| Local (DSO) Flex-Market | Price input option | Explicit | Voluntary | Can be chosen | Local |
| TSO-DSO Flex market (see WG6[4]) | Price input option | Explicit | Voluntary | Can be chosen | Local or national |
| Demand Response Programs | Price Given | Explicit | Voluntary | Automatically defined | Both |
| P2P Trading | Price input option | Implicit | Voluntary | Can be chosen | Both |
| Energy Communities | Price input option | Implicit | Voluntary | Automatically defined | Local |
| Flexible Connection agreements | Price Given | Implicit | Can be both | Automatically defined | Local |
| Variable Grid Tariffs | Price Given | Implicit | Involuntary | Automatically defined | Both |

The following factors, which are both debatable and distinguishing have been identified as key features in defining flexibility concepts and are classifying categories in Table 1:

- **Price input option or price given:** A price input option allows participants to set or bid their own price for providing flexibility, while a price given means the price is fixed or predefined by the market operator. For example, with tariffs or flexibility programs, the prosumer must accept a predetermined price. In contrast, in DSO-Flex-Markets or peer-to-peer (P2P) trading, the prosumer can set a price for the energy they offer. In energy communities, pricing structures depend heavily on the community's organizational structure. Customized pricing agreements can be arranged via energy communities or P2P agreements, however, many larger energy communities now operate on a more standardized basis, where participants simply join and receive a predefined price. However, this distinction does not determine whether or not the concept constitutes a market, according to the broad definition outlined above.

[4] https://www.iea-isgan.org/our-work3/wg_6/

- **Explicit or implicit flexibility:** Explicit flexibility refers to clearly defined flexibility products with a specific quantity and price, which can be traded on markets (e.g., flexibility products in DSO-Flex-Markets). Implicit flexibility, in contrast, occurs when incentives trigger flexible behavior without being structured as a product with a defined volume and price. Examples include tariff structures or participation in energy communities, where prosumers adjust consumption or production based on incentivizing signals rather than trading explicit flexibility units.
- **Voluntary or involuntary participation:** Voluntary participation refers to the case where participants choose freely whether to provide flexibility, while involuntary participation means they are required or automatically obligated to do so under certain conditions or agreements. Usually market-based participation as well as contracted flexibility is voluntary, in the case of tariffs, this is not necessarily true, unless the consumer/user chooses to become energy self-sufficient and disconnect from the grid. While voluntary participation is not a strict requirement, since many essential goods are traded in markets regardless, there is often an element of choice. Specifically, customers frequently have the option to select from a range of tariff schemes, which introduces a degree of voluntary participation within the overall system.
- **Decision about quantity to be traded:** The decision about quantity to be traded refers to whether participants can freely choose how much flexibility to offer or if the quantity is predetermined by the conditions. In all concepts, this can be indirectly controlled by consuming or injecting more or less. In the specific case of energy communities, any surplus is automatically distributed to other households according to a fixed distribution key, meaning the amount is predetermined. However, the prosumers can still self-determine the price at which they sell excess energy to each neighbor.
- **Local vs. national flexibility concepts:** In the context of this fact sheet, both are addressing local grid needs, but local markets procure flexibility within a specific area or network zone (i.e. via a DSO), whereas system-wide mechanisms can also be designed to resolve local issues. While variable grid tariffs often aim to reduce local grid congestion, they typically apply across larger grid areas. This is because network constraints often arise from generation and consumption patterns that are similar across different locations within a wider region, making system-wide flexibility measures effective even if they are locally motivated.

When discussing a flexibility market, the concept appears to become more specific. It can be defined as a market, in which flexibility, considered as a product, is exchanged. However, the term "flexibility" in the sense of a product remains loosely defined and lacks a universally accepted, precise definition. In the EU-context it is defined as *"the ability of an electricity system to adjust to the variability of generation and consumption patterns and to grid availability, across relevant market timeframes"* (Art. 2(79) EMDR). We interpret flexibility as a system's ability to adapt to changes in energy supply and demand, such as shifting consumption or generation in response to external signals. Therefore, even markets where flexibility is not explicitly traded but where actions or signals are designed to prompt flexible responses could be considered flexibility markets. In such cases, flexibility may not need to be a traded commodity in a formal sense, but the goal is to incentivize or enable flexible behavior. In EU-established wholesale markets, such as those operating on the day-ahead market output schedule (e.g., intraday and balancing markets), these can be considered flexibility markets where, traditionally, flexibility was procured primarily from large power plants. However, dedicated flexibility products need to be developed to address specific requirements for network operation. These requirements may include parameters such as minimum size, response time, procurement timeframe (e.g., real-time, day-ahead, or long-term), what is procured: capacity (availability), and/or activation. The concept of a **local flexibility market** introduces an additional layer, where the local aspect is key, i.e. the benefits are more local. In ACERs draft of the NC DR[5], local markets are defined as *markets to solve congestion issue[s] or voltage issue[s] in the transision or distribution network within a same bidding zone.* In an ultimate sense, this can only mean that regional issues, likely involving DSOs or at least triggering distribution grid-friendly behaviour, are addressed through the establishment of such a market.

## Examples of flexibility concepts  implemented in different countries:

### DSO flexibility markets

There are already several initiatives and platforms for DSO-level flexibility and congestion markets across Europe, including NODES, Piclo, EPEX Spot's local market platform[6], Electron[7], OMIE[8] (Spain), and GME[9] (Italy). In the following, two examples are described in more detail to illustrate different approaches and experiences:

**UKPN's (UK Power networks) DSO flexibility market development:**

First began procurement in 2017 to contracting over 1GW in 2023. In April 2024, it launched a day-ahead flexibility market to complement their long-term procurement, working in partnership with EPEX SPOT. Over 200 daily auctions took place in 2024/25, with 13GWh utilisation, up 68% from the previous year.  UK Power Networks was the first GB DSO to procure demand turn-up to make use of excess renewable energy when it would otherwise be curtailed. During 2024/25, households participating in this service received an average of £54 in free electricity. There are now over 175,000 assets registered to provide local flexibility, including batteries, generators,

[5] Source: https://www.acer.europa.eu/sites/default/files/documents/Official_documents/Public_consultations/PC_2024_E_07/1_NCDR_DSO_ENTITY_ENTSO-E.pdf
[6] Source: https://www.epexspot.com/sites/default/files/download_center_files/Epex_flexibility%20market_211117.pdf
[7] Source: https://electron.net/
[8] Source : https://www.omie.es/en/division-innovacion/mercados-locales
[9] Source : https://www.mercatoelettrico.org/en-us/Home/MarketAccess/Electricity/LocalFlexibilityMarketMLF/RulesMLF/ReferenceLegislation-MLF

electric vehicles, heat pumps and other demand in homes and businesses. Since April 2023, UK Power Networks' flexibility services have delivered £205m in savings from more efficient use of distribution network capacity.[10] In 2019, distribution network companies tendered 1306MW of flexibility, and contracted 256MW. There has since been a dramatic increase. In the 2024/25 reporting year alone, distribution network companies tendered 31GW of flexibility, of which 8.9GW were contracted.

**Nodes in Norway (and Flanders):** Norway's NODES platform hosts Euroflex[11], a national local-flexibility exchange where eight of the country's largest DSOs utilise the platform to procure flexibility services for congestion relief, mainly on 110kV grid level, with the possibility of aggregation of assets in lower grid levels. Flexibility-service providers bid through flexibility reservation (LongFlex) or short-term hourly activation (ShortFlex) contracts. Additionally, the MaxUsage product allows for contractual peak shaving. The market's low 1 kW minimum entry threshold encourages participation from small, distributed assets. By mid-2025, Euroflex had reserved more than 3 TWh of capacity and activated over 6 GWh of flexibility.

*✓Price Input Option ✓Explicit Flexibility ✓Voluntary ✓Amount can be chosen ✓Local*

## TSO-DSO flexibility market places in the United Kingdom

**Piclo in the UK:** Currently, Distribution network operators (DNOs) are obliged by the UK regulator Ofgem's network Price Controls (2023-2028 RIIO-ED2) to procure flexibility. Licence Condition 31E sets out the circumstances in which distribution licensees can procure flexibility and what principles they should apply during the procurement process. Since 2018, DNOs have been tendering and procuring various flexibility services to help manage congestion in the local electricity grids. Flexibility is procured individually by each DNO through local flexibility markets using various digital platforms and tools. One example is the platform Piclo[12], which is a digital marketplace that connects electricity network operators (like DSOs and the ESO) with providers of flexible energy services (e.g. batteries, EVs, or demand response). Flexibility providers register and qualify their assets on the platform, then bid in local auctions where networks need help balancing supply and demand. If selected, they're paid to adjust usage or generation when needed. The platform manages the full process—qualification, bidding, dispatch, and payment—making it easier to trade flexibility and support a low-carbon, more efficient grid. However, it should be noted that Ofgem is currently in the process of developing a new process for the next price control period (ED3 = 2028-33), where the intention is to move away from the 'flex first' approach, towards a more proactive investment in network infrustucture development.

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[10] Source: DESNZ Clean Flexibility Roadmap - July 2025. Page 61. Clean Flexibility Roadmap
[11] https://nodesmarket.com/euroflex/
[12] www.piclo.com

✓Price Input Option ✓Explicit Flexibility ✓Voluntary ✓Amount can be chosen ✓Local

### Demand response programs in the Republic of Korea, Canada & Belgium

Since 2021, the Republic of Korea has applied the "Plus Demand Response (Plus DR)" program on Jeju Island, incentivizing flexible consumers, such as EV chargers and energy storage systems (ESS), to increase electricity demand during periods of surplus renewable generation and vice versa. This demand-up flexibility shall reduce the need for curtailment. In 2021, Plus DR delivered 20 MWh of response, rising to 430 MWh in the first half of 2023. In addition, since 2024, the Plus DR scheme has expanded beyond Jeju Island to include mainland South Korea, with Gridwiz registering approximately 14,000 EV charging units and over 200 MW of ESS resources for participation in the program. Moreover, emerging "Fast DR" applications using ESS are being deployed to provide both upward and downward flexibility, including reserve (ancillary) services, enhancing grid responsiveness and mitigating curtailment across the system. Participants receive financial compensation based on the actual demand increase, making the scheme economically attractive and effective in supporting grid stability.[13]

✓Price Given ✓Implicit Flexibility ✓Voluntary ✓Amount can be chosen ✓Local/System

Canada's electricity system is regionally organized, with vertically integrated utilities (VIUs) operating in eight out of ten provinces. Some provinces like Quebec and British Columbia offer demand response programs and variable tariff structures providing financial incentives to customers who can reduce their electricity usage during periods of peak demand.[14]
Several jurisdictions in Canada have industrial peak shaving programs to reduce peaks and electricity bills for large consumers. In Canada's Province of Ontario, large customers with peak demand over 500 kW pay a global adjustment fee based on their peak demand but may also be eligible for the Industrial Conservation Initiative to assist in asset deferral.[15] Smaller demand response resources can also participate via mechanisms like the capacity auction or as dispatchable loads in the real-time market, which operates on five-minute intervals with double-sided bidding.

✓Price Given ✓Explicit Flexibility ✓Voluntary ✓Amount can be chosen ✓Local

[13] https://www.mdpi.com/1996-1073/17/22/5660#B7-energies-17-05660
[14] https://www.iea-isgan.org/wp-content/uploads/2023/10/Characterisation_flexibility_usage_WG9.pdf
[15] https://www.iea-isgan.org/wp-content/uploads/2023/10/Characterisation_flexibility_usage_WG9.pdf

## Peer-to-peer (P2P) trading

P2P energy trading allows consumers to directly exchange electricity, e.g. from local renewable sources, via digital platforms. It enables prosumers to execute decentralized transactions without relying on traditional utilities. An example is the fully automated platform ENTRNCE in the Netherlands, which facilitates daily energy trades for over 10,000 peers. Setups vary from using the public grid for transactions to partly or fully self-sufficient microgrids. In locally organized schemes, participants align generation and demand internally, reducing public grid usage.[16] At the Port of Rotterdam, a P2P microgrid trial leverages automated smart contracts for real-time energy trading. Within two months, participants reduced energy costs by 11 %, increased renewables revenue by 14 %, and reduced public grid connection needs by 25 % - demonstrating the effectiveness of localized, automated energy exchange.[17] P2P Trading is also possible in other countries, such as Belgium (Flemish region), where regulatory frameworks permit P2P trading across the entire region.

*✓Price Input Option ✓Implicit Flexibility ✓Voluntary ✓Mostly rule-based ✓Can be both*

## Energy communities

The collective and locally optimized operation of flexible energy assets in energy communities improves the alignment between local electricity generation and consumption. By enabling surplus electricity to be shared directly among nearby consumers, these systems help reduce dependence on the broader grid. Following EU directives, Member States have begun defining and integrating frameworks for Citizen and Renewable Energy Communities[18], allowing local actors to participate in the energy transition through shared ownership and democratic governance structures. Consequently, energy communities have already been established in various EU countries, including Austria and Switzerland. A cost-benefit analysis by the Flemish Regulator (VREG) highlighted that energy communities currently have limited impact on reducing grid offtake peaks. However, they expect their potential to mitigate injection peaks to grow as more flexible technologies (like EVs or batteries) are adopted and optimized collectively at the community level.[19]

*✓Price Input Option ✓Implicit Flexibility ✓Voluntary ✓Rule-based ✓Local*

[16] https://www.deloitte.com/nl/en/Industries/energy/blogs/peer-to-peer-energy-trading.html
[17] https://www.renewableenergyworld.com/power-grid/microgrid/blockchain-powered-microgrid-pilots-renewables-trading-in-port-of-rotterdam/#gref
[18] https://energiegemeinschaften.gv.at/
[19] https://www.vlaamsenutsregulator.be/sites/default/files/document/rapp-2023-19.pdf

## Flexible connection agreements

Flexible grid connection agreements allow grid operators to temporarily limit the connection capacity of installations e.g. during grid congestion. In return, these agreements facilitate faster and more cost-efficient grid access, especially in congested areas. In Germany, such agreements were legally enabled through legislative amendments passed in January 2025, facilitating faster and more cost-efficient grid access for flexible assets such as battery storage systems. In Brussels, as part of broader flexibility measures, the DSO will, from 2026 onwards, be permitted to limit the charging and discharging capacity of EVs, enabling more active management of local grid constraints. GB is seeing big uptake in Flexible connection agreements too. In Austria, this is already feasible through bilateral agreements of grid operators with new customers. The main goals are to accelerate the integration of generation and storage, improve grid utilization, and ensure secure system operation. Two models are envisaged: (1) temporary access with curtailed feed-in rights until grid reinforcement is completed, and (2) permanent flexibility-based access with reduced capacity during critical periods (e.g. PV peak hours).[20] These measures respond to an EU requirement obliging Member States to establish a legal framework for flexible connections in regions with limited or no available grid capacity.[21]

*✓Price Given ✓Explicit Flexibility ✓Voluntary ✓Amount can be chosen ✓Local*

## Variable grid tariffs in Belgium and Spain, Regulatory sandboxes in Austria

**Volumetric and capacity-based tariffs:** Several examples of capacity tariffs can be observed in Belgium**.** Capacity tariffs on grid level 7 have been introduced in 2023 in Flanders, Belgium. Customers pay for the highest monthly 15min peak, therefore, incentivizing behaviour to reduce peak demand. The benefits and potential introduction of these types of tariffs are currently being discussed in several countries, making the insights gained from investigating the accompanying behavioral changes particularly valuable. The Flemish DSO even performed a study on applying Time of Use (ToU) on capacity tariffs[22]. A progressive evolution is also planned in Brussels to increase the share of capacity tariffs, where a volumetric tariff with a distinction between peak and off-peak periods is implemented. Wallonia, on the other hand, is set to introduce ToU tariffs with a color-coded system (green, orange, red) starting in 2026, signaling different pricing levels based on the time and demand for energy. This new tariff combines energy and capacity components, however since the capacity charge is set to zero until 2029, it currently operates as

[20] https://www.e-control.at/documents/1785851/1811582/2025_06_15+Webinar+Flexibilit%C3%A4t+GKA.pdf/9db5a323-595f-3e8e-af75-d8e58246de7e?t=1750847475439
[21] https://chatham.partners/insights/flexible-netzanschlussvereinbarungen-booster-fuer-die-stromspeicherindustrie/
[22] https://over.fluvius.be/sites/fluvius/files/2024-02/onderzoek-naar-time-of-use-tarieven-en-injectie.pdf

a purely energy-based tariff, while establishing the framework to complement with a capacity-based component in the future.[23]

Another study is being conducted for ORES/Elia to define a grid tariff design for residential customers which incorporates an incentive to adapt the energy consumption so that network congestions are avoided, both on transmission as well as on the distribution level. The tariff will then be implemented in a pilot where the response of the end-users to this pricing structure will be tested.

In Brussels, a progressive evolution is underway to increase the share of capacity-based tariffs, complementing existing volumetric approaches that distinguish between peak and off-peak consumption periods.

*✓Price Given ✓Implicit Flexibility ✓Involuntary ✓Automatically defined ✓Local*

**Non-local tariffs in Spain:** Spain's national 2.0 TD access tariff, which is mandatory for most customers with contracted power below 15 kW, combines time-differentiated energy and capacity charges, enabling implicit demand-side flexibility. Users can contract two distinct capacity terms: one for peak-off-peak hours (weekdays 08:00–24:00) and another for valley hours (00:00–08:00, weekends, and holidays), aligning contracted capacity with usage patterns to reduce costs.[24] While this structure encourages more efficient capacity use, its uniform national application overlooks local grid conditions and may, like dynamic energy tariffs, inadvertently concentrate demand and increase local network stress.

*✓Price Given ✓Implicit Flexibility ✓Involuntary ✓Automatically defined ✓Not Local*

**Regulatory Sandboxes in Austria:** The InnoNet[25] project serves as a prominent example for testing innovative tariff models under real-life conditions. This initiative involves a practical trial with participation from over 1,000 electricity consumers, offering a robust testbed for evaluating variable grid charges. Conducted under the framework of E-Control's regulatory sandbox scheme, the project enables DSOs to experiment with flexible network tariffs and to closely monitor their impacts on consumer behavior, peak load reduction, grid stability, and overall efficiency within everyday operating conditions.

[23] https://www.cwape.be/sites/default/files/cwape-documents/2024.02.22-0054-Projet%20lignes%20directrices%20structure%20tarifaire%20BT%202026-2029%20-%20pour%20concertation-consultation.pdf
[24] https://www.i-de.es/electric-distribution/access-tariff-2-0-td
[25] https://www.e-netze.at/Strom/Projekte/Innonet/Default.aspx

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*✓Price Given ✓Implicit Flexibility ✓Voluntary ✓Automatically defined ✓Local*


## Summary

The growing electrification of energy demand and distributed generation is driving a global shift toward more dynamic and participatory electricity systems. Various countries worldwide are exploring diverse mechanisms such as demand response programs, P2P trading, and energy communities, flexible connection agreements and variable tariffs to enhance grid flexibility and stability.

This analysis demonstrates that while flexibility mechanisms are proliferating across various regions, their design and implementation differ depending on national context and grid challenges. The UK has taken a leading role with DSO-operated flexibility markets such as UKPN's and Piclo, which have achieved gigawatt-scale contracting and measurable network savings. Congestion markets in Norway and Flanders provide frameworks for local flexibility trading, emphasizing low entry barriers and active DSO participation. Belgium and Austria are experimenting with variable and capacity-based tariffs to incentivize consumers to manage peaks and defer grid reinforcement. Furthermore, Korea's Plus DR program and Canada's regional demand response schemes showcase large-scale, incentive-driven flexibility at the system level. P2P trading platforms like ENTRNCE in the Netherlands and emerging energy communities in Austria and Switzerland illustrate the growing role of prosumers and local coordination.

These initiatives demonstrate that flexibility is being integrated and utilised by incorporating a wide range explicit market-based tools and implicit pricing or regulatory mechanisms. Although there are already several local flexibility markets in operation, the challenges around liquidity, coordination, and consistent market definition remain. In the future, the existing national approaches are expected to evolve toward more integrated and interoperable flexibility markets which are enabled by advancing regulatory frameworks which enable transparency, scalability and local coordination.