European Commission

ETIP SNET

European Technology and Innovation Platform
Smart Networks for Energy Transition

Energy Communities' impact on power grids

Energy Community Embedment Increasing Grid Flexibility and Flourishing Electricity Markets

27th of August, CIGRE SESSION PARIS 2024

14:00 - 14:05

European Commission

Welcome of participants and house-keeping rules

Beatrice Profeta
ETIP SNET and PwC

Agenda

Item	Time	Session
14:00		**Welcome of participants and house-keeping rules**
#1	14:05	**Opening remarks and introduction** (Albana Ilo; Antonio Iliceto; Luciano Martini; Joni Rossi)
#2	14:25	**Technical impact of energy communities on the grid:** ○ Comprehensive architecture for the technical integration of energy communities (Albana Ilo, 10 min) ○ DSO perspective (Santiago Gallego, 10 min) ○ TSO perspective (Antonio Iliceto, 10 min) ○ Q&A (All, 5 min)
15:00		**Coffee Break**
#3	15:15	**Economical processing in the power industry to promote energy communities** ○ Status quo of the economical processing in the power industry (Nuno de Souza e Silva, 5 min) ○ Adaptation of existing market structures through different platforms and price tariffs (Janka Vanschoenwinkel, 10 min) ○ Redesign of market structure: The rise of the local market (Luciano Martini; Nikos Hatziargyriou, 10 min) ○ Development of regulation and business organization (Irina Oleinikova, 10 min) ○ Q&A (All, 5 min)
#4	15:50	**Experiences from Energy Communities projects** ○ Platone project (Ilaria Losa, 7 min) ○ INTERACT project – Austrian experience (Helmut Bruckner, 7 min) ○ Q&A (All, 5 min)
#5	16:10	**Conclusive remarks & Recommendations on innovation and research activities** (Albana Ilo, 5 min)
#6	16:15	**Roundtable discussion** (Albana Ilo, Santiago Gallego, Luciano Martini, Achille Honnoset, Nikos Hatziargyriou)
16:45		**End of the meeting**

14:05 - 14:25

European Commission

Opening remarks and introduction

Albana Ilo
ETIP SNET and TU Wien

Antonio Iliceto
ETIP SNET and ENTSO-E

Luciano Martini
ISGAN and RSE Spa

Joni Rossi
ISGAN and RISE

14:05 - 14:10

European Commission

Introduction of the topic and the ETIP SNET-ISGAN Paper

Albana Ilo
ETIP SNET and TU Wien

Antonio Iliceto
ETIP SNET and ENTSO-E

Luciano Martini
ISGAN and RSE Spa

Joni Rossi
ISGAN and RISE

Introduction of the topic and the ETIP SNET - ISGAN Paper

- EU has emphasized the **role of Energy Communities** in **achieving** their **climate and energy goals**.

- Despite legislation supporting them, **Energy Communities are far from fulfilling their expected role**.

- The **barriers to introducing Energy Communities are manifold** and lie at various levels such as the legislative, socio-economic, market and technical levels.

- The paper "Energy Communities' impact on power grids" is the result of the joint work of

ETIP SNET WG1 and ISGAN

- The 17 experts who carried out this work come from various companies such as DSOs, TSOs, academia, and research institutions from 11 EU countries.

European Commission

14:10 - 14:15

European Commission

Introduction of ETIP SNET and its white papers

Albana Ilo
ETIP SNET and TU Wien

Antonio Iliceto
ETIP SNET and ENTSO-E

Luciano Martini
ISGAN and RSE Spa

Joni Rossi
ISGAN and RISE

ETIP SNET is where vision meets action!

The ETIP's main goal is **to guide and identify R&I priorities** in support of Europe's energy transition on and beyond **smart electricity grids.** Structure of the activities:

1. **Advising EC** on Innovation Programs and calls as well as to **SET Plan action 4** which addresses the technical challenges raised by the Energy Transition

2. Identification of **innovation priorities but also barriers**, related to **regulation and financing**

3. Bringing together a **multitude of stakeholders and experts** from the energy sector to reach a consensus on Innovation priorities

4. Elaborating **Visions, Roadmaps and Implementation Plans** as basis of Innovation planning and monitoring

5. Developing **knowledge-sharing mechanisms** that help bringing R&I results to deployment

6. Coordinating with other initiatives at National, European and International level to **reinforce the alignment of R&I priorities and needs**

ETIP SNET governance structure and Working Groups

In order to have a wide representation of stakeholders and offer agile and efficient operation, the **Management and Governance structure** of ETIP SNET is organised as shown below.

WG1: Reliable, economic and efficient smart grid systems

WG2: Storage technologies and system flexibilities

WG3: Flexible generation

WG4: Digitisation of the electricity system and customer participation

WG5: Innovation implementation in the business environment

ETIP SNET recently published papers

Below is an exemplificative list of papers that have been published by the 5 working groups of ETIP SNET:

Hydrogen's impact on grids	• July 2023 by WG1 (link), it focuses on the impact of hydrogen on electricity grids, underlining the importance of clear discussions on hydrogen options and the need for regulations for hydrogen systems
Energy Data Spaces	• January 2024 by WG4 (link). it provides a deep analysis on the identified opportunities, challenges and necessary actions for a rapid deployment of a common European Energy Data Space
Energy communities' impact on grid	• May 2024 WG1 (link), it explores the new role of energy communities in the energy landscape, highlighting how energy communities present opportunities and challenges for DSOs and TSOs, and discussing their potential to increase consumer flexibility and integrate renewable resources and technologies
Ramp-up and the role on hydrogen	• June 2024 by WG3 (link), it provides forecasts and recommendations about provision of H2-ready generation plants for the future decarbonised generation mix
Coordinated energy infrastructure planning	• In publication phase, by WG1, it examines the need and scope for a coordinated approach across voltage levels and among other systems operators to energy infrastructure planning coordination is needed across voltage levels as well as among operators/authorities of other sectors: gas, hydrogen, mobility, heating&cooling, water

14:15 - 14:20

European Commission

Introduction of ISGAN and its activities

Albana Ilo
ETIP SNET and TU Wien

Antonio Iliceto
ETIP SNET and ENTSO-E

Luciano Martini
ISGAN and RSE Spa

Joni Rossi
ISGAN and RISE

ISGAN
International Smart Grid Action Network

The ***International Smart Grid Action Network*** (ISGAN) creates a strategic platform to support high-level government attention and action for the accelerated development and deployment of smarter, cleaner electricity grids around the world.

ISGAN is structured as an ***IEA Technology Collaboration Programme (TCP)***, operating under the IEA Framework for the Technology Collaboration Programme and its own legal Implementing Agreement.

ISGAN also operates as an initiative of the ***Clean Energy Ministerial*** (**CEM**) and participates at the CEM's annual Senior Official Meetings and Ministerial-level events.

ISGAN in a nutshell

ISGAN
INTERNATIONAL SMART GRID ACTION NETWORK

- ISGAN currently consists of **27 Contracting Parties**.
- Their nominated representatives form the **Executive Committee** headed by the Presidium (Chair and four regionally diverse Vice Chairs), assisted by two co-Secretariats and the Operating Agent.
- The work of ISGAN is divided into **six** (6) **active Working Groups** (WG), plus ExCo-level projects like the annual **ISGAN Award of Excellence**.

Co Secretariat & Operating Agent

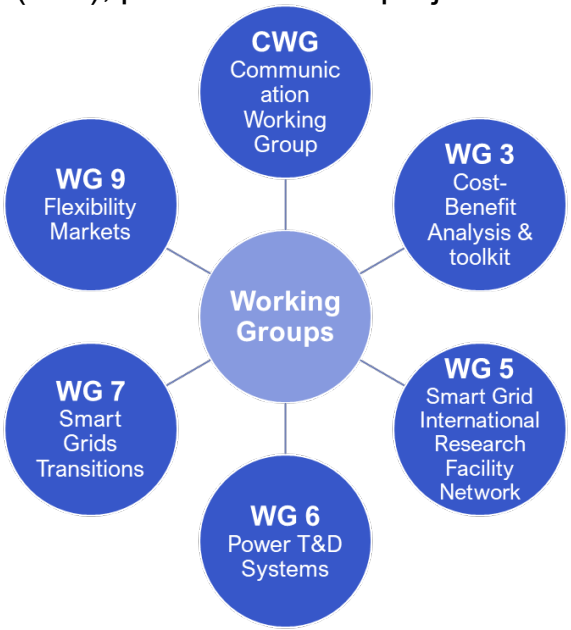
AIT AUSTRIAN INSTITUTE OF TECHNOLOGY

Co Secretariat

KSGI Korea Smart Grid Institute

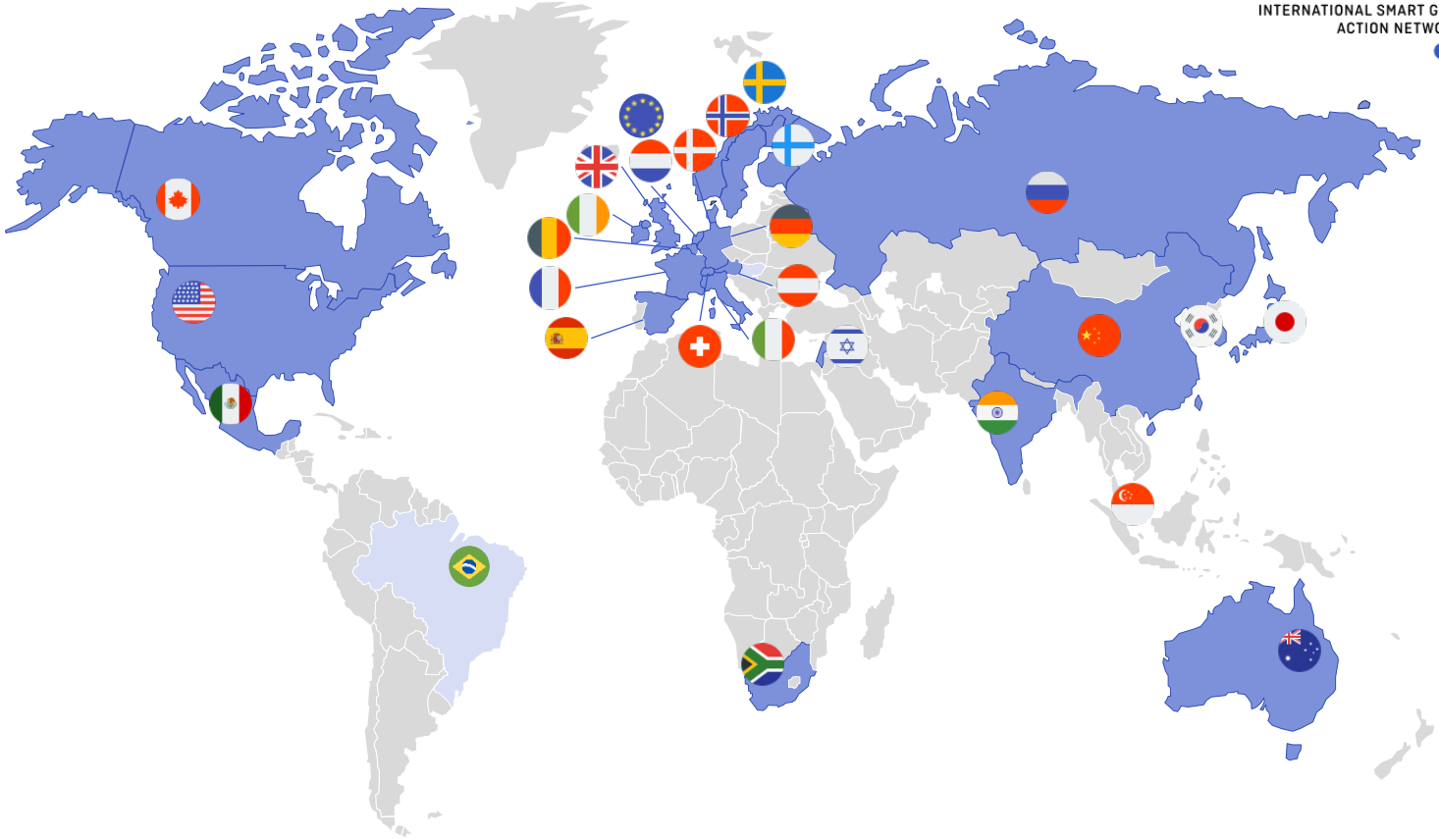
ISGAN Presidium

ISGAN Executive Committee



ISGAN worldwide presence

ISGAN
INTERNATIONAL SMART GRID ACTION NETWORK

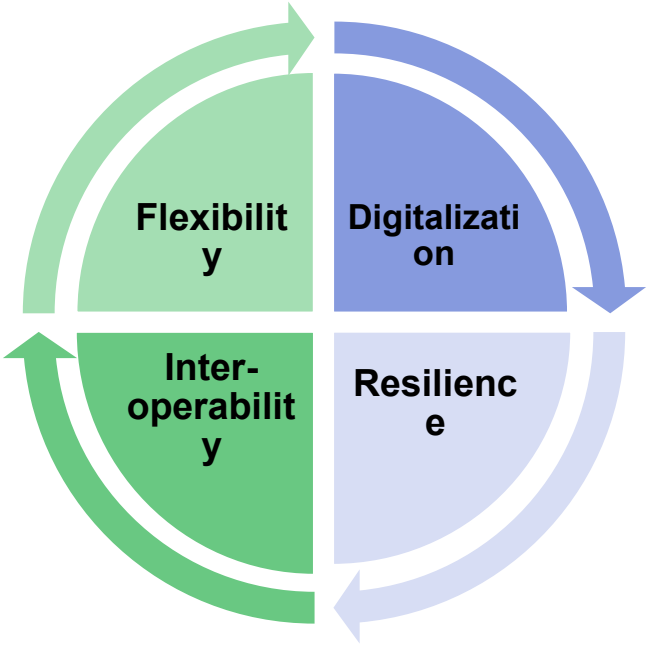


ISGAN Work

ISGAN
INTERNATIONAL SMART GRID ACTION NETWORK

ISGAN activities build a global understanding of smart grid, address gaps in knowledge and tools, improve peer-to-peer exchange and recognize excellence

Main themes



- No direct technology development or demonstration activities
- Develop protocols, tools and best practices, identify environmental issues and mitigation options
- Focus on exchange and dissemination of information and perspectives
- A global benchmark and collaborative attitude among participating countries
- Indicate to emerging economies the technological alternatives available for their own development

International Collaboration: Main partnerships

ISGAN will continue to build **collaborative ties** with other relevant forums, aligning and differentiating activities as appropriate, in a mutual effort to attain the real outcomes needed in energy systems.

14:20 - 14:25

European Commission

Barriers to the deployment of energy communities

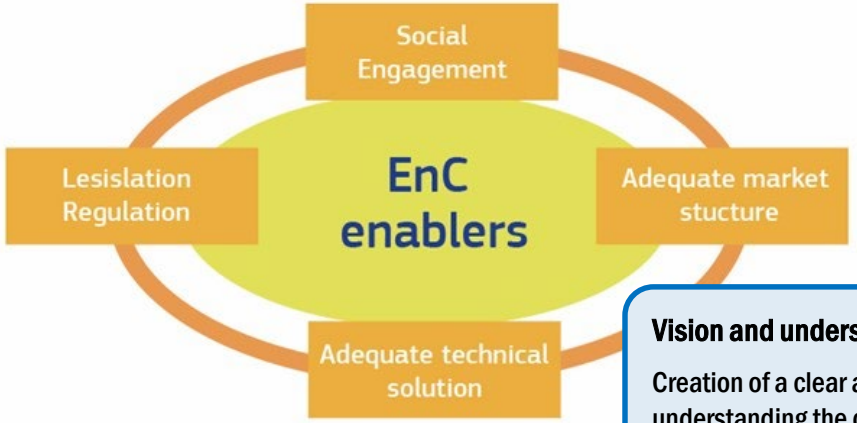
Albana Ilo
ETIP SNET and TU Wien

Antonio Iliceto
ETIP SNET and ENTSO-E

Luciano Martini
ISGAN and RSE Spa

Joni Rossi
ISGAN and RISE

Barriers to the deployment of energy communities



Challenges

Vision and understanding

Creation of a clear and sensible future vision and strategy with distinct goals and stakeholder roles - while understanding the opportunities ECs can bring in a fast changing technical and policy context.

A future-proof business case

Ensuring an inclusive and positive business case for ECs and valorising investments in smart technical and market solutions – through understanding incentives and opportunities coming from innovative market design and the role of automation and digitalisation.

Complexity

Providing simple procedures for all types of stakeholders to broaden citizen participation, simplify the organization and to harness the untapped potential –
with focus on clear and simple regulation, administration and data management.

14:25 – 15:00

Technical impact of energy communities on the grid:
Challenges & opportunities

Albana Ilo
ETIP SNET and TU Wien

Santiago Gallego
ETIP SNET and i-DE (Iberdrola Group)

Antonio Iliceto
ETIP SNET and ENTSO-E

14:25 – 14:35

European Commission

Comprehensive architecture for the technical integration of energy communities

Albana Ilo
ETIP SNET and TU Wien

Santiago Gallego
ETIP SNET and i-DE (Iberdrola Group)

Antonio Iliceto
ETIP SNET and ENTSO-E

Comprehensive architecture for the technical integration of EnC

The technical challenges of energy communities

transfer to

the integration of distributed energy resources.

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Comprehensive architecture for the technical integration of EnC

- The architectural integration of the EnCs relates to their interaction with the grid, addressing all electrical appliances the EnC members use to inject or consume energy.

- Significant changes in the electricity system have occurred since the beginning of this century, like the liberalisation of the power industry and the substantial increase in distributed resources.

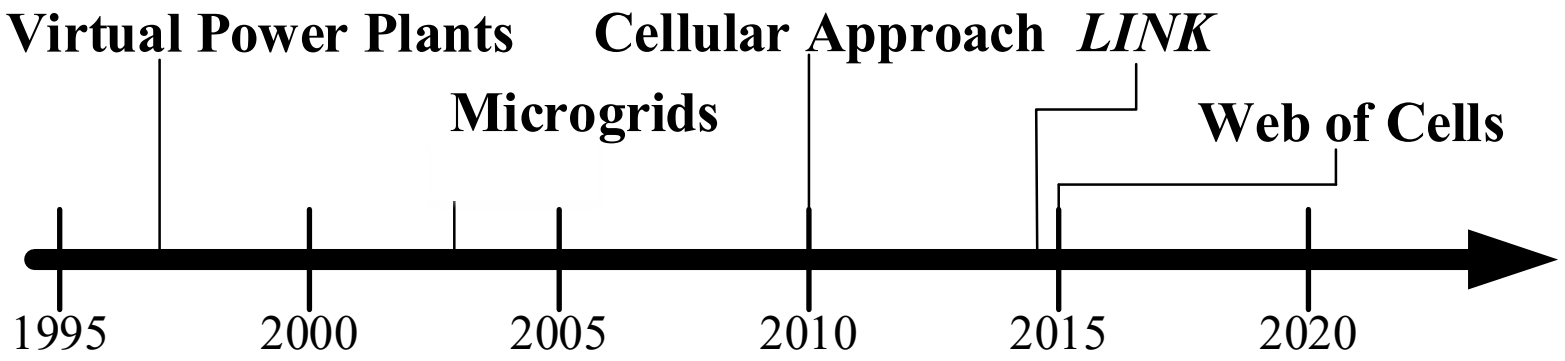
- This distributed resources, generation and storage, lead to a change in the structure of the electricity grids, requiring architectural adaptation.

The emergence of distributed energy resources and the introduction of energy communities to promote integration exacerbate the need to adapt the power grid architecture.

- - In these conditions, a comprehensive, appropriate architecture is needed to avoid the growing and unmanageable patchwork of unsustainable large-scale grid implementations.

Comprehensive architecture for the technical integration of EnC

Timeline of the development of smart grid concepts



Comprehensive architecture for the technical integration of EnC

Centralised architectures consolidate resources, data, and processing power in a powerful server or data centre. The traditional power system structure is centralised, where the TSO is the system's backbone, while the DSO usually follows the hierarchical instruction from the TSO. The whole market is structured to serve this hierarchical structure. The massive DER penetration changes this but the market structure remains the same. The balancing process between electricity generation and consumption is the first to be influenced and challenged by this structural change. Introducing the balancing groups at the distribution level tries to soften this challenge. Meanwhile, introducing of the VPP attempts to mitigate the discrepancy between the new electricity grid structure and the market structure

Decentralised architectures distribute resources, data, and processing power across the power system. The system's robustness is increased by design because of no single point of failure, improving system resilience and reliability. It reduces the latency because data processing occurs closer to users, ensuring faster response times and data protection. The Microgrid is one of the concepts driving the decentralised architecture. It has been introduced to address technical challenges posed by DER penetration at the distribution level. The *LINK* architectural paradigm also leads to a decentralised architecture, considering the entire structure of new power systems and the market holistically

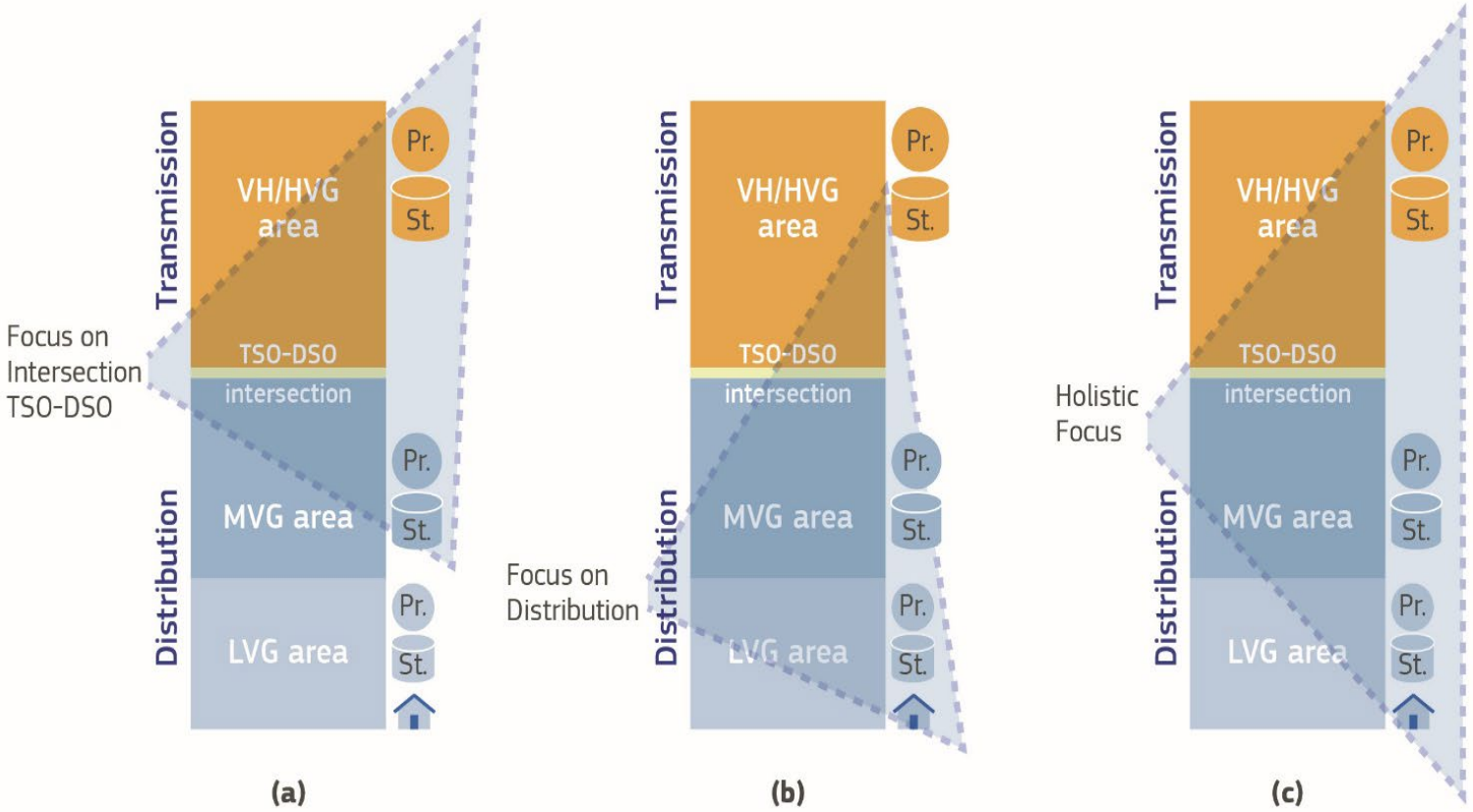
Comprehensive architecture for the technical integration of EnC

Future power system architecture

Centralised? **or** **Decentralised?**

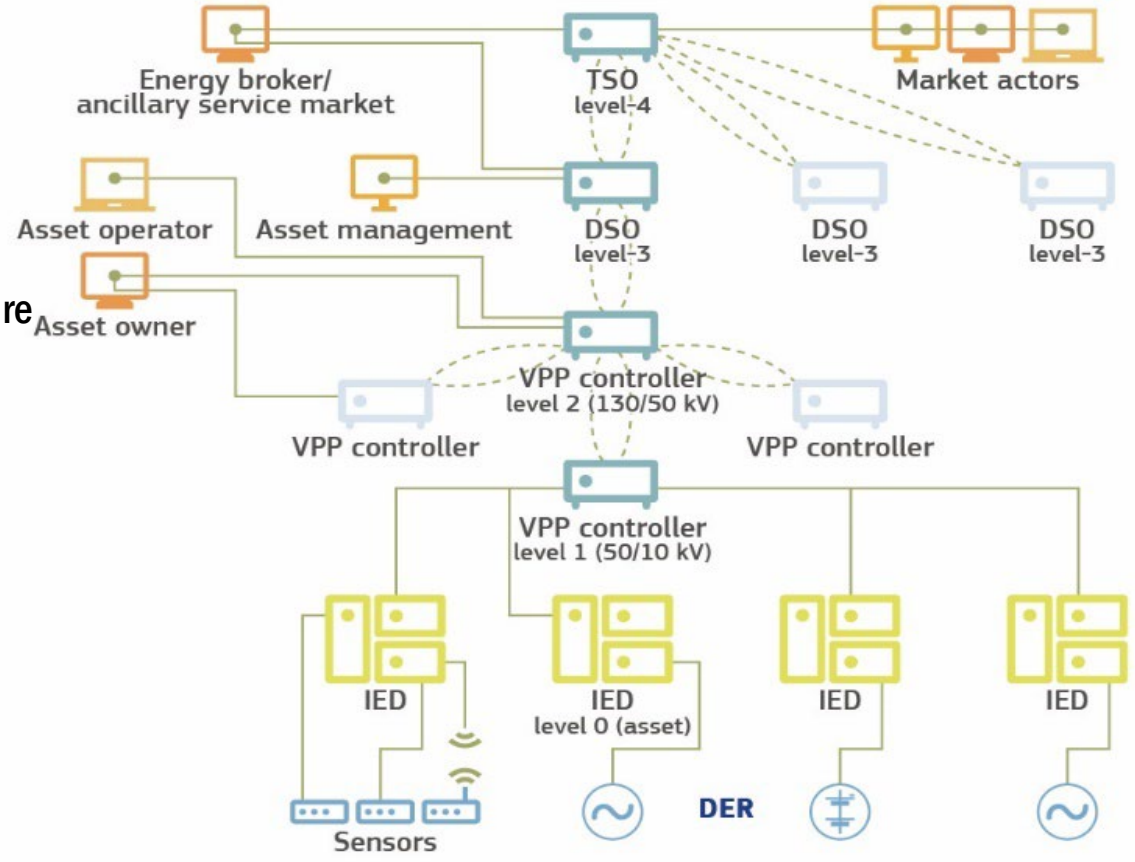
Comprehensive architecture for the technical integration of EnC

Various types of R&D projects to address technical issues of EnC



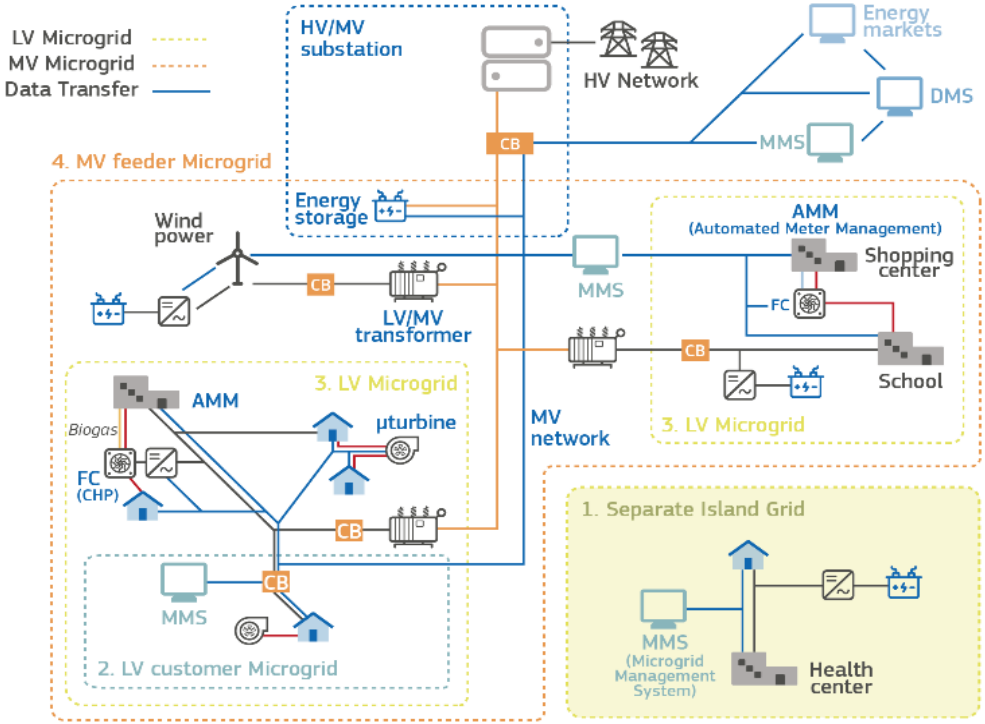
Comprehensive architecture for the technical integration of EnC

Example of the Structure of the architecture based on **VPP**



Comprehensive architecture for the technical integration of EnC

Example of the Structure of the architecture based on **Microgrids**



Comprehensive architecture for the technical integration of EnC

Structure of the architecture based on ***LINK***

Technical impact of energy communities on the grid - Bi-directional power flow

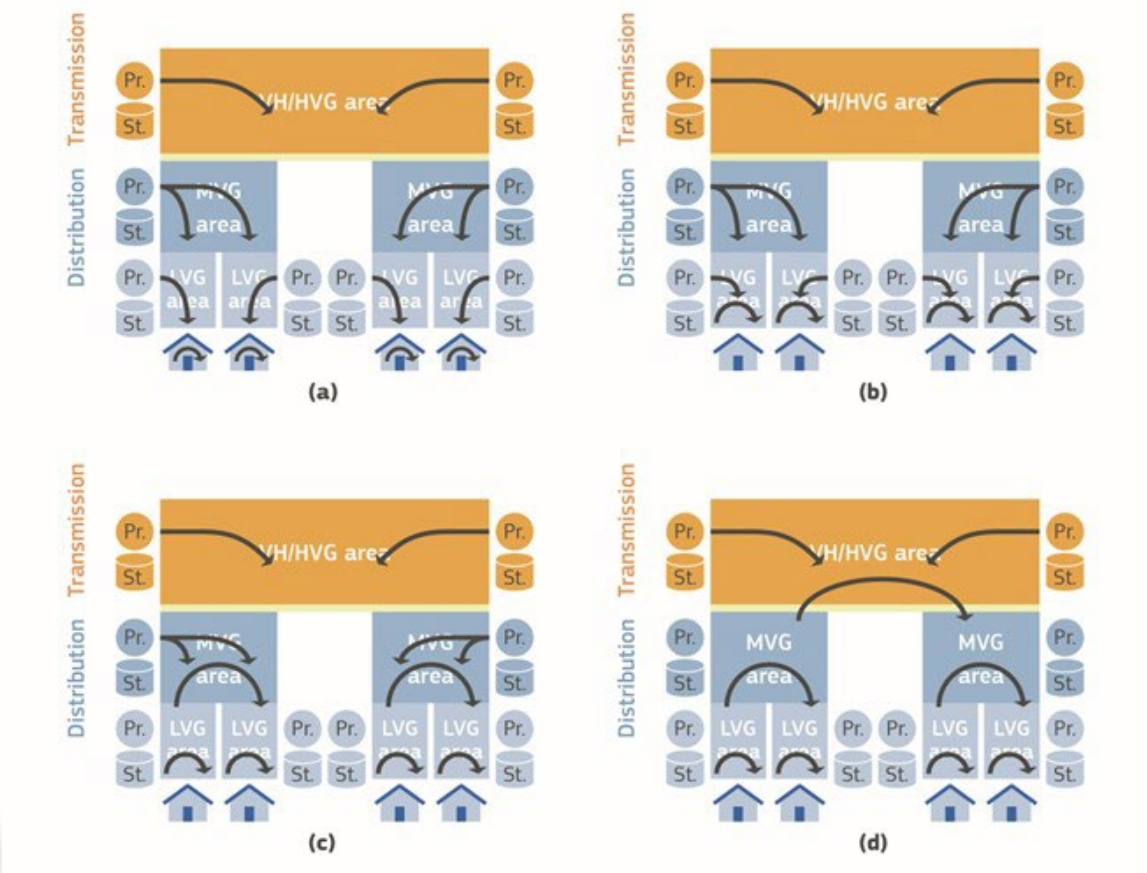


Figure: Different levels of EnC impact on the grid with DERs power flows that: (a) Cover partially or full the customer's load (self-consumption); (b) Penetrate into the superordinated LVG area; (c) Penetrate into the superordinated MVG area; (d) Penetrate into the superordinated HVG area.

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14:35 – 14:45

DSO perspective

Albana Ilo
ETIP SNET and TU Wien

Santiago Gallego
ETIP SNET and i-DE (Iberdrola Group)

Antonio Iliceto
ETIP SNET and ENTSO-E

DSO perspective - Context

- Energy Communities constitute one the **key actors of the energy transition** and they are usually **connected at distribution level**.

- They represent an **opportunity** but also a **challenge** for DSOs.
  - Opportunity to manage the grid with more flexibility.
  - A relevant actor interested in active involvement.
  - Acting on behalf of a group of users.

- But with the **same rights and obligations** as other users of distribution grids.

- Not full/equal **implementation** in all jurisdictions.

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DSO perspective - Challenges

- Violation of upper voltage limit
- Phase Unbalances
- Harmonic distortions
- Protection system philosophy
- Revising the recovery plans after blackout events
- Temporary self-sufficient operation of grid parts
- Planning
- Operation challenges

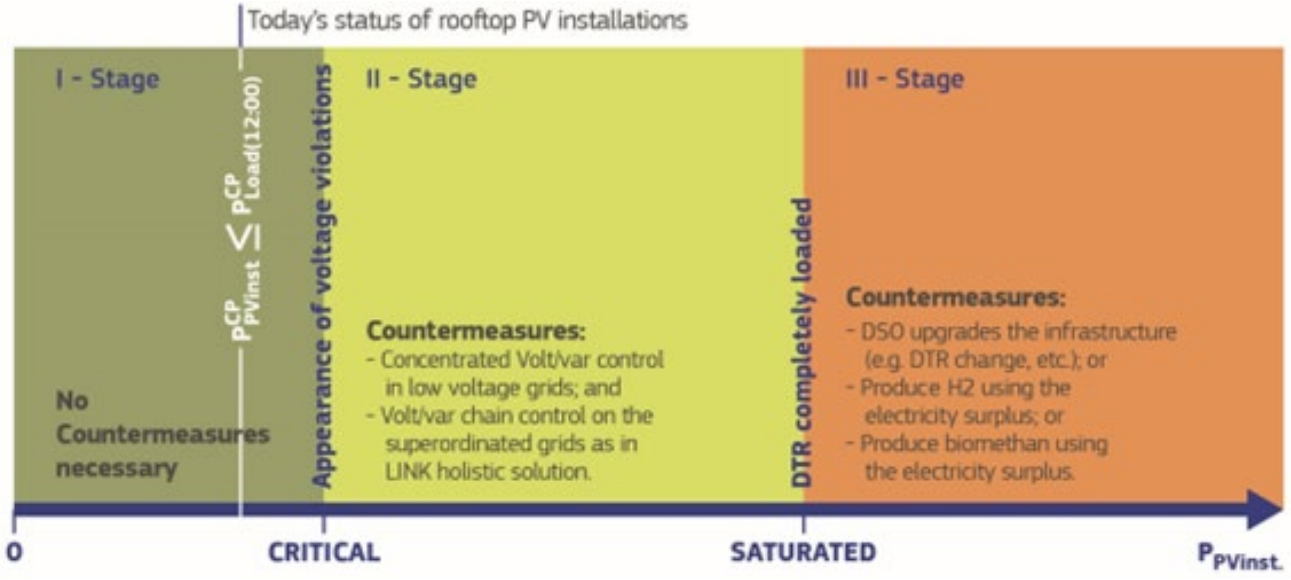

Figure: Critical parameters for the uptake capacity of distributed generation facilities in a radial configuration and the countermeasures for their maximum expansion.

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DSO perspective – Technical opportunities

Technical opportunities

- Potential for deployment of new DERs → EnCs have a significant potential.
- Balanced utilisation of the distribution grid assets → Visibility on their power requirements.
- Increasing the operation flexibility → Coordination between both parties.
- Reliable providers of flexibility services → EnCs offering new solutions.
- Improved forecasting for operation and long-term investment planning → Additional info.
- Improve the quality of the supply → New ways of cooperation.

European Commission

14:45 – 14:55

TSO perspective

Albana Ilo
ETIP SNET and TU Wien

Santiago Gallego
ETIP SNET and i-DE (Iberdrola Group)

Antonio Iliceto
ETIP SNET and ENTSO-E

TSO perspective - framework and governance

- Energy communities and Microgrids are more likely to be realised for **residential**/small business areas or commercial/small industrial **compounds**, not likely for large concentrated loads/utility scale RES, where the power density of consumption/ generation will still require to tranport energy to long distances

- Microgrids and macrogrids shall be **complementary, rather than a competitor** to transmission grids; the challenge is to **strike the right balance** between a distributed resources system, optimising their exploitation, and the wide system necessary to balance out the fluctuations of weather-dependent generation over large areas

- In Europe, although there is a common core legislation, **large differences in deployment** depending on the country may exist, since national regulation has an important role in setting practical implementation; for example, tariff schemes are responsibility of national regulators

TSO perspective - cost sharing and grid independency

- **Sharing of system costs** (especially the fixed ones, asset-based) among all users of the power system in an equitable way remains to be tackled

- The shift to microgrid should never be enacted only (or mainly) for escaping from system costs sharing, which by definition are of general nature and must be born, with proper splitting principles, by the whole of electricity end users

- Going beyond certain thresholds of **grid-independency** would require an overhaul of the existing Regulation and tariffication schemes

TSO perspective – technical opportunities

- EnC impacts the **flexibility** of the transmission grid through the increasing flexibility of the distribution grids connected directly to it. Dynamic and coordinated electricity withdrawal from and feed into the transmission grid will enable better balancing injections and withdrawals at the transmission grid level

- Facilitation of **frequency control**: The more accurate the generation-load balancing is in the distribution level enabled by EnCs, the easier the frequency holding process will become

Ø Facilitation of recovery process after a total or partial blackout: the wide-ranging DER integration through reliable EnCs offers an excellent opportunity to **reduce footprint of blackouts and recovery time**

Ø Increase the **resilience** of power grids in general and distribution grids in particular: with decentralized systems, the risk is also more distributed, i.e. diluted; with their mission of maximising the DER share, EnCs will play a crucial role in **adequacy** and resilience improvement

TSO perspective – challenges

Load shedding

The load-shedding schedules are individually configured and depend on the historical loading patterns of the surrounding grid parts. The extensive integration of DERs promoted by EnCs changes the traditionally foreseable loading patterns, which become dynamic and dependent on the weather conditions. The current static load-shedding strategies are inaccurate and should be adapted to the new requirements.

Voltage–reactive power management

The increasing number of DERs is causing the upper voltage limits in the distribution networks to be violated; DSOs could apply Q(U) regulation to increase the feeders' intake capacity, creating an uncontrolled reactive power flow in the transmission grids. But the Grid Code on TSO connection imposes strict requirements, usually cos(phi), which puts DSOs in a bind, getting in a vicious circle

N-1 security calculations

The power flows through the interconnection points between TSOs, and DSOs are uncertain because the TSOs do not have an overview of the instantaneous composition of the load (it may even behave as an injection instead of a load); the typical self-regulating effect will be massively impacted and existing dynamic models / dynamic equivalents become questionable

Restoration strategies from blackout: strategies and procedures should be elaborated under new conditions

Grid protection: increased DERs driven by EnCs, can drastically affect the protection strategies and parameters' setting

Change of the market-based power flows

Prosumers and EnCs can change some market patterns because of P2P trading, reducing the energy flows on public grids up to transmission grids

14:55 – 15:00

European Commission

Q&A

Albana Ilo
ETIP SNET and TU Wien

Santiago Gallego
ETIP SNET and i-DE (Iberdrola Group)

Antonio Iliceto
ETIP SNET and ENTSO-E

15:00 – 15:15

European Commission

Coffee Break

Meet here at 15:15

15:15 – 15:50

European Commission

Economical processing in the power industry to promote energy communities

Nuno de Souza e Silva
ETIP SNET and R&D Nester

Janka Vanschoenwinkel
ISGAN and VITO

Luciano Martini
ISGAN and RSE Spa

Irina Oleinikova
ISGAN and NTNU

15:15 – 15:20

European Commission

Status quo of the economical processing in the power industry

Nuno de Souza e Silva
ETIP SNET and R&D Nester

Janka Vanschoenwinkel
ISGAN and VITO

Luciano Martini
ISGAN and RSE Spa

Irina Oleinikova
ISGAN and NTNU

Status quo of the economical processing in the power industry

Despite electricity markets undergoing changes

still…

Current re-dispatch process Congestion Management costly and stress to Tx

Access of electricity producers connected to Dx to market

Participation of DSOs in market operation for Congestion Management

Limited effective operation of DER

…

Renewables

Increase of Distributed Energy Resources

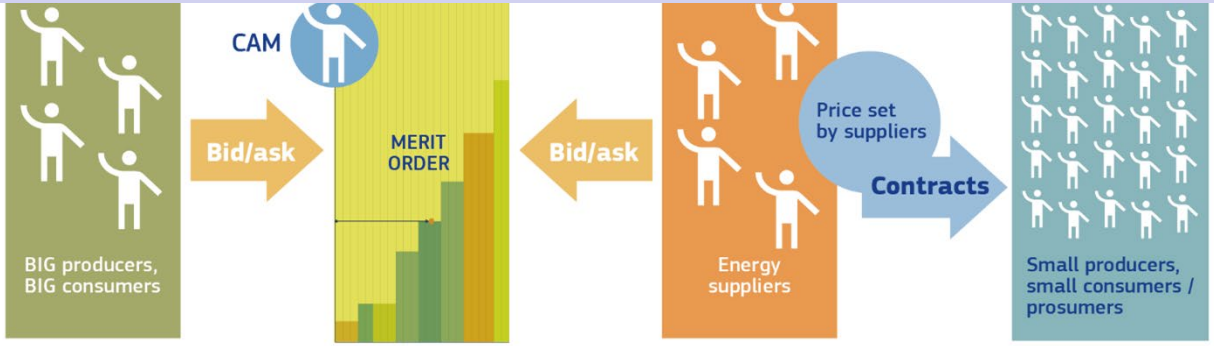
calls for…

Review of market structures

European Commission

Status quo of the economical processing in the power industry

Overview of the current market structure and pricing mechanisms used in the power industry.



1

Prevalent model since the 1990s

Electricity was mainly generated in large power plants

Fed into Tx

Distributed to consumers

Market players (few): large producers, large consumers, energy suppliers

Control Area Manager facilitates market (usually TSO)

2

Energy Supplier Companies trade in market

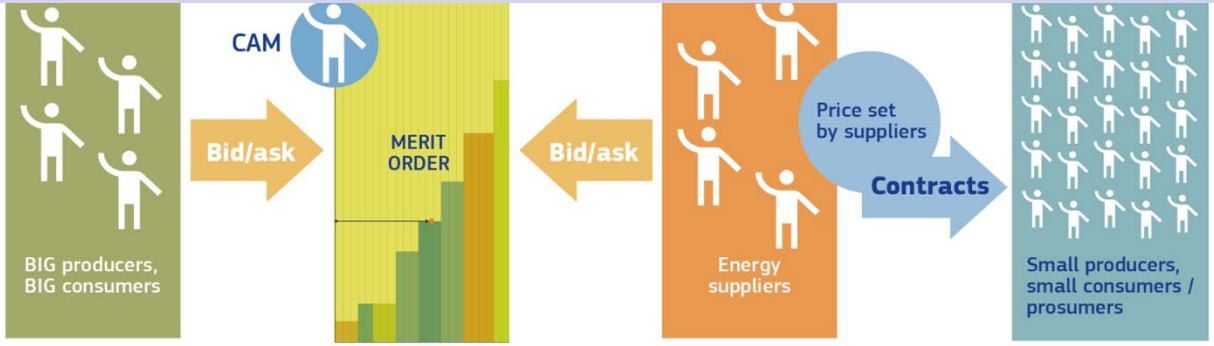
Determine selling / buying prices towards smaller consumers and producers

(high number of) Small consumers and producers recognized as market participants

Limited ability to negotiate (choose between suppliers)

Status quo of the economical processing in the power industry

Overview of the current market structure and pricing mechanisms used in the power industry.



New regulatory and policy changes to promote DERs led to changes in market
Introduction of time-based pricing schemes
Reliability-based incentives
...

Need to increase participation of consumers, prosumers, DERs in the market

European Commission

15:20 – 15:30

European Commission

Adaptation of existing market structures through different platforms and price tariffs

Nuno de Souza e Silva
ETIP SNET and R&D Nester

Janka Vanschoenwinkel
ISGAN and VITO

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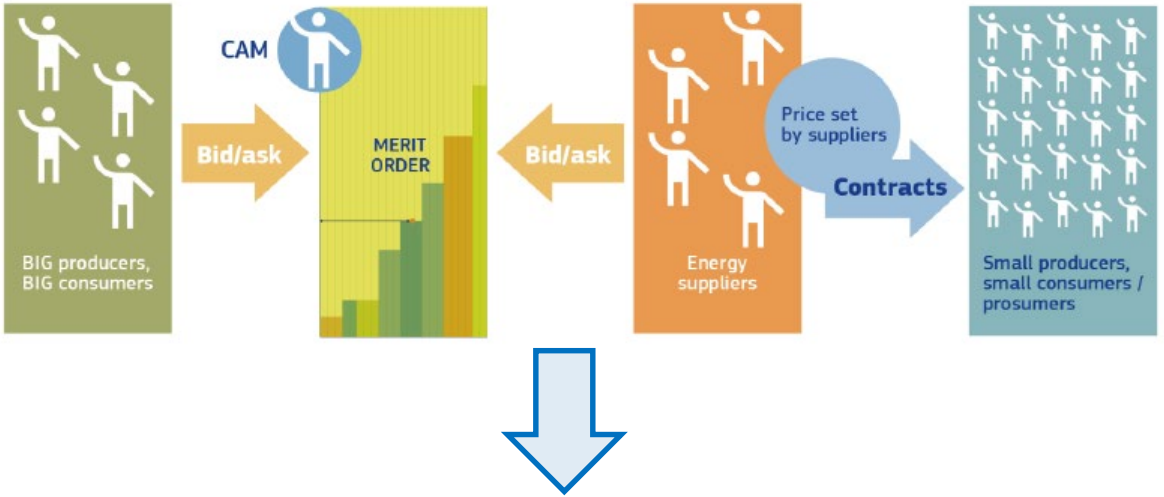
Current electricity market: smaller consumers are unable to negotiate retail prices



2 possible ways to empower consumers

2 possible ways to empower consumers

Adaptation of existing market structures through platforms and tariffs

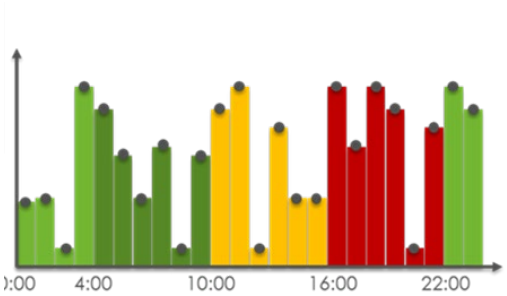
- Traditional (Time of Use) tariffs
- Tariffs based on Grid Topology
- Capacity / Peak tariffs
- Integration of DER in Ancillary Services markets

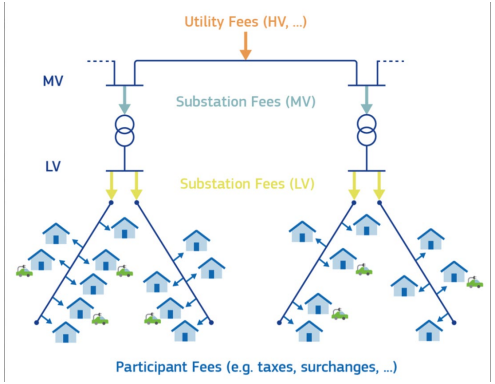
Adaptation of existing market structures through platforms and tariffs

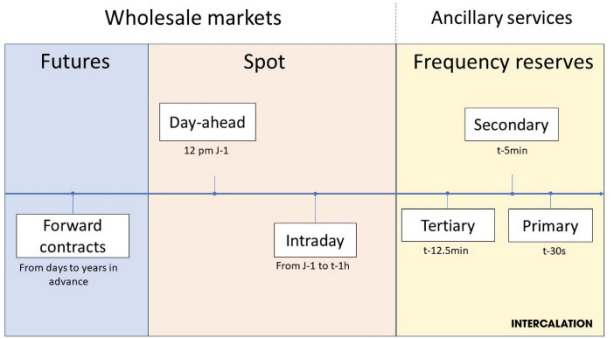
- Local energy markets involving aggregators
- Fractal-based market restructuring

Adaptation of existing market structures through platforms and tariffs

- Traditional (Time of Use) tariffs
- Tariffs based on Grid Topology
- Capacity / Peak tariffs
- Integration of DER in Ancillary Services markets





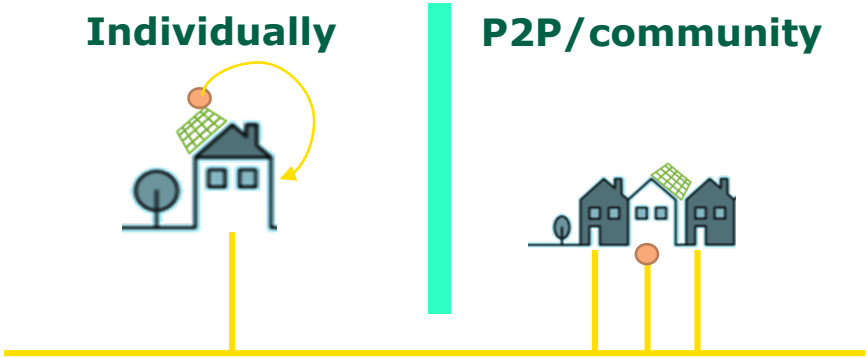


Case study Flanders: cost-benefit analysis

Cost-benefit analysis to examine:

- whether activities of energy communities and active customers in a building,
- can contribute to the relief of the distribution network,
- including the avoided investments and costs in the network,
- and whether adapted grid tariffs and incentives are needed to reward them.

Case study Flanders: individually vs P2P



	Self-consumption from own PV-installation	Consumption from shared energy from neighbor's PV-installation
Energy price	No payment due	Smaller payment due to your neighbor
Grid tariffs	No payment due	Payment due
Taxes	No payment due	Payment due

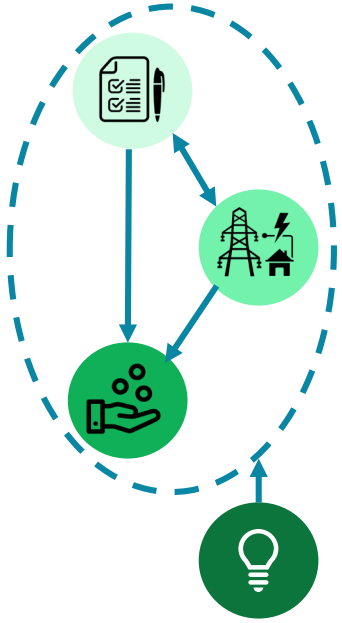
The development of network tariffs is subject to different directives and regulations. For instance: grid tariffs are to be cost-reflective and they should cover the costs of the activities of the grid operator

Directive 2019/944 (recitals 81, art. 15 and 16) and regulation (2019/943) art. 18.)

"We make less usage of the grid"

"Discrimination compared to individual self-consumption"

Case study Flanders: leading questions



Boundary conditions	What boundary conditions should the collective activity meet to realize a positive grid impact?
Impact distribution grid	What is the impact of collective activities on the distribution grid and the costs of the grid operator?
Economic incentives	How can a positive grid impact be incentivized through economic incentives?
Context	What are other contextual elements or lessons learned that need to be accounted for?
Conclusion	What are the final recommendations and further research questions derived from this study?

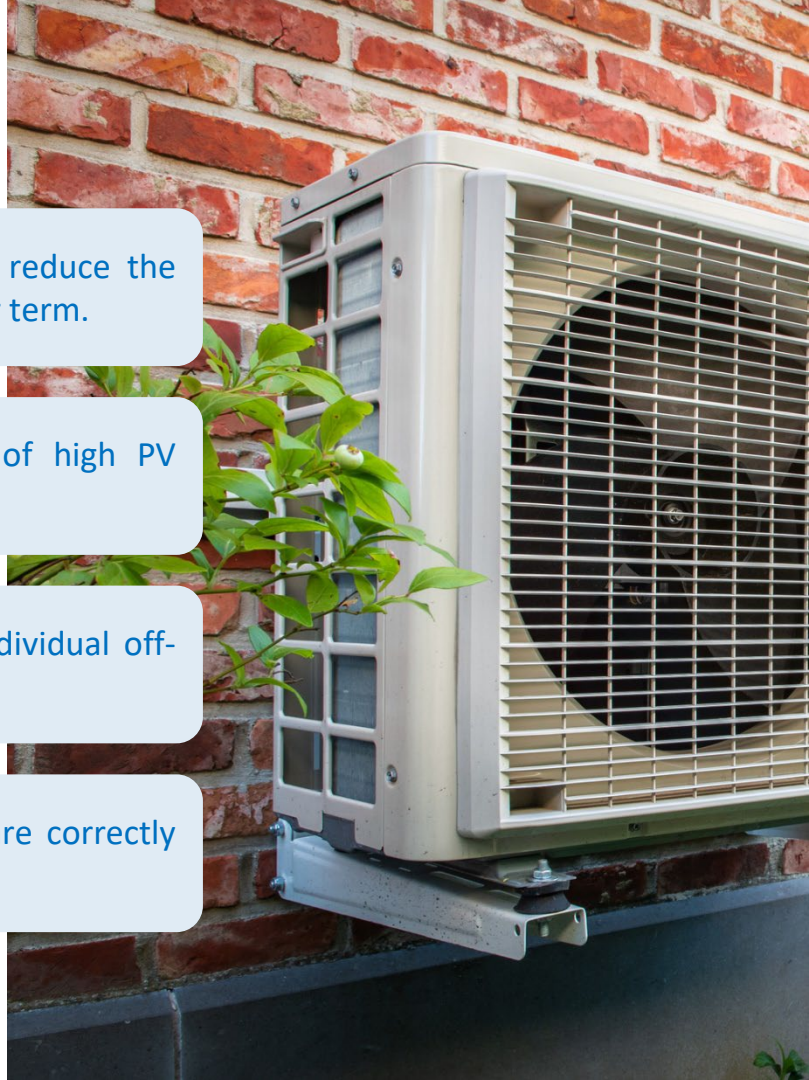
Case study Flanders: conclusions

With larger volumes of flexibility, there is an opportunity to reduce the injection peak. However, this effect is mainly visible in the longer term.

Offtake peak does not sufficiently coincide with moments of high PV production so changes in offtake peak are not significant.

There is an increased probability of greater simultaneity of individual off-take peaks if there is no incentive to monitor the system peak.

Electricity flows through the grid decrease if PV-installations are correctly sized compared to the number and type of participants.



Conclusion

No discrimination between end users based on participation in collective activity:

technology- and customer-neutral policies

15:30 – 15:40

European Commission

Redesign of market structure: The rise of the local market

Nuno de Souza e Silva
ETIP SNET and R&D Nester

Janka Vanschoenwinkel
ISGAN and VITO

Luciano Martini
ISGAN and RSE Spa

Irina Oleinikova
ISGAN and NTNU

Energy communities participation in energy markets

Energy communities can participate in energy markets in several ways, including selling excess energy back to the grid, providing demand response services, and participating in peer-to-peer energy trading platforms, thus generating revenue, helping balance the grid and supporting the integration of RES. Existing methods include:

Feed-in premium

- In feed-in premium (FIP) schemes, electricity from renewable energy sources (RES) is exchanged on the electricity spot market and RES producers receive a premium on top of the market price
- FIP can either be fixed (i.e. at a constant level independent of market prices) or sliding (i.e. with variable levels depending on the evolution of market prices)

Net metering

- Is an electricity billing mechanism that allows prosumers who generate some or all of their own electricity to net their production with the consumption
- The energy is cleared at predefined time slots

Collective Self Consumption

- REDII directive: Jointly acting renewables self-consumers: a group of at least two cooperating “renewables self-consumers [...] who are located in the same building or multi-apartment block” or, where permitted by a member state, within other premises

Key features of the legal framework for energy communities participation in flexibility markets

The legal framework for energy communities participating in flexibility markets varies by country, but is largely influenced by European Union directives and regulations

The common Key Features identified across the different European frameworks are:

1. Need for **legal recognition** of energy communities and support mechanisms for their formation and operation
2. Ensuring a non-discriminatory access to electricity and **flexibility markets**
3. Enabling participation in **demand response programs** and allowing aggregation of distributed resources to provide flexibility services
4. Frameworks that facilitate the provision of **ancillary services** by energy communities to **support grid stability and reliability**
5. Support for the deployment of **smart technologies** such as smart meters, which are crucial for participation in flexibility markets.

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Redesign of market structure: the rise of local market

Potential

The potential of local energy markets is considered very high in the literature:
Nearly all publications identify them as **crucial to promoting the integration of large-scale renewable DERs (Distribute Energy Resources) and creating viable EnCs (Energy Communities).**

The local energy market can provide ancillary services and relieve the balancing market needed to meet electricity demand.
It opens doors for the interactive grid and customer participation.

Challenges

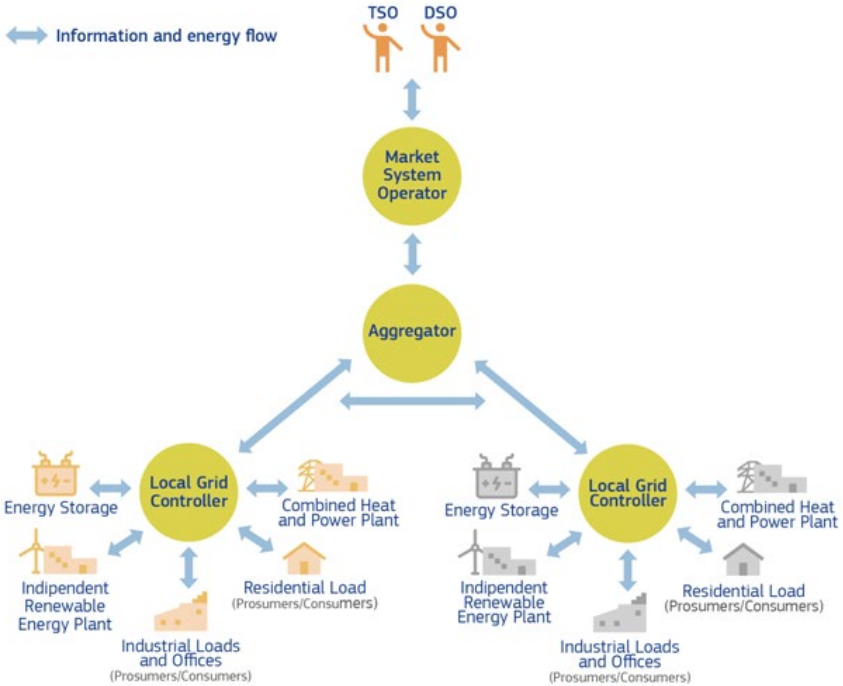
Despite all the developments and progress, **many challenges** have been identified.

They are **mainly related to coordination within the power grids (between transmission and distribution)**, the power grid with the customer, and the new local market structure.

Process for involving aggregators in market design

The process for involving aggregators in market design is divided in the following steps:

1. Prosumers/consumers send **power demand and generation data** to the local grid controller, initiating the auction process
2. Final users and the aggregator **submit bids** based on energy price and volume
3. The market system operator **matches bids with power requirements** between aggregator and TSO/DSO
4. TSO/DSO interact with **day-ahead and real-time markets**, while the intra-market helps adjust the clearing of the real-time market via an aggregator
5. Once the market is cleared, results are communicated, and the **aggregator provides services and delivers power to prosumers** through the local grid controller



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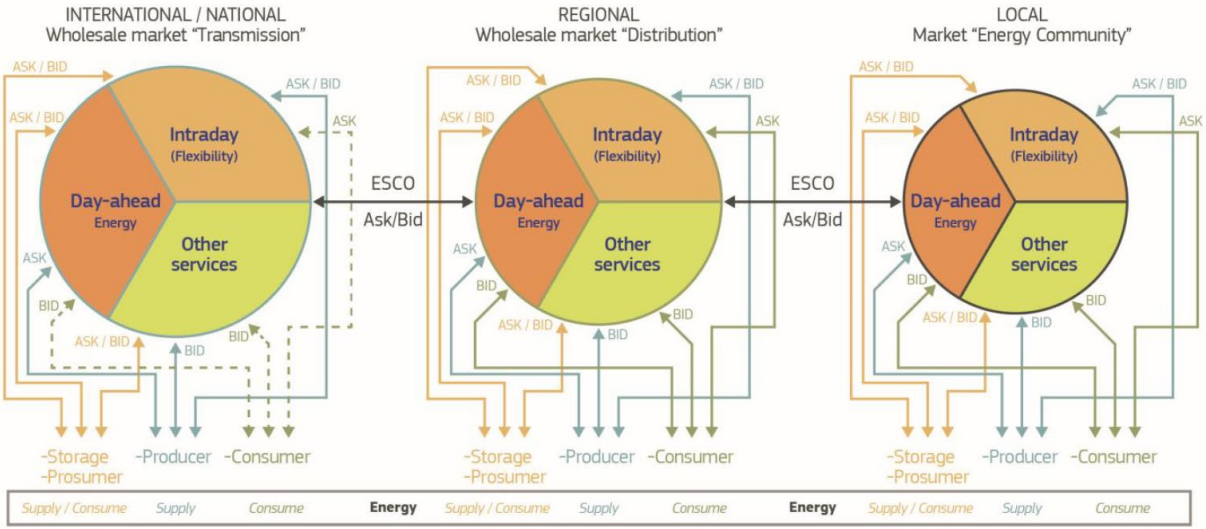
Fractal-based market restructuring

The **fractal-based market restructuring** aims to provide consumers with reliable, environmentally friendly electricity at the lowest possible cost and to promote EnCs and sector coupling.

It has pursued **two main objectives:**

1. **Operation efficiency**, making the best use of existing resources.
2- **Stimulate capital investment** by providing appropriate incentives for its efficient use.



The new market design, shown in Figure, is harmonised with the fractal structure of smart grids.

It increases the space granularity of the electricity market, establishing different market categories such as the **national/international markets in the transmission area**, **regional markets in the distribution area**, and the **local markets in customer plants EnC-area**.

Splitting markets at the national/international, regional, and local levels significantly reduces the current complexity due to the variety and economics of the resources, their uncertainties, and power system constraints.

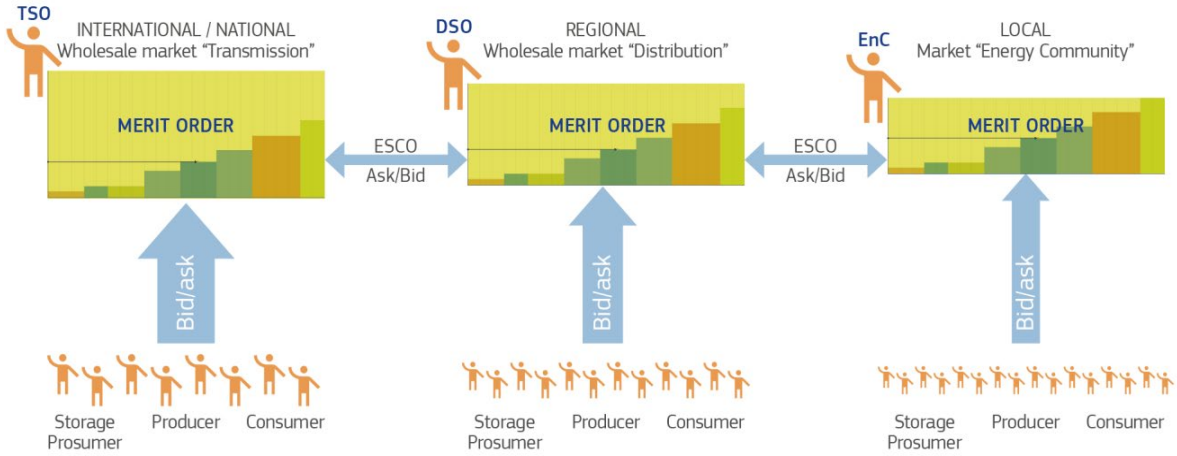
European Commission

Pricing mechanisms used in the different fractal structures of the market

The **trading volume defines the market size**. It refers to the total energy traded during a specific period.

Based on **LINK-Architecture**, production and storage facilities are available in all smart grid fractal levels.

The **Merit Order** mechanism has long been established in the electricity market



The figure shows an overview of the pricing mechanisms used in different fractal structures of the market. The Merit Order mechanism is used in the international, regional, and local markets based on the main fractal principle of repeating the same shape and features in various structure sizes. It enables demand and supply market forces to play freely.

The local EnC market is designed to allow neighbours to supply each other with electricity and democratically set the pricing rules. This approach makes them more independent of international and regional electricity market developments.

Conclusions

Energy communities can contribute to RES promotion and energy savings, providing benefit for their members and/or the local community, based on democratic processes

Local energy markets are expected to:

- Operate for the **benefit of consumers** by serving their loads in an optimal way
- Increase the **integration of distributed generation**, by ensuring the absorption of the energy produced and increasing the return on investment
- Contribute to the **improved operation of the distribution network**, if **ancillary service** markets are properly organized

15:40 – 15:45

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Development of regulation and business organisation

Nuno de Souza e Silva
ETIP SNET and R&D Nester

Janka Vanschoenwinkel
ISGAN and VITO

Luciano Martini
ISGAN and RSE Spa

Irina Oleinikova
ISGAN and NTNU

Development of regulation and business organisation

Key elements

- Collaboration, and TSO-DSO coordination
- Common rules, corresponding market mechanisms and platform
- Flexibility technologies, services and platforms
- Business models
- Consumers engagement and co-creation, replicability and upscaling
- Standardization of network appliances/devices

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Development of regulation and business organisation

Specific needs and developments

- Transition to the DSO (from DNO to DSO)
- Data analytics and data visualization
- Flexibility in the network planning
- Availability of reliable services for consumers
- Sector integration solutions and flexibility valorization
- Advisory services on flexibility modeling and business modeling
- Support for policy, regulation, network codes and standardization

15:45 – 15:50

European Commission

Q&A Session

Nuno de Souza e Silva
ETIP SNET and R&D Nester

Janka Vanschoenwinkel
ISGAN and VITO

Luciano Martini
ISGAN and RSE Spa

Irina Oleinikova
ISGAN and NTNU

15:50 – 16:10

Experiences from Energy Communities projects

PLATONE and INTERACT projects

Ilaria Losa
ETIP SNET, RSE and Platone Project

Helmut Brückner
ISGAN, Sonnenplatz Großschönau and Interact Project

15:50 – 16:10

Experiences from Energy Communities projects

PLATONE project

Ilaria Losa
ETIP SNET, RSE and Platone Project

Helmut Brückner
ISGAN, Sonnenplatz Großschönau and Interact Project

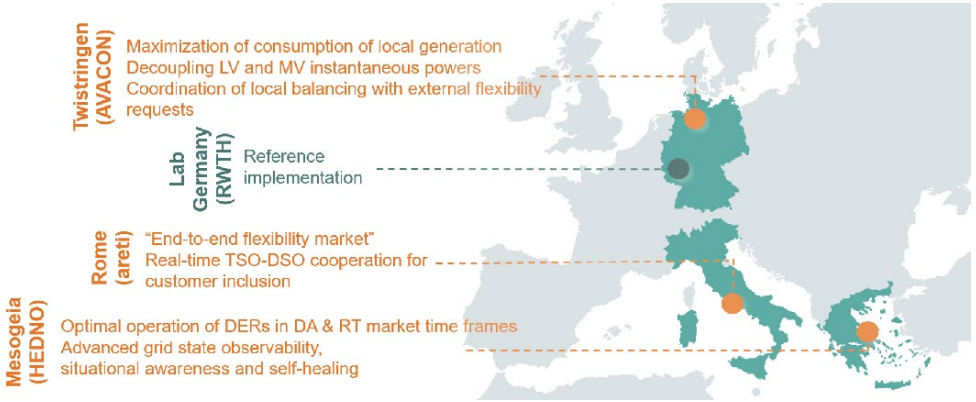
Platone project: Experiences from Energy Communities projects

15:50 – 15:57

Key developments

- Platone Open Framework, platforms and algorithms further developed and deployed
  - tested successfuly in all demos
  - open source through LFE
  - Platform scalability analysis conducted
- Local Flexibility Market implemented in Italian demo
- Coordination and control of DERs and increased obserability in Greek demo
- Monitoring and control of small-scale LV flexibilities in German demo

Platone field and tests and simulation



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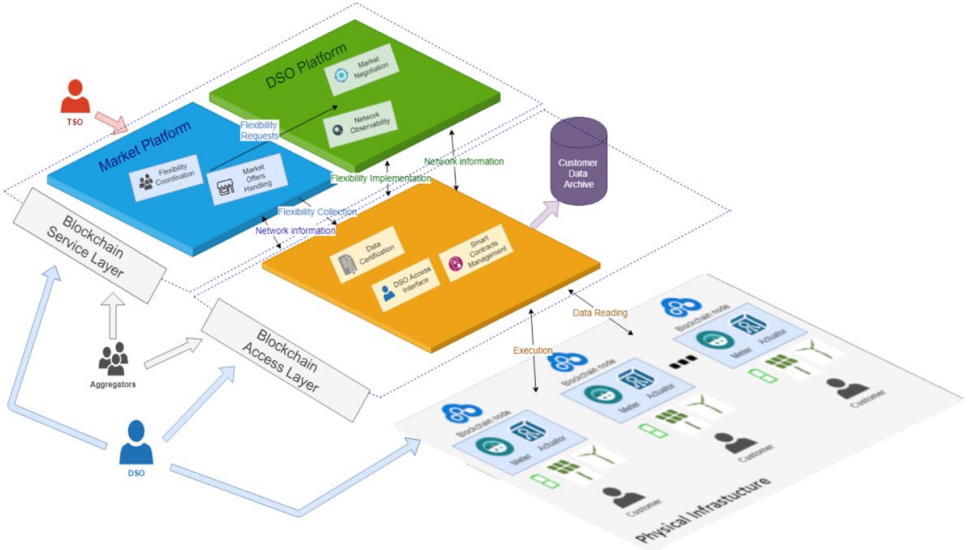
Platone project: Open Source and dual use of data as key ingredient of an open platform

- Architectural proposal of H2020 Platone:
  - Multi-layered hybrid IoT/off chain vs DLT/Blockchain/Smart Contract to enable:
    - Consumer access layer
    - Optimal coordination and operation of fair and transparent multi-stakeholder marketplaces
  - Dual use of data for market and technical services
  - Integration of legacy solutions



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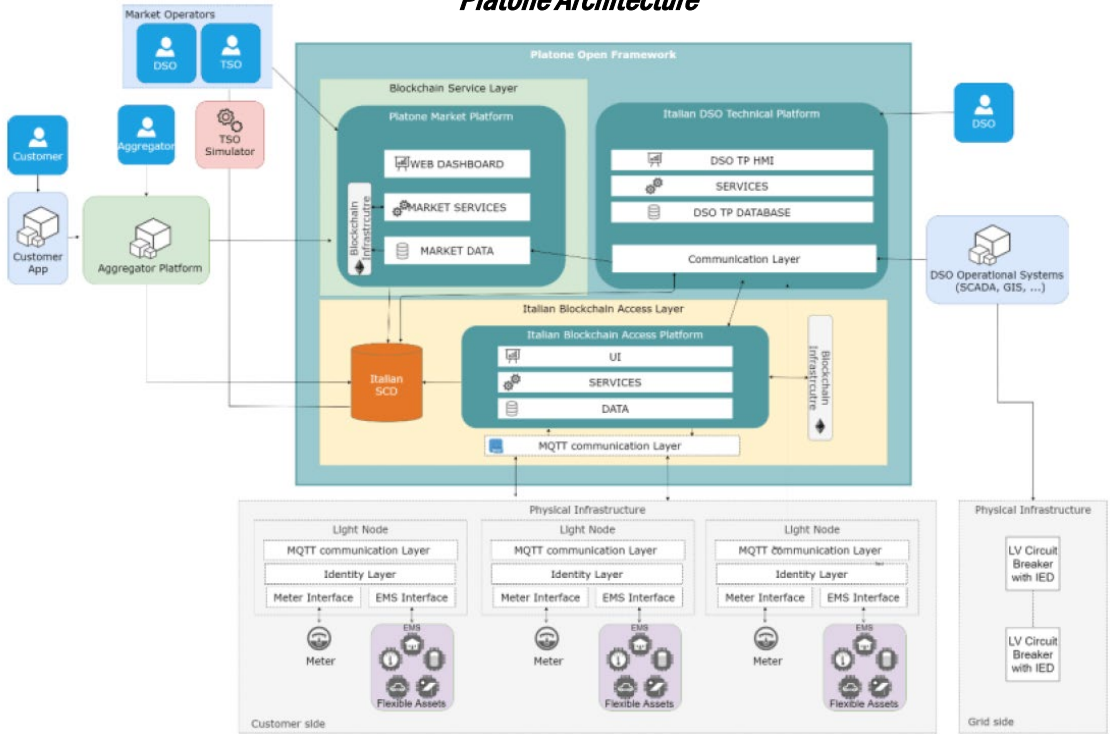
Platone project: Italian Demo Architecture

WP3
Italian Demo
WP Leader: aAeti

Components of the Italian Demo

Platone Architecture



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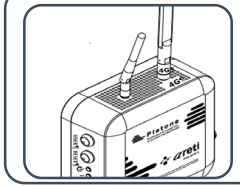
Platone project: Main achievements and lessons learned



Measurements from the field

• Significant updates were made about the communication between Light Node and smart meters. For all the users involved in the project has been activated the profile able to transmit the high granularity data to improve the flexibility process.

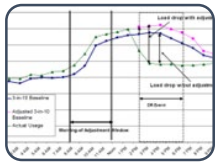
DSO Technical Platform

Grid configuration

Update of the DSO TP Algorithms to take in care in the flexibility requests the grid re-configurations. In detail, power flow calculations manage the flexibility requests considering different networks, in compliance with the real-time market sessions.

Scalability Test

Test have been done to allow smooth scalability and uniform communication across the platforms. Three different scenarios have been performed starting from the actual involved users to almost a thousand ones.



Baseline

• A standard Baseline for procurement phase and an adjustment baseline for the settlement phase has been implemented in the Shared Customer Database.

Platone Architecture is adopted also in **RomeFlex**, an Areti project in compliance with Italian NRA Regulation 352/2021 on Local Flexibility Market. RomeFlex **empowers the DERs** massively to provide local ancillary services through transparent and **blockchain-certified** mechanisms, stimulating the growth of an **open and inclusive market.**

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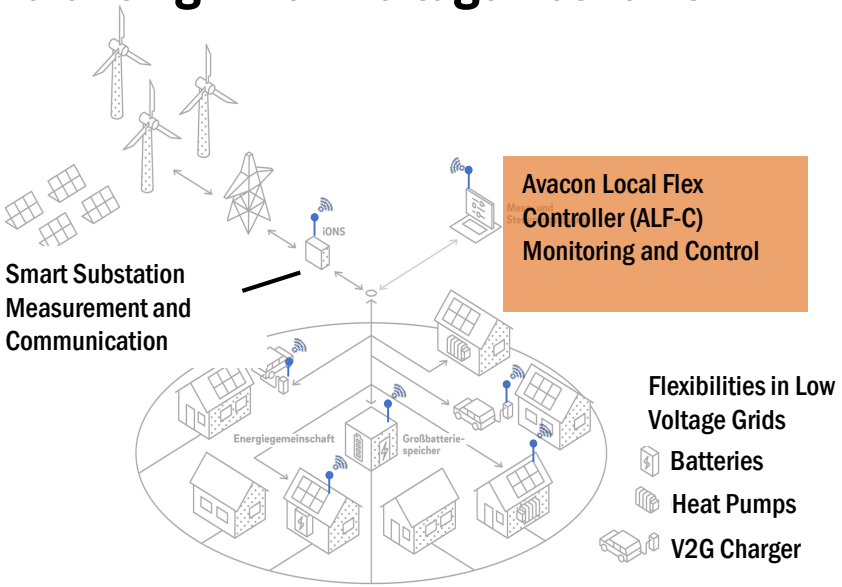
Platone project: KER – Local Flex Controller

Balancing in Low Voltage Networks



Use Cases

Implementation as benefit for DSO, TSO, aggregator and customers (energy communities):

- Virtual Islanding aims at increasing local self-consumption on a local level and decrease of power peaks
- Coordination of Flex-Activation involving different roles (e.g., DSO, TSO, Aggregator)
- Ex-Post Energy Export and Ex-Ante Energy Import in Bulks to reduce stress on medium voltage grids

avacon

European Commission

Platone project: Follow upon Platone and Related Initiatives

Rome's Status

- Transition from research to a commercial project.

Italian Projects Spurred by ARERA

- ARERA's directive inspired several new initiatives.
- Projects extend to other DSOs linked with Areti (e.g. Milano)
- **New Approval:**
  - With Resolutions 372/2023/R/eel and 121/2024/R/eel, ARERA has definitively approved the joint project developed by Areti and GME in response to Resolution 352/2021.

German Demo Development

- Avacon and RWTH expand on the demo within the Kopernikus ENSURE research project.

German Initiative: OpenEnergyTwin

- Launched by Fraunhofer, RWTH, and OFFIS.
- Funded by BMBF, focuses on advancing the SOGNO platform.

European Projects Utilizing SOGNO

- BEFLEXIBLE and InterScada among the projects adopting the SOGNO platform.

15:50 – 16:10

European Commission

Experiences from Energy Communities projects

INTERACT project

Ilaria Losa
ETIP SNET, RSE and Platone Project

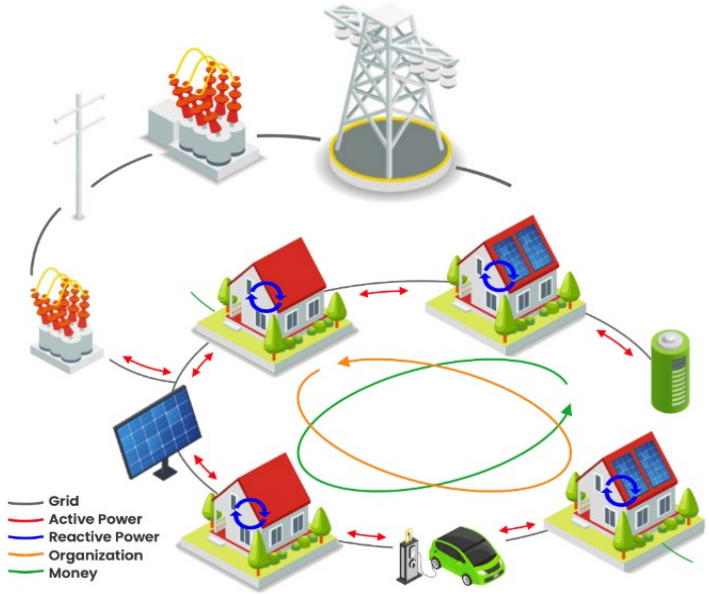
Helmut Brückner
ISGAN, Sonnenplatz Großschönau and Interact Project

INTERACT project: Introduction

15:57 – 16:05

Status quo:	**Activities of the energy communities are limited to a series of contracts for the purchase/sale of electricity**
Target:	**Developing organizational & technical foundations for energy communities that operate in harmony with the grid**

- Develop a roadmap for the implementation of fully integrated Energy Communities based on
  - stakeholder analyses
  - PED best practices and success factors
  - a holistic technical system architecture
- Two pilot regions are analysed:
  - Großschönau: existing village in Austria.
  - Fylling: development project in Sweden.



INTERACT project: Introduction

- **INTERACT** was a transnational research project supported by the Austrian Ministry of Climate Action, Environment, Energy, Mobility, Innovation, and Technology (BMK), Technology Agency of the Czech Republic (TAČR) and Swedish Energy Agency / Viable Cities, Sweden.
- It has received funding in the framework of the **PED Programme**, implemented by the Joint Programming Initiative Urban Europe and SET Plan Action 3.2. The project has been selected for funding **in Positive Energy Districts (PEDs) pilot call JPI Urban Europe**. (see also https://jpi-urbaneurope.eu/ped/)
- **Project Duration:** February 2021 – January 2023
- **Total budget:** 575.000 EUR

Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

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TU WIEN

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INTERACT project: Outcome

WP 2 – Stakeholders & Best Practice

~60 projects in Europe analysed
~20 Interviews with actors in AT & SE
→success factors for EC implementation

WP 3 – Technology

→Common data inventory methodolgy
→Grid simulation in SINCAL for AT pilot
→Communication technology architecture with links to grid and market

WP 4 – Organisation & Operation

→Organizational Structure of EC's
→Technical Use Cases of the EC
→Proposed new market structure in line with power grid structure

Roadmap for the implementation of fully integrated Energy Communities

WP 5 – Legal & Economics

→Legal status on ECs within Europe
→Business Models for ECs
→Economic evaluation and contracting models for ECs

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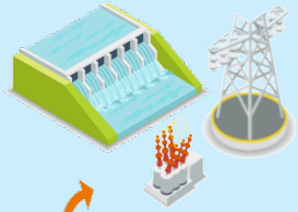
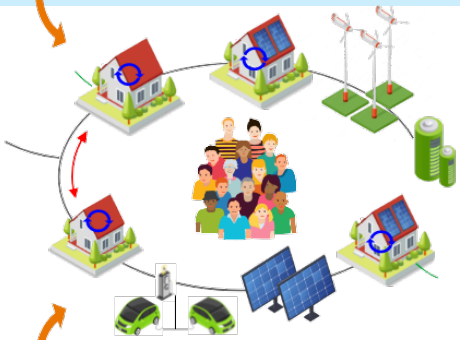
INTERACT project: Result - Fully Integrated Energy Community



harmonized with the power grid

- ✓ Holistic system architecture ensures a standardized structure across all network levels and customer installations, and enables their seamlessly coordinated integration and operation
- ✓ Appropriate reactive power control strategy increases grid capacity, reduces data exchange



- ✓ Citizen centred approach based on trust, transparency and fairness
- ✓ Creation of a local market to optimize the fit of production and demand, and strengthen local value streams
- ✓ Community building and knowledge exchange to strengthen social cohesion and local capabilities

integrated to the energy exchange

- ✓ New market structure proposed:
  national, regional and local market levels
  with vertical integration

INTERACT project: Vision of a Fully Integrated Energy Community

10 Key Implementation Steps to get there:

- Technology: Harmonize customer plants and power system
- Regulation: Fractal Market solution: national, regional and local market
- Regulation: Alignment of legislation on the organization of RECs
- Regulation: Detail Standards and rules for new market structures
- Regulation: Legislation and Grid Codes
- Technology: Establish norms for technology providers
- Policy: Supporting pilots of fully integrated energy communities
- Stakeholder Integration: enable and facilitate participation
- Policy: Large scale roll-out of fully integrated energy communities
- Policy: Continuous Improvement

16:05 – 16:10

European Commission

Experiences from Energy Communities projects

Q&A

Ilaria Losa
ETIP SNET, RSE and Platone Project

Helmut Brückner
ISGAN, Sonnenplatz Großschönau and Interact Project

16:10 – 16:15

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Conclusive remarks

Recommendations on innovation and research activities

Albana Ilo
ETIP SNET and TU Wien

Conclusive remarks

- **Energy Communities locally support the growth of society by promoting investment in DERs and democratising the energy industry.**
- EU policymakers have adopted legislation to support Energy Communities taking responsibility for the energy transition. Their **practicable implementation requires further legislative support.**
- The new role of **Energy Communities represents an opportunity and a challenge for DSOs and TSOs.**
- Energy Communities can **unlock active consumers' flexibility potential**, integrating distributed renewable resources and new technologies more effectively.
- To achieve the desired maturity, **energy communities need to be viable by becoming reliable players** so that DSOs can better integrate the flexibility and other services they acquire into their processes without compromising the quality of the power supply.
- **Establishing a holistic functional architecture** considering the entire grid, customer plants and market **will help to develop a standardised, replicable and repeatable solution.**

Recommendations on innovation and research activities

The following roadmap is proposed to ensure the convergence of R&D results and to enable the development of fully integrated EnCs.

1. Preparation and Pilot Phase

It extends over six years. Establishing a holistic architecture enabling a comprehensive solution is crucial in this period. A European strategy/initiative that guides Member States will effectively avoid any lack of EU-level coordination that would lead to European inequalities.

1a. Establishing a holistic architecture enabling a comprehensive solution

1b. Solutions to mitigate grid-related challenges

1c. Scalability and Replicability and Cost Benefit Analysis

2. National strategies

The stage of the National Strategies extends over one or two years: It aims to prepare the framework at the national level after the European strategy is consolidated.

3. Fast Promotion

It spans five years to advance large-scale implementation of fully integrated EnCs rapidly

16:15 – 16:45

European Commission

Roundtable discussion

Santiago Gallego
ETIP SNET and i-DE (Iberdrola Group)

Luciano Martini
ISGAN and RSE Spa

Achille Hannoset
DG ENER

Nikos Hatziargyriou
ETIP SNET, ISGAN and NTUA

Roundtable discussion questions (Albana I.)

1. Why and how should Energy Communities become reliable actors in the landscape of energy stakeholders? *(Achille H., Luciano M., Santiago G.)*

2. What are the best ways for TSO-DSO cooperation in the framework of Energy Communities in the new electricity era? *(Santiago G., Nikos H.)*

3. Which of the following market development trends will promote Energy Communities and the energy transition process; and how? *(Achille H., Luciano M., Nikos H.)*
   - Adaptation of existing market structures through different platforms and tariffs;
   - Redesign of market structure: The rise of the local market.

4. **Is there the need to perform an assessment of existing "smart grid" concepts to create clarity and bundle resources to accelerate the energy transition?** ***(Albana I., Nikos H., Achille H.)***

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Thank you!