Differences and Synergies between Microgrids and Local Energy Communities

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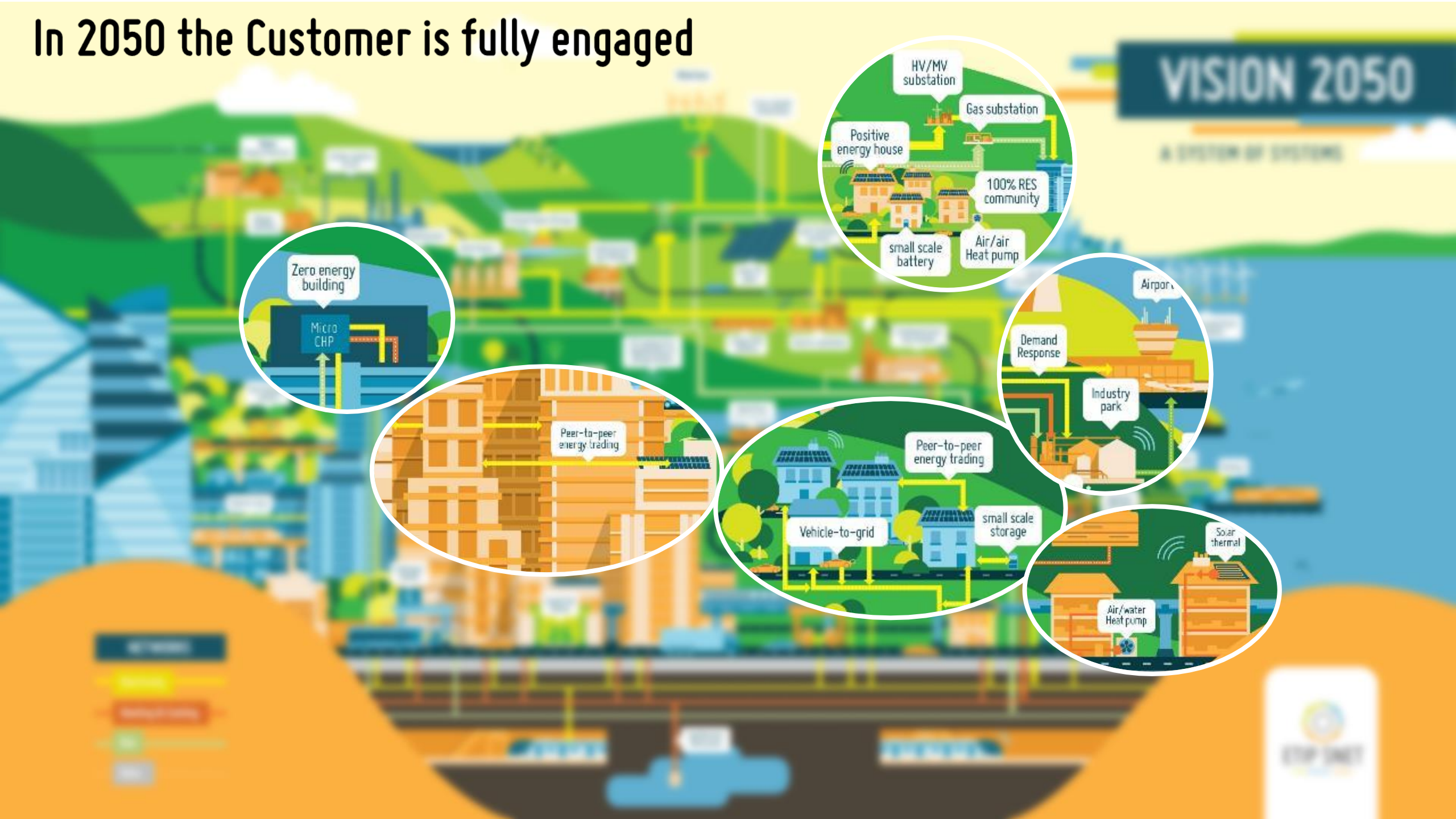
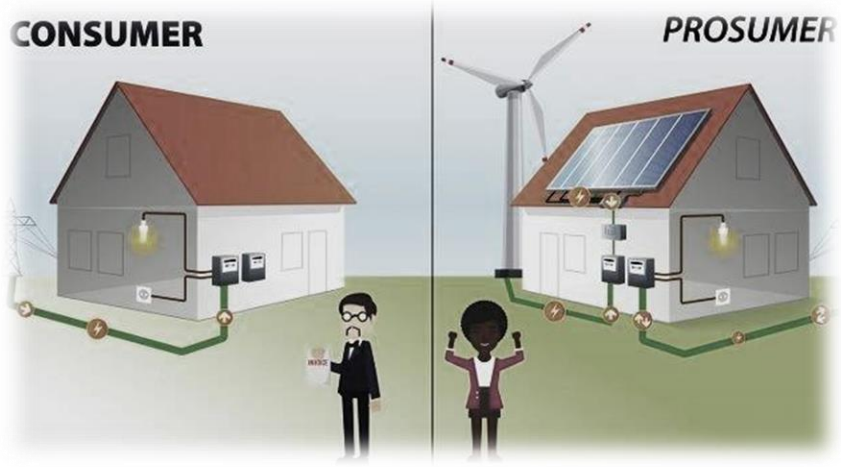
VISION 2050

A SYSTEM OF SYSTEMS

In 2050 the Customer is fully engaged



Local Energy Communities (LECs)



Electricity Directive COM(2016) 864 final/2

An association, a cooperative, a partnership, a non-profit organisation or other legal entity which is effectively controlled by local shareholders or members, generally value- rather than profit-driven, involved in distributed generation and in performing activities of a distribution system operator, supplier or aggregator at local level, including across borders

Long Tradition in Europe: in **Germany** over 650 Stadtwerke (local utility companies that provide heat and electricity) , in the **Netherlands**, over 200 local initiatives involved in RE, including over 55 registered cooperatives, in **Denmark** 100s of electricity production (CHP) and community district heating (CDH) systems, 100 wind cooperatives.

Community Energy Systems

Community Energy Systems can be defined as decentralized energy systems that directly or indirectly involve community as stakeholder in energy production and use.

Community Energy Systems typically utilize locally available renewable sources for energy generation.

Some of the projects involve 100% community participation and some include participation with government and non-government entities.

Community Energy Systems are usually based on microgrids and utilize one or more types of renewable resources.

Benefits of Community Energy Ownership

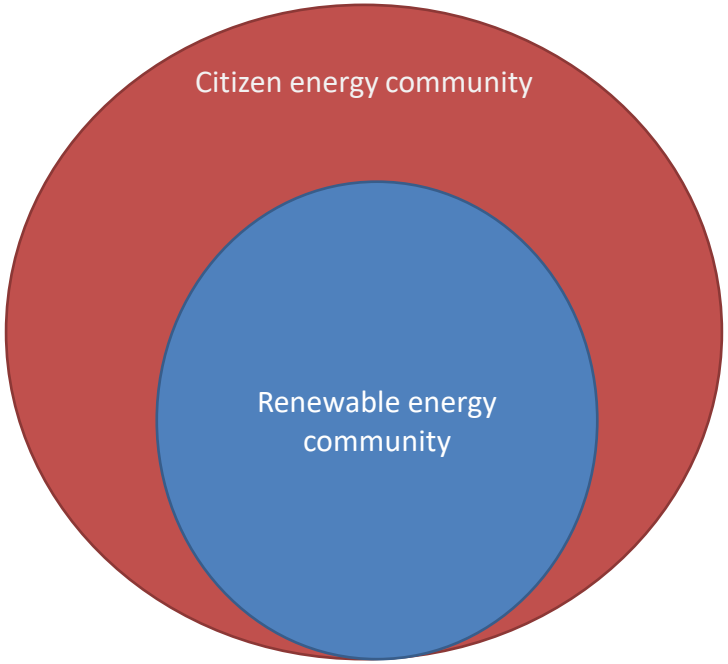
- Revenues from local renewables to meet local needs (e.g. supply, other services, education, renovations, energy poverty)
- Democratic community ownership, empowerment
- Economic benefits for participants (e.g. energy bill savings, return on investment)
- Public acceptance
- Promotion of uptake of clean energy technologies& benefits to energy system

European Legal Framework

Currently there are two definitions for energy communities in Europe.

Clean energy for all Europeans package

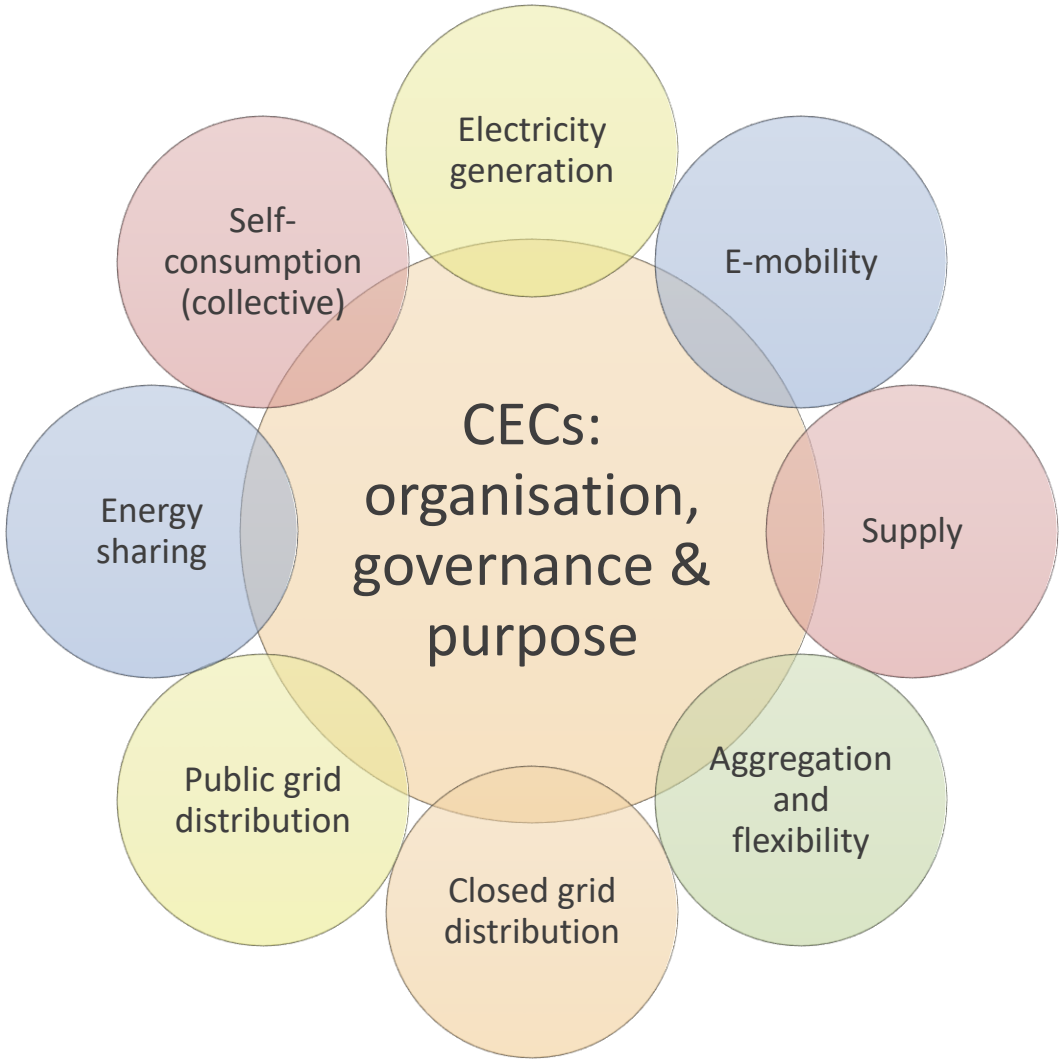
- Renewable energy directive (REDII) 2018/2001/EU
- Electricity market directive (EMD)

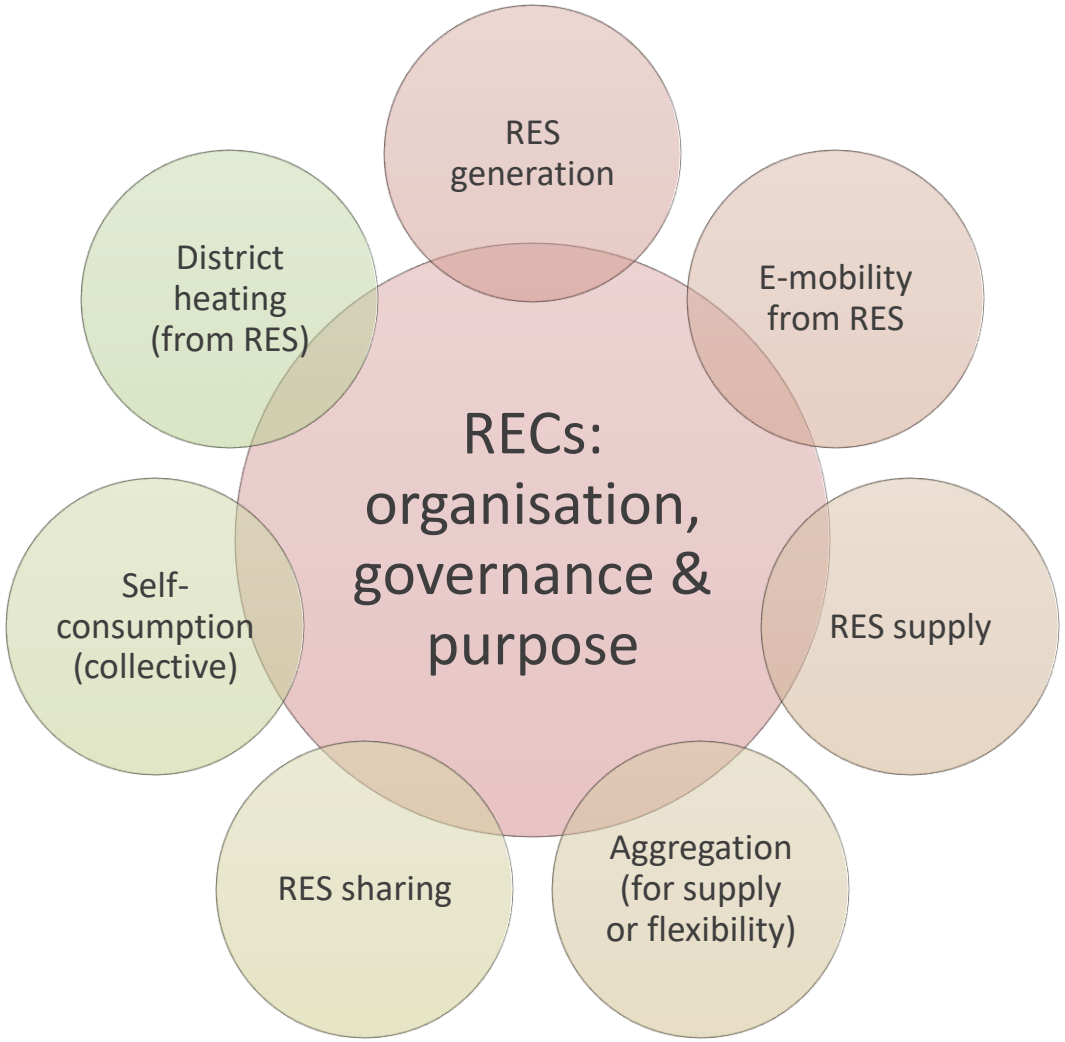


The following characteristics apply to both definitions:

- Legal entity
- Non-commercial purpose
- Open & voluntary membership
- Emphasis on economic participation by citizens, small and medium enterprises and public authorities
- Emphasis on ‘effective control’ by members not engaged in the energy sector

Energy Communities: organizing participation in activities across the market





Energy Communities: CEC and REC

1) Energy communities can help deliver EU energy and climate objectives, while delivering social innovation at the local level

2) Under CEP (Clean Energy Package), energy communities are conceptually defined as non-commercial market actors, and an organizational/social concept

3) Energy communities are not framed around a specific activity – organizational model can be applied to different activities across the market

4) Principles in the definitions are meant to be applied according to context at national level

5) It doesn’t end with a concept - Definitions need to be coupled with enabling frameworks and a level playing field

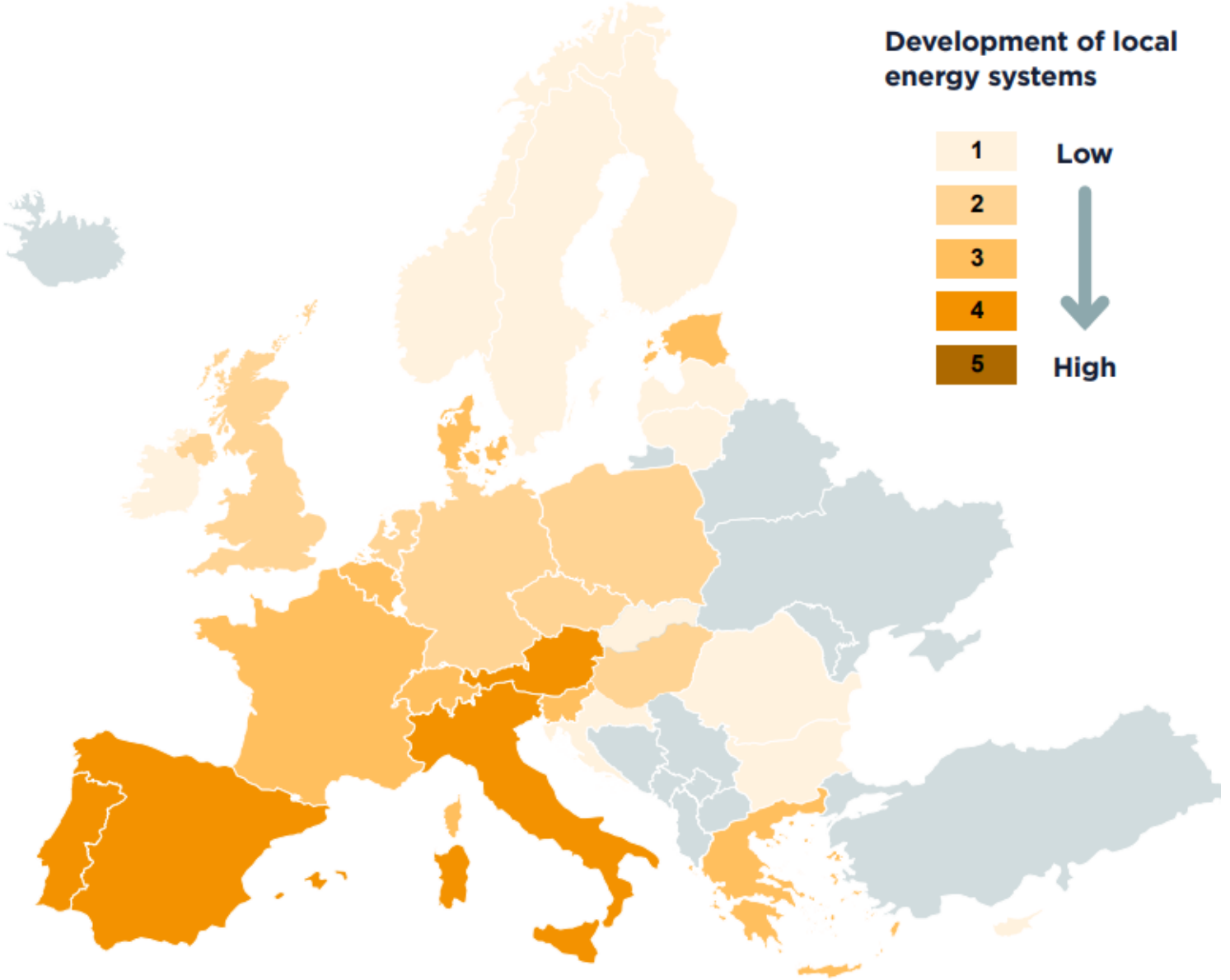
Energy Communities: Barriers

Practical Challenges:

- Lack of experience/expertise & reliance on dedicated volunteers
- Lack of information
- Governance/decision-making efficiency
- Access to finance / investment risk mitigation
- Unequal access to means of investment

Policy-related challenges

- Lack of recognition or strategy/objectives for supporting ECs
- Unstable/market-based incentives structures, particularly for renewables production
- Overburdensome (strict licensing requirements, connection rules) and restrictive regulation (tariffs)
- Complex and non-transparent administrative procedures and related costs (e.g. grid connection, planning)
- Unsuitable laws for legal forms
- Public procurement rules



Portugal, Spain, Italy and Austria leading countries for energy communities, increasing interest in other EU countries

Federation of Energy Communities: European Examples

REScoop.eu is the European federation of citizen energy cooperatives.

Growing network of 1.900 European energy cooperatives with 1.250.000 citizens who are active in the energy transition.

REScoop.EU

FEDERATION OF GROUPS AND COOPERATIVES OF CITIZENS FOR RENEWABLE ENERGY IN EUROPE

Local Energy Trading – Local Markets

Benefits for the grid

Reduction in the public grid usage, thus, reducing the distribution cost. Optimizes the existing grid infrastructure, reducing the need for expansion.

Financial benefit

Tangible financial benefits for the members and the community

Social benefit

Use of RES, reducing the environmental impact

Solidarity

Can support vulnerable citizens by sharing part of the energy.

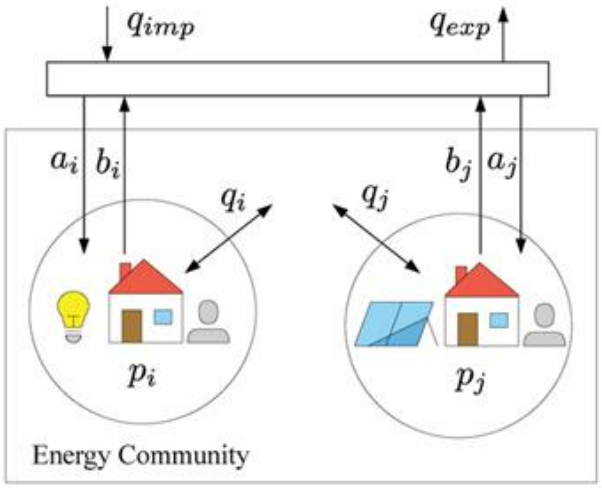
Understanding the problem

Understanding how the energy system operates – shift in consumer behavior

Citizen participation

Democratization of the energy system by the participation of citizens

LEM and Energy communities



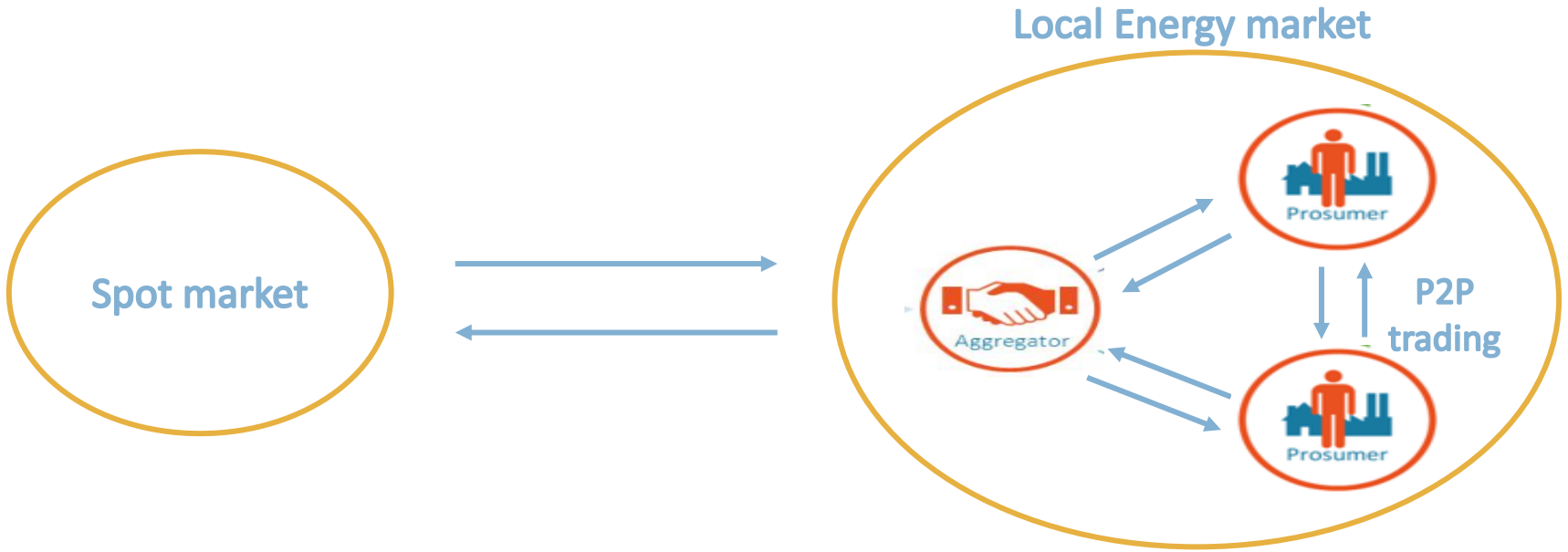
•Energy communities can control and coordinate the operation of small DGs, which enables them to develop and operate **local energy markets**, where members can trade their excess energy.

•The participation in the local market has tangible economic benefits for all participants.

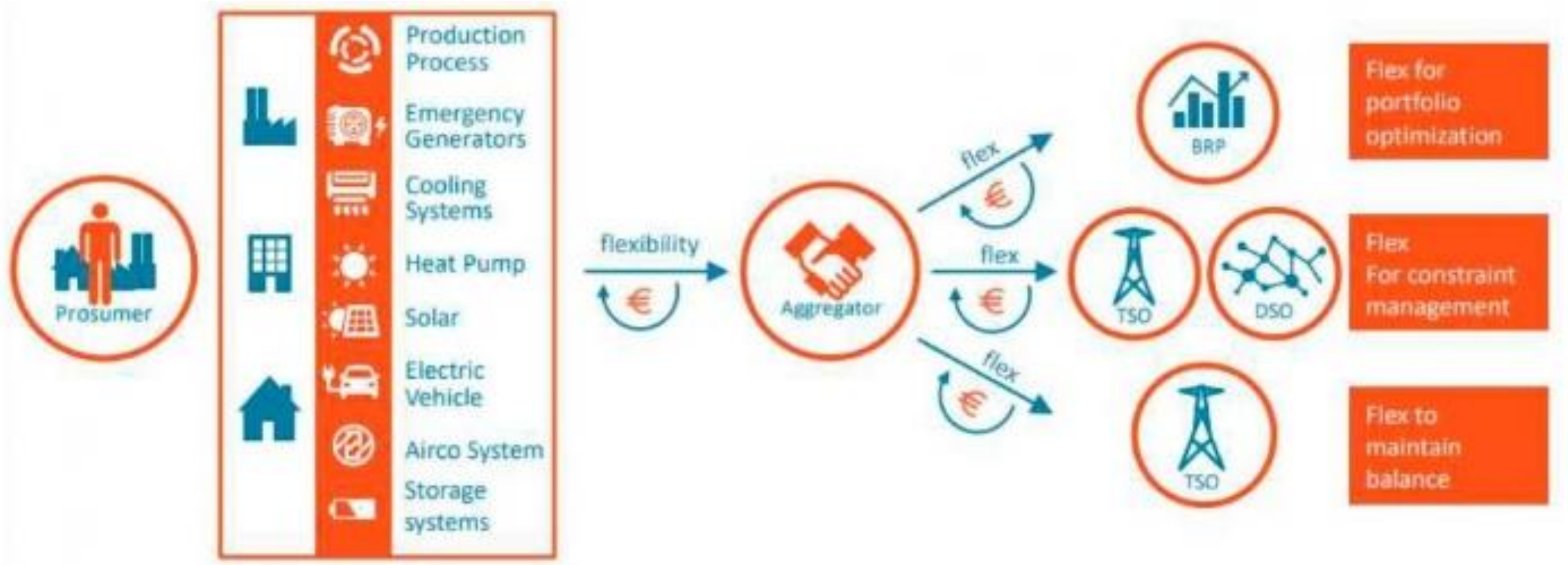
Local Energy Markets (LEMs)

- Platforms facilitating energy exchanges on a local level
- They operate based on the concept of Transactive Energy, on a local scale
  - ***Real time control*** *of distributed energy resources (DER),* ***based on economic or market-based constructs****, exchanging information and exchanged in a* ***decentralized way****, while considering grid reliability constraints*

Types of trading: peer-to-peer, through LEM managers, combination of peer-to-peer and LEM manager



Flexibility – Demand Side Management



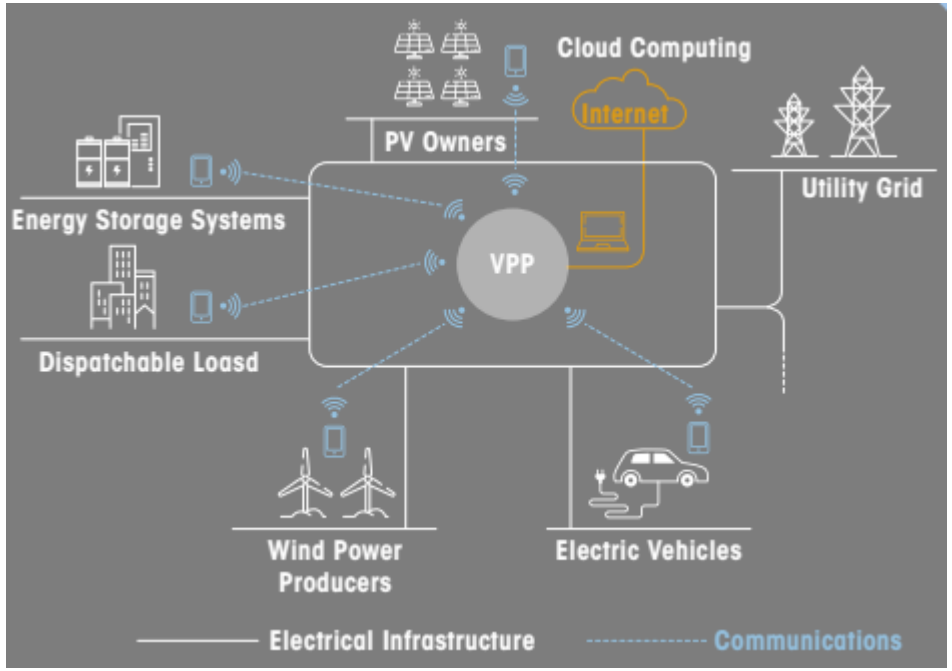
Flexibility value chain [USEF]

Aggregators – Energy communities as aggregators

- Aggregators are intermediate service providers who aggregate DERs and represent them in the energy markets (e.g. VPP manager)

- Aggregated resources:
  - distributed generation, storage, flexible loads, EV charging, etc.

- Energy communities can act as aggregators of production assets, storage and/or flexible demand



Microgrids Definitions

U.S. Department of Energy
Microgrid Exchange Group

A Microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A Microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.

A Microgrid is NOT one form of technology (e.g. a microturbine in a commercial building) or a group of individual generation sources that are not coordinated.

Merrill Smith, U.S. Department of Energy

IEEE standard 2030.7

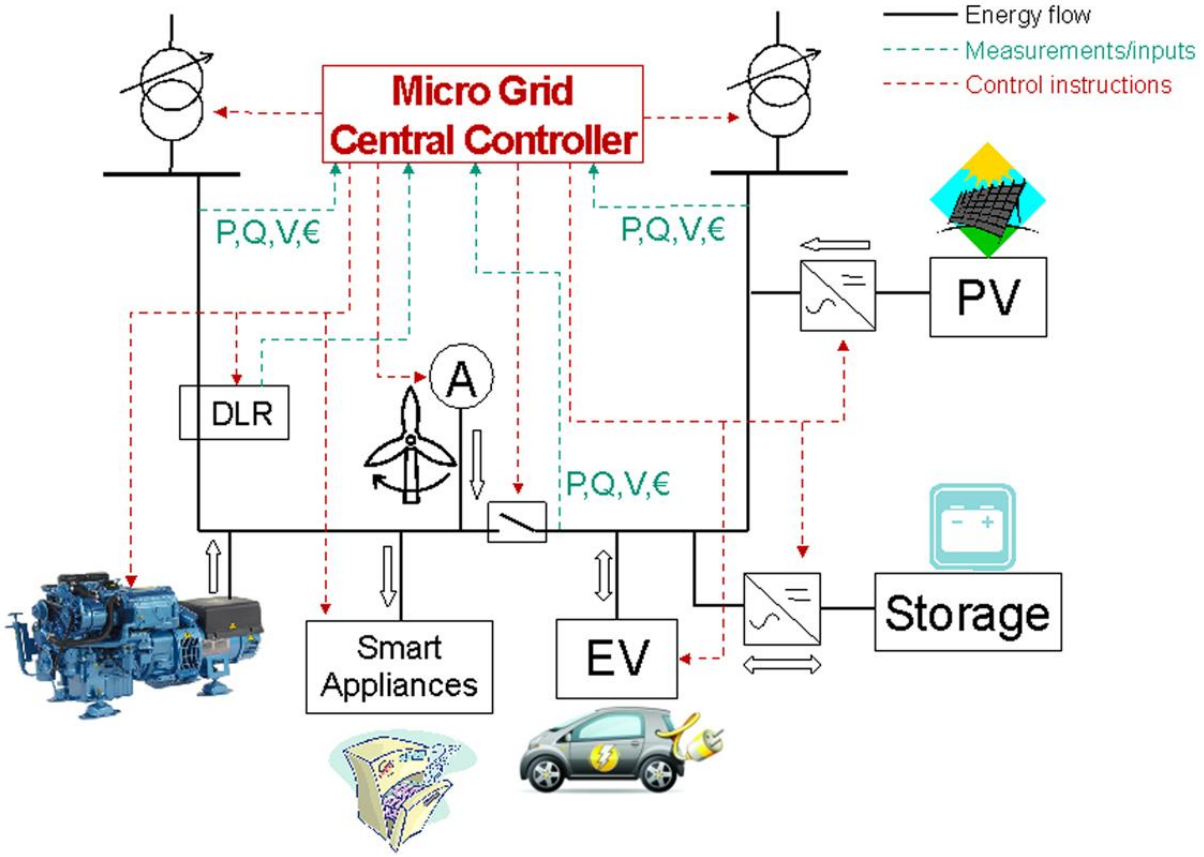
A group of interconnected loads and distributed energy resources with clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid and can connect and disconnect from the grid to enable it to operate in both grid-connected or island modes.

Microgrids Definition

http://www.microgrids.eu

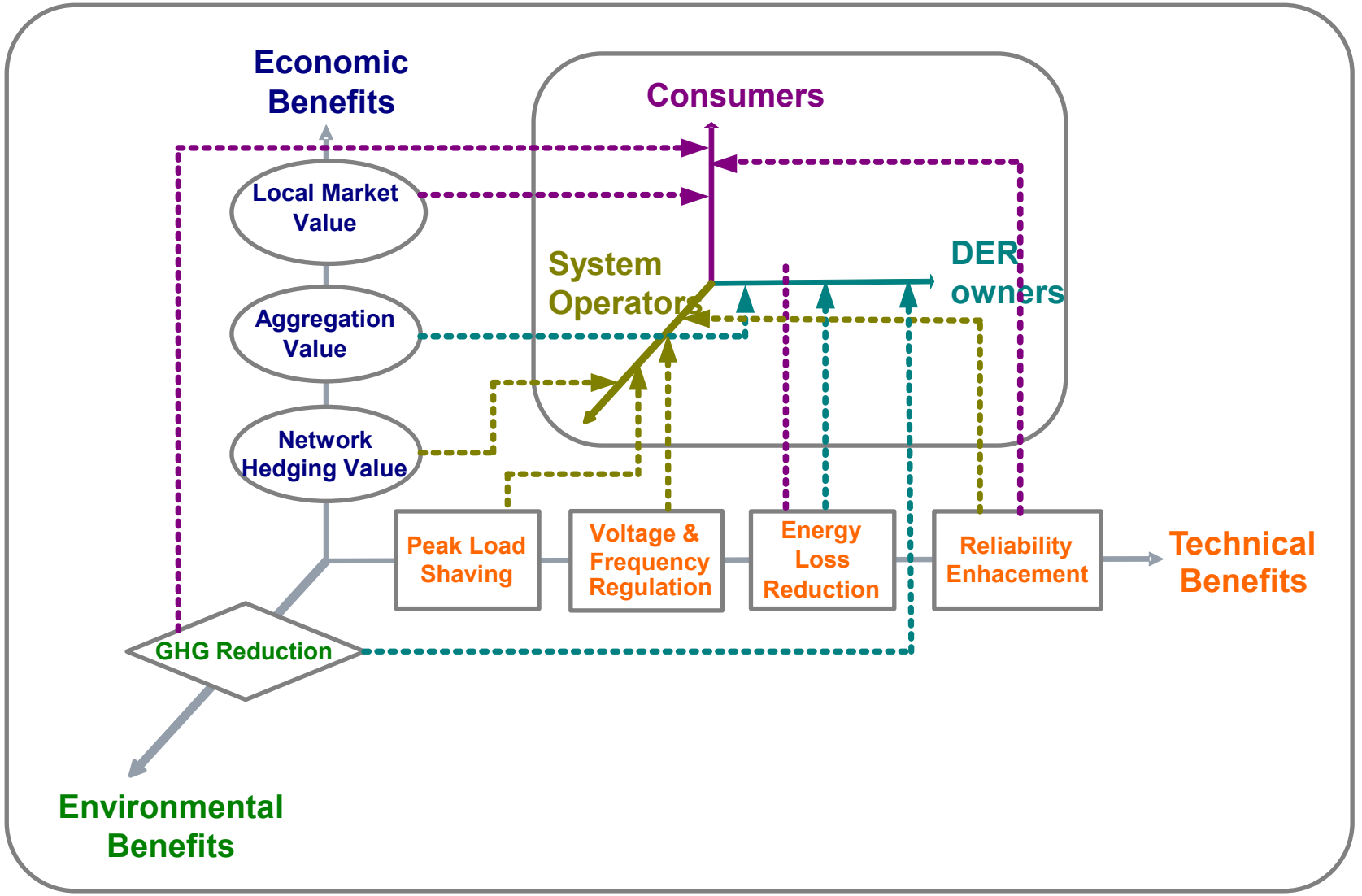
Microgrids are electricity distribution systems containing loads and distributed energy resources, (such as distributed generators, storage devices, or controllable loads) that can be operated in a controlled, coordinated way, either while connected to the main power network and/or while islanded.

(CIGRE WG C6.22)



EU Microgrids (ENK5-CT-2002-00610) and MOREMICROGRIDS (PL019864)

Benefits by Criteria & Stakeholders



"Differences and synergies between local energy communities and microgrids, Nikos Hatziargyriou, Oxford Open Energy, 2023-02-01, **DOI:** 10.1093/ooenergy/oiac013

Who will develop a Microgrid? Who will own and operate it?

- **Utility Microgrid** - The **DSO** owns and operates the DER and the MG. Depending on the regulatory environment, the DSO might also provide the **retailer** function of selling electricity to end consumers. The Utility MG model is not possible in systems that apply **deregulation** of network activities, that are monopolistic in nature, from competitive activities, i.e., generation and energy trading, that are open to market. In these cases, regulators tend to restrict utility control of microgrids beyond the pilot phase projects. **Exceptionally**, DER ownership has been granted only in some states or countries, for resilience or for enhancing flexibility, when relevant services cannot be provided by other market players.
- **Single Owner-Aggregator Microgrid** - It is the case when a single entity, e.g. an industrial complex, a university, a military camp or an airport owns several DERs. An Aggregator maximizes the **value** of the aggregated DER participating in the **energy markets**. This model can be realized in the form of a Virtual Power Plant (VPP), where the Aggregator coordinates the operation of DER, even beyond the MG or belonging to multiple MGs.
- **Community Microgrid** - Groups of consumers, including prosumers, own and operate DER including a substantial amount of **distribution assets** due to the multiple interconnected customers. The aim is to minimize electricity bills or maximize revenues forming **Local Energy Communities (LEC).** Consumers might own collectively a DER plant or own individual installations that they use for **collective self-consumption**. In fact, it makes it easier for consumers, together with other stakeholders (e.g., aggregators, retailers etc.), to jointly invest in energy assets and by teaming up to generate value and participate in markets in a level-playing field.

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Microgrid Services for DSOs

Microgrids can provide several ancillary services that will help manage the electrical grid:

- Peak shaving
- Voltage control
- Islanding operation
- Black start

Microgrid can offer services for EVs (e.g. fast charging at dispersed locations):

- Optimal placement of charging stations and local generation resources to mitigate overloads and bottlenecks of distribution systems;
- Low-cost generation mix for fast charging of EV and truck fleets; optimal capacities for PV, electric storage, generators, CHP;
- Optimal charging and discharging of the electric storage and EV fleet to minimize overall costs;
- Mitigation of the Impact of grid outages on the EV charging schedules.

IEEE Smart Grid Technical Activities Committee, White Paper “Microgrids: Utility Challenges and Opportunities”, Feb. 2022

Differences between MGs and LECs

- Microgrids and Local Energy Communities share basic principles of **decarbonization** and **decentralization**. For example, the operation of LECs requires **optimal coordination** of their energy resources and loads, which is the fundamental feature of MGs, according to their definition.

- Comparison of the two concepts is inherently **difficult**, since MGs have a technical focus on the local distribution network, while LECs are a form of social and economic organization of community prosumers.

- All MGs models inherently assume at least operation and in most cases ownership of **distribution assets**, which is not necessarily the case with LECs.

- Striking differences in the case of Utility Microgrids, i.e., when DSOs formulate and operate MGs for facilitating their network performance and in Single Owner-Aggregator Microgrids. In both these types **community participation** is lacking, which is the fundamental feature of LEC.

- Differences become blur in the case of Community Microgrids, especially the ones, that own, operate and manage electricity networks.

Conclusions

- The role of Microgrids and Local Energy Communities central in Energy Transition
- The two concepts similar but with distinct differences depending on the type
- Several technical advantages
- Local Energy Communities - Established European Leal Framework, rich activity in Europe
- Local Energy Markets – Benefits of Local Trading Energy
- Provision of Flexibility

Thank you for your attention!

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