International Microgrid Symposiums
Virtual Seminar Series 2: Europe and Africa

Panel Discussion: Are Microgrids the building blocks of Energy Communities?

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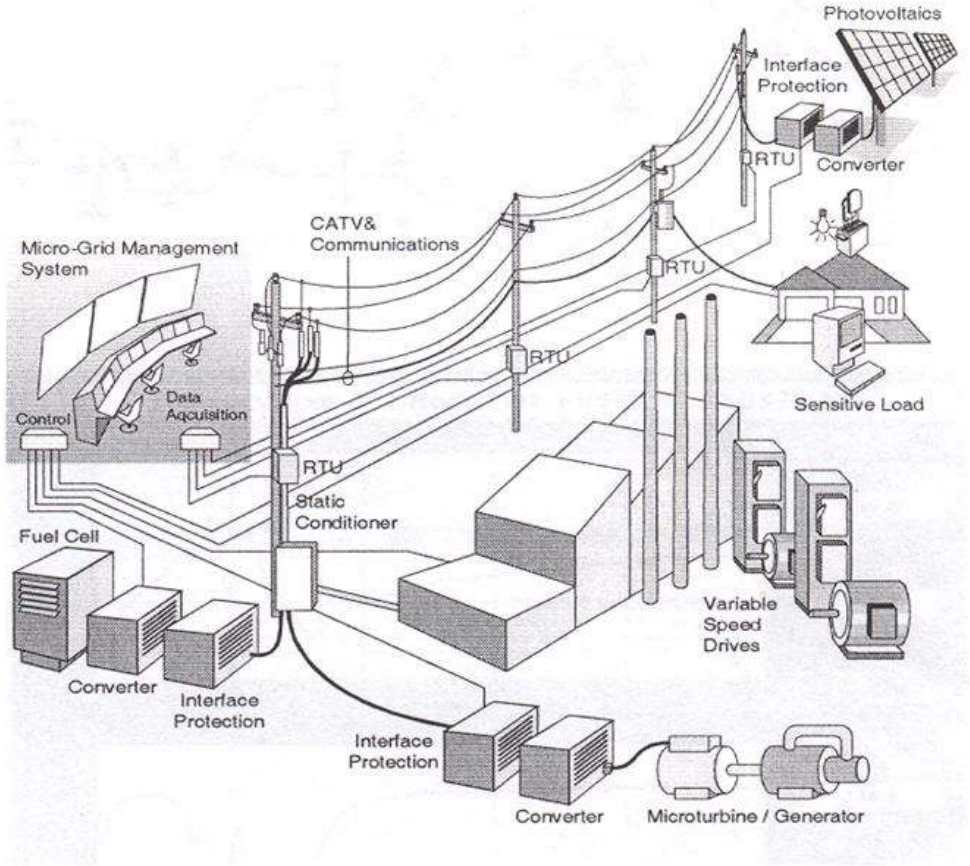
Definition of Microgrids

http://www.microgrids.eu

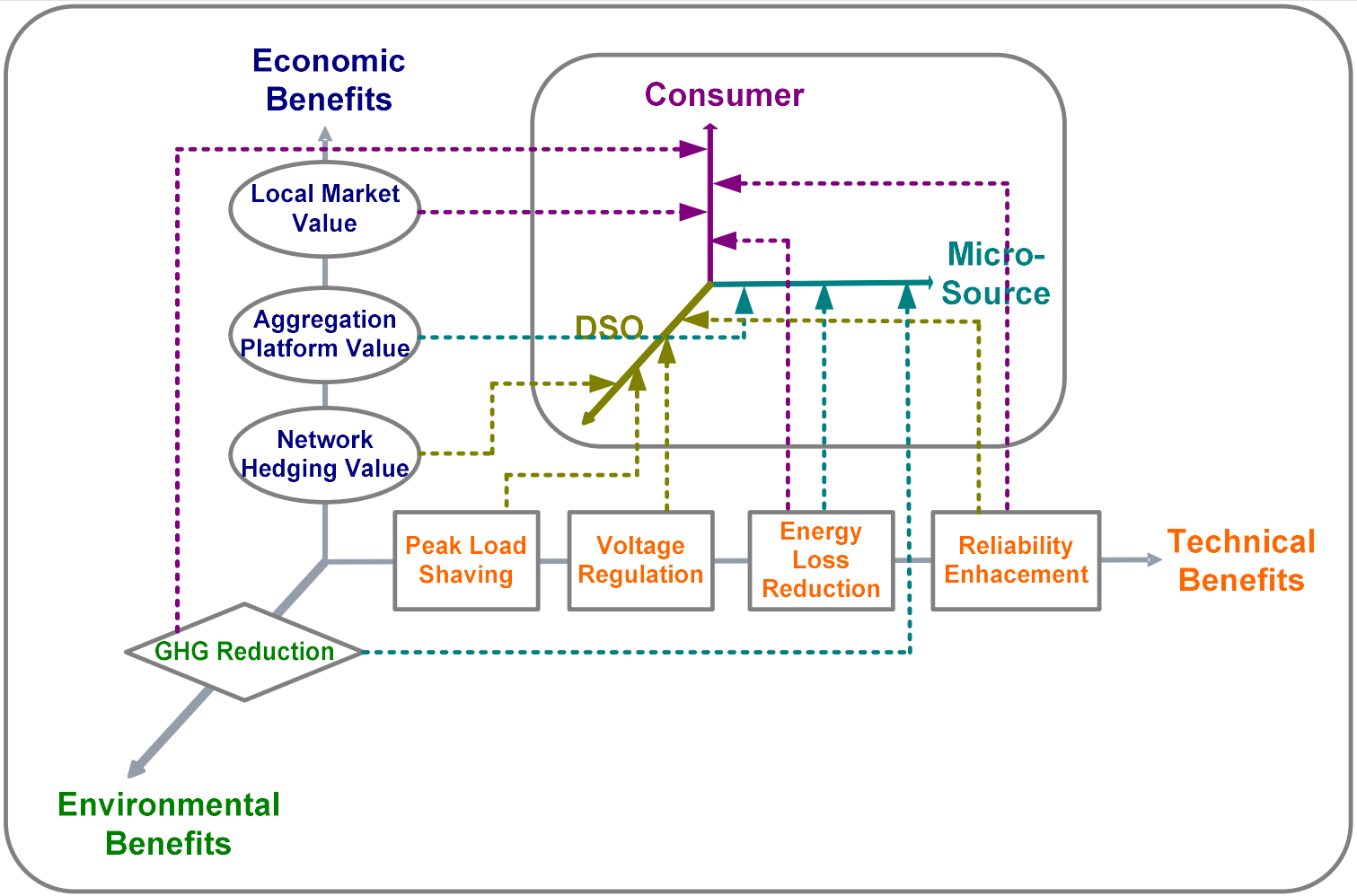
Microgrids are electricity distribution systems containing loads and distributed energy resources, (such as distributed generators, storage devices, or controllable loads) that can be operated in a controlled, coordinated way, either while connected to the main power network and/or while islanded.

(CIGRE WG C6.22)



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

Benefits by Criteria & Stakeholders



Technical Challenges

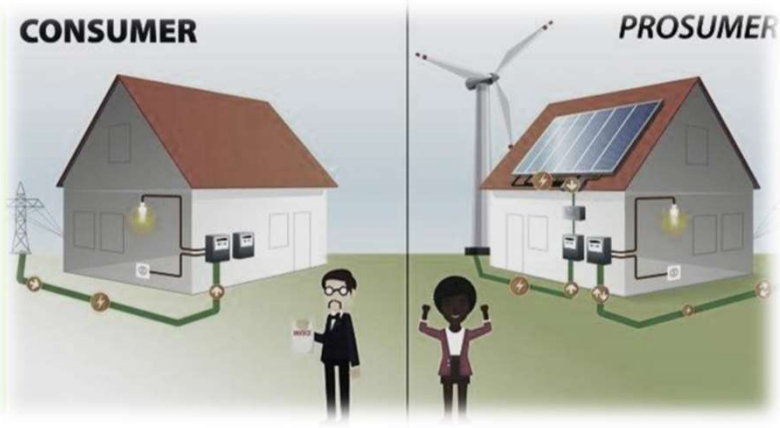
- Small size (challenging management)
- Use of different generation technologies (prime movers)
- Presence of power electronic interfaces
- Relatively large imbalances between load and generation to be managed (significant load participation required, need for new technologies, review of the boundaries of microgrids)
- Specific network characteristics (strong interaction between active and reactive power, control and market implications)
- Protection and Safety / static switch
- Communication requirements
- Complex relations among multiple subsystems implies hierarchical multi-layer approaches for their control.

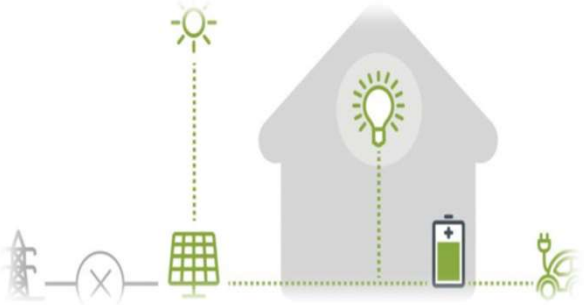
Who will develop a Microgrid? Who will own it? Who will operate it?

- Investments in Microgrids can be done in multiple phases by different stakeholders: end consumers, energy suppliers, DSOs, etc.
- Who develops the networks?
- The operation of the Microgrid will be mainly determined by the ownership and roles of the various stakeholders. Three general models:
  - Integrated Utility or DSO owns and operates the Microgrid. (*Not possible under current European market regulation).*
  - Market Aggregators (ESCOs) maximize the value of the aggregated DER for minimizing bills or participation in local energy markets. (*e.g. Private Microgrid*)
  - Prosumers own and operate DER to minimize electricity bills or maximize revenues (*Local Energy Community Microgrid*) – Network operation know how?

"Microgrids: Architectures and Control", Editor Nikos Hatziargyriou, IEEE-Wiley&Sons, 2014

Prosumers - Local Energy Communities





SMART HOMES/ZERO ENERGY BUILDINGS

LOCAL ENERGY COMMUNITIES

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

(EC Electricity Directive COM(2016) 864/2)

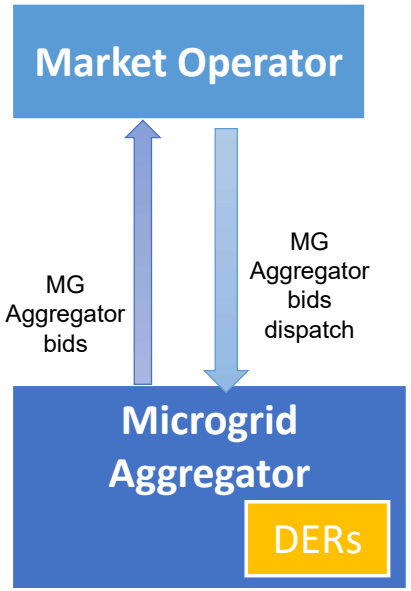
Microgrids Market Models

Market Operator

- Dispatch of DERs performed by the Market Operator through the market clearing process

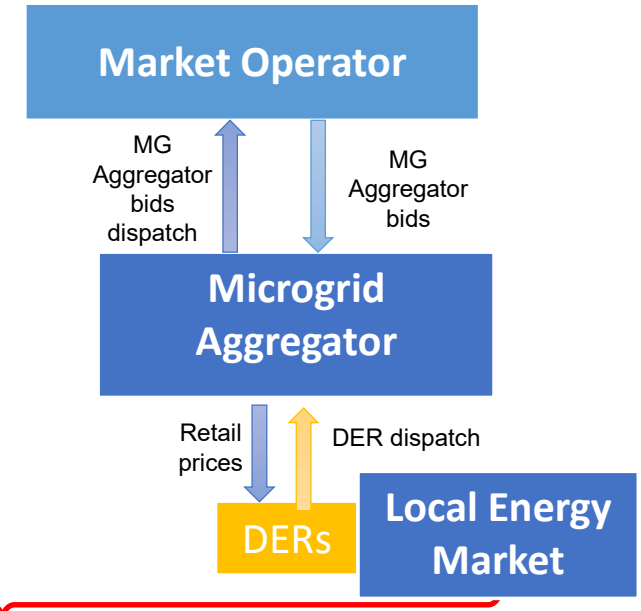
MG Aggregator – DERs Pay-As-Bid (PAB)

- Dispatch of DERs (set-points) by the MG Aggregator)



MG Aggregator – DERs Pay-As-Cleared (PAC)

- DERs decide their own dispatch



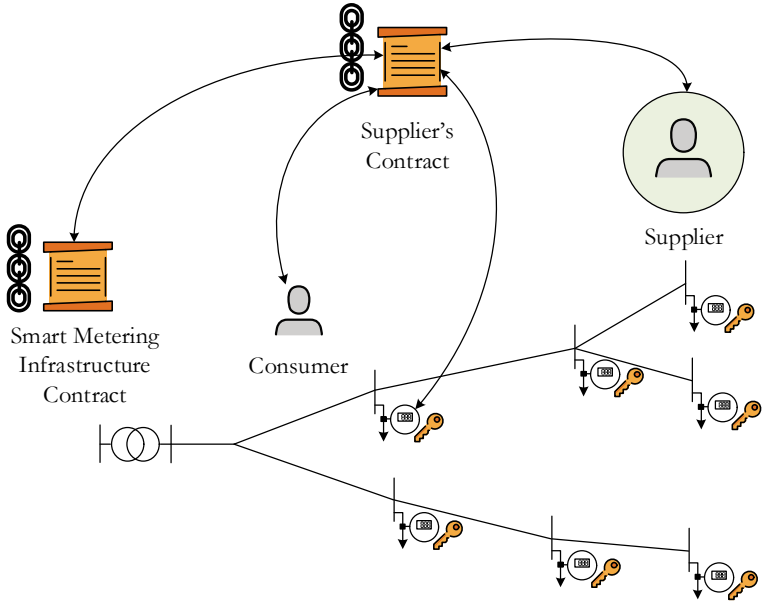
How can a Microgrid Aggregator interact optimally both with his customers and the wholesale market?

Panel Discussion: Are Microgrids the building blocks of Energy Communities?

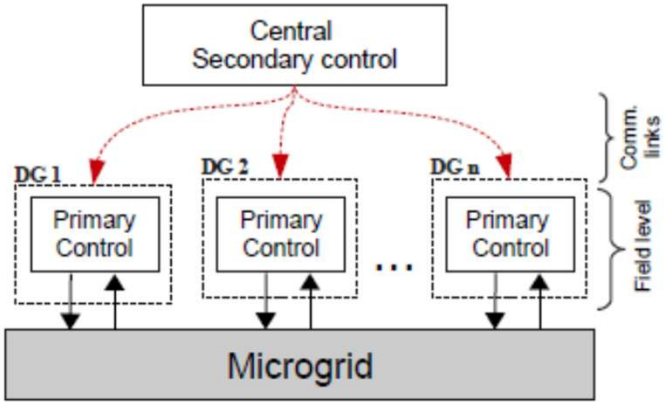
Blockchain Platforms for Active Distribution Grids

Smart Contract excerpt: 1

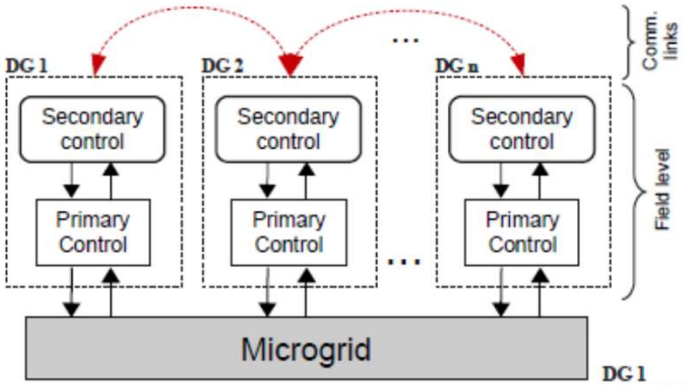
```
1   contract smartMeters {
2
3     address owner;
4
5     struct meter {
6       bool isRegistered;
7     }
8     mapping (address => meter) meters;
9
10    constructor () public {
11      owner = msg.sender;
12    }
13
14    function registerMeter(address meter_) public
15  onlyOwner {
16      require(!meters[meter_].isRegistered);
17      meters[meter_].isRegistered = true;
18    }
19
20    function isValidMeter(address meter_) public
21  view returns (bool) {
22      return meters[meter_].isRegistered;
23    }
24
25    modifier onlyOwner {
26      require(msg.sender == owner)
27      _;
28    }
29  }
```



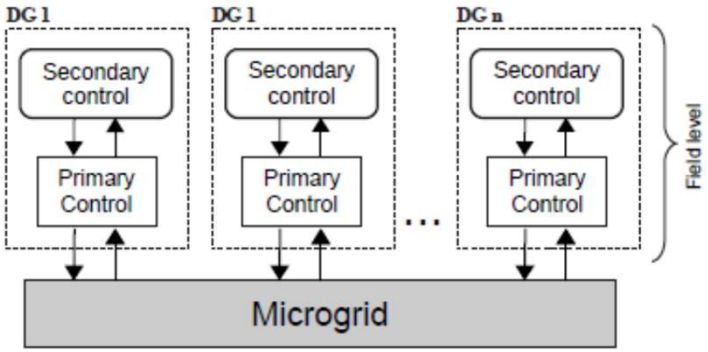
Microgrids Control Structures



Centralized Structure



Distributed Structure



Decentralized Structure

Choice of structure depends on DG ownership, scale, 'plug and play', etc.

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Question: How can Microgrids' technical functions support Local Energy Communities (LECs)?

- ✓ How can DSOs support LECs?
- ✓ How can individual DERs be technically coordinated to ensure efficient and secure operation? Should they have own local operators? Can distributed technologies developed for Microgrids be relied upon, in normal conditions?
- ✓ How can LECs participate in Energy Markets? Can Local Markets be operated? What is the role of distributed technologies, like Blockchain, in the development and operation of Local Markets?
- ✓ How can LECs participate in Ancillary Services Markets? How will LECs provide coordinated services to the upstream network? What is the role of decentralized technologies developed for Microgrids?
- ✓ How can collective Reliability and Resilience, e.g. in case of natural disasters, be maximised? Can they rely on automated (decentralized) Microgrid technologies in times of emergency?