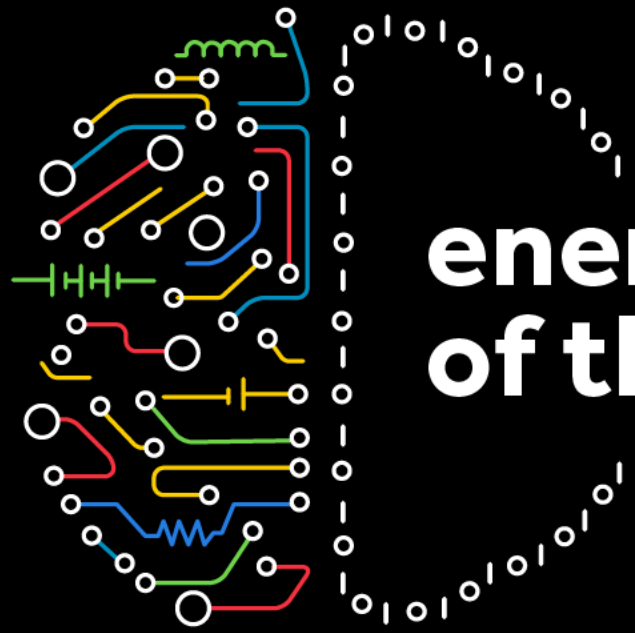


energy systems of the future

INESCTEC

FEUP Main Auditorium

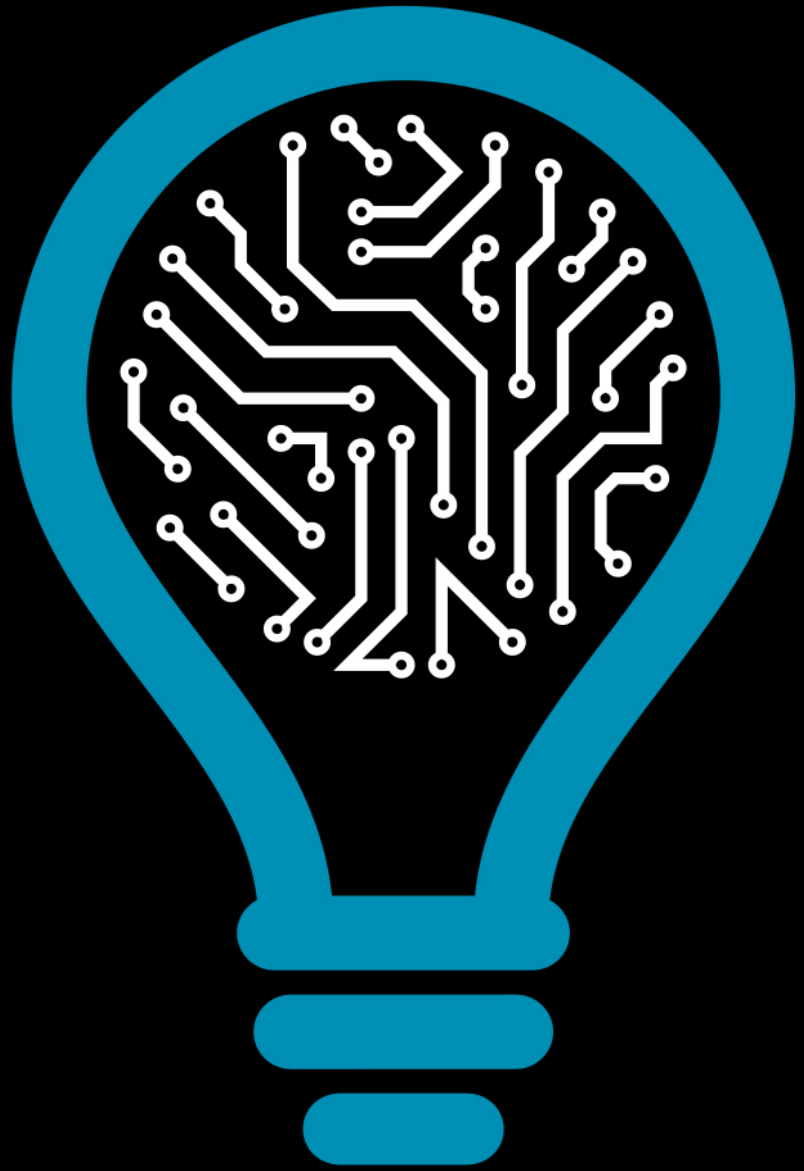
May 29 ○ 14h00

Smart grid technologies for addressing societal challenges

Clara Gouveia, clara.s.gouveia@inesctec.pt

Energy Systems of the Future, FEUP, Porto

29th May 2019



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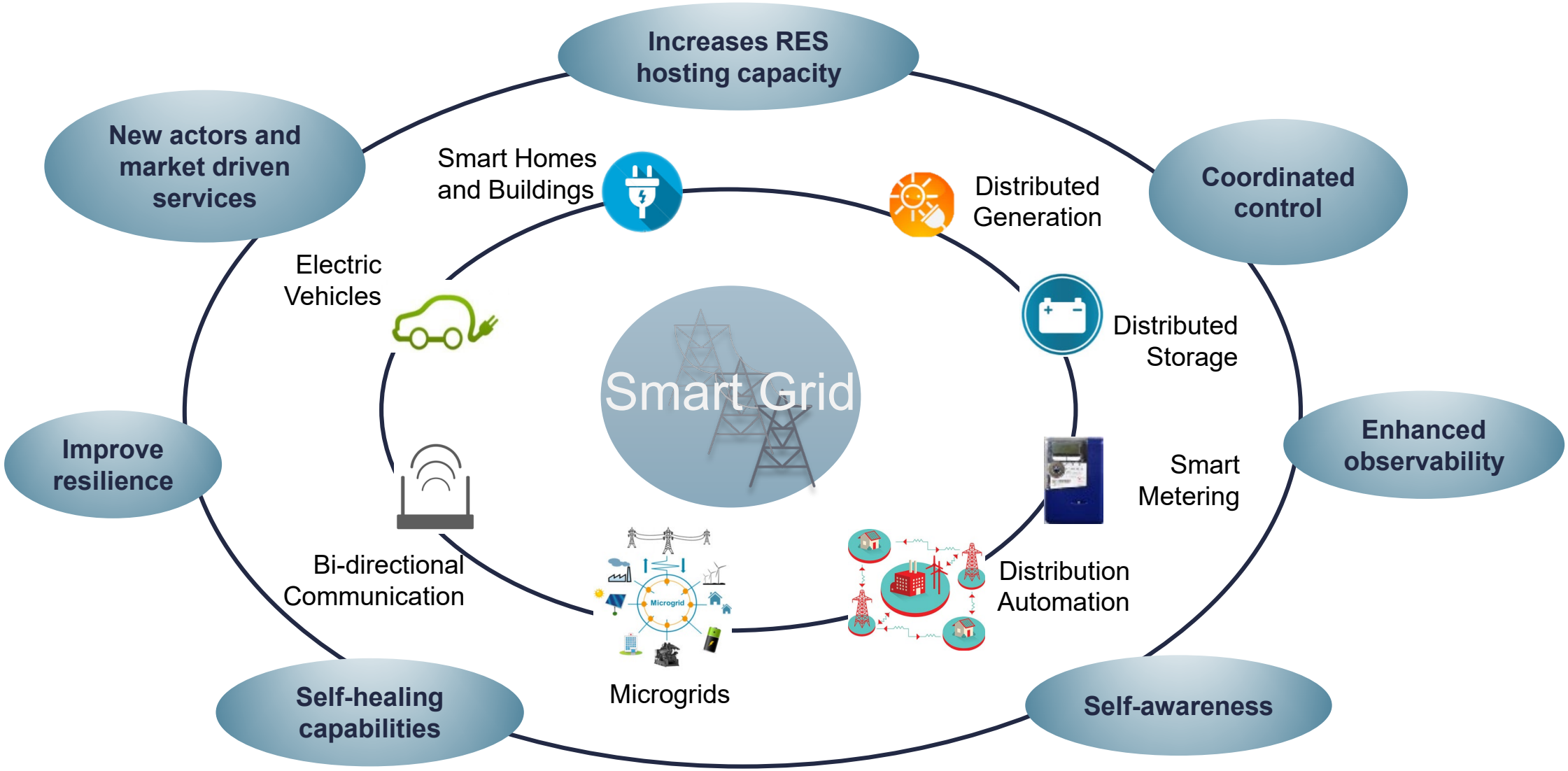
INSTITUTE FOR SYSTEMS AND COMPUTER ENGINEERING, TECHNOLOGY AND SCIENCE

Smart grid technologies: Why do we need it?



Smart and Flexible Distribution Network

Flexibility is the key for smart distribution grids

Distributed storage

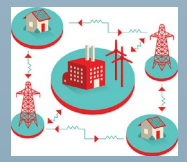
Smart Charging

Demand Response

FLEXIBILITY

Grid Support Services

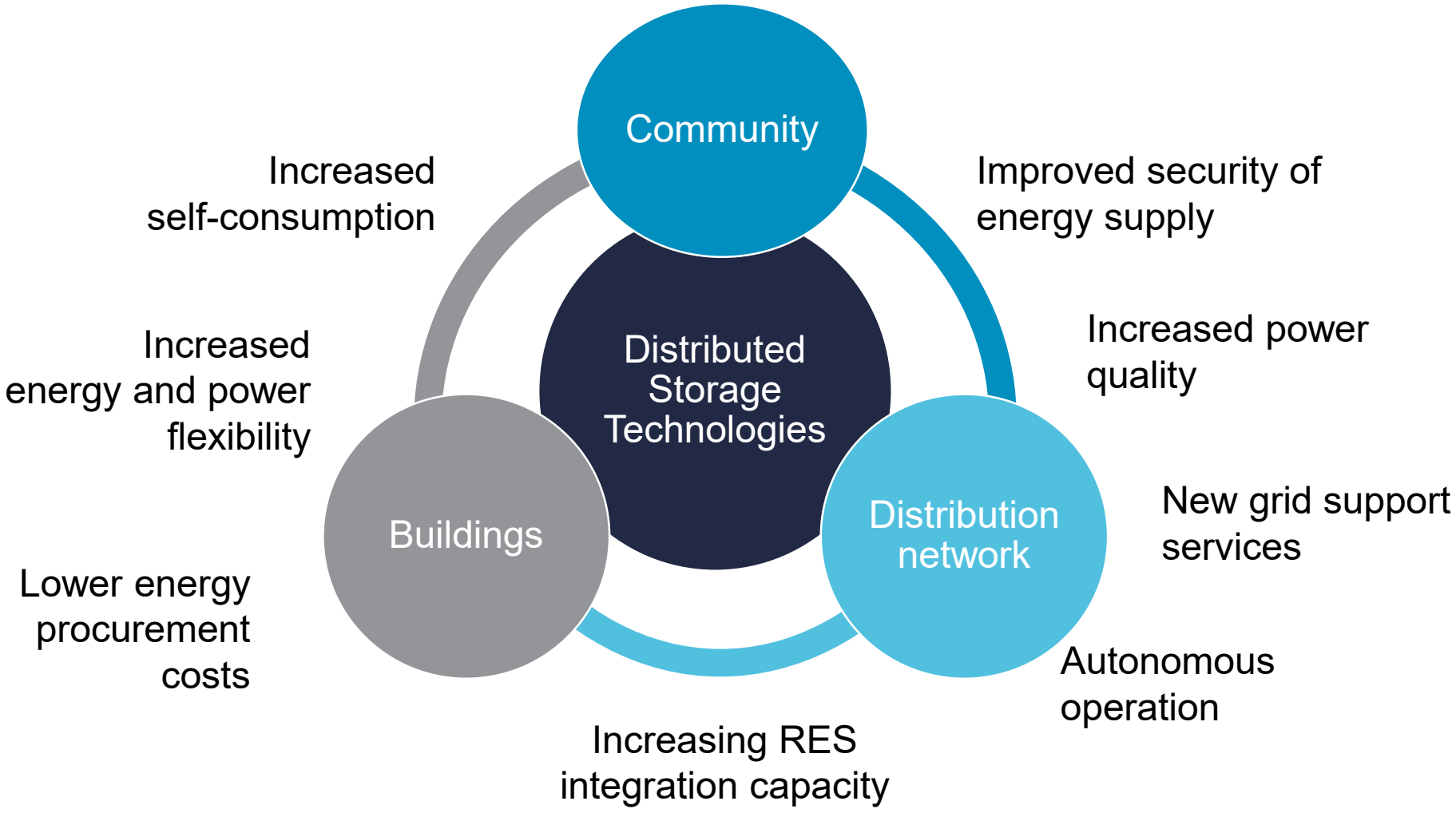
Advanced network applications



Distributed Automation

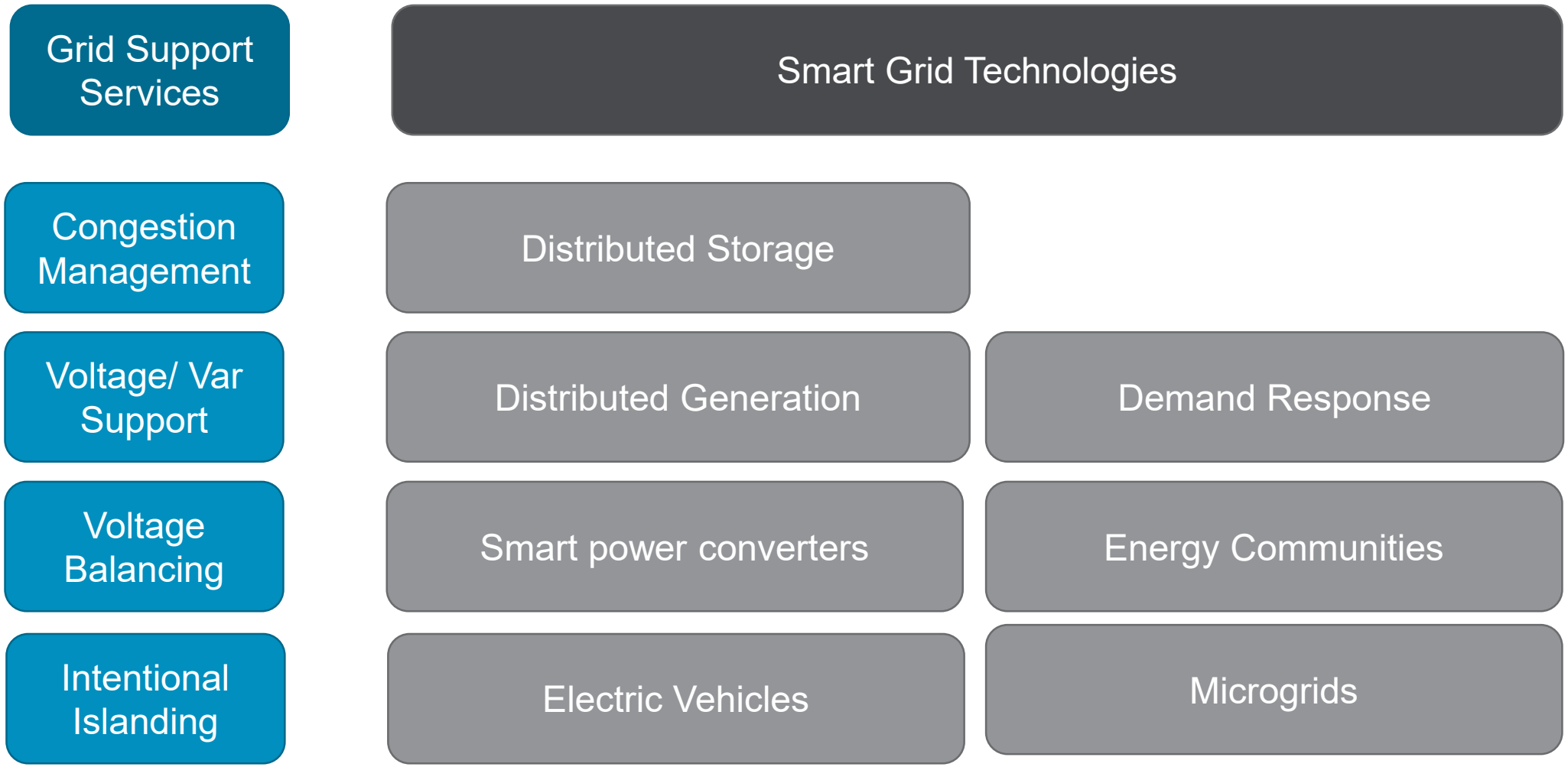
Smart and Flexible Distribution Network: Distributed Storage

Funded by the European Commission
Grant No 645963



Smart and Flexible Distribution Network: Grid Support Services

SENSIBLE
Storage-Enabled Sustainable Energy for Buildings and Communities
Funded by the European Commission Grant No 645963



Smart and Flexible Distribution Network

SENSIBLE
Storage-Enabled Sustainable Energy for Buildings and Communities
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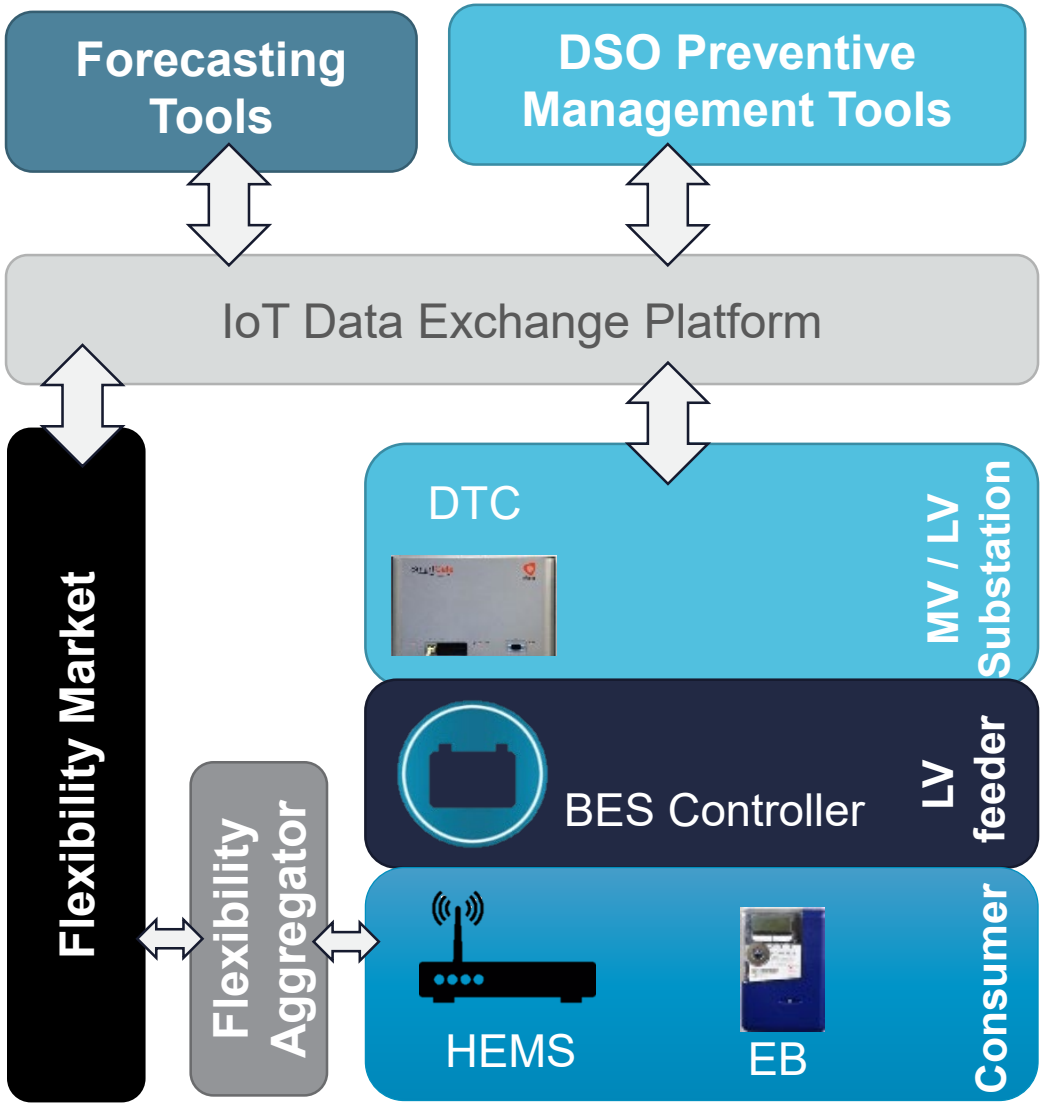
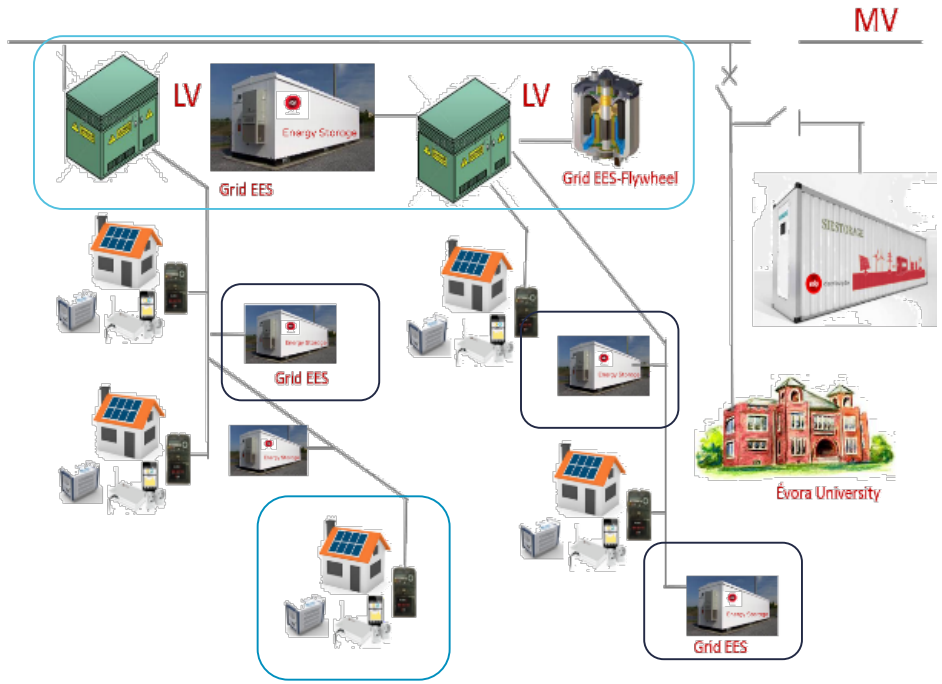
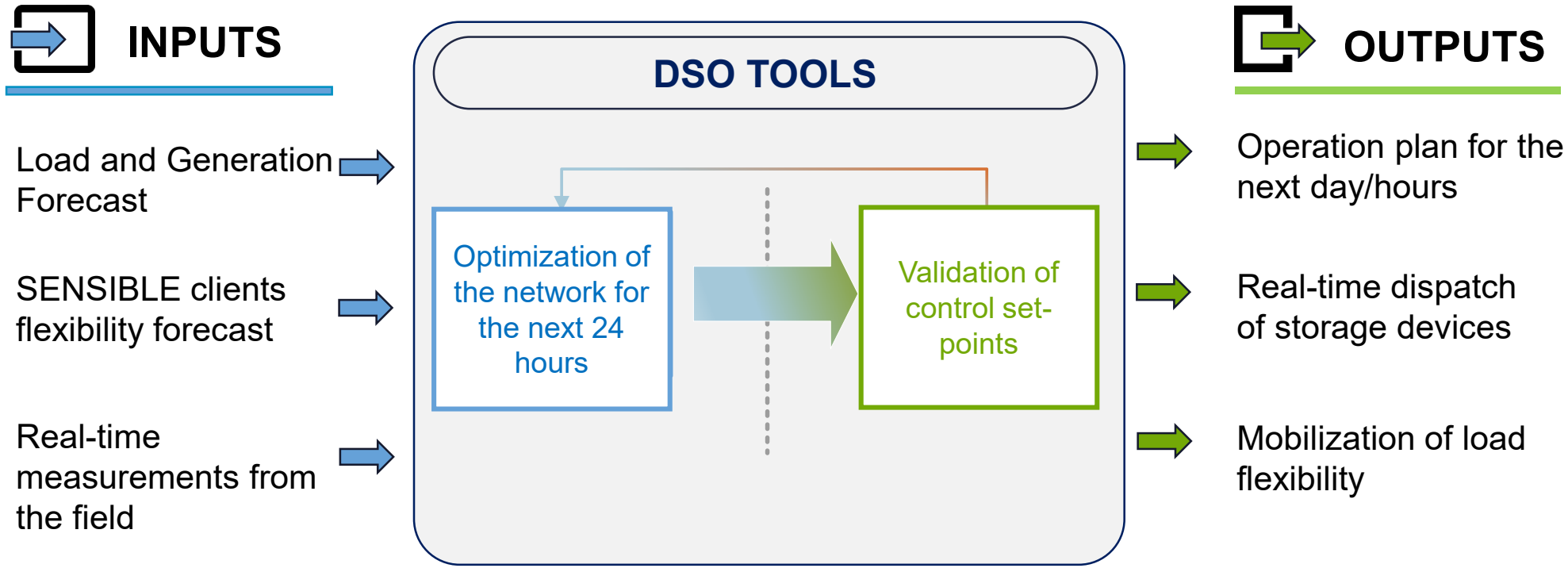




Smart and Flexible Distribution Network: Advanced network applications

Funded by the European Commission Grant No 645963



DSO Tools are able to manage the system both in interconnected and islanded modes

Smart and Flexible Distribution Network: Self-healing

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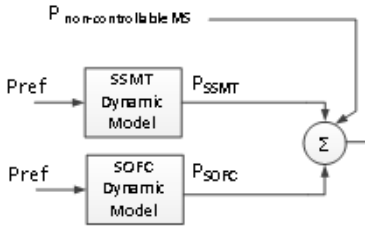
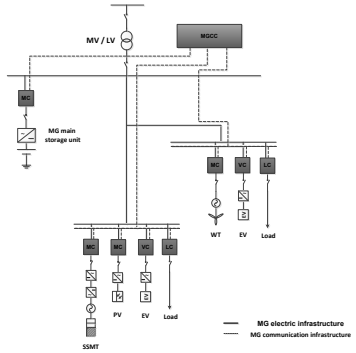
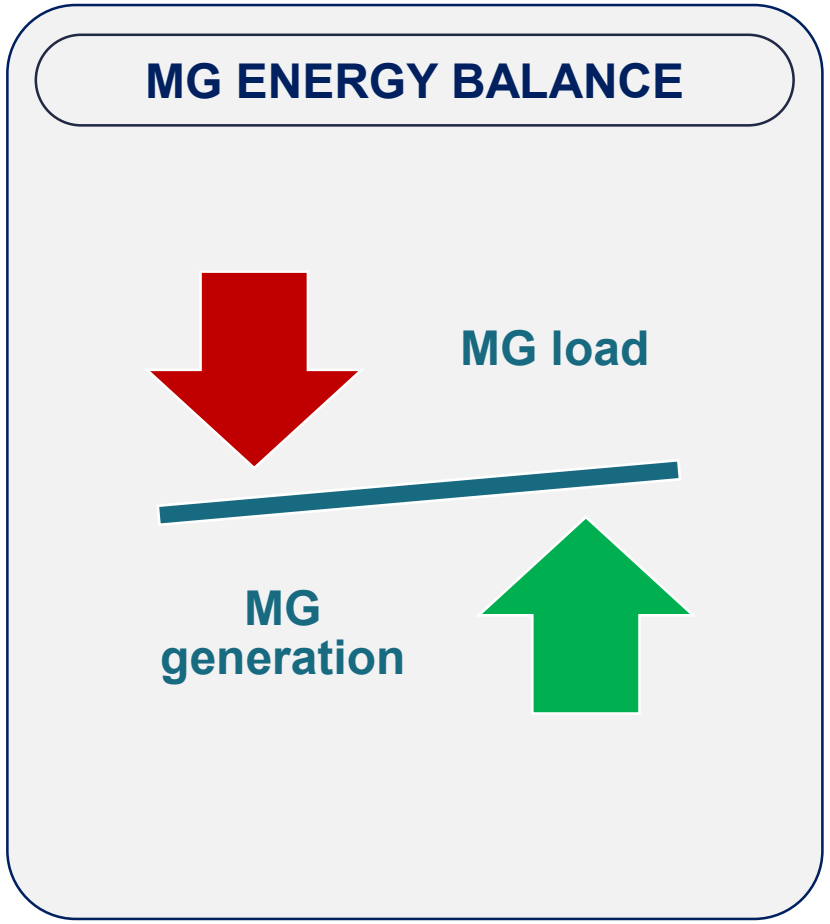
Load, Generation and Flexibility Forecast

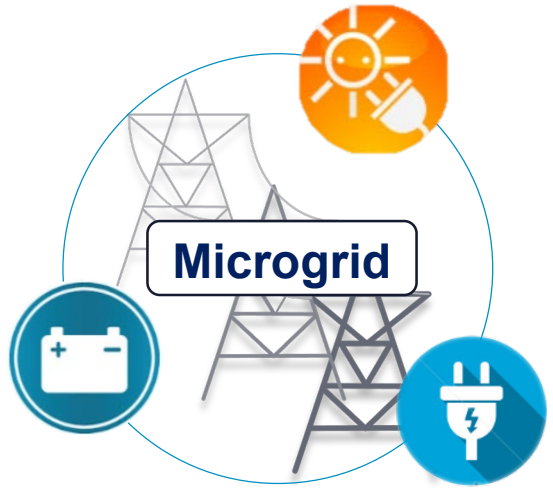


Microgrid dynamic behavior



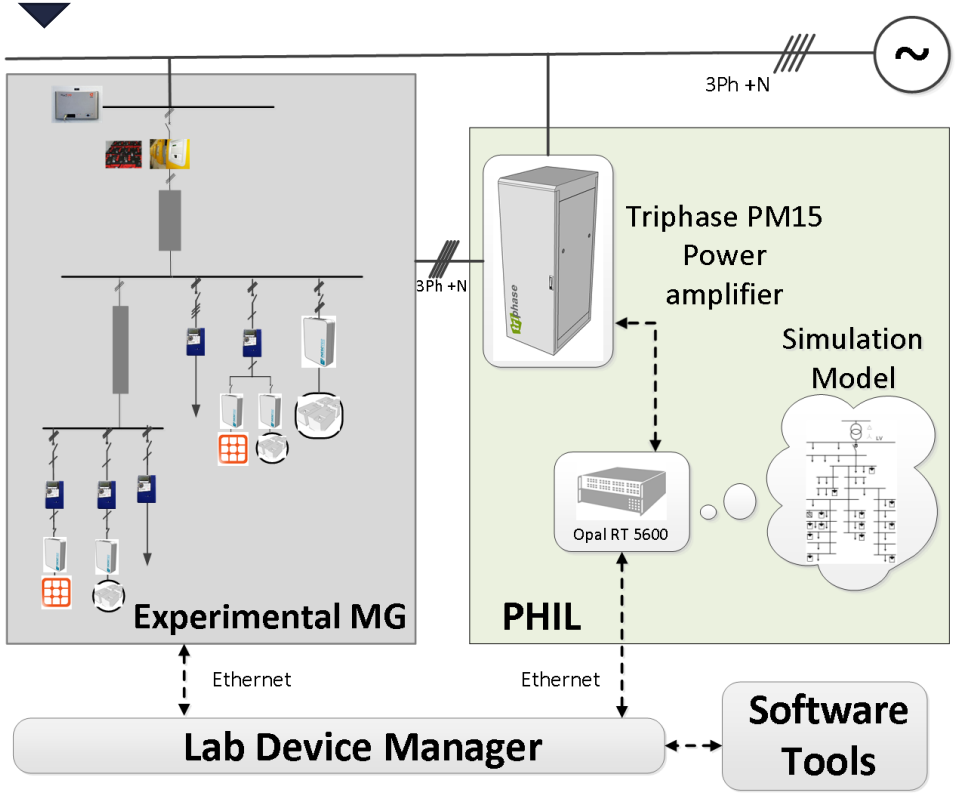
Microgrid steady state analysis

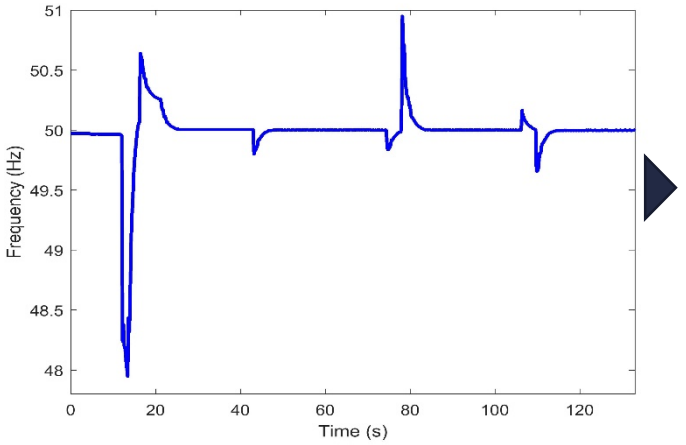




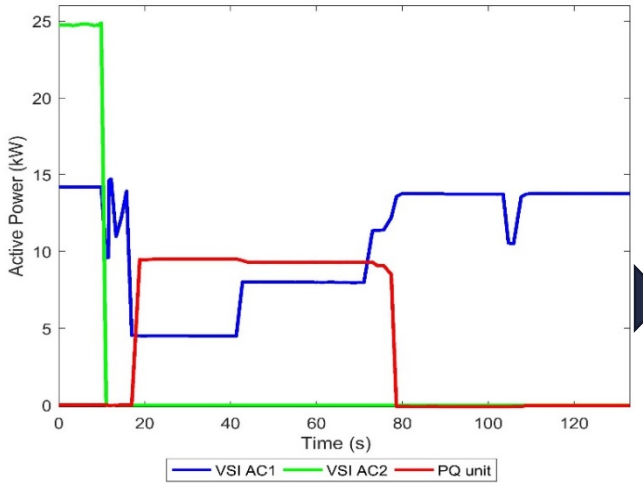
Smart and Flexible Distribution Network: Self-healing

Experimental validation of MG emergency balance at INESC TEC Smart Grid Laboratory





MG measured frequency during islanding



EES power dispatch

Smart and Flexible Distribution Network: Self-healing

SENSIBLE
Storage-Enabled Sustainable Energy for Buildings and Communities
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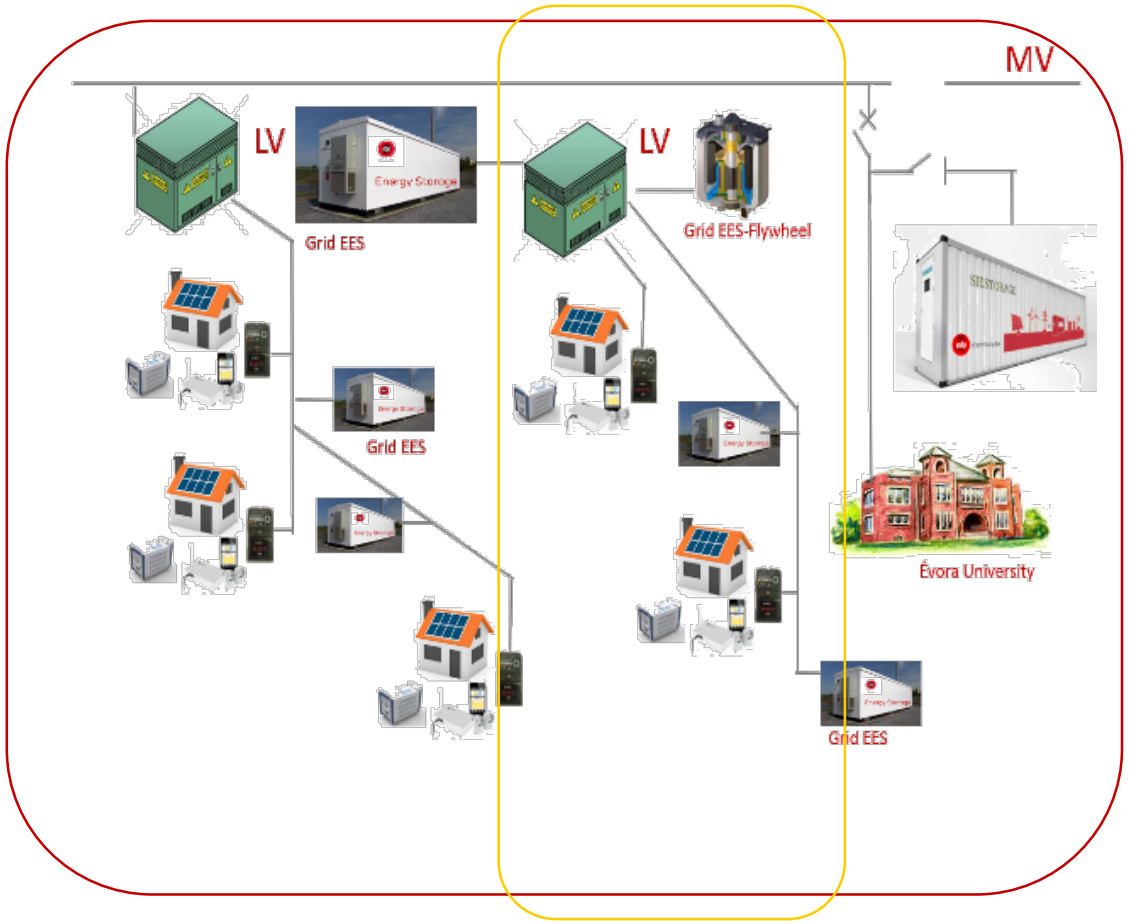
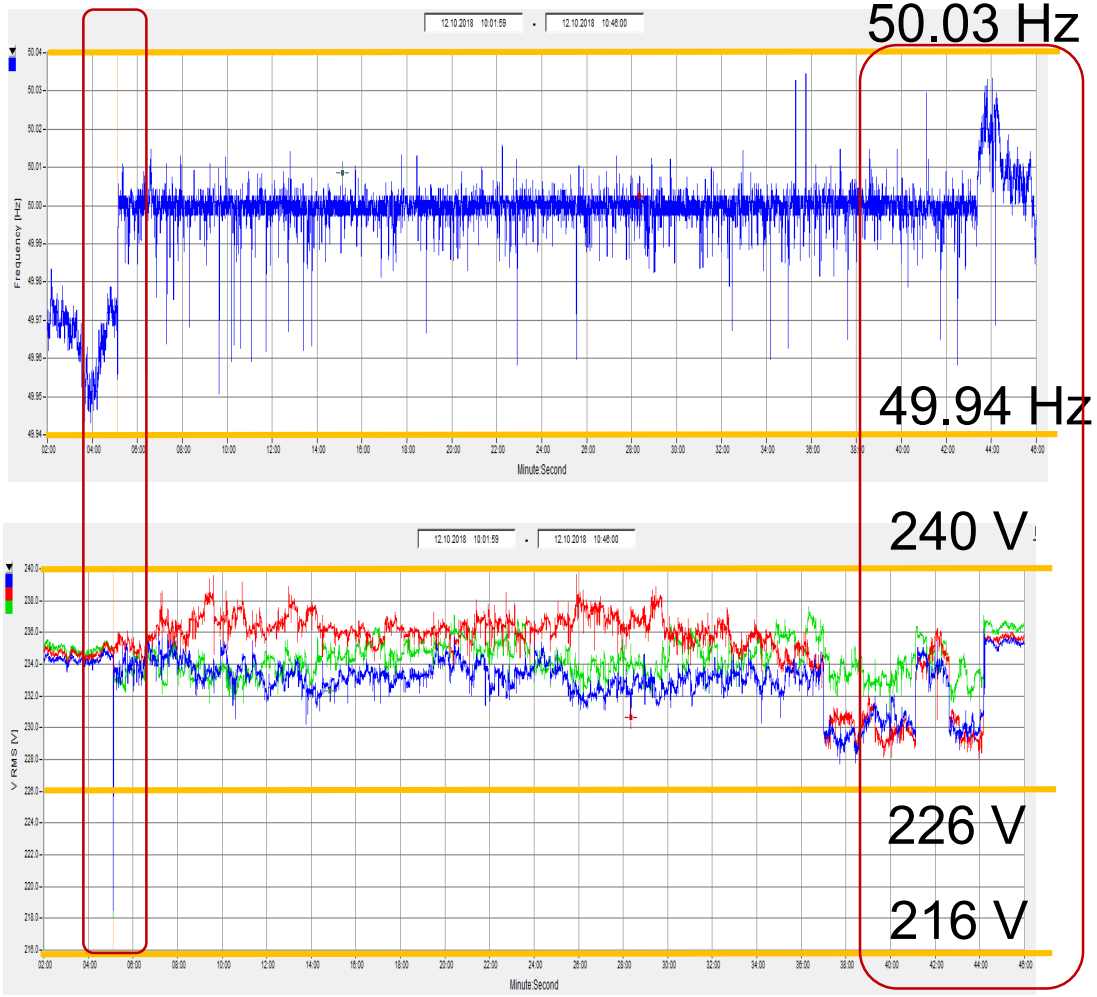


H2020 SENSIBLE Project Pilot

LV ISLANDING **RECONNECTION**



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Smart and Flexible Distribution Network: SENSIBLE project main results

SENSIBLE
Storage-Enabled Sustainable Energy for Buildings and Communities

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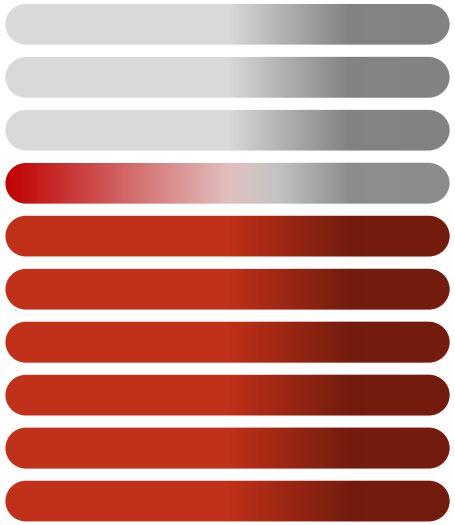
Grant No 645963

65%

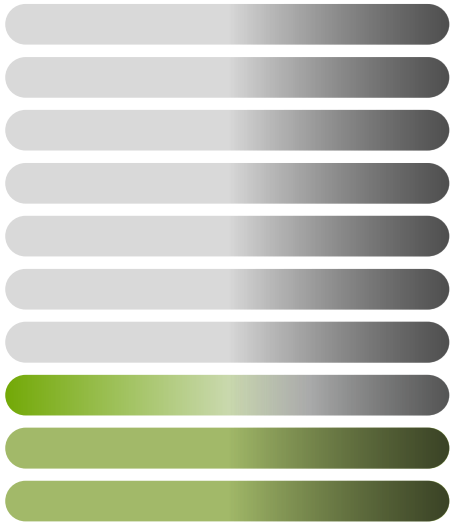


INCREASE SELF-CONSUMPTION

93%

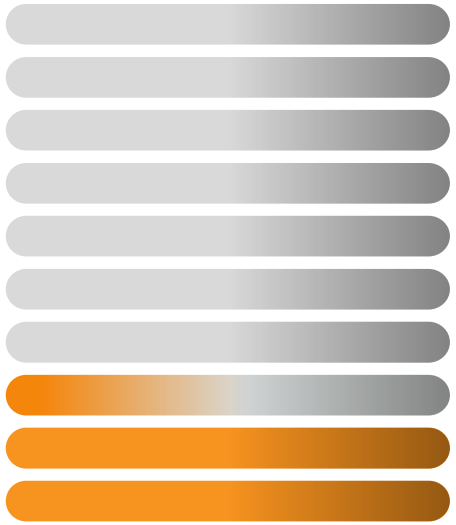
REDUCTION RES ENERGY CURTAILMENT

23-25%



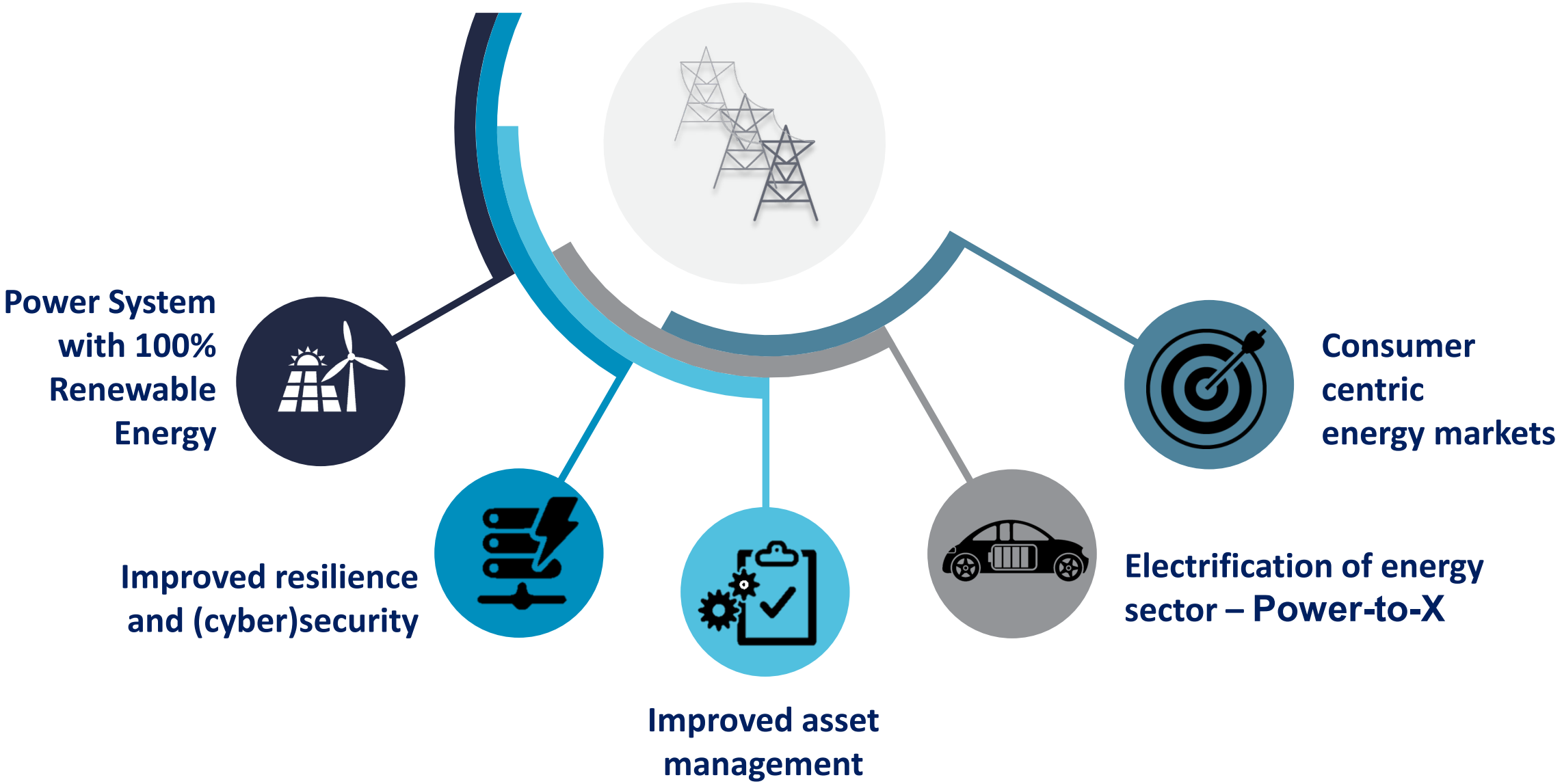
IMPROVEMENT CONTINUITY OF SERVICE (SAIFI AND SAIDI)

16-24%



DEFERRED DISTRIBUTION CAPACITY INVESTMENT

Smart Grid Technologies: Future challenges



Smart Grid Technologies: Digital Technologies

Advanced Analytics

Predictive management and corrective control

Blockchain

Decentralized energy transactions

Data Visualization

Asset optimization, improved situational awareness

Cyber Security

Ensuring security of assets and systems, data privacy

IoT

Interoperable sensors and edge computing

Drones and UAVs

Network mapping and inspection

Augmented and virtual reality

Maintenance and crew support

Distributed Computing

Online optimization and security assessment applications

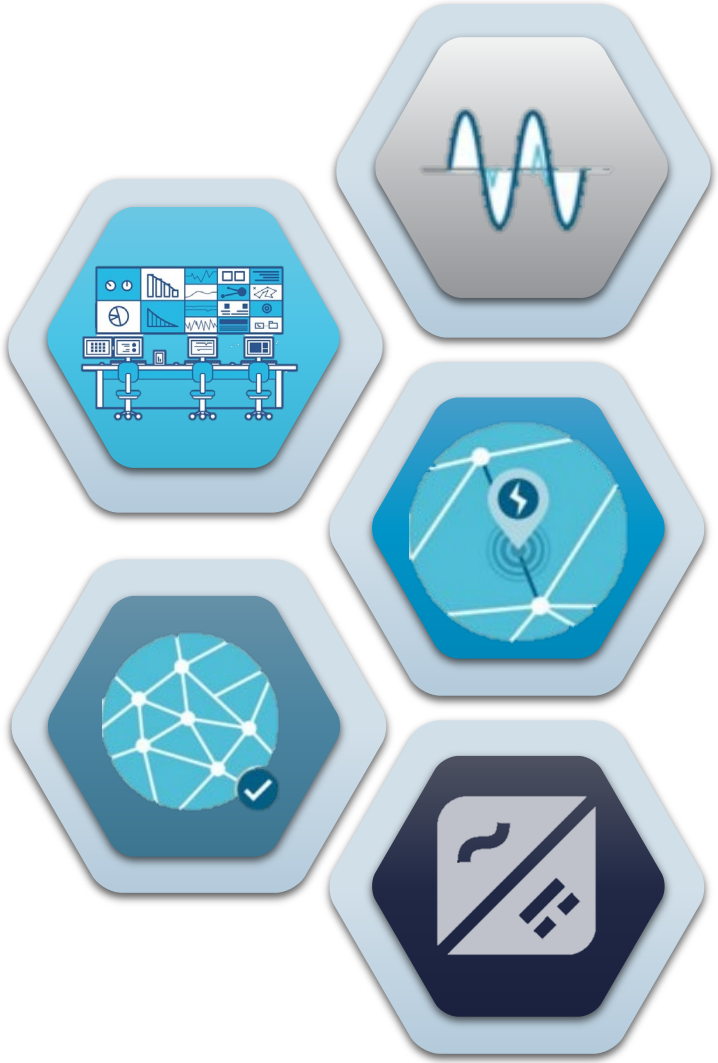
Smart Grid: Future vision

RE-THINKING NETWORK CONTROL CENTRES

- Predictive network operation
- Efficient data vizualiztion tools
- Effective decision support tools
- Cooperative with external plataforms

IMPROVING SITUATIONAL AWARENESS

- Improved asset monitoring and network monitoring
- Real-time data processing and analytics
- Systems interoperability and efficient data exchange



ADAPTIVE DISTRIBUTION NETWORK PROTECTION

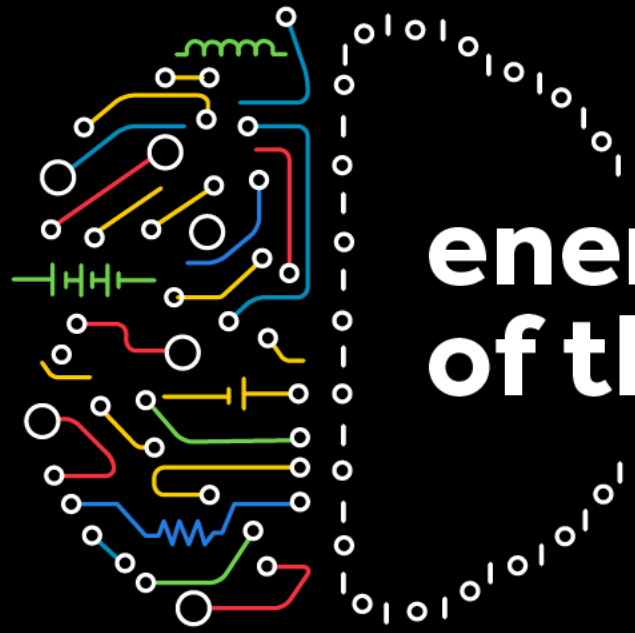
- Adaptive to current and future network conditions
- Enabling islanding
- Compatible with inverter dominated systems

DISTRIBUTED AUTOMATION

- Decentralized fault location
- Decentralized self-healing strategies
- Preventive reconfiguration
- Dynamic islanding

SMART POWER CONVERTERS

- Fault Ride Through Capabilities
- Grid support services and other functionalities
- Highly efficient devices



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