Introduction to Microgrids

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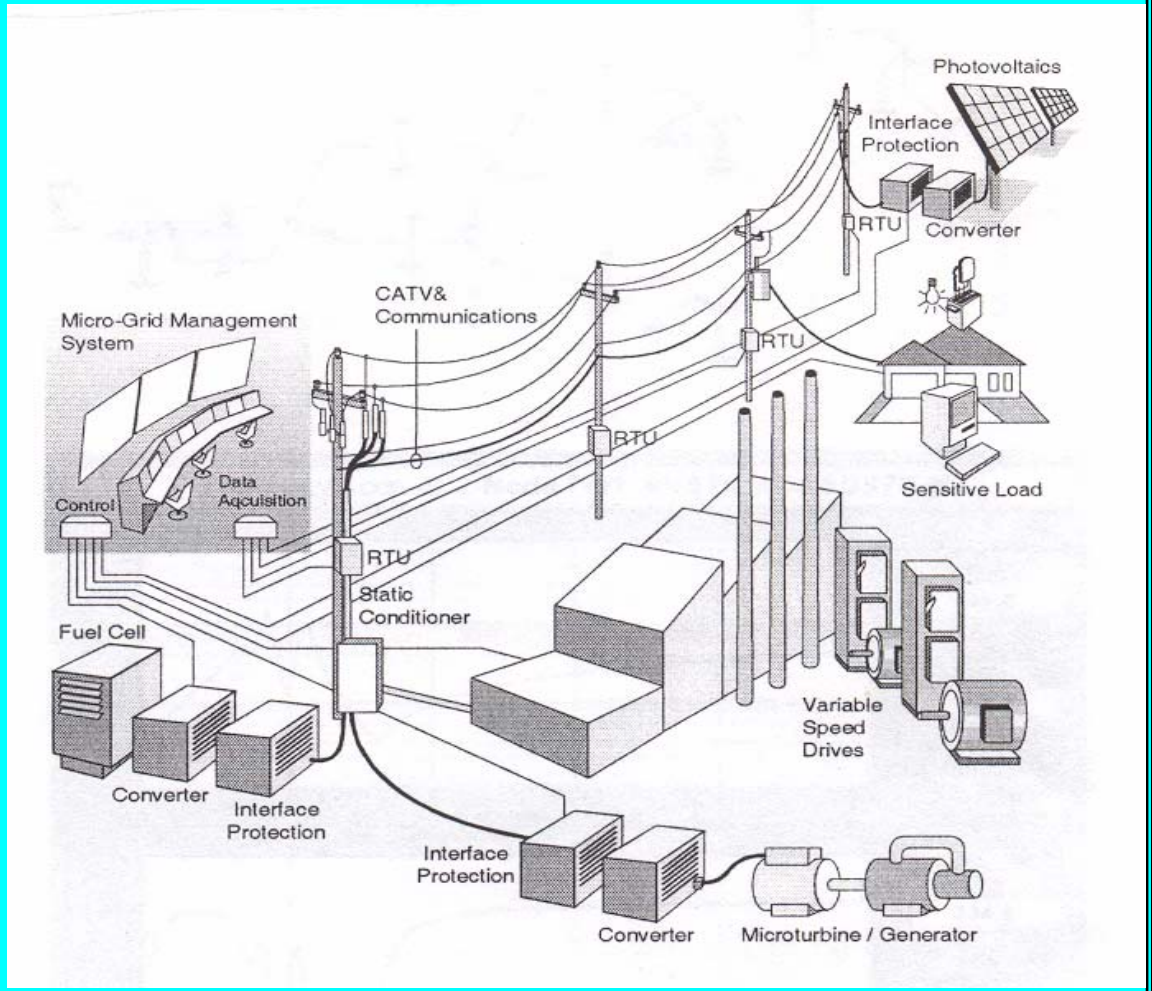
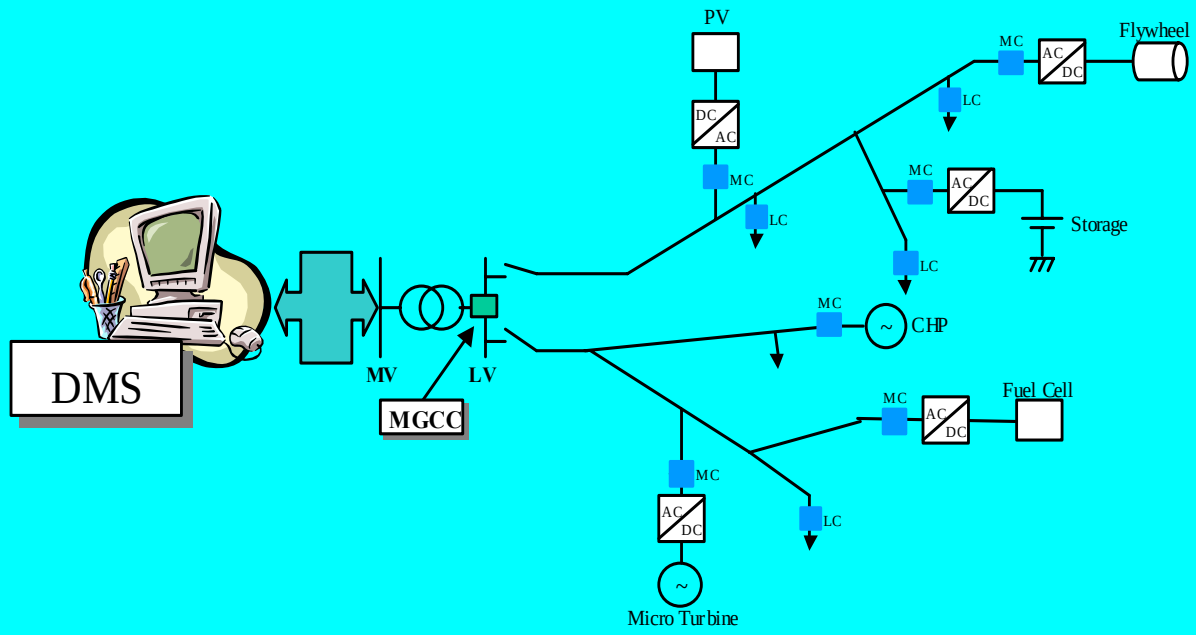
What are MICROGRIDS?

Interconnection of small, modular generation to low voltage distribution systems forms a new type of power system, **the Microgrid**.
Microgrids can be connected to the main power network or be operated **islanded**, in a coordinated, **controlled** way.



Microgrids – Hierarchical Control

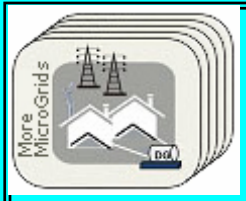
MicroGrid Central Controller (MGCC) promotes technical and economical operation, interface with loads and micro sources and **DMS;** provides set points or supervises LC and MC; **MC and LC Controllers**: interfaces to control interruptible loads and micro sources



Centralized vs. Decentralized Control

Technical, economic and environmental benefits

- Energy efficiency
- Minimisation of the overall energy consumption
- Improved environmental impact
- Improvement of energy system reliability and resilience
- Network benefits
- Cost efficient electricity infrastructure replacement strategies
- *Cost benefit assessment*



Technical Challenges for Microgrids

- 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)
- Small size (challenging management)
- Use of different generation technologies (prime movers)
- Presence of power electronic interfaces
- Protection and Safety

Market and Regulatory Challenges

- coordinated but decentralised energy trading and management
- market mechanisms to ensure efficient, fair and secure supply and demand balancing
- development of islanded and interconnected price-based energy and ancillary services arrangements for congestion management
- secure and open access to the network and efficient allocation of network costs
- alternative ownership structures, energy service providers
- new roles and responsibilities of supply company, distribution company, and consumer/customer

MICROGRIDS Project

"Large Scale Integration of Micro-Generation to Low Voltage Grids

Contract : ENK5-CT-2002-00610

GREAT BRITAIN
- UMIST
- URENCO

PORTUGAL
- EDP
- INESC

SPAIN
- LABEIN

NETHERLANDS
- EMforce

14 PARTNERS,
7 EU COUNTRIES

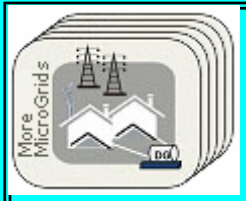
GREECE
- NTUA
- PPC /NAMD&RESD
- GERMANOS

GERMANY
- SMA
- ISET

FRANCE
- EDF
- Ecole des Mines de Paris/ARMINES
- CENERG

http://microgrids.power.ece.ntua.gr

Budget: 4.5M€



Microgrids Highlights

- Control philosophies (hierarchical vs. distributed)
- Energy management within and outside of the distributed power system
- Device and interface response and intelligence requirements
- Quantification of reliability benefits and loss reduction
- Steady State and Dynamic Analysis Tools

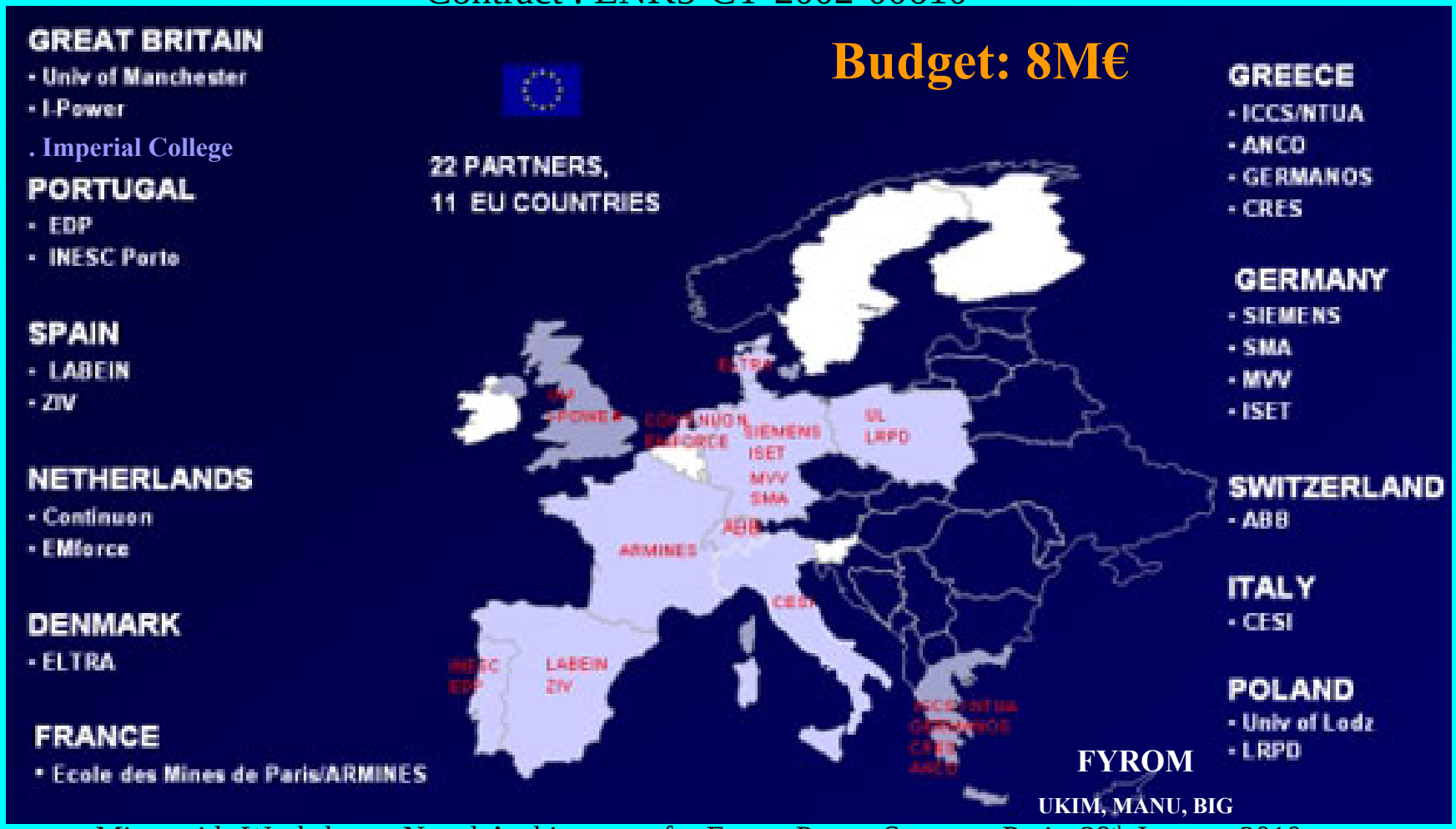
MORE MICROGRIDS Project

"Large Scale Integration of Micro-Generation to Low Voltage Grids

Contract : ENK5-CT-2002-00610

Budget: 8M€

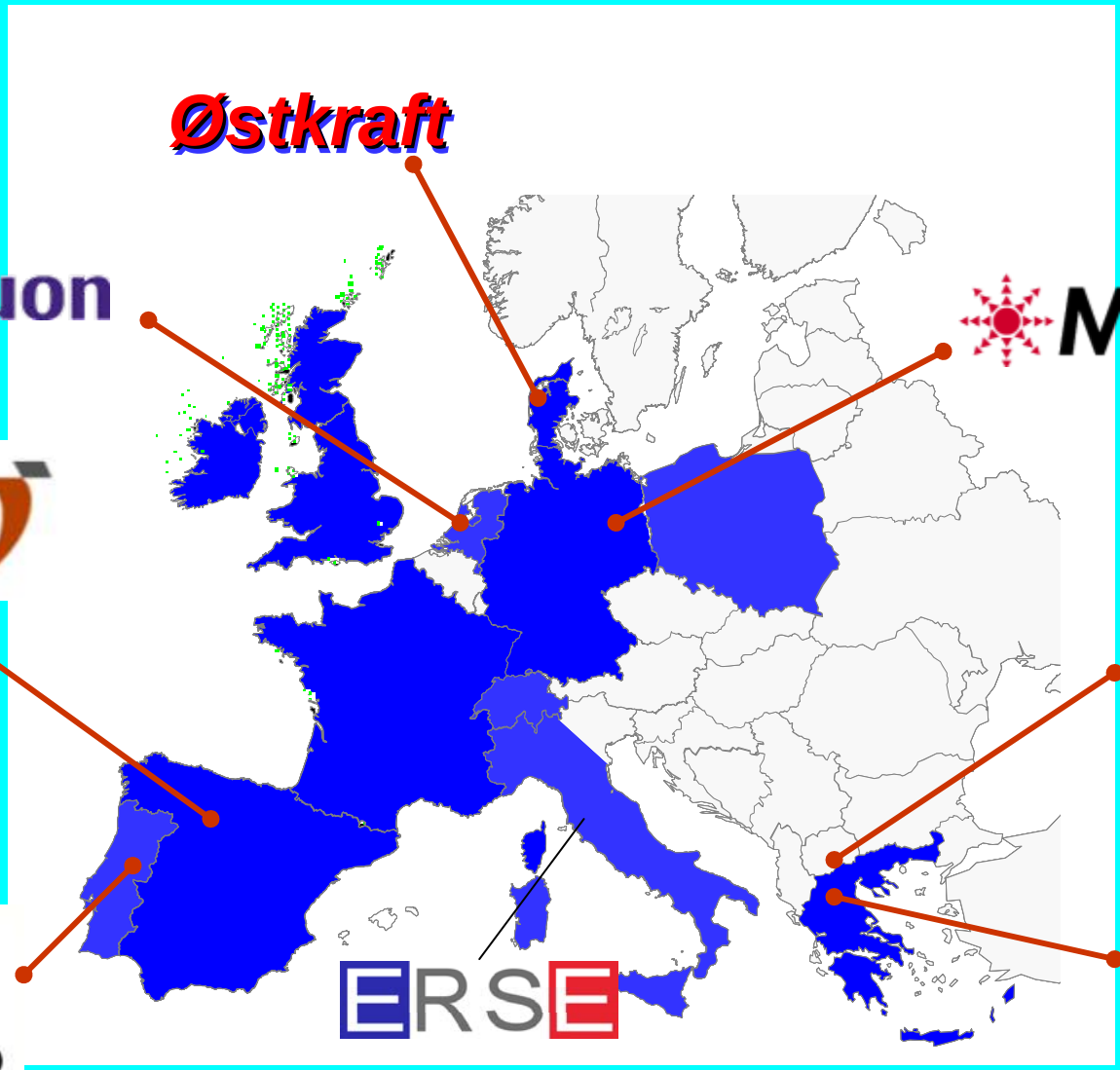
22 PARTNERS,
11 EU COUNTRIES



More Microgrids Highlights

- Sophisticated control techniques for Distributed Generators and Load Controllers to implement
- Integration of several Microgrids into operation and development of the power system. Interaction with DMS.
- **Field trials to test control strategies on actual Microgrids**
- **Quantification of Microgrids effects on Power system operation and planning**

Microgrids Pilots



Test Objectives

Experimental validation of various actual Microgrids (rural, industrial, commercial) in different operating modes.

- The following will be demonstrated :
  - interconnected mode.
  - islanded mode.
  - transitions from interconnected to islanded mode and vice versa.
- The centralized and de-centralized control strategies will be evaluated.
- The advanced power electronic interfaces (Intelligent Load Switch and smart Battery Storage) will be demonstrated.