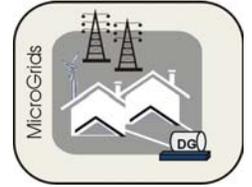


BETA SESSION 4b: Integration of Renewable Energy Sources and Distributed Generation

MicroGrids



Barcelona 12-15 May 2003



MICROGRIDS

LARGE SCALE INTEGRATION OF MICRO- GENERATION TO LOW VOLTAGE GRIDS – TARGET ACTION I

PROJECT No: NNE5-2001-00463

CONTRACT No: ENK5-CT-2002-00610

Total Eligible Costs: 4,394 kE, EC Contribution 2,494 kE

Duration: 36 months

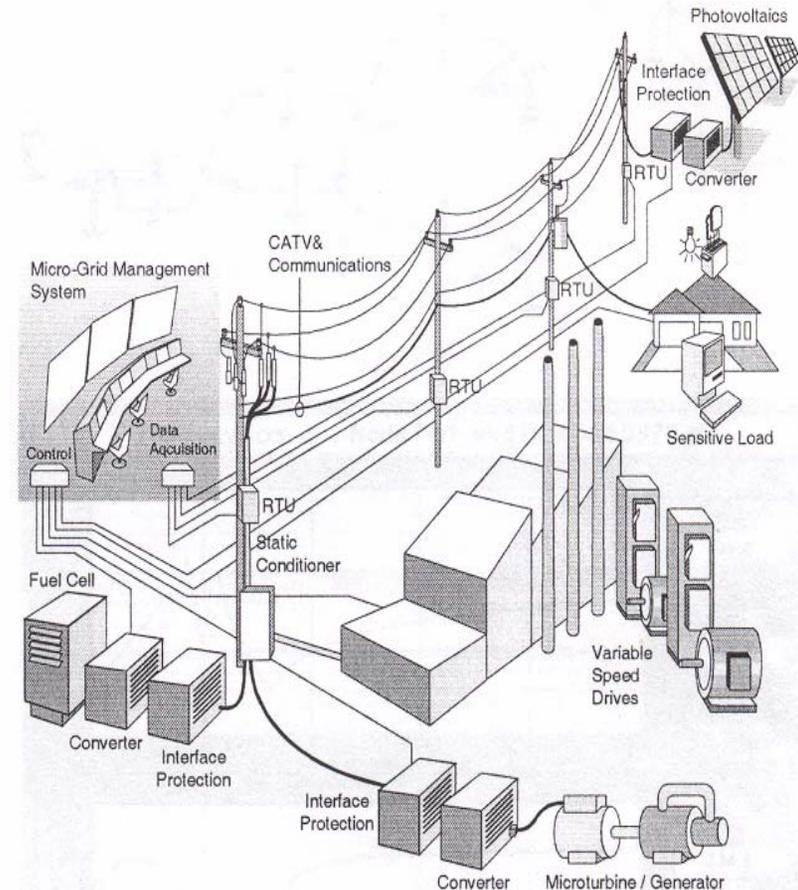
<http://microgrids.power.ece.ntua.gr>



MICROGRIDS - Definition

Interconnection of small, modular generation to low voltage distribution systems can form a new type of power system, **the MicroGrid.**

MicroGrids can be connected to the main power network or be operated autonomously, similar to power systems of physical islands.





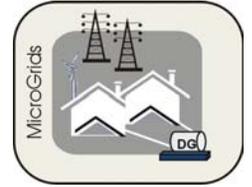
MICROGRIDS - Objectives

- ▶ To increase penetration of RES and other micro-sources in order to contribute for the reduction of GHG emissions.
- ▶ To study operation of MicroGrids in parallel with the mains and in islanding conditions that may follow faults.
- ▶ To define, develop and demonstrate control strategies that will ensure the most efficient, reliable and economic operation and management of MicroGrids.



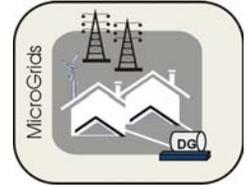
MICROGRIDS - Objectives (2)

- ▶ To define appropriate protection and grounding policies that will assure safety of operation and capability of fault detection, isolation and islanded operation.
- ▶ To identify the needs and develop the telecommunication infrastructures and communication protocols required.
- ▶ To determine the economic benefits and to propose systematic methods and tools to quantify these benefits and to propose appropriate regulatory measures.



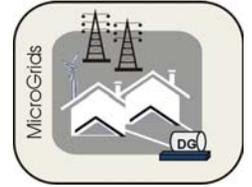
MICROGRIDS - Description of Work

- Study of design and operation of MicroGrids so that increased penetration of RES and other DG achieved;
- Development and demonstration of control strategies so that operation of MicroGrids meets customer requirements and technical constraints and delivers power in the most efficient, reliable and economic way;
- Determination of economic and environmental benefits of the MicroGrid operation and proposal of systematic methods and tools to quantify these benefits and to propose appropriate regulatory measures;



MICROGRIDS - Description of Work (2)

- Definition of appropriate protection and grounding policies for safety of operation and capability of fault detection;
- Needs and development of telecommunication infrastructures and communication protocols;
- Simulation and demonstration of MicroGrid operation on laboratory models;
- Projection of MicroGrid development on distribution feeders in Greece, Portugal and overseas France quantifying via simulation the environmental, reliability and economic benefits from their operation.



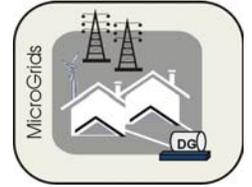
Milestones and expected results

Investigation, Development and Demonstration of the operation, control, protection, safety and telecommunication infrastructure of MicroGrids, determination and quantification of their economic benefits.

The effect of MicroGrids formation on:

- increase of RES and micro sources share (target 15%),
- reduction of annual losses (target 10%),
- increase of reliability levels (target 30%)
- reduction of energy cost for the end-user (target 10%)

via simulation on actual distribution systems



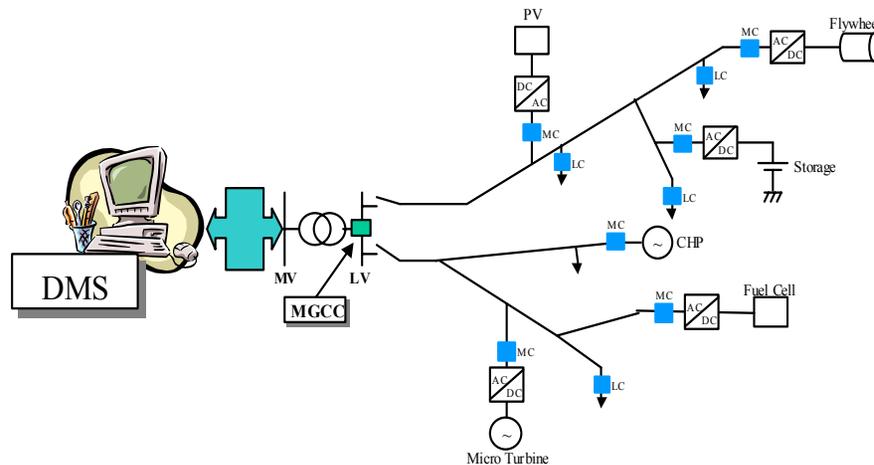
MICROGRIDS - 9 Workpackages

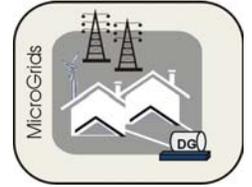
- WP A: Development of Steady State and Dynamic Simulation Tools
- WPB Development of Local Micro Source Controllers
- WPC Development of Micro Grid Central Controller
- WPD Development of Emergency Functions
- WPE Investigation of Safety and Protection
- WPF Investigation of Telecommunication Infrastructures & Communication Protocols
- WPG Investigation of Regulatory, Commercial, Economic & Environmental Issues
- WPH Development of Laboratory MicroGrids
- WPI Evaluation on study case networks

MICROGRIDS - Control Issues

Development of innovative, sophisticated control of the MicroGrid comprising three critical control levels:

- Local Micro Source (MC) and Load Controllers (LC)
- MicroGrid System Central Controller (MGCC)
- Distribution Management System (DMS)



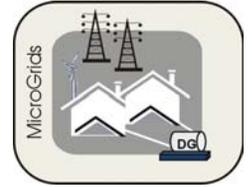


MICROGRIDS - Market Prospects

- DG increasing worldwide due to a number of reasons, most important government support for CHP and RES, desire for diversification of energy sources and commercial advantage.
- Next evolutionary step is the formation of MicroGrids (few city blocks, fuelled by electricity from many small, highly efficient and low-emission DGs, linked by telecommunication systems)
- One leading manufacturer estimates DG and MicroGrids will create business for them about \$1 billion annually by 2005, rising to \$2.5 billion in 2010.
- Booming business in components like Microturbines (in 2000, 2000 units of 100 MW, within five years more than 2000 MW annually).
- Besides Europe, CHP markets (Asia) emerging fast (25% increase per year).



Barcelona 12-15 May 2003



MICROGRIDS - Consortium

PROJECT

COORDINATOR:

CONTRACTORS:

Institute of Communication & Computer Systems (ICCS/NTUA)

Electricidade de Portugal (EDP)

Public Power Corporation S.A. (PPC/NAMD & PPC/RESD)

Electricite de France (EdF)

SMA Regelsysteme GmbH (SMA)

URENCO Power Technologies Ltd. (URENCO)

GERMANOS S.A.

Instituto de Engenharia de Sistemas e Computadores do Porto (INESC Porto)

University of Manchester Institute of Science and Technology (UMIST)

Institute fur Solare Energieversorgungstechnik (ISET)

Association pour la Recherche et le Developpement des Methodes et Processus Industriels (ARMINES/CENERG)

Fundacion LABEIN (LABEIN)

Electric Power Research Institute (EPRI)

Ecole Nationale Superieure des Mines de Paris (ENSM/PCNERG)