

Overview of Microgrid R&D in the US

*presentation at the
Nagoya 2007 Symposium on Microgrids*

Mielparque-Nagoya, Nagoya Japan

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by

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Environmental Energy Technologies Division

Outline

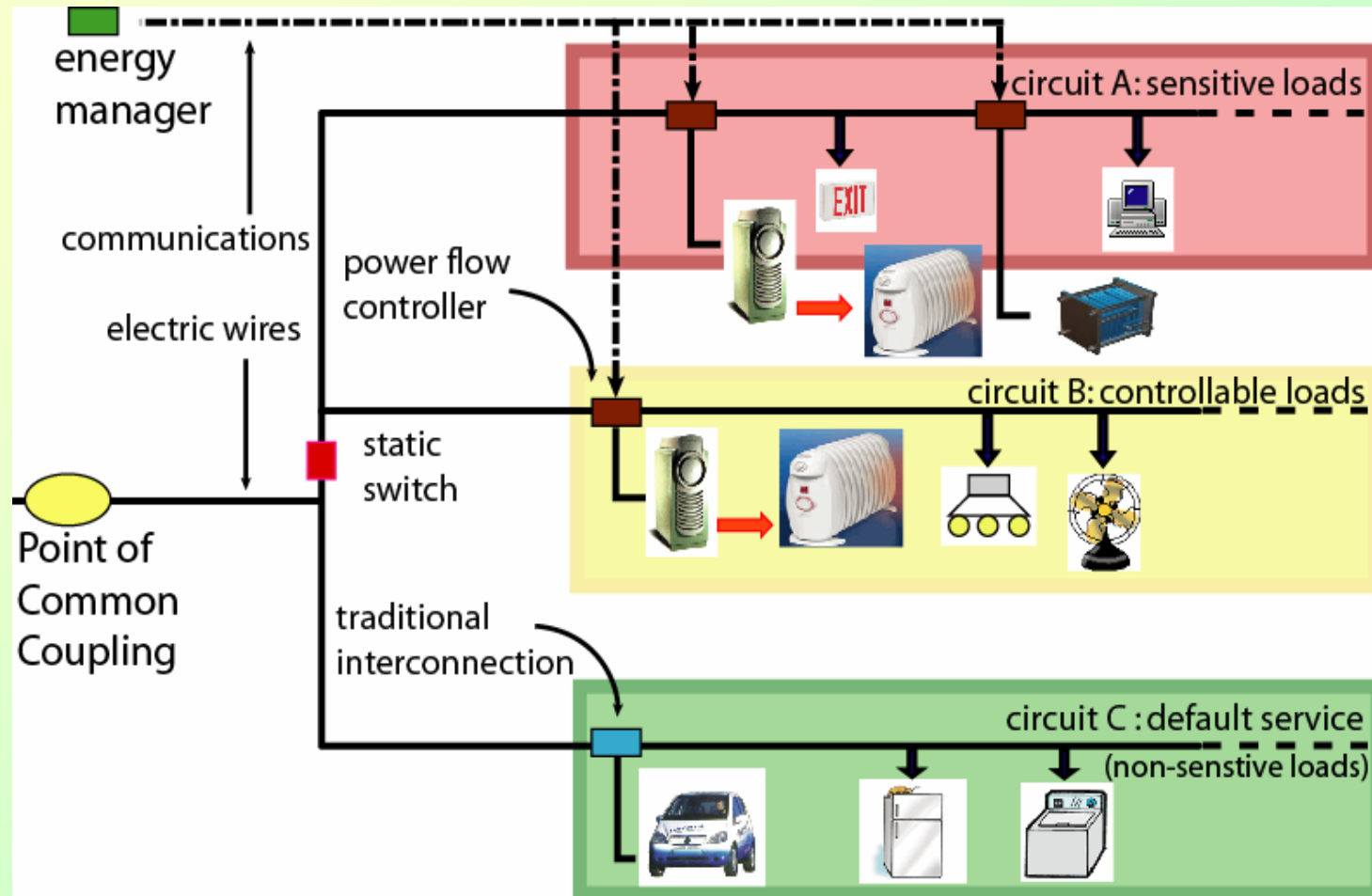
1. CERTS Update
2. GE Microgrid Project
3. DUIT & Benefits Study

1. Consortium for Electric Reliability Technology Solutions (CERTS) Microgrid

The CERTS Microgrid Features

- peer-to-peer electronic microgrid devices avoids dependence on any central fast control or protection scheme
- devices are plug-and-play, so configuration is flexible, maximum advantage of CHP possible (possibly highly dispersed)
- a cluster of small (e.g. < 500 kW) sources, storage systems, and loads which presents itself to the grid as a legitimate entity, i.e. as a *good citizen*, and manages power quality and reliability locally
- interconnected with the familiar wider power system, or *macrogrid*, at a point of common coupling, but islands at a fast static switch

Example CERTS Microgrid



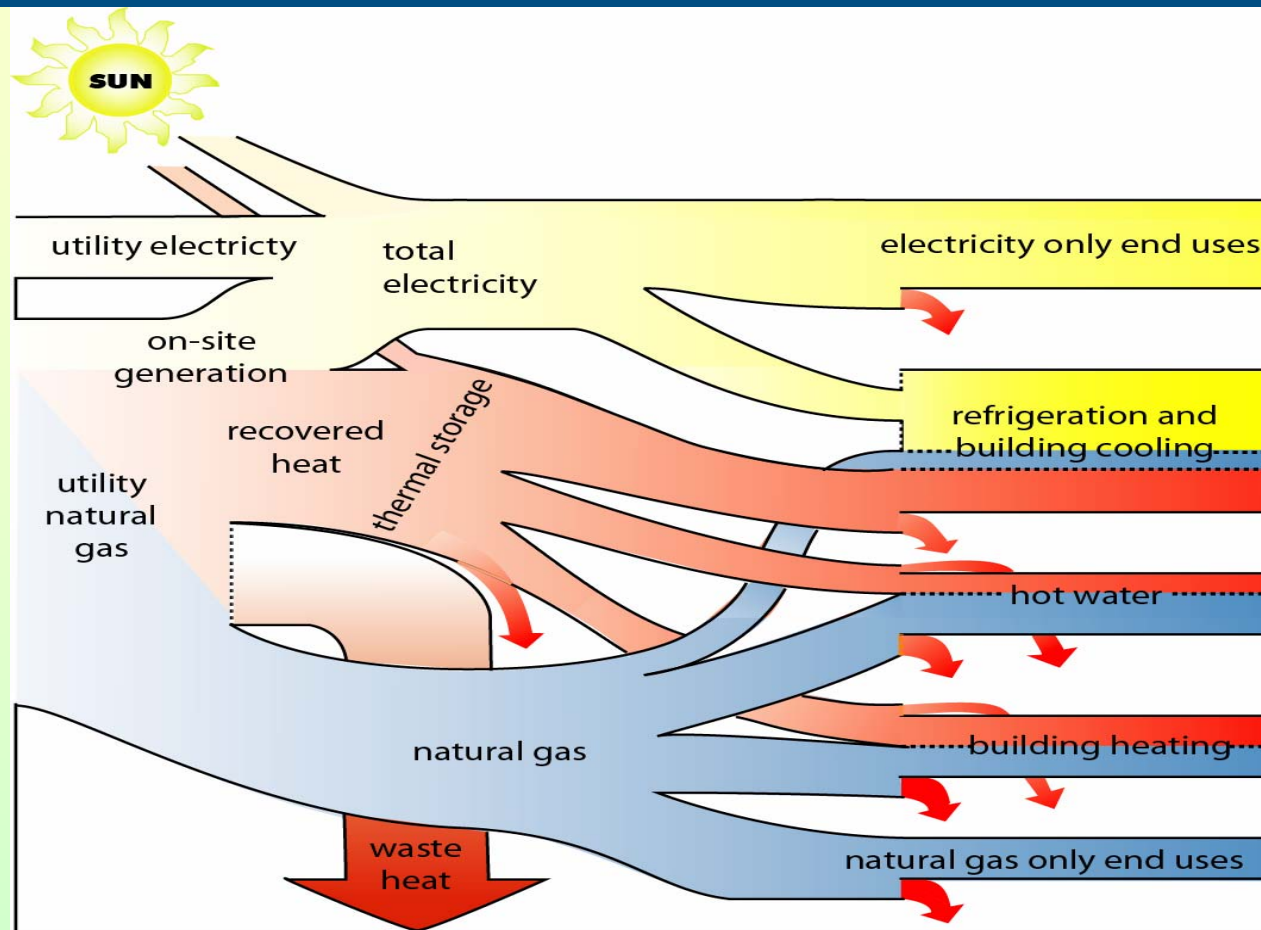
Dolan Tech Center, Columbus OH



<http://certs.aeptechlab.com/>

DER Customer Adoption Model (DER-CAM)

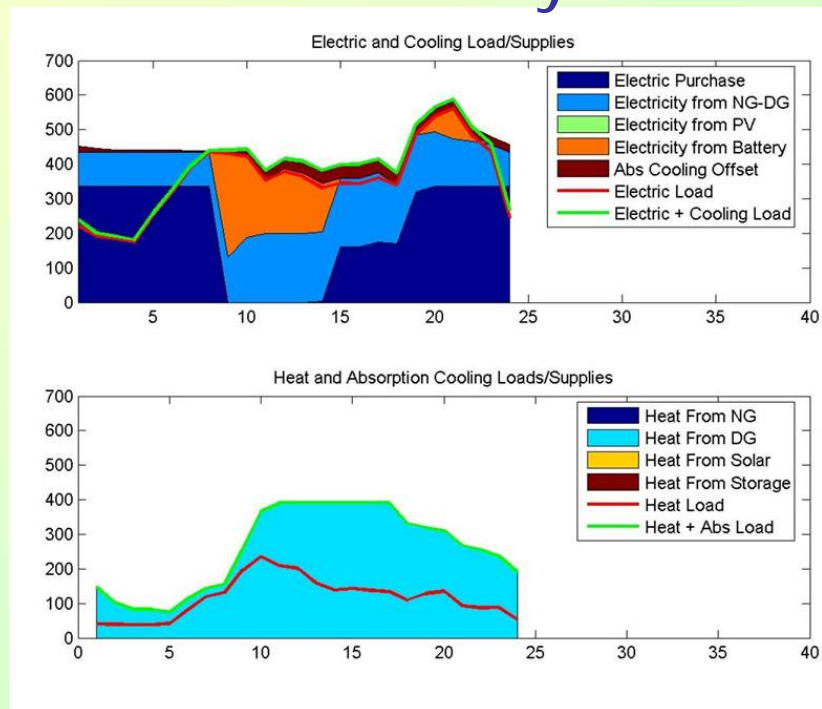
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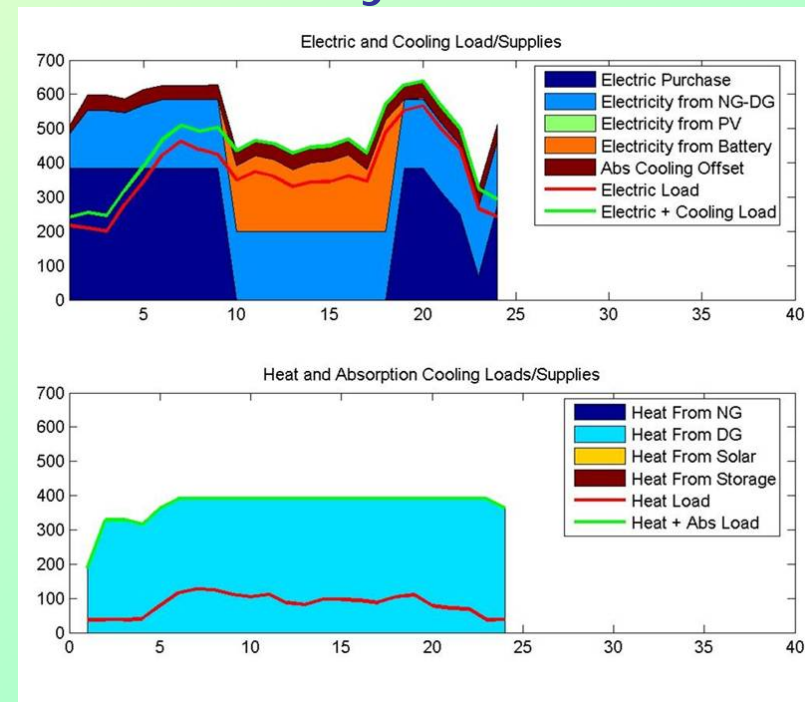
Optimal Solution, Low Cost Batteries

- 1 x 200 kW reciprocating engines with heat recovery
- 320 kW absorption chiller
- 3680 kWh electrical storage

January



July



μ GRD: Unique Characteristics

components are modeled in **direct phase quantities** without any approximating assumptions, for example symmetrical components.

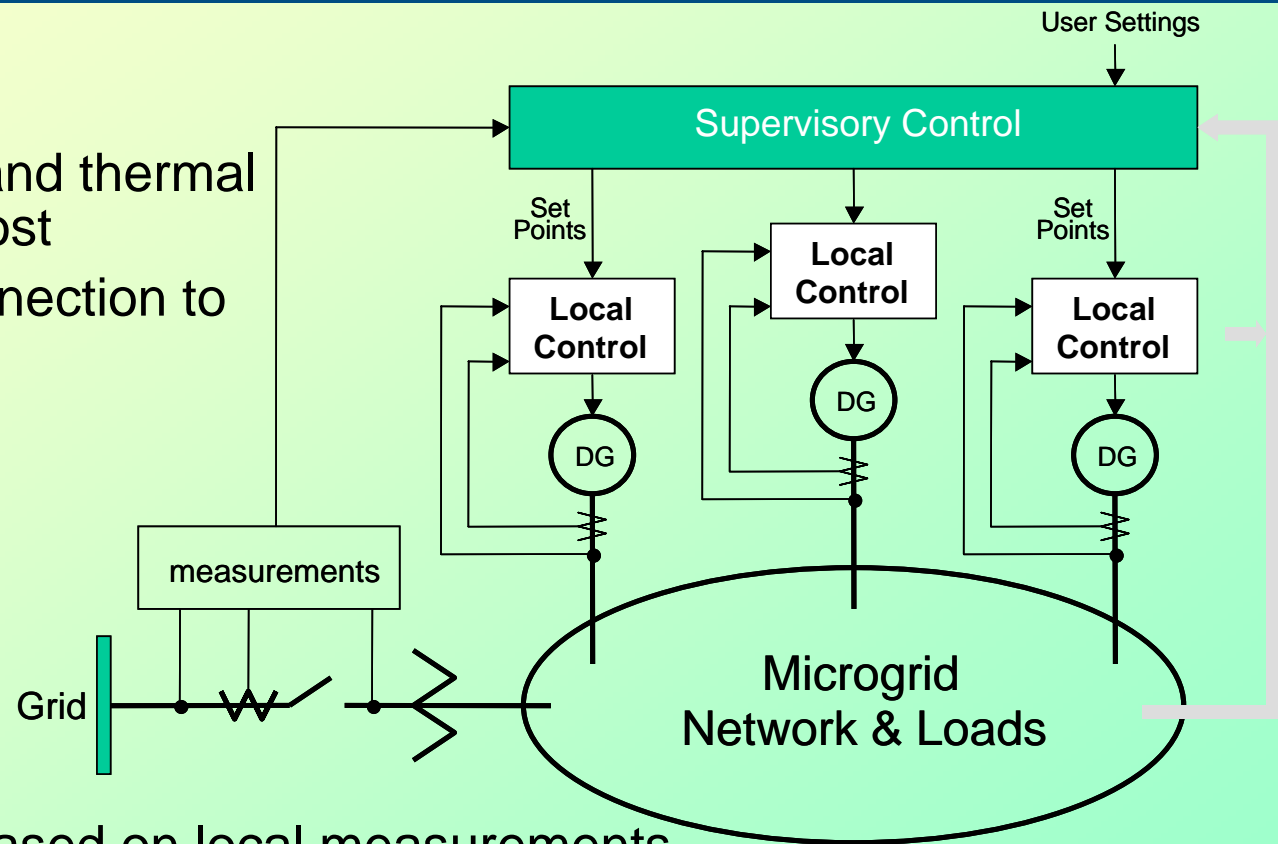
- provides the capability of handling three wire, four-wire and five-wire systems
- provides high fidelity models
- provides voltages and currents in Neutral wires and ground wires

2. GE Microgrid Project

General Electric Project: MicroGrids

Supervisory Controls

- optimize electrical and thermal performance and cost
- manage feeder connection to bulk grid
- manage renewable intermittency



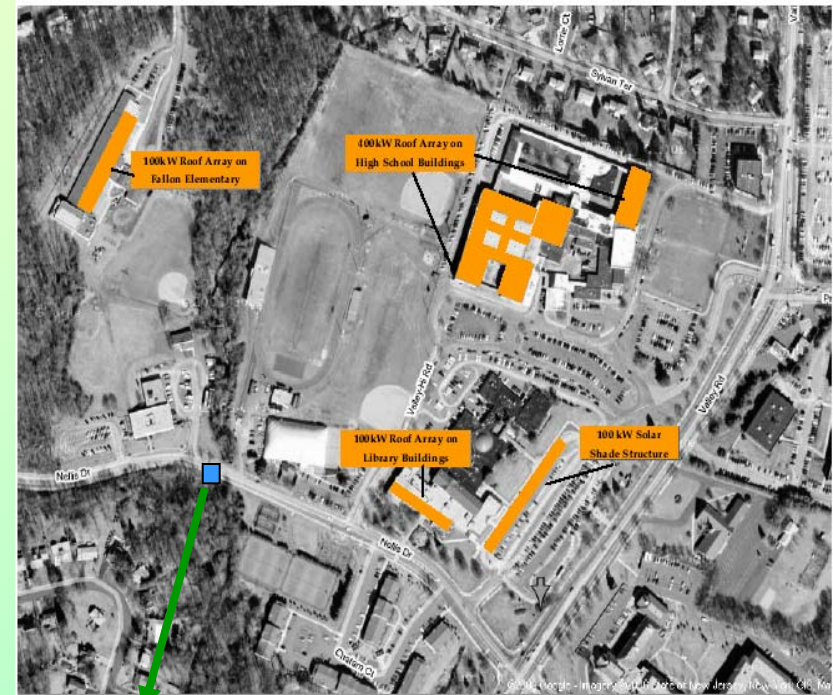
Local Controls

- control response based on local measurements
- respond to system disturbances and supervisory level commands
- provide stability and load sharing

Demonstration at a Campus

demonstrate energy efficiency, CHP and renewable integration achieving long-term cost savings, enhanced reliability, and improved environmental quality

- **peak load of 1.3 MW & peak critical load for island operation of 670 KW**
- **combined cooling, heating, and power (CCHP)**
- **islanded operating mode**
- **Islanded black start capability**
- **control of active and reactive power at PCC**
- **optimal dispatch**



Central Plant

- 7 buildings and 2 additional facilities
- Grid electricity, NG boilers for heat
- 2 X 335 kW Jenbacher
- 305 KW of PV
- 1 point of interconnection to the grid

} → Today

} → Tomorrow

3. Other Activities

Distributed Utility Integrated Test: 14 Objectives

- measure interactions among diverse DER on the distribution system
- examine issues related to the high penetration of DER
 - including islanding, voltage regulation, & stability
- test solutions that mitigate adverse interactions, using distribution design techniques as well as optimizing DER

The DUIT Facility: A Complete Medium Voltage Distribution System



- tied to medium voltage distribution system via one or more pole-mount transformers
- 21 kV motor-operated load break switch allows for isolation of total DUIT facility from grid
- (34) single phase PV inverters from 2.5-5 kW, 115 kW
- 2 three phase inverters, 140 kW
- 2 Capstone microturbines, 90 kW
- 500 kVA Genset
- ability to insert impedances equaling ~50 km of distribution line



DOE Benefits Study

THE POTENTIAL BENEFITS OF DISTRIBUTED GENERATION AND RATE-RELATED ISSUES THAT MAY IMPEDE THEIR EXPANSION

A STUDY PURSUANT TO SECTION 1817
OF THE ENERGY POLICY ACT OF 2005

February 2007



U.S. Department of Energy

- major study of DER benefits
- required by EPO Act 2005
- limited to requirements of Act
i.e. not comprehensive
- some parts are informative
e.g. background material
& sec. 7: DER and security
- open for public comment

available at:

http://www.oenergy.gov/epa_sec1817.htm



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If You Have More Questions

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amgato gozaimas!