

Electric Grid R&D Program at ORNL



DECC Laboratory Annual Planning Meeting

October 11th, 2007

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Oak Ridge National Laboratory evolved from the Manhattan Project



ORNL in 1943
The Clinton Pile was the world's first
continuously operated nuclear reactor

Today, ORNL is DOE's largest science and energy laboratory



- \$1.1B budget
- 4,200 employees
- 3,000 research guests annually
- \$300 million invested in modernization
- Work with over 600 companies
- World's most powerful open scientific computing facility
- Nation's largest concentration of open source materials research
- Nation's most diverse energy portfolio
- Bringing the \$1.4B Spallation Neutron Source into operation
- Managing the billion-dollar U.S. ITER project

ORNL is going through a major modernization

East Campus



Chestnut Ridge Campus



Science and Technology Park



West Campus

ORNL performing R&D to assist DOE in improving electric grid reliability

Power Delivery Test Facilities



Advanced Conductor Test Facility



Power Electronics Test facility



HTS cable & subsystems



DE Systems (DECC)

Advanced Materials



HTS - 2G wire & components



Power Electronics



Next-Gen components



Energy Storage

Computation. Modeling & Analysis



VERDE - Transmission Monitoring



Computational Modeling & Controls



Transmission Reliability

National Security



Micro-grids - Reconfigurable Grid



Critical Infrastructures - Distributed Systems Integration

Ensure the Reliability & Security of the Nation's Grid

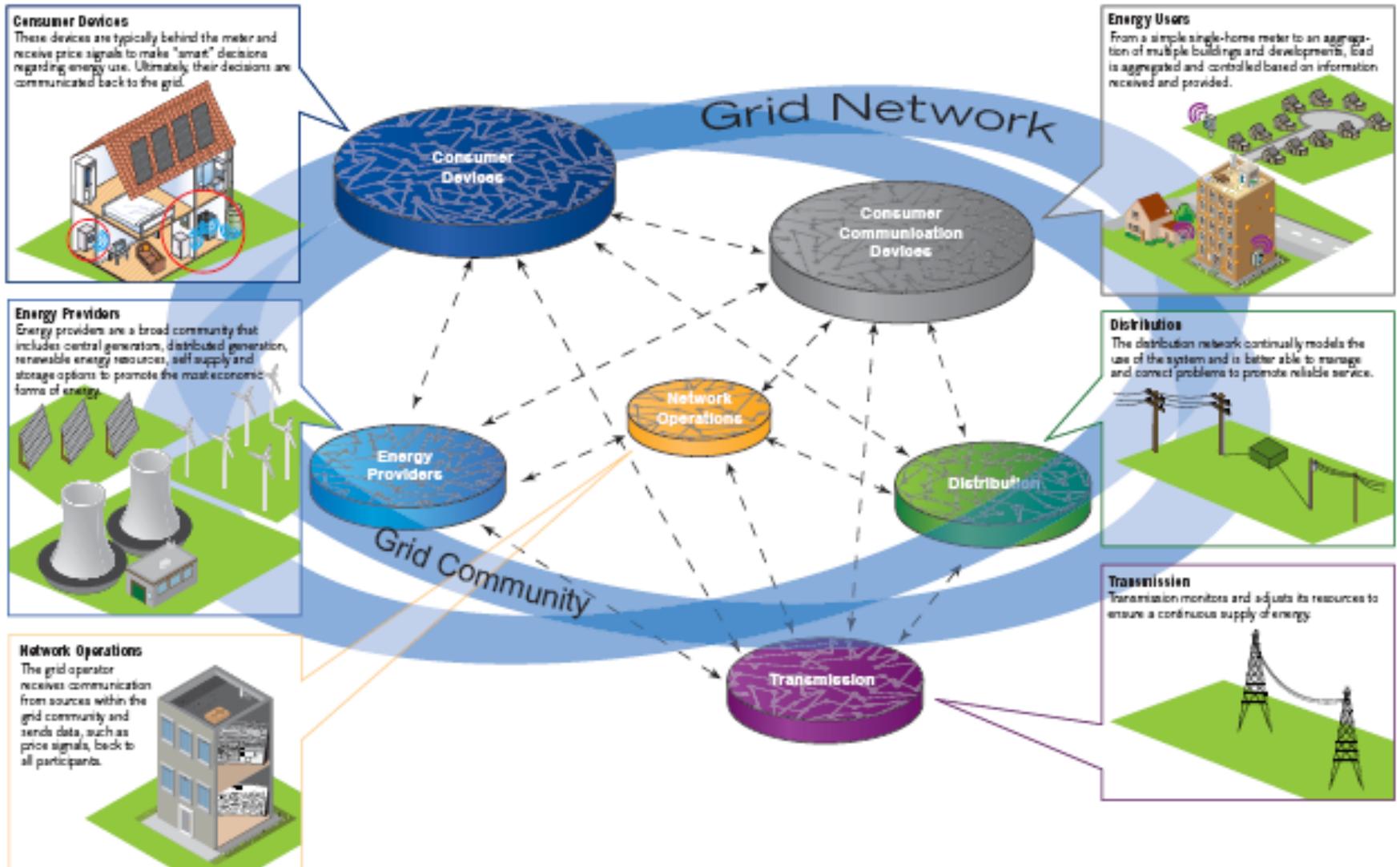
Reduce Transmission Congestion

Improve Power Quality

Reduce Major Outages

Improve Restoration Times

Modernizing the Electric Grid



ORNL was involved in the first fully integrated distribution automation system

- DOE funding from Office of Energy Storage and Distribution
 - FY82-FY88
- Project Team
 - ORNL
 - AUB, Athens Utilities Board
 - TVA, TVPPA, EPRI
 - Baltimore Gas & Electric
- Industrial Advisory Committee
- Athens Utilities Board (1985)
 - Municipal utility for the city of Athens, Tennessee
 - Population of 30,000 with 10,500 electric customers
 - 90 MW peak load
 - Three substations with 11 feeders



Athens Automation and Control Project

The purpose of the Athens Automation Control Experiment was to develop and test:

- load control options,
- voltage and reactive power control options,
- distribution system reconfiguration capabilities

on an electric distribution system from the transmission substation transformer to individual residential appliances.

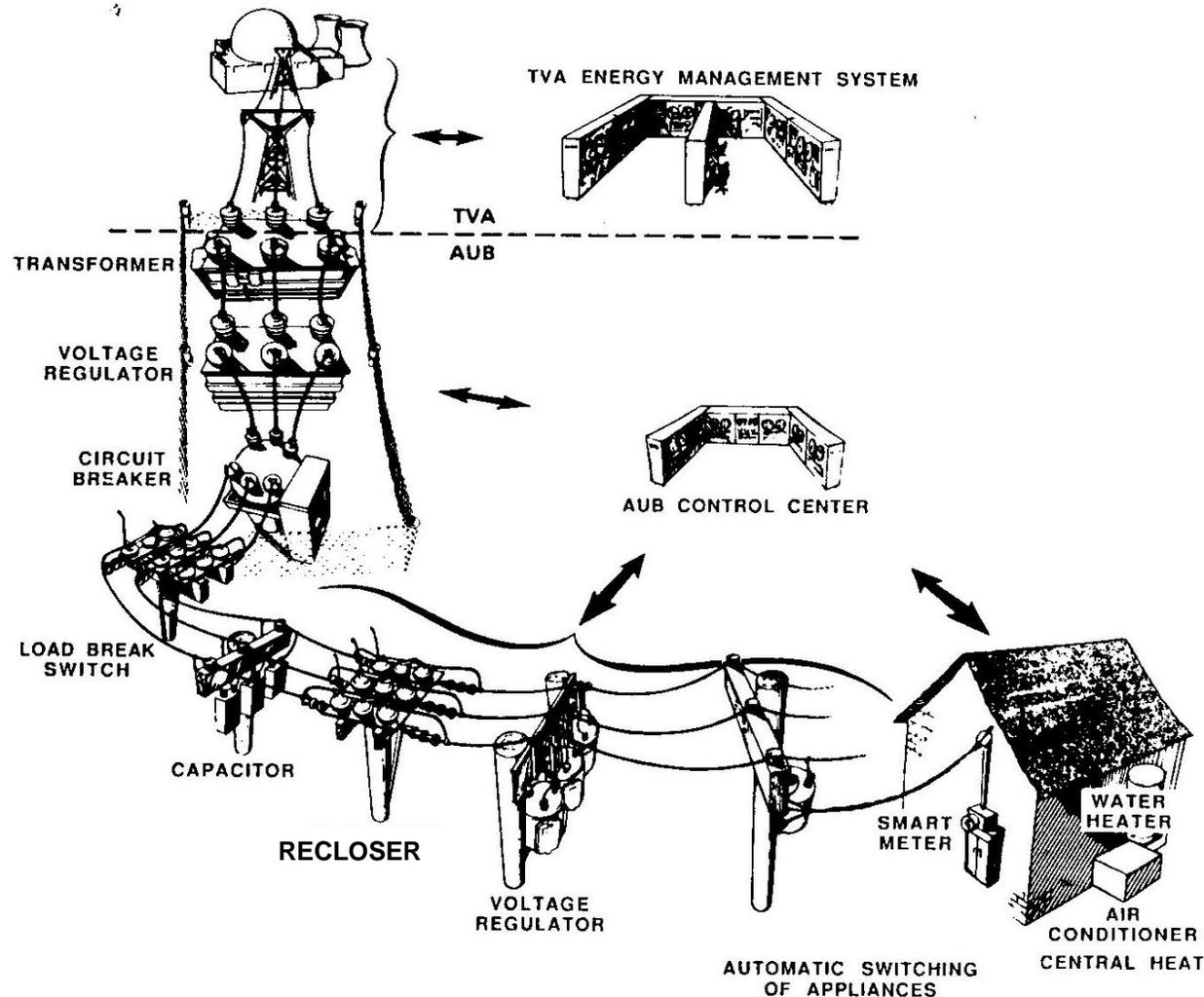


Figure 1-1 Automated equipment for the Athens Automation and Control Experiment.

Improving Grid Reliability through Distributed Energy Systems

DECC Facility

- **Unique facility for testing reactive power from distributed energy (DE) established in 2006**
- **Located on ORNL campus and interfaces with ORNL distribution system**
- **Developing controls for voltage and power factor regulation to improve system reliability**
- **Partnering with utilities and generation suppliers**



Distributed Energy Communications and Controls (DECC) Facility can test inverter and rotating generation equipment

DECC Facility Plans

- Photovoltaic units to assess opportunity for reactive power compensation
- PHEV to study interface with grid
 - Charging while providing reactive power
 - Ancillary Services

