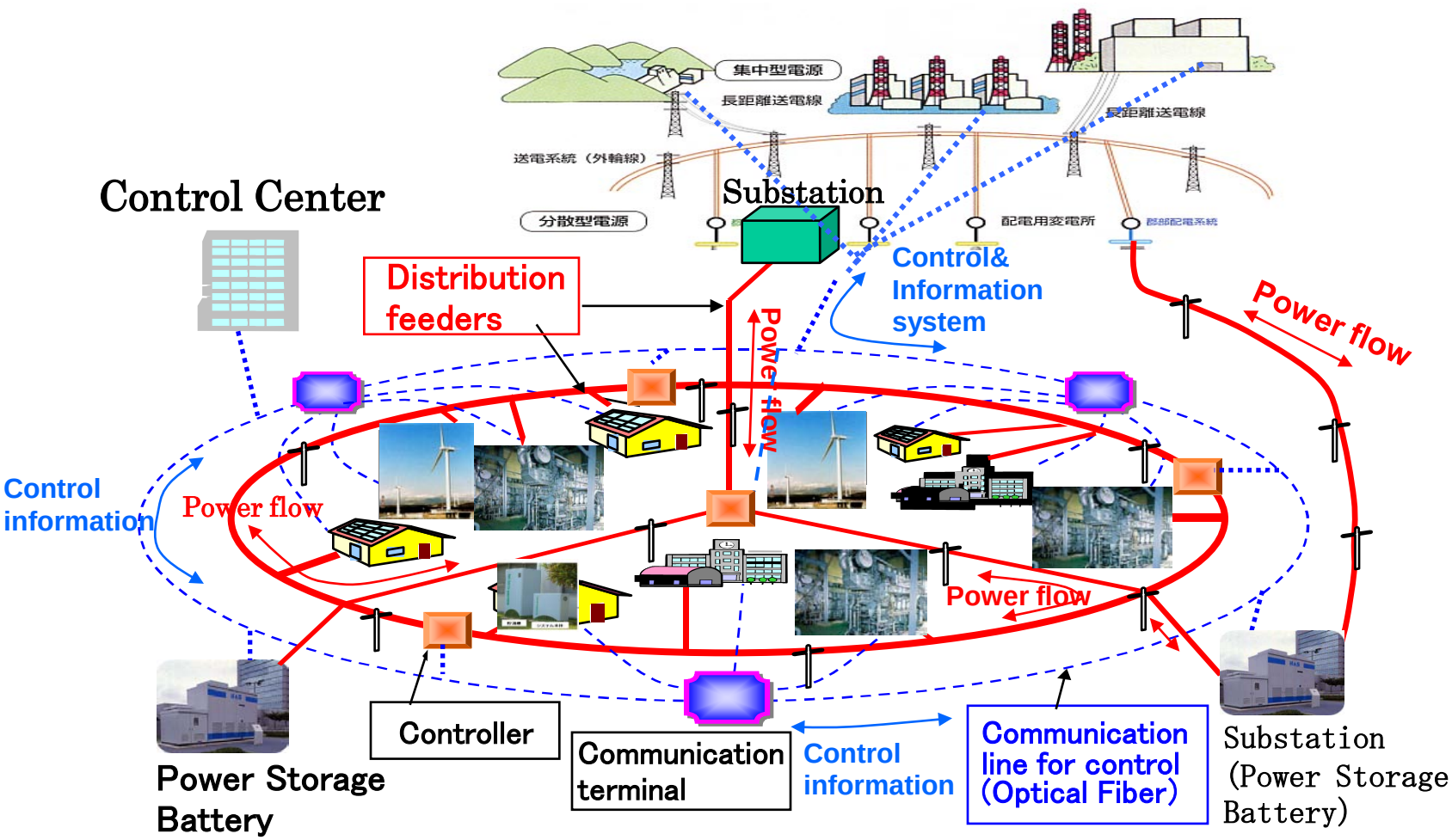
Microgrid Symposium
September 17, 2009
San Diego

Overview of Microgrid R&D in Japan

Akihiko Yokoyama
The University of Tokyo

Concept of Advanced Power Supply Network

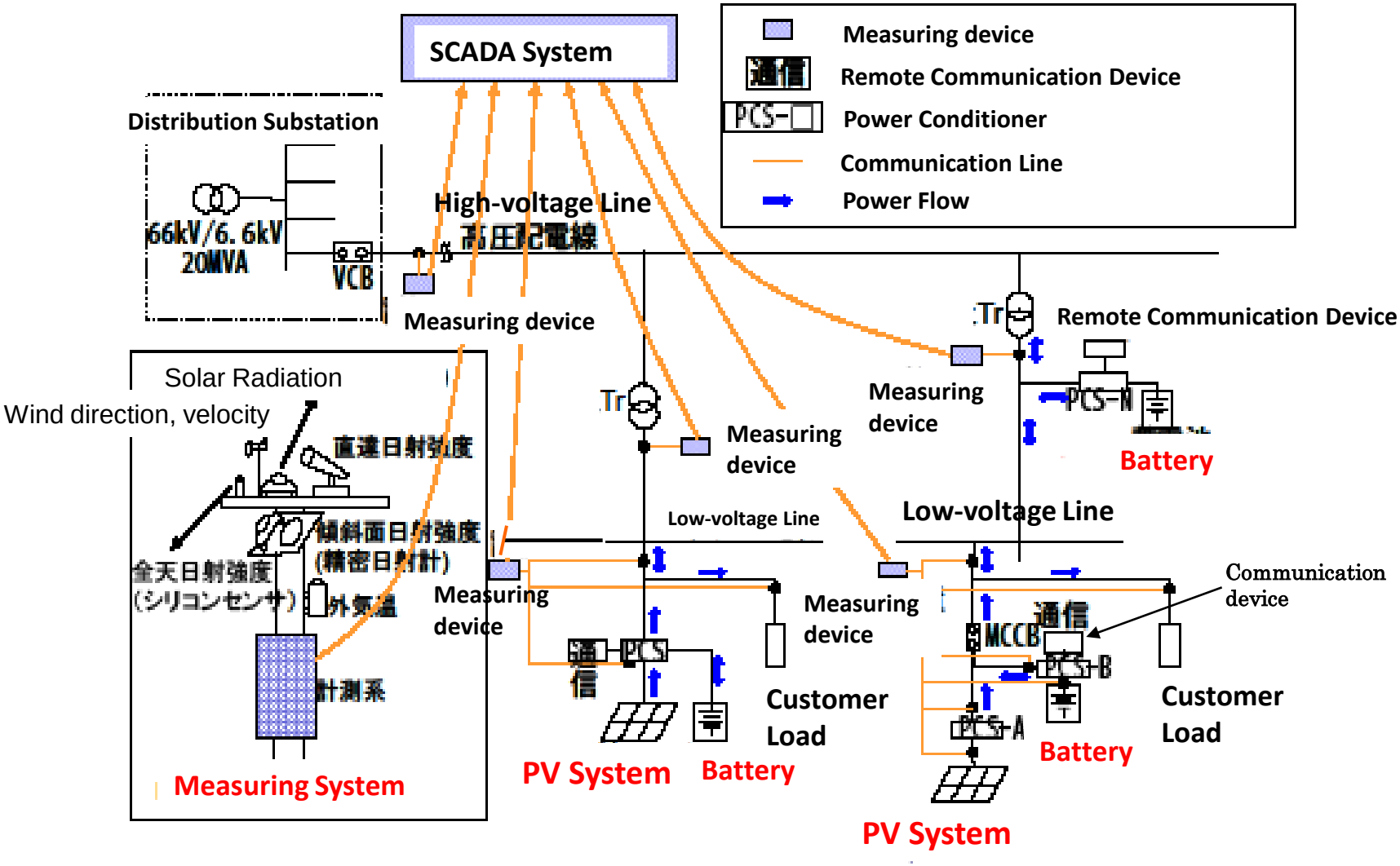
From 2001 to 2003



Technical Committee supported by METI

Voltage Control of a Feeder with a Large Penetration of PV Generations by Batteries

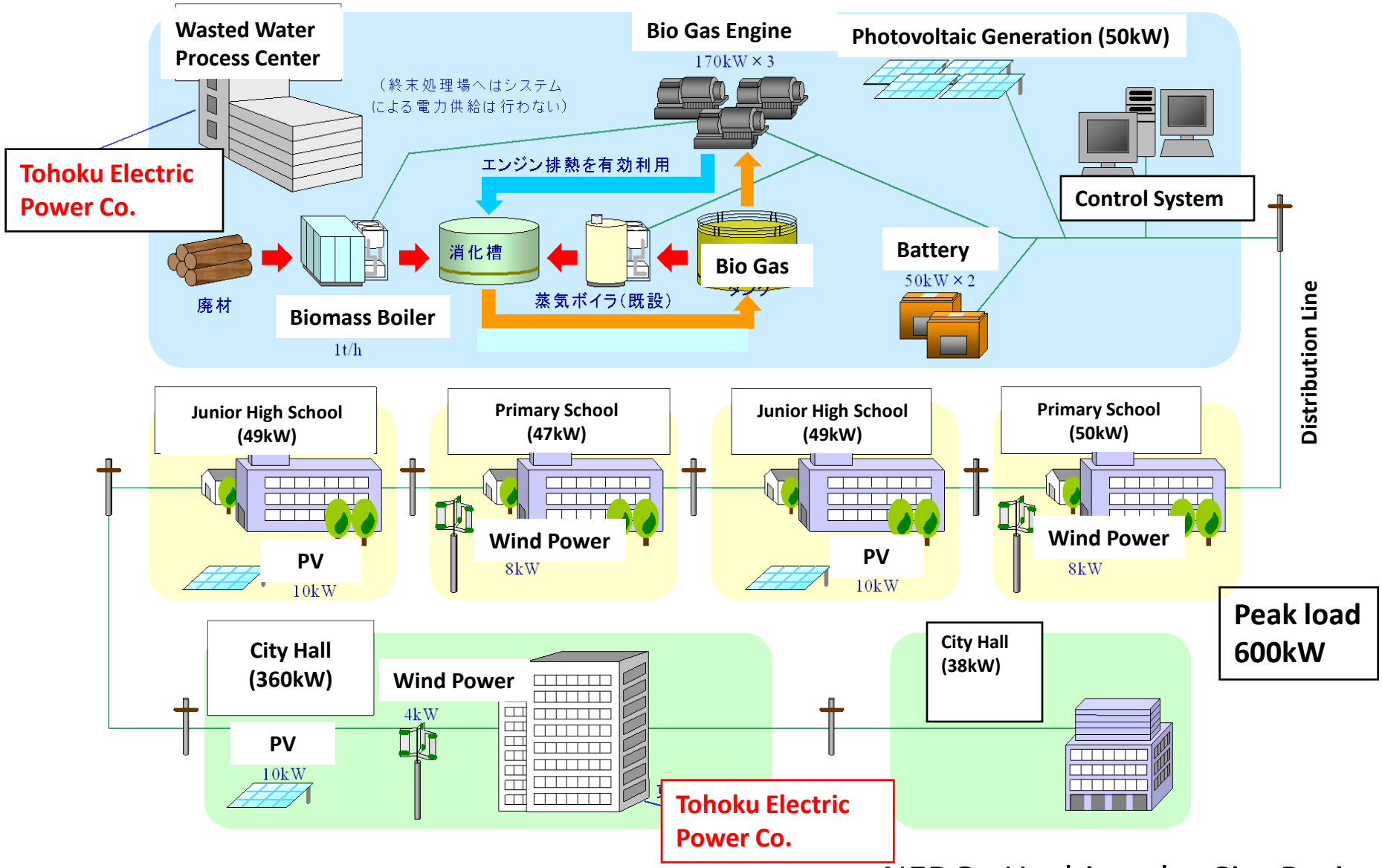
From 2002 to 2007



NEDO Ohta City Project

Independent and Islanding Operation of Microgrid

From 2003 to 2008

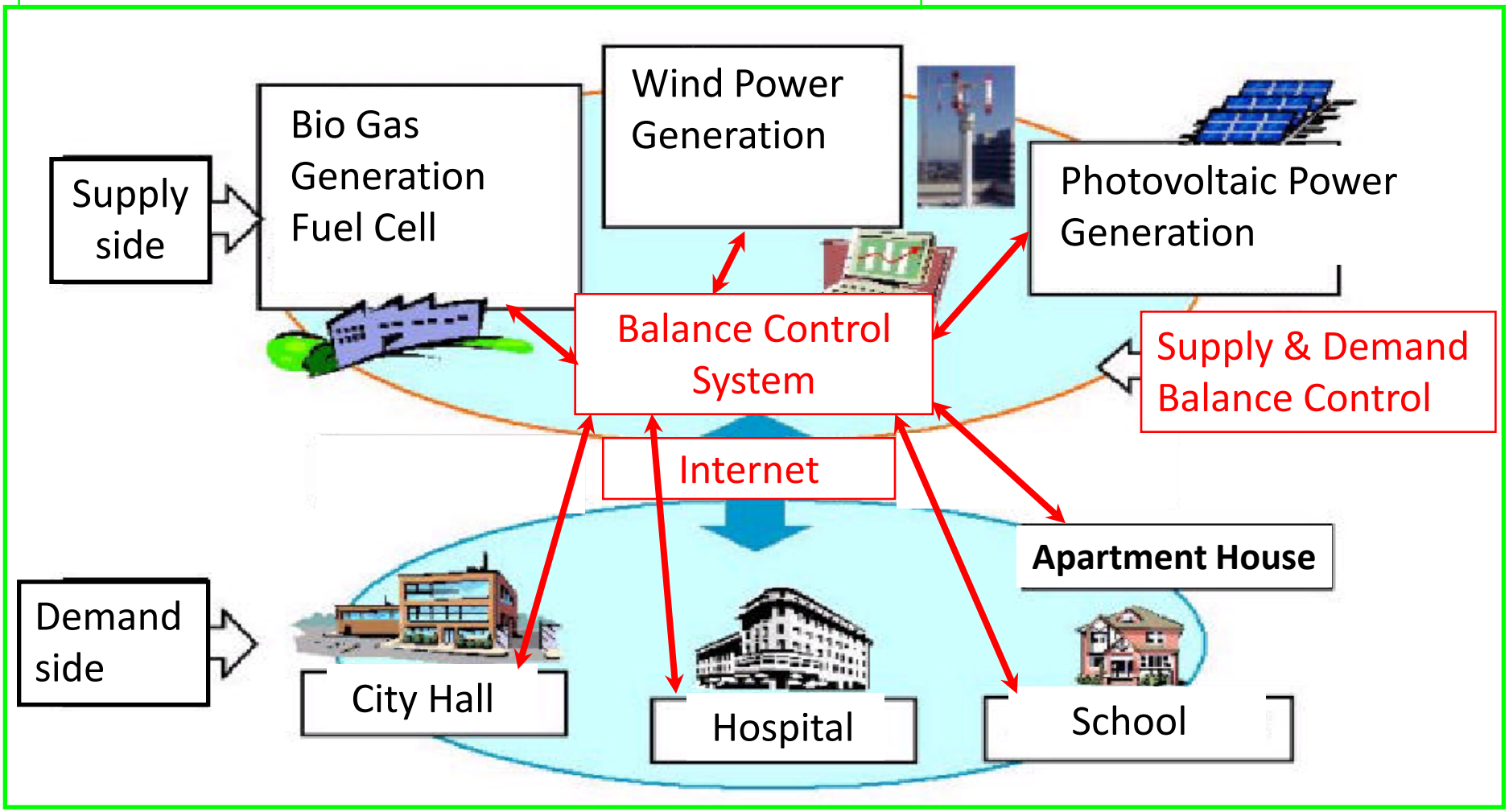


NEDO Hachi-no-he City Project

Operation of DGs including RES as a Virtual Power Plant

From 2003 to 2008

Commercial Power System, Utility Power System

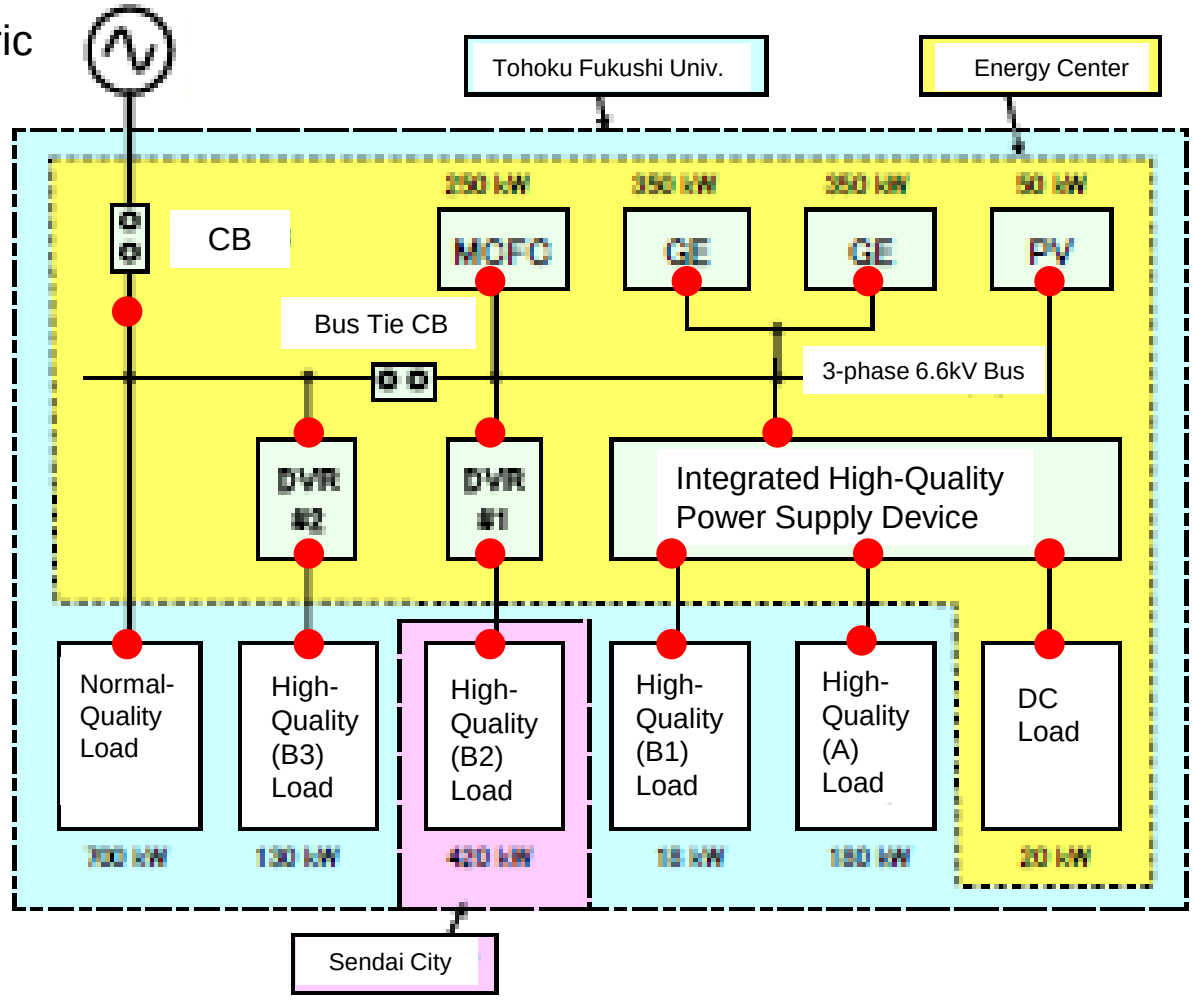


NEDO Kyoto Project

Multiple Power-Quality Electricity Supply Network

From 2003 to 2008

Utility
(Tohoku Electric
Power Co.)



● Measuring point (Total 22 pts)

DVR：Dynamic Voltage Restorer

NEDO Sendai City Project

Supply and Demand Integrated Distribution System

--- Autonomous Demand Area Power System ---

From 2003 to 2008

Main trans.
- 2000kVA (2 units)

66kV commercial line

Experimental substation

Loop Power Controller

N

Supply & Demand Interface

DG & Load

Site A

DG & Load

Site D

1km

0.5km

DG & Load

Site B

DG & Load

Site C

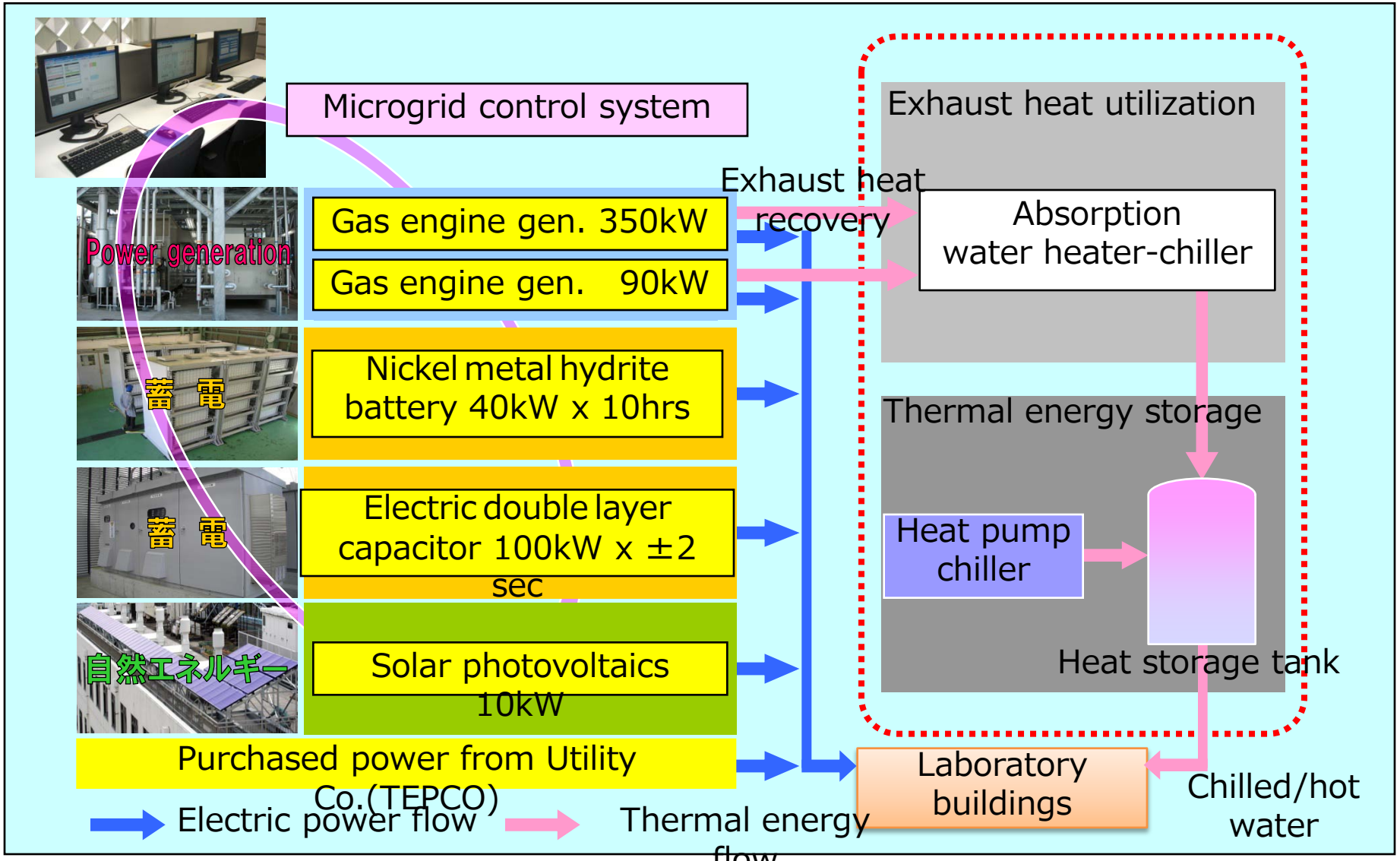
Operation system

Communication network

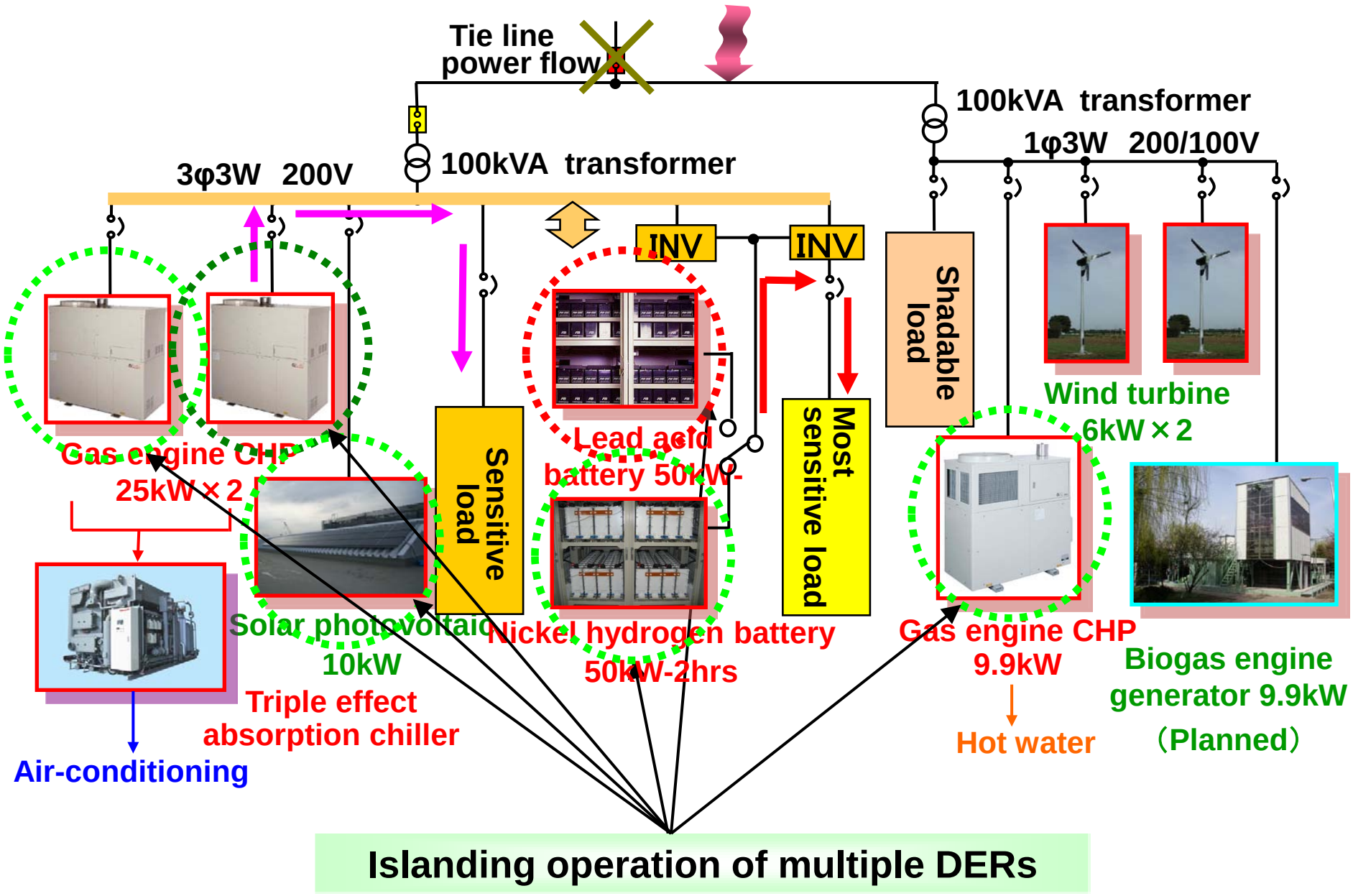
6.6kV and 22kV Distribution line (Total length; 5km)

- Many types of DGs installed in 4 places separately
- Communication Network

Shimizu Microgrid System

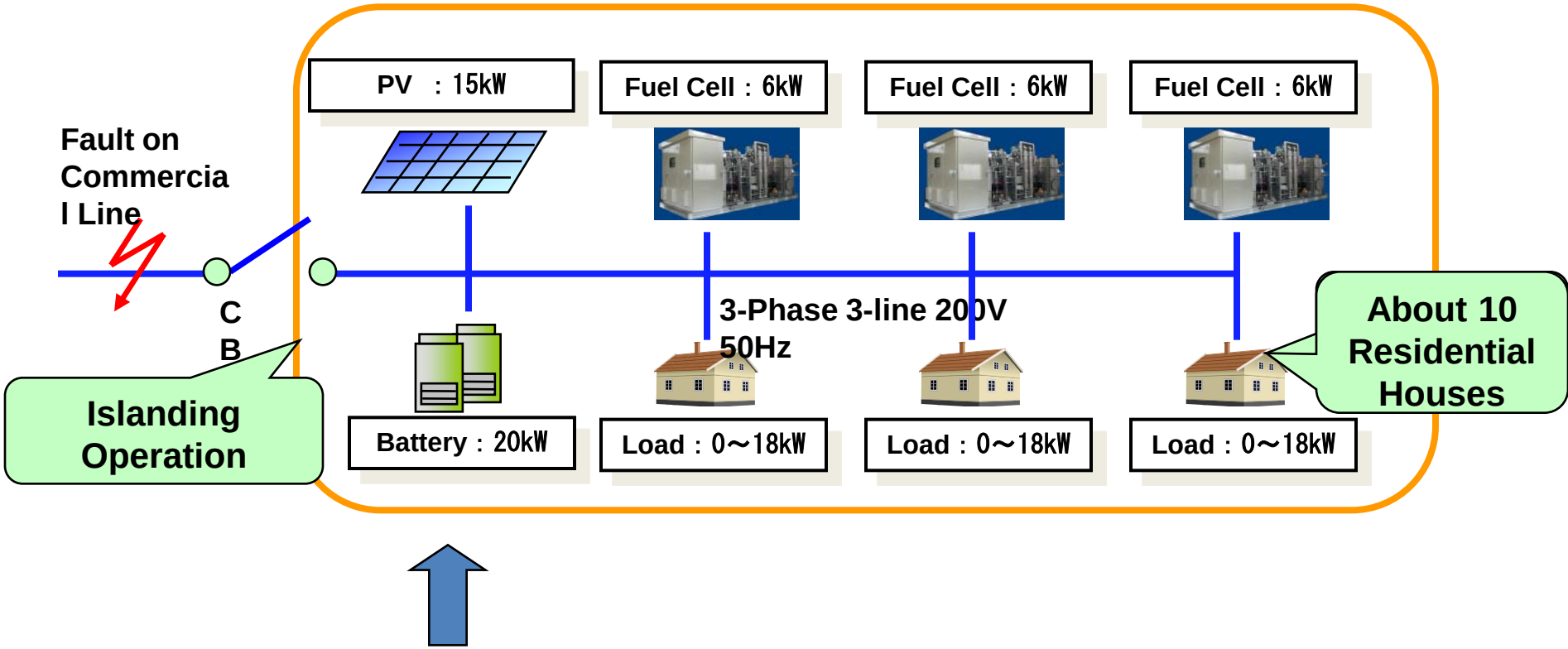


Tokyo Gas Microgrid System



Simulation Study on Islanding Operation of Microgrid with DC based DGs and AC Feeder

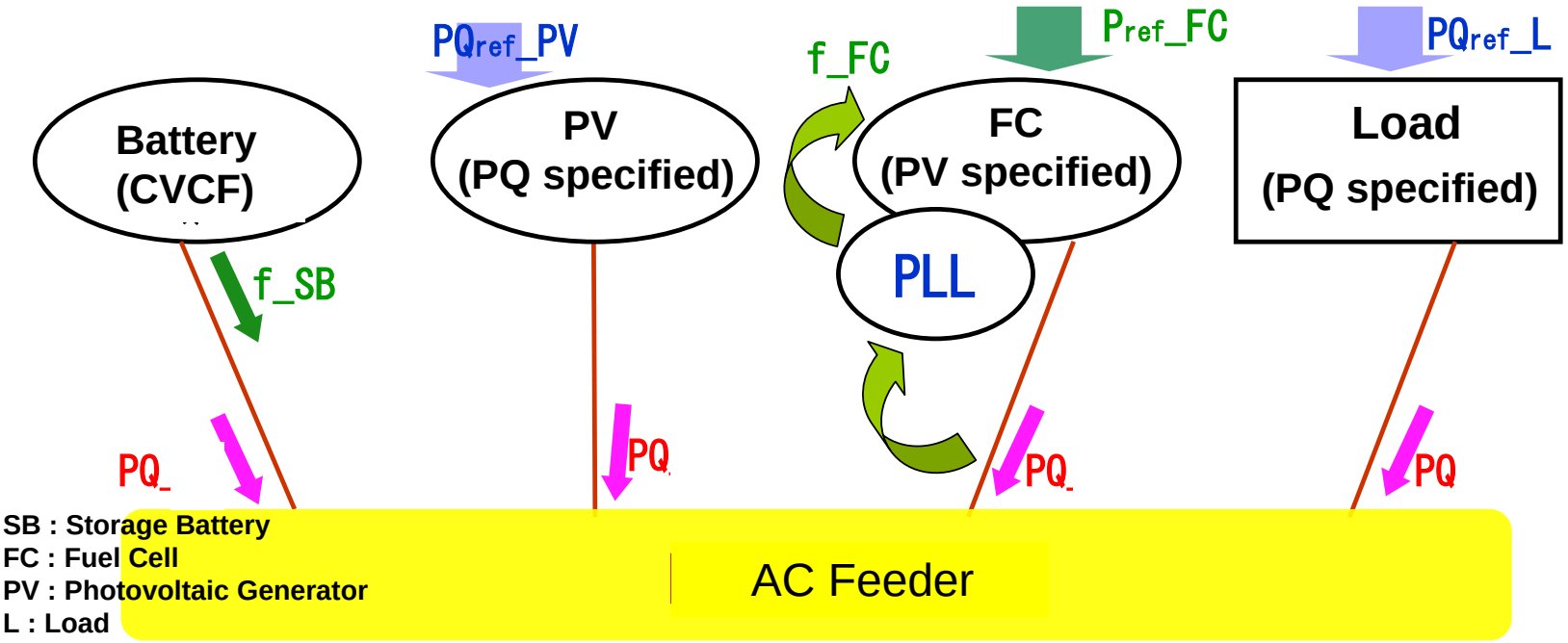
From 2004 to 2006



Minimization of the required capacity of Battery

Joint Project of Univ. of Tokyo and Mitsubishi

Autonomous Decentralized Control by use of AC Feeder Frequency

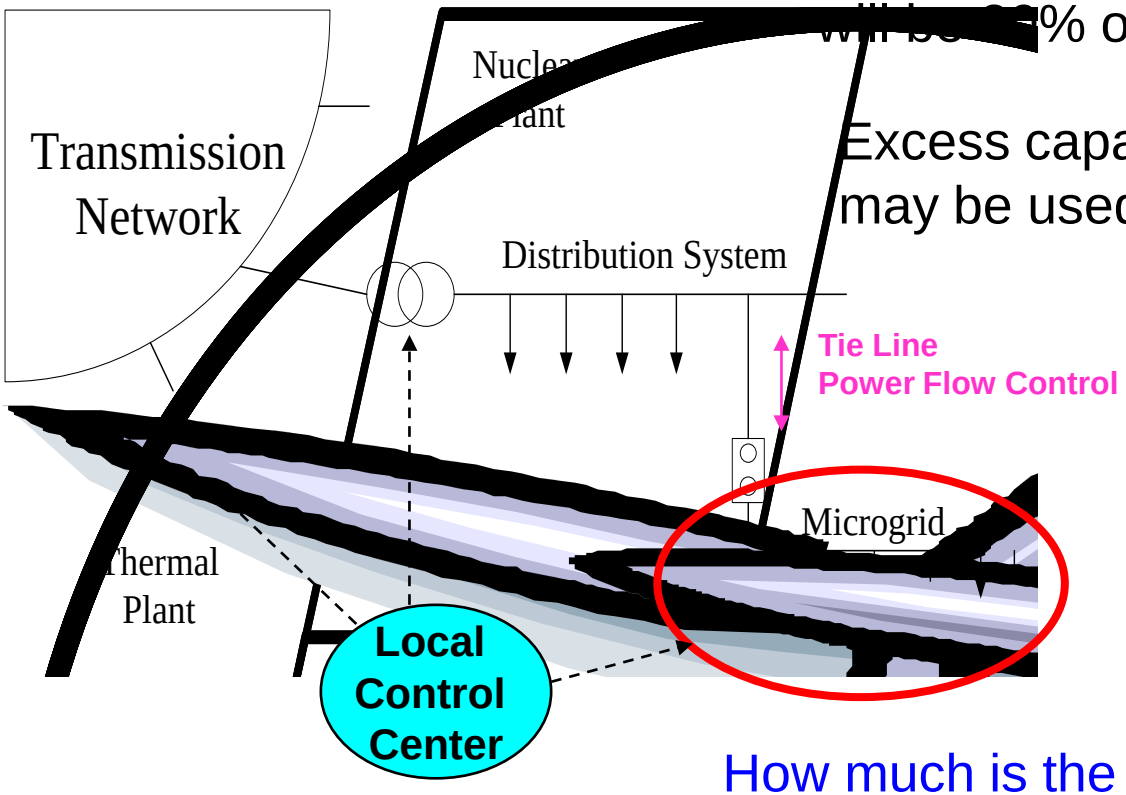


- The System Frequency is used for Active Power Balance Control of Fuel Cell and Battery.
- The Battery changes the frequency according to its output power and each FC detects the frequency change and decides its output.

Contribution of Microgrid to Utility Grid

Expected total capacity of Microgrid
will be [illegible]% of total utility load demand.

Excess capacity of Microgrid
may be used for the contribution.



Ex. Load Frequency Control

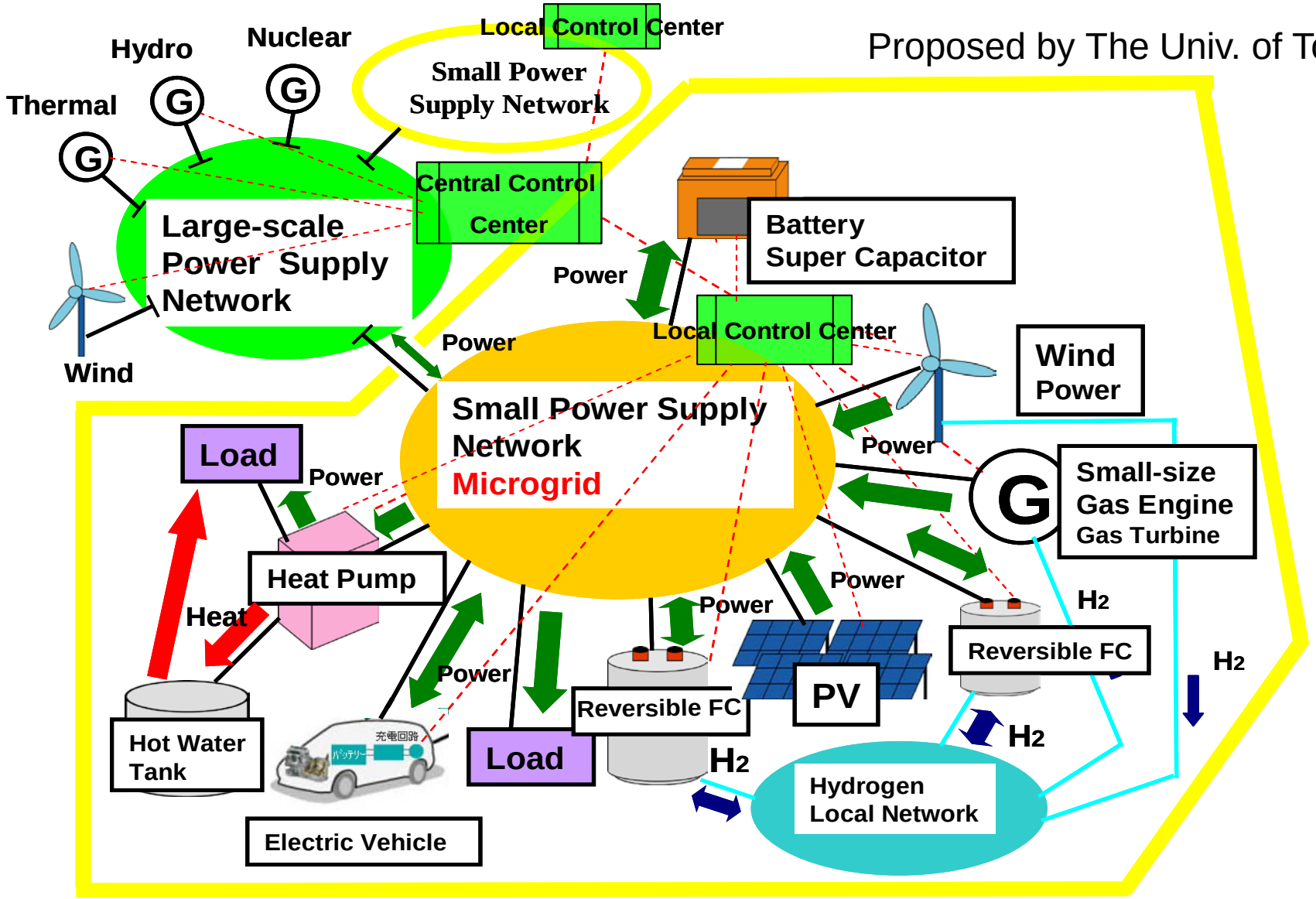
How much is the excess capacity used?

How is the microgrid controlled?

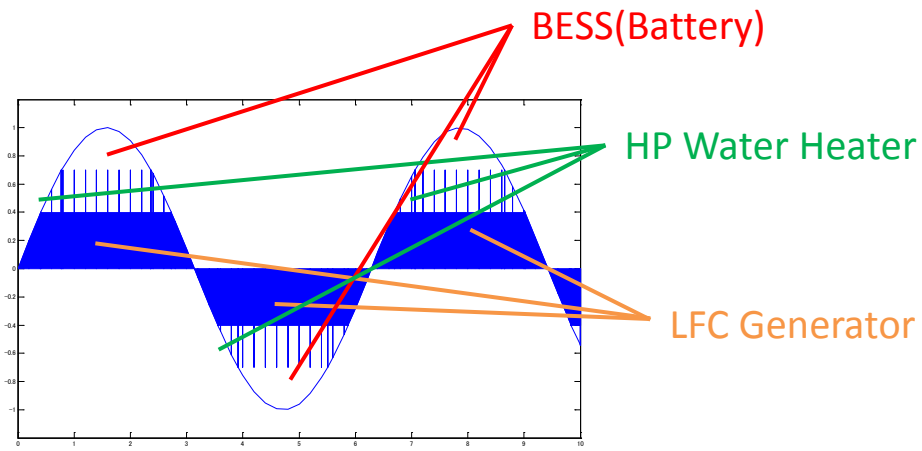
How is an ancillary service cost is defined?

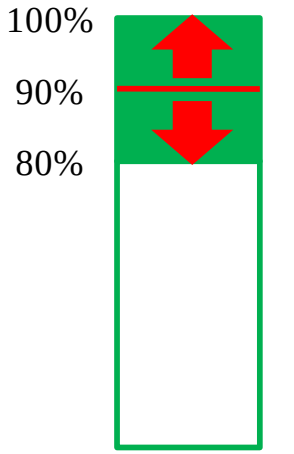
Joint Project of Univ. of Tokyo and Tokyo Gas

Concept of Advanced Smarter Grid in Japan (Ubiquitous Power Grid)



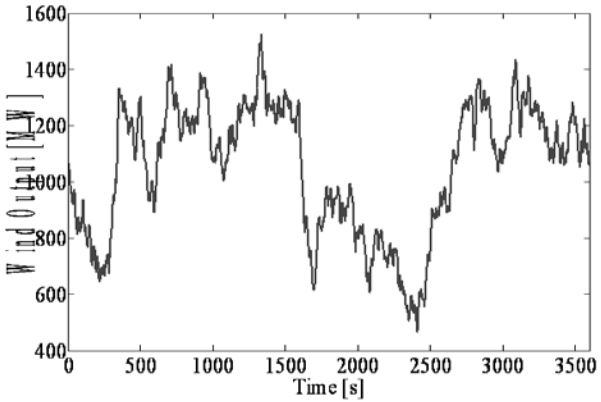
Contribution of Heat Pump based Water Heater to LFC for Reduction of Battery Capacity



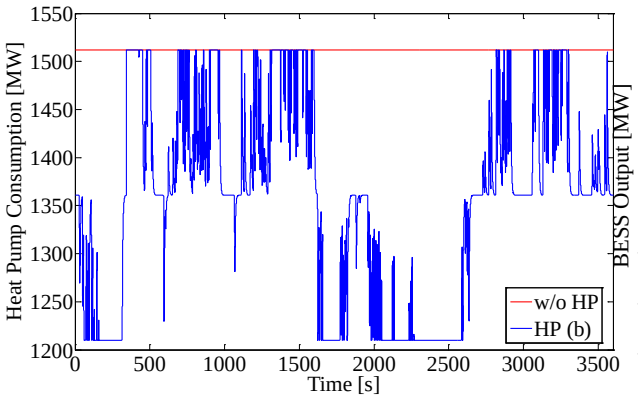


Type (b)

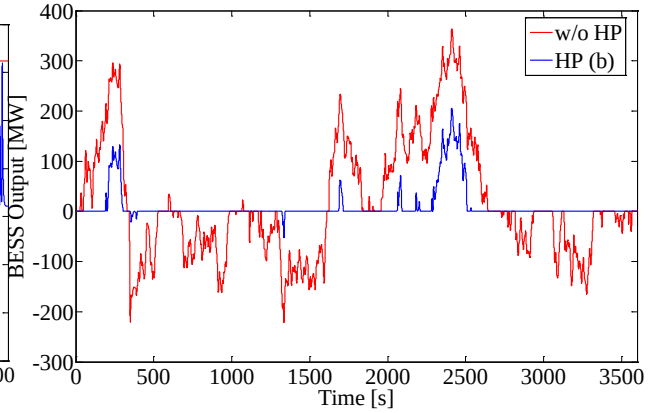
HP Water Heater



Wind Power Output

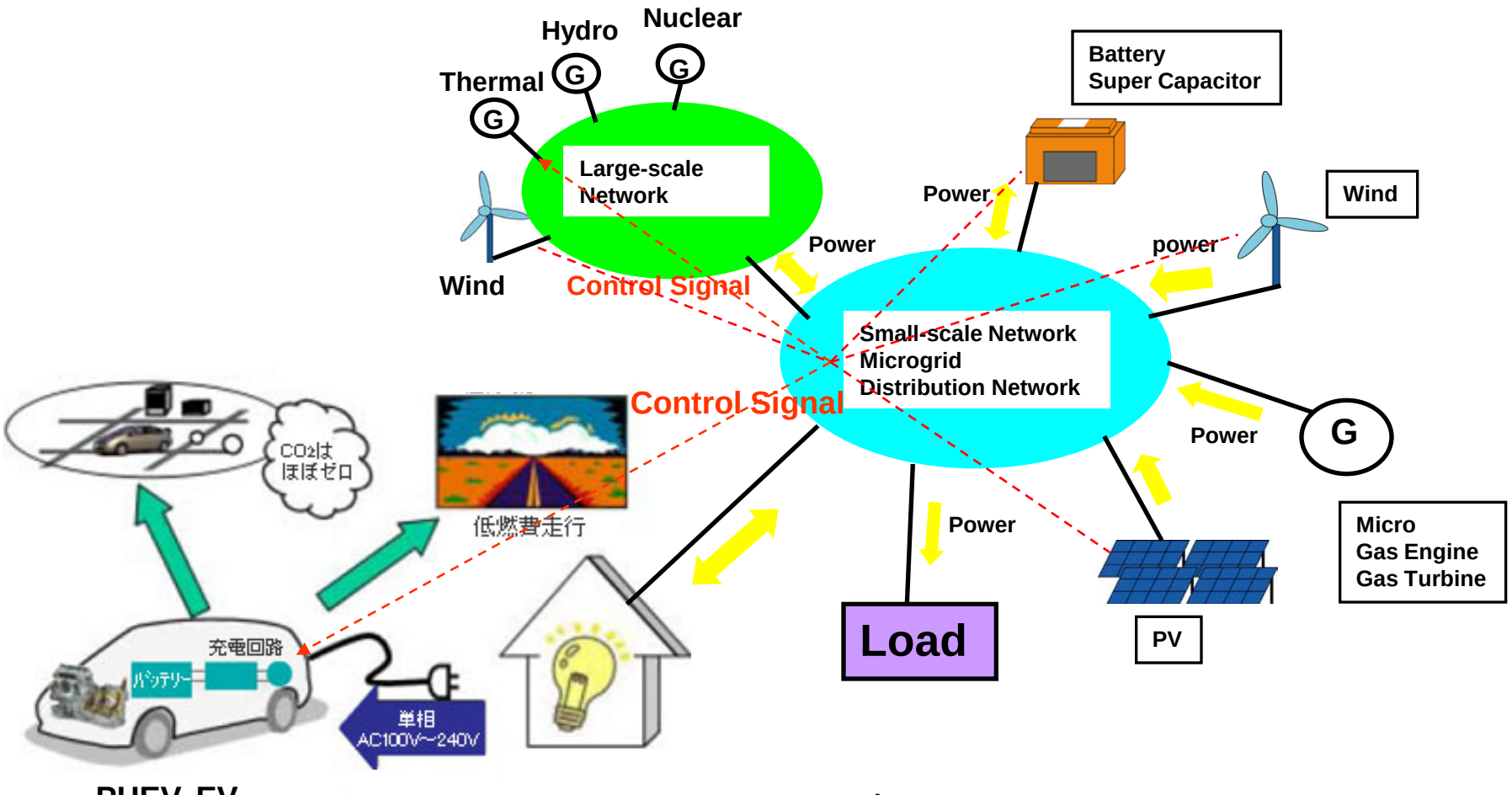


HP Water Heater



Battery

Coordinated Control of PHEV, EV, Battery, RES and Thermal Power Plant



- When?
- How?
- How much?

Outline of Battery System R&D for Grid Integration of RES Generations

Purpose

Development of Technologies Required for Low-Cost, Long-Lifetime and Large-Capacity Battery System for Grid Integration of RES Based Generations

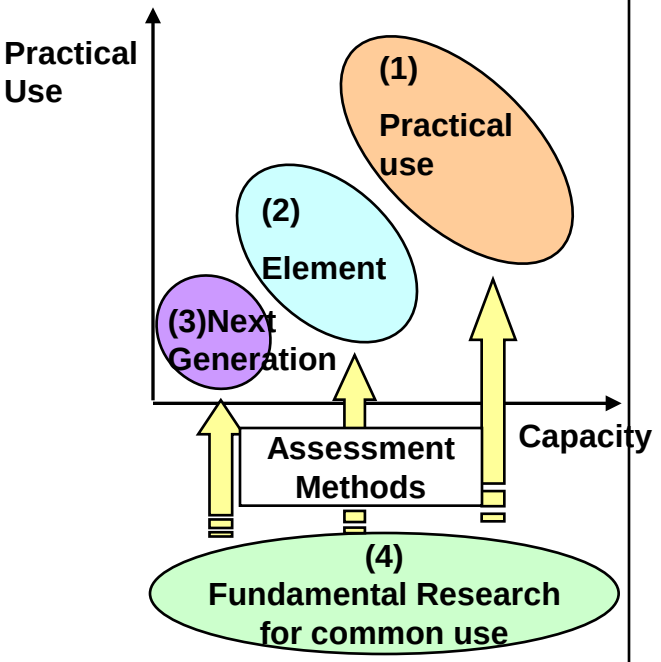
Topics and Final Targets

(1) Technology Development for Practical Use
Large-Capacity Battery System and Output Power Control Technology
※Final target＝Field test for more than 6 months

(2) Elemental Technology Development
Materials for High Performance
※Final target＝Cost $400/kWh, Lifetime10 years

(3) Next Generation Technology Development
New Materials and Their Production Methods, etc.
※Final target＝Feasible Cost $150/kWh, Lifetime 20 years

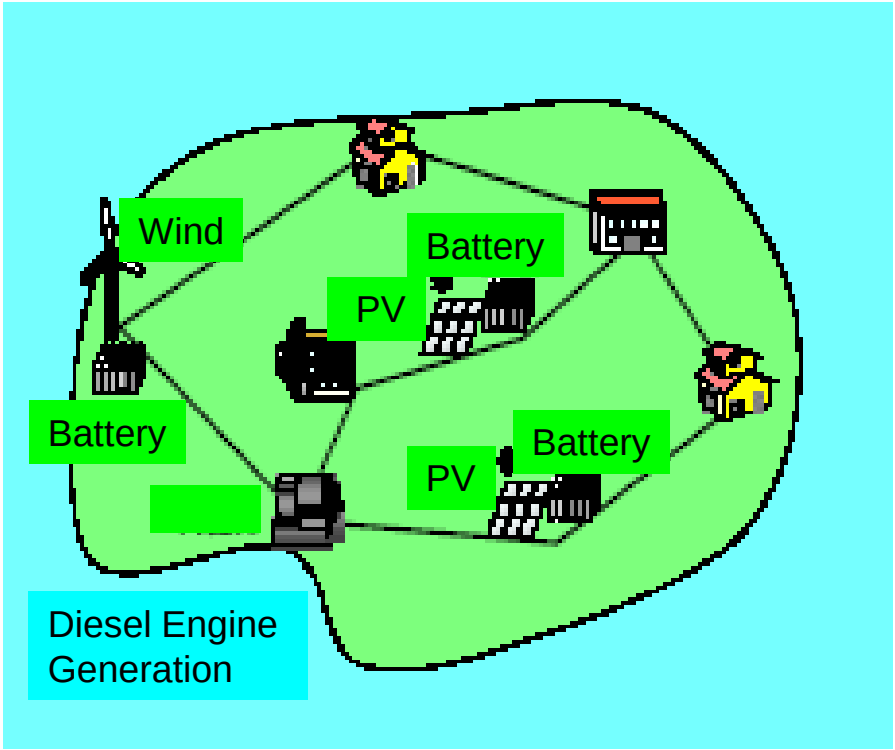
(4) Fundamental Research for Common Use
Assessment Methods Applied to Battery Produced in the Above Projects
※Final target＝Assessment methods for Cost, Safety, Lifetime, Performance



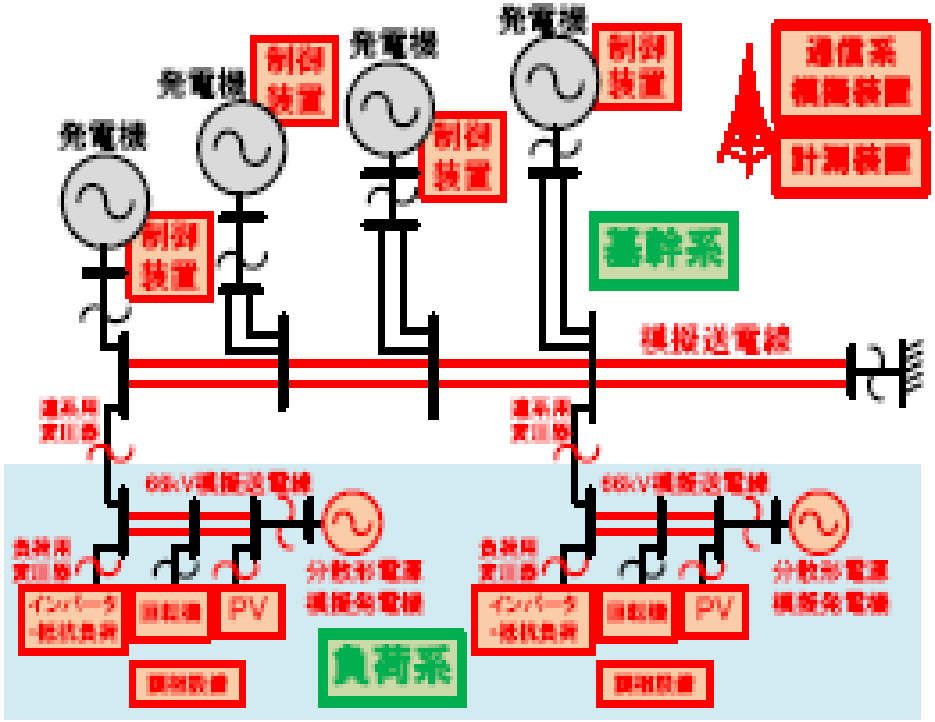
NEDO Project from 2008 to 2010

New National Projects in Japan

From 2009 to 2014



Remote Island Microgrid Project with a Large Penetration of PV and Wind Power Generations



Simulation Study using Analog type Power System Simulator with DGs such as PV and Controllable Load