Micro-grid symposium in Nagoya 2007

Overview of Micro-grid R&D in Japan

Satoshi Morozumi

The New Energy and Industrial Technology Development Organization (NEDO)

The projects related grid-connection issues in NEDO

Grid-connection technology projects (domestic)

- Verification of Grid Stabilization with Large-scale PV Power Generation Systems
- Wind Power Stabilization Technology Development Project
- Demonstrative Project on Grid-interconnection of Clustered Photovoltaic Power Generation Systems

Grid-connection technology projects (in abroad)

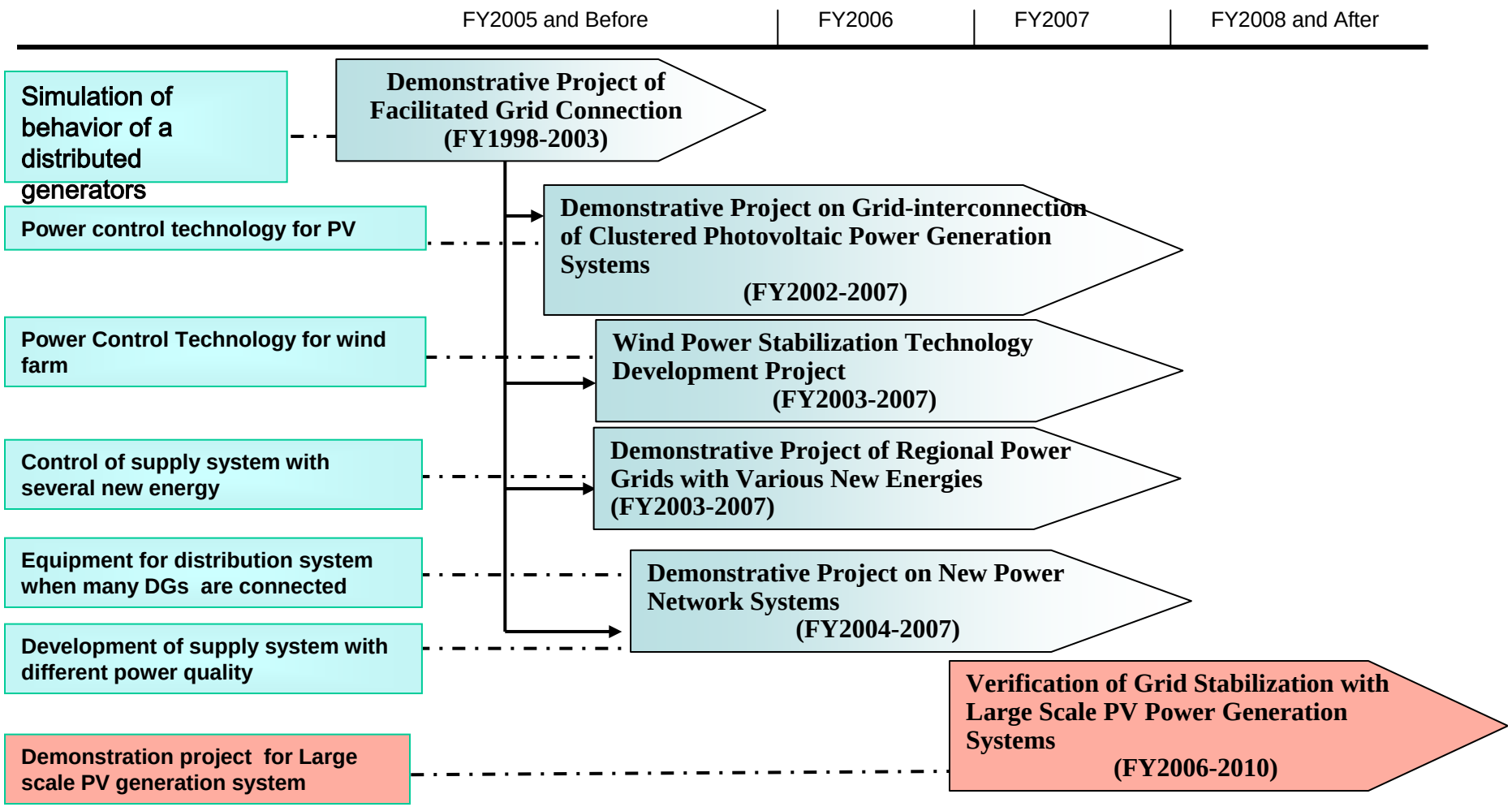
- International Cooperative Demonstration Project Utilizing Photovoltaic Power Generation Systems

Micro-grid technology projects

- Demonstrative Project on New Power Network Systems
- Demonstrative Project of Regional Power Grids with Various New Energies
- International Cooperative Demonstration Project for Stabilized and Advanced Grid-connection PV Systems

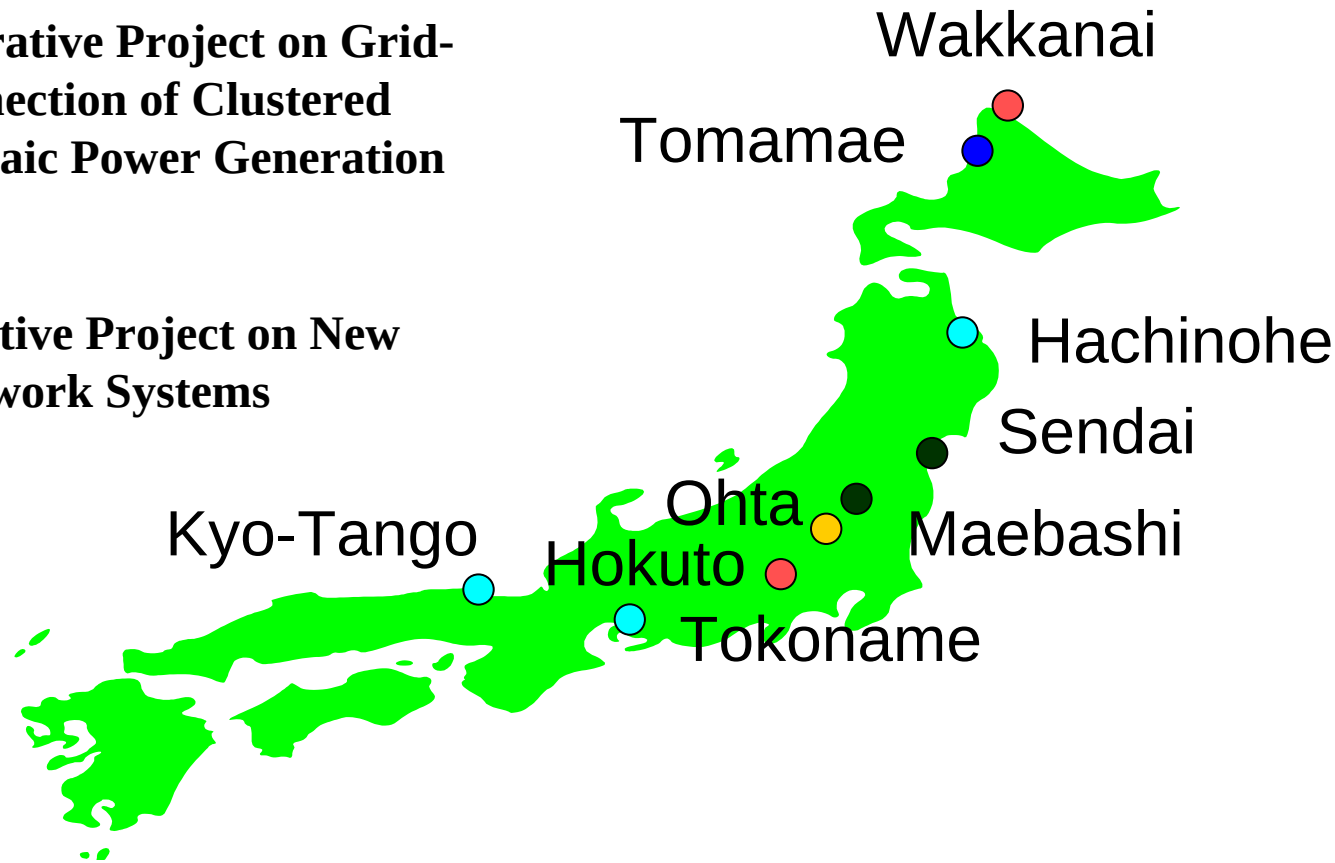
NEDO’s new energy and micro-grid related projects promoted domestically

Grid-connection related projects in NEDO



NEDO's project sites

- **Demonstrative Project on Grid-Interconnection of Clustered Photovoltaic Power Generation Systems**
- **Demonstrative Project on New Power Network Systems**



- **Wind Power Stabilization Technology Development Project**
- **Demonstrative Project of Regional Power Grids with Various New Energies**
- **Verification of Grid Stabilization with large-scale PV Power Generation Systems**

“Demonstrative Project of Regional Power Grids with Various New Energies”

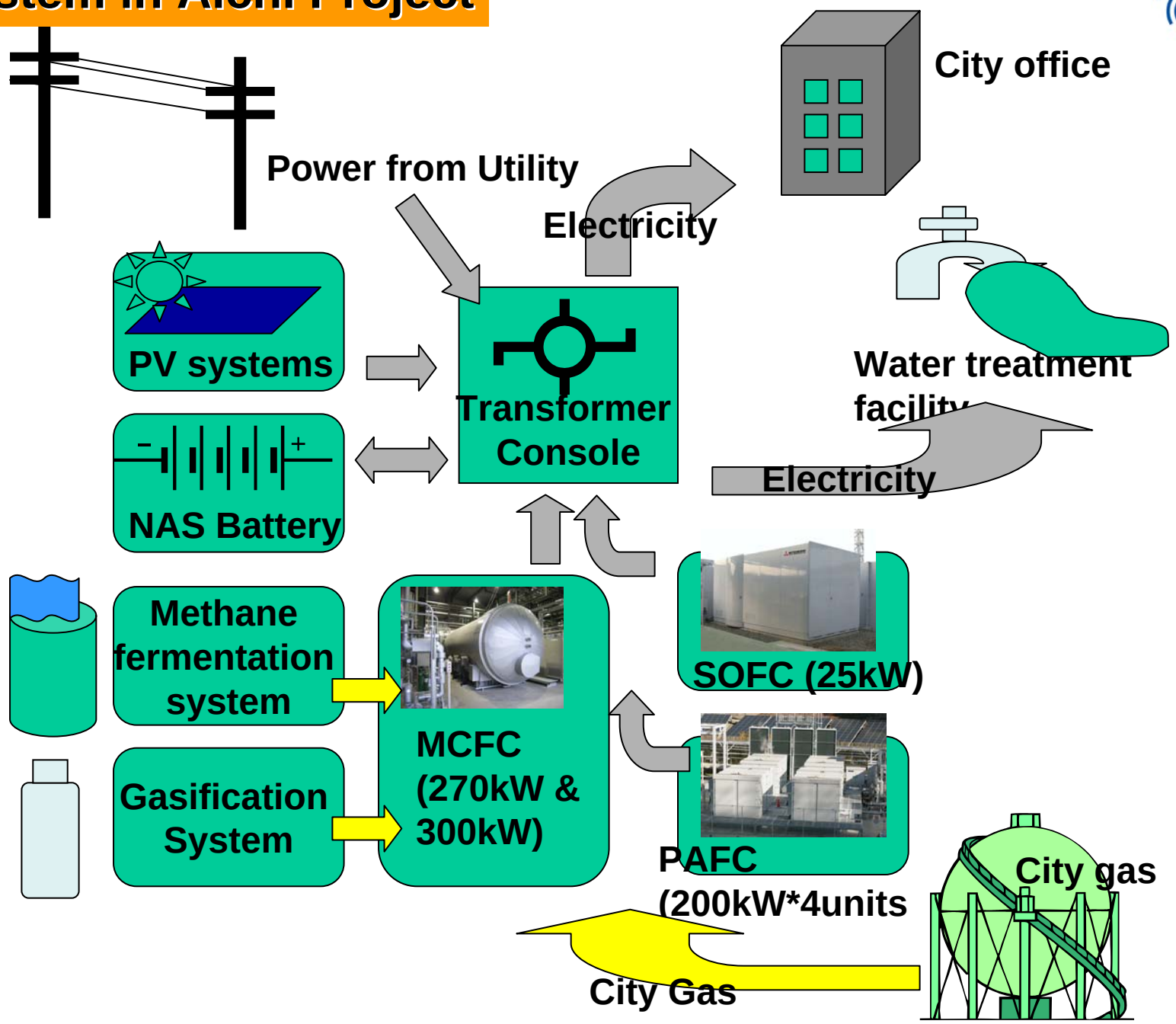
Name	Demonstrative Project of Regional Power Grids with Various New Energies at 2005 Aichi-Expo and Chubu airport proximity city	Kyoto, Eco-Energy Project	Hachinohe-city, the project returning water flow by electricity
System	Co-generation with private distribution line (Micro-Grid)	Virtual Micro-Grid with utility distribution line	Power supply by private distribution line (Micro-Grid)
Remarks	All resources are inverter type (PV, PAFC, MCFC and SOFC)	Main resource is Gas-engine and MCFC consuming bio-gas.	Main resource is Gas-engine burning digestion gas

Tokoname plant

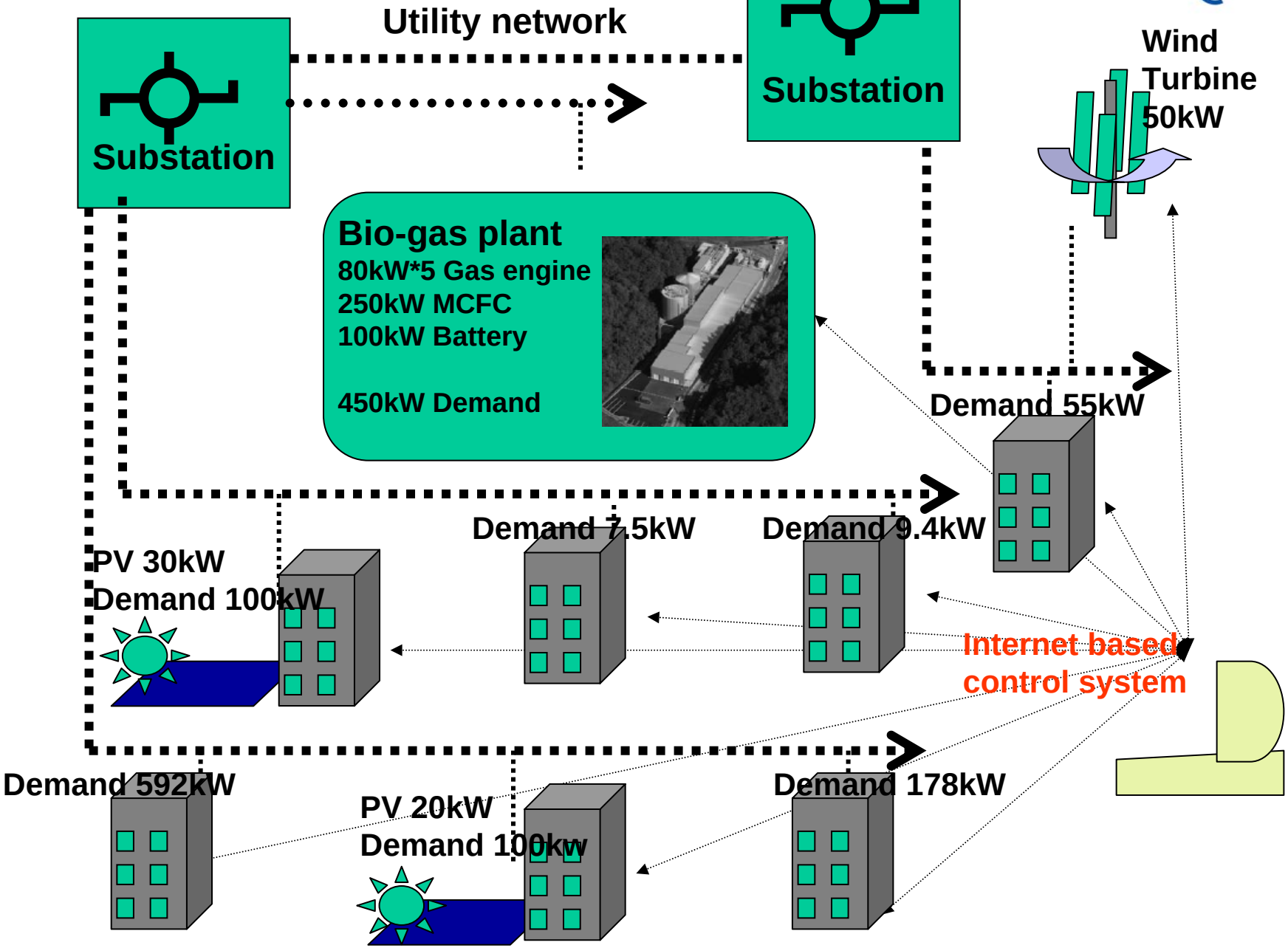
Bio-gas plant in Kyotango

Sewage plant in Hachinohe

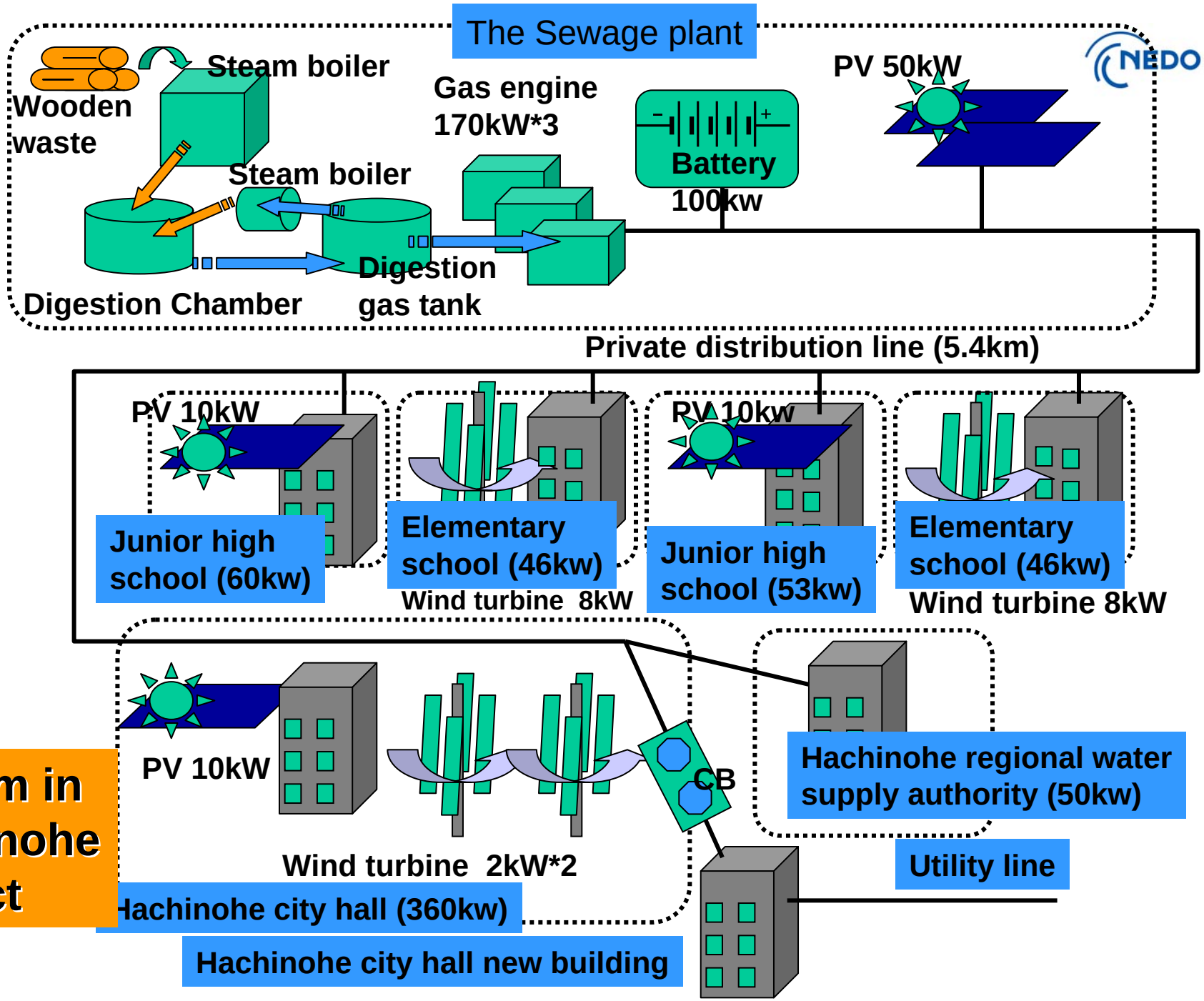
System in Aichi Project



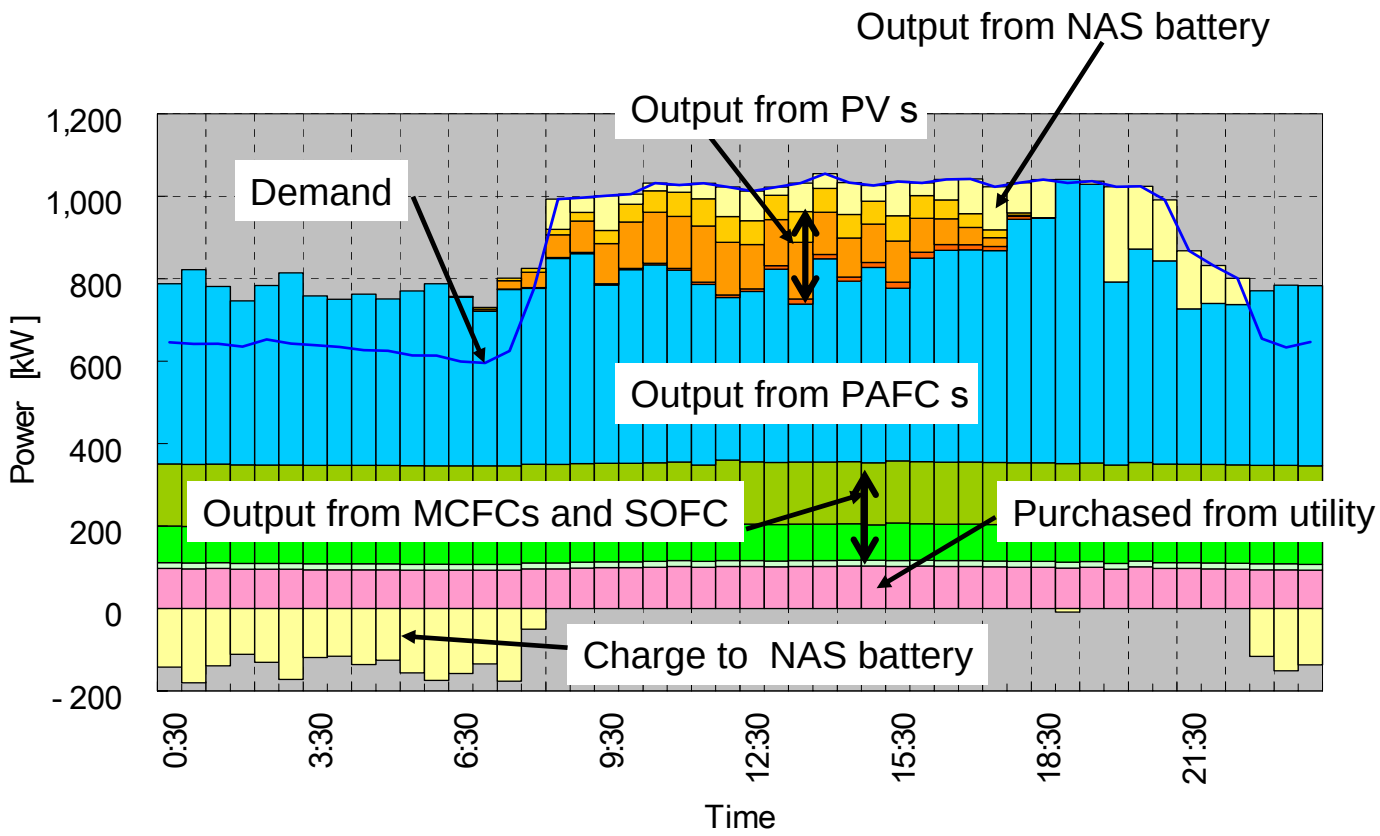
System in Kyotango Project



System in Hachinohe Project

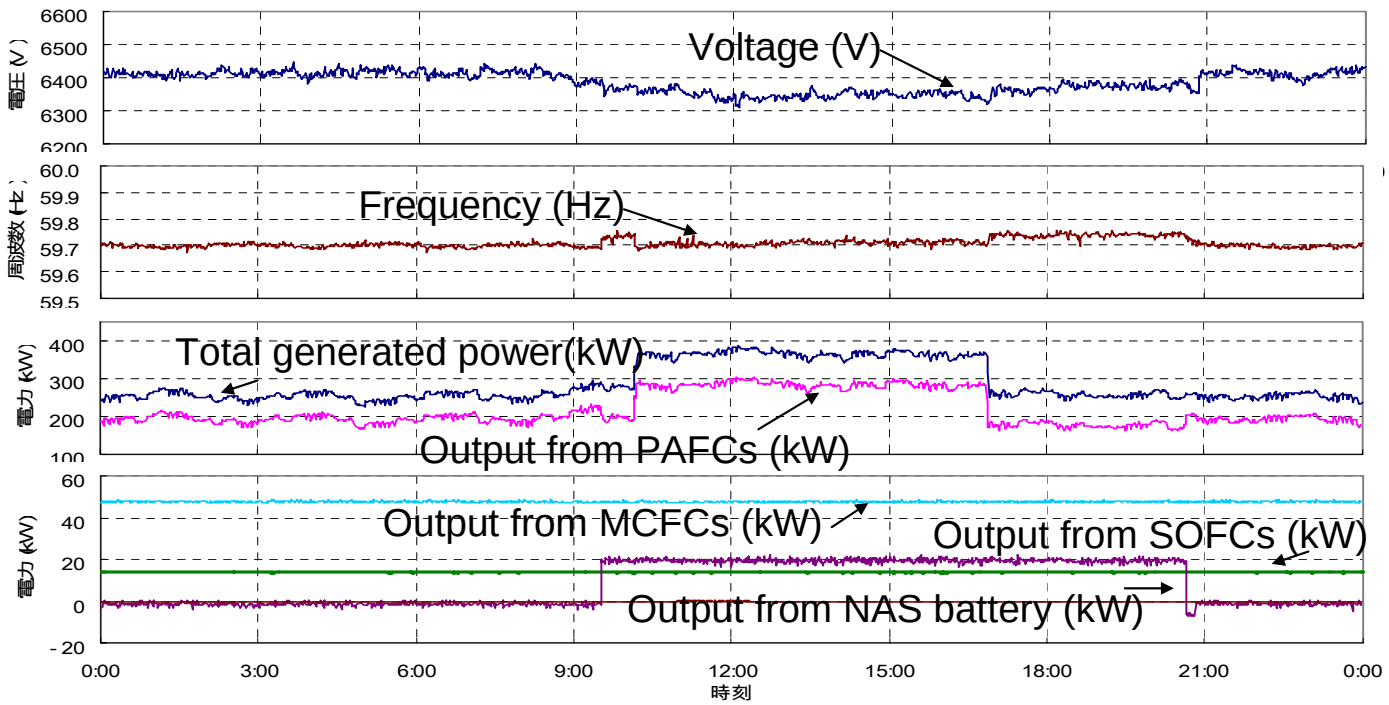


Typical micro-grid operation (in Aichi project)



Typical daily operation in Aichi project. A NaS battery is used to store energy within the supply system and it plays an important role in matching supply and demand.

Typical independent operation of micro-grid (in Aichi project)



In September 2005, the potential for independent operation with only inverter-equipped power sources was examined. As shown, the operating voltage and frequency were stable, but slightly lower than the target values (6600V and 60Hz).

Achieved operation target of micro-grid

Matching of Demand and Supply

By 30 minutes
The observance of a contract

→

By 5 or 6 minutes
Influence reduction to frequency

→

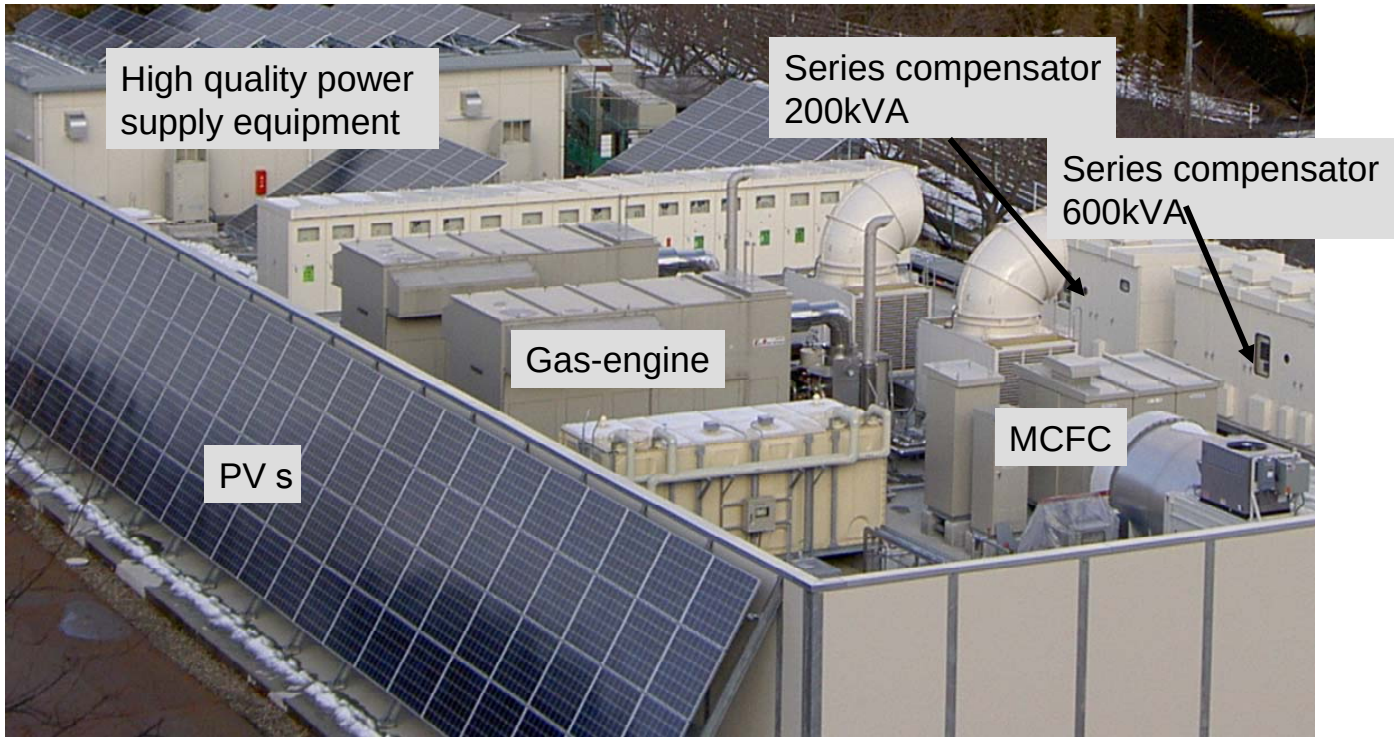
stand-alone operation
Separation from utility's grid

Project	Matching error target	Achieved results
Aichi EXPO	3% by 30 minutes	The matching error target was 99% achieved with operation of NaS battery system. After the end of EXPO 2005 Aichi, stand-alone operation was examined under a limited demand condition.
Kyotango	8% by 5 minutes	Continuous operation was started in Feb. 2006. By the end of the fiscal year, the target was achieved.
Hachinohe	3% by 6 minutes	During operation from Oct. 2005 to Feb. 2006, the matching error target was 98.2% achieved..

“Demonstrative Project on New Power Network Systems”

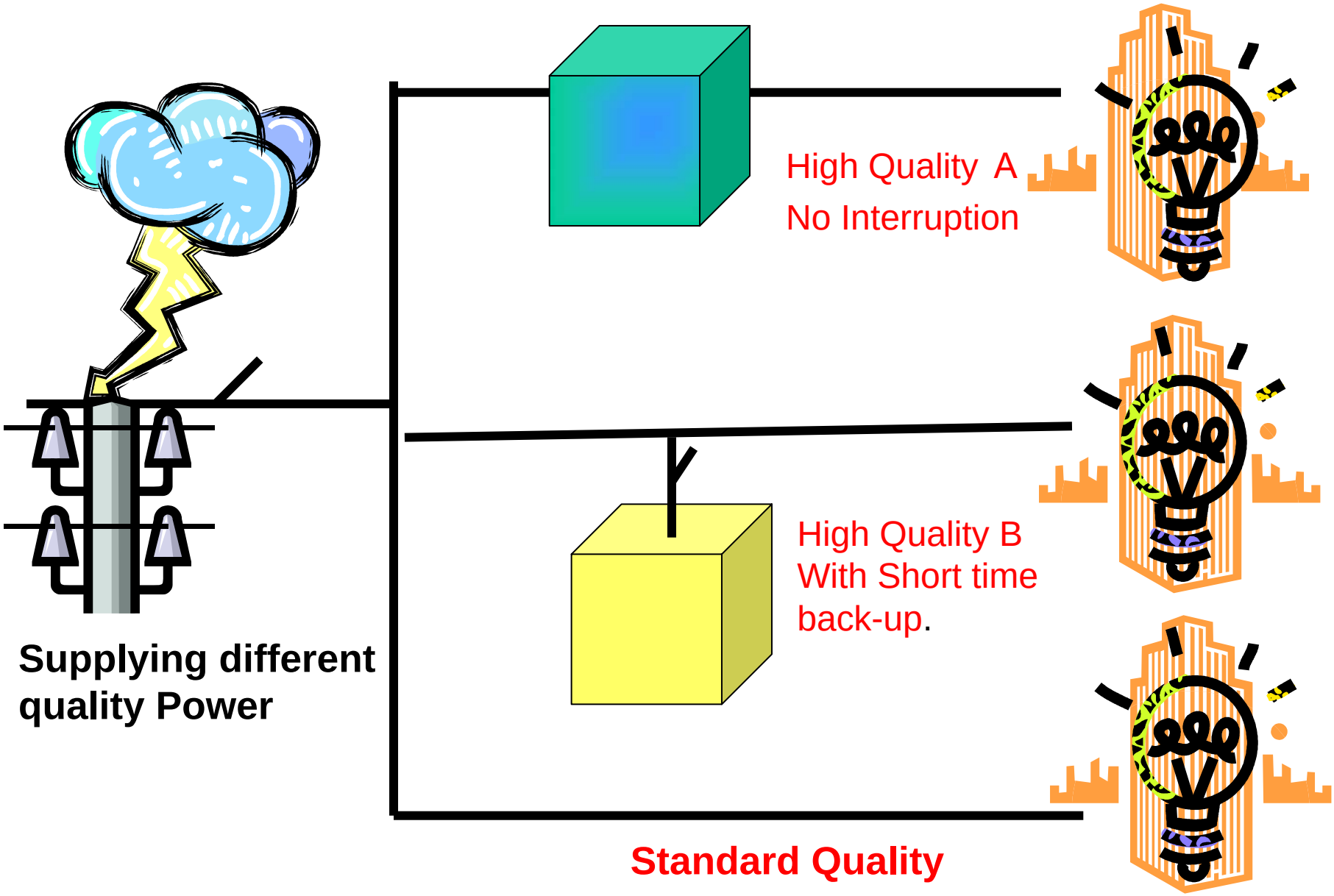
- **Demonstrative Project on New Power Network Systems (Maebashi)**
  The project demonstrating voltage and power flow control device on distribution network.

- **Demonstrative Project on Power Supply Systems by Service Level (Sendai)**
  The project demonstrating several power quality service level by grid.

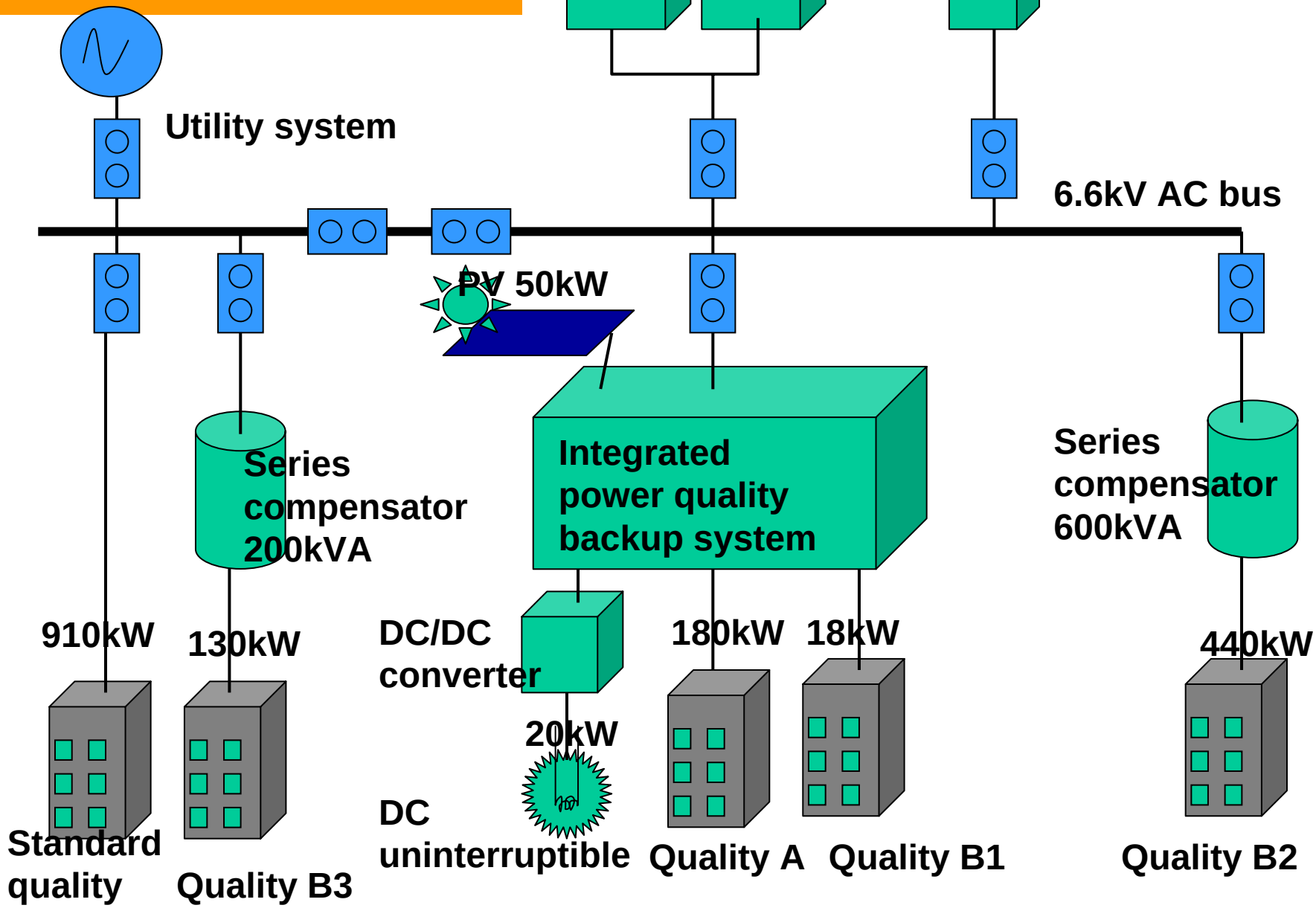


Demonstrative Project on Power Supply Systems by Service Level (Sendai)

How different quality service is operated



Demonstrative Project on Power Supply Systems by Service Level



Main compensating equipments in Sendai project

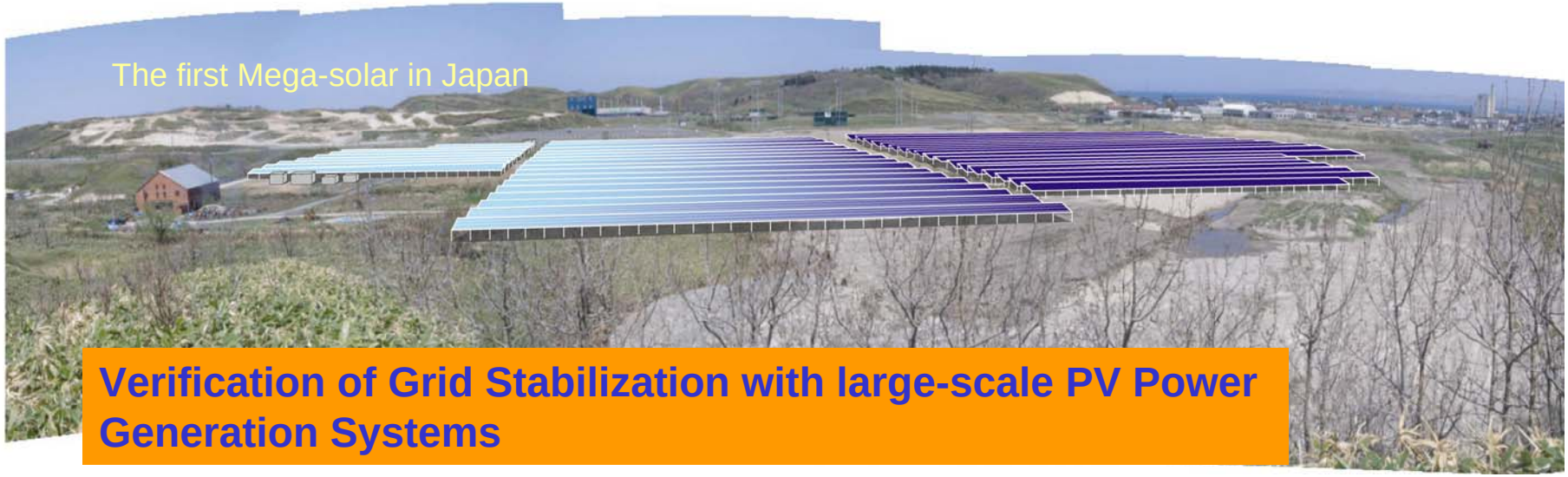
Table. Specification of main compensator

Type of power electrnics	Capacity	Input voltage	Output voltage	Remarks
Bidirectional converter	300kVA	AC400V	AC200V	Power quality B1
			DC428V	
High quality A inverter	20kVA	AC400V	AC400V	High quality A
		DC 428V		
PV connection converter	50kW			
DC-DC	20kW	DC 428V	DC 300V	DC Output
Battery	600Ah			

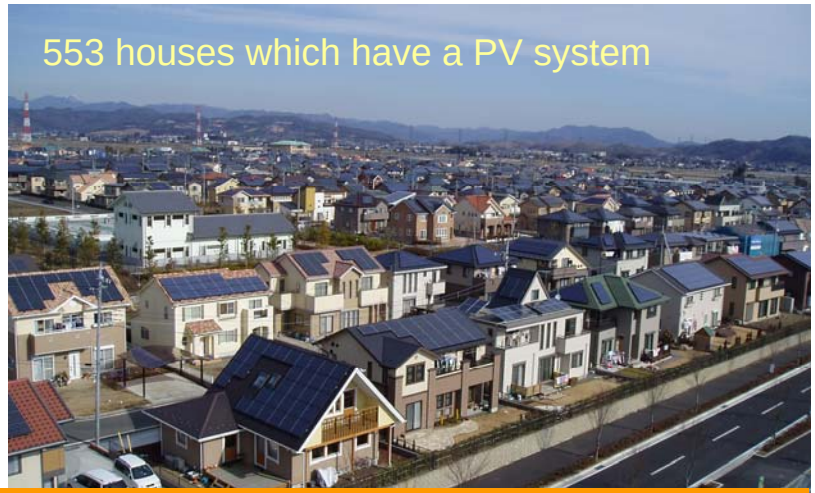
Table. Specification of series compensators

Terms	Specification
Input-output voltage	AC 6600V
Capacity	200kVA and 600kVA
Compensating length	Compensationg 100%drop in 200msec
Compensation condition	Starting compensationg within 10msec by detecting 8%of voltage drop
Connected consumer	Consumer class B2 and B3

Other grid-connection related projects



Verification of Grid Stabilization with large-scale PV Power Generation Systems



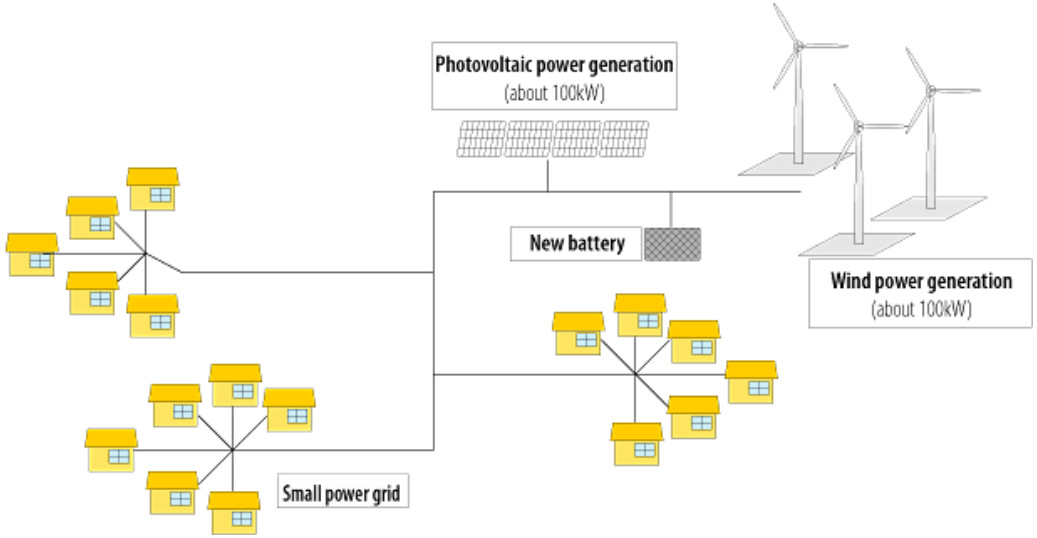
Demonstrative Project on Grid-interconnection of clustered Photovoltaic Power Generation

Wind Power Stabilization Technology Development Project

NEDO’s new energy and micro-grid related projects in abroad

“International Cooperative Demonstration Project Utilizing Photovoltaic Power Generation Systems (FY1992 – Open)”

NEDO conducts the International Cooperative Demonstration Project Utilizing Photovoltaic Power Generation Systems with developing countries whose natural conditions and distinctive social systems are rarely seen in Japan.



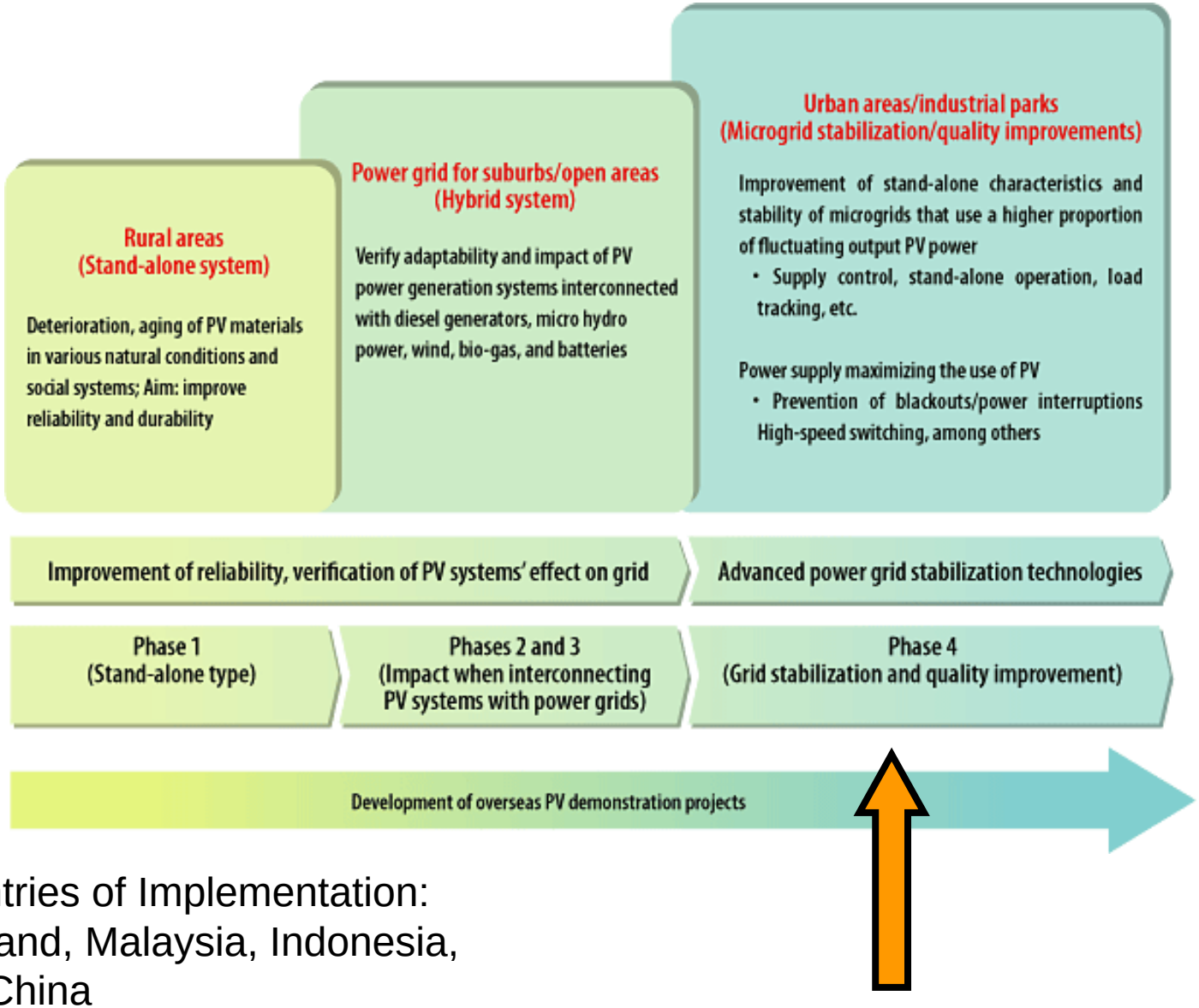
Demonstrative Research Project on Combined Power Generation Systems (photovoltaic and biogas) Sihanoukville, Cambodia (2002-2004)

Demonstrative Research Project on Dispersed Power Generation Systems (photovoltaic and micro hydro) Kampong Cham, Cambodia (2002-2004)

“International Cooperative Demonstration Project Utilizing Photovoltaic Power Generation Systems (FY1992 – Open)”

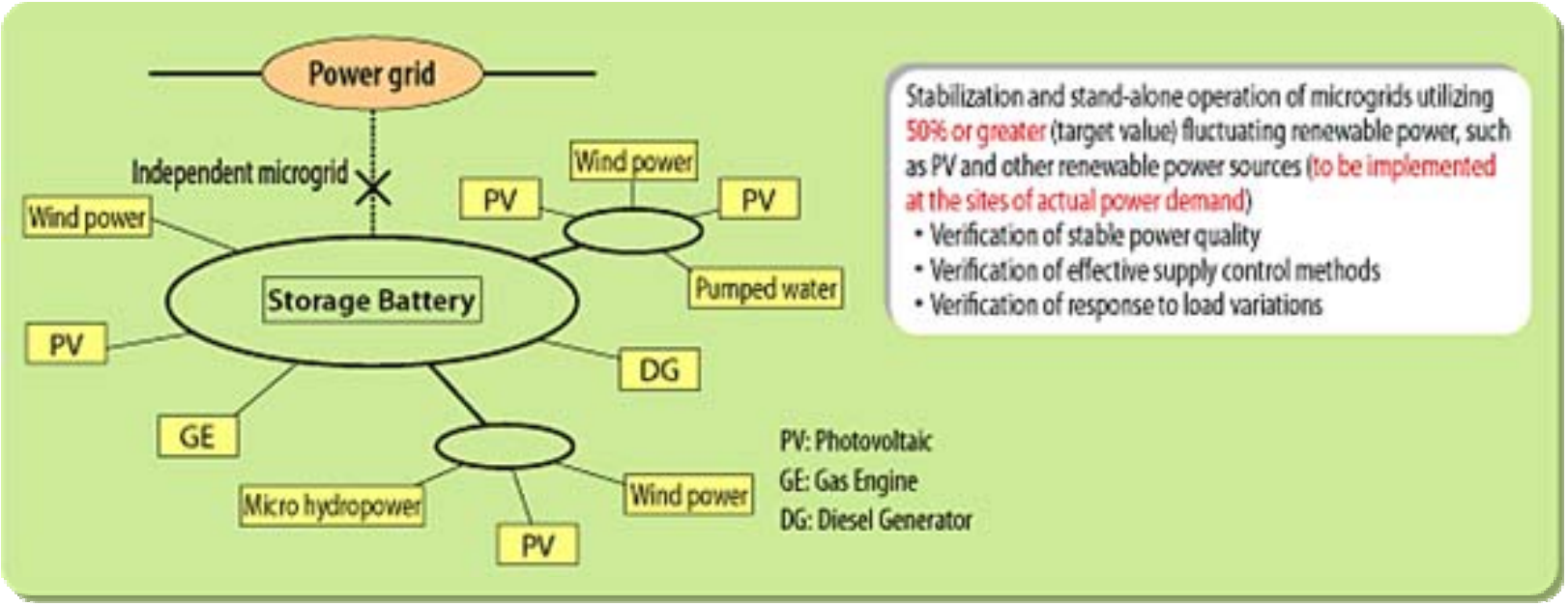
Project name	Counterpart country & Implementation site	Term of project implementation
Accelerated Demonstrative Research Utilizing Highland Weather Conditions	Nepal Kathmandu	1992- 1996
Demonstrative Research of Movable Type PhotovoltaicPower Generation System	Mongolia	1992- 1996
Demonstrative Research on Photovoltaic Power Generation System for Battery Charging Stations	Thailand Phang- nga Province Bann Prunai Kah Yao Yai	1992- 1997
Accelerated Demonstrative Research Under Tropical Weather Conditions	Malaysia Sabah Marak Parak	1992- 1997
Demonstrative Research on a Hybrid System of Photovoltaic Power Generation and Micro Hydro Power Generation	Vietnam Dak Doa	1997- 2001
Demonstrative Research on a Grid- connected Photovoltaic Power Generation System	Thailand Trang Province Ko Li Bong	1999- 2003
	Myanmar Ayeyarwady Division Chaungthar	1999- 2004
Demonstrative Research Project on Dispersed PowerPhotovoltaic Power Generation System	Mongolia Noyon Soum	2002- 2004
Demonstrative Research Project on Dispersed Power Generation Systems (photovoltaic and micro hydro)	Cambodia Kampong Cham	2002- 2004
Demonstrative Research Project on Combined Power Generation Systems (photovoltaic and biogas)	Cambodia Sihanoukville	2002- 2004
Demonstrative Research Project on Small- scale Pumping Up Power Generation System with Photovoltaic	Laos Oudomxai Province	2003- 2005
Demonstrative Research on Efficient Photovoltaic Power Generation Units for Grid- connected System	China Beijing	2003- 2004
Demonstrative Research on Efficient Technologies for Photovoltaic Power Generation for Grid- connected System (water- cooled photovoltaic, diesel generator and advanced storage batteries)	China Xinjiang Uygur Autonomous Region	2003- 2005
Demonstrative Research on Dispersed Power Generation System Technologies (photovoltaic, wind power and advanced storage batteries)	China Gansu Province	2003- 2006
Development of Islanding Prevention Methods under Clustered PV Conditions and Improvement of Electricity Quality	Thailand Bangkok	2004- 2006

“International Cooperative Demonstration Project for Stabilized and Advanced Grid-connection PV Systems(FY2005-FY2007)”



Countries of Implementation:
Thailand, Malaysia, Indonesia, and China

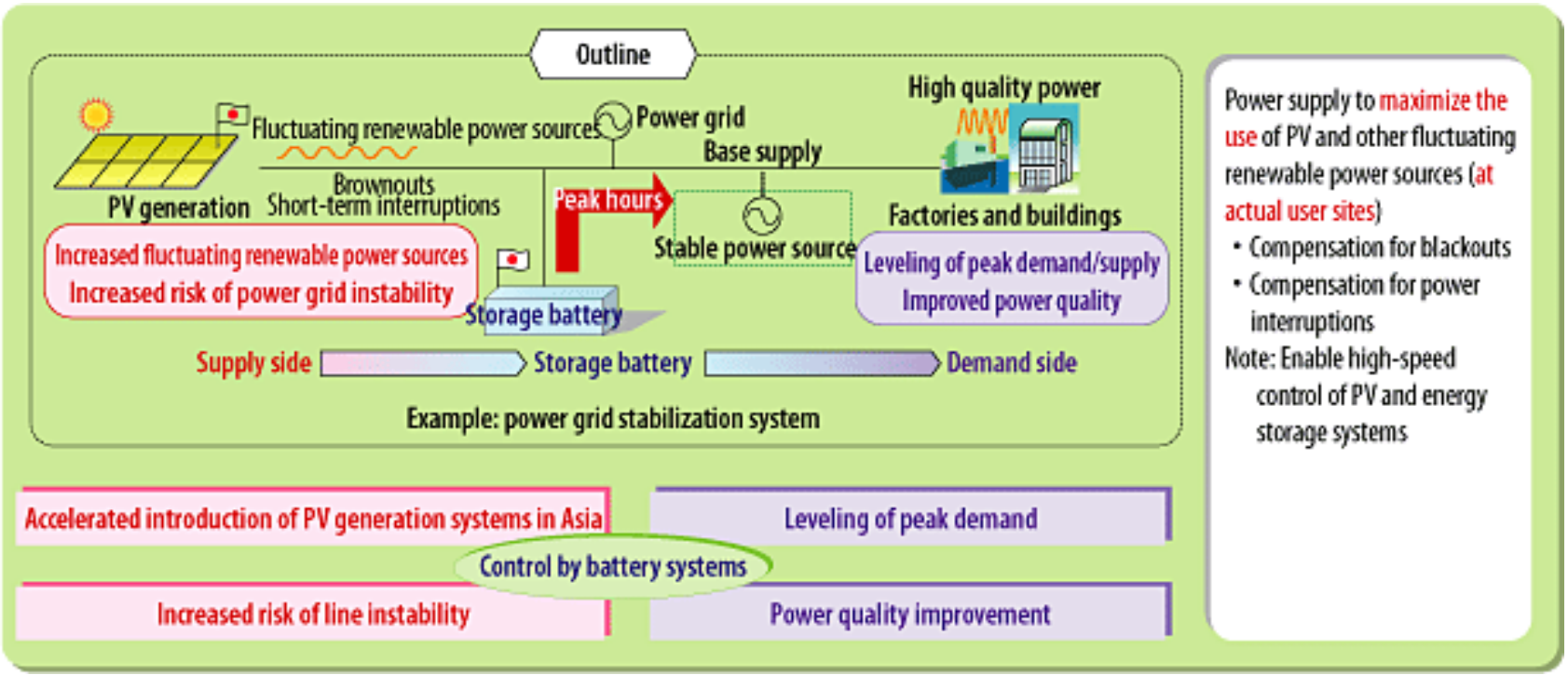
“(1) Demonstrative Research Project on Micro Grid Stabilization”



✓Demonstrating a micro-grid system consisting of fluctuating renewable power sources.

✓Ensuring stable stand-alone operation when disconnected from the power grid.

“ (2) Demonstrative Research on Power Supply Systems to Maximize the Use of Solar and Other Fluctuating Renewable Power Sources”



This experimental study aims to optimize the utilization of fluctuating renewable power sources, also studying how to compensate for instantaneous voltage drops, power interruptions, and correction of waveform distortion caused by harmonics.

Thank You for your attention !!