3rd International Conference on Integration of Renewable and Distributed Energy Resources

Large scale DER integration experiments in Japan

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New Energy and Industrial Technology Development Organization (NEDO)

Japan

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Nice • France

eu-deep

GDF SUEZ

ADEME French Environment & Energy Management Agency

European Commission Research Directorate-General

ISET

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Development and Demonstration of new energy-related grid-connecting technology in NEDO

The New Energy and Industrial Technology Development Organization (NEDO) is Japan's largest public R&D management organization for promoting the development of advanced industrial, environmental, new energy and energy conservation technologies.

One of the important objectives of NEDO's R&D is solving problems that arise when distributed and renewable resources are connected to power grids.

1) Frequency Stabilization
2) Voltage Control
3) Protection
4) Other Power Quality Issues
5) Technology Development

Grid-Connection related Projects in NEDO

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FY2005 and Before | FY2006 | FY2007

Voltage control technology for clustered PV systems

Demonstrative Project on Grid-interconnection of Clustered Photovoltaic Power Generation Systems
(FY2002-2007)

Power Control Technology for wind farm

Wind Power Stabilization Technology Development Project
(FY2003-2007)

Control of supply system with several new energy and dispersed generators

Demonstrative Project of Regional Power Grids with Various New Energies
(FY2003-2007)

Interconnection technology for large scale PV generation system

Demonstrative Project on New Power Network Systems
(FY2004-2007)

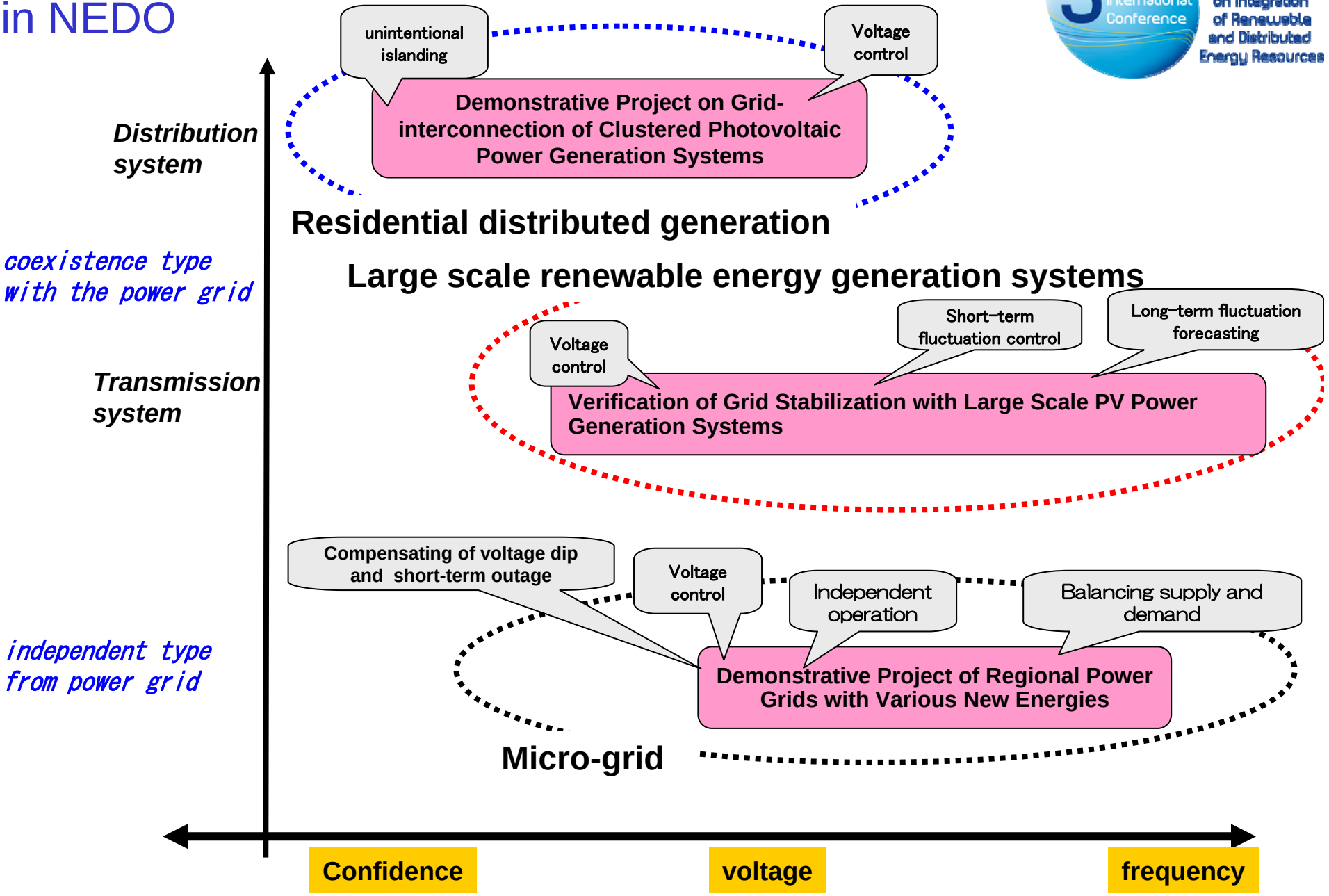
Voltage control technologies for distribution system when many DGs are connected
Development of supply system with different power quality

Energy storage system for new energy

Verification of Grid Stabilization with Large Scale PV Power Generation Systems
(FY2006-2010)

Development of an Electric Energy Storage System for Grid-connection with New Energy Resources
(FY2006-2010)

The positioning of grid-Connection related Projects in NEDO



Demonstrative Project on Grid-interconnection of clustered Photovoltaic Power Generation (FY2002-2007)

Background

Clustered installation of Photovoltaic on the distribution network is expected.

There are tangible problems, such as voltage swell by output from PV systems .

Objects

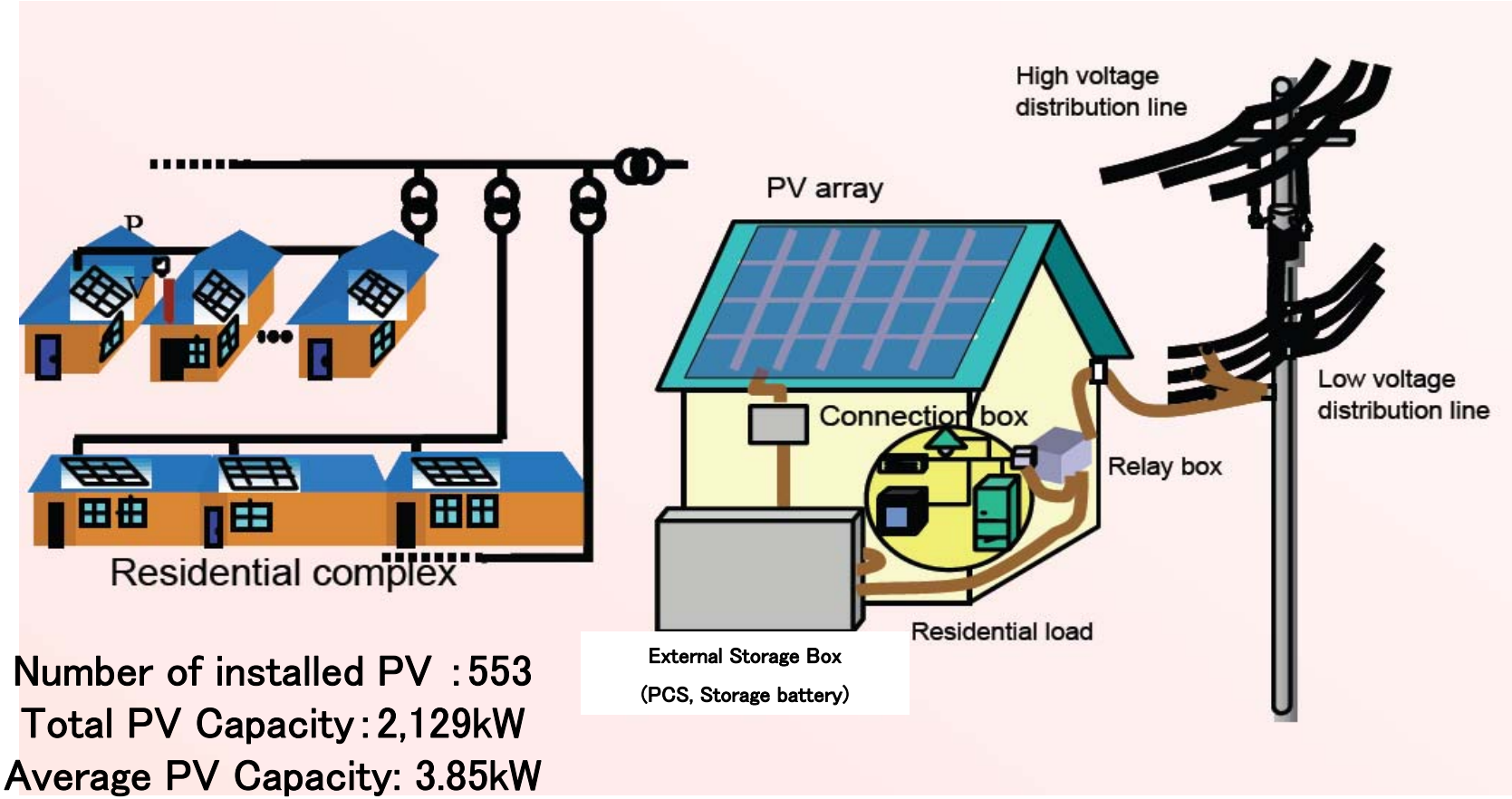
- Development of the technology to avoid restriction of PV system output.

-Development of function to prevent unintentional islanding.

Demonstrative Project on Grid-interconnection of clustered Photovoltaic Power Generation (FY2002-2007)

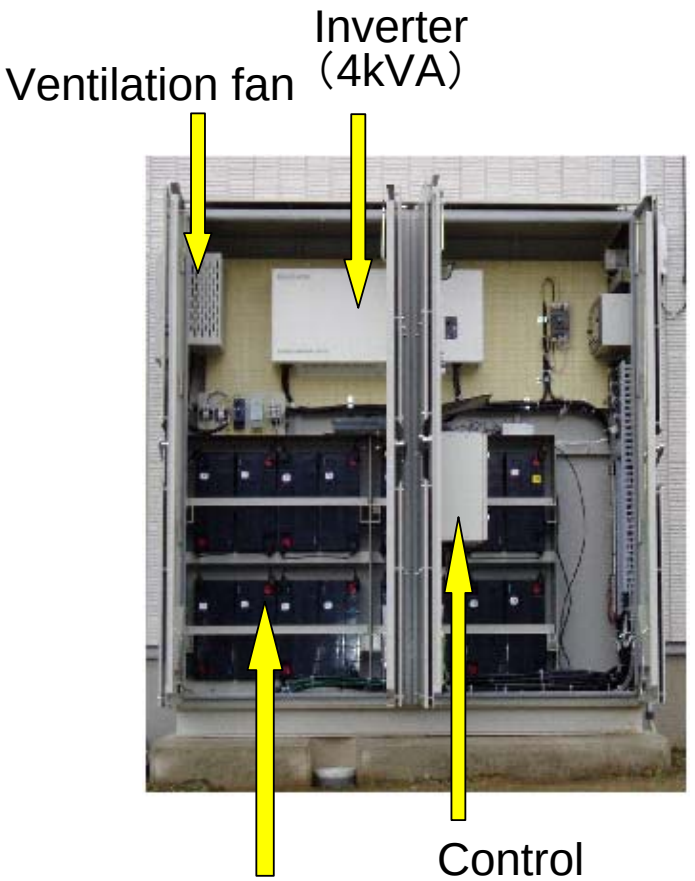
Demonstrative Project on Grid-interconnection of clustered Photovoltaic Power Generation (FY2002-2007)

Concept of battery storage system



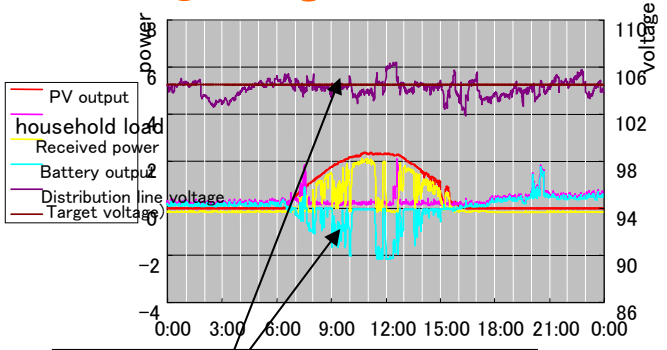
Number of installed PV : 553
Total PV Capacity : 2,129kW
Average PV Capacity: 3.85kW

Demonstrative Project on Grid-interconnection of clustered Photovoltaic Power Generation (FY2002-2007)



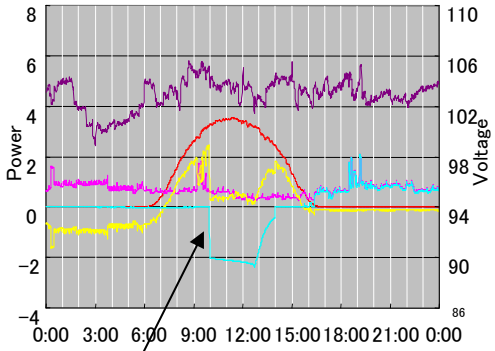
The technology to avoid restriction of PV system output.

①Voltage control mode



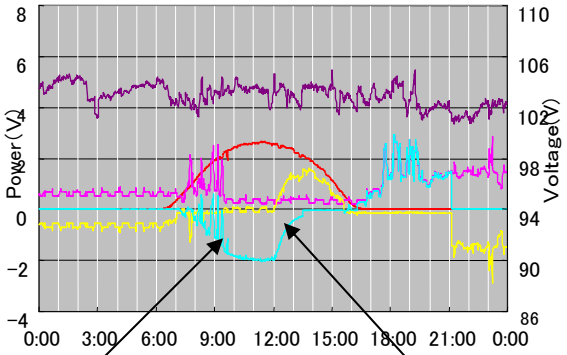
The voltages on distribution line becomes higher than the voltage standard

② Schedule mode



In this case, battery started to charge energy from 10:00 AM to 3:00PM.

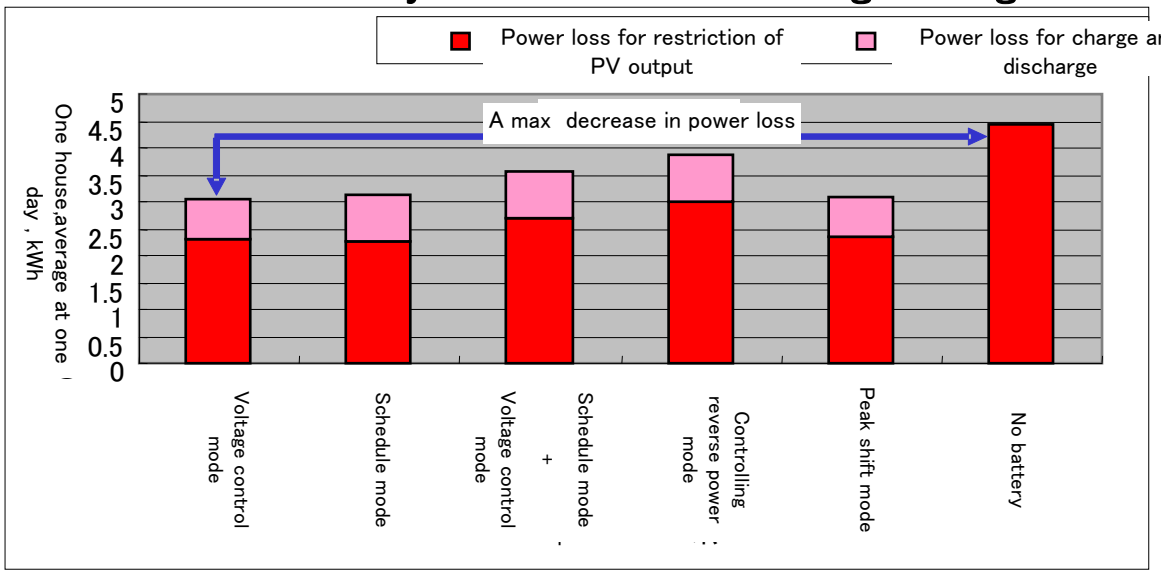
③Controlling reverse power mode



when reverse power occur, battery start to charge energy

The battery is charged fully

Results: Efficiency for restraint of voltage rising



The voltage control mode is the most efficiency

Demonstrative Project on Grid-interconnection of clustered Photovoltaic Power Generation (FY2002 2007)

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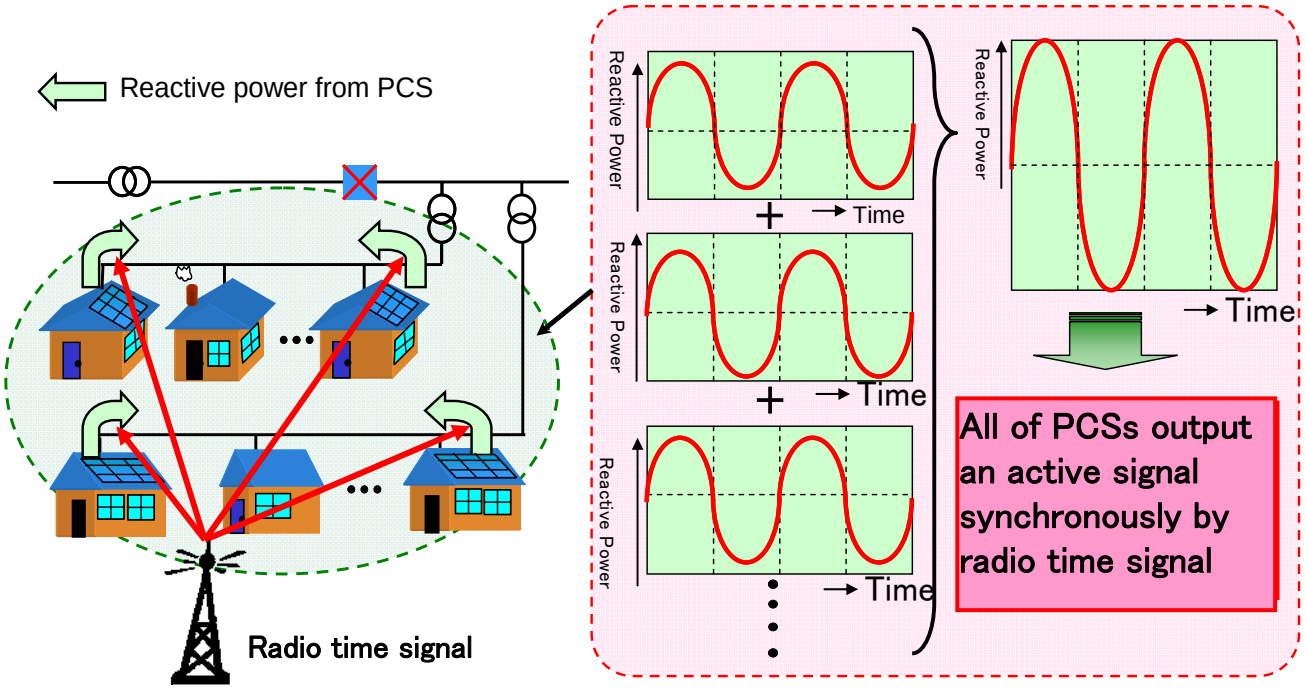
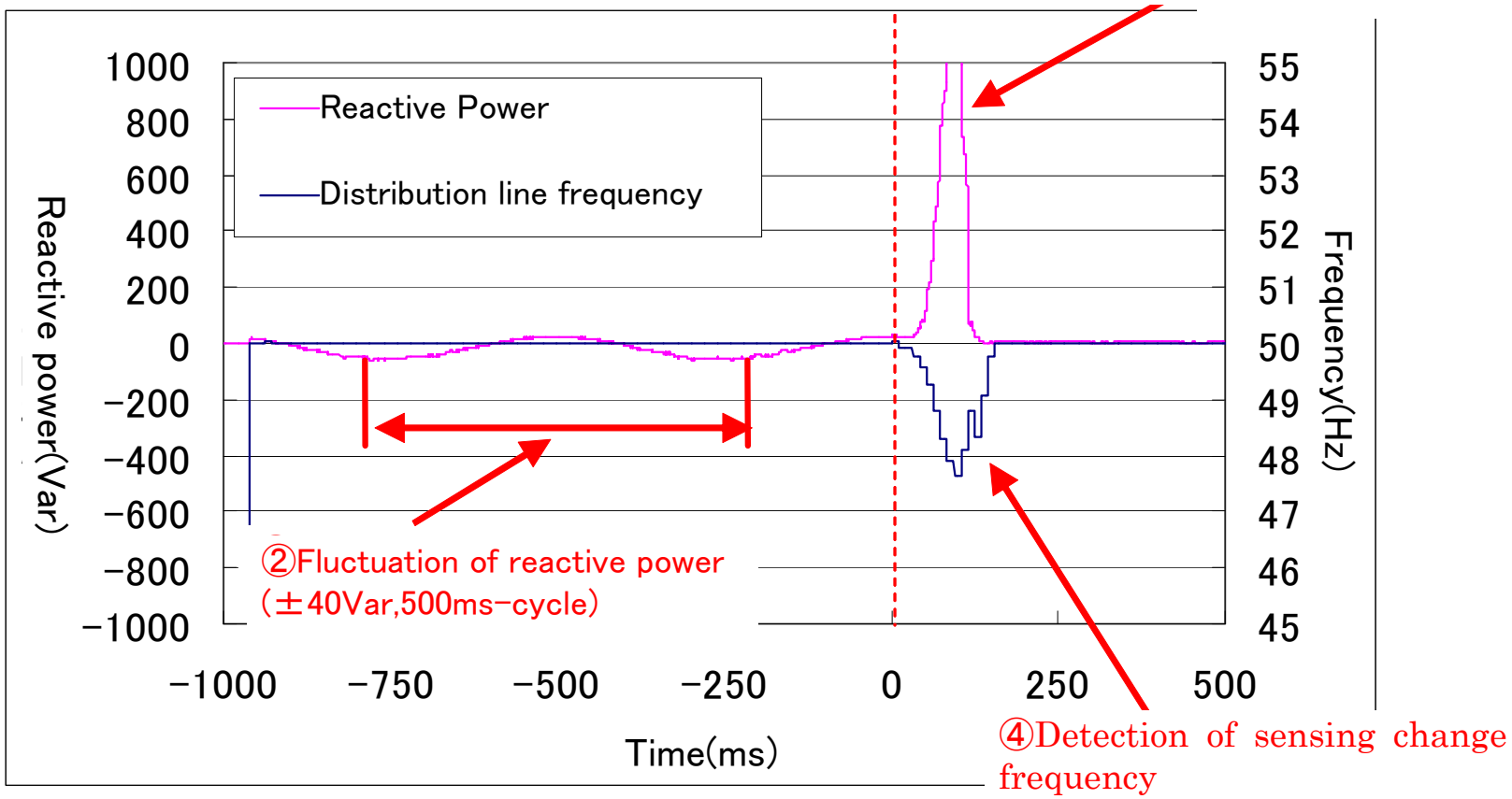
Concept of islanding islanding detection without any confliction



New islanding detection method



Verification of Grid Stabilization with large-scale PV Power Generation Systems (FY2006-2010)

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Background

If PV becomes popular in future, large scale (MW level) PV power station will be introduced to power system.

It is possible that such large scale PV power station may influence voltage and frequency in the utility system.

Objects

★Technology for reduction of fluctuation of voltage and frequency using battery storage will be demonstrated. Also, countermeasure of harmonic will be developed and demonstrated.

Demonstrative projects site

Wakkanai site
2000kW
(5000kW Will be installed finally)
Most of PVs are crystal type.
NAS (Sodium-Sulfur) battery : 500kW-7.2hr
(finally 1500kW-7.2hr will be installed)

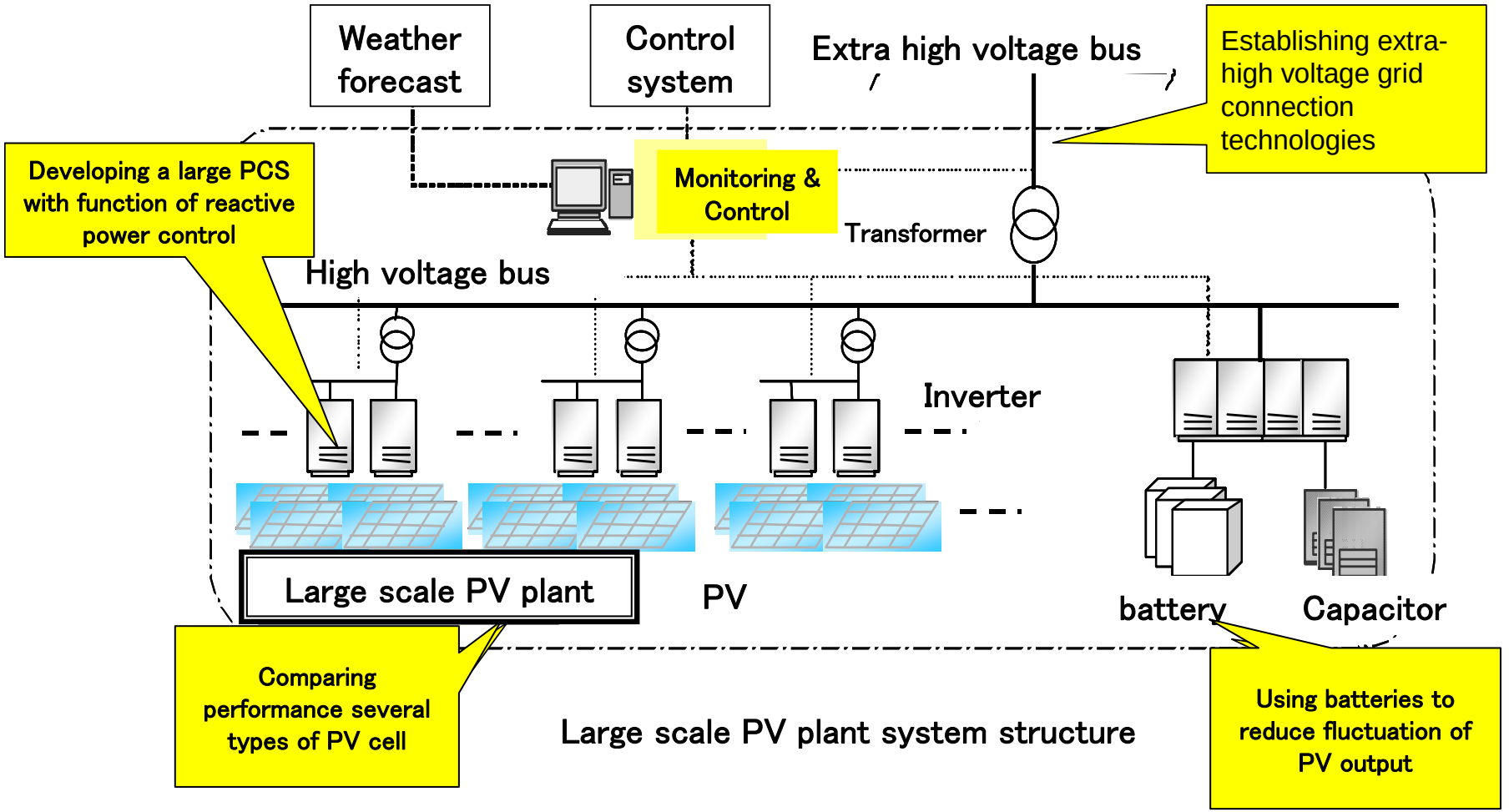
Wakkanai Site completion forecast figure

Hokuto site
600kW
(2000kW will be installed finally)
26 types of PVs were installed.

Hokuto Site completion forecast figure

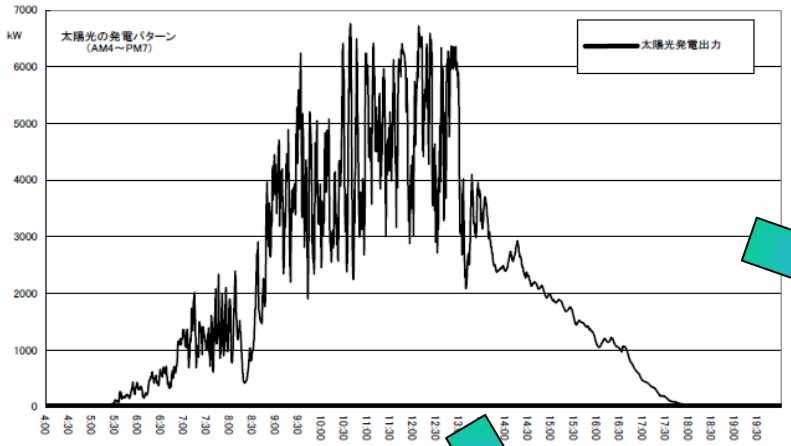
The first Japanese Mega-Solar

Verification of Grid Stabilization with large-scale PV Power Generation Systems (FY2006-2010)

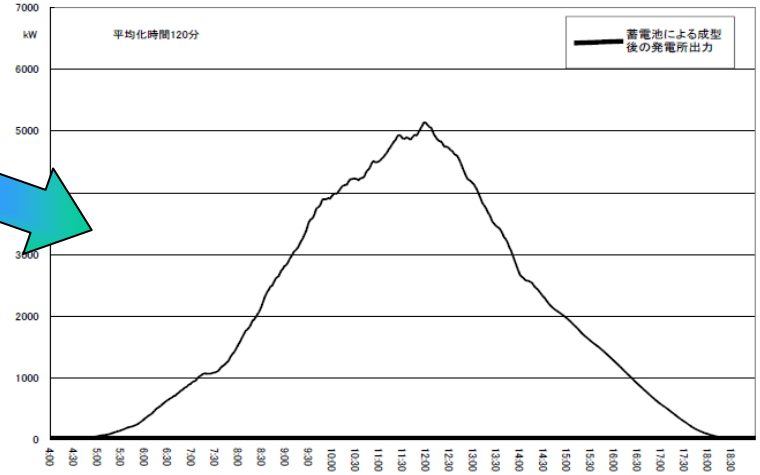


The concept of power system stabilization by using battery

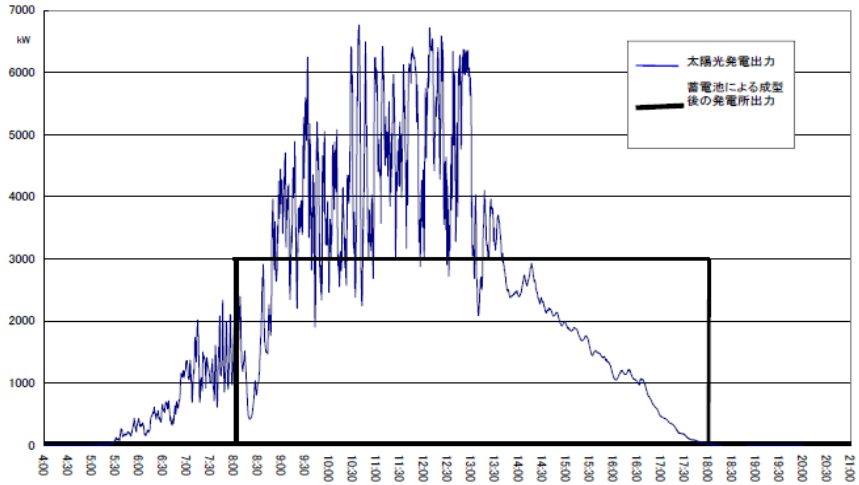
Fluctuated PV output



Smoothed output from PV power station



Scheduled output operation



Verification of Grid Stabilization with large-scale PV Power Generation Systems (FY2006-2010)

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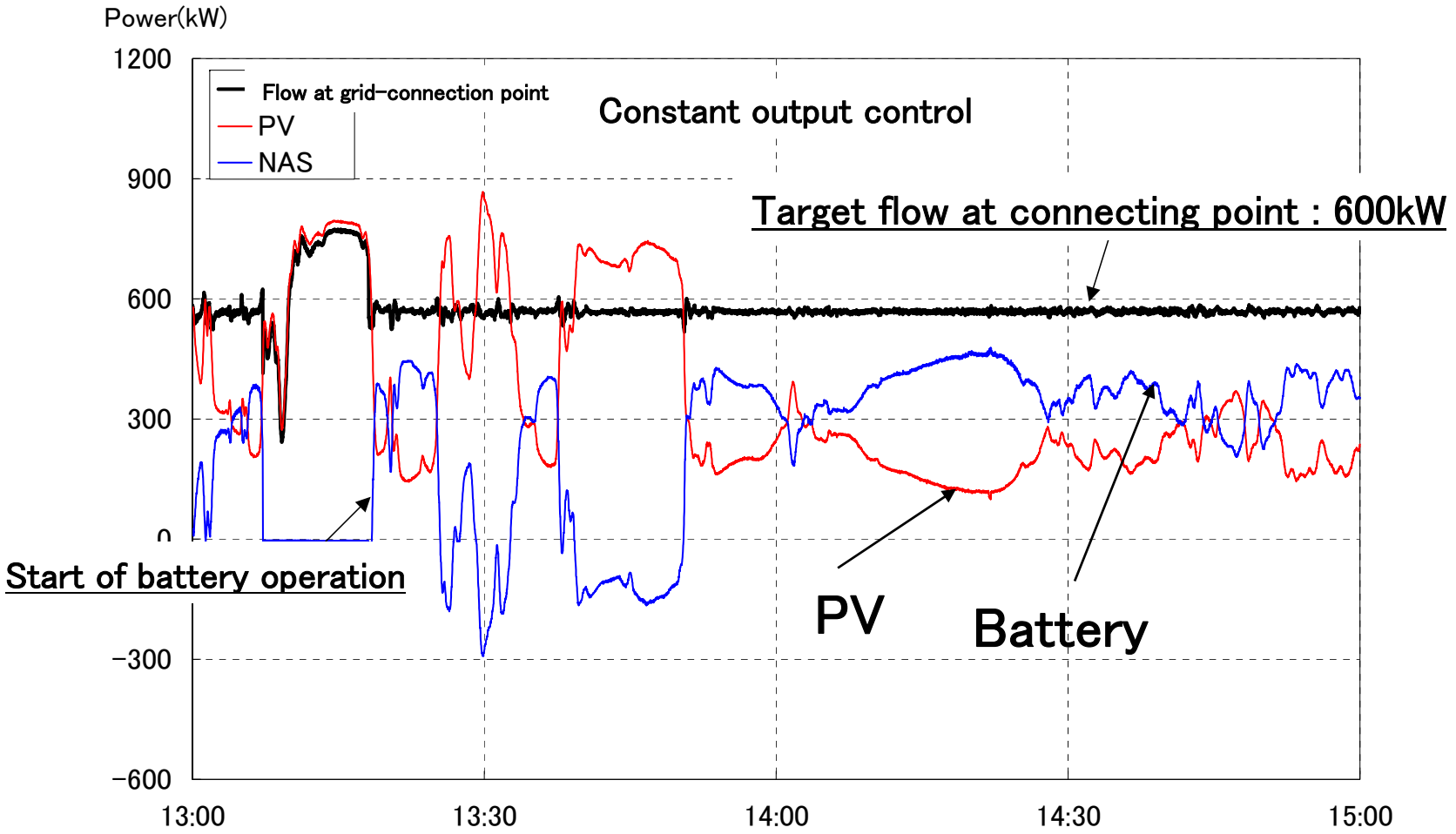
Appling battery storage to make power flow form PV power station as constant



Demonstrative Project of Regional Power Grids with Various New Energies(FY2003-2007)

Background

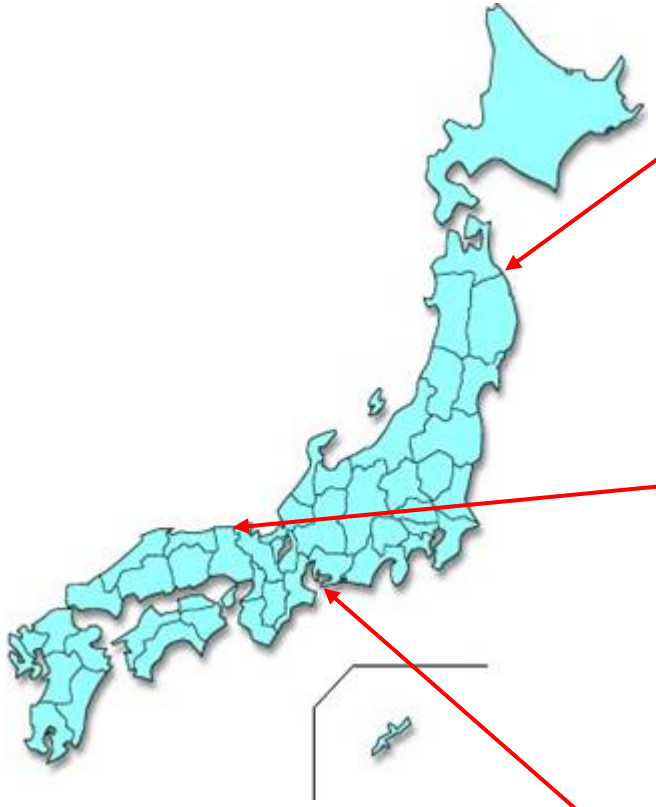
Establish energy (electricity and thermal) Supplying system to demonstration area, by creating control and manage system of mixture of new energy resources.

Objects

(1)Creating energy supplying system from new energy economically.
(Also, this system should be less influence of fluctuation of output from new energy to power system.)

(2)Measuring power quality and other data such as operation cost In the system.

Demonstrative projects site



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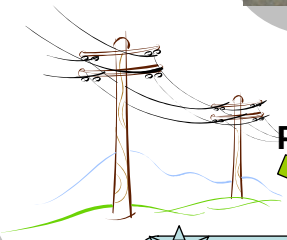
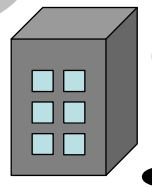


Power from Utility

Electricity



City office building

Water treatment facility

330kW PV systems

Transformer console

Electricity

500kW NAS batteries

4.8t/day Methane fermentation system

20kg/hr Gasification system

MCFC (270kW & 300kW)

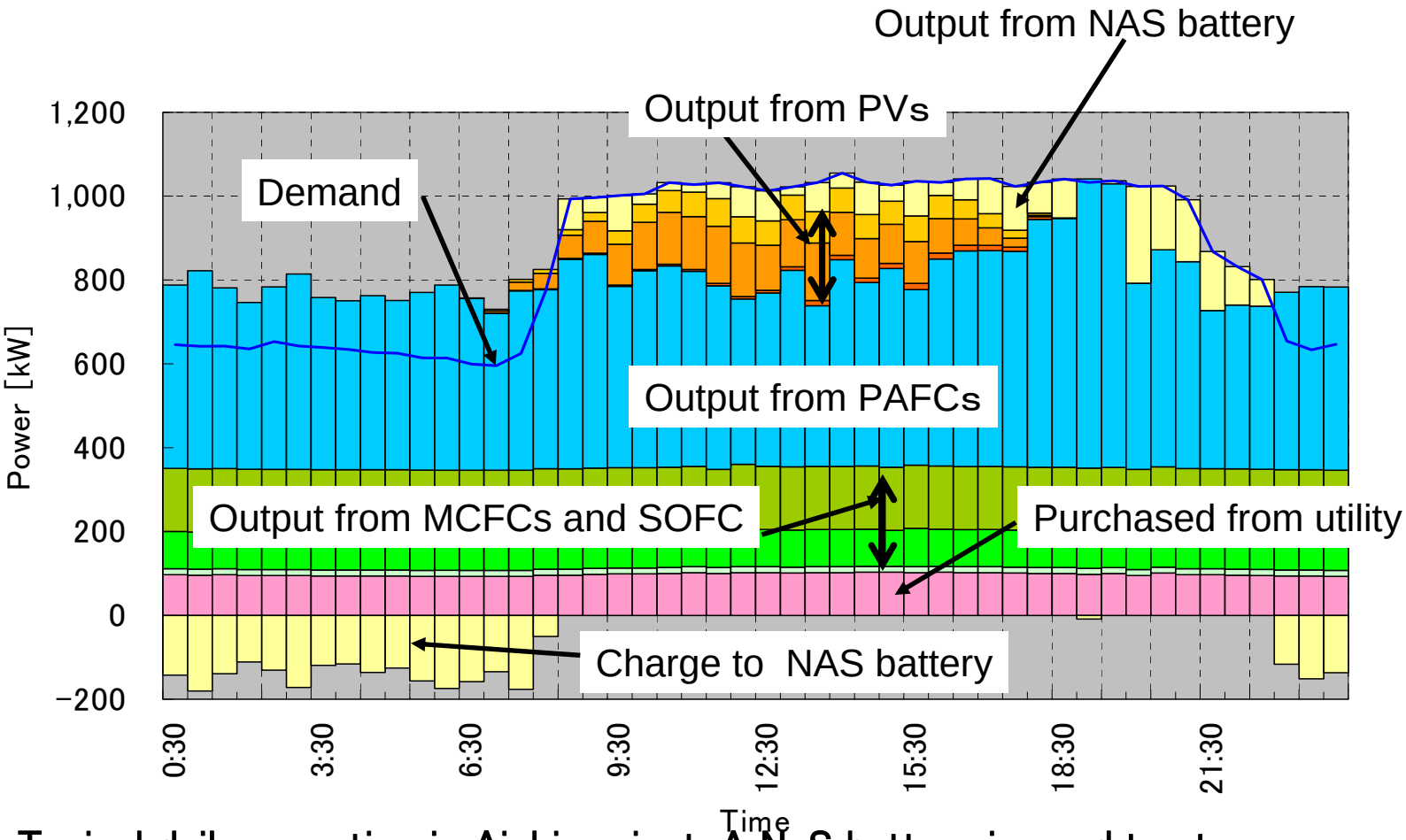
SOFC (25kW)

PAFC (200kW*4units)

City gas

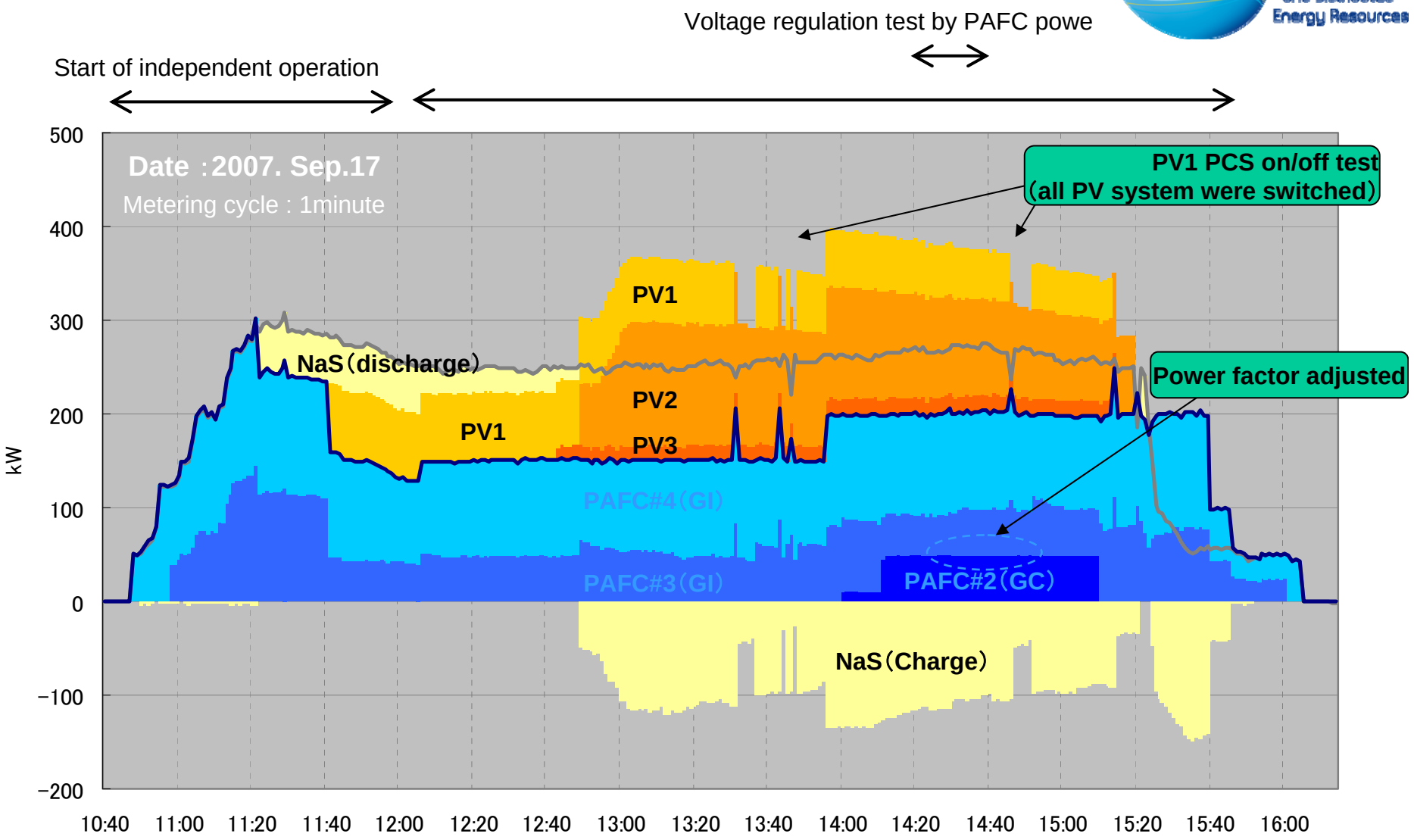
City gas

Daily operation of micro-grid (in Aichi)

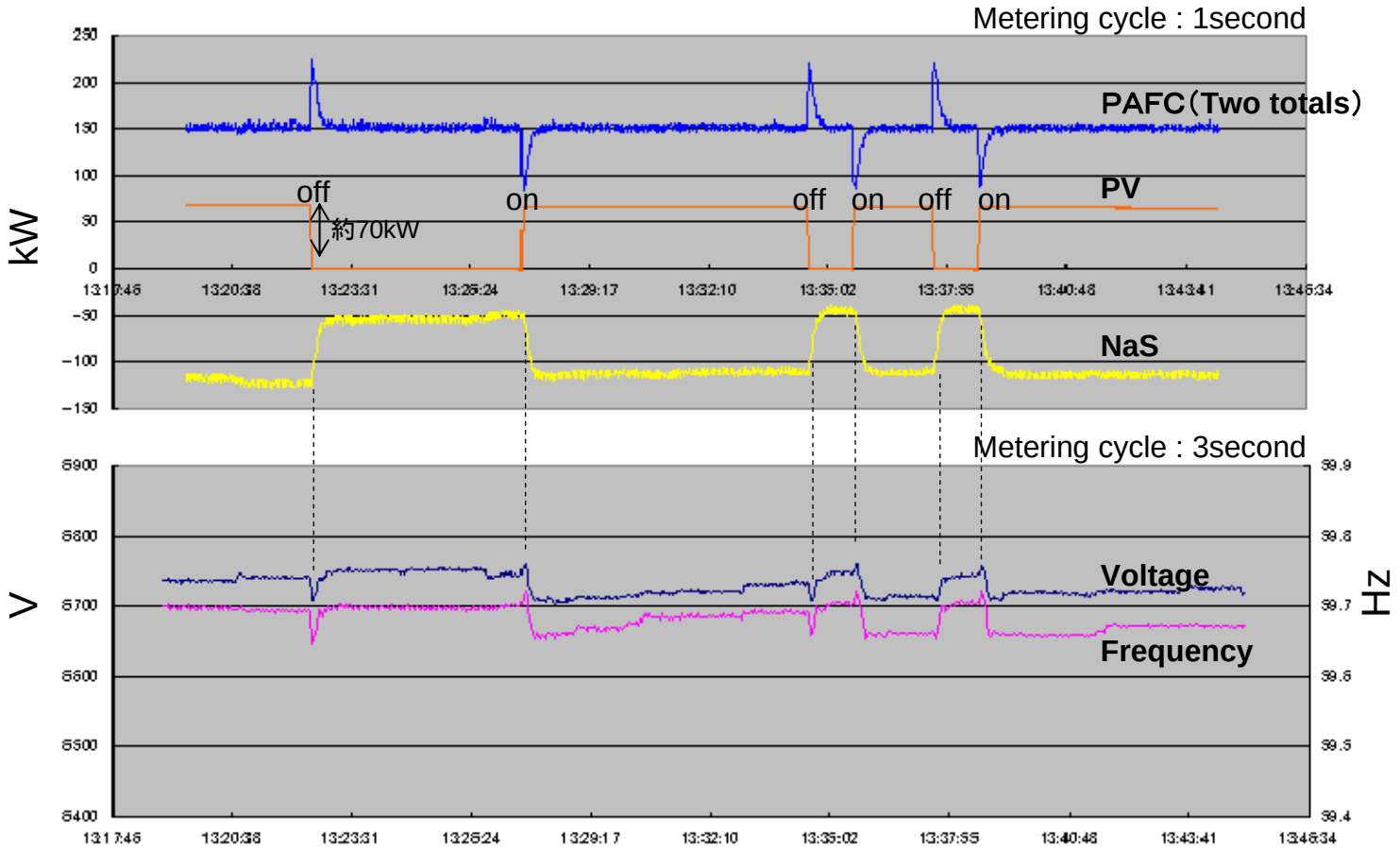


Typical daily operation in Aichi project. A NaS battery is used to store energy within the supply system and it plays an important role in balancing supply and demand.

Independent operation (in Aichi)



Independent operation(PV:Start/stop) (in Aichi)



Balancing results of the micro-grids

Balancing 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	Balancing error target	Achieved results
Aichi EXPO	3% by 30 minutes ↓ 3% by 10 minutes	The matching error target was 99% achieved with operation of PAFC load following operation and NaS battery system.
Kyotango	8% by 5 minutes ↓ 3% by 5 minutes	Continuous operation was started in Feb. 2006. By the end of the 5years study period, the target (3% by 5 minutes) was achieved.
Hachinohe	3% by moving 6 minutes average	During operation from Oct. 2005 to Feb. 2006, the matching error target was 98.2% achieved.. These quality could keep until the end of the project..

Conclusion throughout our demonstration projects

(1) NEDO recognized importance of battery technology development.

Cost -> Cost should be half of the cheapest NAS battery.

Lifetime -> Lifetime should be extended as 20years long as lifetime of renewable energy facilities.

(2) Technologies related battery operation and micro-grid were almost demonstrated.

Road map: Creating a road map for grid-connecting technologies will be important, because who should invest such technology is very important issue.

(3) Micro grid technology and battery application for renewable energy may be available as the technology of electrification by renewable energy in developing area. However, in future those technologies will appear in paradigm shift in utility network system when so many renewable energy are connected on the network.

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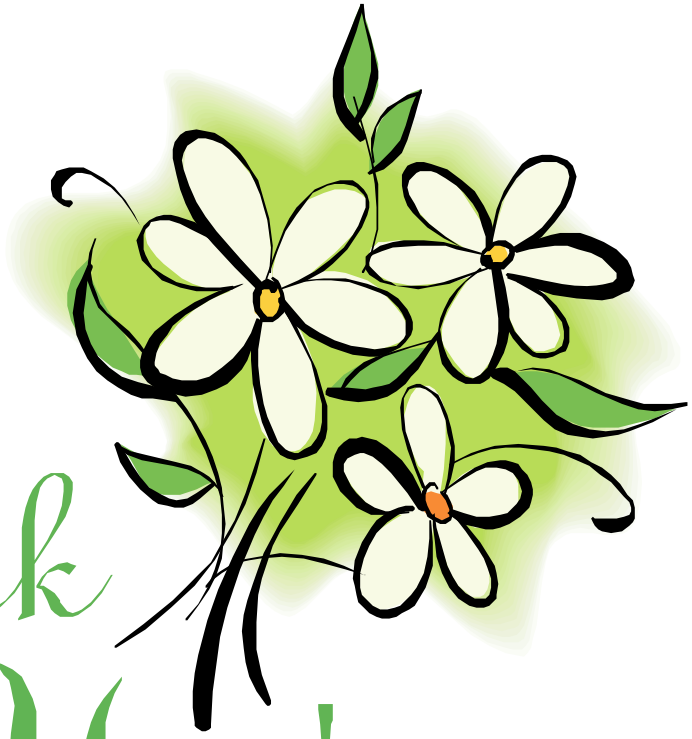

Thank You!