



NEDO's R&D in New Energy

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Contents

1. Introduction

2. PV

3. Wind

4. Biomas

5. Grid connection

Part□

Introduction

Long-Term Outlook on Energy Supply and Demand

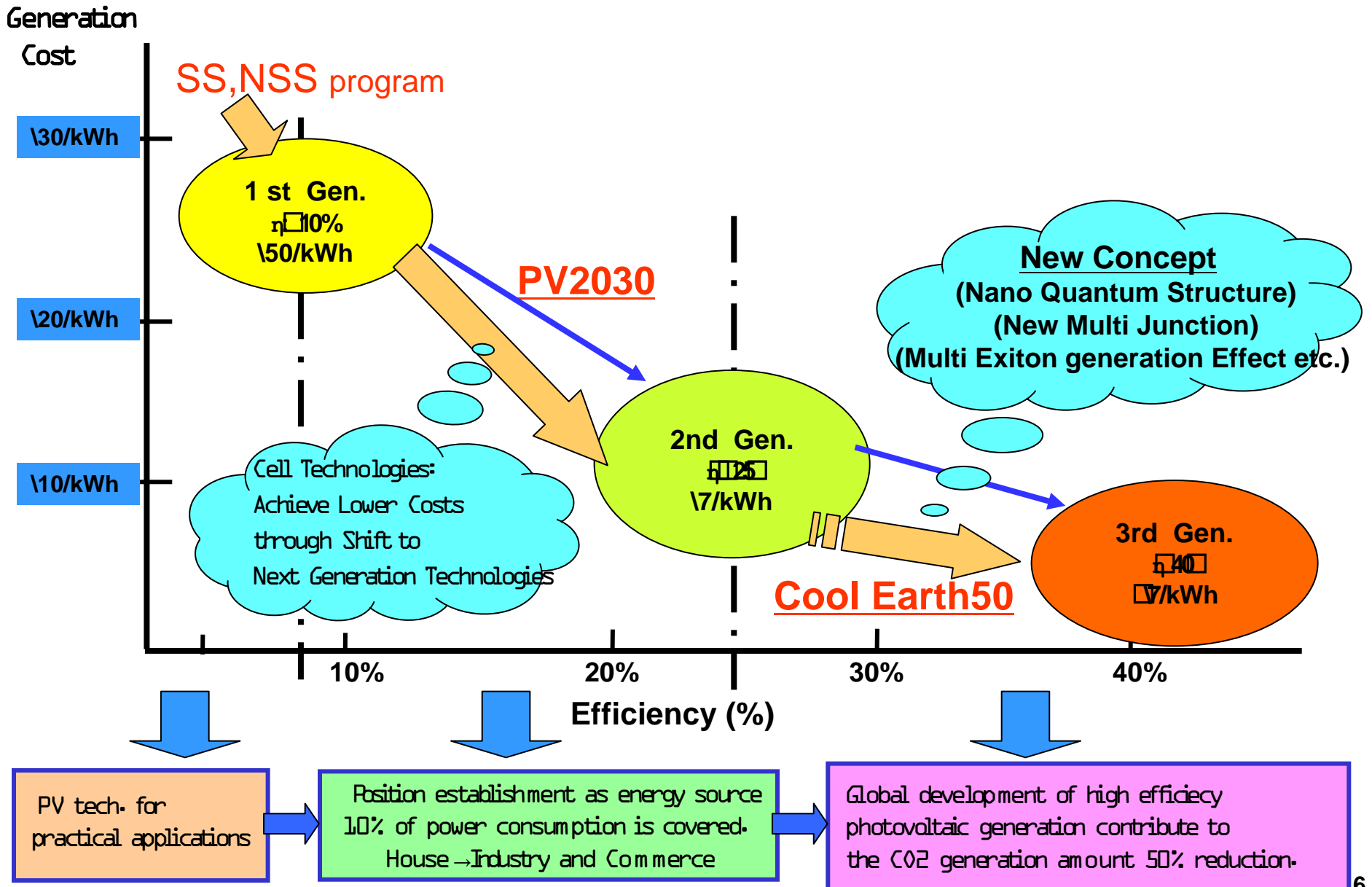
	Unit	FY2022	FY2030	FY2040	Times
		Actual figure	Maximum Introduction Case	Maximum Introduction Case	
Solar power generation (PV)	Thousand kL in crude oil equivalent	100	1000	4000	100 times
	×10 ⁴ kW	1000	4000	4000	
Wind power generation	Thousand kL in crude oil equivalent	100	1000	1000	100 times
	×10 ⁴ kW	1000	1000	1000	
Waste power generation □	Thousand kL in crude oil equivalent	1000	1000	1000	100 times
	×10 ⁴ kW	1000	1000	1000	
Biomass power generation	Thousand kL in crude oil equivalent	1000	1000	1000	100 times
Biomass heat utilization	Thousand kL in crude oil equivalent	1000	1000	1000	100 times
Others □	Thousand kL in crude oil equivalent	1000	1000	1000	100 times
Total	Thousand kL in crude oil equivalent	4000	4000	4000	100 times

*'Others' include 'solar heat utilization,' 'waste heat utilization,' 'untapped energies' and 'black liquor/waste timber.'

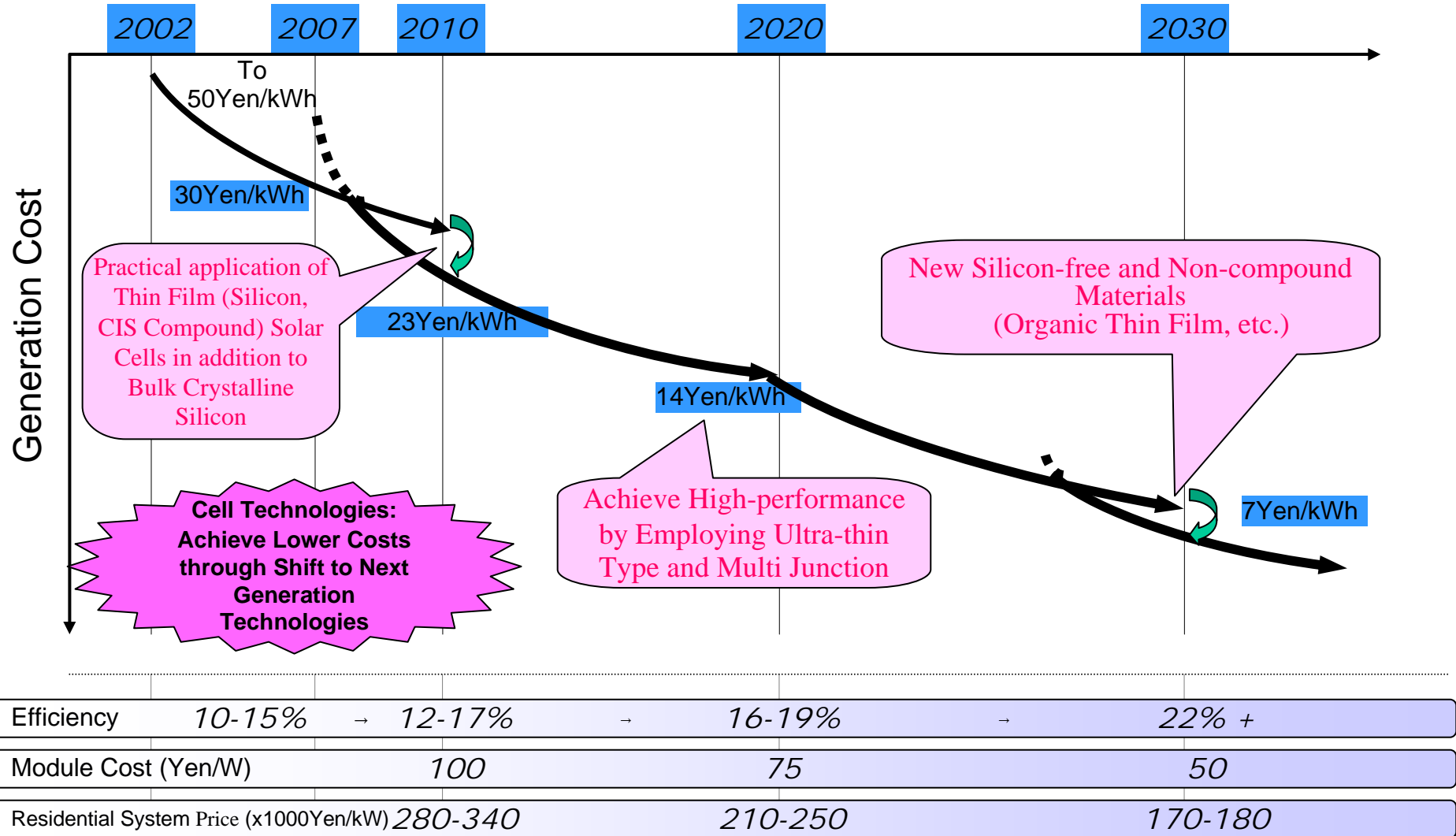
Part□

PV

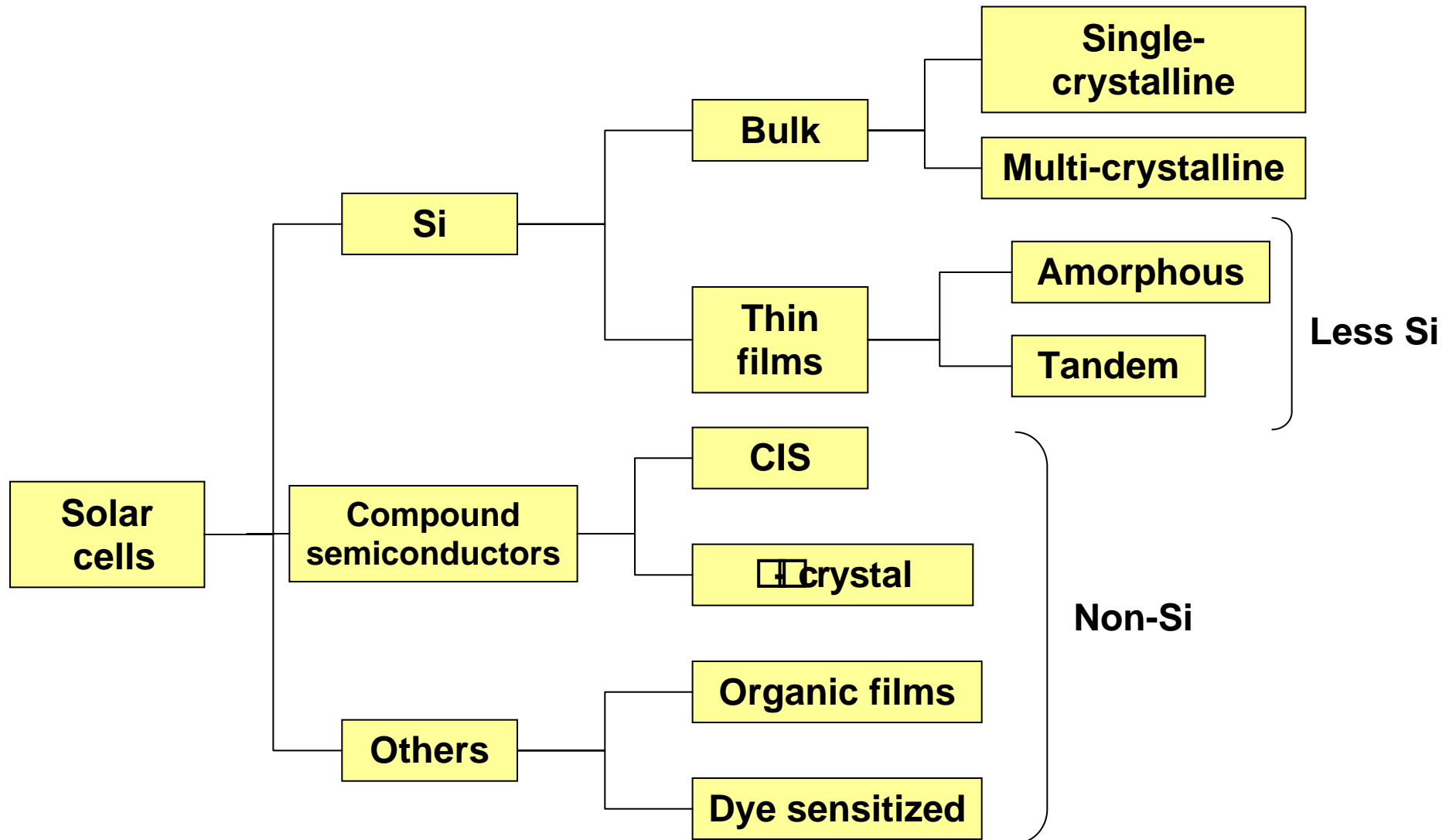
PV Technology Development Targets for 2050



PV Technology Development Targets (PV2030)



Varieties of Solar Cells



R&D for Next Generation PV System (FY2006-2009)



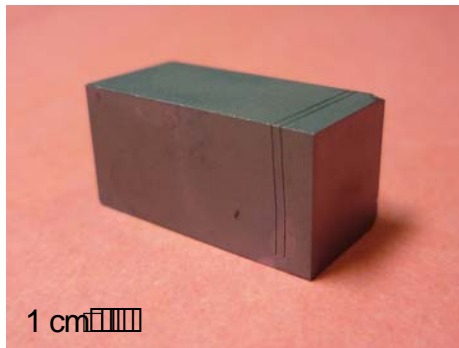
Wafer-based thin Si solar cell

High quality poly-crystalline Si, New slice technology, High efficiency $\eta=21\%$ for mono-Si $\eta=18\%$ for poly-Si thin Si $100\ \mu\text{m}$ solar cell

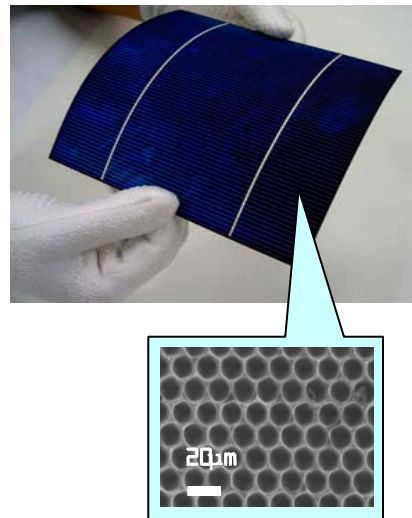
Thin-film Si solar cell:

High efficiency solar cell technology for stabilized efficiency of 15%

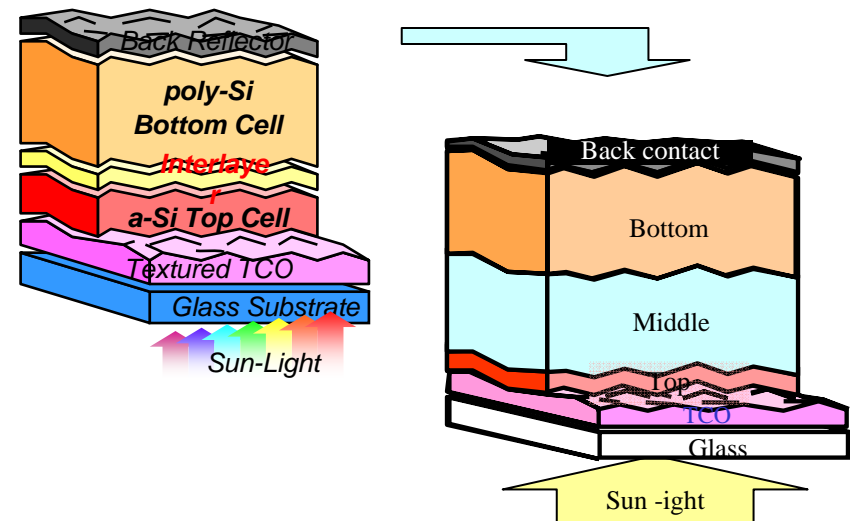
Si block slicing by catalyzed reaction
with cell width of $50\ \mu\text{m}$



$100\ \mu\text{m}$ thick Honeycomb texture cell with $\eta=18.9\%$



Thin-film Si solar cell
2 junction-3 junction



R&D for Next Generation PV System (FY2006-2009)



□ CIS solar cell □

High efficiency ($\eta=18\%$) □ sub-module □ $10 \times 10 \text{ cm}^2$ □, Solar cell on light weight substrate

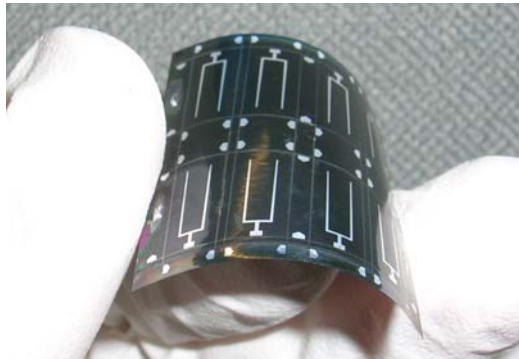
□ Dye-Sensitized solar cell □

Long life time module with $\eta=8\%$, High efficiency cell with with $\eta=15\%$ at 1 cm^2

□ Organic thin-film solar Cells □

High efficiency cell with with $\eta=7\%$ at 1 cm^2 , Improve the durability

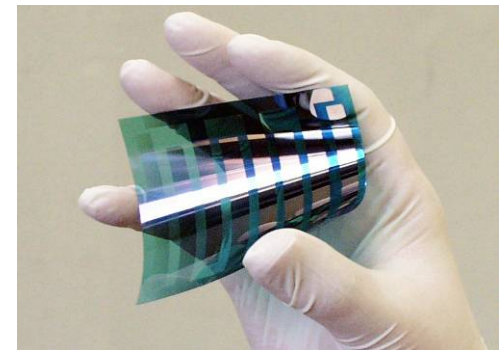
17.7% flexible CIS solar cell



Dye-Sensitized solar cell



Organic thin-film solar Cell

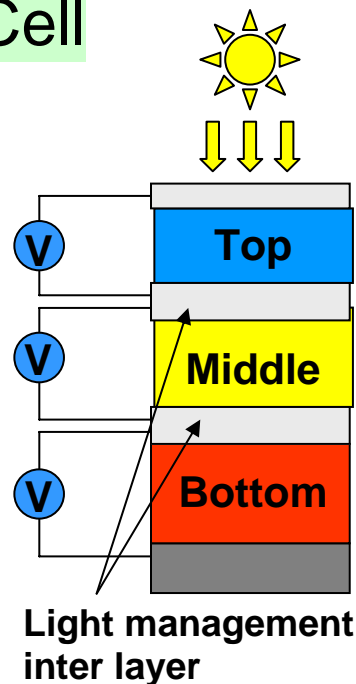
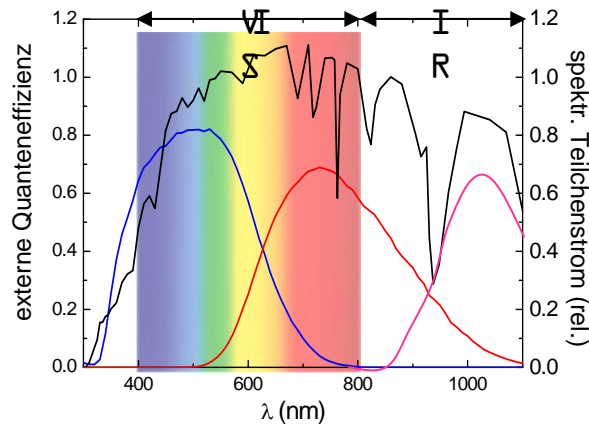


Super High Efficiency

PV system with over 40% efficiency at 2050

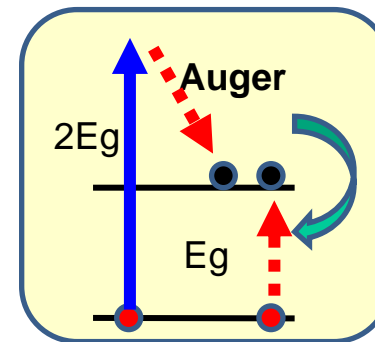
- Multi Junction, Concentrator
- New Concepts, New Materials

Multi Junction Solar Cell

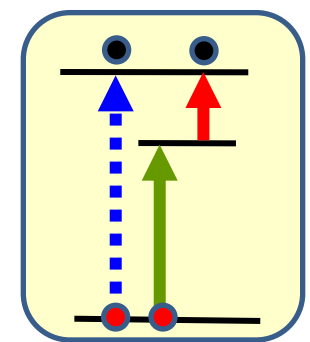


Examples of new concept

Challenge by Quantum Structure



Multi-Exciton



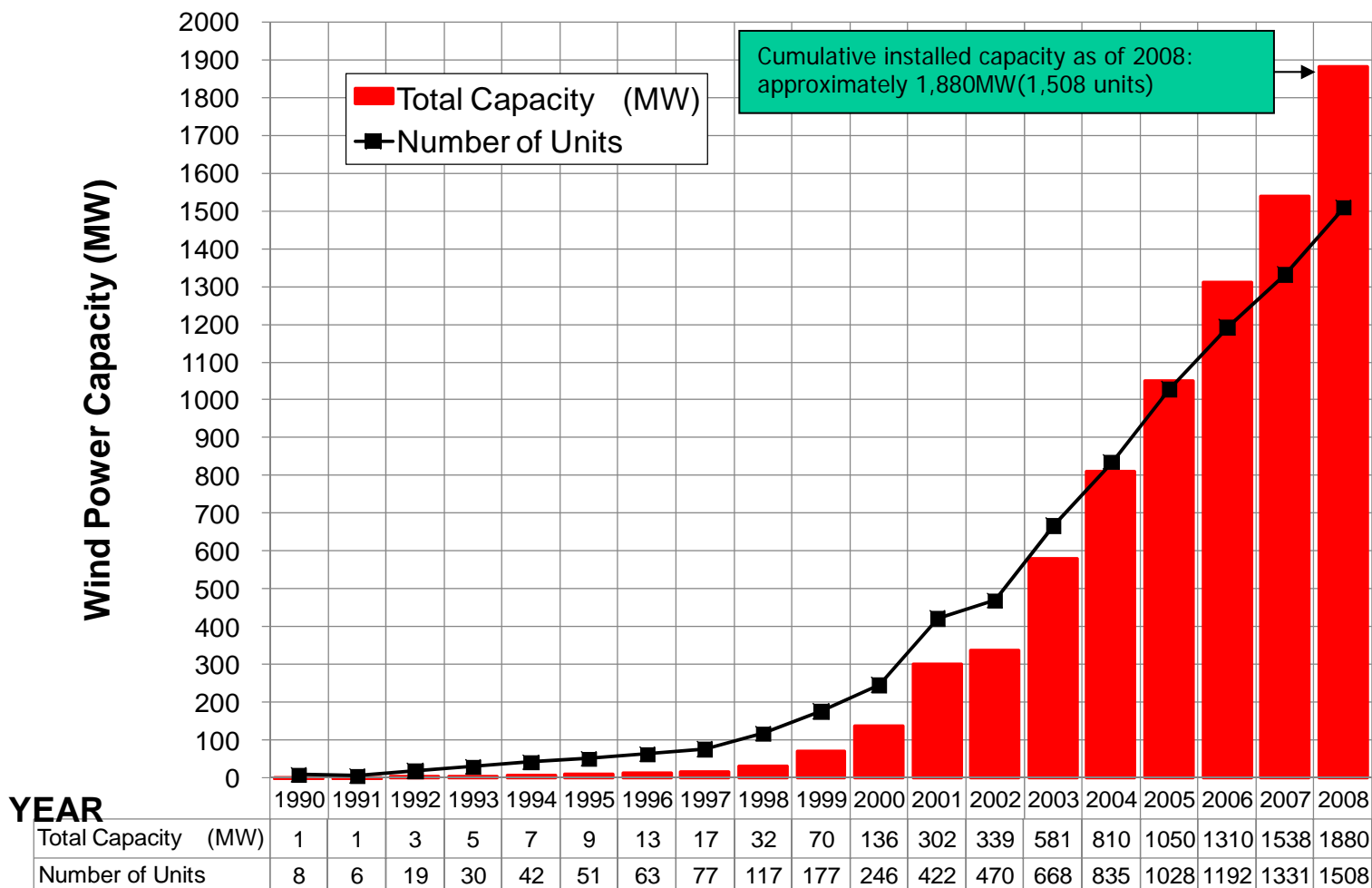
Intermediate band absorption

Part□

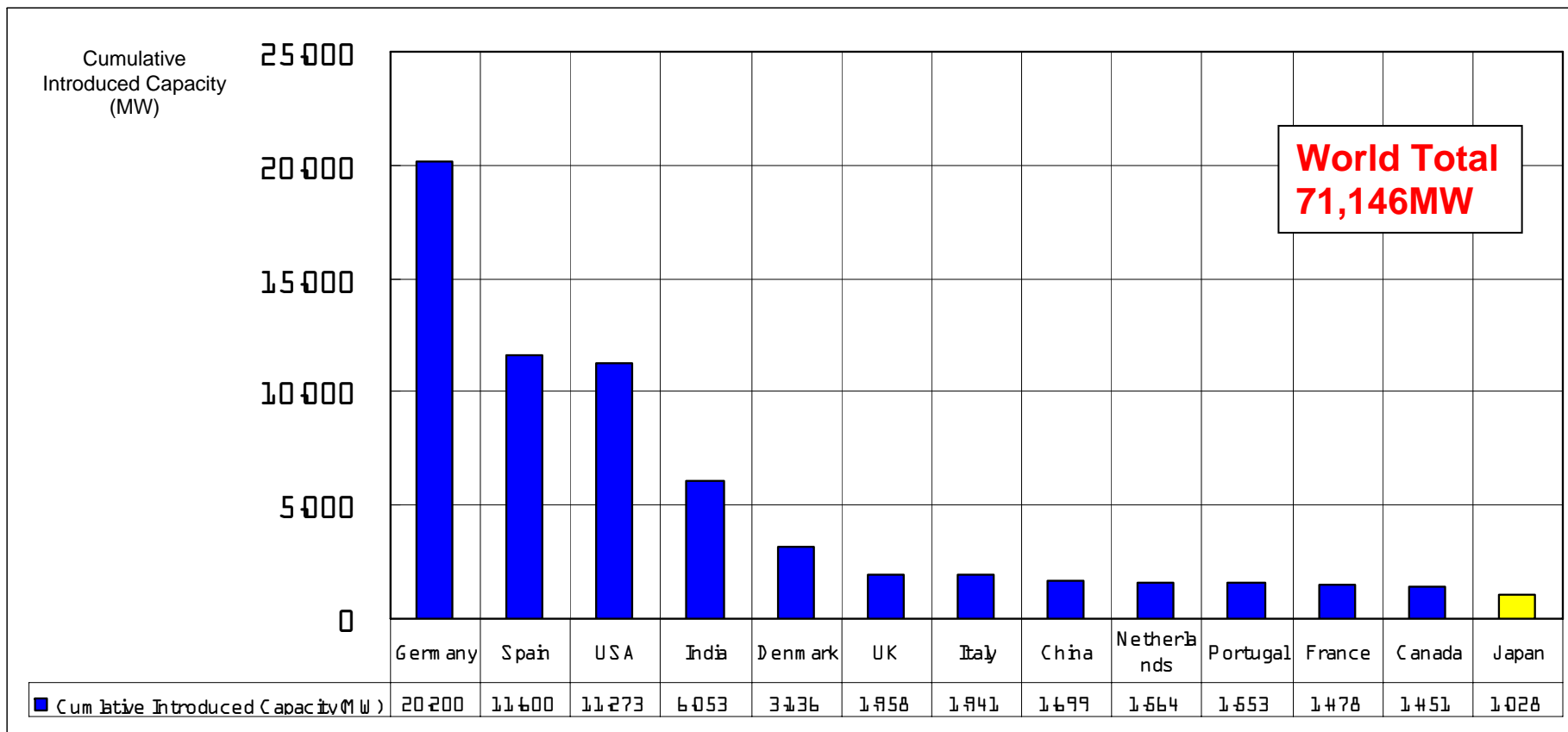
WIND

Growth of Wind Power Generation in Japan

Cumulative Installed Capacity and Number of Wind Turbines



Wind Power Generation in Key Countries (2006)



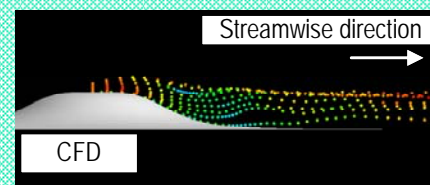
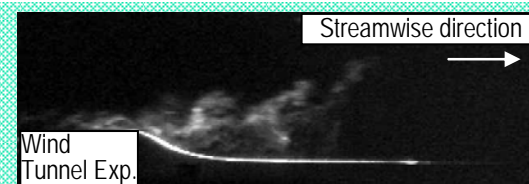
Source: Windpower Monthly

NEDO's Project for Wind Power Generation

□ R&D of next-generation wind power generation technology

- Research on technologies to facilitate the design of wind turbines suitable for Japan's unique conditions.

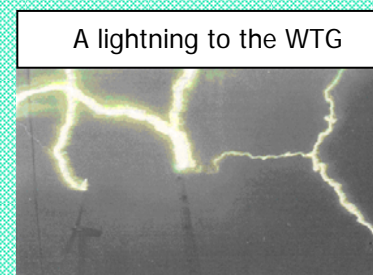
- Wind tunnel experiment and field measurement



- Establishment of more effective lightning protection techniques.

- Lightning damage investigation

- Inspection of lightning protection measures



NEDO's Project for Wind Power Generation

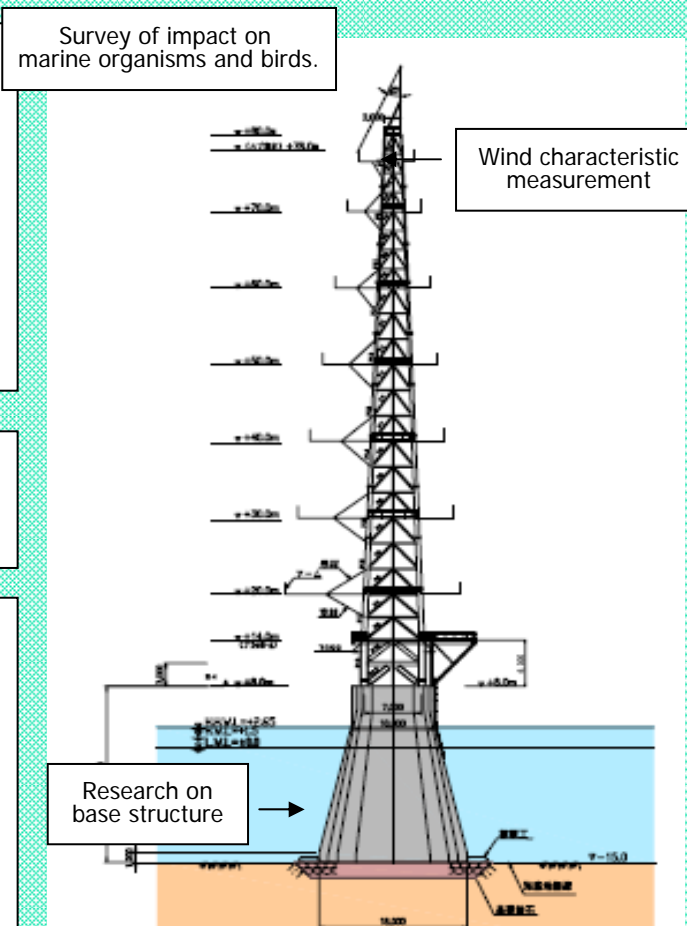
□ R&D of offshore wind power generation technology

Identification of ocean wind characteristics, and meteorological and oceanographic conditions specific to Japan. Development of technologies related to wind power generation systems suitable for the specific nature conditions around Japan.

FY2008: A feasibility study (FS) to assess the potential for demonstration research in Japan.

From FY2009:

- Installation of the offshore wind observation system to collect and analyze ocean wind, waves and tidal current data.
- Installation of the offshore wind power generation systems to evaluate the performance.

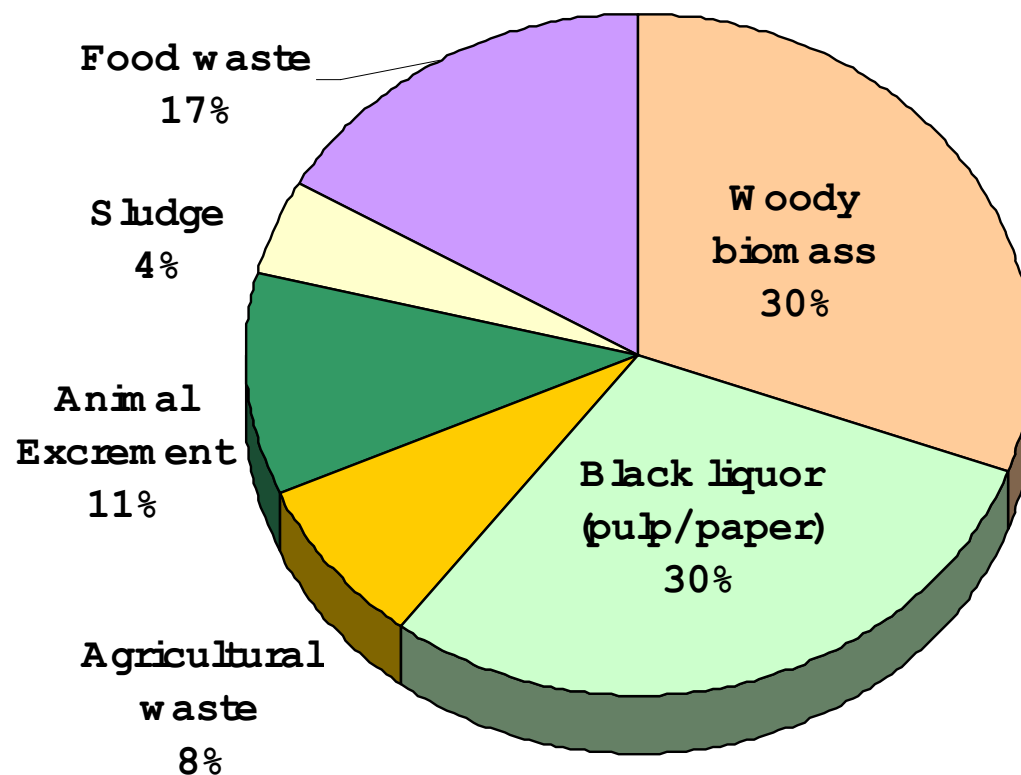


Part□

Biomass

Biomass Energy Resources in Japan

**Available energy: 45,600,000kl/year
(approx. 8% of gross primary energy supply in Japan)**



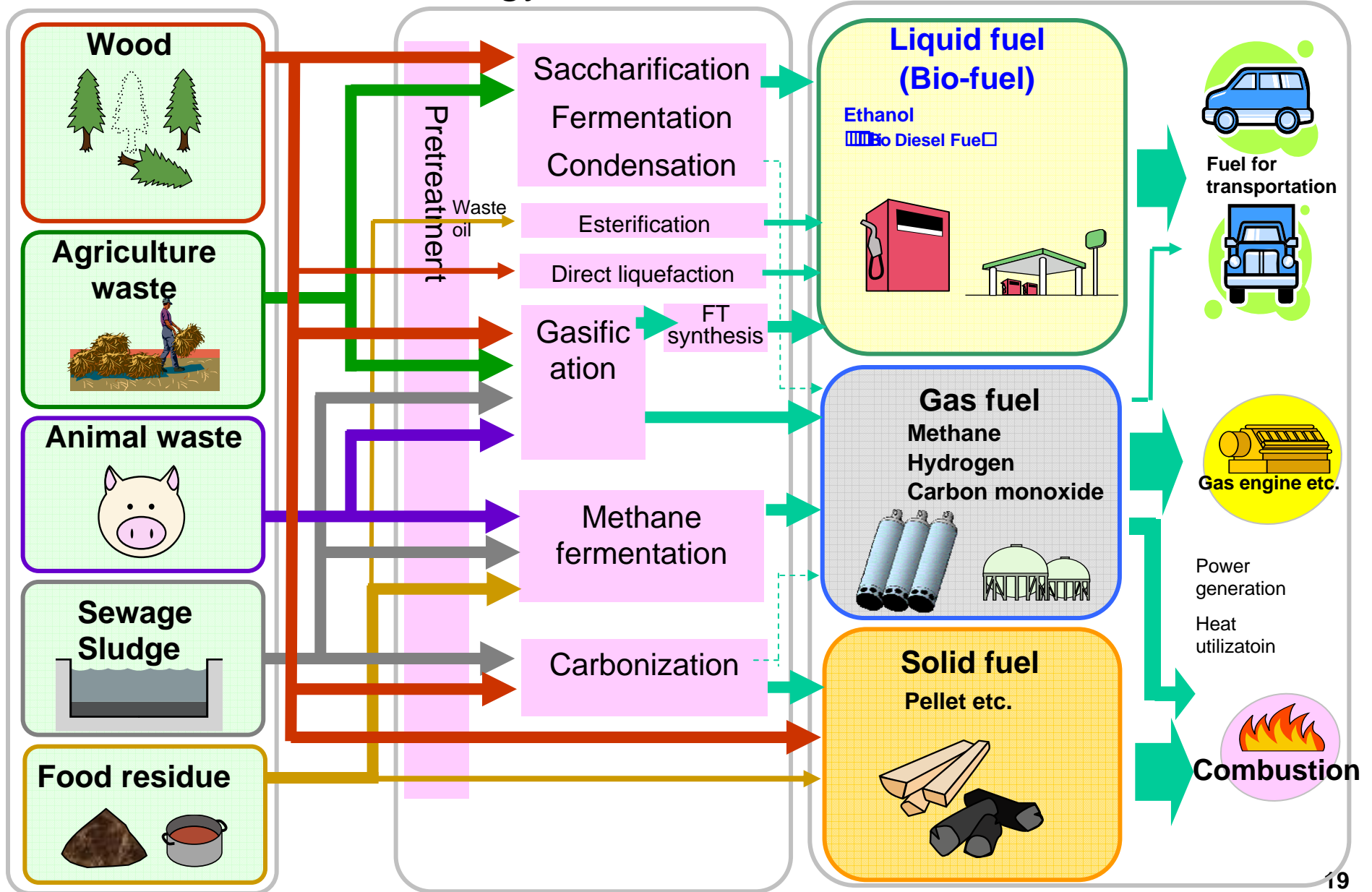
Biomass energy utilization in Japan



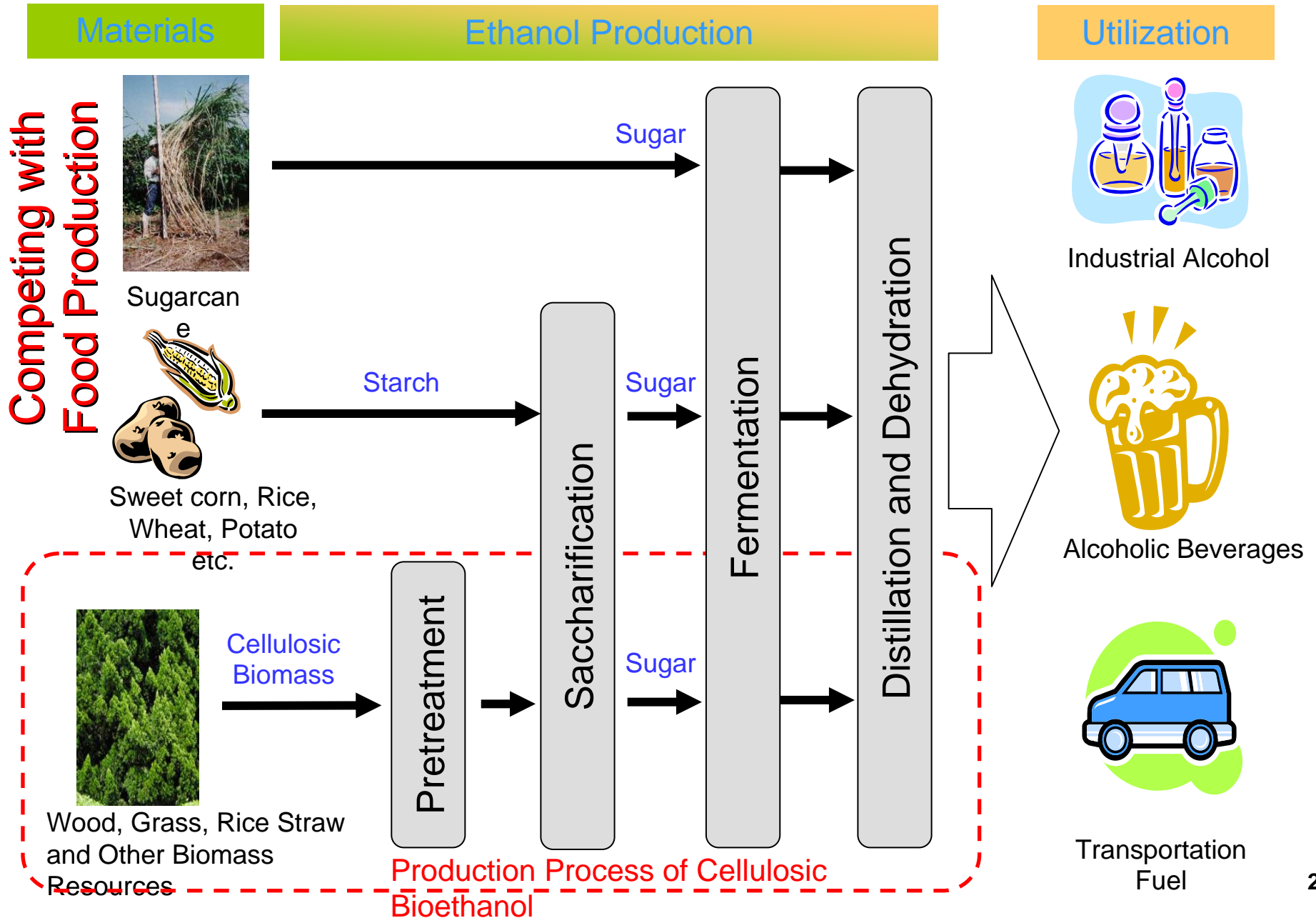
Materials

Energy conversion

Utilization



Process of Ethanol Production



Part□

Grid Connection

Positioning of NEDO's grid-connection related projects



Islanding detection

Overvoltage control

Clustered Photovoltaic Power Generation Systems (Ohta-city)

Residential distributed generation

Short term fluctuation reduction

Long term fluctuation reduction

Large scale new-energy generation

Large Scale PV Power Generation Systems (Wakkanai-city, Hokuto-city)



Wind Power Stabilization Technology (Tomamae)



Demonstrative Project of Regional Power Grids with Various New Energies

Micro-grid

Distribution System

Coexistence with the power system

Transmission system

Independent from the power system



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 and preservation by output from PV systems .

Objects

Development of the technology to avoid overvoltage of distribution lines without restriction of PV system output.

Development of function to prevent unintentional islanding.



Ota city



CRIEPI(Central Research Institute Electric Power Industry)Akagi test facility in Maebashi-city

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



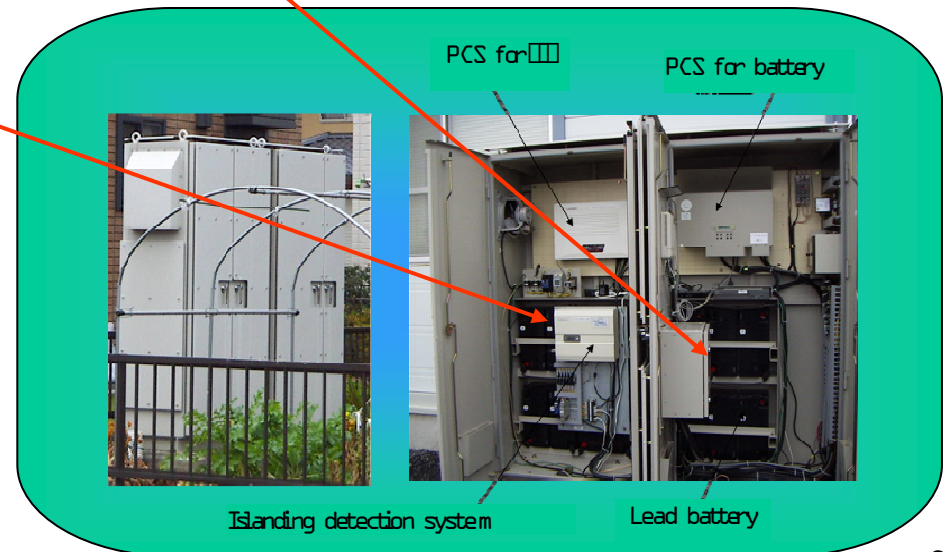
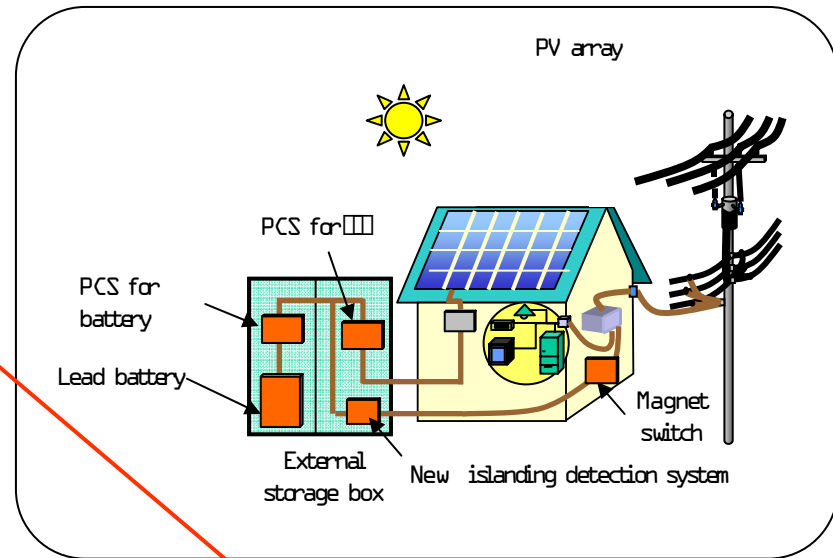
Results

■ Development of technology to avoid overvoltage of distribution lines without restriction of PV system output

- Field test of 553 battery systems
- Confirmation of battery operation modes

■ Development of function to prevent unintentional islanding operation of clustered PV systems

- Synchronizing of reactive power injection by external signal



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



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.



Wakkanai site (1MW)

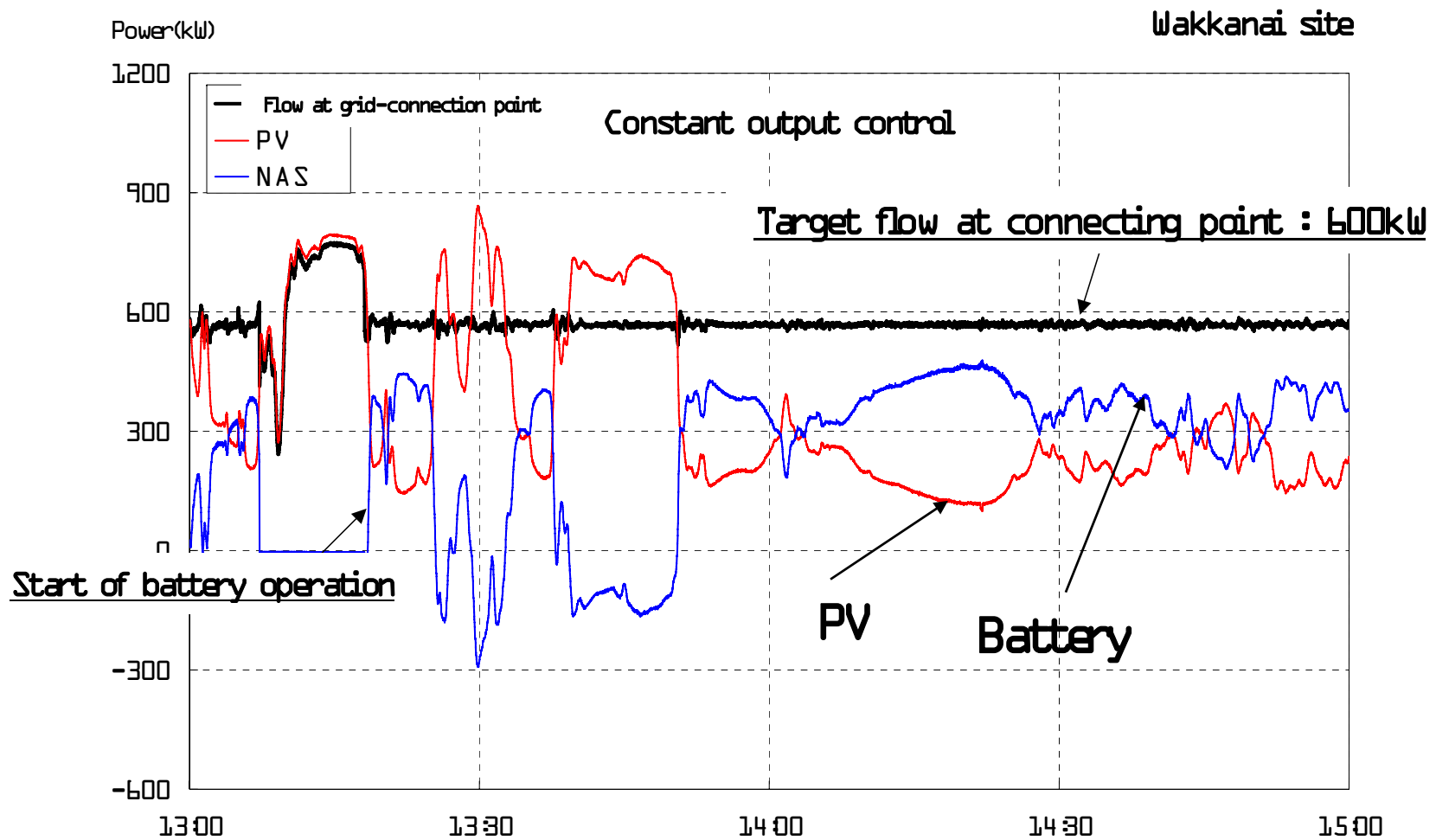


Hokuto site (1MW)

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



Applying battery storage to make power flow from PV power station as constant



Hokuto site in March 2008



24 kinds of PV modules in 1st stage

SUMMARY

PV

- Roadmap toward 2030 and 2050 target
- Focus on low-Si and non-Si types of PV

Wind

- Adjustment for natural condition in Japan
- Offshore wind power generation

Biomass

- Focus on ethanol production from cellouse

Grid-connection

- Focus on stabilization technology for new energy power stations

Thank you for your attention!