Toward a New Energy Economy

January 20-21, 2010
“Governance on Green Energy and Carbon Reduction”

Tomoya Ichimura
New Energy and Industrial Technology
Development Organization (NEDO), Japan

Presentation Outline

- Overview of NEDO
- Energy Policy in Japan
- NEDO's Technology Development Efforts
- International Collaboration

About NEDO

Japan's largest public management organization promoting R&D and deployment of industrial, energy and environmental technologies.

Mission: to address energy and global environmental challenges and enhance industrial competitiveness.

History

1980: ***New Energy Development Organization*** established

1988: Scope broadened to include industrial technology R&D

- ***New Energy and Industrial Technology Development Organization*** -

1990: Scope broadened to include global environmental R&D

1993: Began promoting deployment of new energy and energy efficiency technologies

2000: Began support for private companies to strengthen international competitiveness

2003: Re-organized as an "Incorporated Administrative Agency"

Personnel

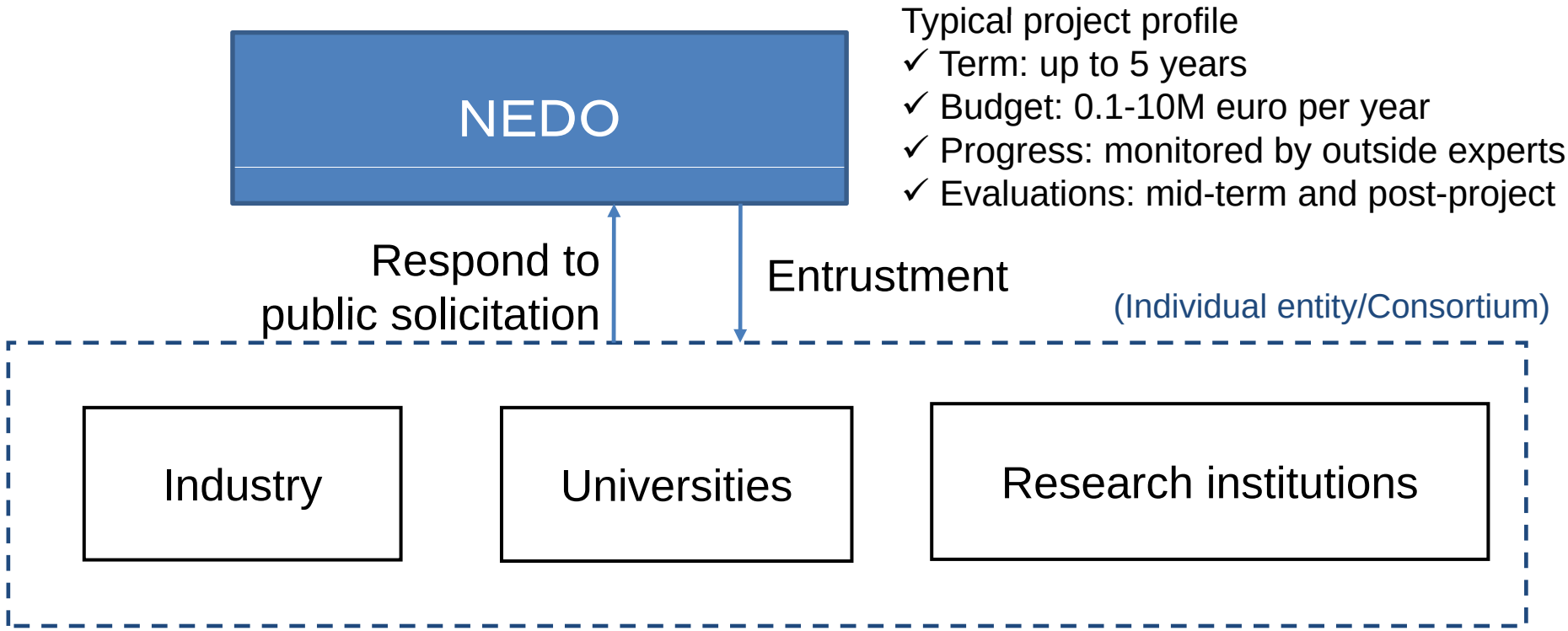
Approximately 1,000

Budget

Approximately 235 billion yen in FY2009 (about 2 billion euro)

NEDO's R&D Project Scheme

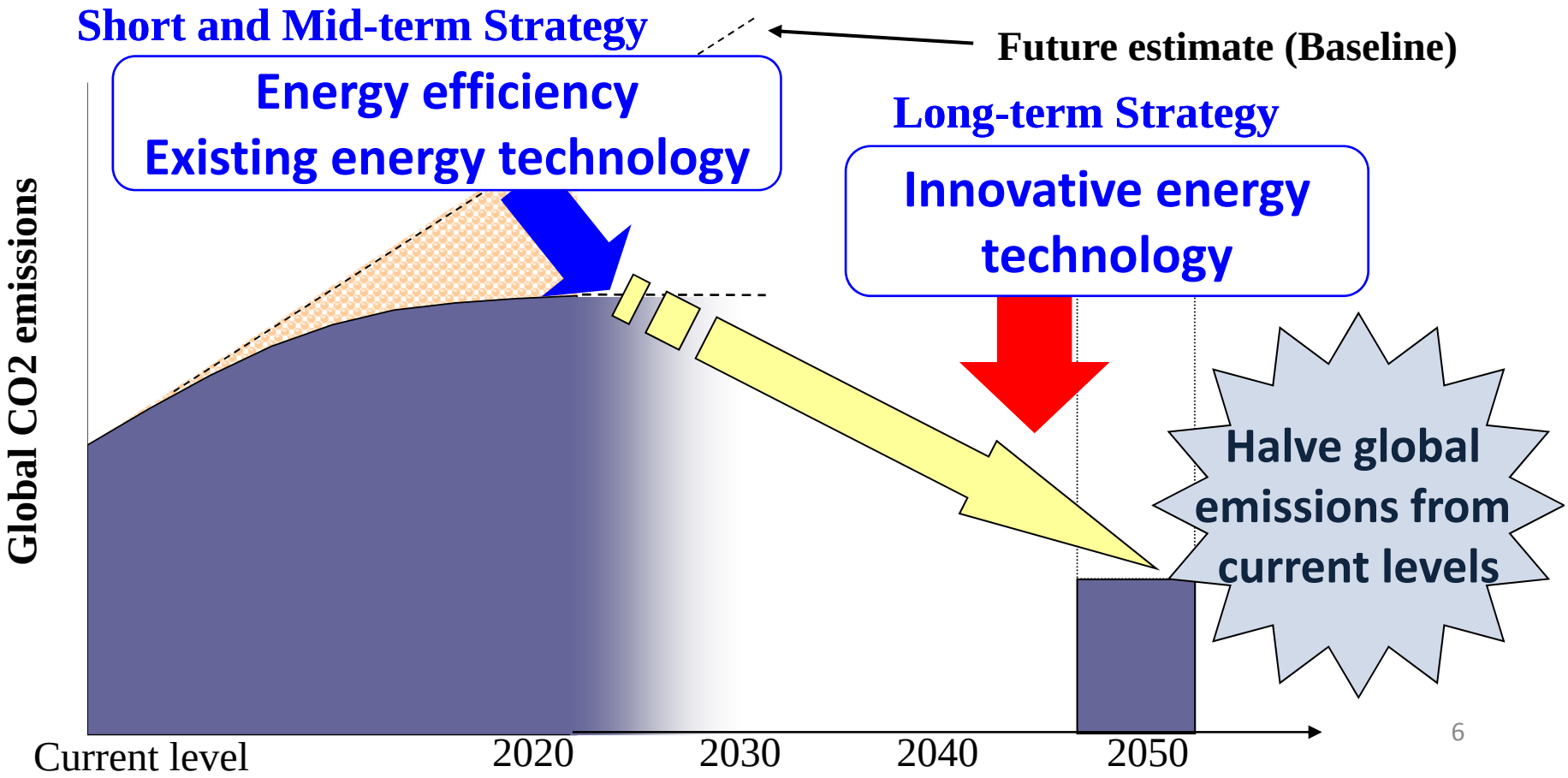
Under its normal scheme, NEDO selects the best entity or consortium among those that respond to NEDO's call for proposals. Entrusted entities then implement research under the management of NEDO.



Energy Policy in Japan

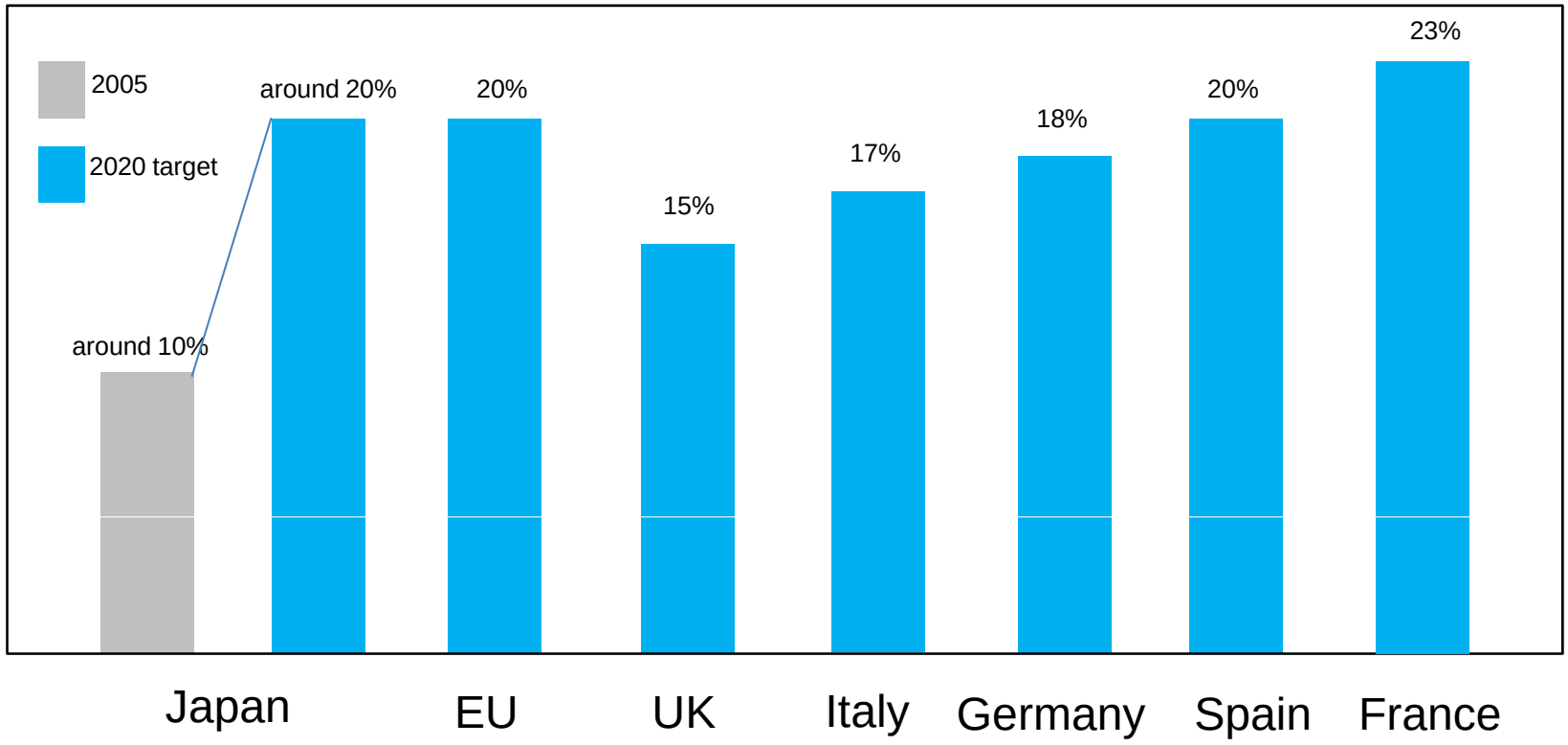
Strategy for Short/Mid-term and Long-term Targets

- ✓ Short and Mid-term (e.g. by 2020)
  - ➢ Deployment of existing energy technology
  - ➢ Development of innovative energy technology
- ✓ Long-term (e.g. from 2020 to 2050)
  - ➢ Deployment of innovative energy technology



Renewable Energy Deployment Target

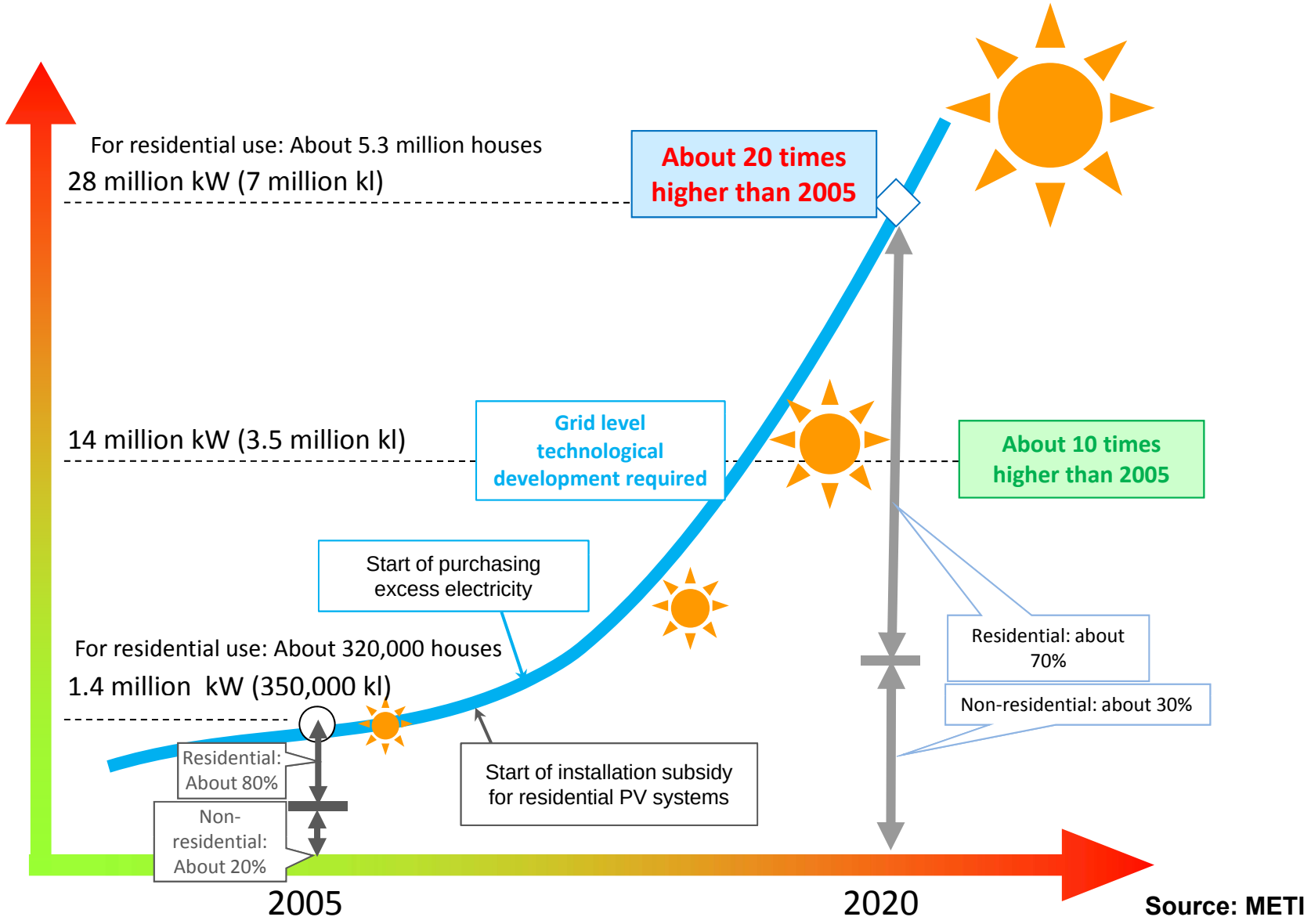
RE as a percentage of final energy consumption



(Including heat supplied by heat pumps as prescribed in EU directive)

Source: METI

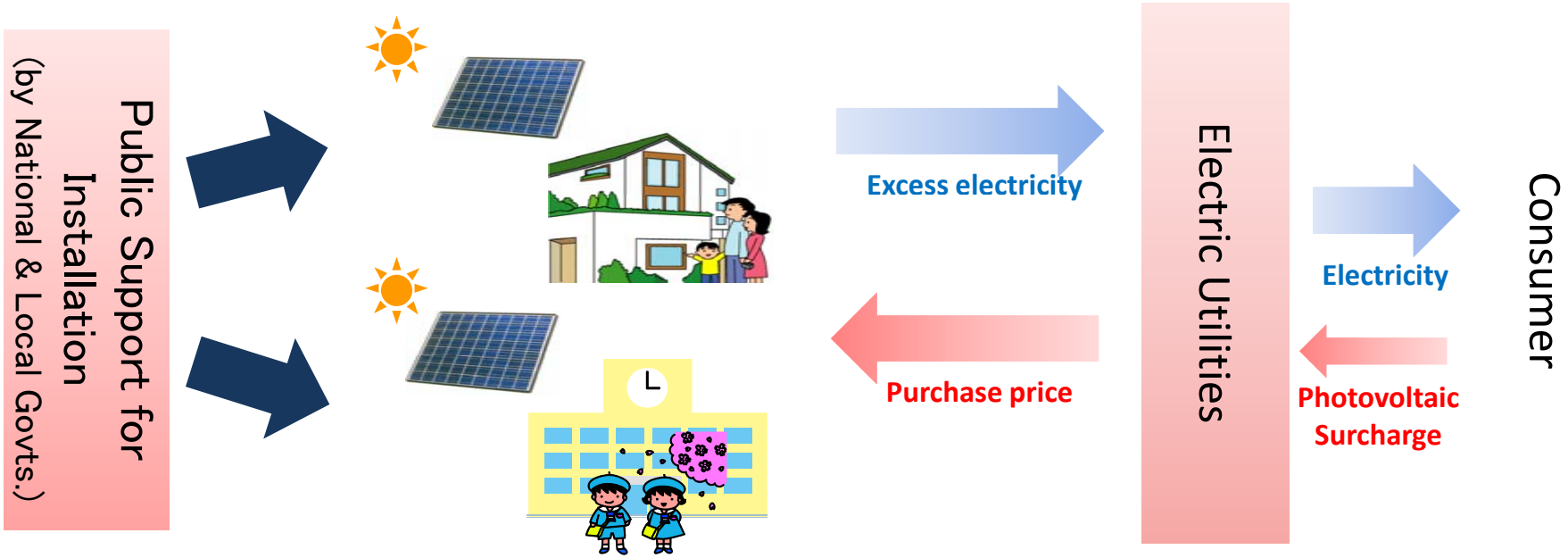
Scenario Expanded PV Deployment (Estimate)



Source: METI

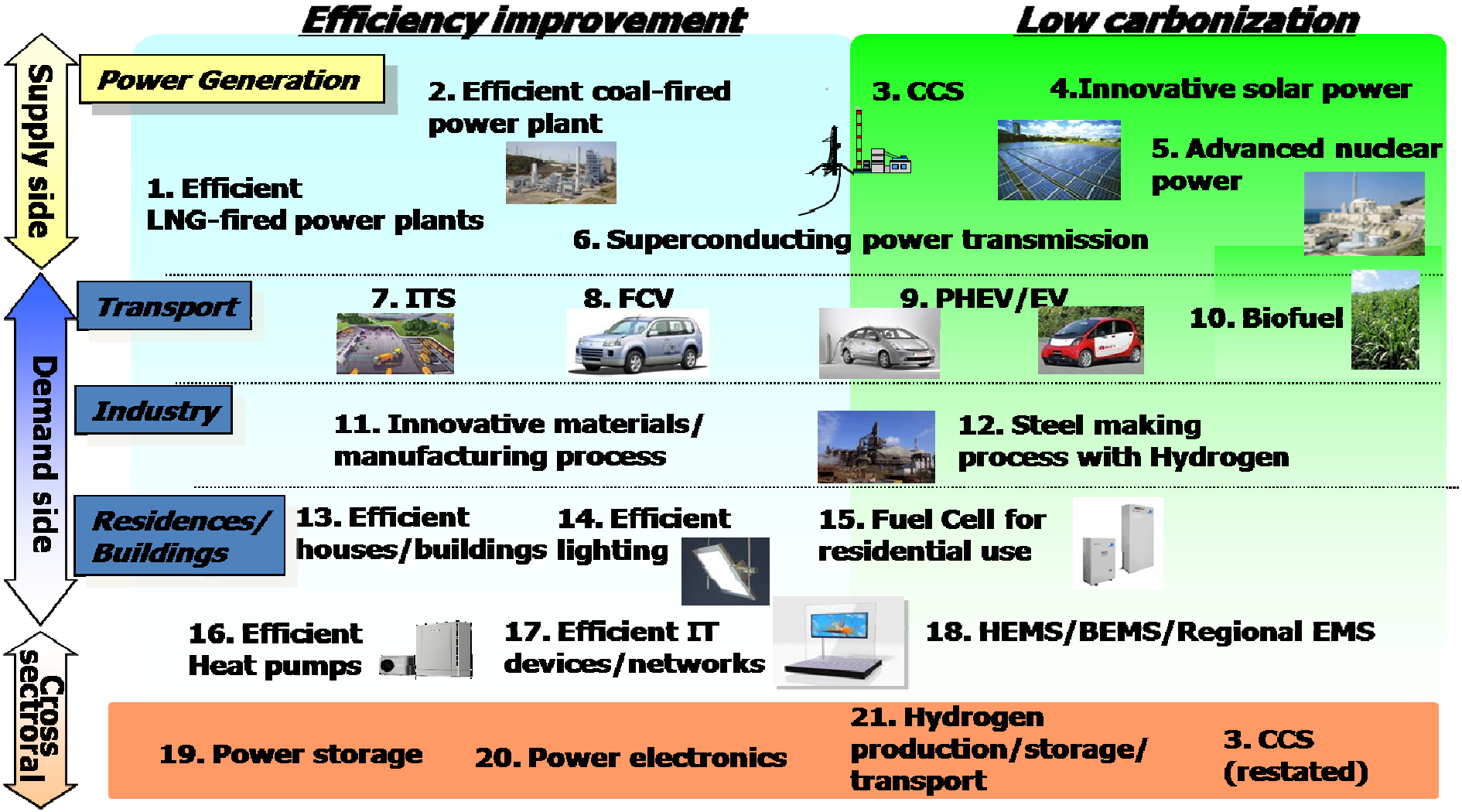
New Purchase Scheme for PV-generated Electricity

- Target: EXCESS electricity from PV (excludes facilities for electric utilities)
- Price: 48 yen/kWh (residential sector), 24 yen/kWh (non-residential sector)
- Starting price for the purchase will be decreased year by year
- Duration of purchase: 10 years
- Start: November 1, 2009



21 Key Innovative Energy Technologies

Japan formulated "Cool Earth - Innovative Energy Technology Program" to achieve long-term goals and identified 21 key innovative energy technologies. (March 2008)



NEDO's Technology Development Efforts

- PV
- Wind Power
- Biomass Energy
- Smart Grid

Progress of PV R&D in Japan

2009 PV Roadmap 2030+

2004 PV Roadmap 2030

New Sunshine Project completed

2000 Thin-film Silicon Solar Cells (140 ¥/W)

Low Cost mc-Silicon Solar Cell Production Technology (Efficiency = 17.2%, 189 ¥/W)

New Sunshine Project initiated

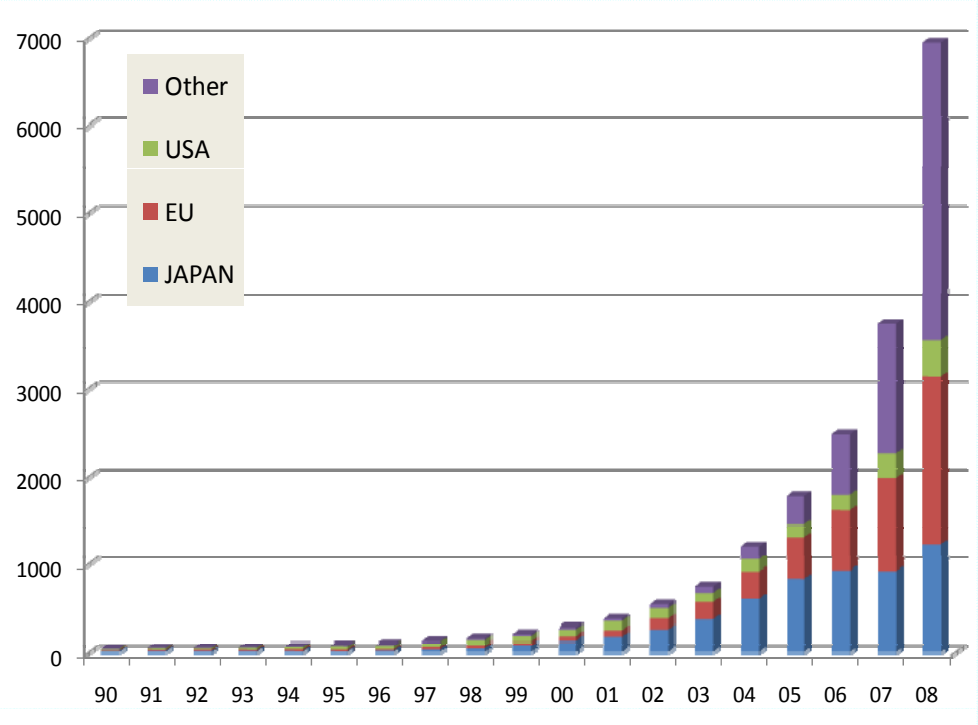
1993 Residential PV System Technology

500 kW Pilot Production Line for mc-Silicon Solar Cells

1980 Establishment of NEDO

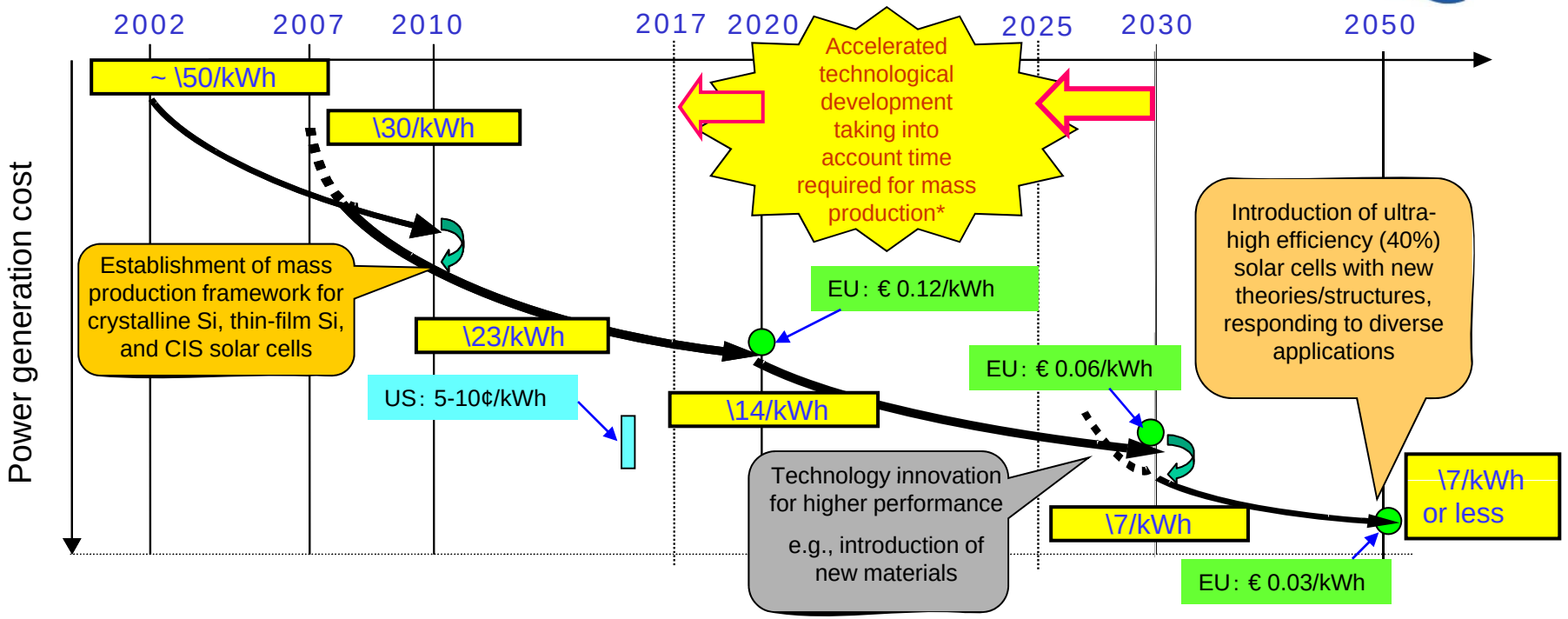
1974 Sunshine Project initiated

Global PV Module Shipments



Source: PV News, April 2008 (Prometheus Institute)

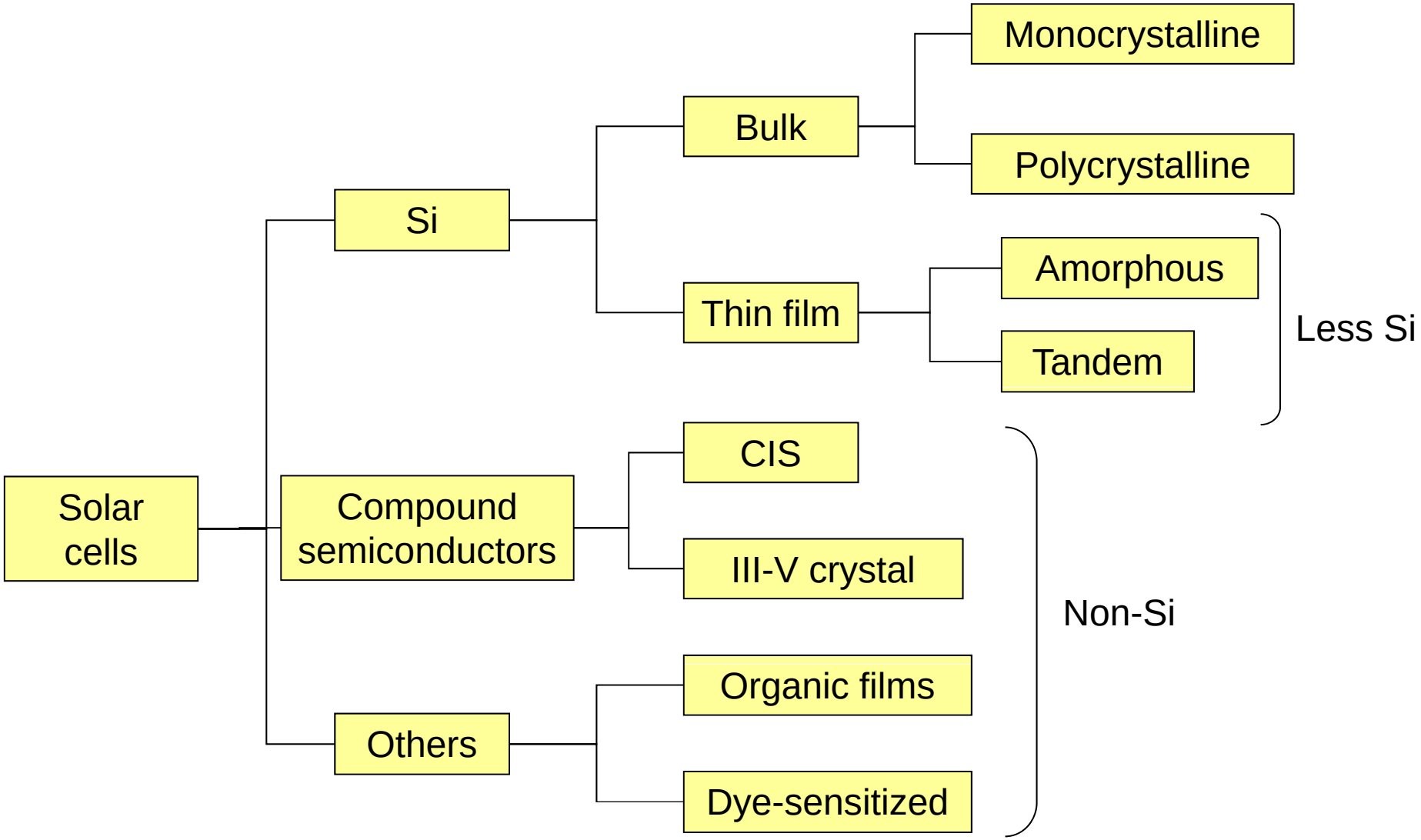
Japanese PV R&D Roadmap (PV2030+)



Target (completion of development)	2010 or later	2020 (*2017)	2030 (*2025)	2050
Power generation cost	Equivalent to residential electricity rates (\23/kWh)	Equivalent to commercial electricity rates (\14/kWh)	Equivalent to thermal power production costs (\7/kWh)	PV used as general power source (\7/kWh or less)

Source: NEDO PV R&D Roadmap (PV2030+) (2009)

Types of Solar Cells

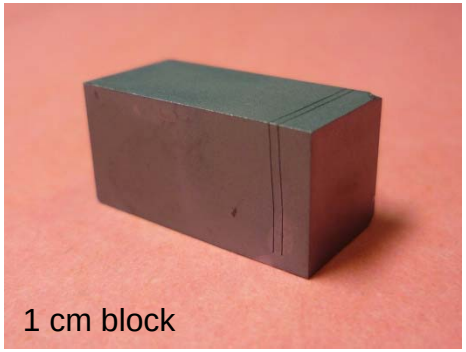


R&D on Next-generation PV System Technologies

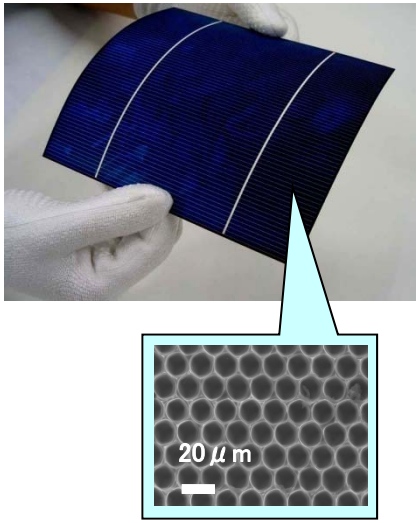
✓**Wafer-based thin Si solar cells**:
High quality polycrystalline Si, new slicing technology, improved efficiency (*h*=21% for mono-Si, *h*=18% for poly-Si) thin Si (-100 mm) solar cell

✓**Thin-film Si solar cells:**
High efficiency solar cell technology for stabilized efficiency of 15%

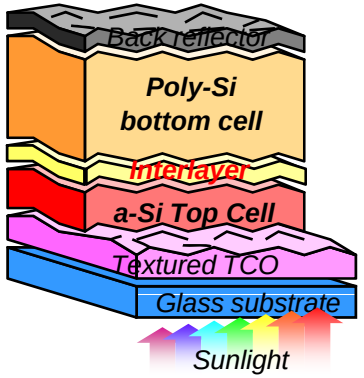
Slicing Si block through catalyzed reaction with calf width of 50 μm

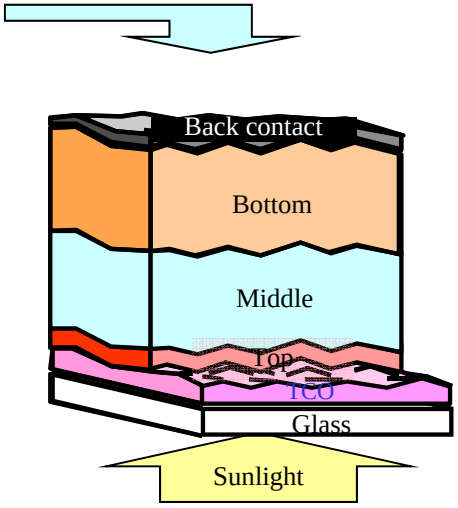


100 μm thick honeycomb texture cell with η=17.4%



Thin-film Si solar cell with multi-layer





R&D on Next-generation PV System Technologies

✓**CIS solar cells**

High efficiency (*h*=18%) sub-module (10x10 cm^2) solar cell on lightweight substrate

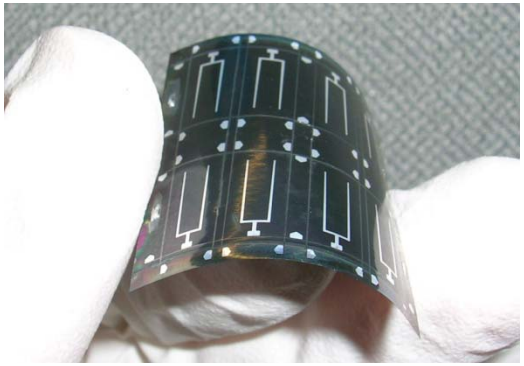
✓**Dye-sensitized solar cells**

Long lifespan module with *h*=8%, high efficiency cell with *h*=15% at 1 cm^2

✓**Organic thin-film solar cells**

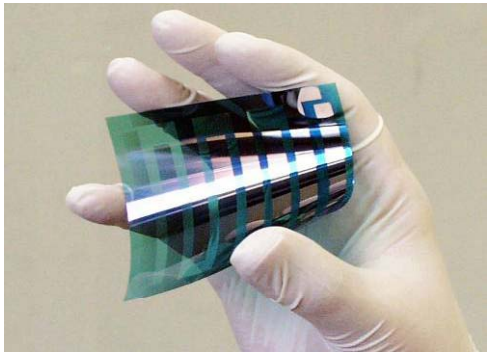
High efficiency cell with *h*=7% at 1 cm^2, improved durability

17.7% flexible CIGS solar cell



Dye-sensitized solar cell

Organic thin-film solar cell

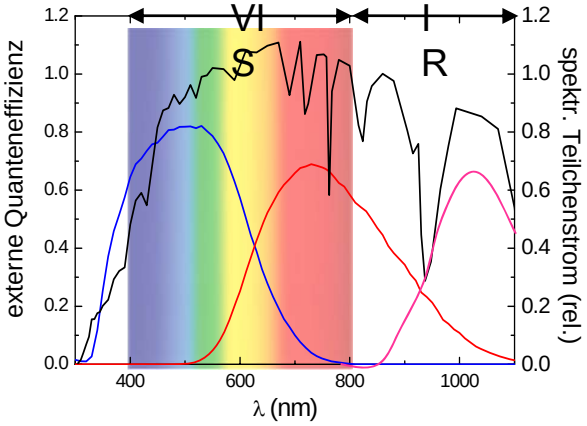


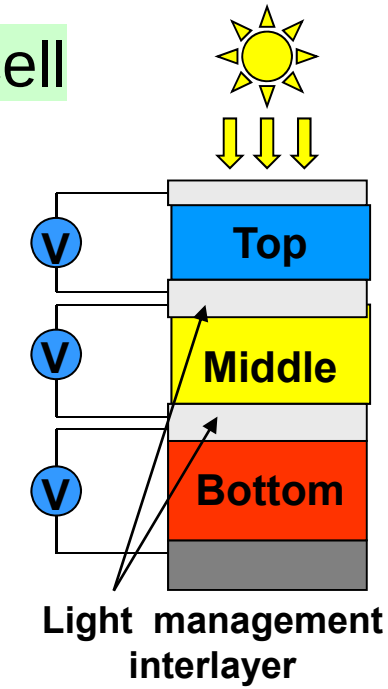
R&D on Innovative Solar Cells

✓PV systems with efficiency exceeding 40% by 2050

- ➢ Multi-junction, concentrator
- ➢ New concepts, new materials

Multi-junction solar cell

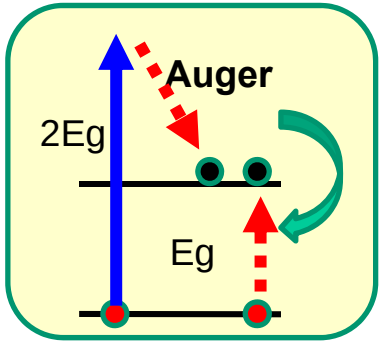


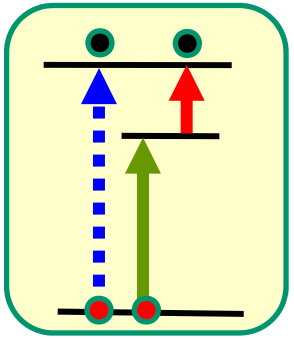


Light management interlayer

Examples of new concepts

Verification of quantum structure





Multi-exciton

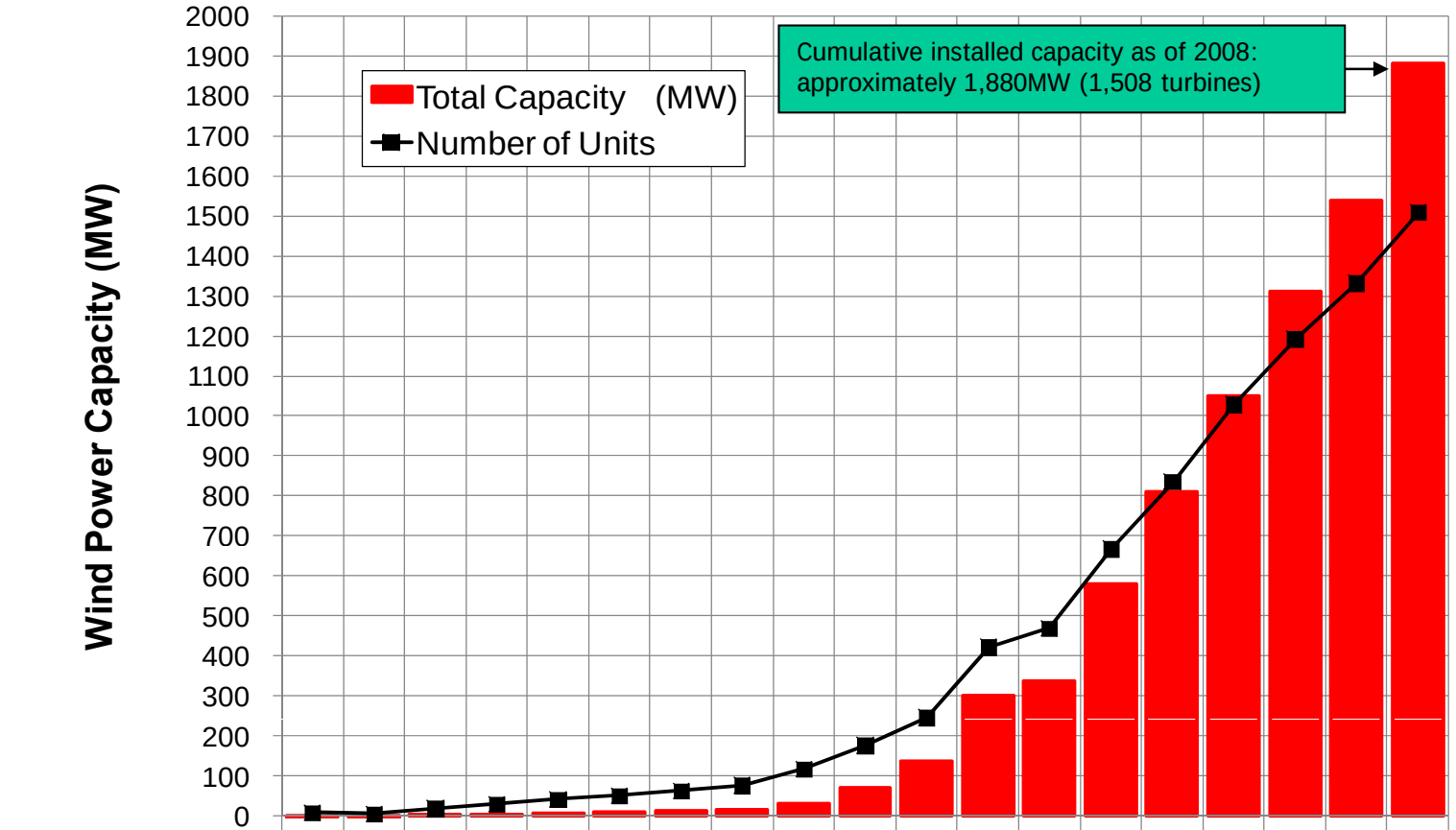
Intermediate band absorption

Technology Development

Wind Power

Growth of Wind Power Generation in Japan

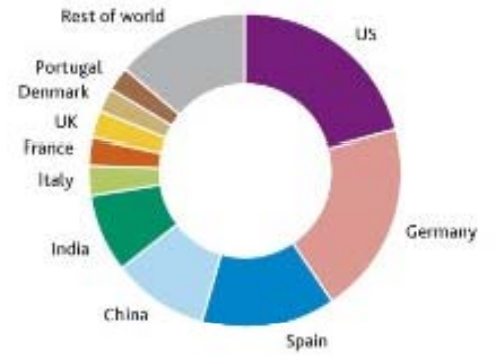
Cumulative Installed Capacity and Number of Wind Turbines



YEAR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total Capacity (MW)	1	1	3	5	7	9	13	17	32	70	136	302	339	581	810	1050	1310	1538	1880
Number of Units	8	6	19	30	42	51	63	77	117	177	246	422	470	668	835	1028	1192	1331	1508

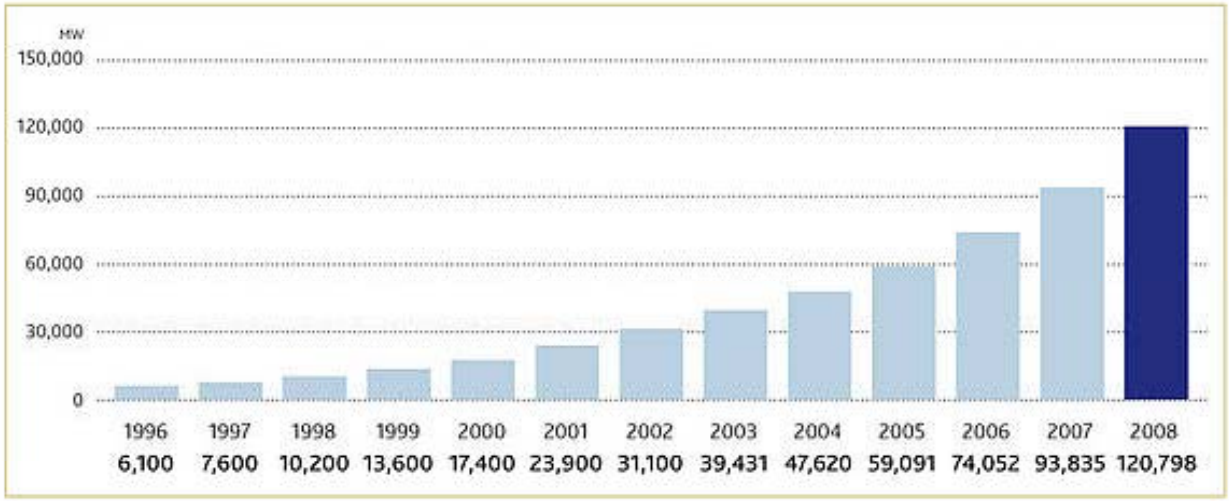
Wind Power Generation in Key Countries (2008)

TOP 10 TOTAL INSTALLED CAPACITY 2008



	MW	%
USA	25,170	20.8
Germany	23,903	19.8
Spain	16,754	13.9
China	12,210	10.1
India	9,645	8.0
Italy	3,736	3.1
France	3,404	2.8
UK	3,241	2.7
Denmark	3,180	2.6
Portugal	2,862	2.4
Rest of world	16,693	13.8
Total top 10	**104,104**	**86.2**
World total	**120,798**	**100.0**

GLOBAL CUMULATIVE INSTALLED CAPACITY 1996-2008



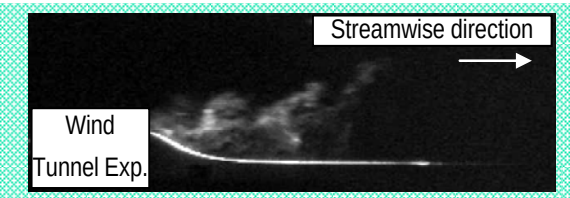
Total Installed Capacity in Japan									
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
MW	136	302	338	580	809	1,049	1,309	1,538	1,880

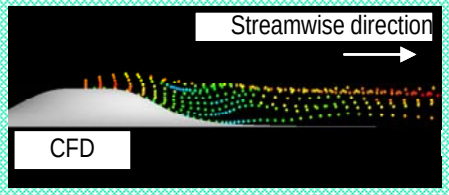
Source: Global Wind Energy Council

R&D of Next-generation Wind Power Generation Technology

- Technical research to support the design of wind turbines suitable for Japan's unique conditions

  -Wind tunnel experiments and field monitoring

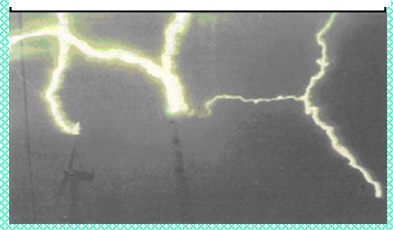




- Establishment of more effective lightning protection techniques

  -Lightning damage studies
  -Evaluation of lightning protection measures

Lightning striking turbines



Typhoon damage

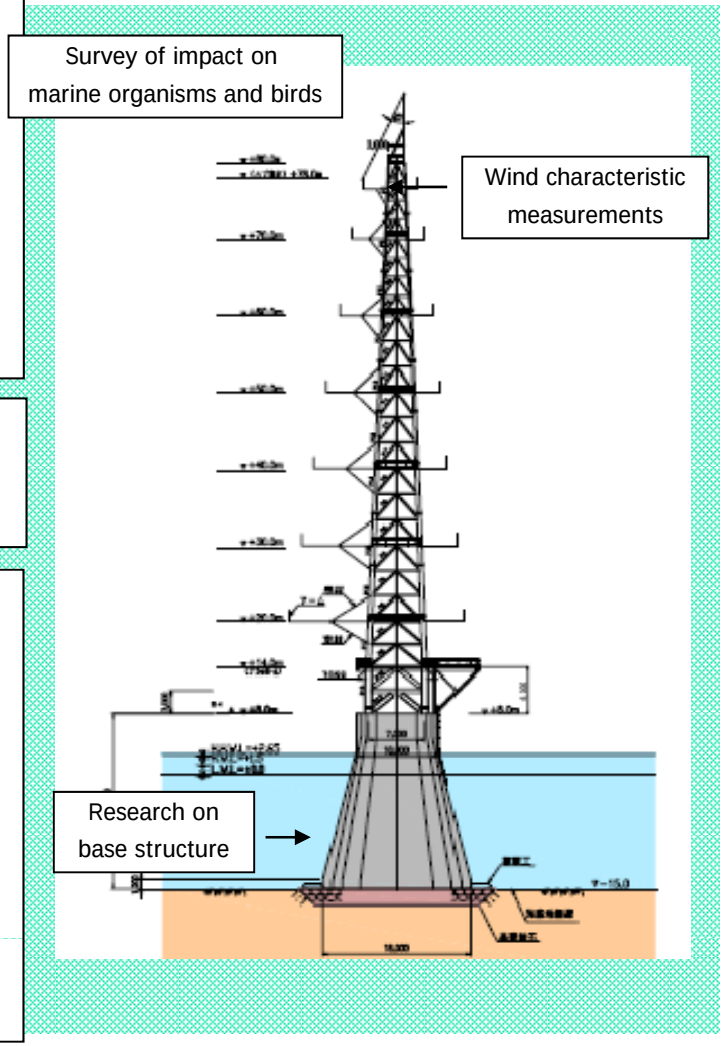
R&D of Offshore Wind Power Generation Technology

- Evaluation of ocean wind characteristics, and meteorological and oceanographic conditions unique to Japan
- Development of technologies related to wind power generation systems suitable for unique natural conditions around Japan

FY2008: Feasibility study (FS) to assess potential for demonstration research in Japan

From FY2009:

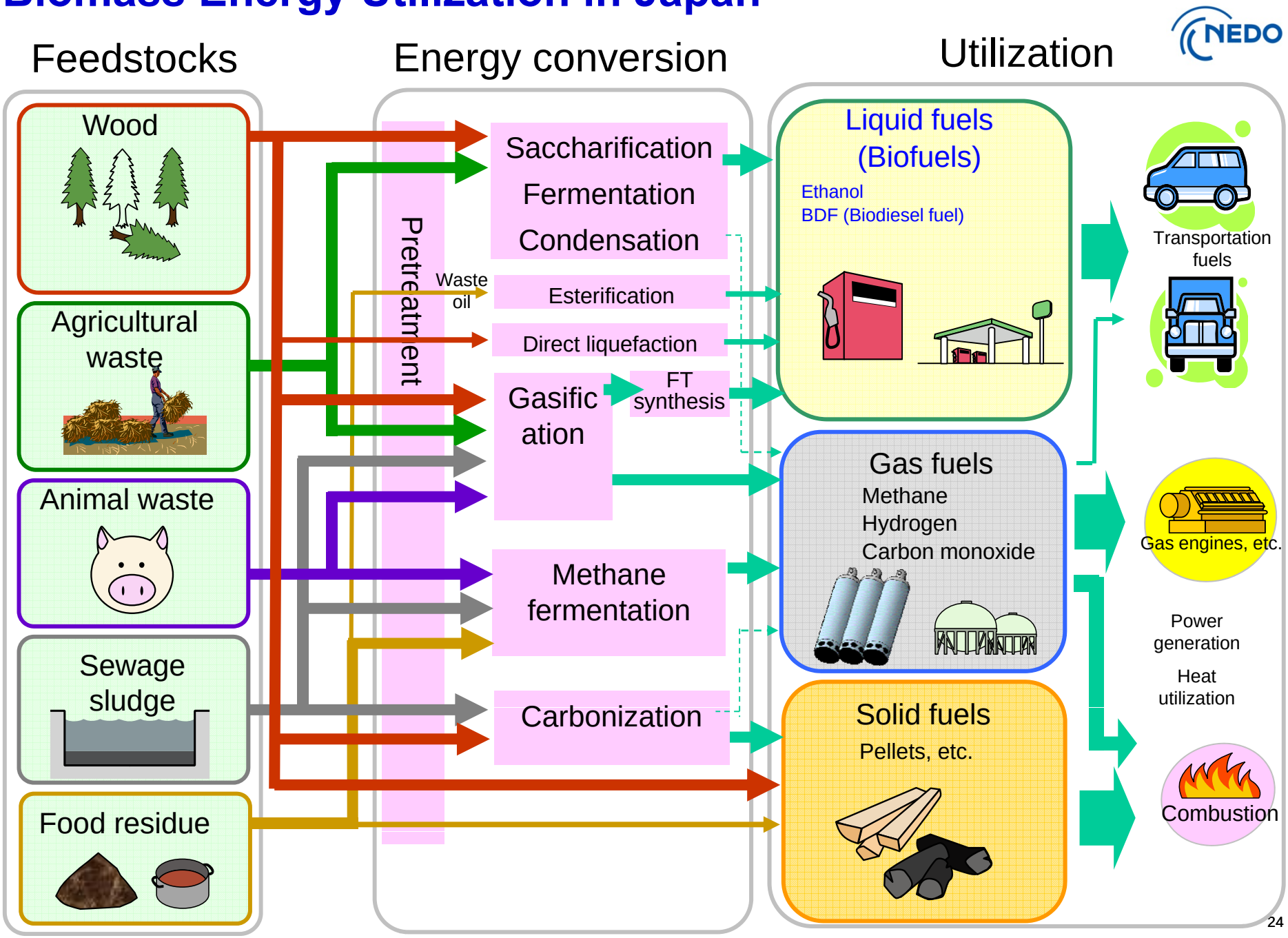
- Installation of offshore wind observation system to collect and analyze ocean wind, wave and tidal current data
- Installation of offshore turbines to evaluate performance



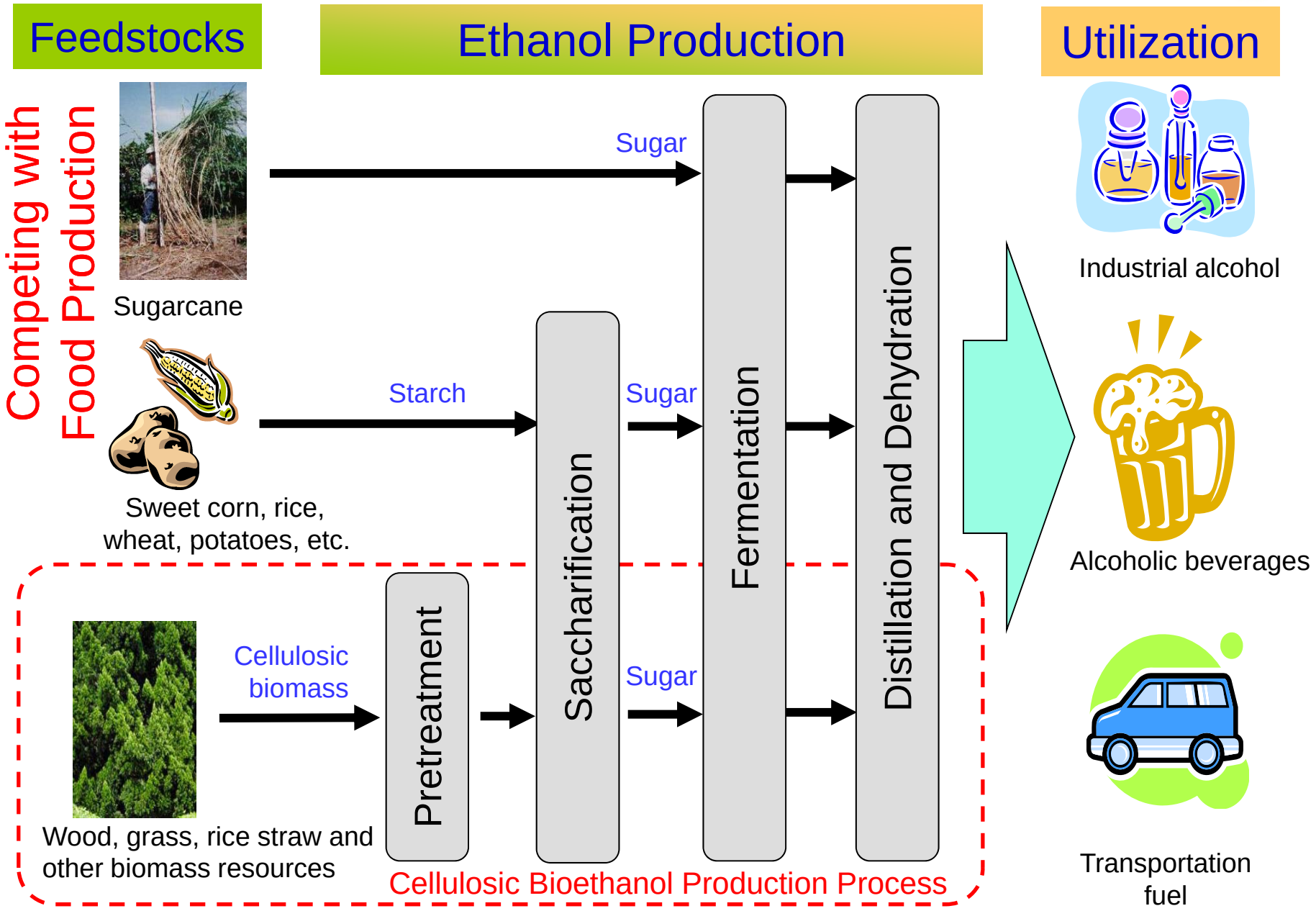
Technology Development

Biomass Energy

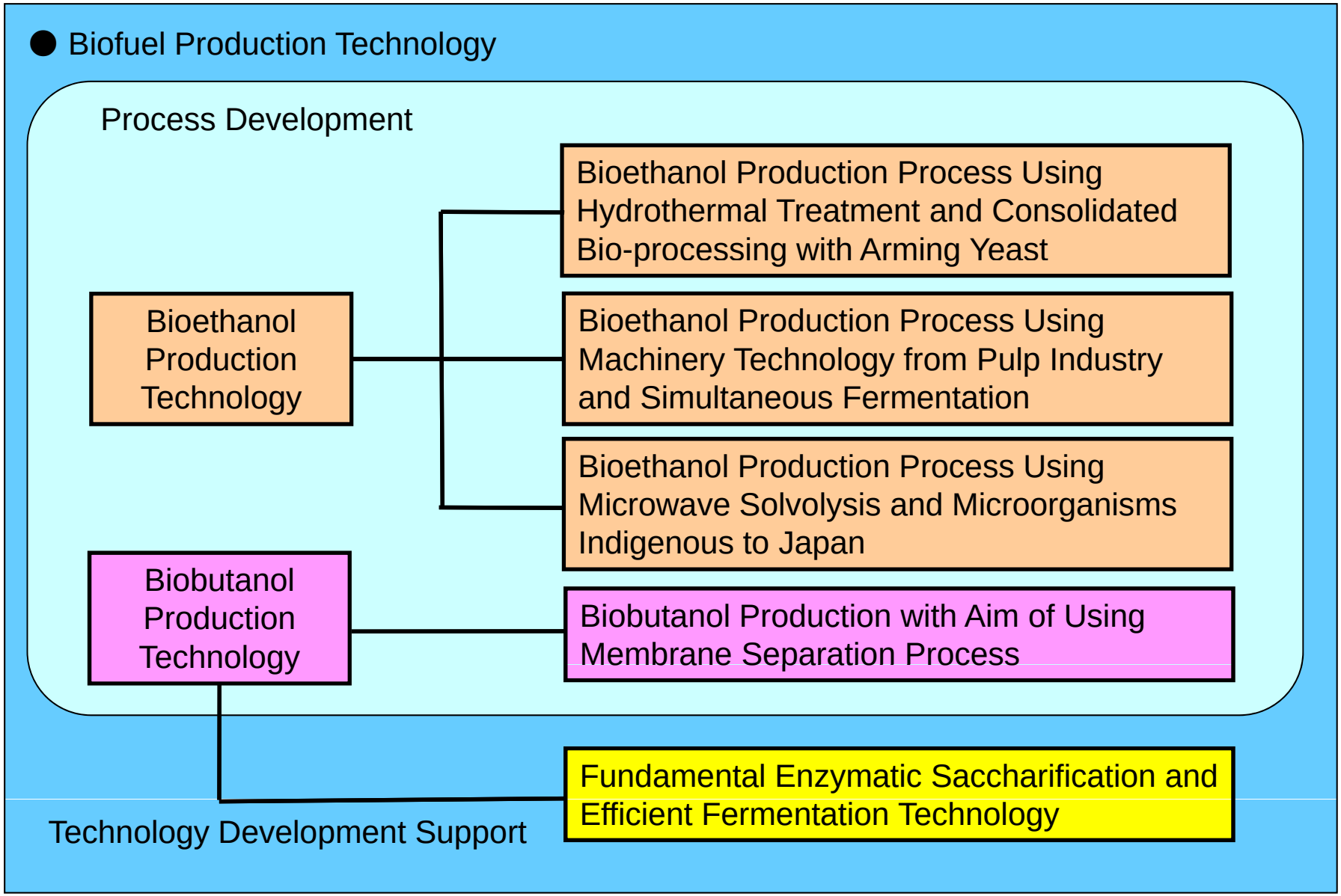
Biomass Energy Utilization in Japan



Ethanol Production Process



Biofuel Challenge Program



Technology Development
Smart Grid

Smart Grid

A paradigm shift is now taking place in energy systems

Reduced carbon dioxide emissions, greater introduction of renewable energy, diversification of power transactions, etc.

Emerging challenges

Examples:

- Improving power grids ability to accept increased volumes of RE
- Improving communications between grid and various types of power suppliers
- Creating services that meet needs of wide range of end users

Key solution

Using IT, smart grids can efficiently control power flows, integrating not only the supply side but also the demand side.

Why Smart Grid Technology is Needed

Year 2030

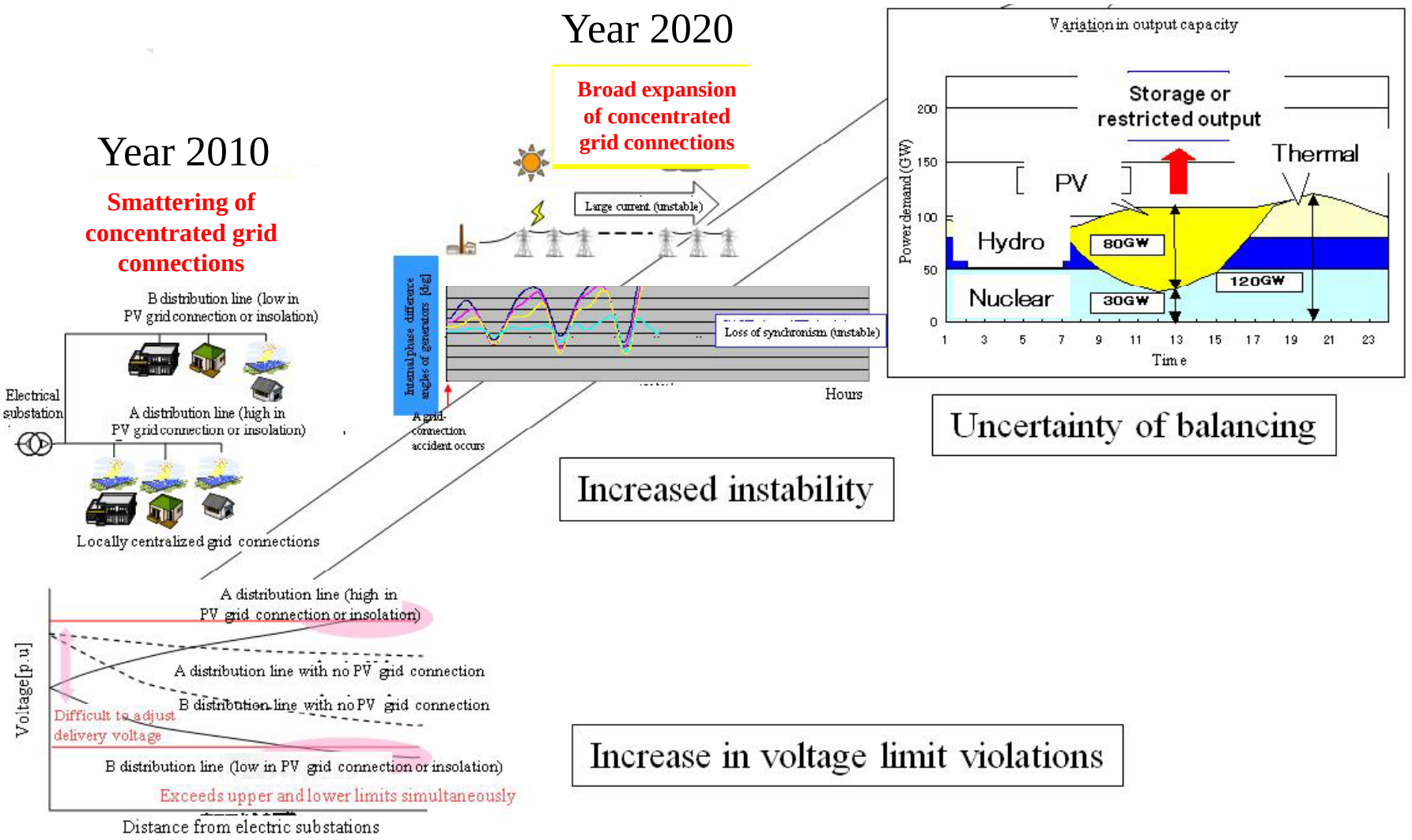
Mass introduction nationwide

Year 2020

Broad expansion of concentrated grid connections

Year 2010

Smattering of concentrated grid connections



NEDO's Experience

FY2005 and Before | FY2006 | FY2007 | FY2008 and After

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 multiple new energy and dispersed generation

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 multiple diesel generators 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)

Clustered Photovoltaic Project

Demonstrative Project on Grid-interconnection of Clustered Photovoltaic Power Generation

1. Development of technology to avoid restriction of PV system output
2. Development of method to prevent unintentional islanding
3. Development of applied simulation technologies:

   a. Power flow of harmonics

   b. Battery storage operation and network voltage distribution

   c. Islanding detection mechanism

Test bed: Testing of 30 inverters

PV systems installed: 553

Total PV capacity: 2,129 kW

Avg. system capacity: 3.85 kW

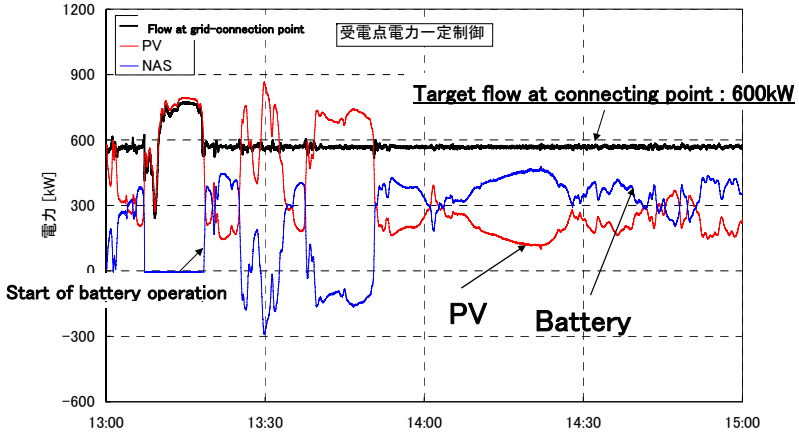
Mega-solar PV Installations

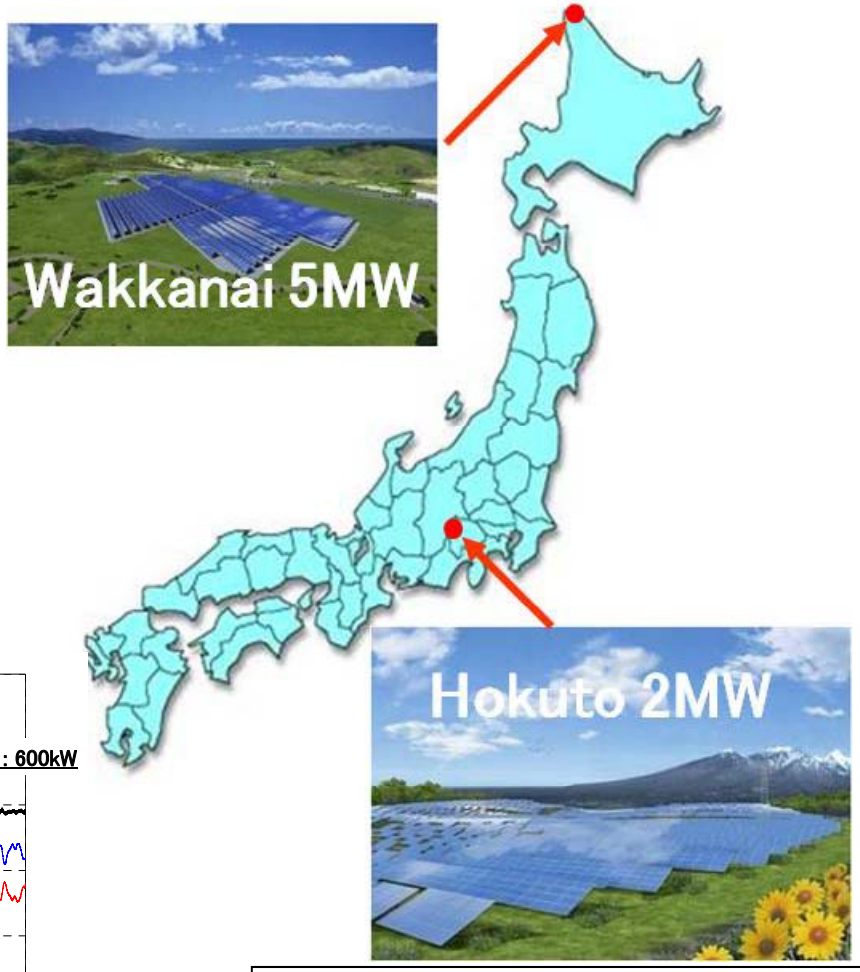
Verification of Grid Stabilization with Large-scale PV Power Generation Systems

Battery storage (1.5 MW-7.2 hr) is being tested.

(1) Demonstration of technology to reduce voltage and frequency fluctuations through use of battery storage; Development and demonstration of harmonic countermeasures

(2) Development of simulation technologies





Reactive power controlled by PCS

Summary of Technology Development Efforts

PV

- 2030 roadmap and 2050 targets
- Focus on low-Si and non-Si types of PV

Wind Power

- Modifications for environmental conditions in Japan
- Offshore wind power generation

Biomass Energy

- Ethanol production from cellulose

Smart Grid

- New technologies to enable expanded use of RE without affecting grid power quality
- Demonstration in Japan and US

International Collaboration

- Information Exchanges
- Researcher Exchanges
- Collaborative Projects
- Model Projects

Information Exchanges

Information exchanges involving experts can accelerate cooperation. The EU-Japan Joint Strategic Workshop on Energy Research and Technological Development, held in March 2009, and which is now leading to a coordinated project, is one good example.

Examples:

- At the workshop held in March 2009, the EU and Japan selected PV, power storage, and CCS as topics for cooperation and possible means of cooperation were discussed in the workshop sessions.

- Sharing a recognition of the importance of collaboration in the smart grid field, NEDO and ADEME (France) have started discussions regarding further cooperative activities

Researcher Exchanges

Closer and more detailed cooperation can be expected through researcher exchanges. Not only can exchanges accelerate research carried out by both sides, but they can also establish a basis for further cooperation.

Examples:

- Under NEDO's innovative solar cell R&D program, an exchange of leading researchers has been coordinated.

  Area: Research on development of multi-junction thin-film cells

  - ✓ Germany: Helmholtz Berlin Institute
  - ✓ Japan: National Institute of Advanced Industrial Science and Technology

- The Innovative Battery Research and Development Center (I-BARD) at Kyoto University will be a center of excellence for battery-related R&D in Japan.

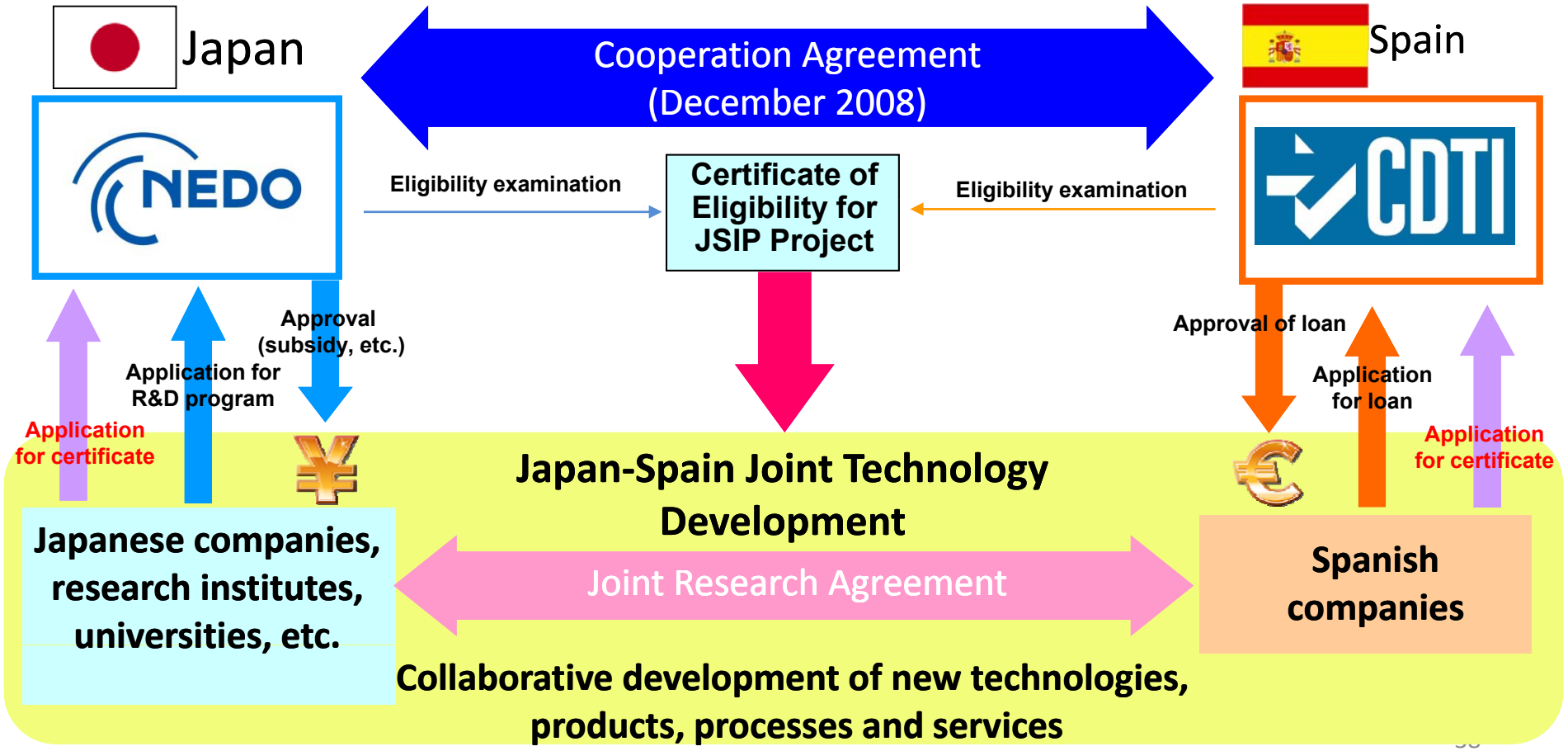
Collaborative Projects

A parallel funding scheme can be established in order to support joint or coordinated research projects that are at a precompetitive state as well as large-scale demonstration projects.

- NEDO has established a parallel funding scheme with Spain. It experienced its first coordinated call with an international partner in 2009.
- METI/NEDO have recently reached agreement with the European Commission to launch a coordinated project for research on photovoltaics.
- METI/NEDO will start a coordinated project for smart grid demonstration with the State of New Mexico and national laboratories under the U.S. Department of Energy.
- NEDO is now discussing with ADEME of France the possibility of a joint demonstration project based on our cooperation agreement.

Example: Collaboration with Spain

NEDO has started parallel funding with Spain under the Japan-Spain Innovation Program (JSIP). NEDO and CDTI are supporting collaborative research teams from each side. Research activities have started in two areas– soil and groundwater treatment, and sensing technology.



Example: Collaboration with EU

・In order to asses progress on cooperation, an EC-METI/NEDO Officials Meeting was held in Naples on October 2009.

・The following joint actions were agreed to under the cooperation framework:

PV: To start working on coordination for a coordinated call and a researcher exchange to be launched in 2010

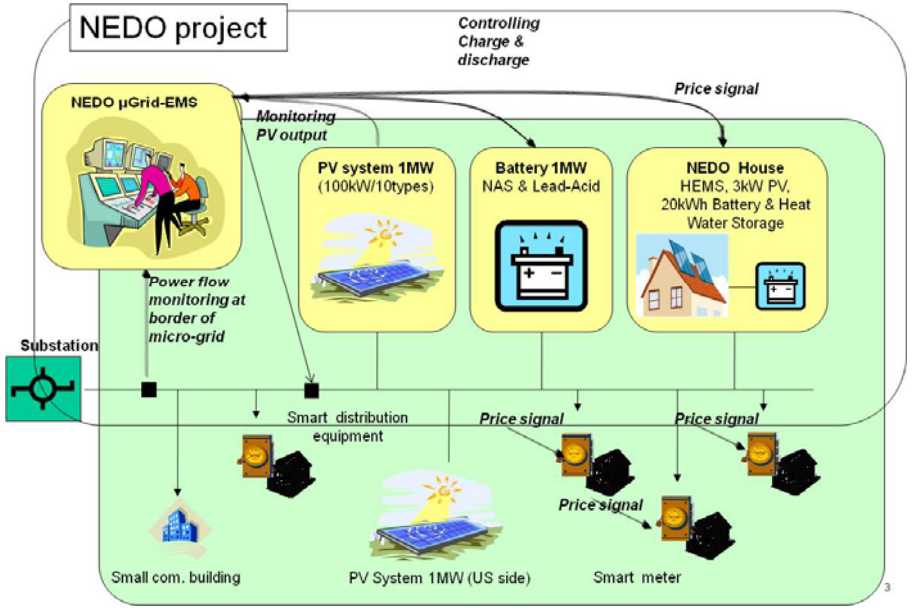
Power Storage: To make preparations for holding an expert meeting on safety testing and evaluation methodology in the first half of 2010.

CCS: To make preparations for holding a workshop on non-competitive issues, such as modeling, public perception and storage safety.

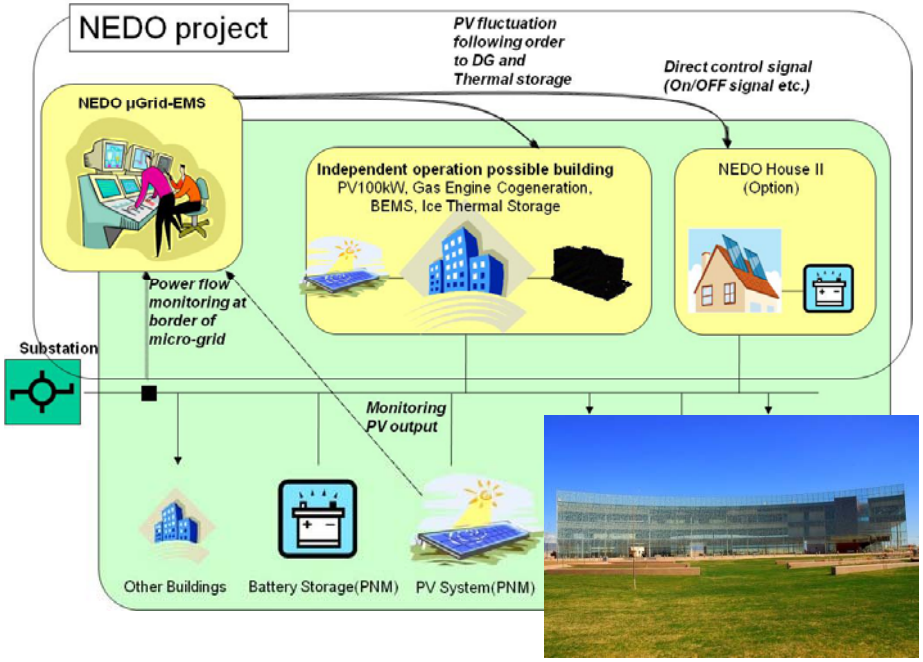
Example: Collaboration with USA

NEDO is now examining proposals submitted by Japanese companies for a smart grid demonstration project, which will be implemented in close coordination with the New Mexico Green Grid Initiative.

NEDO microgrid in Los Alamos



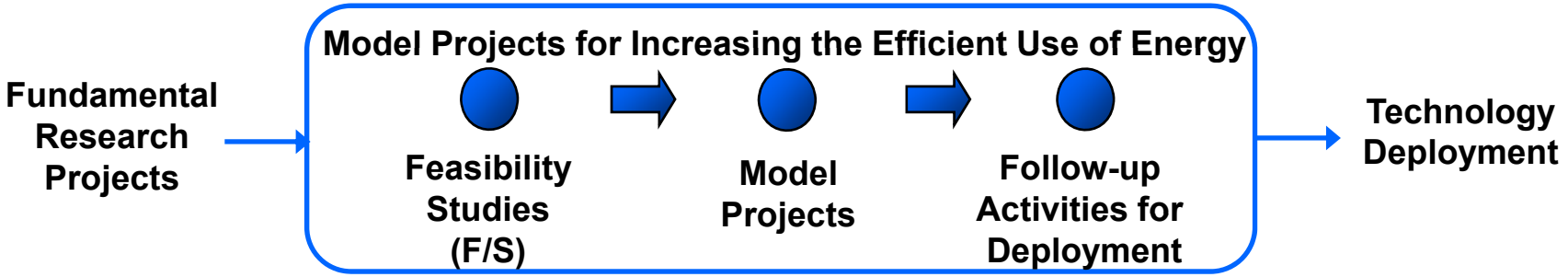
NEDO microgrid in Albuquerque



Example: Collaborative Model Projects

NEDO model projects introduce technologies that are new to host country but proven in Japan.

- ✓ Demonstration of energy efficiency and fossil fuel alternative energy technologies
- ✓ Supporting host countries' efforts to promote energy efficiency and environmental conservation through deployment of introduced technologies in host country
- ✓ Collaborative effort between Japan and host country, with sharing of tasks and costs



NEDO Overseas Offices

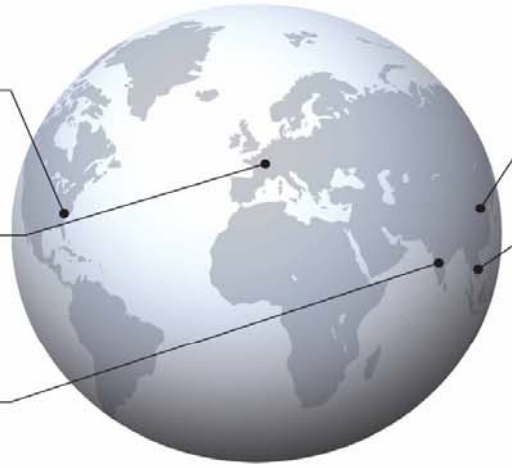
Overseas Offices

Washington
2000 L Street, N.W., Suite 605,
Washington, D.C. 20036 U.S.A.
Tel: +1-202-822-9298 Fax: +1-202-822-9289

Europe
10, rue de la Paix 75002 Paris, France
Tel: +33-1-4450-1828 Fax: +33-1-4450-1829

Square De Meeus, 37 1000 Bruxelles, Bergique
Tel: +32-2-791-7705 Fax: +32-2-791-7900

New Delhi
7th Floor, Hotel Le Meridien Commercial Tower
Raisina Road, New Delhi 110 001, India
Tel: +91-11-4351-0101 Fax: +91-11-4351-0102



Beijing
Beijing Cofco Plaza B-Tower 8F Unit 10
No. 8 Jianguomennei Dajie, Beijing 100005, P.R. China
Tel: +86-10-6526-3510 Fax: +86-10-6526-3513

Bangkok
8th Floor, Sindhorn Building Tower 2,
130-132 Wittayu Road, Lumphini, Pathumwan,
Bangkok 10330, Thailand
Tel: +66-2-256-6725 Fax: +66-2-256-6727

Jakarta
10th Floor, SUMMITMAS 1, Jalan Jenderal Sudirman
Kav. 61-62, Jakarta Selatan 12190, Indonesia
Tel: +62-21-252-3480 Fax: +62-21-252-3478

Principal activities:

1. General coordination regarding promotion of collaborative NEDO projects
2. Information exchange and consultation on NEDO projects and Japan's R&D
3. Public relations

Thank you very much for your attention.

ichimuratmy@nedo.go.jp

http://www.nedo.go.jp/english/