Ministry of Economy, Trade and Industry

Japan's Approaches to Smart Community

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Topics for today

Three kinds of change have been occurring in Japan regarding smart grid.

- Expansion of stakeholder
  Utility → Industry → Community
- Expansion of scope
  R & D → Demonstration → Business
- Expansion of application area
  Project → Local → Global

Japan's situations on Energy and Environment

➢ Highly reliable electricity supply

✓ No urgent need for improvement now. But …

(Power failure time per year / per household: Japan 16min, US 162 min)

➢ Urgent need for CO_2 emission reduction

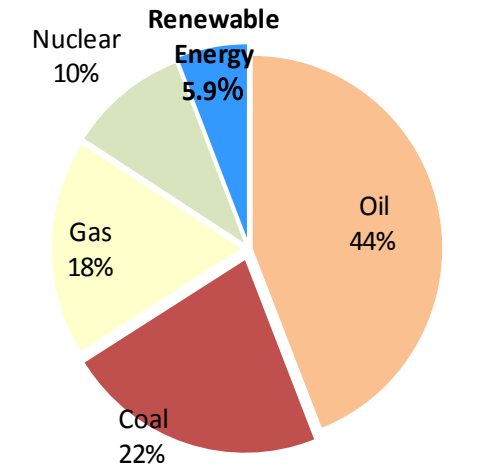
✓ 25% CO_2 reduction by 2020 !?

✓ Further promotion of energy efficiency

✓ Broad introduction of renewable energy

28 GW of PV is needed

FIT system will be expanded



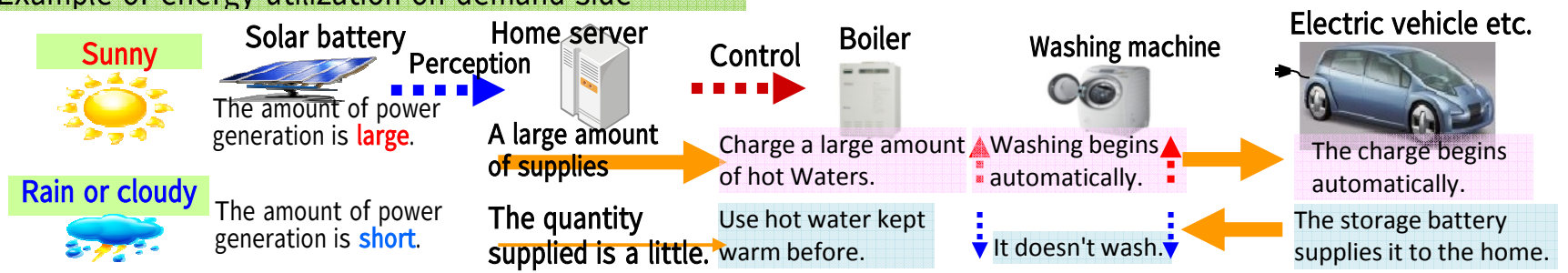
【Primary Energy Supply,Japan:2007】

Deployment of Smart Grid is inevitable!

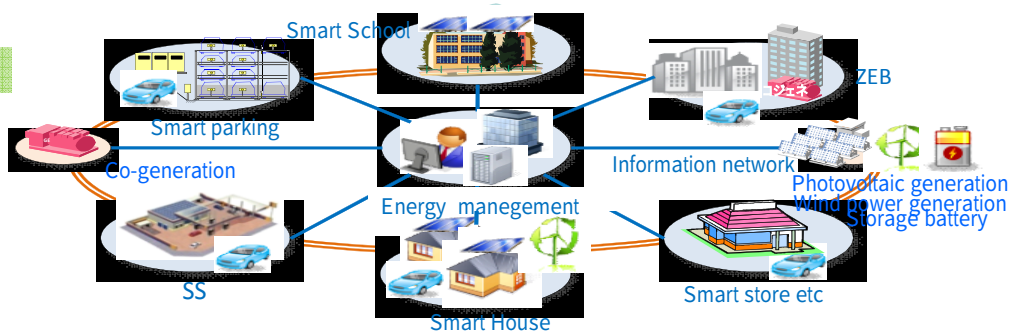
Merit of “Smart Grid”

- 'Smart grid' is an electricity transmission and distribution grid to promote the stability of electric power supply by using information and communication technology while introducing huge amount of renewable energy.
- Once renewable energy, home electrification, EV etc. are introduced, energy supply-demand system will change. There is a potential for the demand side to play an adjustment function role which is currently assumed by energy suppliers.
- Energy can be used more efficiently if the demand side manages to distribute power supply locally, i.e. “local production for local consumption”.

◆Example of energy utilization on demand side

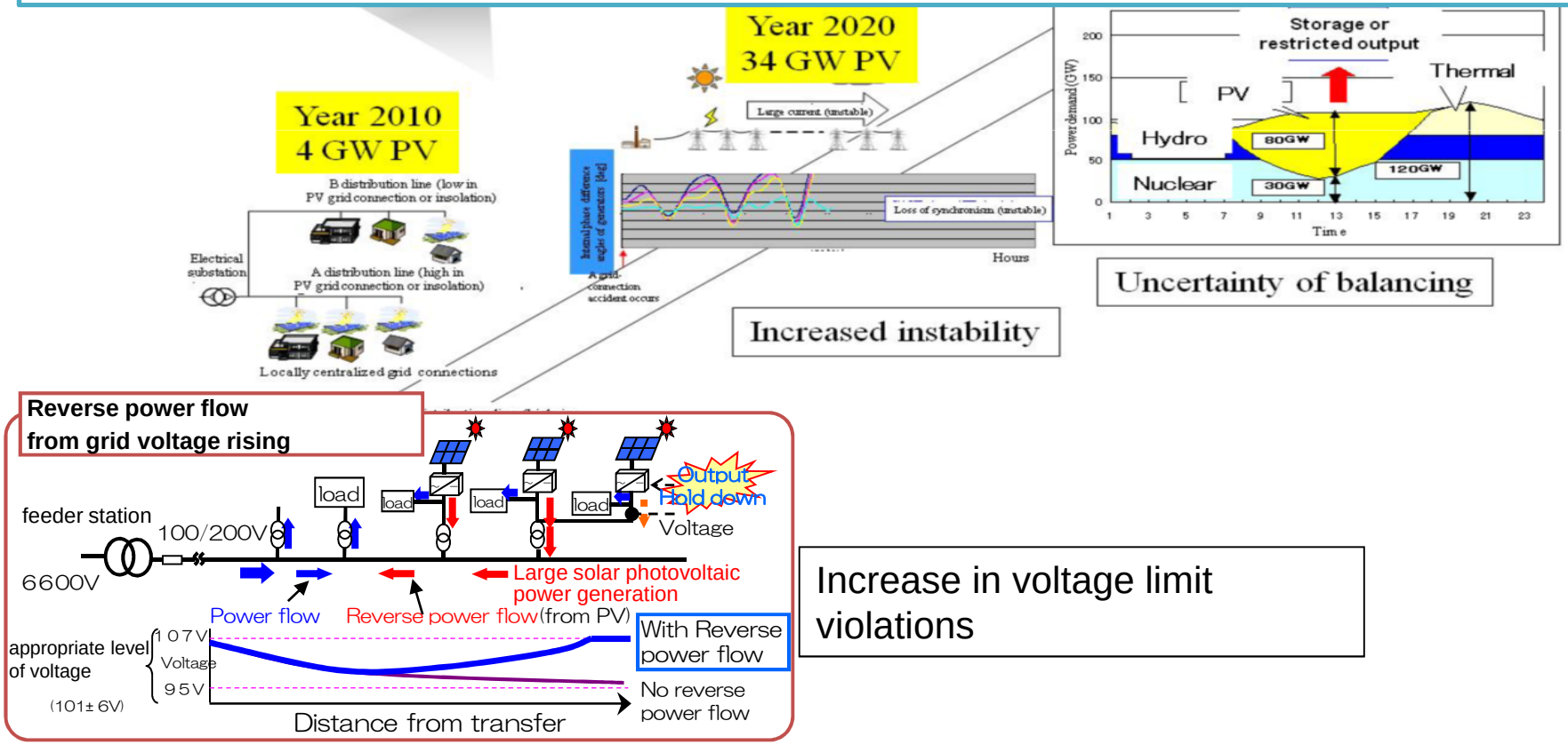


◆Image of energy management in the regions



~~Merit~~ of “Smart Grid”

- 'Smart grid' also bring some challenges to the grid, since huge amount of renewable energy is connected to the grid;
  - Increase in voltage limit violations
  - Increase instability (fluctuation on frequency)
  - Uncertainty of balancing
- Managing and controlling technology is necessary.

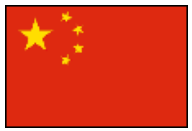


Situations of major countries

➢Introduction of Smart Grid differs depending on each country's situation.
➢Networked electric appliances and EV are connected to grid regardless of SG deployment.

・Vulnerable transmission infrastructure and insufficient investment for new power plants
・Need for enhancing the reliability of electricity supply through ICT
・Creation on new business through utilizing demand information

・Set the target of "20-20-20" by 2020
・Introduction of huge amount of renewable energy
・Development of EV charging infrastructure
・Deployment of smart meter for billing and efficient use of energy.



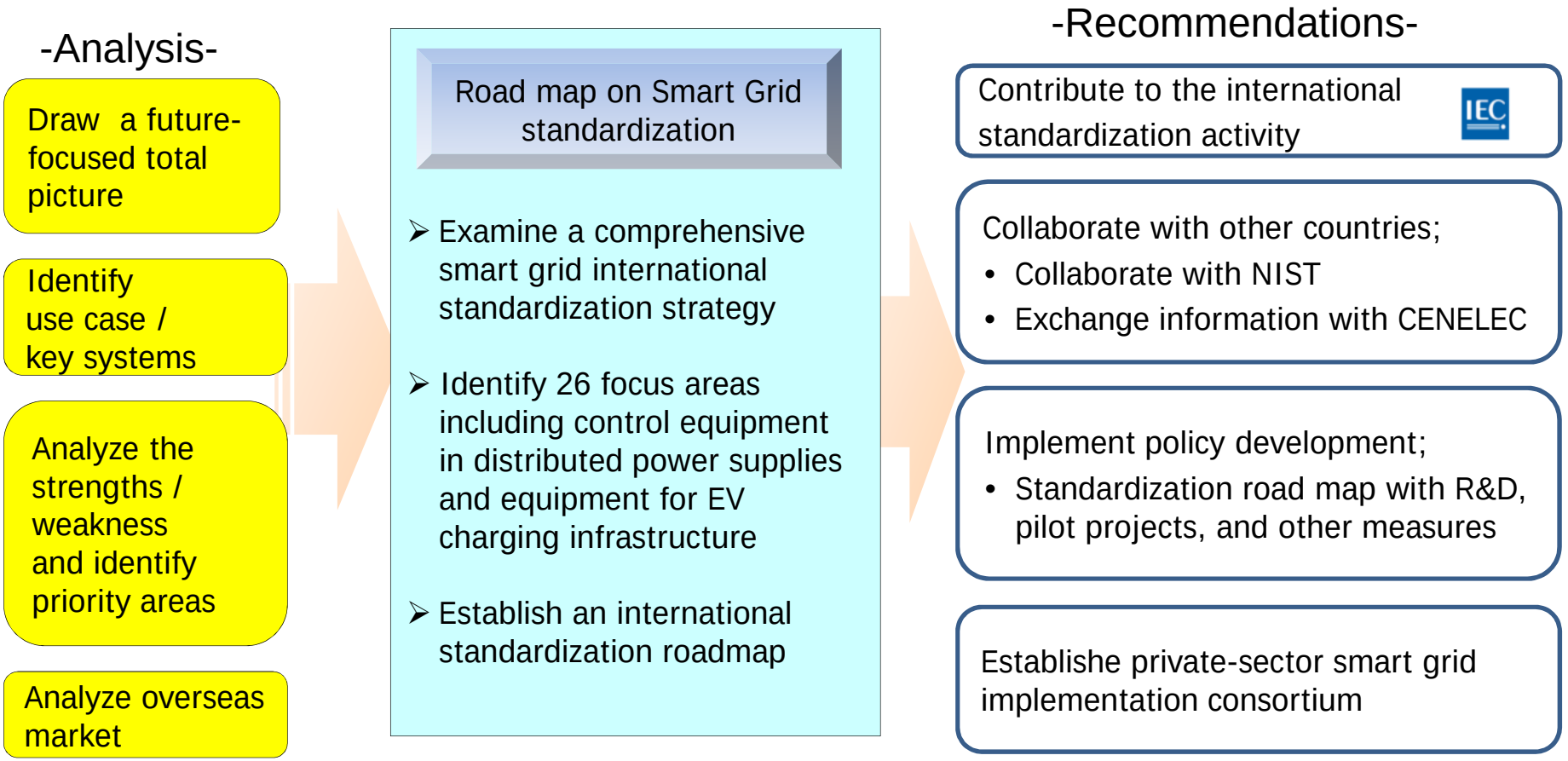
・Rapid growth of energy demand due to economic boom and needs for higher QOL. Construction of energy infrastructure is inevitable.
・Development of urban city including energy infrastructure such as Tianjin Eco-city.

Expectations of industry

- **Discussions on the challenges for power grid**
  - ✓ Increases in voltage limit violence, frequency instability and uncertainty of balance etc.
  - ✓ Smart metering
- **Great interests were shown by the industry**
  - ✓ Expectation to huge potentiality of new business domestically and internationally.
- **Standard is a key for complex system such as SG**
  - ✓ Smart Grid consists of many sub-systems which needs interoperability and common standards.

Contribution to international standardization

- "Study Group on International Standardization for Next Generation Energy Systems" was set up to deliberate road map for Japan's contribution for international standardization activity in Smart Grid area.
- The road map was released on January 2010.



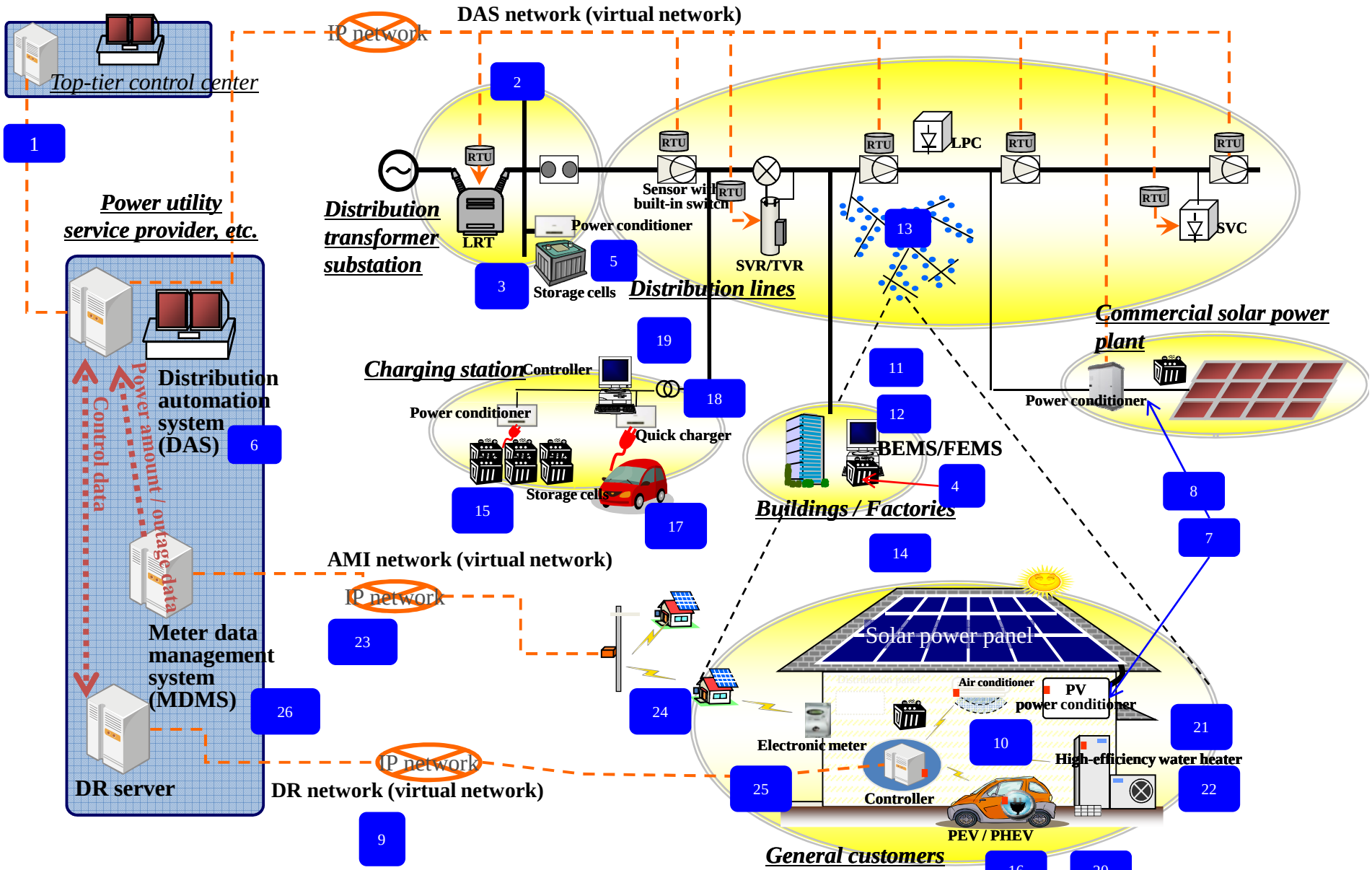
Focus Areas Identified by the Study Group

The Study Group, in view of the overall smart grid market, identified the following 26 focus areas and drew up a corresponding international standardization roadmap.

26 Focus Areas Identified by the Study Group

1 Wide-area situational awareness (WASA) in transmission systems	14 Fixed energy storage systems
2 Optimized controls for system storage cells	15 Storage cell modules
3 Optimized controls for distribution storage cells	16 Methods of assessing the salvage value of EV storage cells
4 Optimized controls for building/community energy storage	17 Quick EV charger-vehicle communications
5 High-efficiency power conditioners for storage cells	18 Quick EV charger connectors
6 Distribution automation systems	19 Quick EV charger unit design
7 Power conditioners for distributed power supplies	20 Safety testing of lithium-ion batteries for vehicles
8 Power electronic devices for distribution	21 Vehicle-to-regular EV charger infrastructure communications
9 Demand response networks	22 Infrastructure control of regular EV chargers
10 HEMS	23 Wide-area meter access communications
11 BEMS	24 Local meter access communications
12 FEMS	25 Gas metering for AMI systems
13 CEMS	26 Authentication method between meter communicators and higher-level systems

26 Focus Areas

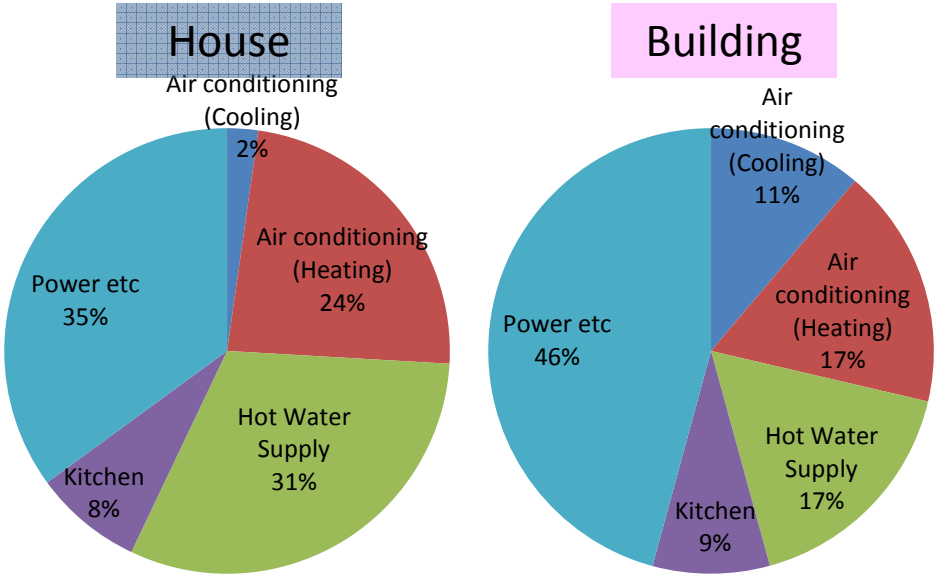


AMI: Advanced Metering Infrastructure, **BEMS**: Building EMS, **DAS:** Distribution Automation System, **DR**: Demand Response, **EMS**: Energy Management System, **FEMS**: Factory EMS, **FRT**: Fault Ride Through, **H/W**: Hardware: **I/F**: Interface, **IP**: Internet Protocol, **LRT**: Load Ratio control Transformer, **LPC:** Loop Power Controller, **MDMS**: Meter Data Management System, **PEV**: Plug-in Electric Vehicle, **PHEV**: Plug-in Hybrid EV, **PV**: Photovoltaic, **RTU**: Remote Terminal Unit, **SVC**: Static Var Compensator, **SVR**: Step Voltage Regulator, **S/W**: Software, **SW**: Switch, **TVR**: Thyristor Voltage Regulator, **WASA**: Wide Area Situational Awareness

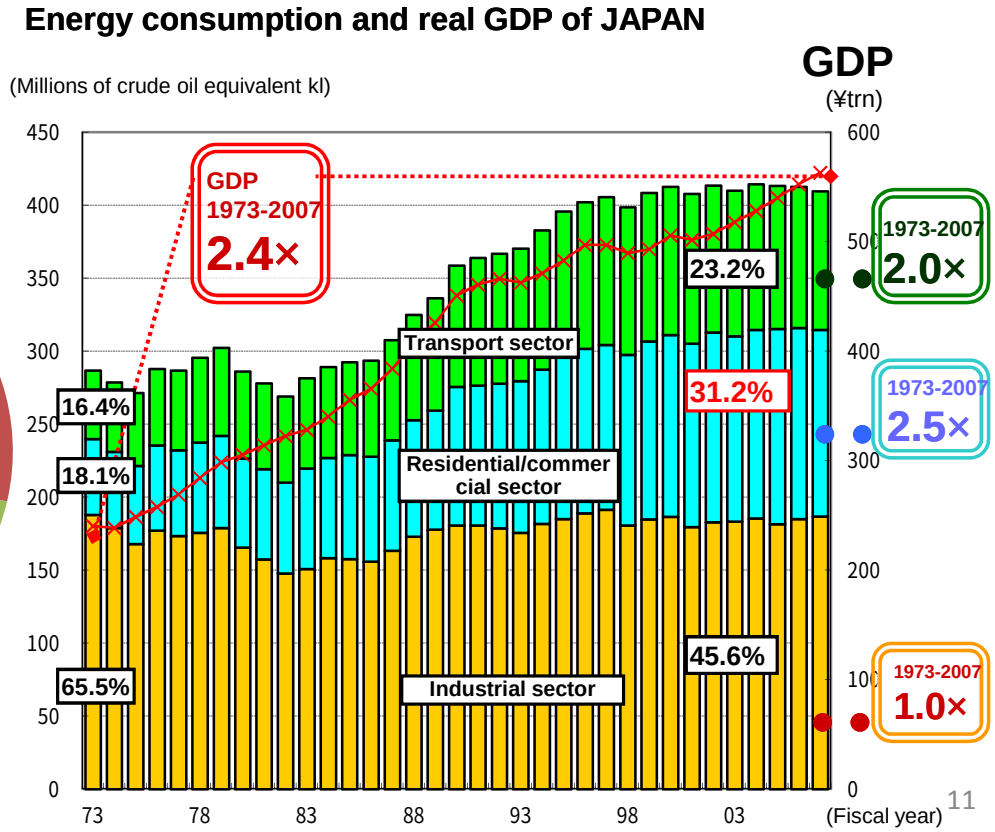
Why not Smart Grid but Smart Community ?

- Integration of electricity and heat management system is quite important, since half of energy demand is heat.
- Certain amount of energy demand in transportation sector would be merged into electricity demand.
- Our lifestyle should also be changed so as to fully utilize the new energy infrastructure. These integrated system is the “Smart Community”.

Energy consumption in house & building



Reference: Institute of Energy Economics, Japan



Smart Community

- Designing a future society to come -

Designing a new energy system

- Community Grid – interconnected energy system
  - Managing distributed energy sources (PVs, wind power, fuel cells) in each community to stabilize fluctuation and to make most use of energy produced
  - Utilizing demand response or home storage batteries to absorb excess energy produced in the community, in order to minimize negative impact on the main grid system
- Moving storage device - EV as energy storage
  - Introducing smart charging system at homes in order to absorb fluctuation in the energy system
  - Utilize electric cars as energy storage (G2V & V2G) in the Community Grid to stabilize energy supply (near future)

Smart Community

- Designing a future society to come -

Designing a city

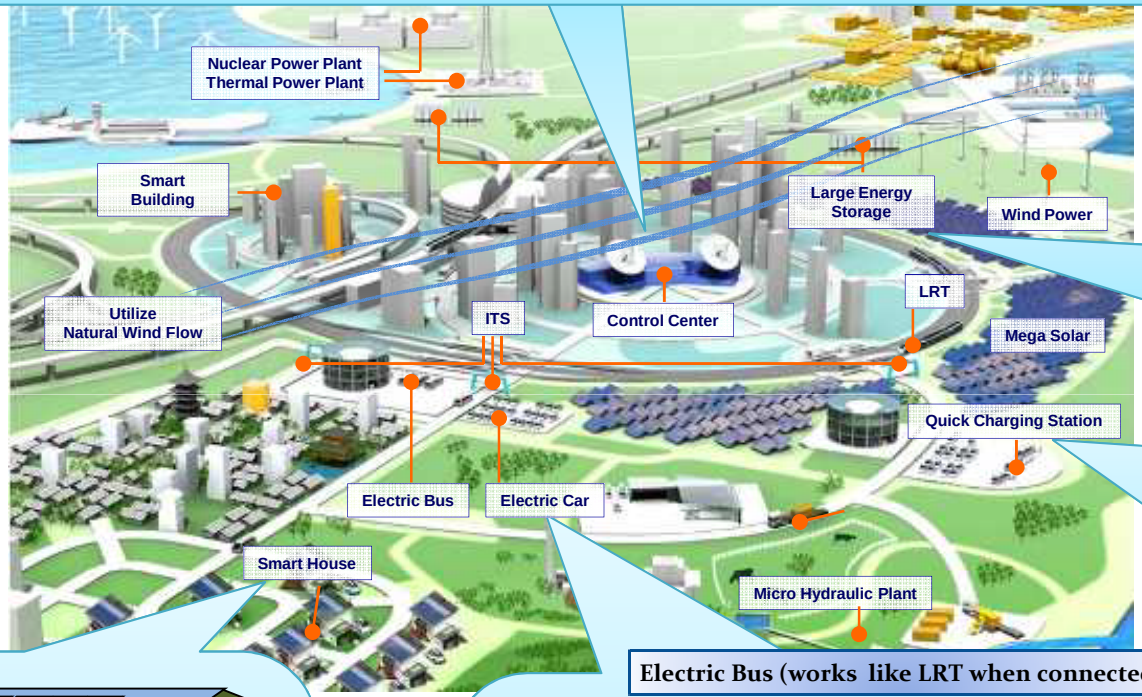
- New transportation system (modal shift)
  - Enabling various type of personal vehicles (including bicycles and small EVs) to run inside the city
  - Introducing environmentally friendly and convenient public transportation system such as LRT or connectable electric bus
  - Designing organic transportation system which enables smooth transfer from personal vehicles to public transportation and vise versa
- A city coexisted with the nature
  - Redesigning and redeveloping a city to create environmentally friendly but comfortable environment which utilizes natural wind flow, river flow, and sunlight

An Image of "Smart Community"

Control Center for optimizing energy demand/supply

- Maximize the use of renewables, such as PVs, wind power, and micro hydraulic
- In order to absorb fluctuation caused by renewables in the community, share energy with homes and office in the region
- Utilize EV and EB as part of energy infrastructure by managing their location and battery status

Original Visual Image made by Mitsubishi Heavy Industries

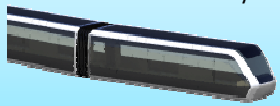


Utilize Electric Car
As a part of energy infrastructure

Shortage: EV → House
Excess: House → EV

Power Line Free LRT

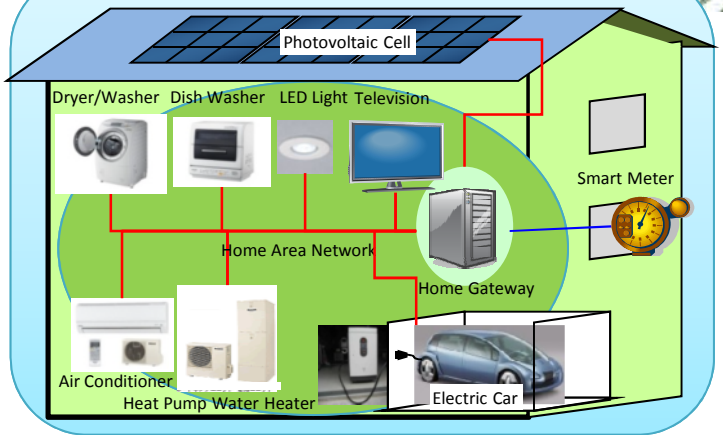
LRT with Battery
At the station: Charge to battery
Between stations: Move by battery



Quick Charging Station

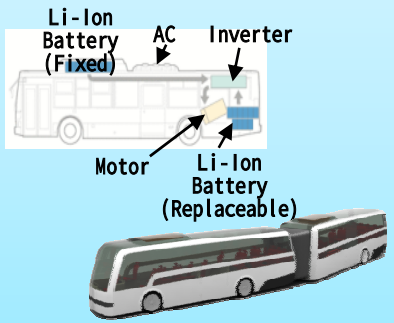
80% charge in 30 minutes

Smart House



Electric Bus (works like LRT when connected)

Battery Replaceable Bus / Works like LRT by connecting multiple buses

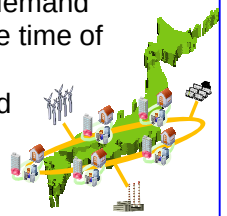


Connected buses will operate like LRT

Japan's Smart Community Roadmap

To address the 3Es simultaneously, it is important to realize the best mix of power sources by introducing large-scale RE utilizing storage. This roadmap illustrates a future social system Japan is aiming at, concentrating on regional EMS and lifestyle changes, under such an energy supply structure.

(3E (Environment • Energy Security • Economy))

	Today - Year 2020	2020 - 2030	2030 -
Relation between regional EMS and entire grid	■ Solar panel prices will decrease significantly due to large-scale introduction of panels to houses as well as commercial buildings. ■ Measures to maintain the quality of electricity while the large-scale introduction of PV will be carried out mainly for the grid side. Storage cells will be installed at substations. ■ As regional EMS are further demonstrated, technology and know-how will be accumulated. ■ The cost of storage cells will go down due to technology development and demonstration.	■ Due to a decline in PV prices, more PV systems will be installed at houses. ■ Regional EMS, which contribute to effective use of RE generated at houses, will become more important. ■ Regional EMS will be realized as storage cells become cheaper and are further disseminated. ■ Distribution and transmission networks that enable two-way communication between demand side and grid side will be actively established. 	■ Cost competitiveness of RE will improve as fossil fuel prices increase by more than double. Use of RE will be prioritized and nuclear power will be used as a base. ■ EMS that can provide an optimized balance in terms of economy and security between regional EMS and grid will be established. ■ EMS that creates demand by charging EVs at the time of excessive RE, and supplies energy to grid at high demand, will be used. 
Houses	■ Remote reading using smart meters will start. ■ HEMS will be disseminated. Some houses will install home servers. Demand response demonstration will start. ■ Demonstration of EVs will start.	■ HEMS and regional EMS will be integrated. All power generated at houses will be used optimally. ■ Various services using home servers will be disseminated. ■ EVs will be used for power storage as well.	■ A fully-automated HEMS will be realized.
Buildings	■ ZEB introduction will start.	■ ZEB will be realized at new public buildings.	■ ZEB will lead to a greatly reduced level of emissions for all new buildings as a group.

Japan Smart Community Alliance

- The “Japan Smart Community Alliance,” a public-private consortium, consists of a broad range of Japanese organizations, companies, has founded in April 2010.
- It carries out various work for development of roadmaps or dissemination of information to pormote international standardization, and strengthening collaboration.

Members: 453（As of September 14, 2010）

JSCA has members from the electric power, gas, automobile, information and communications, electric machinery, construction and trading industries as well as the public sector and academia.

Japan Smart Community Alliance

Board

Japan Smart Community Alliance

Chair：Toshiba
Board：Hitachi, ITOCHU, JGC, Mitsubishi Electric, Panasonic, TEPCO, Tokyo Gas, Toyota
Secretariat：NEDO

Steering Committee

International Strategy WG

This working group will identify domestic and global smart grid trends and JSCA will then share such information with international organizations. It will also study and develop strategies to support Japanese companies in their international deployment activities.

International Standardization WG

With the aim of achieving international smart grid standardization, this working group will facilitate practical activities in different areas. Collaborative activities with organizations in Europe and the United States will also be carried out.

Roadmap WG

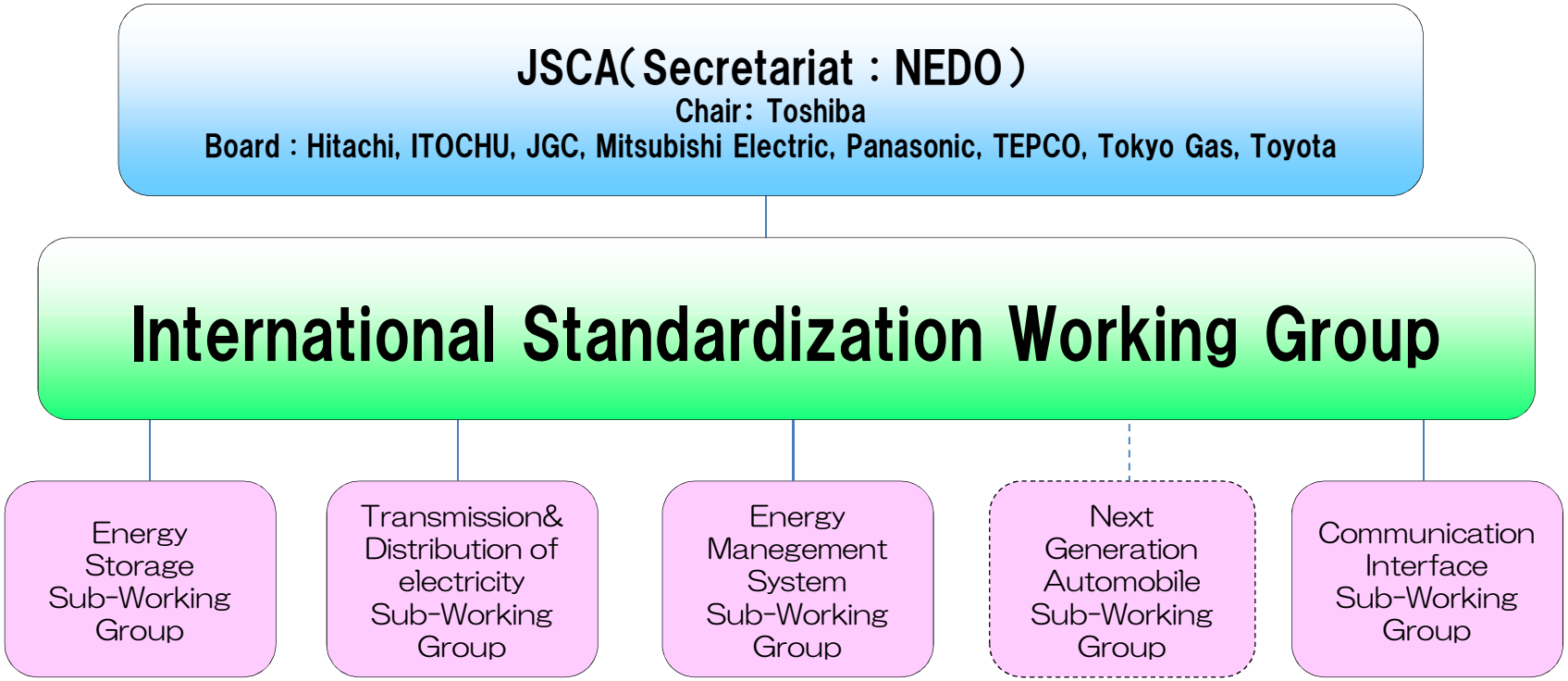
This working group will prepare a roadmap for smart grid technology development. In addition, it will promote technology development as part of a social system by developing a scenario for a next-generation society in which smart grid-related technologies have been disseminated.

Smart House WG

With a view to early commercialization of smart house technologies, this working group will review an information infrastructure (platform) that will enable visualization and monitoring of home energy use evaluation as a basic consumer service.

Japan Smart Community Alliance

Japan
Smart Community Alliance



Support for SGIP/PAP, IEC,IEEE etc.

Toward the Demonstration Project

- **Development of individual renewable energy and technology for grid connection**
  - ✓ - 2005; so many R&D projects
- **Development of grid connected system and verification of grid stability**
  - ✓ 2002 – 2010; grid connected system
- **Demonstration Pilot project at community level**
  - ✓ Small scale 2005 - 2011
  - ✓ Large scale 2010 - ;

Next Generation Energy & Social System Demonstration(4 cities)

Smart Community Related Experience

Up to FY2005 | FY2005 | FY2006 | FY2007 | FY2008 | FY2009 and beyond

Technology development of renewable energies (PV, WT, etc.)

Development of individual technology for RE grid connection

Control of Clustered PV voltage

Prove of renewable energy supply system with large storage

Prove of energy storage technology

Grid-connected system development

Operation and grid-connection of high penetration RE or storage and EMS application technology to reduce fluctuation of renewable energy output

Demonstrative Project on Grid-interconnection of Clustered PV Power Generation Systems **(FY2002-FY2007)**

Wind Power Stabilization Technology Development Project**(FY2003-FY2007)**

Demonstrative Project of Regional Power Grids with Various New Energies **(FY2003-FY2007)**

Demonstrative Project on New Power Network Systems (FY2004-FY2007)

Research and Development of Islanding Testing Technology for Clustered PV Power Generation Systems (FY2008-FY2009)

Verification of Grid Stabilization with Large-scale PV Power Generation Systems (FY2006-FY2010)

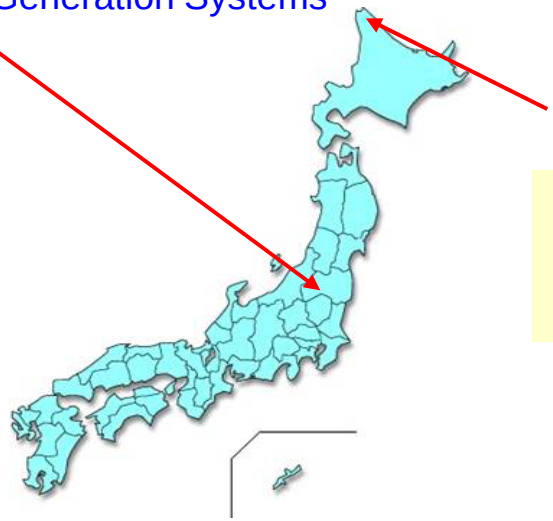
Development of an Electric Energy Storage System for Grid-connection with New Energy Resources (FY2006-FY2010)

Technology Demonstration Project

Ota City Demonstration Site

◆**Number of PV-equipped houses: 553**
Total PV capacity: 2,129 kW
Average capacity per house: 3.85 kW

Demonstration Project on Grid-interconnection of Clustered PV Power Generation Systems (FY2002-FY2007)

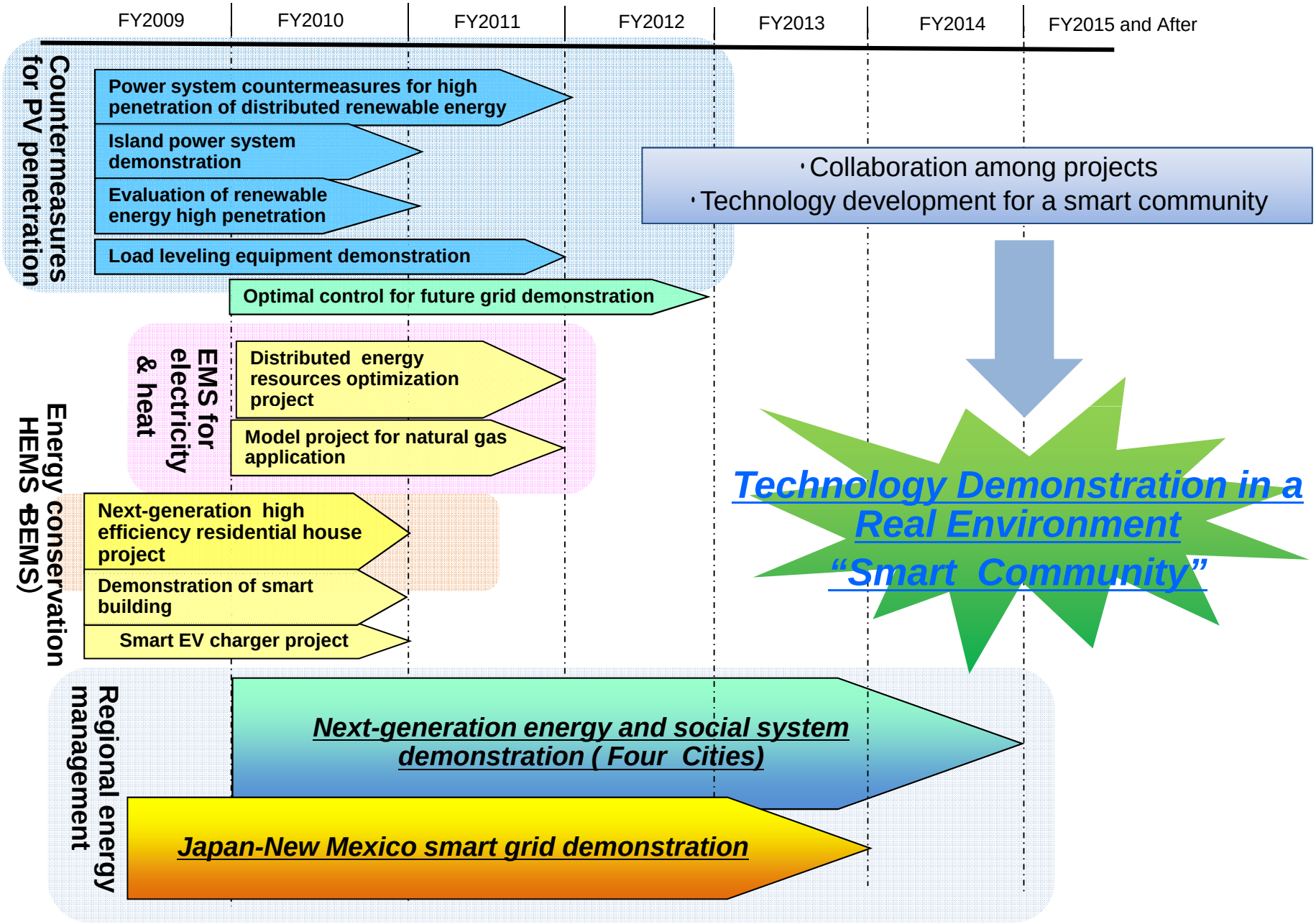


Wakkanai Demonstration site

◆**<u>Wakkanai site</u>**
5 MW: Most PV cells are crystalline.
NaS battery: 1500 kW-7.2hrs

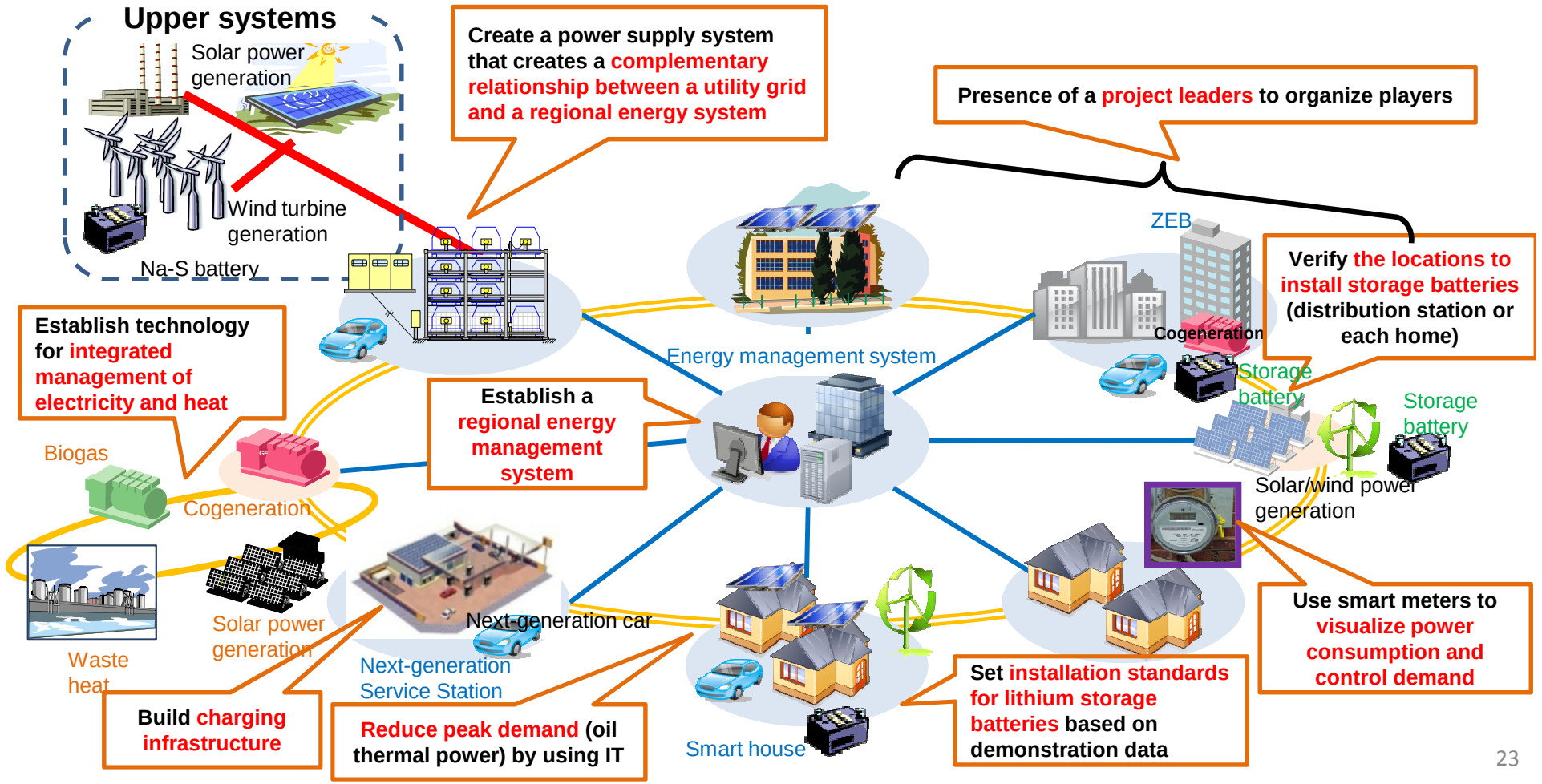
Verification of Grid Stabilization with Large-scale PV Power Generation Systems (FY2006-FY2010)

Future Plan for Smart Community Related Projects



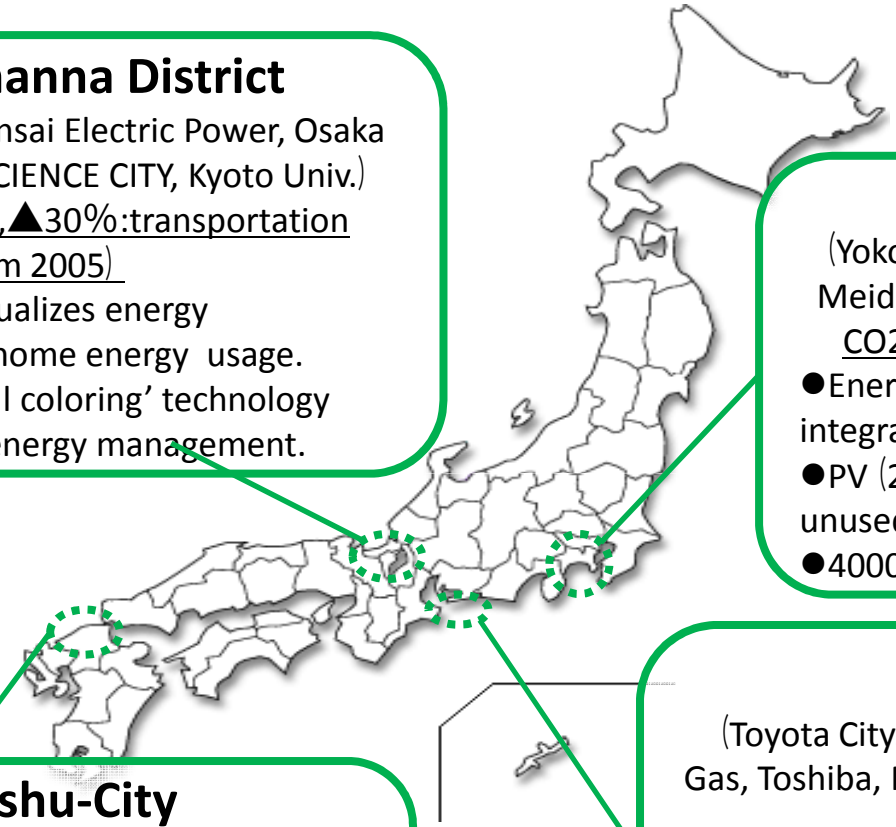
Demonstration of a Next-Generation Energy and Social System

- Need to gather actual data and create a system to manage it with the establishment of next-generation energy and social systems in view
- Need to make the entire region, including local industry, citizens, and local government, involved in the project in order to allow the systems to be tried in the actual region and visualize CO2 emissions reductions in the residential/commercial and transport sectors
- Need to establish a complementary relationship between the overall utility grid and the regional energy management system in a demonstration (e.g., storing electricity in the area or controlling consumption by users when electricity surpluses or shortages occur)



Smart Community Projects

– Four large scale pilot projects started in 2010 –



Kyoto Keihanna District

(Kyoto Prefecture, Kansai Electric Power, Osaka Gas Power, KANSAI SCIENCE CITY, Kyoto Univ.)

CO2▲20%:houses,▲30%:transportation (from 2005)

- 'Smart tap' which visualizes energy consumption controls home energy usage.
- 'Electric power virtual coloring' technology actualizes total home energy management.

Yokohama City

(Yokohama City. Toshiba, Panasonic, Meidensha, Nissan, Accenture, etc.)

CO2▲30% by 2025 (from 2004)

- Energy management system which integrates HEMS,BEMS,EV
- PV (27000 kW) Use of heat and unused energy
- 4000 Smart houses, 2000 EVs

Toyota City

(Toyota City. Toyota, Chubu Electric , Toho Gas, Toshiba, Mitsubishi Heavy, Denso, Sharp, Fujitsu, etc.)

CO2▲20% :houses,▲40%:transportation

- Use of heat and unused energy as well as electricity
- Demand response with more than 70 home 3100EV, V2H, V2G

Kitakyushu-City

(Kitakyushu City, Fuji Electric , GE, IBM, Nippon Steel) CO2▲50% (from 2005)

- Real-time management in 70 companies and 200 houses
- Energy management by HEMS, BEMS
- Energy system which integrates demand-side management and high energy system.

Initiatives for international cooperation

- **Project base**
  - ✓ Each technology was proven at the research project level.
- **Local deployment**
  - ✓ Micro Grid project
  - ✓ Smart Community project
    - → Still its impact is limited.
- **Global deployment**
  - ✓ Western countries
  - ✓ BRICs
    - → Contribution to the world though cooperations

New Mexico-Japan Demonstration Project

Research will be carried out at five sites in the State of New Mexico. NEDO participates in research in Los Alamos and Albuquerque projects as well as collective research on the overall project.

State of New Mexico, NEDO, Los Alamos National Laboratory (LANL), Sandia National Laboratories (SNL), New Mexico State University, Intel

Collective Research on Overall Project — NEDO

・Data management
・Cyber security
・Evaluate effect of Smart grid introduction

Site	Los Alamos	Albuquerque	Taos	Roosevelt	Las Cruces
U.S. partners	Los Alamos County, LANL	PNM, SNL			
	NEDO demonstration research	NEDO demonstration research	・Smart meter -Real time pricing -Direct load control	・Wind farm demonstration ・Stable supply test with power grid	・μ-grid concept in New Mexico State Univ.

- Power storage demonstration
- Home demand response demonstration

- Demand response in industrial or commercial buildings

NEDO

New Energy and Industrial Technology Development Organization

Hawaii-Okinawa Clean Energy Cooperation

Significance of cooperation

Okinawa and Hawaii shares many similarities.

Island, Subtropical to tropical climate

Energy structure

(% of fossil fuel: Hawaii 91%, Okinawa 99%)

Proactive to renewable energy

➢ Maximum synergy is expected by sharing best practices between the two.

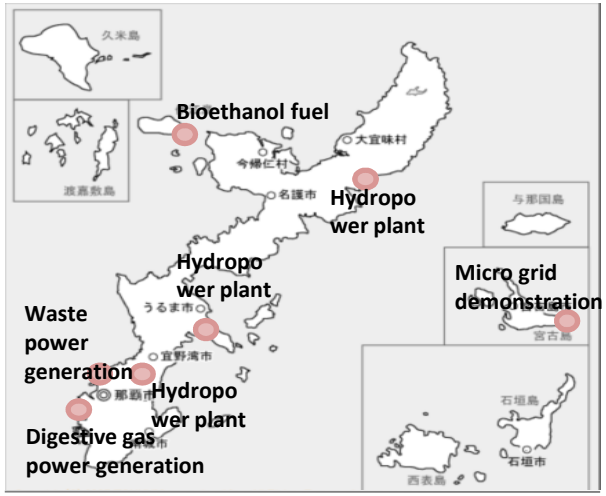
Establishment of a smart community

Introduction of next generation vehicles (e.g. EV)

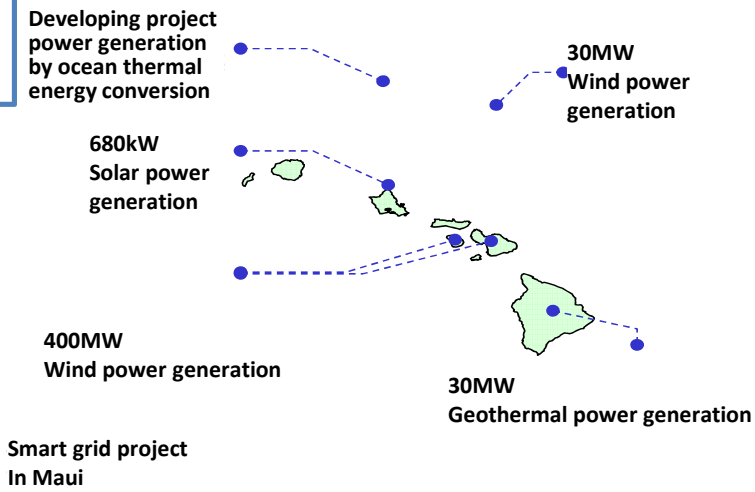
Promotion of energy efficiency (e.g. ZEB for subtropics)

Development of REs

Example of activities in Okinawa

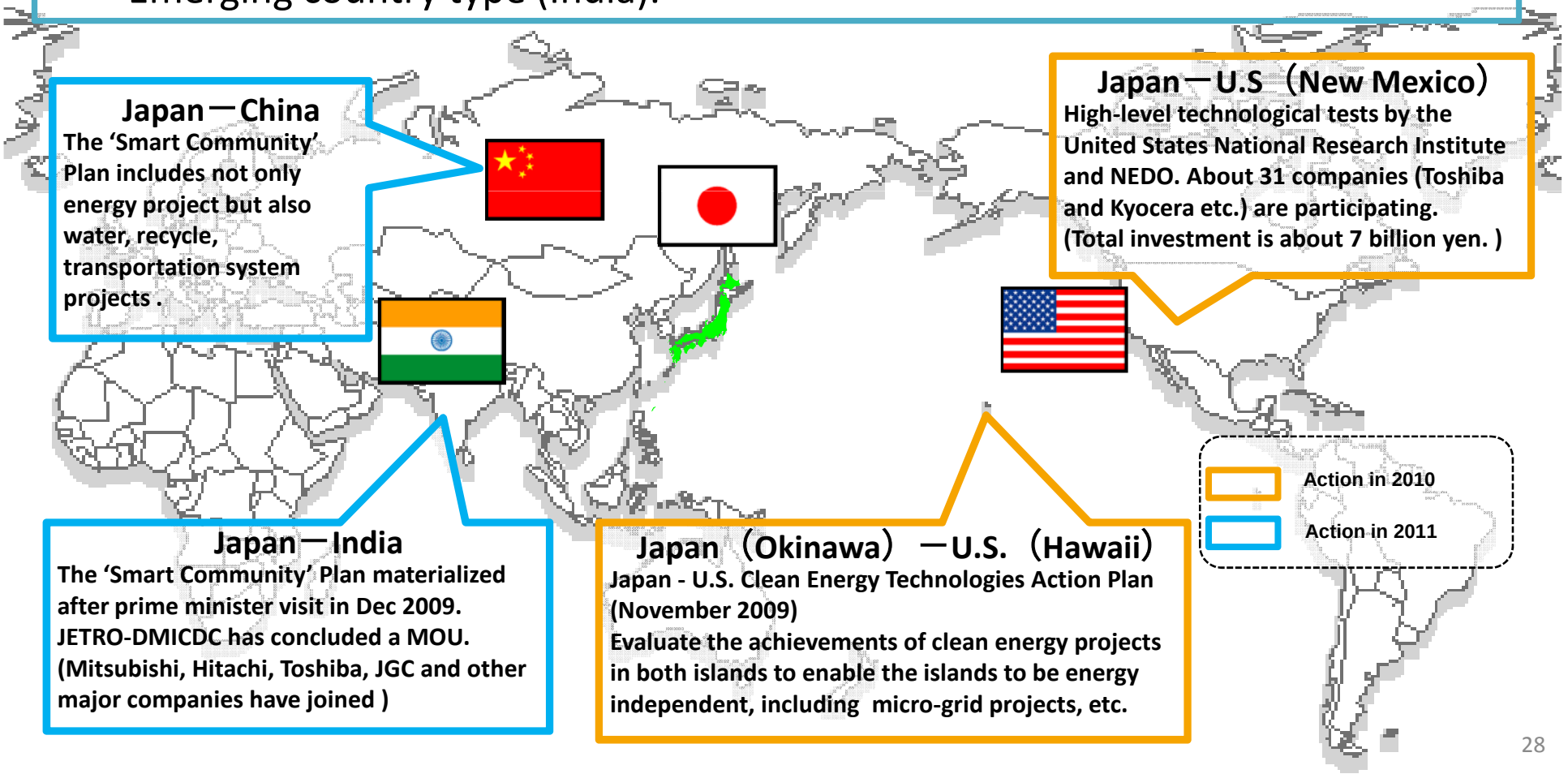


Example of activities in Hawaii



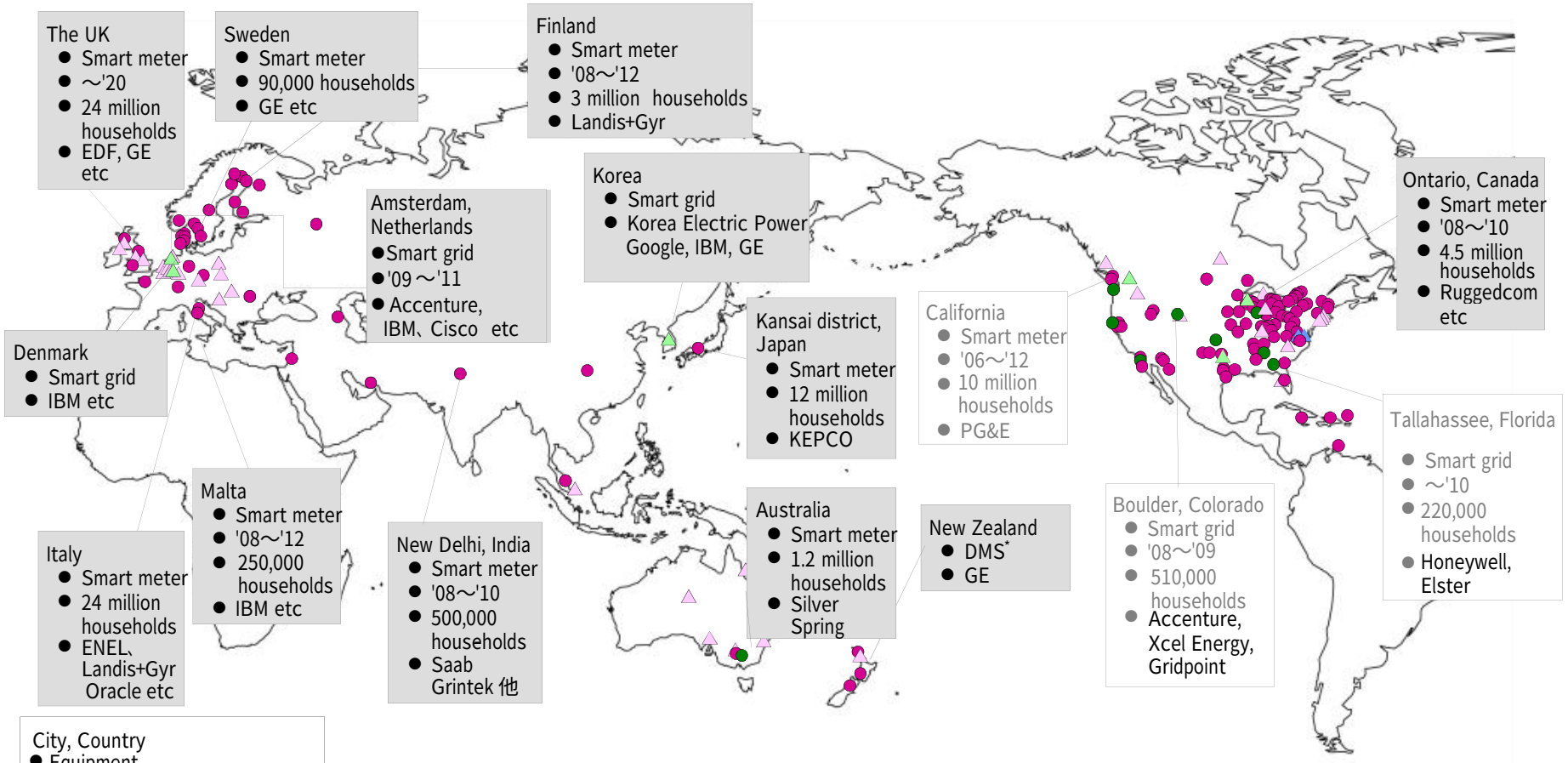
Overseas Deployment of Smart Community

- Overseas demonstrations are planned in parallel with domestic projects.
- JSCA has been organized to promote domestic and overseas Smart Grid projects.
- Different types of systems will be developed;
  - Urban type (Domestic projects and New Mexico project),
  - Remote island type (Okinawa-Hawaii project),
  - Emerging country type (India).



Smart grid projects – Now and the future

- Due to rapid growth of developing countries, they have high demand for infrastructure development such as electricity, water, railway, and road.
- Many projects including smart grid or infrastructure development in the future.



* Distribution Management System

Thank you very much.

nakanishi-hironori@meti.go.jp

Yokohama City, Kanagawa

Planned action

- ✓ Large-scale deployment of renewable energy (27,000 kW photovoltaic system)
- ✓ Introduction of smart house/building technology (at 4,000 households/establishments)
- ✓ Coordinated control of regional energy (e.g., electricity, heat) complementary to a large network
- ✓ Diffusion of the next-generation transport system (2,000 next-generation vehicles)
- ✓ Lifestyle innovation through visualization
- ✓ Enhanced promotional structure through the establishment of a business alliance

Proposal outline

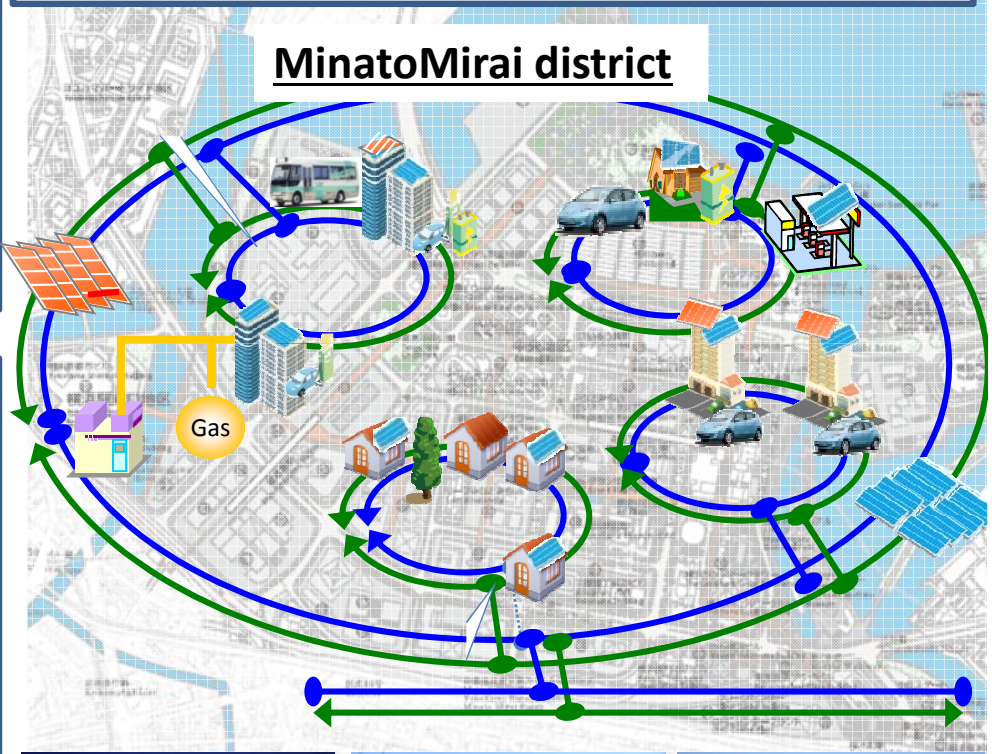
- Construct a new social system by bringing together in Yokohama the wisdom of companies for reducing CO2 emissions and increasing national wealth and promote its deployment overseas.

In doing so, make the utmost use of Yokohama's excellent assets and opportunities, such as civic power, diverse geographical features, and APEC meetings

- To make the project sustainable, construct a system in an existing urban district where people actually live
- Establish an entity responsible for overall decision making, investments, and publicity to organize a promotional structure involving energy companies and users
- Seek to reduce CO2 emissions by 30% by 2025 compared to the 2004 level

Partner

横浜市 TOSHIBA Leading Innovation accenture Tokyo gas NISSAN Panasonic MEIDEN



Toyota City, Aichi

Planned action

- ✓ Efficient use of energy in households (70 or more households)
- ✓ Efficient use of energy based on communities
- ✓ Establishment of a low-carbon transport system (diffusion of 3,100 next-generation vehicles)
- ✓ Lifestyle innovation through support to encourage consumers to change their action patterns and verification of its effect as an incentive (to reduce social costs)
- ✓ Development of strategy for global deployment (global deployment and international standards)

Proposal outline

- Focus on the household sector (homes and cars) and aim to construct a low carbon social system through joint efforts of global companies, leading local firms, and the local government in cooperation with consumers
- Demonstrate the efficient use of a mix of different energy sources (electricity, heat and unused energy) and the construction and linkage of low carbon transport systems, while restricting social costs
- Make standardization and other efforts emphasizing international competition
- Seek to reduce CO2 emissions by 20% in households and 40% in transport

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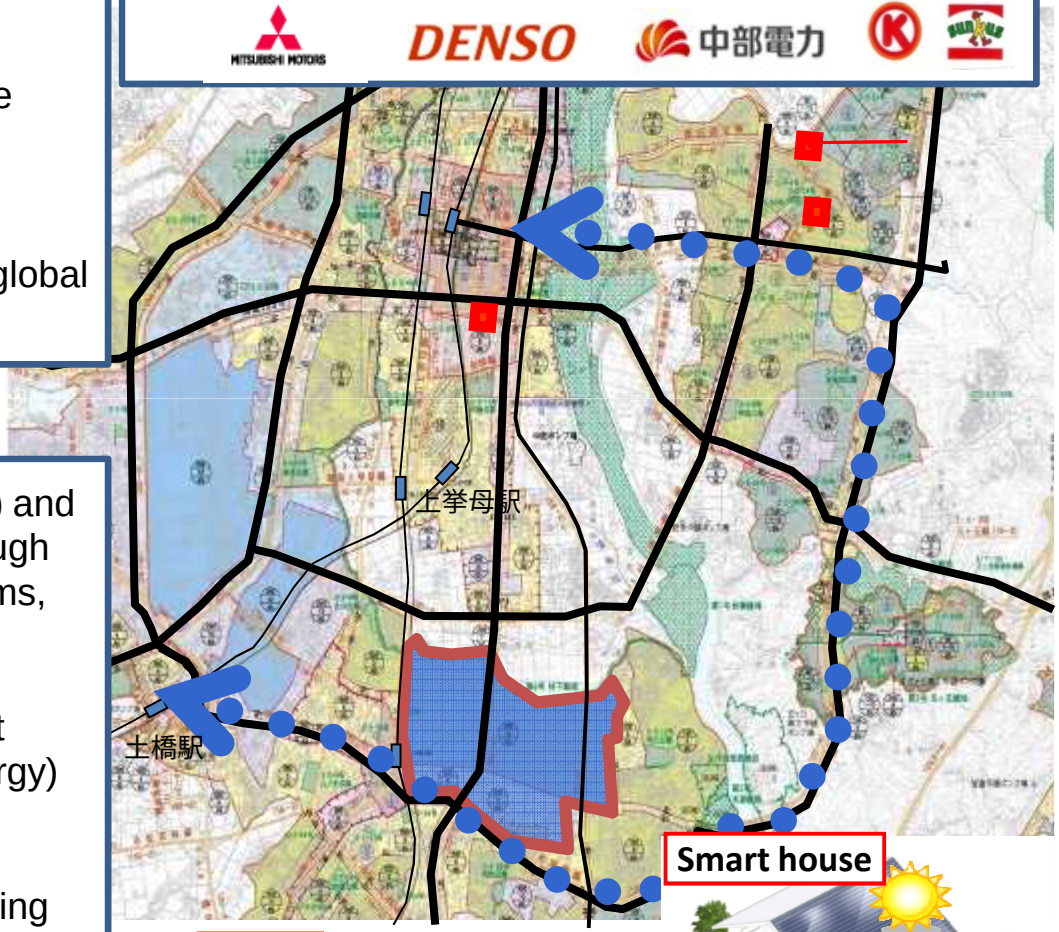
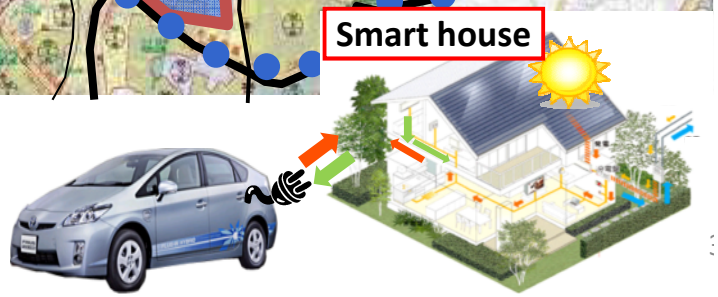
TOYOTA
TOSHIBA Leading Innovation
TOYOTA HOME Drive@earth
SHARP
TOHO GAS
CircleKSunkus
MITSUBISHI MOTORS
DENSO
中部電力



EV
V2H
V2G



Kansai Science City, Kyoto

Planned action

- ✓ Installation of photovoltaic systems in 1,000 households
- ✓ Building “nano-grids” in homes and buildings to intelligently control power generation systems (e.g., solar cells, fuel cells) and electrical storage systems through “computerized” management of energy
- ✓ Active deployment of EVs and construction of a network of charging stations
- ✓ Proposal of a regional energy economy model based on “Kyoto eco-points”
- ✓ Establishment of a model for local energy production for local consumption by integrating the above actions
- ✓ Experiments to demonstrate complementarities between a regional nano-grid and the national grid

Proposal outline

- Control energy by visualizing energy flows in homes and offices as well as those through EVs (a “nano-grid” project) in Kansai Science City, which aims to study and demonstrate sciences for a sustainable society and create new industries based on them
- By doing so, confine fluctuations in demand arising from human activity patterns and the instability of natural energy sources, and aim to establish a stable and efficient regional energy system and create new industries
- Seek to reduce CO2 emissions by 20% in households compared to the 2005 level and 40% in transport by 2030

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京都府 Kyoto Prefecture Web Site
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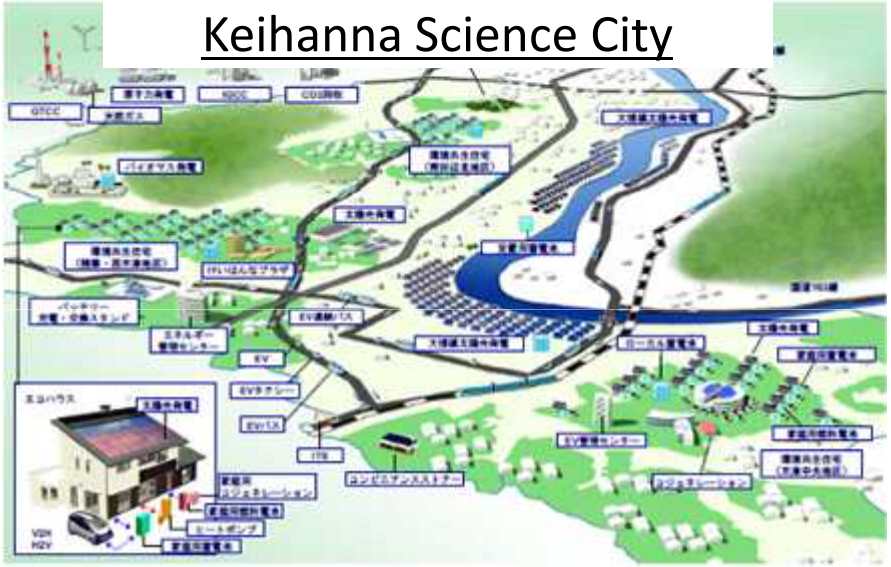
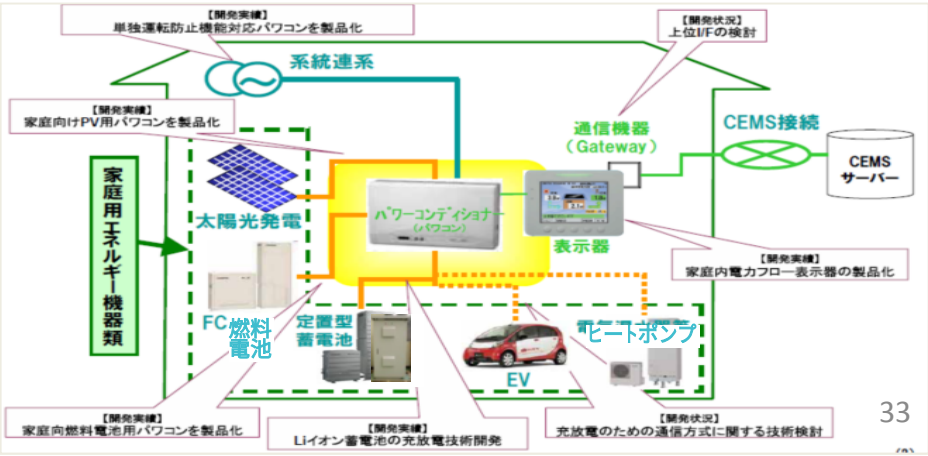
MITSUBISHI Changes for the Better
三菱重工
OMRON
(財)関西文化学術研究都市推進機構

Keihanna Science City





Kitakyushu City, Fukuoka

Planned action

- ✓ Creation of a city block where new energy, including that from industry, accounts for 10% of energy consumption
- ✓ Deployment of energy conservation systems for an entire town (e.g., real-time energy management for 70 companies and 200 households using smart meters)
- ✓ City block energy management through a regional energy saving station
- ✓ Development of communities and transport systems based on energy infrastructure
- ✓ Establishment of a system to transfer the outcomes to other parts of Asia

Proposal outline

- Aim for regional energy management in which citizens and all other community members participate, by building a smart grid based on the local new energy infrastructure (solar power, hydrogen, etc.) and community infrastructure of the Yahata Higashida district, which has been pursuing an eco-friendly community under the leadership of the private sector, and eventually create a society with 50% less CO2 emissions
- Disseminate the outcome across the city by incorporating it in the city's community development policy and expand it to Asia through networking with other Asian cities
- Seek to achieve, in addition to the current target of reducing CO2 emissions by 40% by 2030 and 70% by 2050 in the residential/commercial and transport sectors), an additional 10% reduction (80% reduction instead of 70% by 2030, 80% reduction instead of 70% by 2050)

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