November 2, 2012

Green Innovation and Future Smart Community in Japan

Tomoaki WADA
Affiliated Senior Fellow
National Institute of Science and Technology Policy
Professor, Tokyo University of Science

Aiming to be an advanced science- and technology-oriented nation

Science and Technology Basic Law
（enacted in 1995）

1st & 2nd Basic Plan
（FY 1996-2005）

- **Increase in governmental R&D expenditure**
- **Construction of new R&D system**
  - Doubling of competitive research funds
  - Promotion of industry–academia–government collaboration
  - Support plan for 10,000 post–doctoral fellows (including PhD students)
- **Three basic ideas**

(i) Creation of wisdom
(ii) Vitality from wisdom
(iii) Sophisticated society through wisdom

3rd Basic Plan
（FY 2006-2010）

- **S&T Policy Goals**
  - Quantum leap in Knowledge Discovery & Creation
  - Innovator Japan
  - Sustainable Development etc.
  - **Our focus for future: stronger emphasis on the role of "Wisdom"**

Nurturing creative S&T personnel

Further reform of S&T systems, leading to higher performance irrespective of Japan's serious situation due to limited resources

4th Basic Plan
（FY 2011-2015）

- **Science, Technology and Innovation**
  - **Green Innovation**
    - **Regeneration from disaster**
    - **For Environment and Energy**
  - **Life innovation**
- **Basic research and reinforcement to foster S&T personnel**
  - **Establish more than 100 research/education centers within the world's top 50 citations ranking in individual research areas**
  - **Major enhancement of graduate school education**

Investment under the Basic Plan
Approx. 25 trillion yen
(Annual investment - over 4% of GDP, Gov. investment - 1% of GDP)

Low Carbon Energy Supply - 4th S&T Basic Plan-

- R&D of renewable energy technologies

  solar power, biomass utilization, wind power, small scale hydropower, geothermal power, tidal power, and wave power
- Innovation for distributed energy supply systems

  storage batteries, fuel cells, hydrogen supply systems, superconducting power transmission, smart grids
- Higher efficiency and low-carbon generation in basic energy supply sources

  a zero-emission thermal power generation system where an integrated gasification combined cycle and collection and storage of carbon dioxide are combined, high efficiency thermal power generation, high efficiency petroleum refining, R&D related to nuclear energy

High Efficient and Smart Use of Energy - 4th S&T Basic Plan-

- In manufacturing sectors

  Innovative manufacturing process in steel production, green sustainable chemistry, bio-refineries, innovative catalyst technology
- In consumer sectors (household and commercial) and transport sectors

  higher grade insulation systems for houses and buildings, stationary fuel cells, more efficient lighting, power semiconductors, next-generation heat pump system, next-generation automobiles
- Information and telecommunication technology

  next-generation IT networks, further energy-savings for IT equipment and system components, optimized control of entire network systems

Tsunami wave strikes Fukushima Nuclear Power Plant on March 11, 2011

Fukushima Daiichi Nuclear Power Plant (4696 MW)

	No.1 Unit	No.2 Unit	No.3 Unit	No.4 Unit	No.5 Unit	No.6 Unit
Capacity (MW)	460	784	784	784	784	1100
Operations Started from	1971	1974	1976	1978	1978	1979
Status in March 11	Operation	Operation	Operation	Shutdown	Shutdown	Shutdown
AC Power	Lost	Lost	Lost	Lost	Lost	Lost
Emergency power	Lost by tsunami	Lost by tsunami	Lost by tsunami	Lost by tsunami	Lost by tsunami	Safe
Sea water pump&Motor	Broken by tsunami	Broken by tsunami	Broken by tsunami	Broken by tsunami	Broken by tsunami	Broken by tsunami
Injection date of water from line for extinguishing fire	March 12 5:30	March 14 19:54	March 13 9:25	No	No	No
Hydrogen explosion	Hydrogen explosion March 12, 15:36	No	Hydrogen explosion March 14, 11:01	Explosion March 15, 6:00	No	No
Fuel in core	Meltdown	Meltdown	Meltdown	None	Safe	Safe

Reasons why Fukushima nuclear accident occurred

- TEPCO (Tokyo Electric Power Company) and NISA (Nuclear and Industrial Safety Agency) had recognized that the cores of the nuclear reactors could be damaged if a tsunami higher than the ground level of the nuclear plant occurred, but no action was taken because of the interference with the plant operations, inducing concern over plant safety among residents, and weakening their stance in potential lawsuits,
- Guidelines from the Cabinet Office's Nuclear Safety Commission stated that power companies need not consider a situation where all electric power is lost for an extended amount of time because the probability was so small and other measures were in place.
- After the Sept. 11, 2001, terrorist attacks on the United States, the U.S. government required power companies to prepare for the potential loss of all electricity. NISA did not adopt similar requirements.

Electricity Saving in summer 2011 and 2012

- In 2011, a legally mandated 15% cut was put in place from July 1st (until the beginning of September) due to expected power shortages after the March 11, 2011 disaster.

- Instructions for all home users
  - If there is 10% electricity to spare
    - continue normal energy saving.
  - If there is 6% electricity to spare
    - turn off air conditioners.
  - If there is 2% electricity to spare
    - turn off televisions and air conditioners and unplug personal computers.

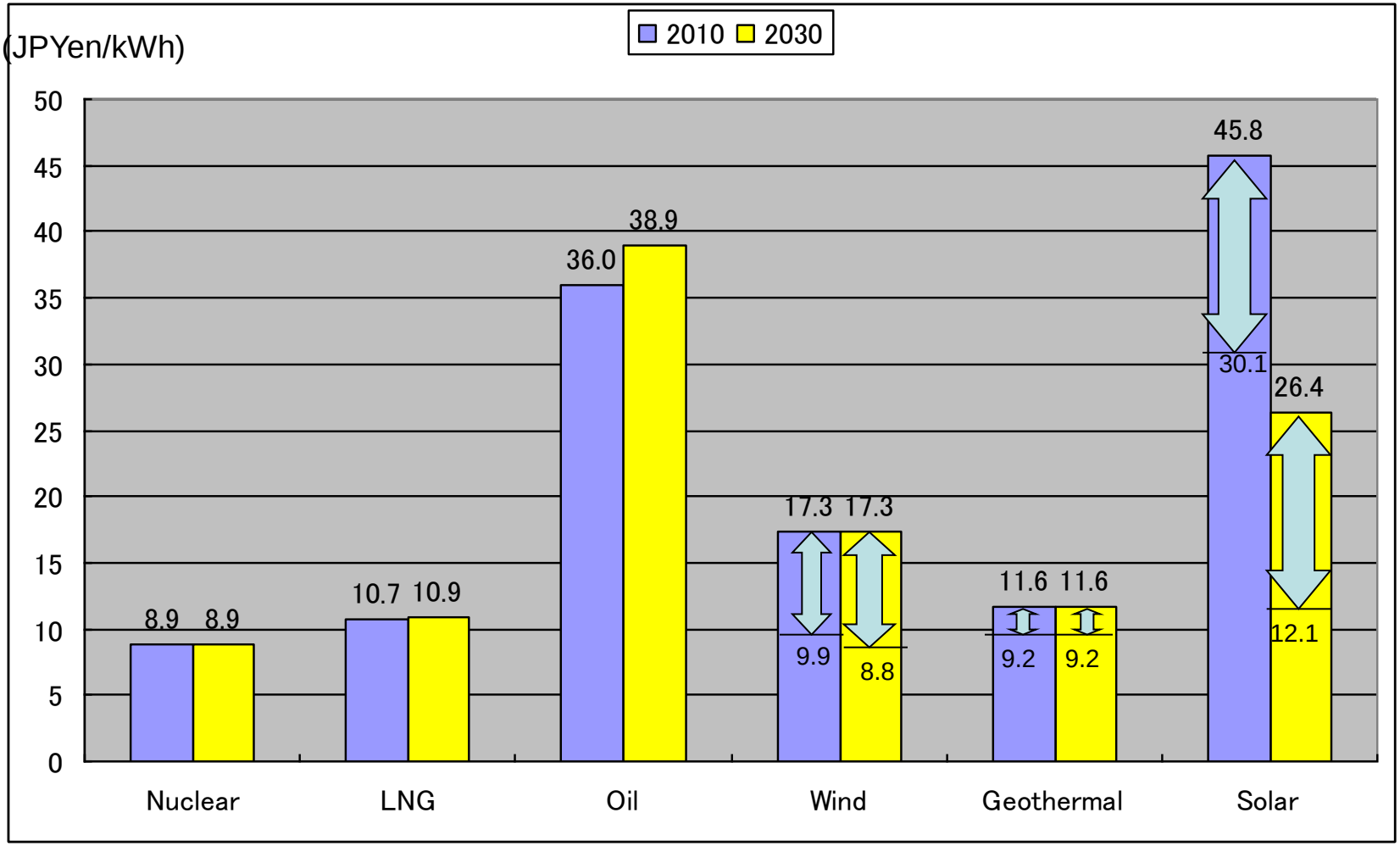
- In fact, more than 20% saving in electricity was realized by the efforts of factories and home users.

- In 2012, a 3% to 10% cut was put in place in some local areas of Japan in summer.

Recent Progress on Shale Gas

- It used to be difficult to mine shale gas because it is confined in hard shale.
- In 2005, technology for breaking down the hard, deep-strata bedrock using water pressure was developed and put into practical use.
- As a result, in the United States, production of shale gas has been sharply increasing in Pennsylvania and Texas, to the extent that, by 2009, the United States had overtaken Russia as the world's leading producer of LNG.
- Shale gas is widely distributed in North America, Europe, China and Australia. Combustion of LNG produces significantly less carbon dioxide emissions than burning heavy oil or coal.
- Japan is already the world's largest importer of LNG. Its LNG sources include Malaysia, Australia and Indonesia. And Japan is planning to increase LNG imports from the U.S. After obtaining approval from the U.S. Energy Department, it plans to begin importing the gas as early as 2015.

Estimating the future costs of power generation



Fixed purchase cost of renewable energy (July, 2012)

Proposed purchase prices (per kilowatt-hour)

Power sources	Purchase prices	Purchase prices requested by industry
Large-scale solar power	¥42	¥42
Wind power	¥23.1	¥22-¥25
Small wind power	¥57.75	¥50-¥55
Geothermal power	¥27.3 (above 150,000 kilowatts)	¥25.8 (at about 30,000-kilowatt level)
Small or midsize water power	¥25.2-¥35.7	¥24-¥34.06
Biomass	¥13.65-¥40.95	¥14.5-¥39

Impact of overseas production

- Overseas production rate of Japanese companies

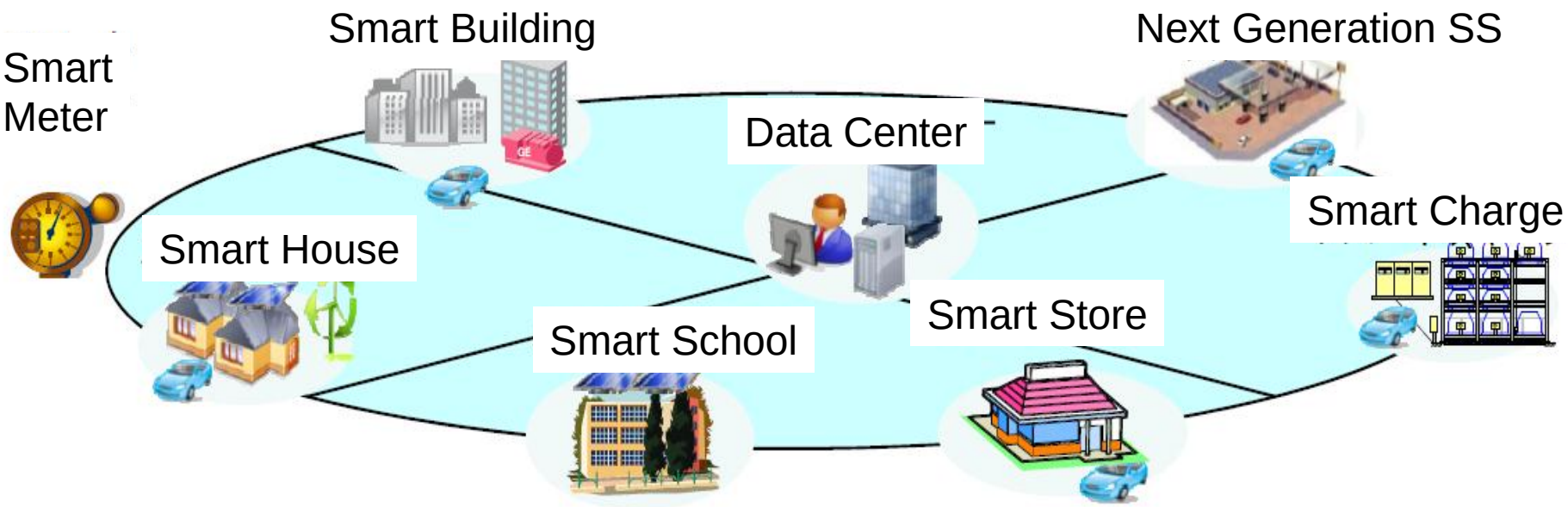
  23% (in 2000) ⇒ 31.8% (in 2010)
- If the overseas production rate increases by 1%, the number of employees in domestic industries will decrease by 280,000.

(estimate by Daiichi Life Economic Research Institute)

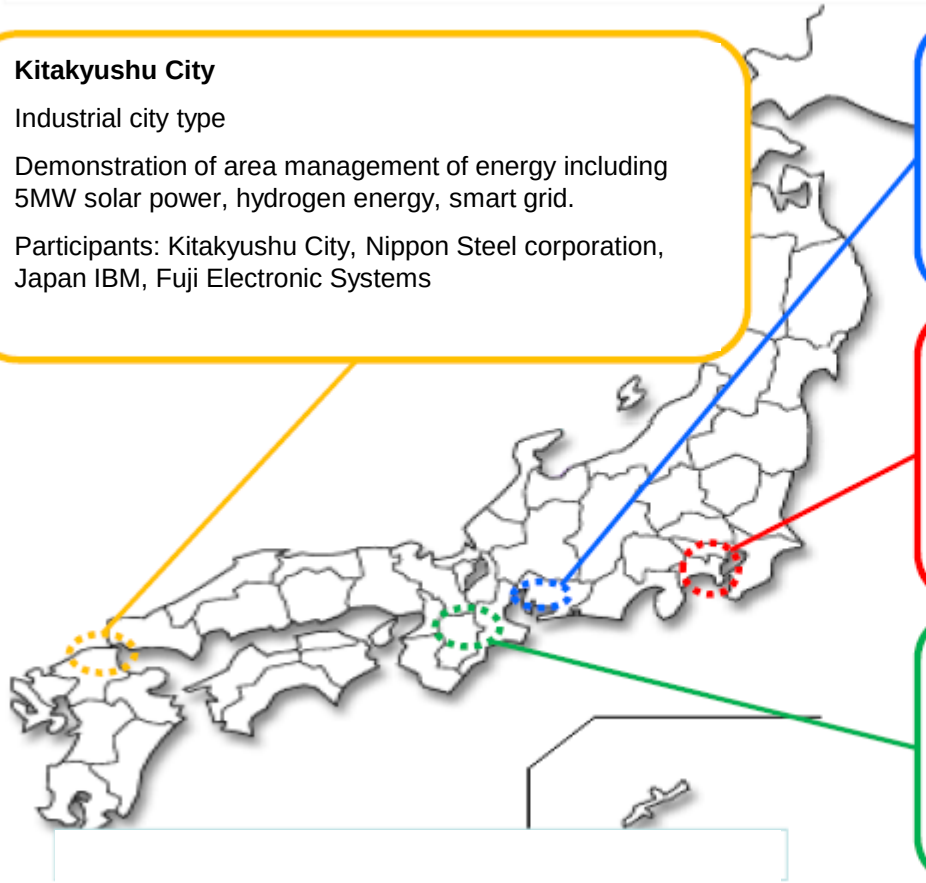
New Energy Policy under discussion

- Discussions of a new strategy had been held in the government to set a target of zero nuclear power plants operating in the 2030's.
- The business community as well as local governments expressed their strong dissatisfaction.
  - ✓ "Electricity charges may double if the government implements a zero nuclear policy, and force companies to relocate production overseas, leading to massive employment losses."
- In September 2012, the Cabinet merely decided the policy "to conduct reasonable discussions with related local governments and the international community based on the strategy and implement future energy and environment policies while making tireless efforts to examine and revise them."

Image of Smart City



Four Smart Community Demonstration Areas in Japan



Kitakyushu City

Industrial city type

Demonstration of area management of energy including 5MW solar power, hydrogen energy, smart grid.

Participants: Kitakyushu City, Nippon Steel corporation, Japan IBM, Fuji Electronic Systems

Toyota City

Local city based on everyday living

Effective use of energy including low-carbon transportation system (3100 next generation vehicles), .

Participants: Toyota City, Toyota, Denso, Chubu Electric Power, Toyota Home, Fujitsu, Sharp, etc.

Yokohama City

Major city, large- scale

27 MW solar power, 4,000 smart houses, 2,000 next generation vehicles

Participants: Yokohama City, Accenture, Toshiba, Nissan Motors, Panasonic, TEPCO, Tokyo Gas, Meidensha

Keihanna Eco City

Academic Research Town based on new technologies

Demonstrations of technologies for visualization of energy and energy control in each home and building

Participants: Kansai Science City, Doshisha Urban City Commission, Kansai Electric Power, Osaka Gas, etc.

Kitakyushu
Smart Community Project

1.Outline

A wide range of demonstrations in areas of communication, town construction, transportation, and lifestyle, mainly in order to make people realize about the smart use of electricity

2. Operator

Kitakyushu Smart Community Association

(Kitakyushu City, Shin-nihon Steel, Japan IBM, Fuji Electronics, and other 49 firms)

3. Area

Yahata East area (approximately 120 ha) in Kitakyushu City

4. Period

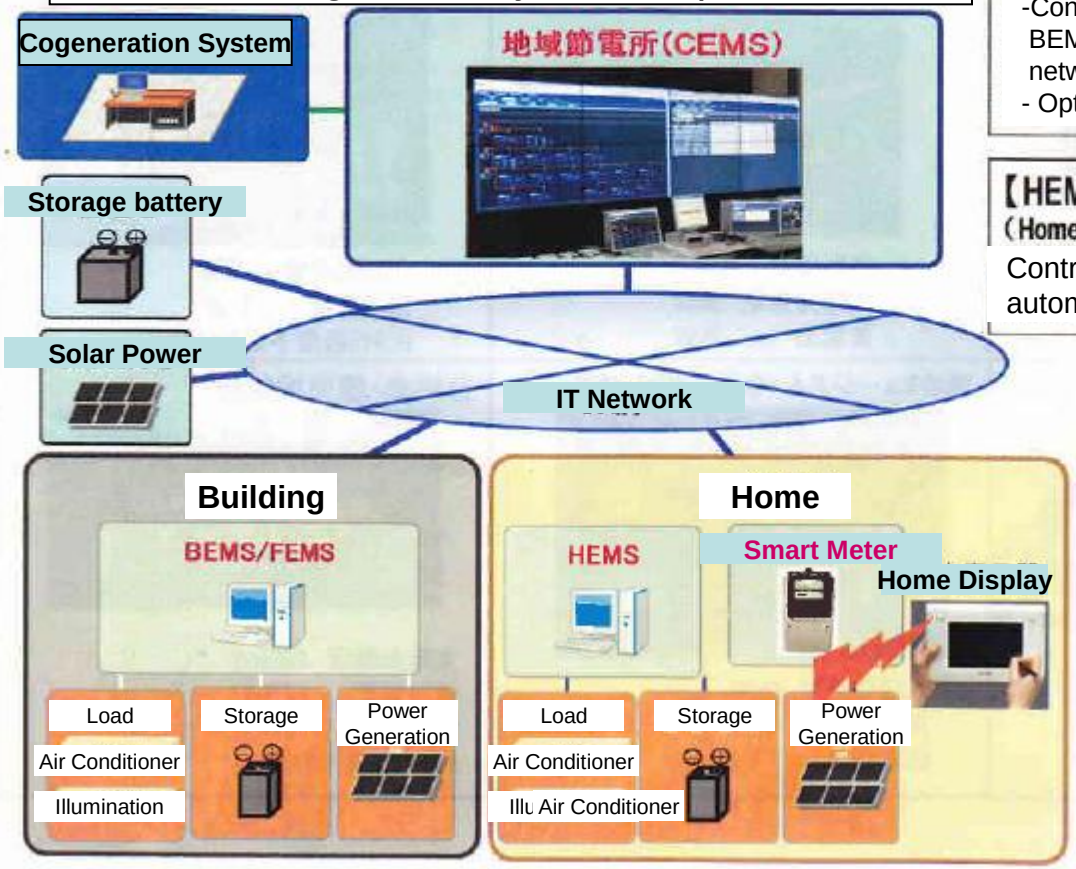
2010–2014 (5 years)

5. Budget

16.3 billion Japanese Yen over 5 years

Kitakyushu Smart Community Project (Energy Field)

[Smart Meter]
Receiving the notice of electricity cost and sending electricity consumption



[CEMS]
(Cluster Energy Management System)
-Connected with renewable energy, BEMS, HEMS, Electricity Grid, and IT network
- Optimized control of local energy

【HEMS】
(Home Energy Management System)
Controlling energy usage in homes automatically, connected with CEMS

【BEMS】
(Building and Energy Management System)
Controlling energy usage in buildings automatically, connected with CEMS

【FEMS】
(Factory Energy Management System)
Maintaining stable electric supply to factory, connected with CEMS and its own renewable energy

Progress of the Project
(Renewable Energy)

(As of February, 2012)

Apartment Building, Dormitory

[Apartment]

Solar Power 170kW
HEMS
Smart Meter

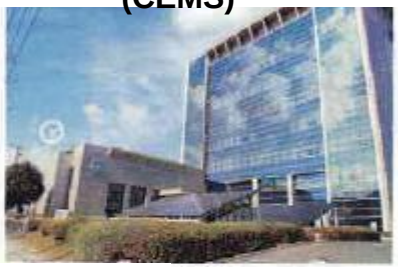
[Dormitory]

Solar Heat System
Geothermal System
BEMS

Hydrogen demonstration house

Fuel Cell 1kW × 7
Solar Power 3kW
Storage Battery 3kW

Tenant office Building (CEMS)



Solar Power 10kW
Wind Power 3kW
BEMS (2012)

Hospital

Solar Heat System
BEMS

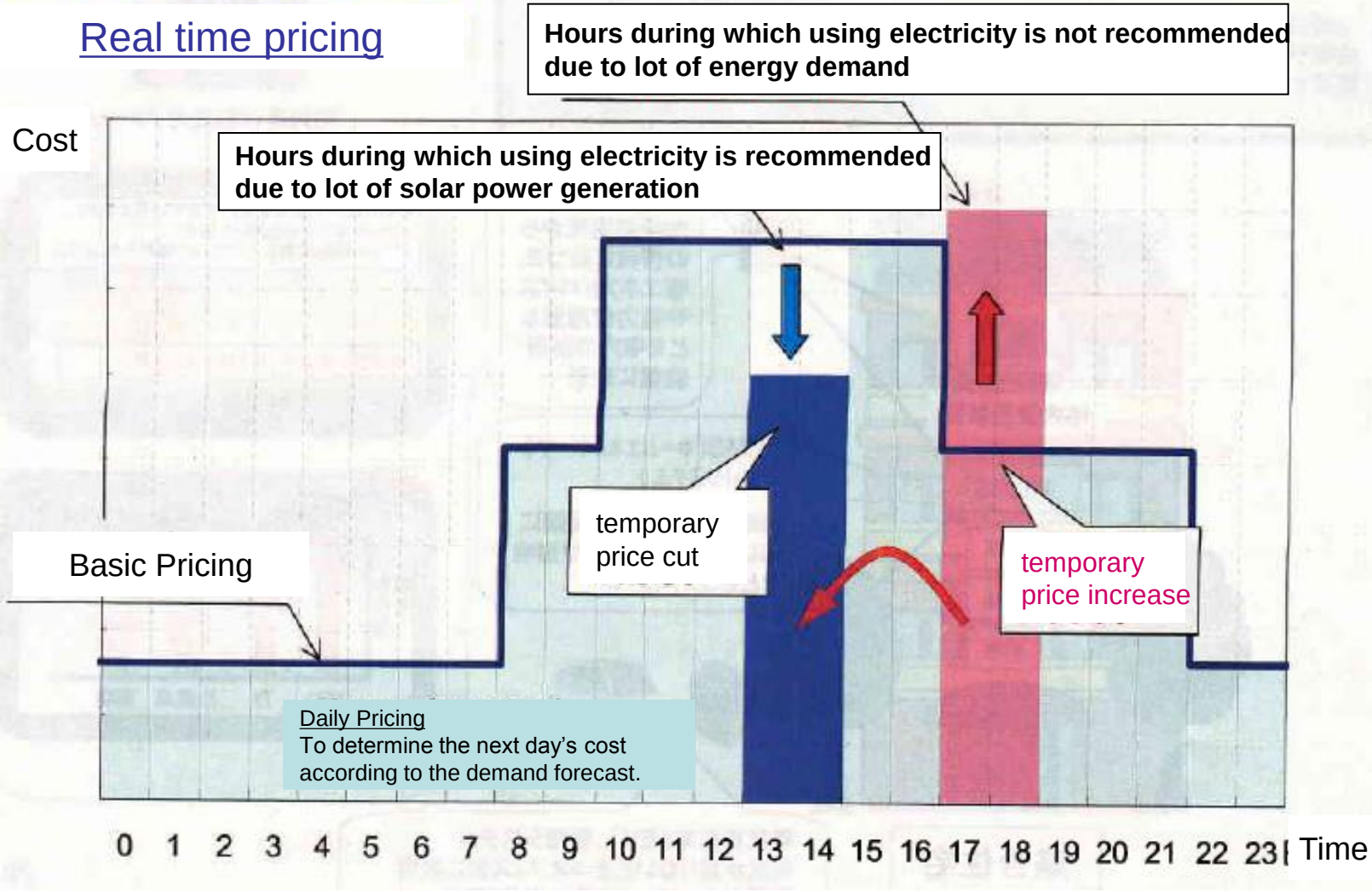
Eco-museum, Eco-house

Solar Power 6kW
Wind Power 3kW
Storage Battery 1kW

History Museum

Solar Power 160kW
Fuel Cell 100kW
Storage Battery 120kW
BEMS (2012)

Demonstration of Dynamic Pricing



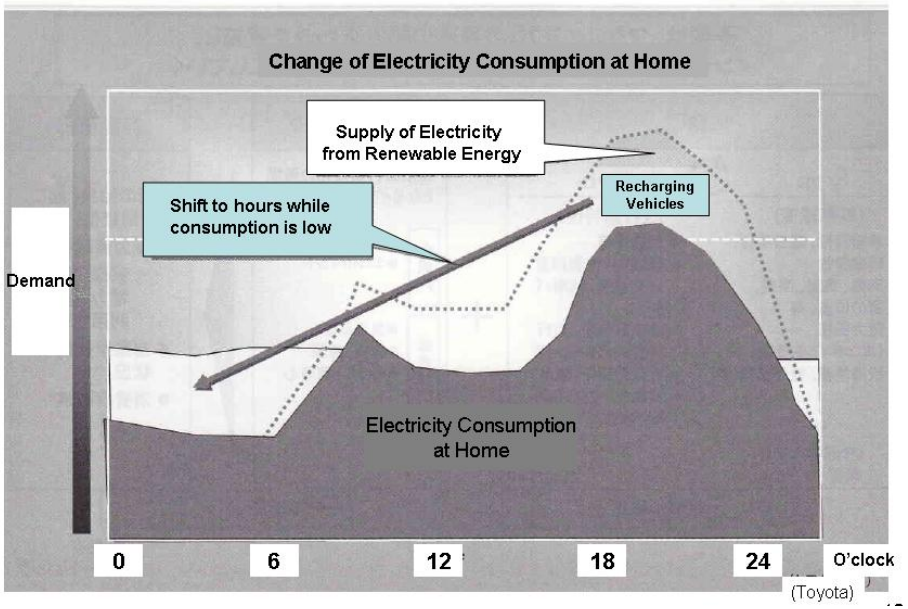
Toyota Smart Community Project

Outline of Demonstration

	At home	Transportation	Destination	City Life
Project	●67 demonstration houses ●Energy control by HEMS ●Power supply from EV/PHV to home (V to H)	●Next generation cars on a massive scale ●Eco- driving ●Traffic control by ITS ●FC bus, TDMS*	●EV charger and storage battery at convenience store ●Utilization of batteries on EV/EHV at the disaster	●Analysis of energy consumption data by EDMS** ●Promotion of contributions to low carbon society
Coordinator	ハイブリッド・シティ とよた, TOYOTA, 中部電力, DI, 愛知県, 名古屋大学, 豊田商工会議所			
Promoting Companies (27)	DENSO, TOYOTA HOME, TOYOTA, トヨタすまいるライフ株式会社, AISIN, KDDI, 中部電力, TOYOTA, SHARP, YAZAKI, SECOM, TOHO GAS	ハイブリッド・シティ とよた, TOYOTA, TOYOTA, 豊田通商, 三菱商事, EITETSU, TOHO GAS, KDDI, NEXCO	TOYOTA, DENSO, ヤマト運輸, 株式会社セック, ハイブリッド・シティ とよた, TOYOTA, 三菱商事, TOHO GAS	TOYOTA, ハイブリッド・シティ とよた, DI, TOSHIBA, FUJITSU, KDDI, 中部電力, 三菱商事, TOHO GAS, トヨタすまいるライフ株式会社, hp, TOYOTA HOME, ENERES
Demonstration Area	•67 houses in Takahashi& Higashiyama area	•Whole city	•Commercial/public facilities •Low carbon society model area	•Whole city •Low carbon society model area

*Traffic Data Management System **Energy Data Management System

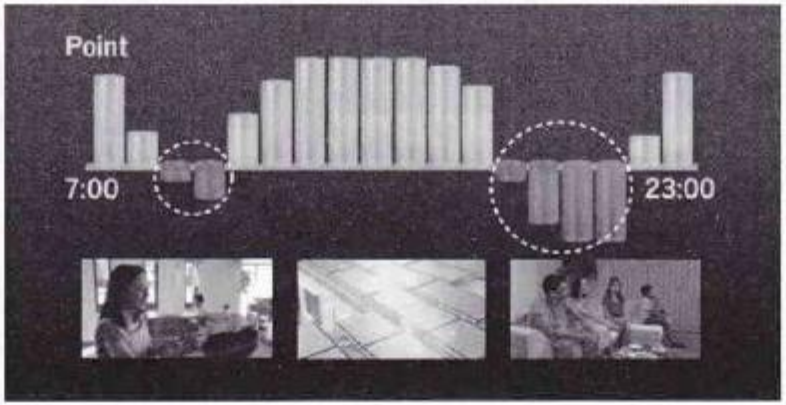
Equalization between Electricity Supply and Consumption



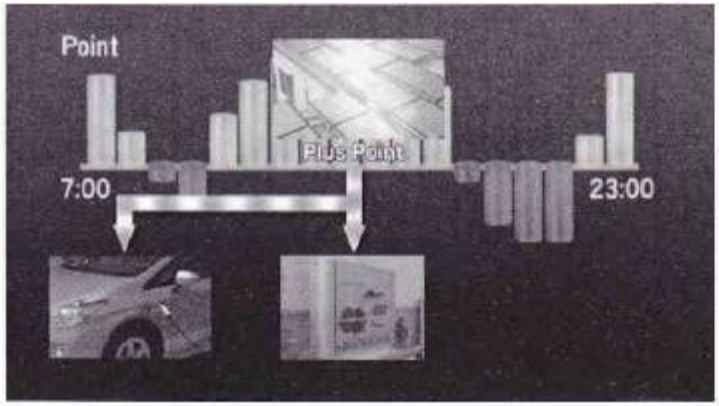
Point Incentive System

Getting plus points when Energy demand is low

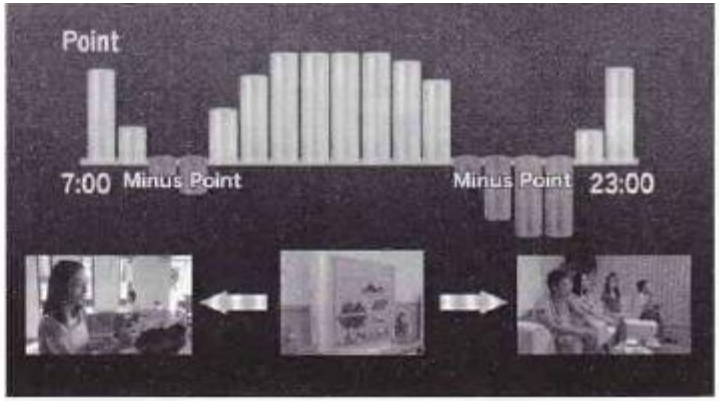
Getting minus points when Energy demand is high



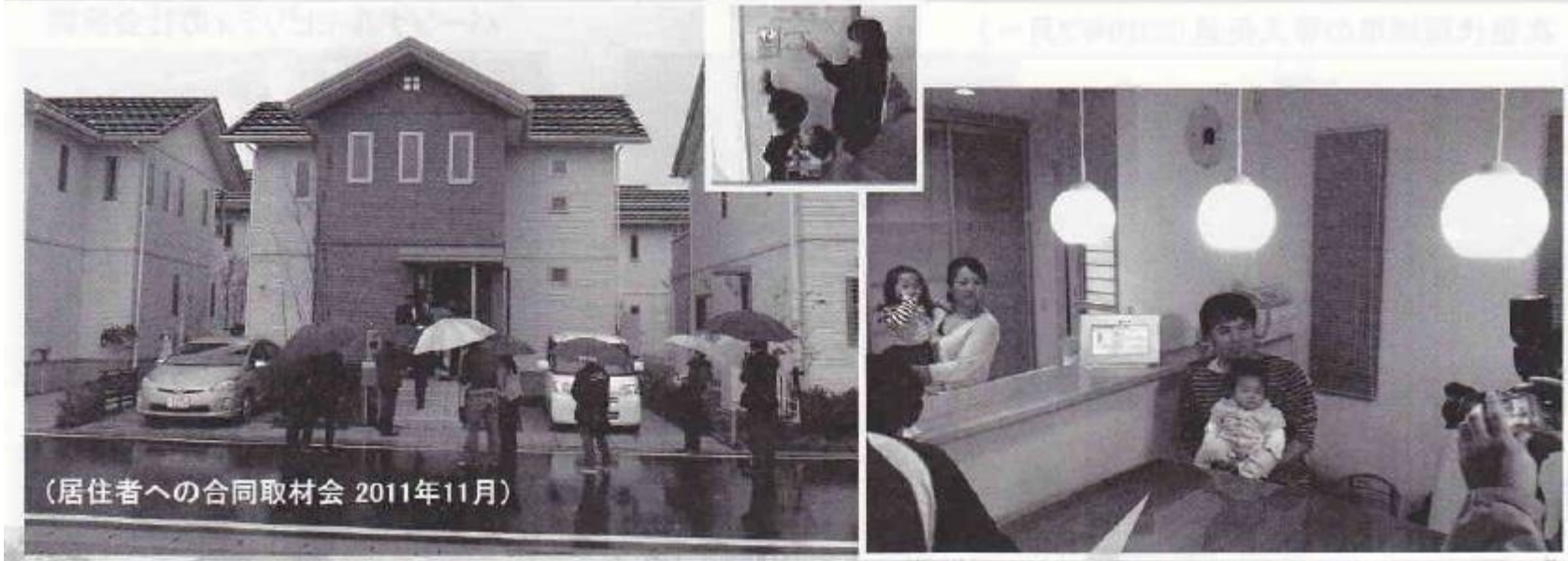
Use/Save electricity when point is plus



Use saved electric power when point is minus



Voices of Residents



“The entire family has started taking measures to save energy.”
“ It was difficult at first, but we have deepened our understanding and interest since starting to use the system.”
“This system is optimizes energy utilization, so we can work on energy saving without effort.”

Summary

- Regarding Green Innovation of the fourth S&T Basic Plan which began in August 2011, it is emphasized to promote R&D of renewable energy technologies, innovation related to distributed energy supply systems, and higher efficiency and low-carbon generation in the basic energy supply.

- On the other hand, the nuclear accident that occurred at the Fukushima nuclear power plant in March of last year, has seriously affected the Japanese energy situation and future energy plans. Future energy strategy, including nuclear power, is currently being discussed intensively.

- Smart community demonstration projects were launched last year in four local cities, Yokohama, Toyota, Keihanna, and Kitakyushu. The research results from these demonstration projects will be utilized nationwide and will be shared with smart cities in Asia and other regions.