Smart Community Projects in Japan

-Unleashing Energy Efficiency in Cities: A Role for National Policies-

Masayuki Dewaki

International Affairs Office,
Energy Conservation and Renewable Energy Dept.
Agency for Natural Resources and Energy
Ministry of Economy, Trade and Industry

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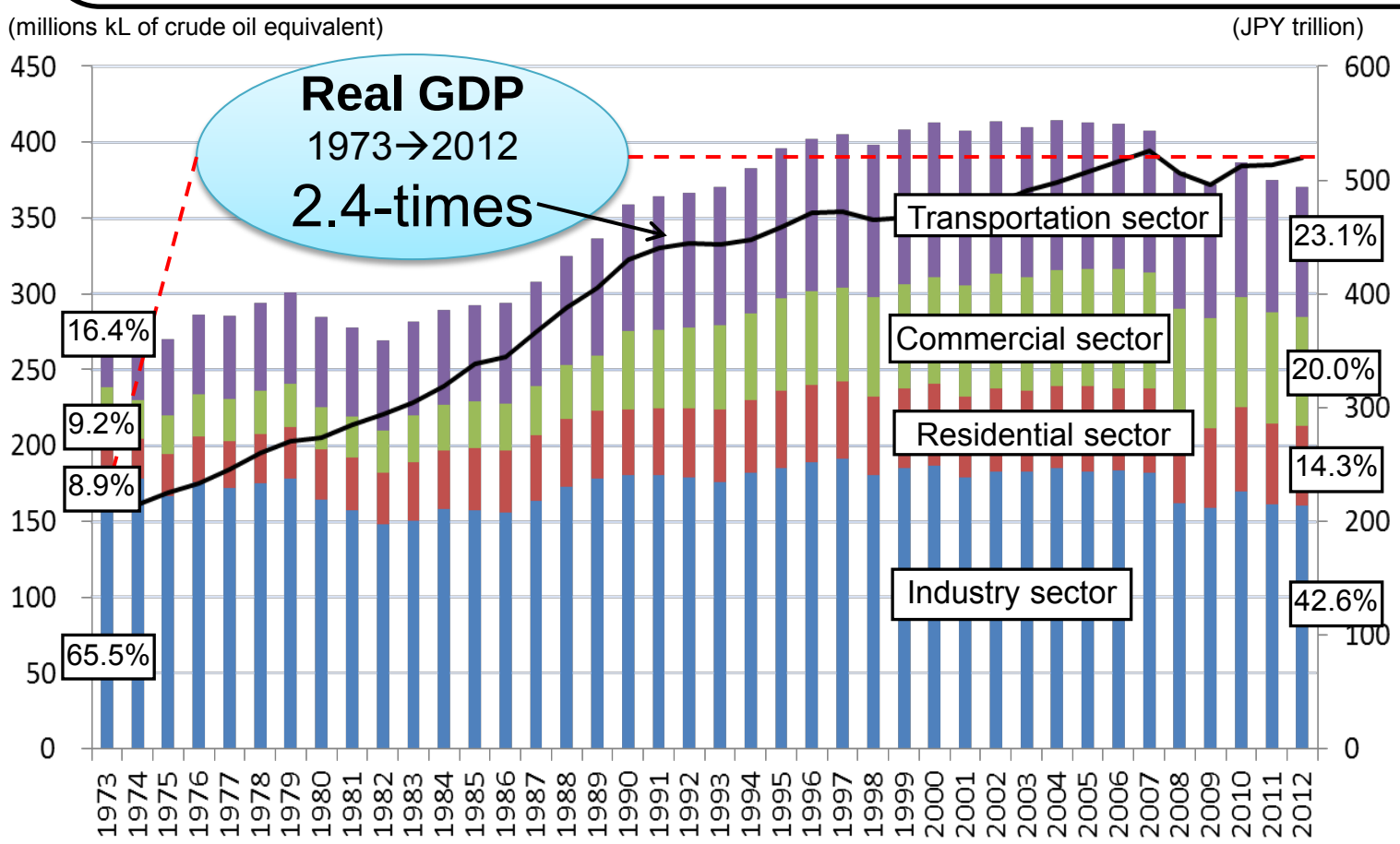
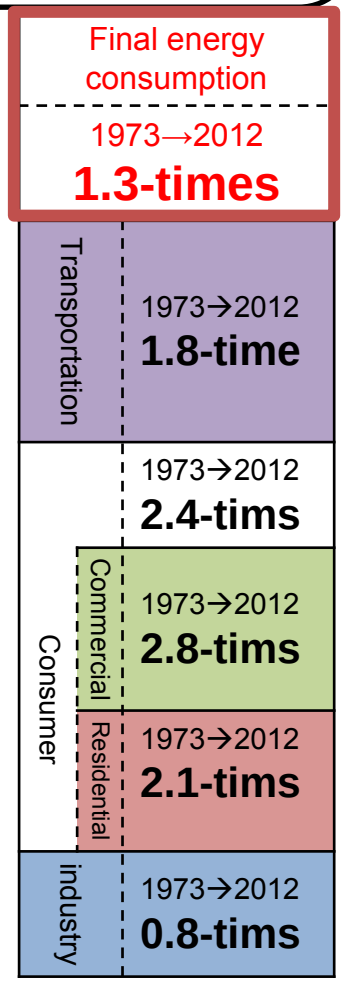
Trends in Final Energy Consumption in Japan

Ministry of Economy, Trade and Industry
Agency for Natural Resources and Energy

- The final energy consumption of Japan has basically consistently increased, except for periods immediately following the two oil crises and the recent economic downturn.
- Until 2012 the GDP continued increasing to about 2.4 times the 1973 level and the consumption of energy for individual sectors significantly increased with the Consumer sector increasing to **about 2.4 times**, while the transportation sector increased to **about 1.8 times**, whereas the industrial sector decreased to **about 0.8 times**.



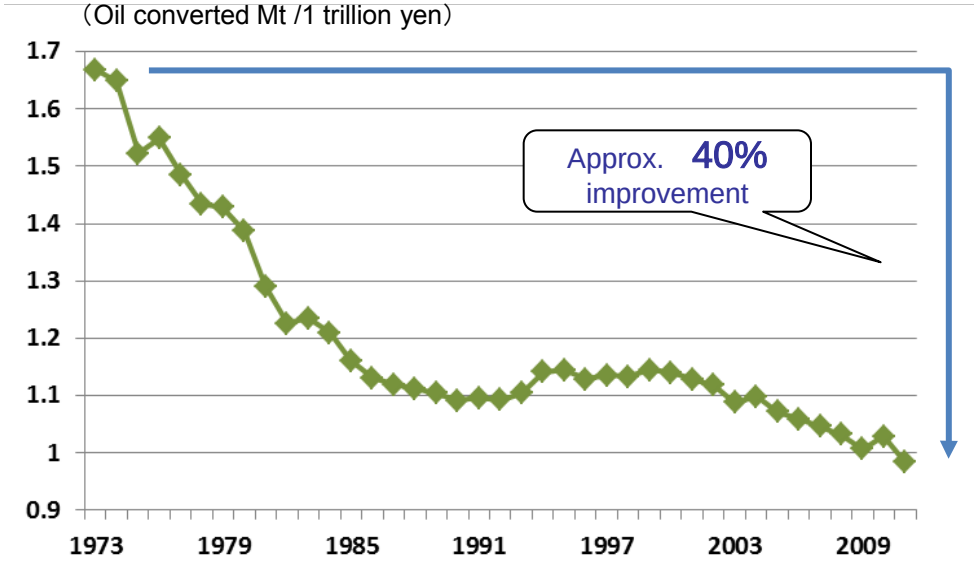


Sources: "Comprehensive Energy Statistics" and "Annual Report on National Accounts." ※Value of 2012 are preliminary.

Energy Conservation Efforts of Japan after Oil Crises

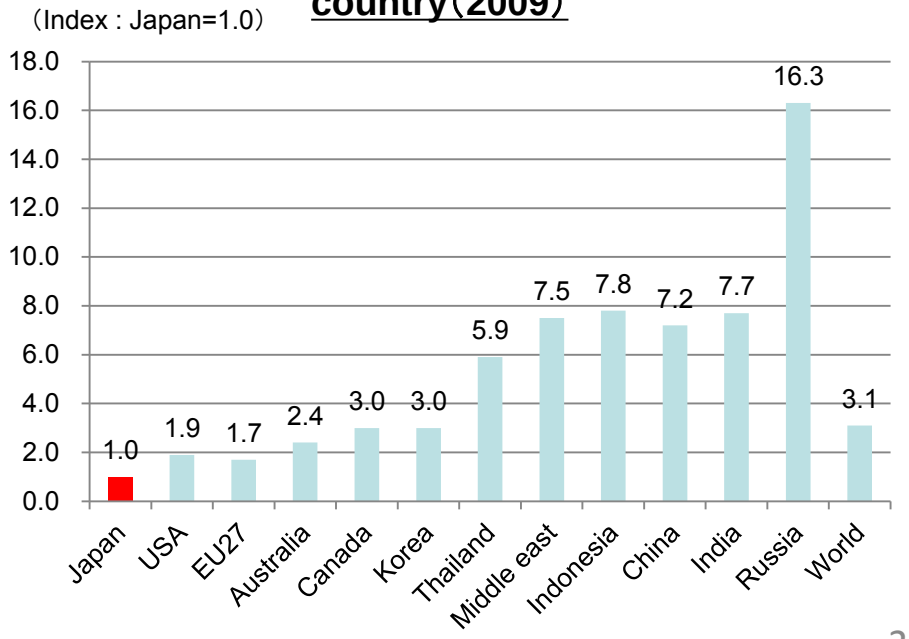
- Japan has improved energy efficiency by approx. 40% after the oil crises since 1970s as a result of positive actions by both public and private industrial sectors.
- Japan intensively introduced "Energy Management System based on Energy conservation law", then achieved the lowest energy consumption per GDP.

Primary energy use per real GDP of Japan



Source) Total Energy Statistics by ANRE/METI

Primary energy supply per GDP unit of each country(2009)

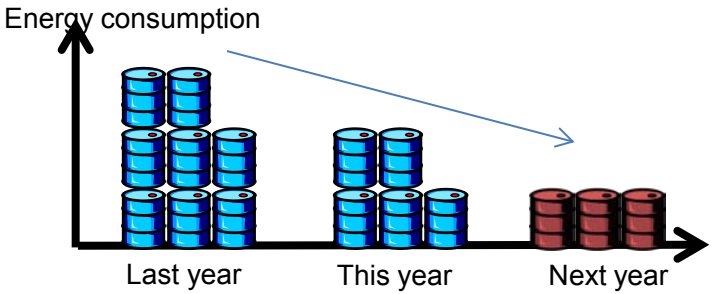


Calculated according to IEA statistics

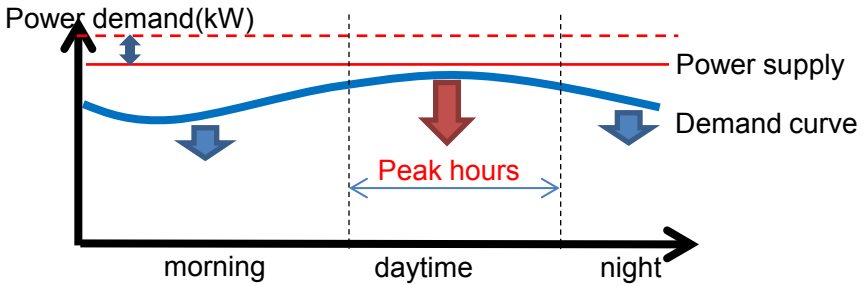
Priority Areas of Next Energy Efficiency Policy

■ The challenge is to keep consumers' efforts of energy conservation in the long term.

Usual energy conservation



Peak Demand Management



- Evaluation measures to deal with peak demand of electricity

Improve Energy Efficiency of Houses and Buildings

- Reviewed Energy Conservation Standards for Residential Buildings and Structures
- Top Runner Program for Building Materials ets.
- Equipment added to Top Runner Program（LED ets.）

Promote Energy Management Systems

- Energy Management System（BEMS・HEMS）
- ISO 50001
- Smart Community（DR）

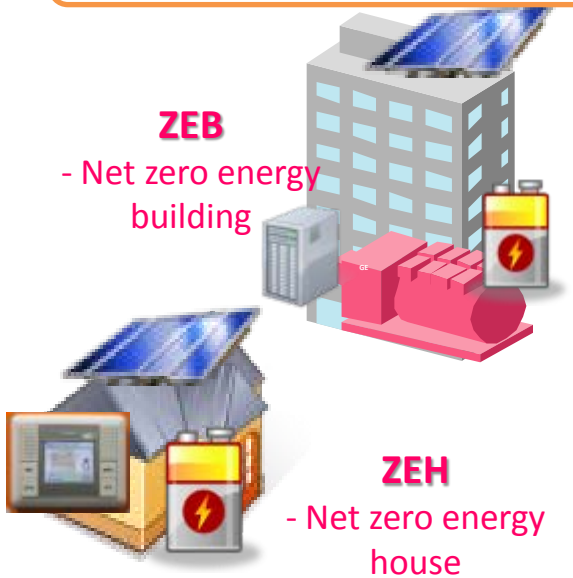
Next Step in Energy Management

- Handle electricity supply-demand problem with promotion of introduction of HEMS / BEMS, high efficient air conditioners, lighting and hot-water supply.
- Pursue energy efficiency of entire systems by managing entire houses and buildings.
- In addition, more efficient energy management can be realized by cross-management of houses and buildings, or regional management.

Installation of energy management equipment

Cooperate by buying equipment such as efficient air conditioners and lighting, and controlling them with HEMS or BEMS.

Optimize houses and buildings



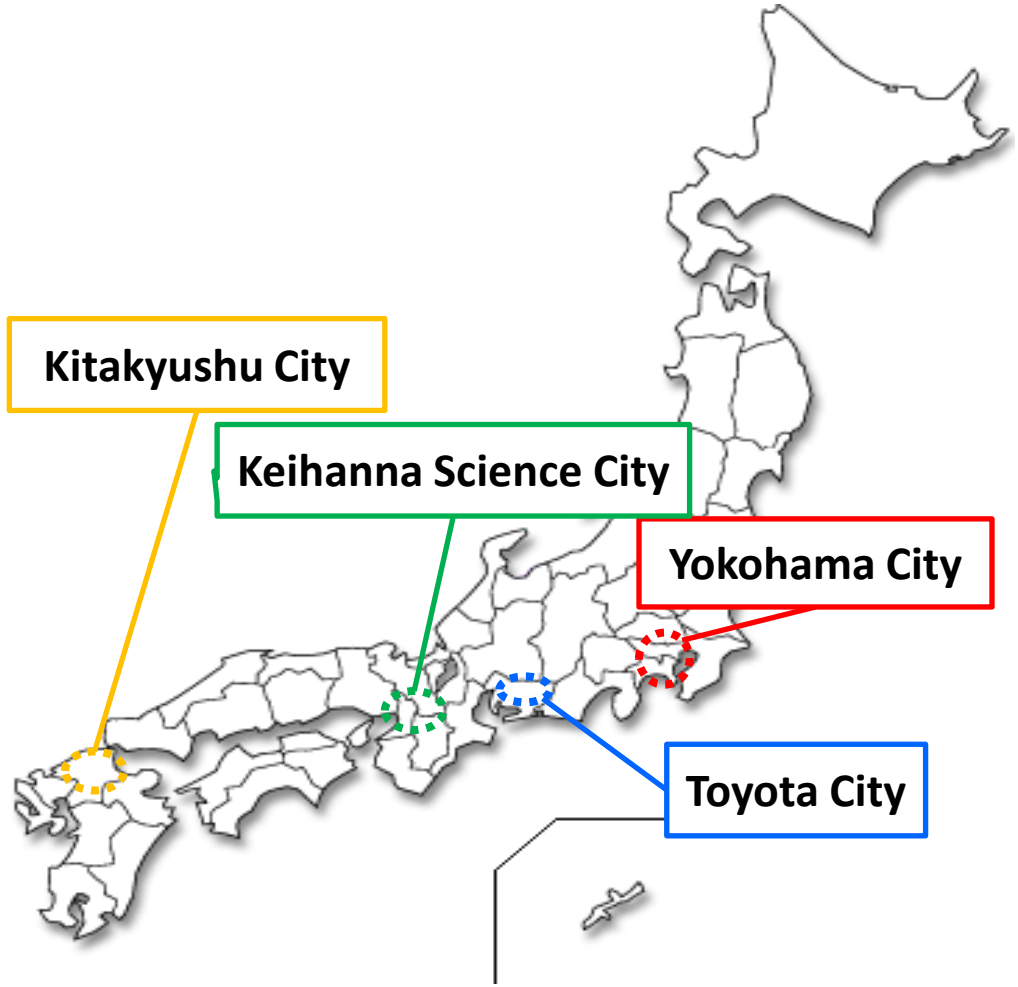
"Net zero energy" means that net annual primary energy consumption is approximately zero.

Regional or cross-regional optimization

Demonstration of Smart Communities in Japan

Ministry of Economy, Trade and Industry
Agency for Natural Resources and Energy

■ Starting in FY2011, large-scale smart community demonstration projects have been proceeding in 4 regions across Japan that constitute representative examples of different concepts, with the participation of many residents, local governments, and corporations.



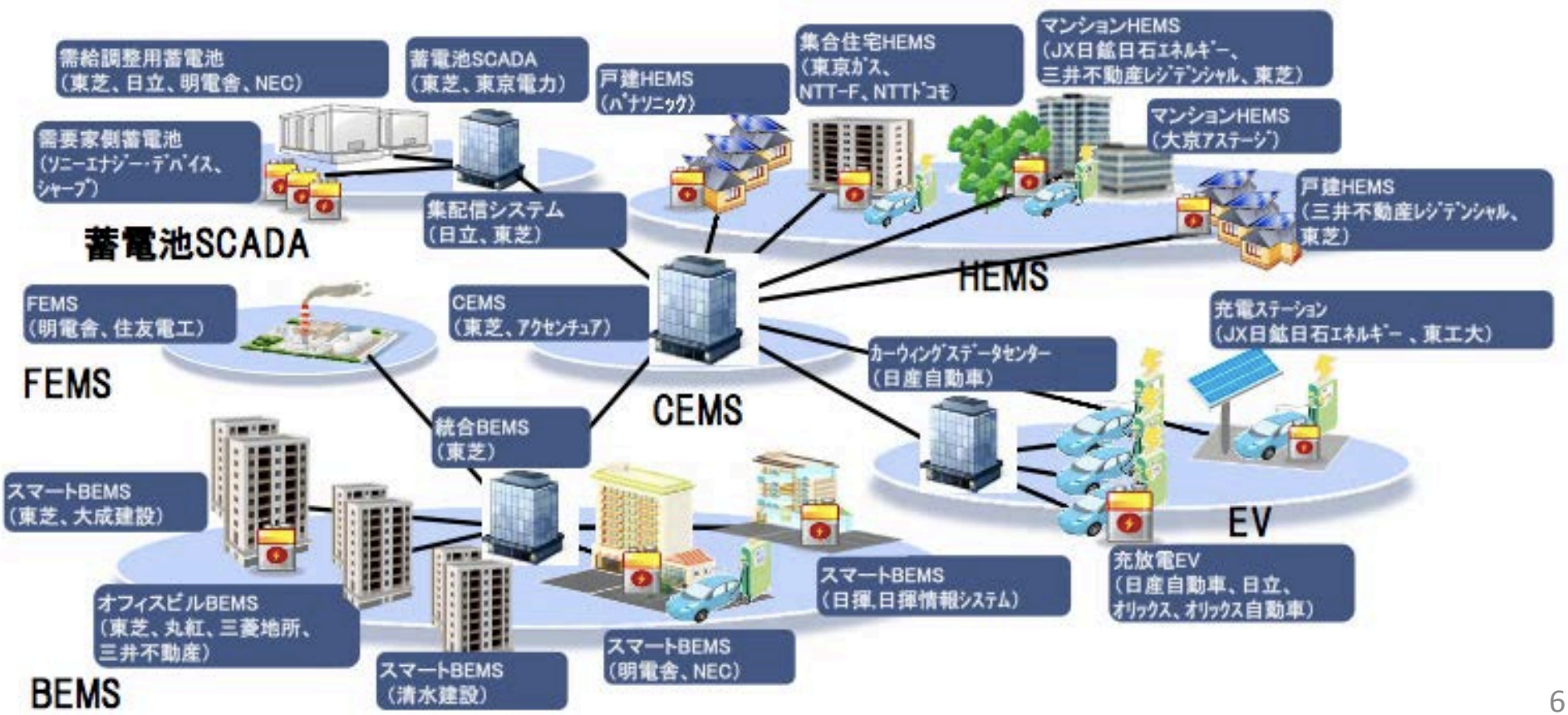
Yokohama City	Wide-area metropolis Introduction of an energy management system for an existing wide-area metropolis. As the sample number is high (4,000 households), demonstration using a variety of strategies is possible.
Toyota City	Separated housing Automatic control of home appliances in 67 homes. Secondary cells equipped in vehicles are used to supply energy to households. Approaches to drivers for reducing a traffic jam
Keihanna Science City	Housing development Demand response demonstration based on a point system is being implemented for general households (approximately 700 households) where PV or HEMS automatic control has not been introduced.
Kitakyushu City	Designated supply area In an area where power is supplied by Nippon Steel Corporation, a pricing system is being implemented where the energy price fluctuates for 2 hours afterwards in accordance with the state of supply and demand of energy for the day, applicable to 50 business establishments and 230 households,.

Demonstration in Yokohama City

Reduce CO2 emissions by 25 % through wide-area energy management
- Introduce demand response for large-scale consumers
- Produce system stability through energy management systems for storage batteries

Target Scale

HEMS (installed in 4,000 houses) / BEMS (installed across 800,000 m2) / EV (2,000 vehicles introduced)



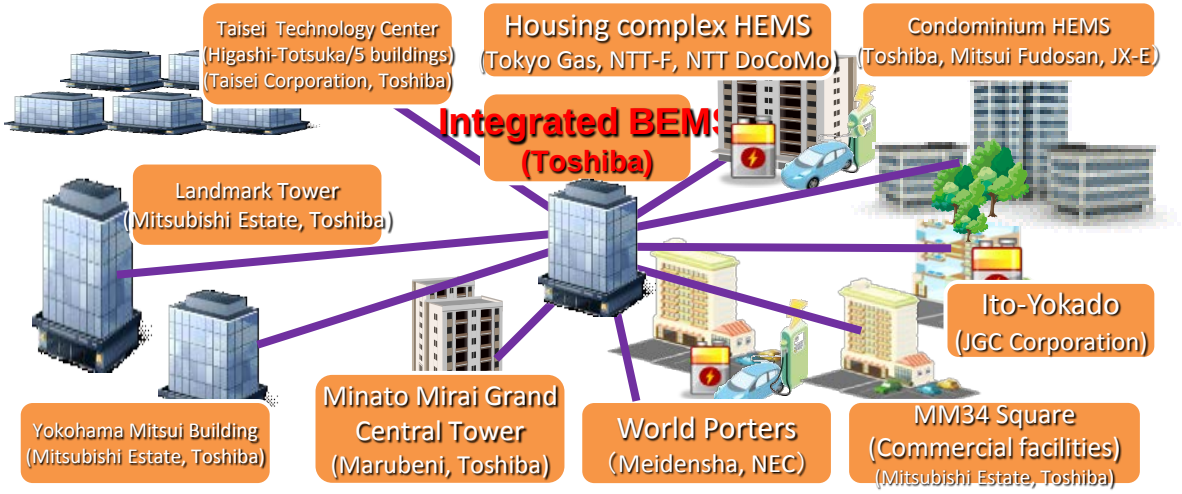
Demonstration in Yokohama City

MEMS

- Solar power generation, fuel cells, solar heat, EV, etc. have been introduced into housing complexes, and demonstration where interchange of power and heat within residential buildings is carried out was initiated in April of 2012.
- Aim for a reduction of approximately 40% in energy usage through introduction of renewable energy and distributed energy, interchange of electrical heat/integrated control, and introduction of HEMS (Tokyo Gas company housing).
- Aim for a self-sufficiency rate of 80% or higher for electrical power energy (JX Nippon Oil & Energy company housing).

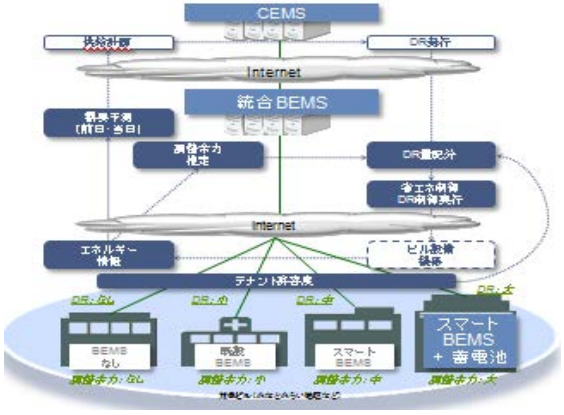
Integrated BEMS

- "Integrated BEMS" where multiple buildings are managed in an integrated manner was developed, and connection was initiated sequentially.
- Aim for approximately 10% more energy-saving than regular energy-saving buildings



CEMS

- Large-scale demand response demonstration targeting 4,000 households, etc. planned on being initiated this FY.
- Aim to control use of energy and a peak cut of approximately 20%.



Demonstration in Toyota City (Smart Houses)

- In demonstrations conducted in Toyota City, 67 smart houses equipped with solar panels, fuel cells for household use, Eco Cute, secondary cells, plug-in hybrid vehicles, electric vehicles, etc. are being constructed in the Higashiyama and Takahashi districts. All homes have already gone on sale (sales prices is approximately 50 million yen in the Higashiyama district), and 66 homes are already inhabited.
- Demand response demonstration of awarding of points has been initiated since December of 2011.

Model Home Specifications (Exterior)

Demonstration in Toyota City (Point Incentives)

- In accordance with the amount of power used, Edy points are subtracted if used during peak hours and awarded when used during periods when power supply and demand are relaxed. By doing so, pseudo-dynamic pricing is implemented.
- In the future, approaches for drivers will be carried out in order to reduce fuel costs for transportation, and plans are being made to implement demand response demonstration, such as by awarding points to drivers who avoid congested areas.

Demonstration in Toyota City

Energy data management system (EDMS)

Demand forecasting information

1

2

Subtracting/awarding of points

○Use of power during peak hours
→Points subtracted

○Use of power during periods when supply and demand of power is relaxed
→Points awarded

Households/community

3 **Changes in behavior in accordance with pseudo fluctuations in power prices (Demand response)**

Charge and discharge of PHV in accordance with the state of electricity use

Saving energy during power peaks

Demonstration in Keihanna (Large-scale Demand Response)

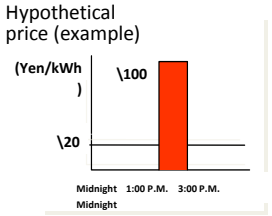
- In 3 municipalities in Keihanna Science City, large-scale demand response demonstration was initiated in summer in 2012, targeting approximately 700 households without bias in household composition and that do not possess power generators.
- Aim to control use of energy by households.

DR design

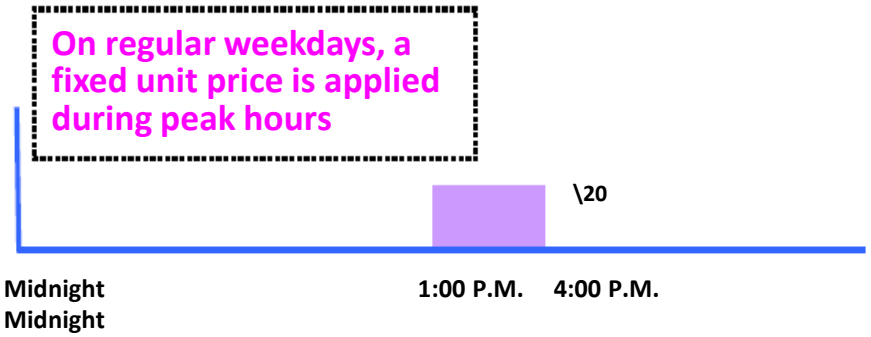
- Implemented for 3 months during the summer and the winter.
- Before each season, a fixed amount per household (7,000 yen for this summer) is granted.
- The peak period amount of “used amount x unit price” is collected during the peak hours of 1:00 to 4:00 PM on weekdays (6:00 to 9:00 PM during the winter).
- The premium unit price is 20 yen for regular weekdays, and either 40 yen, 60 yen, or 80 yen during CPP.
- The condition for CPP during last summer consisted of “arbitrary days where the forecast on the previous day is 30° C or higher,” occurring 5 times for each unit price for a total of 15 times.

***CPP = Critical Peak Pricing**

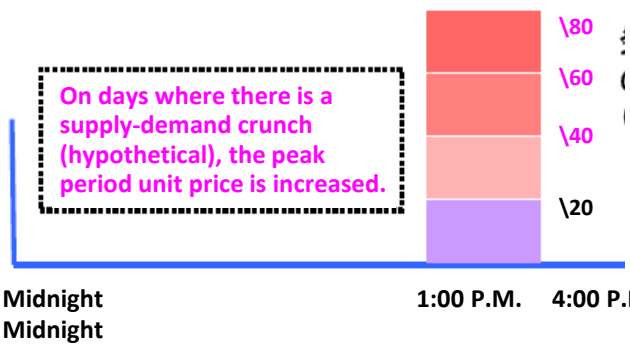
E-mail notification stating that the following day is a day on which the hypothetical pricing is applied



Summer weekdays: Not put into motion



Summer weekdays: Put into motion



On days where the special pricing is put into motion, the unit price increases to one of those on the left (notification is provided regarding the unit price beforehand)

Demonstration in Kitakyushu City

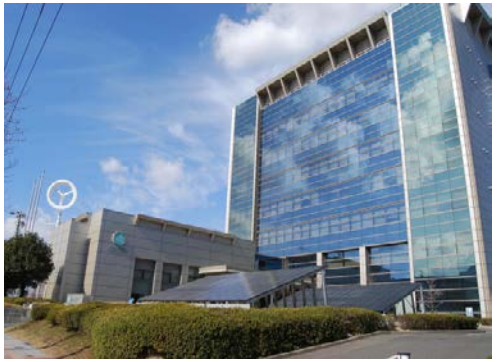
- Distribution lines were transferred from Kyushu Electric Power to Nippon Steel; and designated supply of power has been implemented independent of general power companies' supply areas. Nippon Steel is supplying power by providing flexible power prices.
- Dynamic pricing demonstration for 50 business establishments and 230 households in the Higashida district, in which power prices fluctuate in accordance with the state of supply and demand of energy for the day, was implemented.

Environmentally symbiotic condominium, corporate dormitory for single-person households

Condominium
Solar power generation 170kW
HEMS installed
Smart meters installed

Dormitory
Solar heat system
Geo-heat system
BEMS installed

Tenant office building (CEMS installation location)



Solar power generation 10kW
Wind power generation 3kW
BEMS installed

Environment Museum/Kitakyushu Eco House

Solar power generation 6kW
Wind power generation 3kW
Fuel cells 1kW

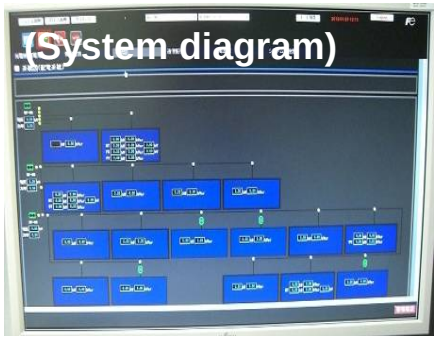
Museum of Natural History & Human History

Solar power generation 160kW
Fuel cells 100kW
Secondary cells 120kW
BEMS installed

Dynamic Pricing in Demonstration for Kitakyushu

- CEMS (Community Energy Management System) where energy for an entire designated supply area is managed in an integrated manner was developed.
- Dynamic pricing where prices are changed in accordance with the state of supply and demand as based on information related to supply and demand of power that is aggregated in CEMS, and notification regarding power pricing is sent to each customer beforehand was initiated in summer of 2012.
- By increasing the pricing during peak periods (by up to 10-fold), usage cutbacks during peak periods were verified.

Examples of screens for CEMS



Dynamic Pricing in Demonstration for Kitakyushu

Smart Meters and HEMS

現地設置のスマートメータ

宅内表示器

宅内表示器画面例

（電力使用量確認画面）

（お知らせ画面）

（電力料金確認）

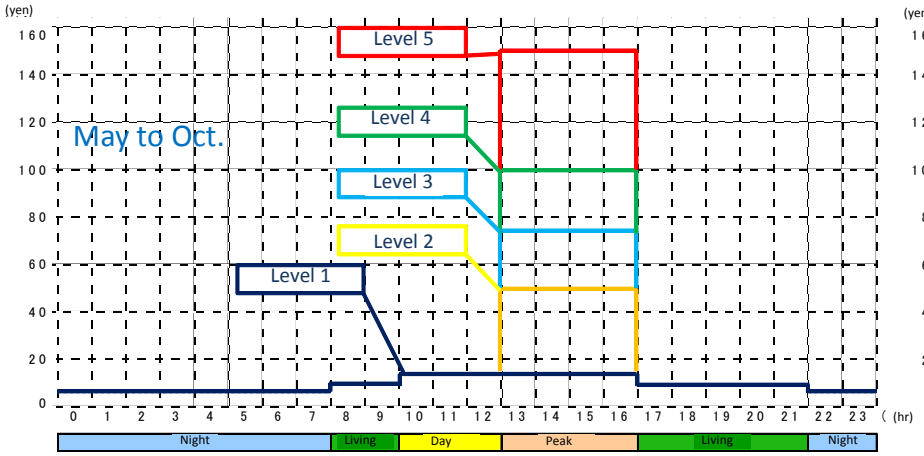
HEMSに設置される
コミュニケーションロボット

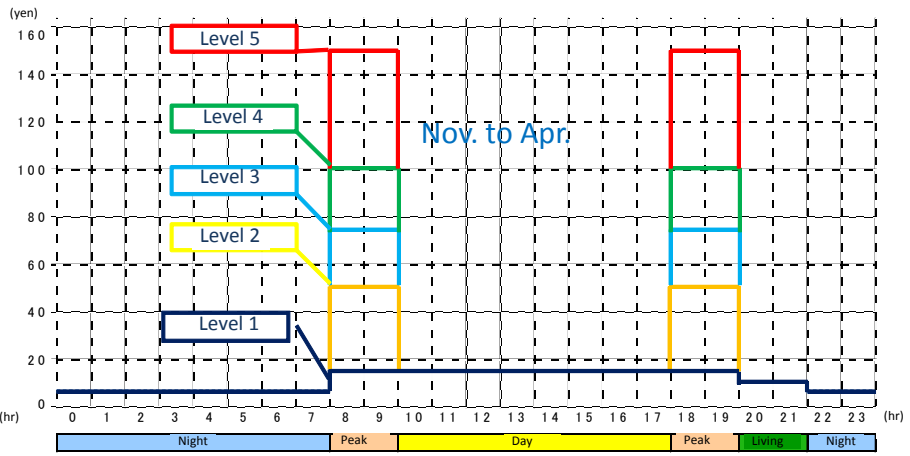
Incentive Program for Demonstration in Kitakyushu City

- Depending on the extent of the power crunch for the day, demonstration where pricing fluctuated based on 5 patterns, from “Level 1 (15 yen/kWh)” to “Level 5 (150 yen/kWh)” was implemented

Pricing table (Yen/kWh)

Category	Season	Time period	Level 1	Level 2	Level 3	Level 4	Level 5
Peak periods	May to Oct.	1 P.M. to 5 P.M.	15.18	50.22	75	100	150
	Nov. to Apr.	8 A.M. to 10 A.M. 6 P.M. to 8 P.M.	15.09	50.02	75	100	150
Daytime	May to Oct.	10 A.M. to 1 P.M.	15.18	15.18	15.18	15.18	15.18
	Nov. to Apr.	10 A.M. to 6 P.M.	15.09 to 15.18	15.09 to 15.18	15.09 to 15.18	15.09 to 15.18	15.09 to 15.18
“Living” time	May to Oct.	8 A.M. to 10 A.M. 5 P.M. to 10 P.M.	10	10	10	10	10
	Nov. to Apr.	8 P.M. to 10 P.M.					
Nighttime	Year-round	10 P.M. to 8 A.M.	5.94	5.94	5.94	5.94	5.94





Results of Demand Response Demonstration

■ From the results of demand response demonstration, peak cut effects of 20% and energy-saving effects are statistically confirmed. A review is ongoing regarding reflection of these results in reform of power regulations.

Peak cut effects from demonstration in Kitakyushu City

Peak cut effects (1 to 5 P.M.) (Base price = 15 yen)	Effect (%)	Statistical significance
CPP=50 yen	−18.1%	5% level
CPP=75 yen	−18.7%	5% level
CPP=100 yen	−21.7%	1% level
CPP=150 yen	−22.2%	1% level

Data from June to September 2012. Sample number = 180

Source: Results of statistical demonstration by Professor Ida of the Graduate School at the University of Kyoto, Associate Professor Tanaka of the National Graduate Institute for Policy Studies, and Research Ito of the Stanford Institute for Economic Policy Research at Stanford University

Thank you for your attention !!

Japan Smart City Portal
http://jscp.nepc.or.jp/en/