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

Japanese Smart Community Pilot Projects

May 15, 2014

Yasuhiro SAKUMA

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

The except from the 4th Strategic Energy Plan of Japan

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

Ⅱ. Principles of Energy Policy and Viewpoints for Reform

1. Principles of Energy Policy and Viewpoints for Reformation

(1) Confirmation of basic viewpoint of energy policies (3E + S)

- Stable Supply (**E**nergy Security)
- Cost Reduction (**E**conomic Efficiency)
- **E**nvironment
- **S**afety

+

Global Viewpoint
-Developing energy policies with international movement appropriately
-Internationalizing energy industries by facilitating business overseas

Economic Growth
-Contribution to reinforce Japan's locational competitiveness
-Activating Japan's energy market through energy system reform

2. Evaluation of each energy source

(1) Renewables (solar, wind, geothermal, hydroelectricity, biomass)

- Promising, multi-characteristic, important, low carbon and domestic energy sources
- Accelerating their introduction as far as possible for three years, and then keep expanding renewables

The excerpt from the 4th Strategic Energy Plan of Japan Cont.

Ⅲ. Policies on Energy Supply/Demand Structures

2. Realization of an advanced energy–saving society

(1) Enhancing energy efficiency in each sector

- Formulating energy efficiency indexes in order to facilitate energy-saving on each sector

<residential & commercial sector>

- Introduction of complementary energy efficiency standards for buildings/houses

<transport sector>

- Promoting ITS which enables automatic driving system to improve fuel efficiency

<industry sector>

- Encouraging investment to replace more efficient facilities

(2) Realization of smart energy consumption through various options to end users

- Establishing a method of “Demand Response” through smart meters in all homes and all businesses

9. Energy leading Growth Strategy : creation of new energy enterprises etc,

(2) Fostering new energy enterprises

- Mitigating regulations for creation of comprehensive energy enterprises
- Promoting smart communities which would give a new energy supply service with other regional public services

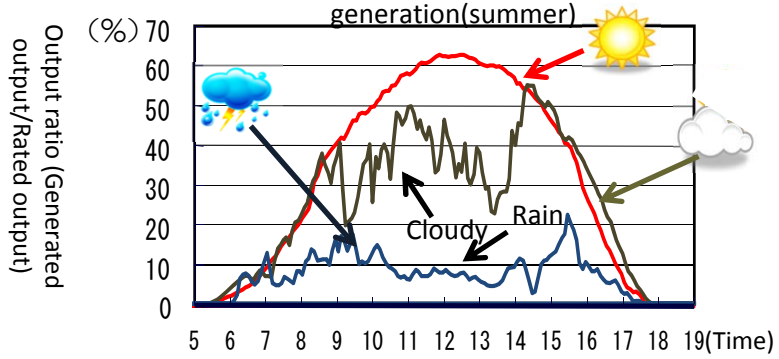
Energy Situation and Smart Communities After the Earthquake

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

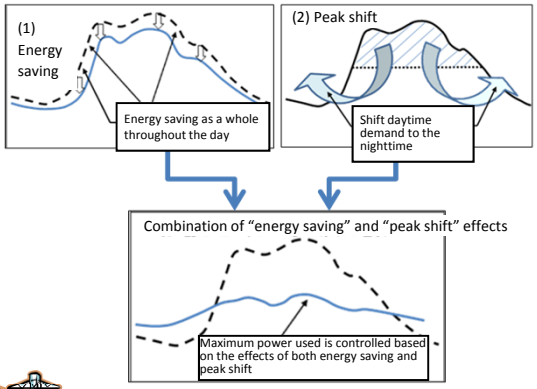
- After the Great East Japan Earthquake, saving energy and cutting back during peak hours became an urgent issue.
- With the increase of renewable energy introduction, the concerns on electricity quality, adjusting power fluctuation and increasing voltage of the power network, occurred.
- The solution to these kinds of problems is an efficient system for energy, including electricity, heat, and transportation.

1. Due to large-scale induction of renewable energy, ensuring the quality of electricity, such as voltage and frequency, becomes a problem

◆Example of output fluctuation of solar power generation(summer)



2. After the disaster, saving energy and cutting back during peak periods became issues.



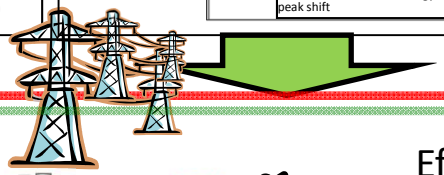
3. Sales of products that promote safety.

V2H

System where electricity can be supplied to residences from lithium ion batters equipped in Leaf

Capacity	Price
1kWh	¥870,000
2.5kWh	¥1,890,000

Yamada Denki
(Edison power)



Smart grids


Smart meters


HEMS


Secondary cell


EV

Efficient use of electricity based on IT technology and secondary cells

Smart communities


Co-generation


Fuel cells


Car sharing

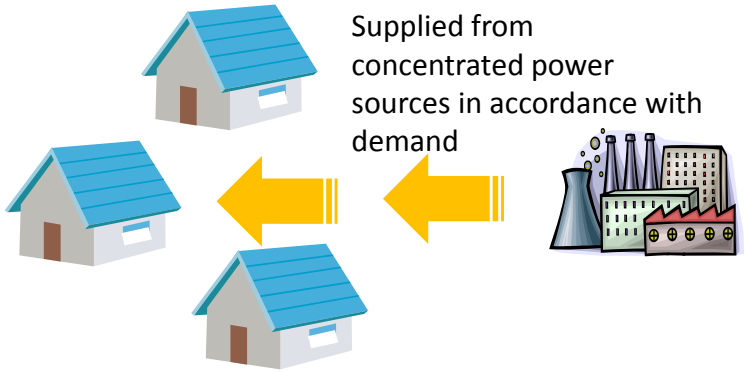
Efficient use of energy that includes electricity, heat, and transportation

Structural Changes by Smart Communities

- Power utilities have supplied the necessary amount of electricity at the same price category when required by consumers.
- If the high amount of renewable energy is deployed, consumers will play a role of handling the supply-demand adjustment function which the supplier side used to be responsible for.
- The reform from an large-scale and concentrated energy structure supplying energy in a single direction, to a distributed energy structure having the adjustment functions on supply-demand based on bi-directional movement.

Traditional energy system

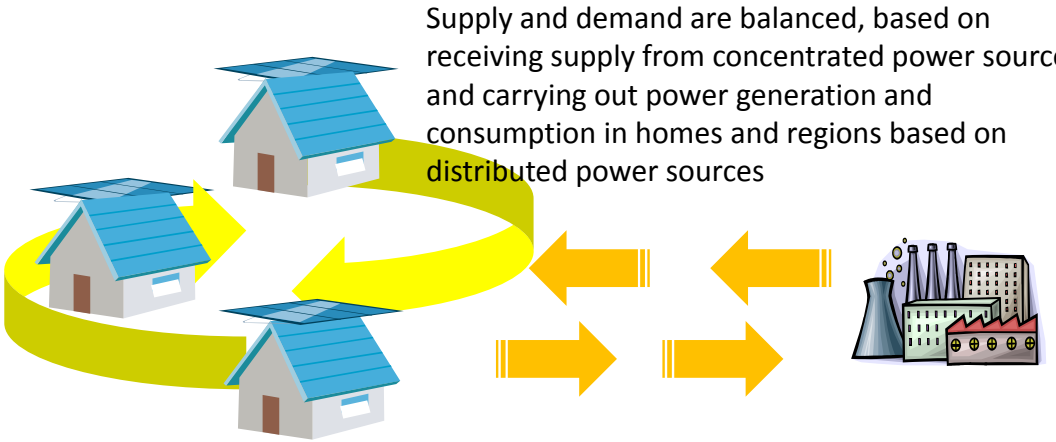
Unidirectional type



Large-scale, concentrated model

Future energy system

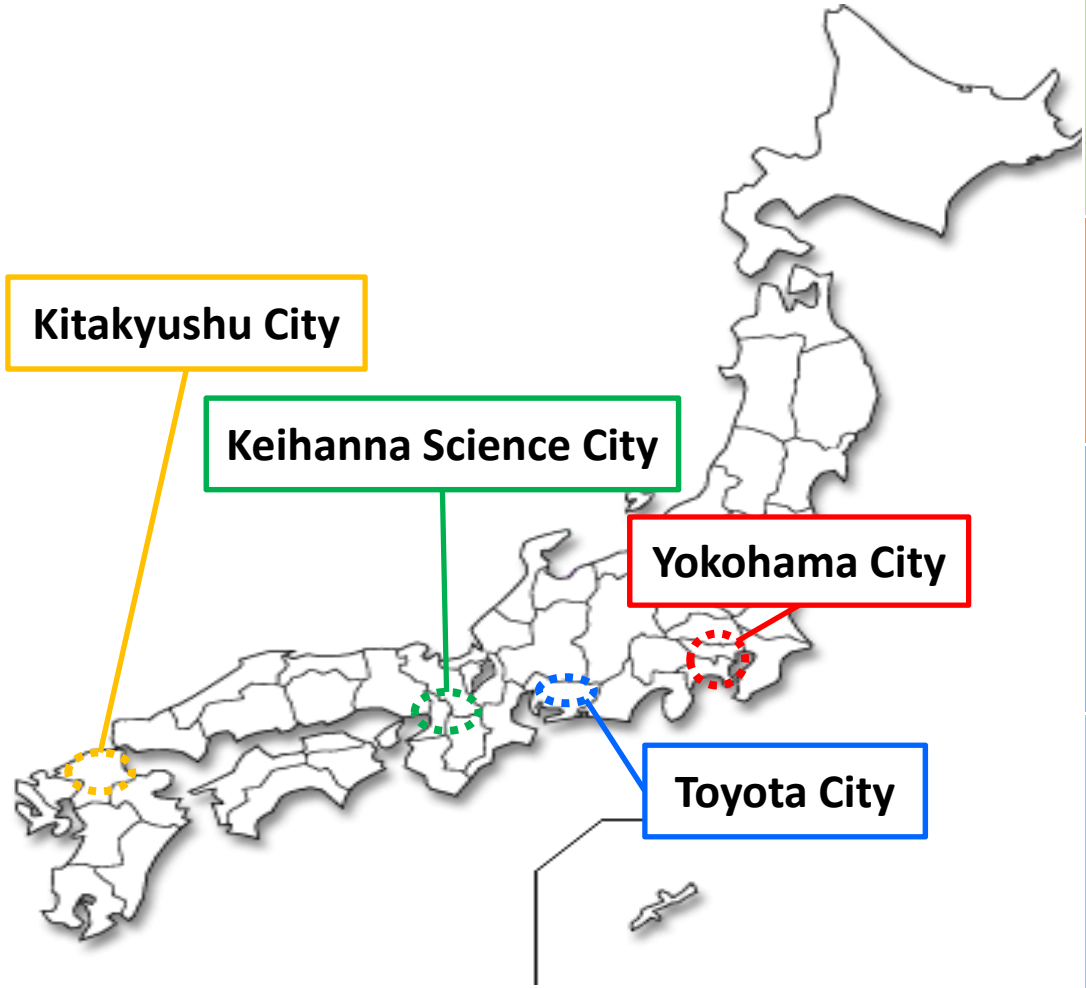
Bi-directional type



Demonstration of Smart Communities in Japan

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

■ Starting in FY2011, large-scale smart community demonstration projects have been ongoing in 4 regions across Japan. Those constitute representative examples of various patterns, based on participation by 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 hypotheses is possible.
Toyota City	Separated housing Automatic control of home appliances in 67 households. Secondary cells equipped in vehicles are used to supply energy to households. Approaches for drivers to alleviate congestion.
Keihanna	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 where the power 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, is being implemented.

Demonstration in Yokohama City

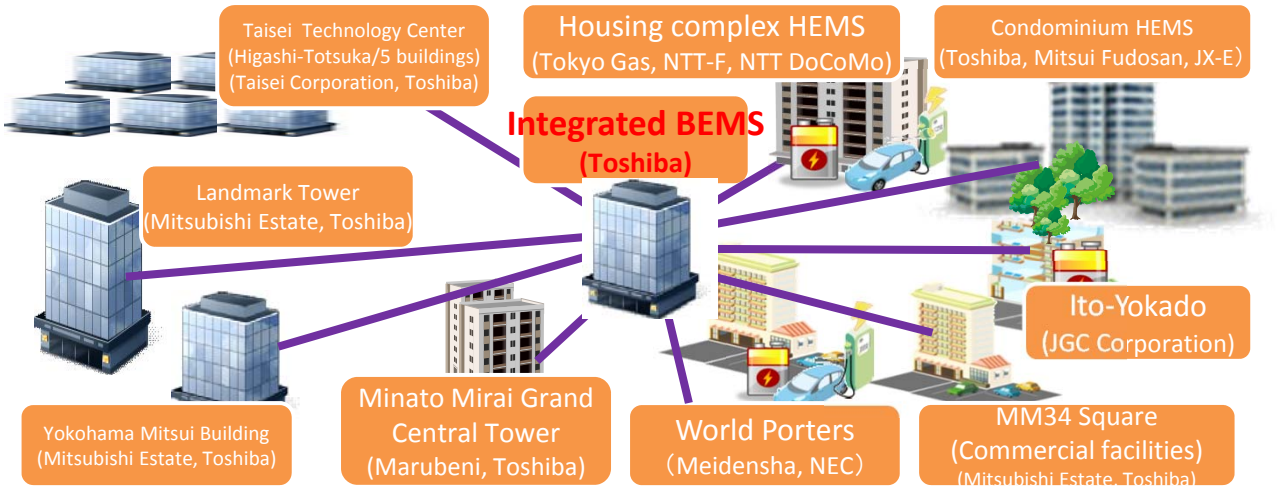
Ministry of Economy, Trade and Industry
Agency of Natural Resources and Energy

MEMS

- Solar PV, fuel cells, solar heat, EV, etc. have been introduced into housing complexes.
- 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.
- Aim for a self-sufficiency rate of 80% or higher for electrical power energy.

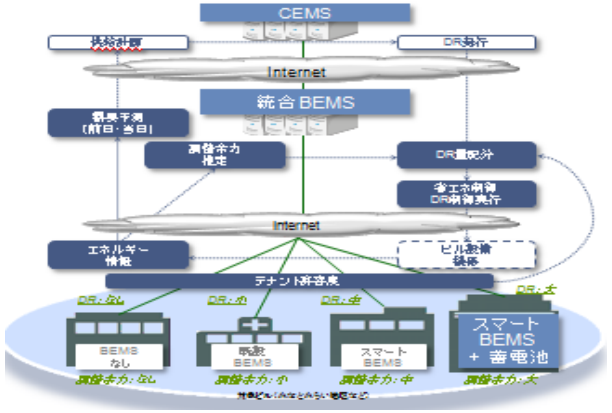
Integrated BEMS

- "Integrated BEMS" where multiple buildings are managed in an integrated manner was developed.
- 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.
- Aim to control use of energy and a peak cut of approximately 20%.



Demonstration in Toyota City (Smart Houses)

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

■67 smart houses equipped with solar PV, fuel cells, Eco Cute, secondary cells, plug-in hybrid vehicles, electric vehicles(EV), etc. are being constructed.
■Demand response demonstration of awarding of points has been initiated since December of 2011.

Model Home Specifications (Exterior)


Solar panel (3.2 kW)


Ene Farm


EcoCute (370L)


Secondary cell (5kWh)


Charging stand (supports V2H)

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 off-peak periods. By doing so, pseudo-dynamic pricing is implemented.
- In the future, the approaches for transportation by awarding points to drivers who avoid congested areas will be carried out in order to reduce fuel costs for transportation.

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

V2H (Vehicle to Home)

■ After the earthquake, V2H (Vehicle to Home) technology, which allows for energy to be supplied to households in case of energy crisis, was demonstrated.

Demonstration in Yokohama City

- In summer of 2011, demonstration of V2H technology from Nissan Leaf to homes was initiated in “KANKANKYO” as part of demonstration for Yokohama City.
- As a result of the demonstration, the V2H system was introduced to the market for the first time in the world in June 2012.
- Based on a 24kWh secondary cell equipped in vehicles, it is possible to cover approximately two days’ worth of energy used by general households during a disaster.

Demonstration in Toyota City

- In autumn of 2012, demonstration of V2H technology from Toyota Prius PHV to homes was initiated as part of demonstration for Toyota City.
- Commercialization expected around 2013.

- V2H Standardization Review Panel
  In aiming towards formulation of V2H standardization, the V2H Standardization Review Panel formulated “Charging and Discharging System Guidelines for Electric Vehicles” in March 2012.

Demonstration in Keihanna (Large-scale Demand Response)

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

- Since summer in 2012, targeting approximately 700 households which do not possess power generators.
- Aim to control use of energy by households; peak cut of approximately 20%.

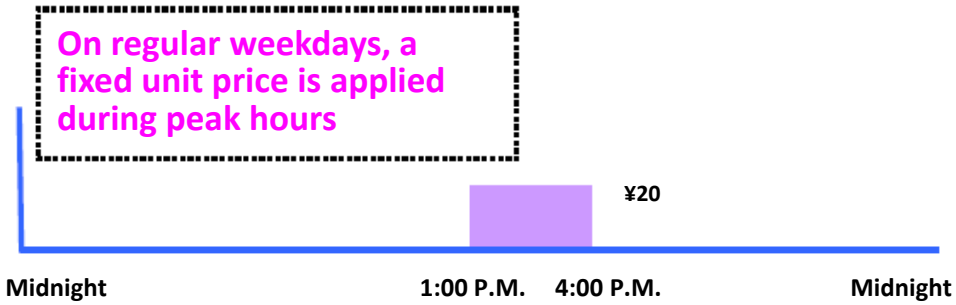
DR design

- 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.

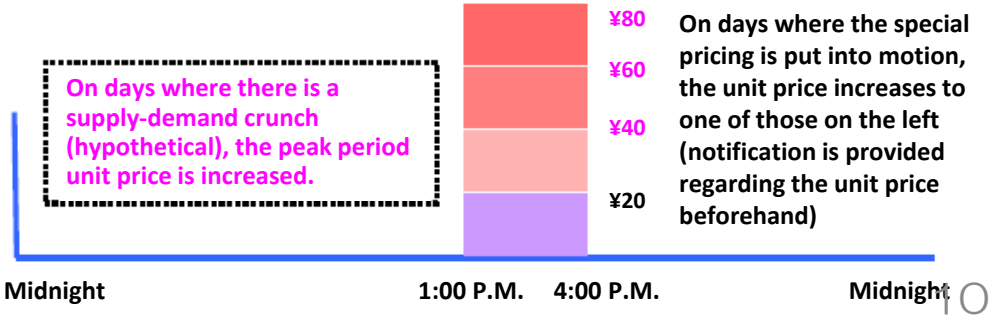
***CPP = Critical Peak Pricing**

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

■ Dynamic pricing demonstration for 50 business establishments and 230 households, 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

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.

Kitakyushu City

Results of the FY2012 demonstration trials (number of sample cases: 180)

	Summer (June to September)		Winter (December to February)	
Electricity price (*1)	Peak cut effect	Statistical significance (*3)	Peak cut effect	Statistical significance (*3)
Time of Use (TOU)	- (*4)	- (*4)	- (*4)	- (*4)
CPP= 50 yen	-18.1%	5% level	-19.3%	1% level
CPP= 75 yen	-18.7%	5% level	-19.8%	1% level
CPP= 100 yen	-21.7%	1% level	-18.1%	1% level
CPP= 150 yen	-22.2%	1% level	-21.1%	1% level

Keihanna Science City

Results of the FY2012 demonstration trials (number of sample cases: 681)

	Summer (July to September)		Winter (December to February)	
Electricity price (*2)	Peak cut effect	Statistical significance (*3)	Peak cut effect	Statistical significance (*3)
TOU (premium: 20 yen)	- 5.9%	1% level	-12.2%	1% level
CPP (premium: 40 yen)	- 15.0%	1% level	-20.1%	1% level
CPP (premium: 60 yen)	-17.2%	1% level	-18.3%	1% level
CPP (premium: 80 yen)	-18.4%	1% level	-20.2%	1% level

Source: Results of the statistical demonstration conducted by Dr. Takanori Ida, professor, Kyoto University, Graduate School of Economics, Dr. Ryuichi Tanaka, associate professor, National Graduate Institute for Policy Studies, and Dr. Ito , fellow, Stanford Institute for Economic Policy Research

Thank You For Your Attention!

Japan Smart City Portal

http://jscp.nepc.or.jp/en/