

# Smart Community Demonstrations - Experiences in Japan -

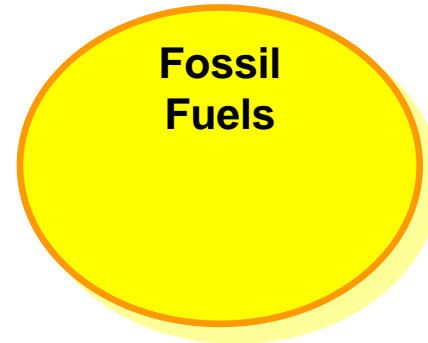
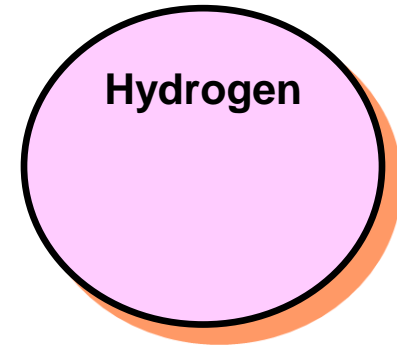
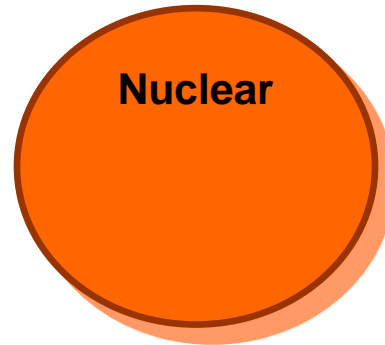
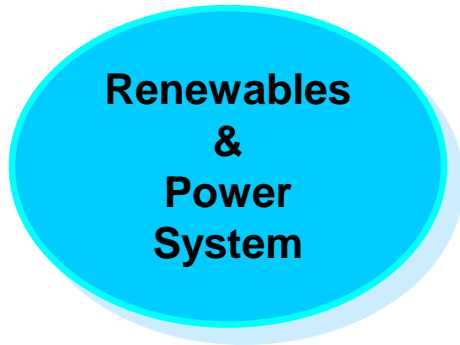
Experts' Group on R&D Priority-setting and Evaluation (EGRD)  
IEA Committee on Energy Research and Technology (CERT)  
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The views expressed in this material are those of the individual author and do not represent the organizational view of Institute of Applied Energy.

# IAE overview

- Since 1978
- Non-profit organization
- Expertise - energy technology assessment
- Energy areas
- Visit <http://www.iae.or.jp> for further information



# Outline

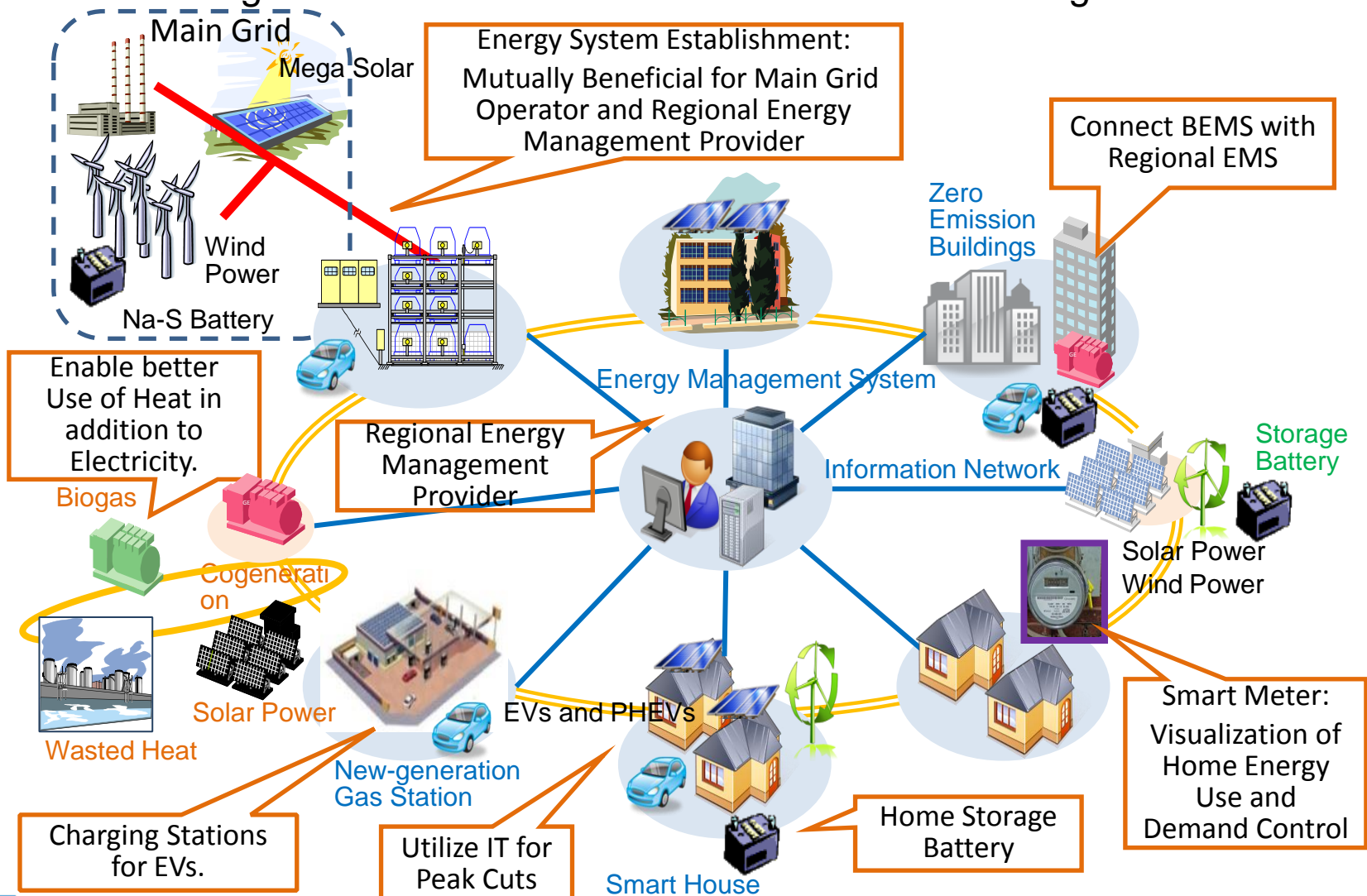
- 1. Motivation of Smart Community Energy Development**
- 2. Energy Management System Demonstration Projects in Japan**
- 3. Summaries**

# Outline

- 1. Motivation of Smart Community Energy Development**
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# Concept of Smart Community Development

- Smart community is a new community utilizing advanced ICT with participation of citizens, and involves smart transportation, homes, office buildings and factories, while enabling the introduction of distributed renewable energies.



# Great Earthquake changed the situation

- Technology demonstration
  - Renewable power (PV etc.), batteries, appliances, automobiles, etc.
  - Integration through information exchange
- Strong energy saving and peak-shift incentive by shortage of power supply after Great Earthquake in 2011.
- Relative importance of demand response has increased.

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# EMS Demonstration Projects in Japan

- Energy Management System (EMS)
  - Commercial or office Building (BEMS)  
Factory (FEMS), Home (HEMS)
  - Community (CEMS) – Integrated
- Large social system demonstration

- *From FY2010 to FY2014*
- *METI and other gov't ministries support*

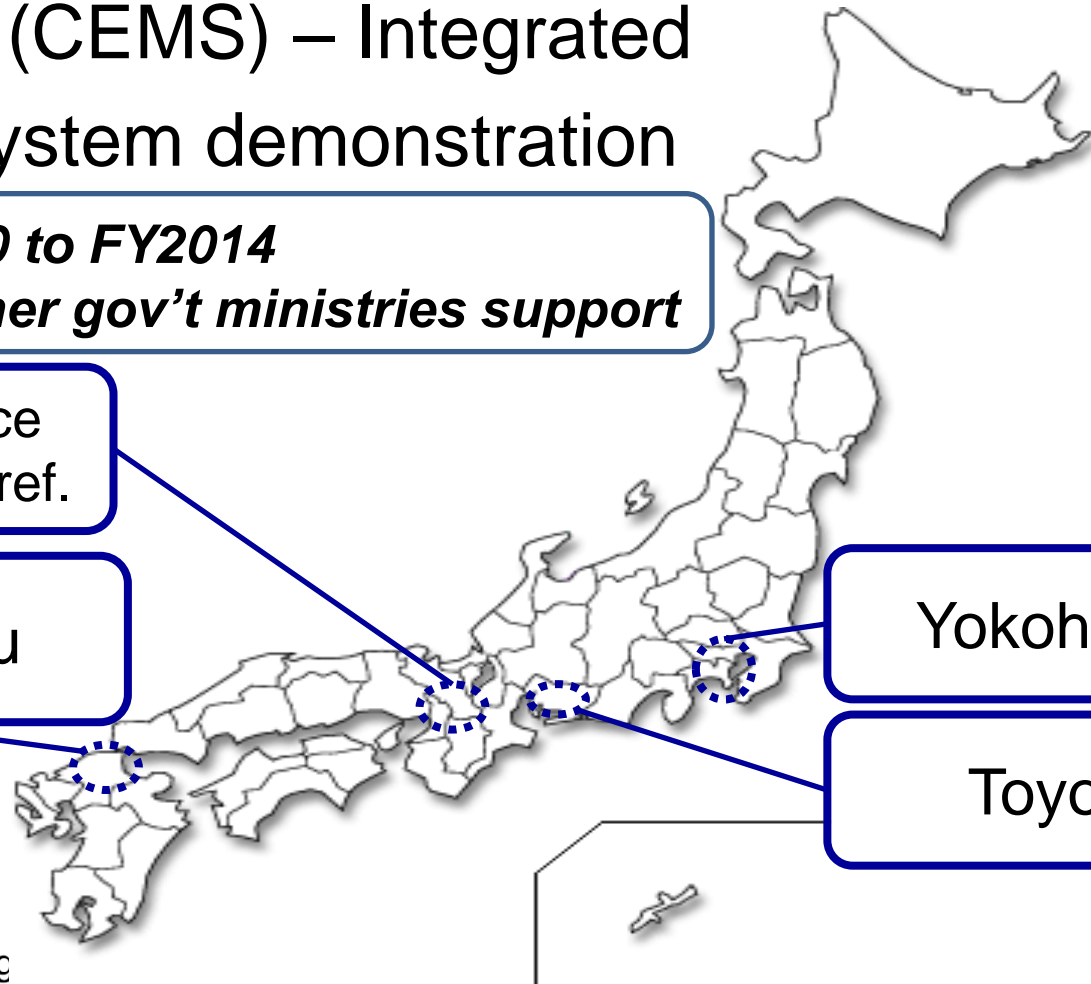
Kansai Science  
City in Kyoto Pref.

Kitakyushu

Yokohama

Toyota

- Many other initiatives





# Large Social System Demonstration

<b>System dependency</b>	<b>Target sector</b>	<b>Household</b>	<b>Multiple</b>
Highly dependent		Residential Estate - Keihanna	Wide area - Yokohama
Less dependent		Individual housing - Toyota	Specific urban area - Kitakyushu

# Japan Smart Community Alliance

- The Japan Smart Community Alliance (JSCA) was established in April 2010.

<https://www.smart-japan.org/english/index.html>

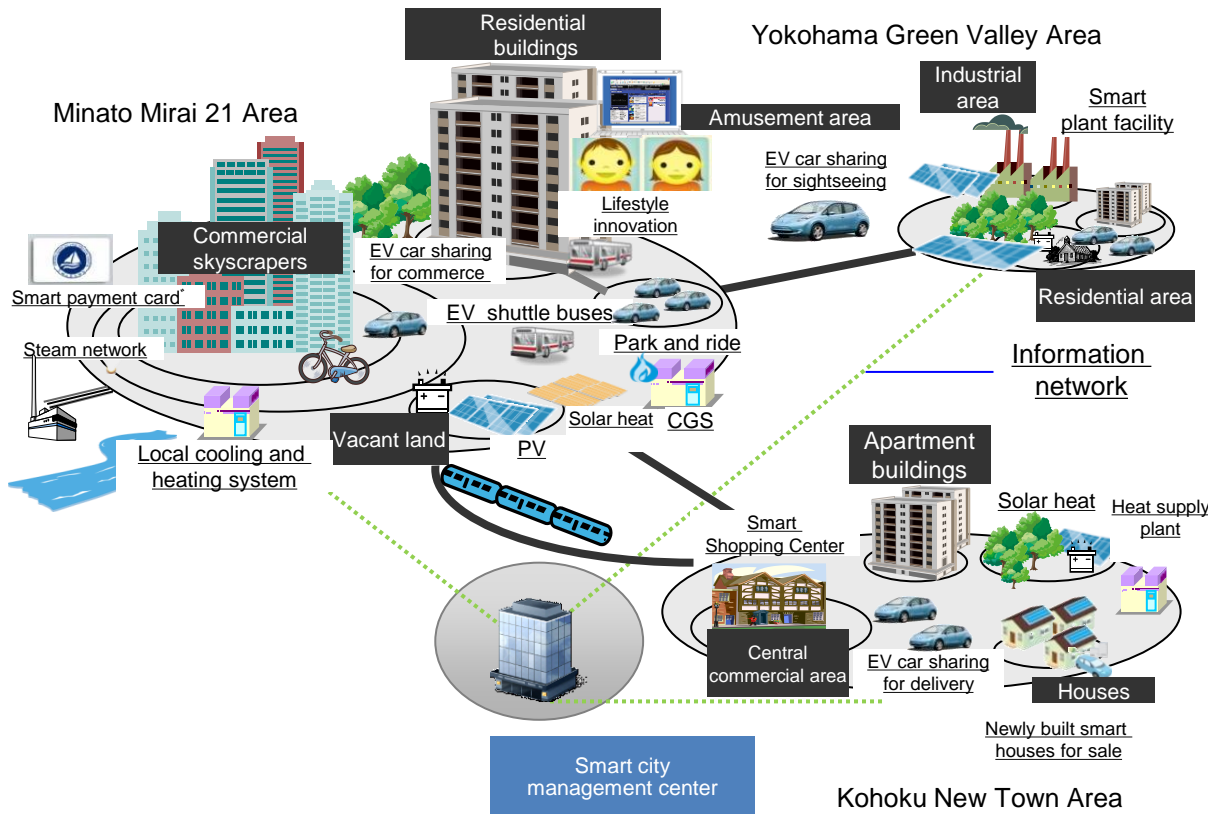


- 282 members (as of May 20, 2015) from industries, academia, local governments and non-profit organizations.
- JSCA interacts with overseas organizations, such as the Global Smart Grid Federation (GSGF).
- Latest information of large scale demonstration can be found at Japan Smart City Portal website.

<http://jscp.nepc.or.jp/en/index.shtml>

# Yokohama City

- Integrated energy management in 3 areas (commerce, residence, industry), existing facilities
- Large-scale demand response and energy management programs



- \*Integrated virtual batteries
- \*Fuel cell sharing (elec. & heat generated)
- \*Smart BEMS (with CEMS or multi. bldgs.)
- \*Fast EV charging (using integrated charging machine with stat. batteries)

- Goals:**
- HEMS: 4,000 households
  - EV: 2,000 vehicles
  - PV: 27 MW

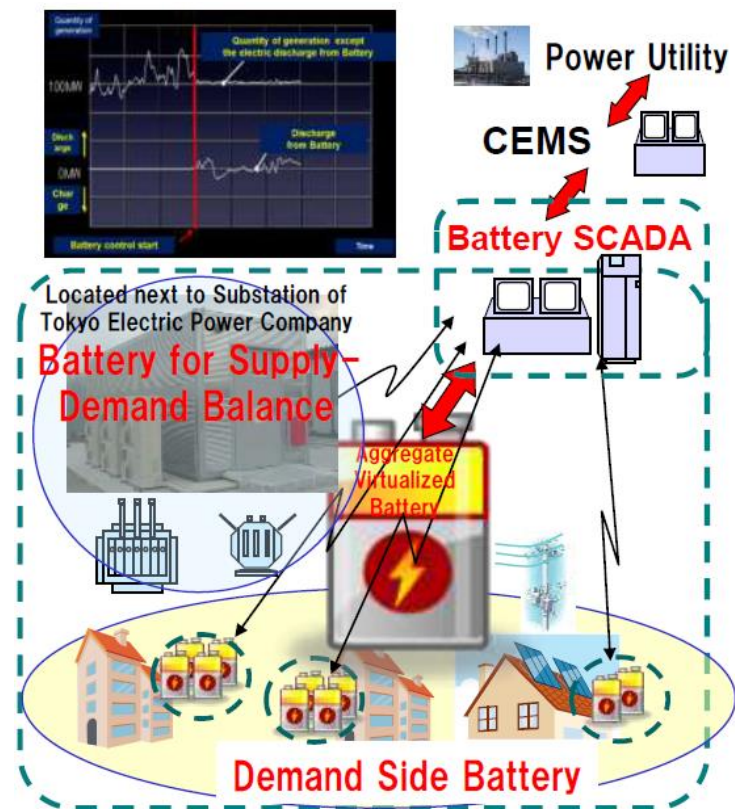
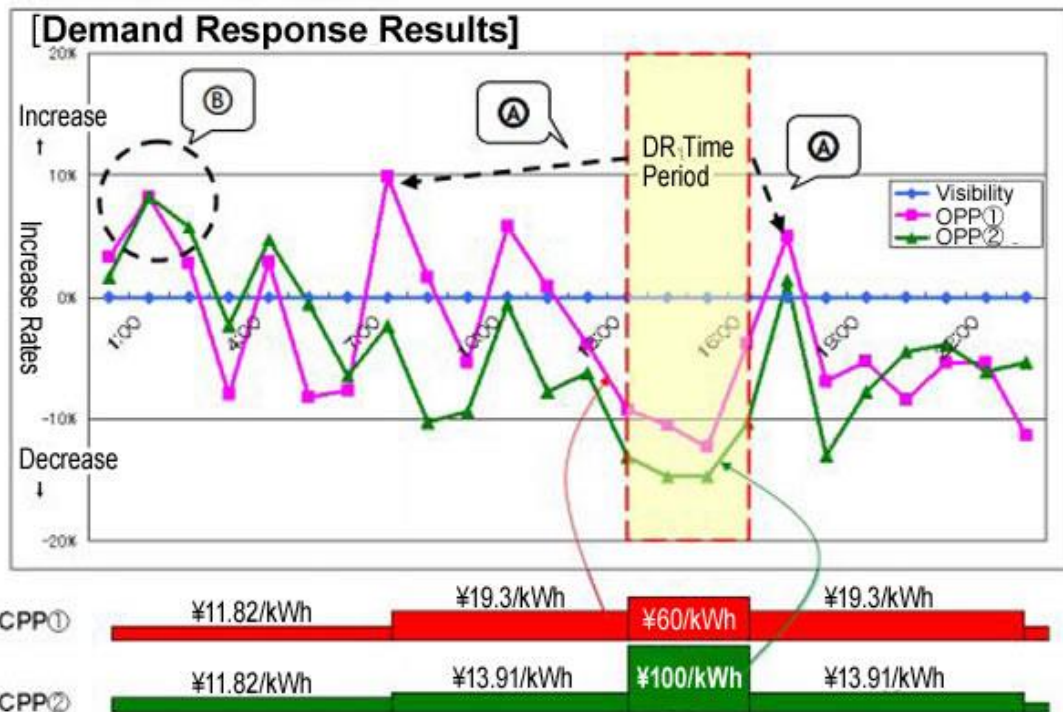
# Yokohama City

## □ Demand response experiment

- 1,200 households in FY 2013.
- Maximum peak demand reduction rate --- 15.2%.

## □ Virtual battery aggregation

- Reduce imbalance between renewable generation power and unstable demand in community.



# Toyota City

## □ Focus on households & new-generation vehicles

- PVs, fuel cells, stationary batteries for households
- Automatic control of air-conditioning, TV and illumination
- V to H (PHEV to home) – peak-cut and preparation for blackout
- Incentives for demand conservation

Three FC buses      BRT (Coupled EV buses)



100 shared mobility scooters for short distance travel

67 PHVs/EVs For VtoH

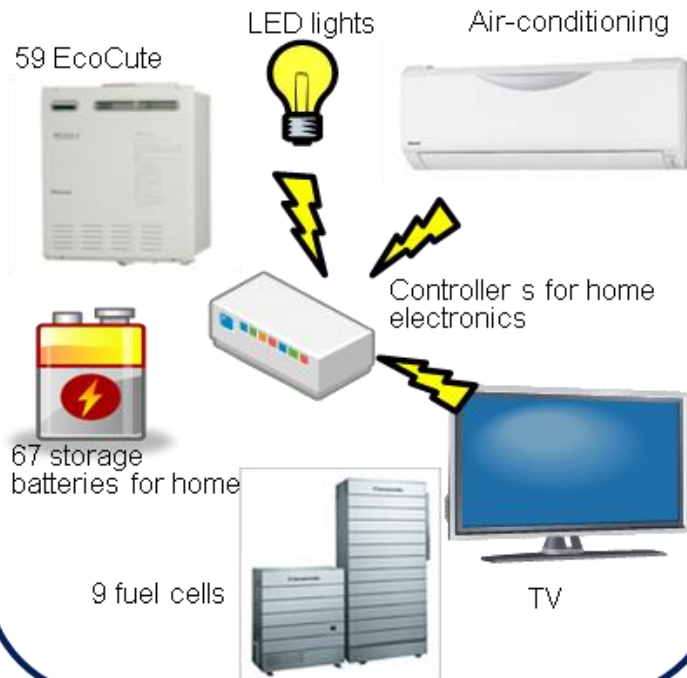


67 newly-built houses with PV systems (2011).  
160 more houses by 2014



134 portable terminals

※ Precision controls that maintain comfort levels



# Toyota City

- ❑ 67 smart houses
  - PV panels, FCs, heat pump, home battery, PHEVs, EVs, etc.
- ❑ Demand response demonstration
  - Shopping points (i.e. electronic money) from 2012
  - 18.7% CO2 reduction



Solar panel (3.2 kW)



Fuel Cell



Eco Cute (370L)  
CO2 Heat Pump



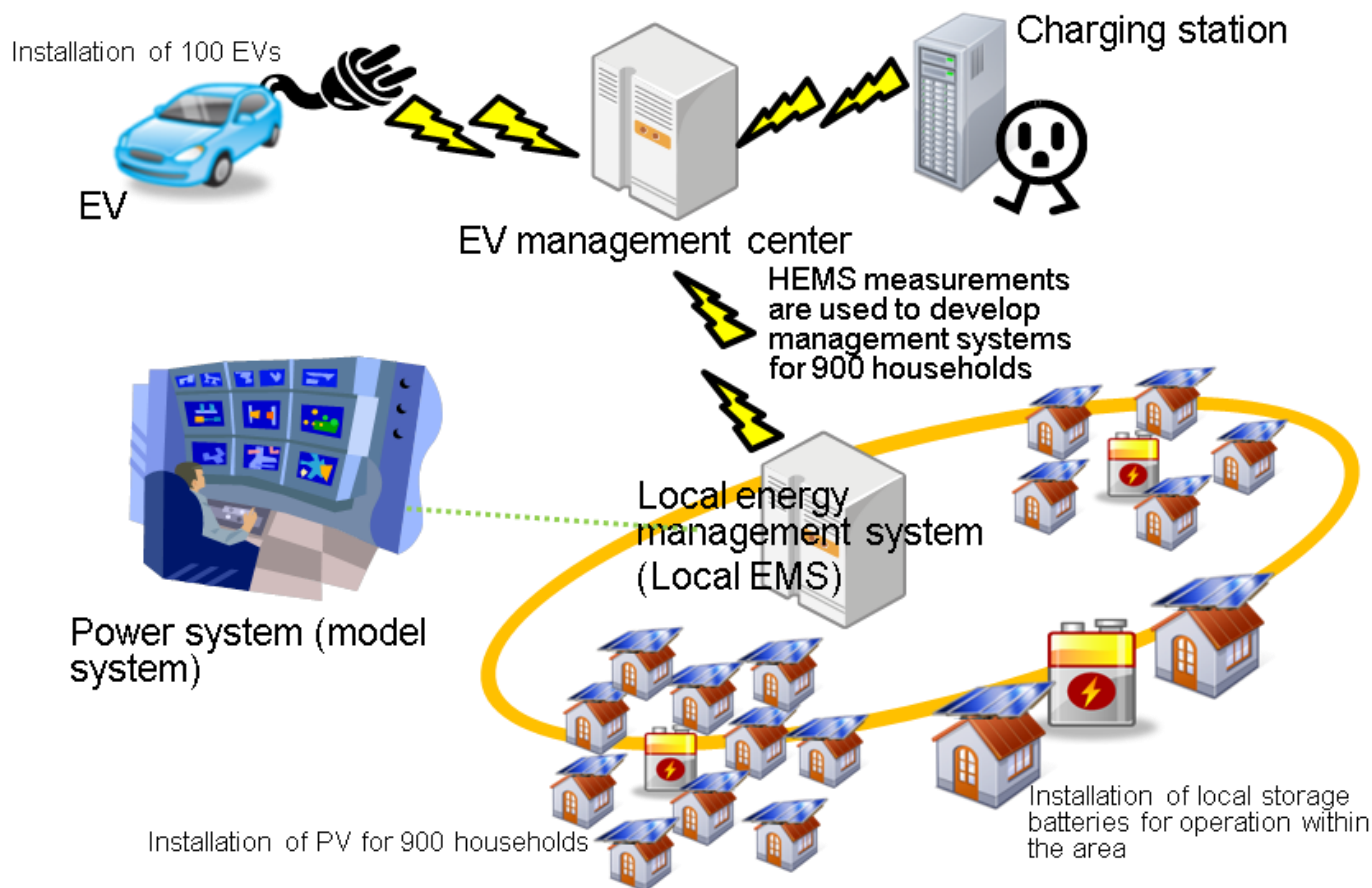
Home battery (5kWh)



Charging stand  
(supports V2H)

# Kansai Science City (Keihanna)

- About 600 to 700 households, DR by changing tariff
- Conservation consulting (e.g. new equipment info.)
- Optimal charging consultation system for each EVs.



# DR responses

## □ Keihanna DR

- Samples : 681 in FY2012, 635 in FY2013
- Summer peak hours : 13:00-16:00
- Winter peak hours : 18:00-21:00

Keihanna	Summer FY2012 (Jul-Sep)	Winter FY2012 (Dec-Feb)	Summer FY2013 (Jul-Sep)
<b>Tariff</b>			
<b>TOU(+20 JPY/kWh)</b>	<b>-5.9%##)</b>	<b>-12.2%##)</b>	<b>-15.7%##)</b>
<b>+CPP(+40 JPY/kWh)</b>	<b>-15.0%##)</b>	<b>-20.1%##)</b>	<b>-21.1%##)</b>
<b>+CPP(+60 JPY/kWh)</b>	<b>-17.2%##)</b>	<b>-18.3%##)</b>	<b>-20.7%##)</b>
<b>+CPP(+80 JPY/kWh)</b>	<b>-18.4%##)</b>	<b>-20.2%##)</b>	<b>-21.2%##)</b>

(##)Significance level 1%

Source: METI (2014)  
(original information from Yoda, Tanaka and Ito)



# Kansai Science City (Keihanna)

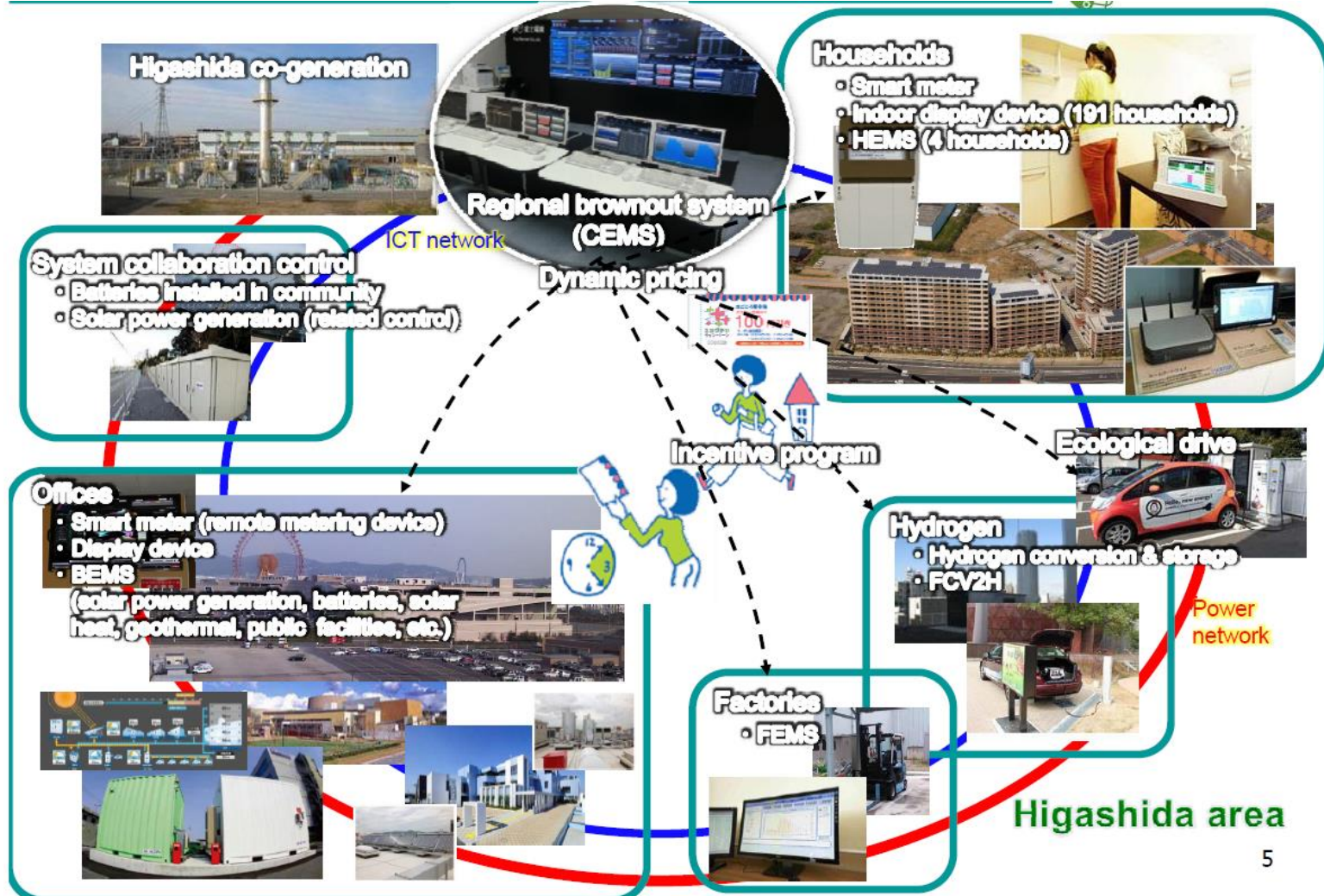
- ❑ Experiments of 14 households with HEMS and solar PVs.
- ❑ 51% CO2 reductions, 62% peak demand reductions.

Smart Life Graph: August 2013



# Kitakyushu City

- ❑ Independent power supply by CHP, 230 households and 50 businesses
- ❑ CEMS delivers price and incentive information. Tariff DR experiments.



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# Kitakyushu City

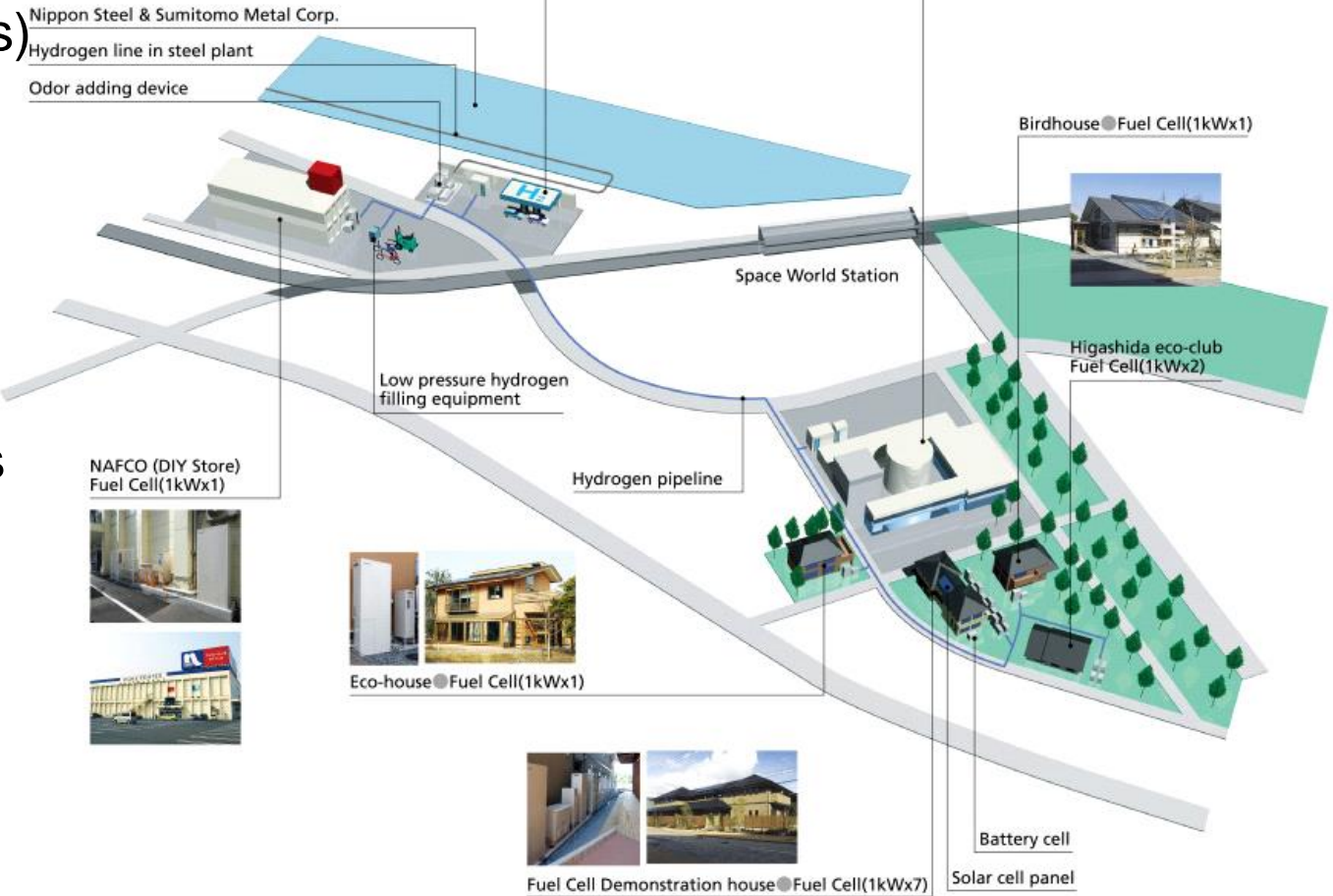
1. Technical demonstration of hydrogen supply through pipeline for "stable supply", "safety assurance" and "appropriate charging procedures".
2. Demonstration of pure-hydrogen type fuel cells for actual home and business uses over years.
3. Demonstration of hydrogen supply on specialty small vehicles: FC bicycles and FC lifts.



Hydrogen station



Kitakyushu Museum of Natural History & Human History Fuel Cell(100kWx1)



NAFCO (DIY Store) Fuel Cell(1kWx1)



Eco-house Fuel Cell(1kWx1)

Birdhouse Fuel Cell(1kWx1)



Higashida eco-club Fuel Cell(1kWx2)



Fuel Cell Demonstration house Fuel Cell(1kWx7)

Battery cell

Solar cell panel

## Hydrogen

- From COG (coke oven gas)
- V to H FCV to Home
- H2 pipeline
- H2 refueling station
- Stationary FCs



# DR responses

## □ Kitakyushu DR

- Samples : 180 in FY2012, 178 in FY2013
- Summer peak hours : 13:00-15:00
- Winter peak hours : 08:00-10:00, 18:00-20:00
- CPP tariff for households, also costumers before CPP experiments. TOU effects cannot be evaluated.

Kitakyushu	Summer FY2012 (Jun-Sep)	Winter FY2012 (Dec-Feb)	Summer FY2013 (Jun-Sep)
<b>Tariff</b>			
<b>TOU</b>	<b>Not evaluated</b>	<b>Not e evaluated</b>	<b>Not evaluated</b>
+CPP=50JPY/kWh	-18.1% (#)	-19.3%(##)	-20.2% (##)
+CPP=75JPY/kWh	-18.7%(#)	-19.8%(##)	-19.2% (##)
+CPP=100JPY/kWh	-21.7% (##)	-18.1%(##)	-18.8% (##)
+CPP=150JPY/kWh	-22.2%(##)	-21.1%(##)	-19.2% (##)

(##)Significance level 1%, (#) 5%

Source: METI (2014)  
(original information from Yoda, Tanaka and Ito)

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# Summaries

- ❑ In the smart community demonstration projects, we have learned much knowledge of elemental technologies and system integration.
- ❑ Challenges ahead towards post 4 areas demonstration
  - Stakeholder interests
    - Public, local governments, project coordinators, energy service providers and ICT vendors.
  - Business models
    - Recovery of initial investment
    - Co-benefit valuation other than energy and CO2
  - Institutions
    - Tariff, aggregation, trading, etc.
  - Multiple carriers
    - Non-electric energy (e.g. heat, hydrogen, etc.)
    - Non-energy demand (e.g. traffic information, water supply)

# Innovation Cool Earth Forum (ICEF 2015)

## Objectives

- World-leading researchers, business executives, and policymakers discussions
- Promotion of energy and environment technologies innovation
- Diffusion of technologies to address climate change
- Enhancement of the cooperation among academia, business, and government

Host: METI, NEDO

Date / Venue ICEF 2015

Date : October 6-8, 2015

Venue : Hotel Chinzanso Tokyo, Japan

See <http://www.icef-forum.org>



# Innovation Cool Earth Forum (ICEF 2015)



## Plenary Sessions:

- Principal issues in the future GHG reduction
- Future perspectives from innovators and visionaries
- Future strategy for climate change

## Concurrent Sessions (Topics are tentative):

### 14 Technologies

- Advanced liquid biofuels / Artificial photosynthesis / CCS
- / Electricity storage / Energy efficiency in buildings / Geothermal power
- / Hydrogen / Low-carbon mobility / Materials: iron and steel
- / Materials: cement / Nuclear energy / **Smart grids** / Solar (PV and CSP)
- / Wind power

### 4 Cross-sectional issues

- Energy systems / International framework for complementing UN
- / Role of public funding for RD&D
- / Tech. transfer to developing countries and investment promotion

[http://www.icef-forum.org/annual\\_meeting/program/index.html](http://www.icef-forum.org/annual_meeting/program/index.html)