Experience of NEDO Smart Community Demonstration

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New Energy and Industrial Technology Development Organization
What is NEDO (New Energy and Industrial Technology Development Organization)?

Mission:
- Addressing energy and global environmental problems
- Enhancement industrial technology development

Organization: Established in 1980; NEDO is organization operated under the Ministry of Economy, Trade and Industry of the Government of Japan

Head Office: Kawasaki City, Japan

Personnel: About 900

Budget: Approximately 129.8 Billion yen (≒ 1.05 B €) (FY2016)

Chairman: Mr. Kazuo Furukawa
Definition of Smart Community

Smart Community means Network involving smart supplier and smart customer. Early stage of demonstration, this system was tested in limited area as local community. However, this trial system is expanded into wider society now.

Smart community includes Smart Grid and Smart Users. Important change will be allocation of Interagency on system.
Smart Community related activity in Japan

2009
METI directly managing Projects

2010

2011 Higashi-Nihon Earthquake

2012
Next Generation Energy-Social System Demonstration Project

2013
Demand Response Demonstration Project

2014
Virtual Power Plant Demonstration Project

2015 International System Demonstration Project

2016 Start of the electric market deregulation

2020 Unbundle will be completed

Domestic
International

METI directly managing Projects
NEDO managing Projects
4 Smart City Projects in Japan (2010-2014)
Next Generation Energy-Social System Demonstration Project

**YOKOHAMA project**
- To achieve into low-carbon and comfortable city, CEMS is introduced as the best energy management system.
- HEMS to households, BEMS to office/commercial buildings, FEMS to factories and EV & charging station to transport sectors are introduced too.
- By collaborating them to each other, reduction of the peak demand and energy savings will be achieved.

**TOYOTA project**
- Focusing on household sector (home & transport), the society 10 years later are imagined, when grid parity of PV system is achieved.
- Concretely, providing high incentives (such as Eco points) to the residents for contributing to low-carbonization.
- At design of effective incentives and visualization of result, residents should be able to achieve satisfaction of social life and contribution of low-carbon.

**KEI-HANNA project**
- In Kei-hanna are research institutions, Science City, there universities, private companies, and also, large estate development is on process.
- It is suitable field for demonstrating on researches of new smart community related technologies and new social systems with residents’ participation.
- “Community Energy Management System (CEMS)” minimizes CO2 emissions without deteriorating residents’ quality and conveniences of lives.

**KITA-KYUSHU project**
- Constructing and operating management system for closed power system in Higashida of generation area by so-called “Local Power Saving Station” is established.
- It is a kind of CEMS which can manage real-time pricing. Also, visualization of energy will encourage the innovation of their lifestyles and business styles.
- Additionally, mass penetration of new generation vehicles, and collaboration with public transports will be demonstrated.
NEDO Smart Community International Demonstration Projects (Sep. 2016)

Manchester UK
Demand Controllable HP demonstration.

Lyon France
Positive Energy Building and Energy monitoring demonstration.

Malaga Spain
Inner city QC demonstration project.

Haryana India
Smart Meter and AMI demonstration.

Putrajaya Malaysia
EV bus demonstration.

Suryacipta Indonesia
Power quality Management for Industrial Park.

Ontario Canada
PV with Battery demonstration.

New Mexico USA
Smart Grid, Smart House and Smart Building demonstration.

California USA
Self consumption HEMS demonstration.

California USA
Utility owns Battery Storage demonstration.

California USA
Inter city EV Quick Charger demonstration.

Hawaii USA
Demand Response by EV and Smart inverter demonstration.
New Mexico Smart Grid Demonstration (2009-2014)

Efforts in Los Alamos
- Monitoring
- Monitoring & control
- PV
- Battery
- Smart house
  - Control
  - Smart appliances, etc

Efforts in Albuquerque
- μEMS
- Load control signal
- Commercial building (MESA DEL SOL)
  - Storage battery
  - Gas engine
  - PV
  - Fuel cell

State of New Mexico
- Los Alamos County
- Los Alamos National Laboratory
- Sandia National Laboratories
- Univ. of New Mexico
- PNM
- Mesa Del Sol


General houses (900 homes)

Demand response signal/
Measure power consumption

PLC transfer trip

Interrupt signal

Smart meter
Distribution Feeder Micro-Grid Demonstration in Los Alamos (NM Demonstration)

By introducing Micro-EMS on the feeder in Los Alamos, Battery storage absorbs fluctuation of photovoltaics and demand, and achieves flat flow injection from transmission system. It means that it is possible for distribution company to purchase energy strategically from whole sale market.

Introducing; 1MW land fill PV system, 1MW NAS battery, 0.8 MW Lead Acid Battery, 1600 smart meters and Micro EMS.
**900 Participants Demand Response Demonstration in Los Alamos (NM Demonstration)**

<table>
<thead>
<tr>
<th>Group</th>
<th>Flat</th>
<th>CPP</th>
<th>PTR</th>
<th>total</th>
</tr>
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<tbody>
<tr>
<td>Opt-in CPP</td>
<td>132</td>
<td>233</td>
<td>—</td>
<td>365</td>
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<tr>
<td>Opt-out CPP</td>
<td>5</td>
<td>178</td>
<td>—</td>
<td>183</td>
</tr>
<tr>
<td>Opt-out PTR</td>
<td>5</td>
<td>—</td>
<td>173</td>
<td>178</td>
</tr>
<tr>
<td>Control</td>
<td>174</td>
<td>—</td>
<td>—</td>
<td>174</td>
</tr>
<tr>
<td><strong>合計</strong></td>
<td>316</td>
<td>411</td>
<td>173</td>
<td>900</td>
</tr>
</tbody>
</table>

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**Demand Response Trial**  
From 2013-2014  2 Years  4 Seasons  
15 demand response trials per one season.

<table>
<thead>
<tr>
<th>Group</th>
<th>ITT effect</th>
<th>TOT effect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summer</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opt-in CPP</td>
<td>-6.90%</td>
<td>-10.49%</td>
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<tr>
<td>Opt-out CPP</td>
<td>-4.59%</td>
<td>-4.71%</td>
</tr>
<tr>
<td>Opt-out PTR</td>
<td>-4.06%</td>
<td>-4.17%</td>
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<tr>
<td><strong>Winter</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opt-in CPP</td>
<td>-4.78%</td>
<td>-7.12%</td>
</tr>
<tr>
<td>Opt-out CPP</td>
<td>-4.27%</td>
<td>-4.41%</td>
</tr>
<tr>
<td>Opt-out PTR</td>
<td>-3.26%</td>
<td>-3.37%</td>
</tr>
</tbody>
</table>

* TOT effect : Treatment on the Treated. Net peak cut effect when a treatment was given.  
* ITT effect : Intention to Treat. Choice probability x TOT effect.
Independent Operation of Smart House in Los Alamos (NM Demonstration)

Upper figure shows independent operation of smart house. Air conditioning demand was controlled by HEMS looking at PV generation situation.
Resiliency Building Micro-Grid in Albuquerque (NM Demonstration)

Aperture Center Building at Mesa Del Sol in Albuquerque

Connecting Operation

Power Flow at Connecting Point

Independent Operation
Registration of Micro Grids Use Case to NIST-EPRI (NM Demonstration)

NEDO – BEMS Control of DERs and HVAC Equipment in a Commercial Building Which Enables Islanding Operation and Demand Response
- Albuquerque Smart Building

NEDO – Energy Management by Configuring a Virtual Microgrid
- Kyo-Tango Virtual Microgrid

NEDO – Equipment Control within Smart House by HEMS
- Los Alamos Smart House

NEDO – Sendai Microgrid Use Case
- Sendai Microgrid

NEDO A1 Energy Management of Grid Connected Microgrid
- Aichi Microgrid

NEDO A2 Autonomous Decentralized Microgrid Islanding Mode
- Aichi Microgrid

NEDO H1 Energy Management of Grid Connected Microgrid
- Hachinohe Microgrid

NEDO H2 Energy Management of Microgrid Islanding Operation
- Hachinohe Microgrid

NEDO S1 Cooperative Control Among Smart Grid and External Area EPS Energy Management Systems
- Los Alamos and Albuquerque EMS

Discussion in IEEE P2030.7 Standardization
Lyon Smart City Project (2011-2017)

http://www.nedo.go.jp/english/whatsnew_20111226_index.html

Grand Lyon has a plan to update CMS.

Those part should be the business by private.

TASK1 HIKARI Building
By introducing BEMS, HEMS, PV resources, energy storage element and energy saving equipment, positive energy building is achieved.

TASK2 SUNMOOV
By introducing 30 EVs and charging infrastructure, car shearing and renewable energy charging system were demonstrated.

PV energy consumption rate was 82% in summer, 79% in autumn.

TASK3 Conso Tab.
By introducing energy audit system at the public apartment house, energy conservation was achieved in the exist residential houses.

3.9% saving in electricity consumption
6.5% saving in gas consumption

TASK4 Community Management System (CMS)
By visualization of social index, CMS supports promotion of local government’s city development plan.
http://www.nedo.go.jp/english/whatsnew_20111129_index.html

(I) EV Based Remote Island Smart Grid Model on Maui
(II) Smart Grid Model at a Substation with One Distribution Grid Level in Kihei
(III) Smart Grid Project for Low-voltage Transformer Level Systems
(IV) Comprehensive Research

Demand Response result using charging management for EV.

JSM volunteer charging behavior at home (July – Mid-Oct. / 45 volunteers)

- Current status and findings:
  - Home charge occurrence is not favorable for system load pattern.
  - (need validation with more volunteers)

System load and wind output curtailed in Maui

- Expected effects:
  1. Lower load peak
  2. Reduce wind output curtailment
Malaga EV demonstration Project (2012- 2016)
http://www.nedo.go.jp/content/100789468.pdf

Period : 2013 April -2015 Dec
Place: City of Malaga
Participants : 209 EV cars

- Demonstration of EV managing Center and Infrastructure
- Demonstration of M:N output allocation type Rapid Charger
- Demonstration of Electric managing System
- Integrated ICT Infrastructure
- Demonstration of total service.
- Grovel business vision and standard.
NEDO Begins Its Demonstration Operations of a Hybrid Inverter System for Unified Control of Solar Panels and Storage Batteries. A Disaster-Resilient Housing Model that Coexists with Renewable Energy will be Established. This Systems are owned by utility and customer demand will be supplied by this system.
NEDO will analyze best DR strategy by analysis of demand profile of water heater heat pumps of 600 residents.
NEDO will demonstrate self consumption system managed by HEMS with battery and heat pump.

PV generated power

Energy storage

Selling of power

Heat storage

Consumption power

Grid Power
(Purchase of power)

Consumption power

(Average of June, 4000kWh/year)
Big Data Analysis in EV related demonstrations

- Lyon Project Task2
  40 EVs
  Charging by Renewable Energy

- Malaga Project
  200 EVs
  Inner City PV usage
  Inner City Quick Charger needs
  Connected car service by terminal

- Maui Project
  400 EVs
  Demand Response
  V2G demonstration

- North California Project
  Some thousands EVs
  Inter City PV usage
  Inter City Quick Charger needs
  Connected car service by Smart Phone
Big Data Analysis in HEMS and Home Appliances

Manchester Auto Demand Response
- 600 Heat Pumps

New Mexico Demand Response
- 900 homes participated

Speyer Cloud HEMS Demonstration
- 12 Homes

New Mexico Smart House
- 1 house, 3 different HEMS

Oota Clustered PV
- 553 homes participated (2002–2009)

Oshawa Hybrid Inverter Demonstration
- 30 Homes
Conclusion

- NEDO experienced several type of smart community demonstration.
- Mainly purpose of demonstration is showing solution against high penetration of renewable energy.
- Some type of demonstrations include big data analysis which is useful for understanding large number of customer of energy and motorization.
- Those kind of demonstrations will contribute creating new business, new rule of public service and high ICT application service to customers.
Thank you for your attention!