Hitachi’s Smart Energy Activities - worldwide case studies -

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Information & Telecommunication Systems Group
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1-1. Business fields of Hitachi (FY2014)

Information & Telecommunication Systems

- Financial Services: 11%
- Other (Logistics & Other services): 3%
- Smart Life & Ecofriendly Systems: 19%
- Automotive Systems: 4%
- Construction Machinery: 15%
- Electronics Systems & Equipment: 11%
- Social Infrastructure & Industrial Systems: 7%
- High Functional Materials & Components: 9%
- Power systems: 14%
- Total: 9,761.9 billion yen

*Figures are on a consolidated basis
1-2. Hitachi Social Innovation Business

Social Innovation Business

IT × Social Infrastructure

Infrastructure Systems

Information and Telecommunication Systems

High Functional Materials & Components

Power Systems

Construction Machinery

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1-3. Strategic Journey – Global Portfolio

New Business created through global demonstration projects of technology and business model

**CHINA [Dalian]**
- Eco-City

**JAPAN [Okinawa]**
- EV Charging

**JAPAN [Y-PORT]**
- Smart City global support
  - Kashiwa-no-ha Smart City Project

**JAPAN [Yokohama]**
- Smart City Project

**JAPAN [Rokkasho-village]**
- Smart Grid Demonstration Site – Micro-grid

**JAPAN [Hitachi-city]**
- Future City Model Project in Hitachi City

**U.S.A. [Hawaii]**
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- Smart Grid Demonstration - Battery Storage

**UK [ETI SSH Project]**
- UK Nation-wide Smart Systems & Heat Programme

**UK [Greater Manchester]**
- Load-balancing aggregation technology in Greater Manchester

**UK [LCN/WPD Cornwall]**
- Voltage Control Systems

**SLOVENIA (feasibility study)**
- Smart Community Demonstration Project in Slovenia

**SPAIN [Malaga]**
- Smart Community Demonstration Project in Malaga City

**Development & Renovation of Smart City (incl. IT)**

**Real business**
- Energy
- Mobility
- IT

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**Demonstration**
- Real business
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2-2. Hawaii Case: Background

- Community Objective
  - Reduce energy cost
  - Secure energy supply

- Technical Challenge
  - Maximize utilization of RE power
  - Keeping frequency stabilization using distributed energy resources

Hawaii’s electricity prices are three times higher than the U.S. average.

Source: Hawaii Energy Facts & Figures, DBEDT State of Hawaii

Renewable Energy ratio

<table>
<thead>
<tr>
<th>Actual</th>
<th>Hawaii Target</th>
</tr>
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<tbody>
<tr>
<td>18%</td>
<td>25%</td>
</tr>
<tr>
<td>18%</td>
<td>25%</td>
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<td></td>
<td>40%</td>
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<td>18%</td>
<td>40%</td>
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<td>18%</td>
<td>100%</td>
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Target of Hawaii Electric Company is 65% at 2030
2-3. Hawaii Case : Project Outline

- Project : NEDO Hawaii PJ (Ph.1/2011~, Ph.2/2015~)

Solution: Advanced Distribution Management System

Distributed Energy Resources (for Ph.1)
- Bulk battery (2 Li-ion, 1 Lead Acid) and Others
- Home battery (10 set),
- Home water Heater (30)
- EV (>200)
- EV Charger (20/Fast Charger, 200/Normal Charger)

This demonstration is supported by the METI (Ministry of Economy, Trade, and Industry) and NEDO (New Energy and Industrial Technology Development Organization).

EV: Electric Vehicle
2-4. Hawaii Case (Ph1) : System Architecture

EVECC: EV Energy Control Center
DMS: Distribution Management System
DLC: Direct Load Control
DR: Demand Response

AMI: Advanced Metering Infrastructure
M2M: Machine to Machine
SVC: Static Var Compensator
DMCD: Data Measuring & Communication Device

DP: Distribution Panel
PV: Photovoltaic
PCS: Power Conditioning System

EVECC → DMS → DLC (DR)

Smart City Platform (Information Control Hub)
M2M Network

SVC 1 set
Battery 3 sets
Switch 12 sets

20 sets
DC Fast Charger Station 20 sites

DC Fast Charger
EV Level2 Charger

Home Battery 10 sets
SmartPCS 10 sets
Water Heater
EV Level2 Charger
2-5. Hawaii Case : Feature (1)

Maximum Utilization of Renewable Energy

Advanced load shift

Helps shift energy demand by integrating forecasts of renewable power generation with the operating schedule of the project’s batteries.

The charging is scheduled to start when the balance would have excess supply.

Excess energy is forecasted

Start charging

The charging is scheduled to start when the balance would have excess supply.
Stable Supply of Electric Power

Emergency demand and supply control

Keeps the electric power system stable by controlling and helping to restore loss of balance between power supply and demand.

When power generation of wind farm and PV decreased …

Cut off low priority load such as water heaters temporary.

Emergency discharge battery and Shift a charge time zone of EV at another time.

The Control Center
2-7. Hawaii Case (Ph1): Location of Equipments

Whole Maui Island:
- Normal Chargers 200 sets

µ-DMS:
- 15 sets
- SmartPCS 10 sets
- Home Getaway 40 sets
- Home Battery 10 set
- Switch 12 sets

Bulk Battery:
- #1 & #2 (Li-Ion)

Bulk Battery (Lead Acid)

Server room:
- DMS
- EVECC
- DLC

DC Fast Chargers:
- Installed
- On going

EVECC: EV Energy Control Center
DMS: Distribution Management System
DLC: Direct Load Control
DC: Direct Current
SVC: Static Var Compensator
PCS: Power Conditioning System

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2-8. Hawaii Case : Example of DCFC installation

Volunteer recruit kick-off Ceremony
@ Queen Kaahumanu Center
Jun 15, 2013  4:30 pm - 6:00 pm

DCFC: Direct Current Fast Charger
By demonstration in highly RE penetrated area like Maui:
Phase2 will evaluate using integrated, controlled EV battery discharge and management of distributed loads including V2X, as a “Virtual Power Plant (VPP)”

V2H (Vehicle to Home) → V2G (Vehicle to Grid) → VPP (Virtual Power Plant)

Virtual Power Plant (VPP):
Aggregating and optimizing available distributed energy resources (such as EV, storage and home side energy capability) to use optional energy sources
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**Energy**
**Mobility**
**IT**

**Development & Renovation of Smart City (incl. IT)**

**Real business**
3-2. UK Case: Project Outline

- National Objective: Reduce carbon emission by 80% at 2050
- Project: NEDO UK Smart Community PJ (2013 - 2016)

This demonstration is supported by the METI (Ministry of Economy, Trade, and Industry) and NEDO (New Energy and Industrial Technology Development Organization).

Solution:

Heat Pump Aggregation System

- Replace gas boilers with heat pumps (Low carbon heating)
- Manage heat pumps for the grid (Less impact to the grid)

Distributed Energy Resources:

Heat Pump in Insulated House (600 Social Housing)

Greater Manchester, UK

Photo by DAIKIN
This experiment is subsidized by the Ministry of Economy, Trade, and Industry, and by the independent administrative agency NEDO (New Energy and Industrial Technology Development Organization).
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4-2. Japan Case: Kashiwa-no-ha City Outline

Objective: Low carbon emission & Resilient town against disaster

Power interchange related facilities
- Power interchangers
- Super-high voltage Substations
- Bulk batteries
- PVs

Smart Center (AEMS)

AEMS: Area Energy Management System
BEMS: Building and Energy Management System
HEMS: Home Energy Management System

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