

Enabling Smart Cities and Smart Communities

5th Annual Smart Grids & Cleanpower
2013 Conference
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www.cir-strategy.com/events/cleanpower

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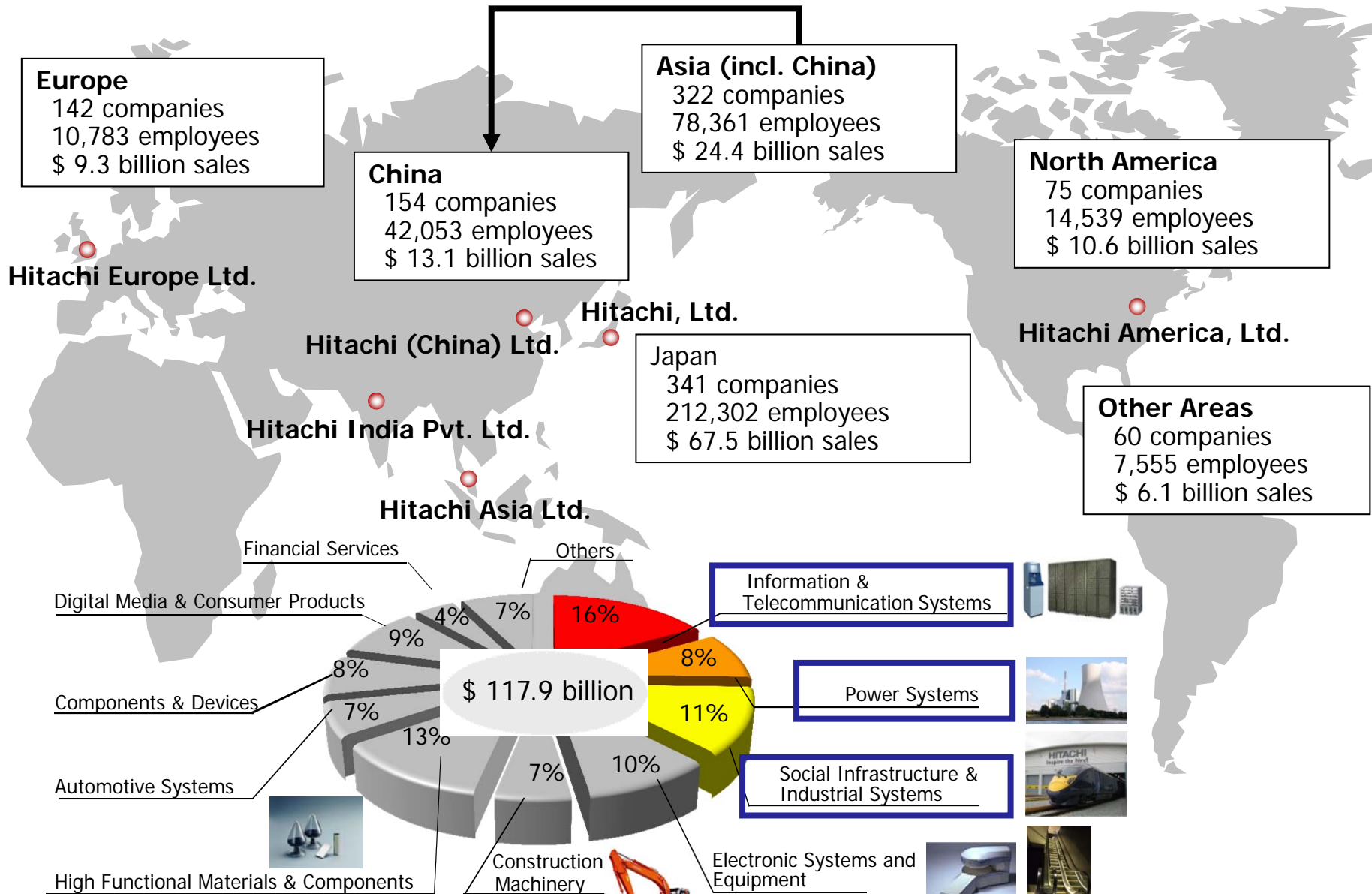


Agenda

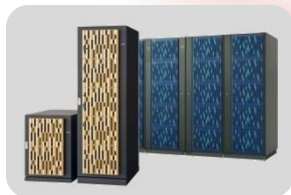
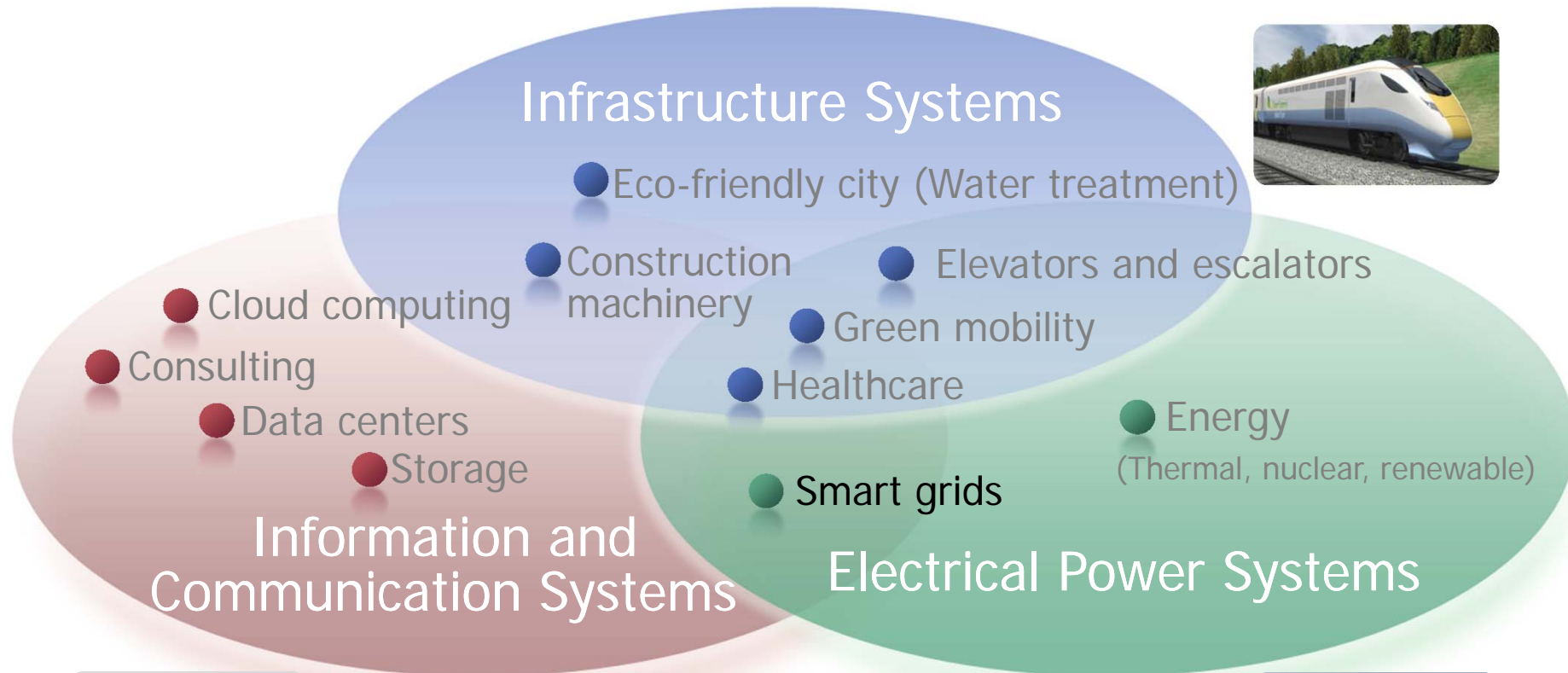
HITACHI
Inspire the Next

1. Introduction to Hitachi
2. Portfolio of Smart Solutions
3. Smart Communities Case Studies
4. Collaboration Approach
5. Q&A

Overview of Hitachi Group



*As of March 31, 2012



**As a global leading company,
Hitachi provides multiple solutions
to "Social Innovation Areas"**

Hitachi Solutions Map – from Supply to Demand

PCS for PV and wind



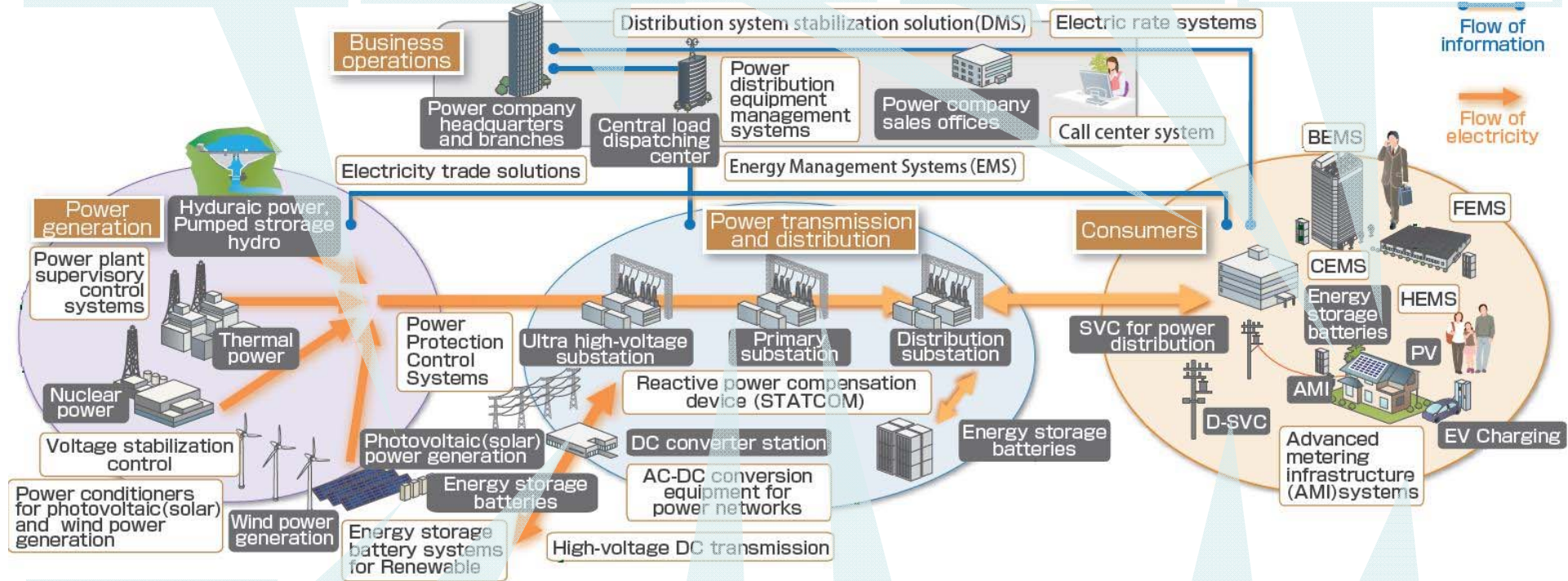
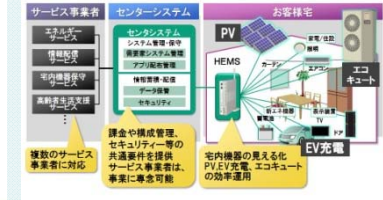
Energy Management System Distribution Management System



AMI and MDMS



Demand Response, HEMS



Battery System



HVDC



Substation (GIS, Tr)



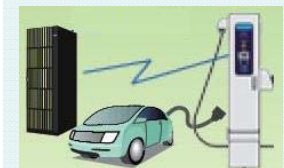
STATCOM



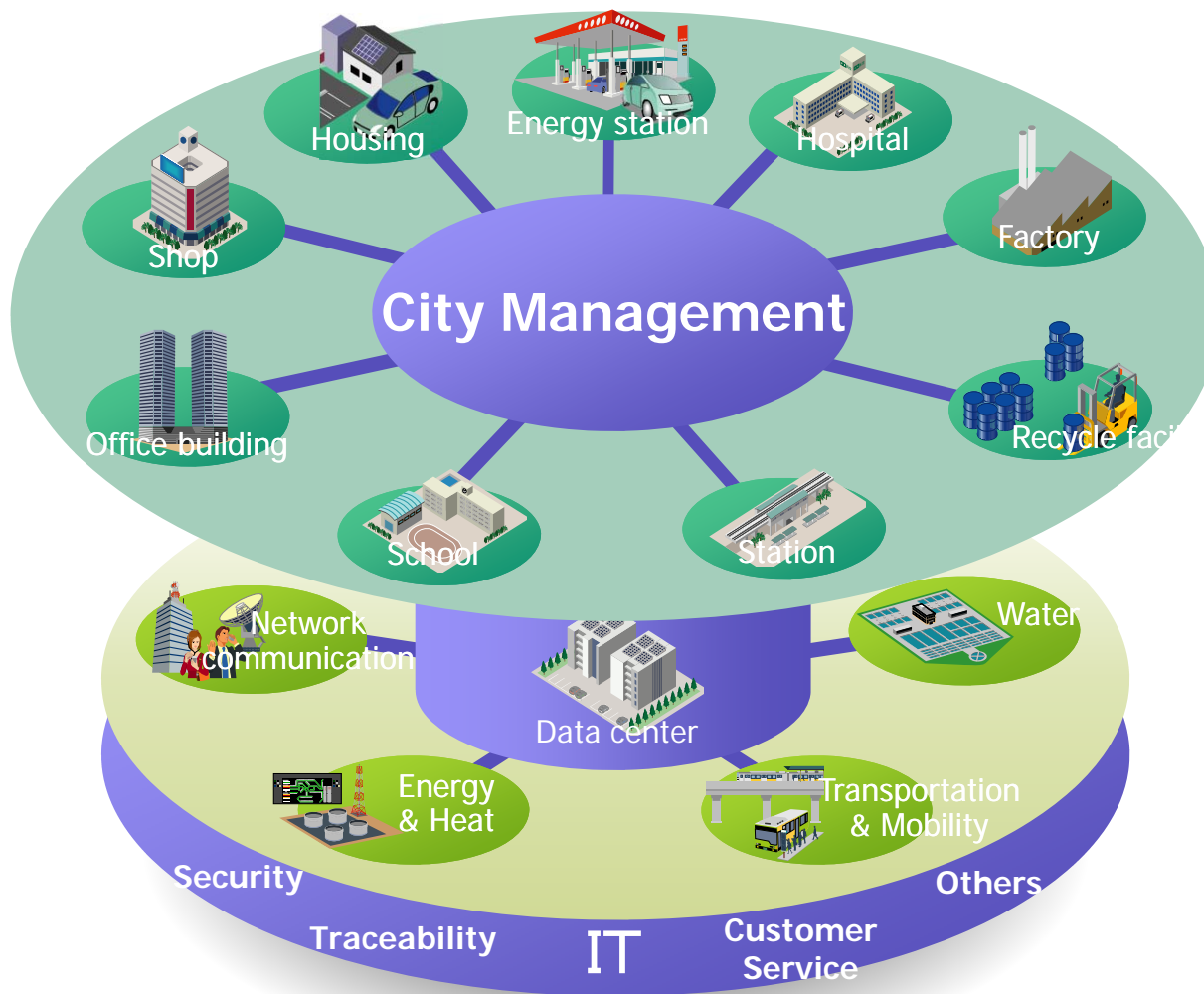
D-STATCOM



EV charger and managing system

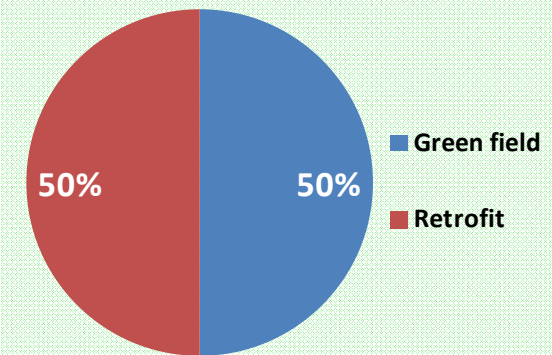


- Smart Communities vary in size and character, but are based on common concept of city management and services enabled by an IT infrastructure



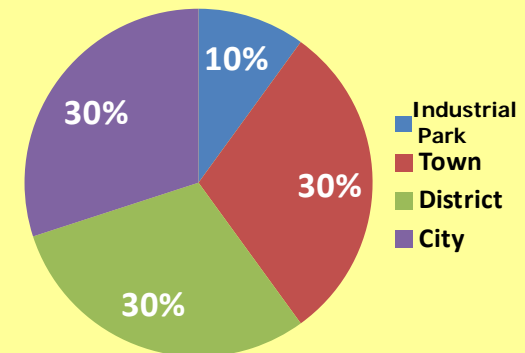
Smart systems in multiple fields

Green field vs Retrofit



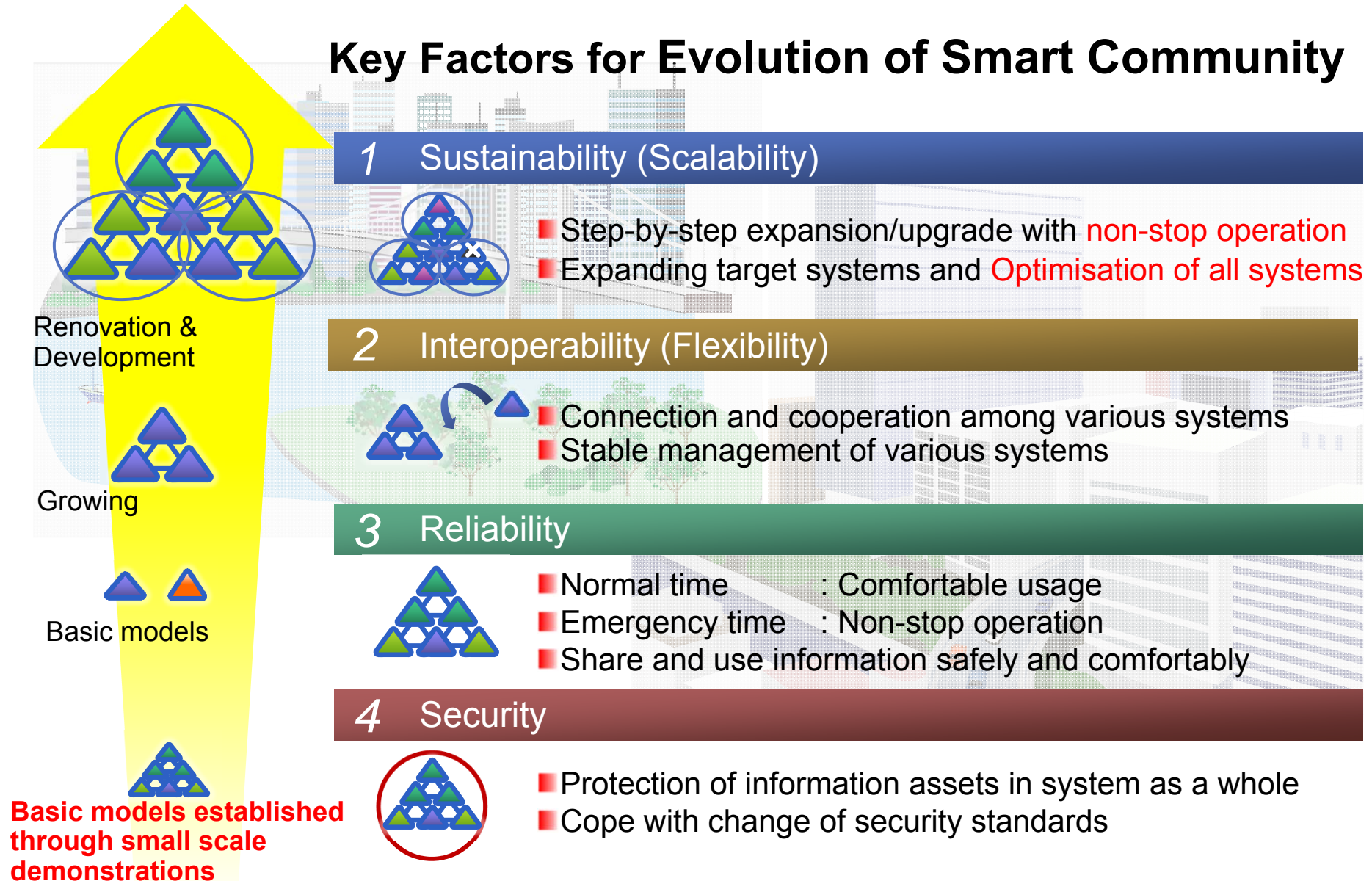
Different approach is required

Scalability

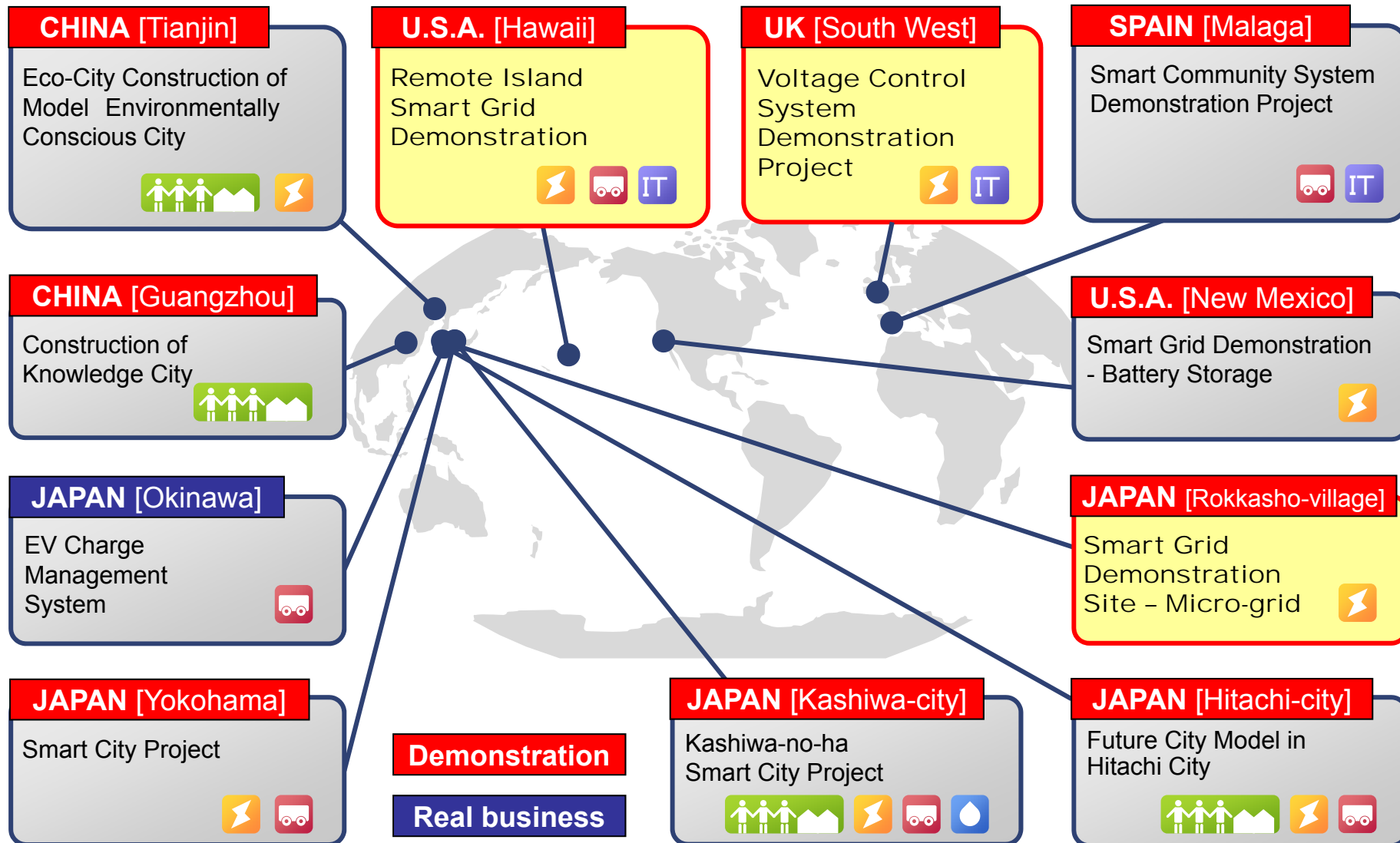


Core solutions support various sizes of systems

Key Factors for Evolution of Smart Community

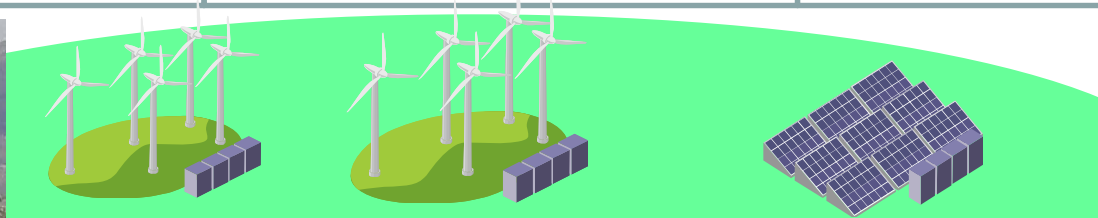


Hitachi Smart Communities Global Activities



Development & Renovation of Smart City (incl. IT)
 Energy
 Mobility
 Water
 IT

2015	2020	2030
RE Capacity(Target): 15% Annual Generation: 1566.2GWh Wind: 30MW PV: 12MW Hydro: 0.5MW Biomass: 12MW	RE Capacity(Target): 25% Annual Generation: 1709.6GWh Wind: 72MW PV: 42MW* Hydro: 0.5MW Biomass: 12MW	RE Capacity(Target): 40% Annual Generation: 2034.8GWh Wind: 72MW PV: 112MW* Hydro: 0.5MW Biomass: 12MW



In Maui, large scale renewable energy has been introduced, and it is expected that there will be high levels of PV and EV penetration

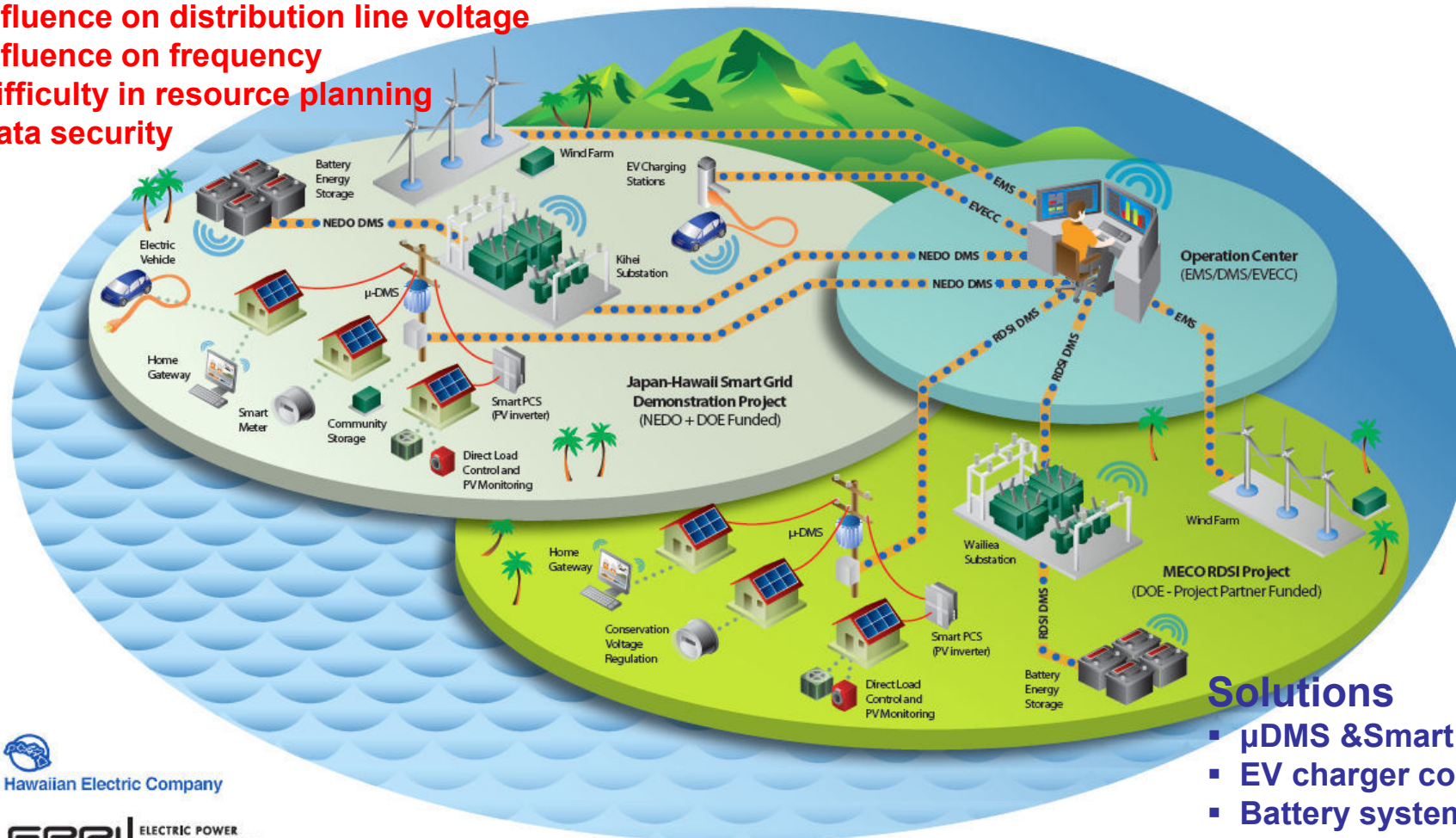
Solution for Impact of EV & PV High Penetration

Stable Supply of Electric Power

Maximum Utilization of Renewable Energy

Issues

- Excess energy
- Influence on distribution line voltage
- Influence on frequency
- Difficulty in resource planning
- Data security

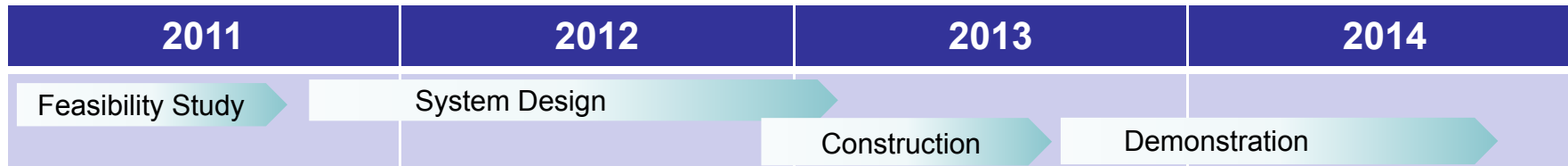


Solutions

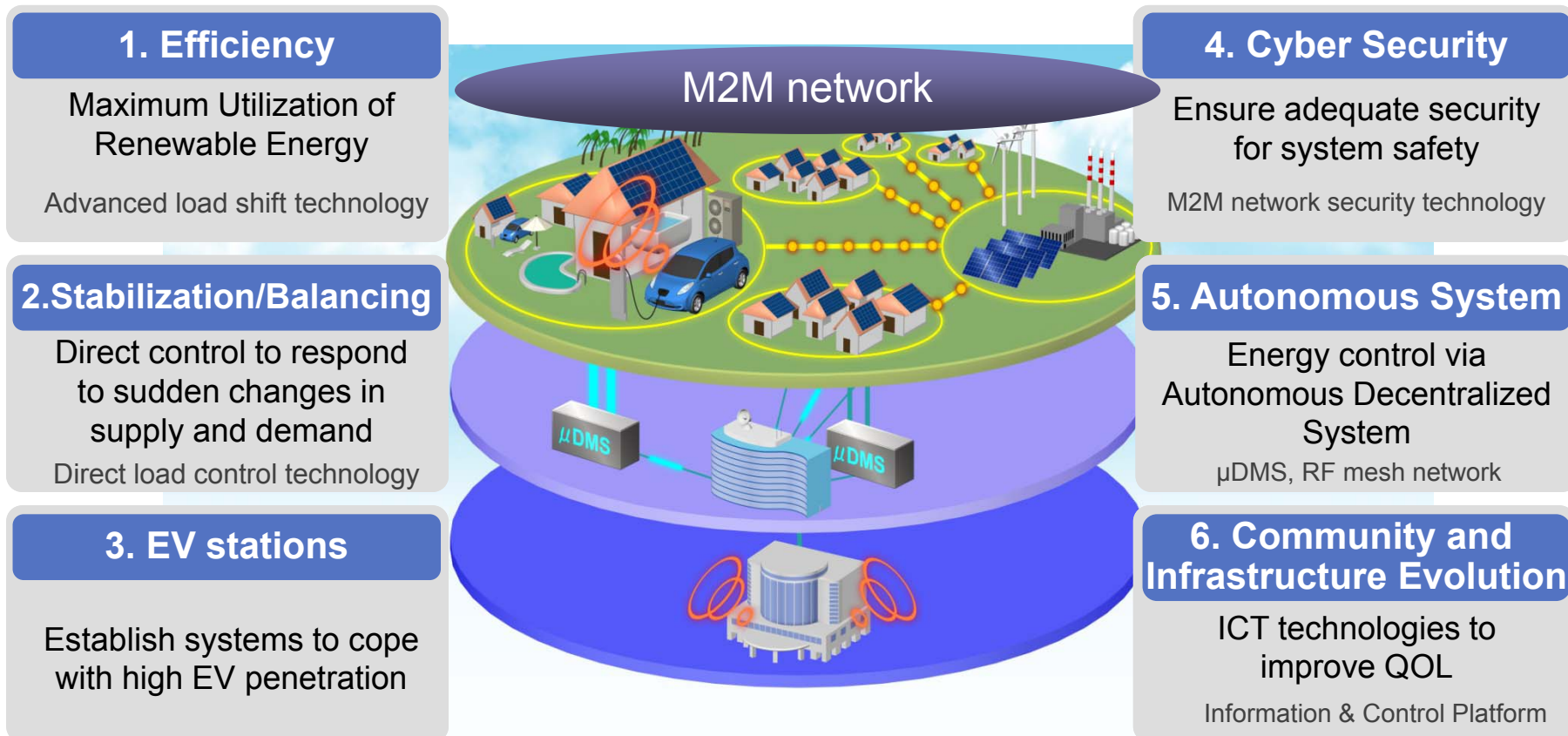
- μ DMS & Smart PCS
- EV charger control
- Battery system
- Demand Response
- ICT Platform


Hawaiian Electric Company

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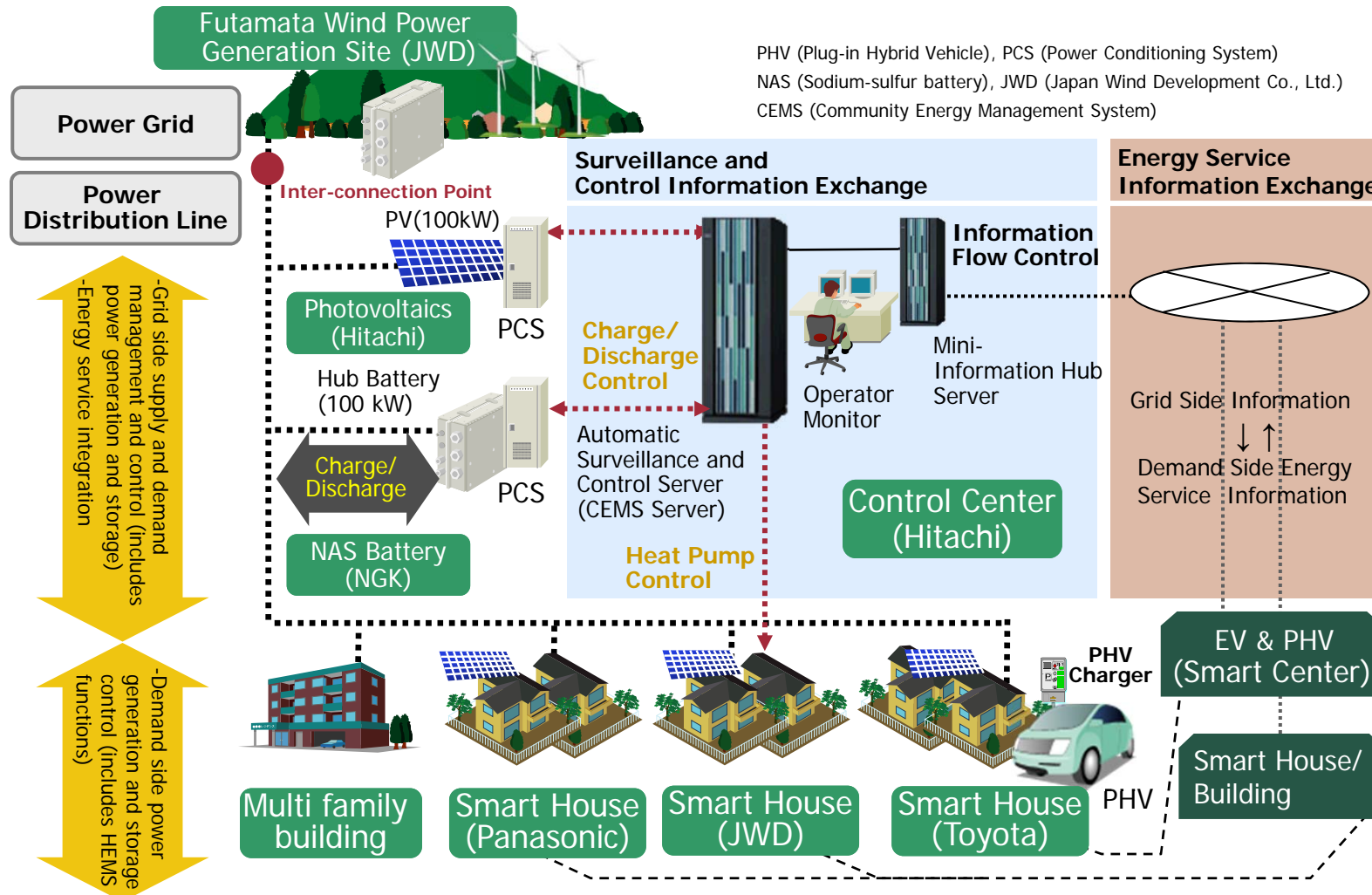


Six cutting-edge initiatives and verification biz model for Smart Grid are core activities for demonstration.



Rokkasho Village Demonstration Project Overview

Community Energy Management System (C-EMS) provides an integrated optimization system for mid-size and individual renewable energy generation, community energy storage, and Smart houses including HEMS and Plug-in Hybrid cars. C-EMS helps create a 100% CO₂-free community. (Commenced Sep. 2010)

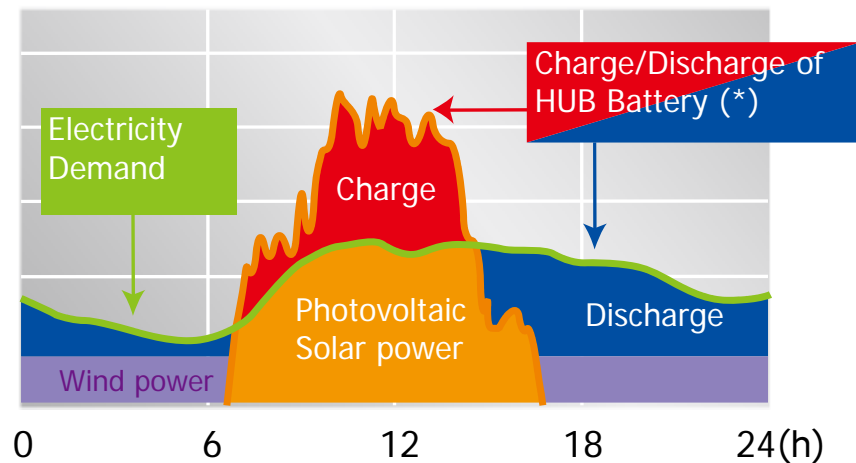


PHV (Plug-in Hybrid Vehicle), PCS (Power Conditioning System)
 NAS (Sodium-sulfur battery), JWD (Japan Wind Development Co., Ltd.)
 CEMS (Community Energy Management System)

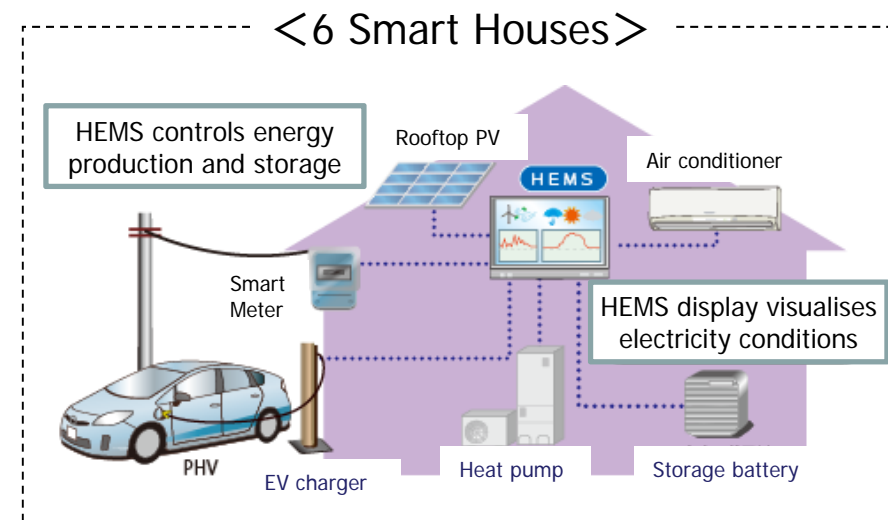
The model for Supply and Demand balance control



<a case of energy demand and supply>



(*) Assumption for reducing battery capacity:
Includes hub battery and demand-side control (i.e. Heat Pump and PHV charging), these are key to reducing battery cost (= capacity)

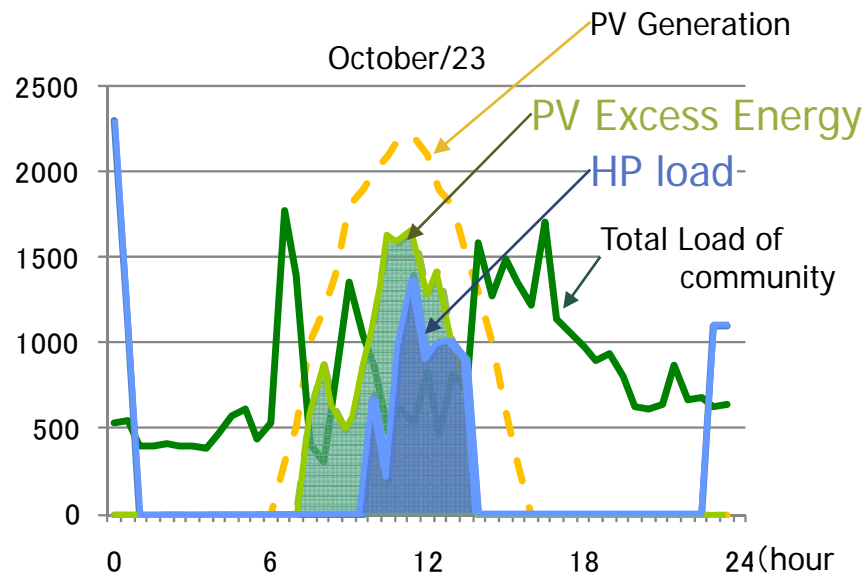
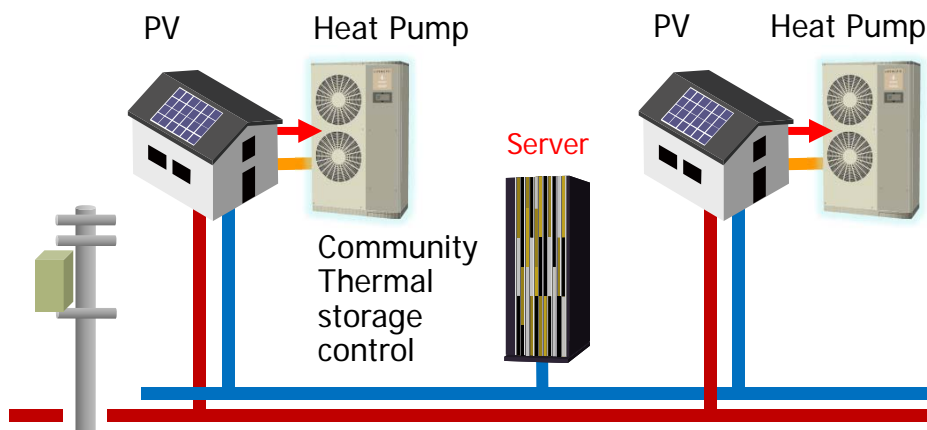


- Each company (Japan Wind Development, Toyota, Panasonic Corp) built 2 houses and introduced their own equipment for demonstration
- HEMS controls DER, e.g. wind turbine, PV and energy storage

Rokkasho Village DLC Result: Self-sufficiency ratio

- DLC (Direct Load Control) function controls Heat Pumps on/off together with PV generation prediction. These functions convert electricity into hot water which is then stored in the tank (thermal energy storage control)

DLC Load Shift for a group of HPs



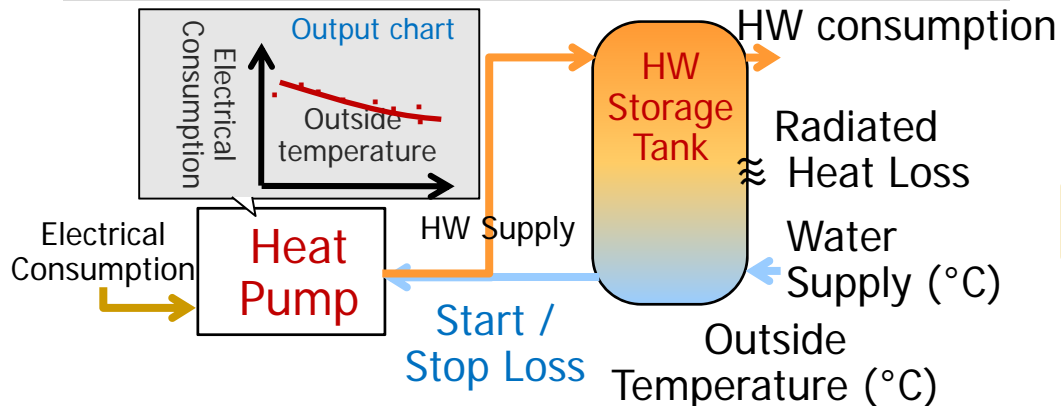
50.1% of Excess Energy consumed

The figure would be 24.5% with DLC Load Shift for individual HPs

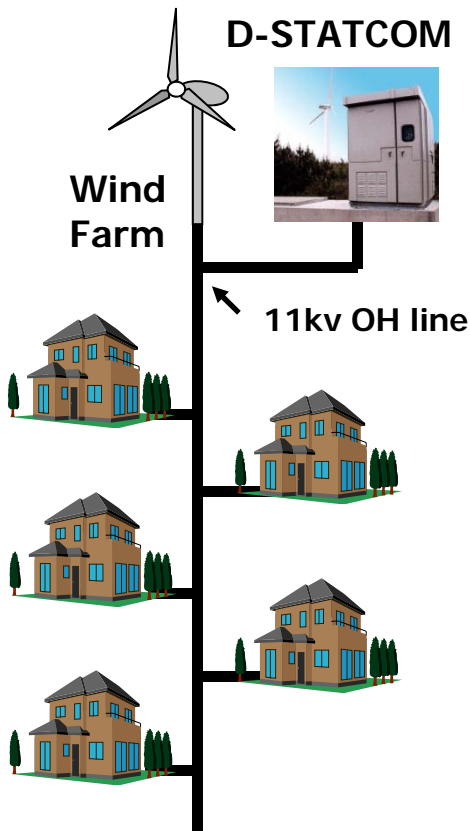
The self-sufficiency ratio = 83%

The figure of DLC load shift for individual HPs is calculated by simulation

Heat Pump control parameter



LCNF Tier 1 project



Substation

Background

- As DG (Distributed Generation) becomes more common, the growing number of renewable connections to distribution lines is expected to cause voltage fluctuations (specifically high or low voltage) due to the variable power output of the DG. In turn this can affect the efficiency and capacity of the distribution network.

Goals

- Determine the effectiveness of D-STATCOM as a dynamic voltage control system in rural 11kV networks to address voltage fluctuation.
- Optimise control by using a D-VQC (Voltage and Reactive Power Control System) to network multiple D-STATCOMs.

Scope

- 2 Strand project, initially 1 D-STATCOM as proof of concept, then 3 additional units as well as a D-VQC server.

Expected Benefits

- Improvement of power quality and mitigation of voltage spikes issues, thereby increasing network stability, efficiency and load capacity in distribution networks.
- Learning from project will be beneficial for informing DNOs business case for alternative responses to network rebuild.



4 Project Locations

- Agreed
- Tentative



ETI Smart Systems & Heat Programme



Launched in April 2012, the focus of the programme is the design, development and demonstration of a first-of-a-kind energy system aligned with the needs of UK consumers in the domestic and small commercial sectors with a particular focus on heat delivery. Hitachi was announced as Programme Associate.

There are four key themes:

- Understanding real mass-market consumer behaviour in order to design and communicate effective service products
- Providing energy services and integrated products to consumers in domestic and commercial buildings (primarily domestic & retrofit)
- Space and water heating – but including other energy service needs in or connected to buildings
- Understanding the evolution of the whole energy system out to 2050, including building retrofits and energy distribution choices

ETI Smart Systems & Heat Programme



- Budget of £100mil allocated over 5 years, culminating into the demonstration of a first of its kind Smart Energy System in the UK
- Hitachi is involved in the delivery of several WAs awarded through open competitive tendering:

WA1.1 – Enabling Technologies



+ other sub-contractors

Hitachi as Consortium Leader

WA3.1 – Data Management and Overall System Architecture

+ other sub-contractors

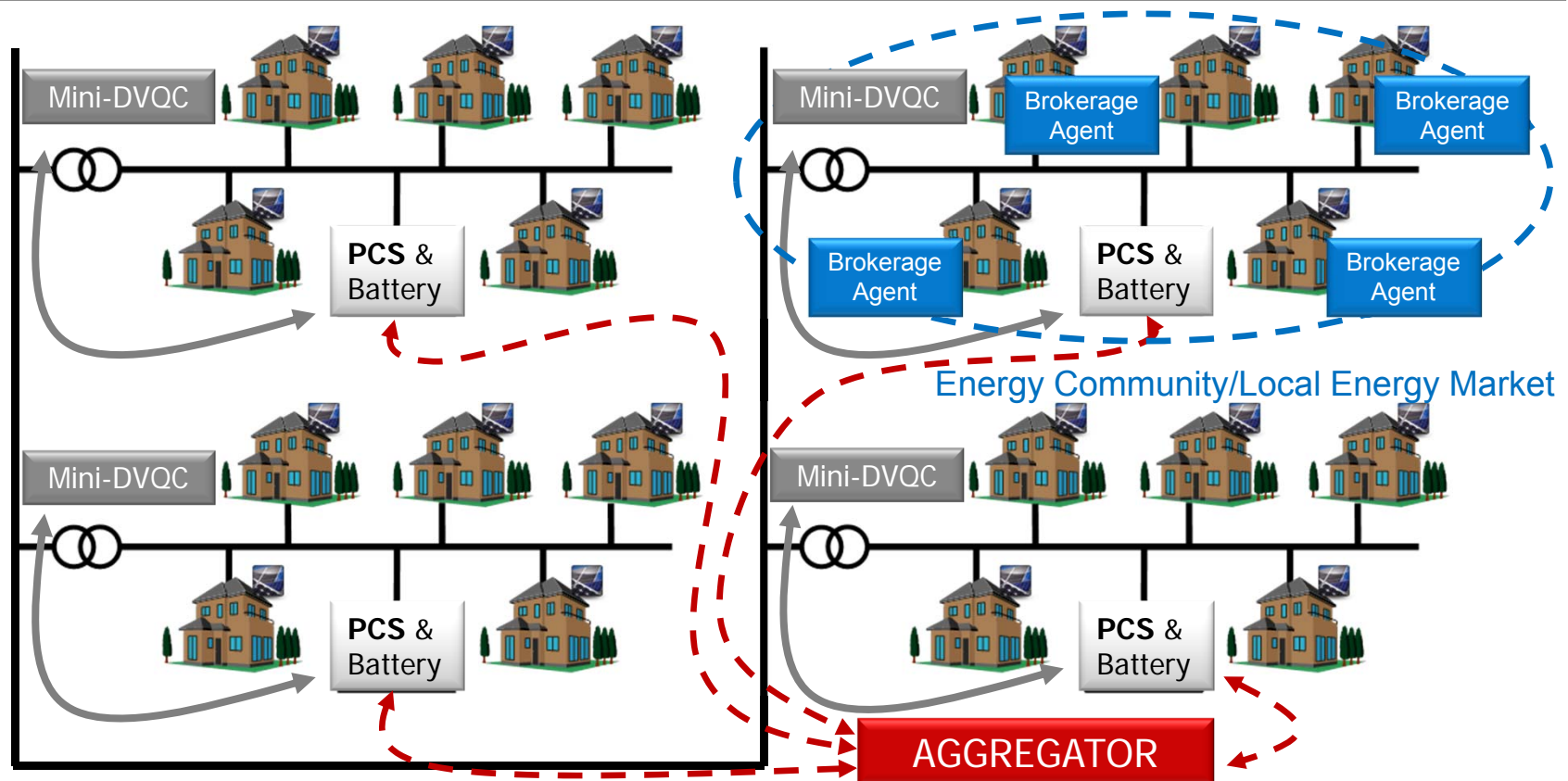
Hitachi as a Prime Contractor

WA5 – Consumer Response and Behaviour



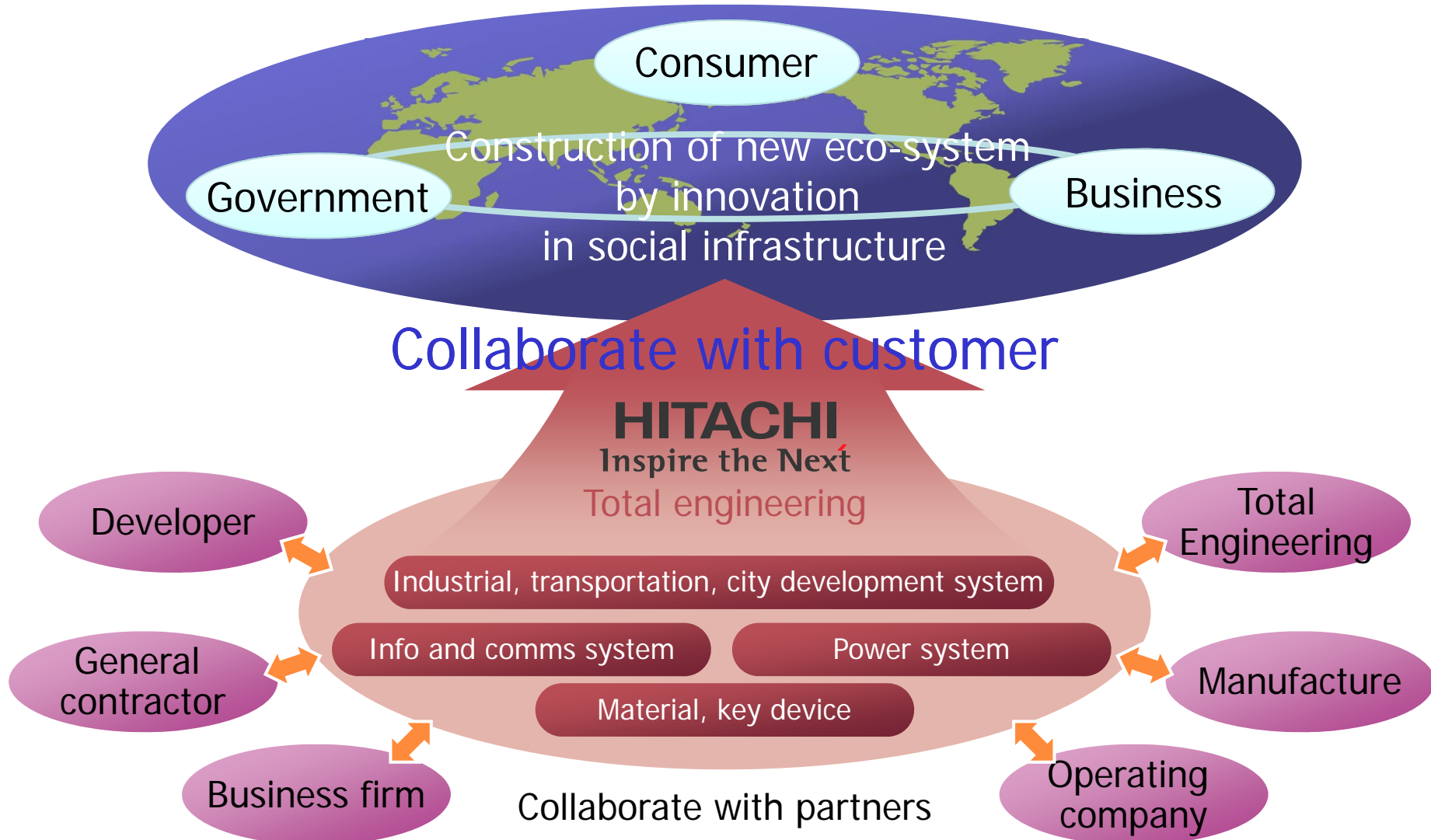
Hitachi as a Sub-contractor

Smart community energy storage system



- **PCS** associated with **Batteries** for 4-quadrant voltage control on low voltage grid connected with PVs & low carbon loads(heat pump/EV charger)
- **Mini-DVOC** to control networked PCSs
- Involvement of **Aggregator** to test aggregation of storage from batteries
- Deployment of a high-level management system which optimises multiple Mini-DVOCs and other assets on the network

- Establish value that is tailored for each country or region with local partners



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