



Hitachi Smart Community Projects

November, 2013

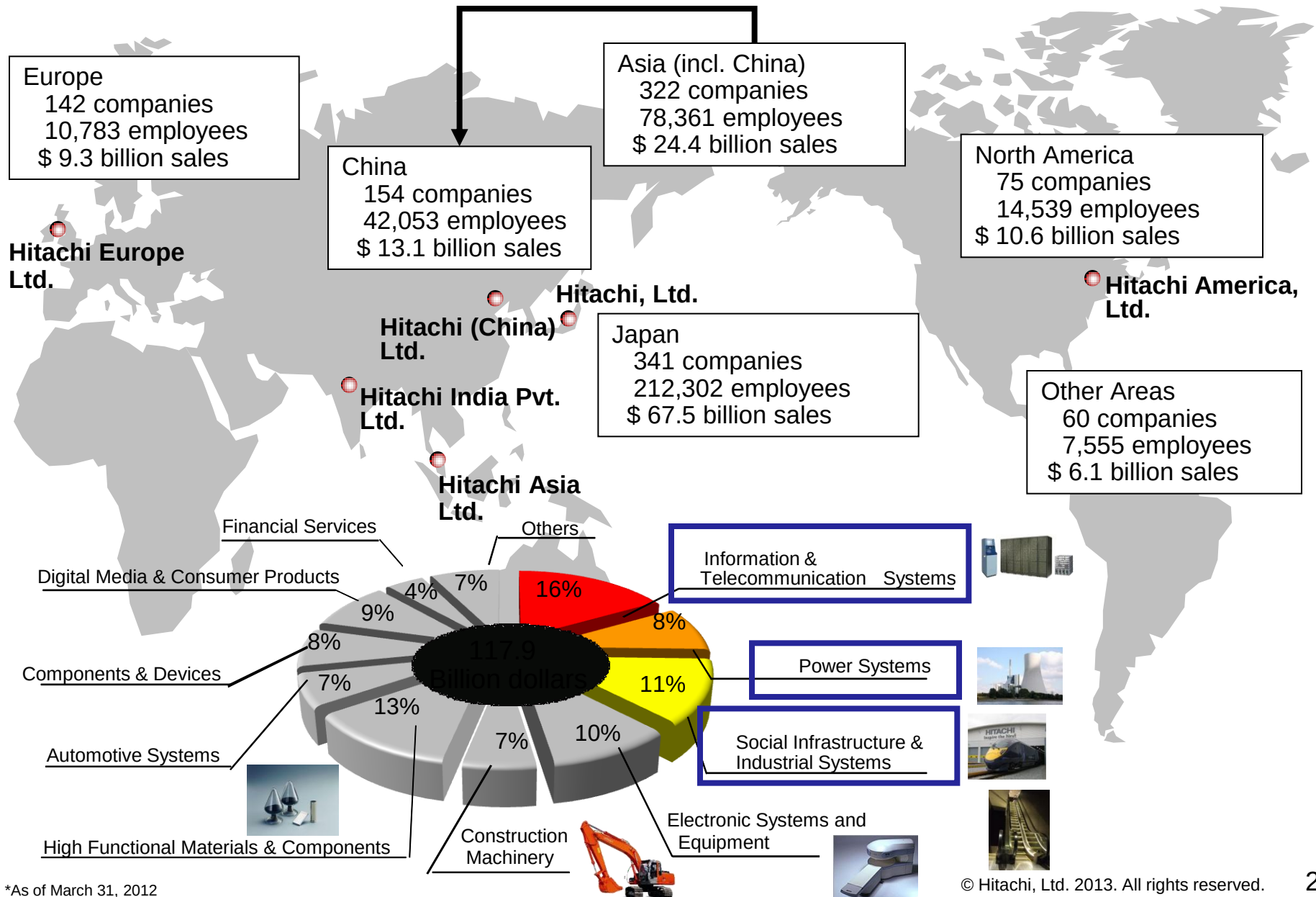
NBPD, Smart City Project Div.,
Social Innovation Business Project Div.,
Hitachi, Ltd.

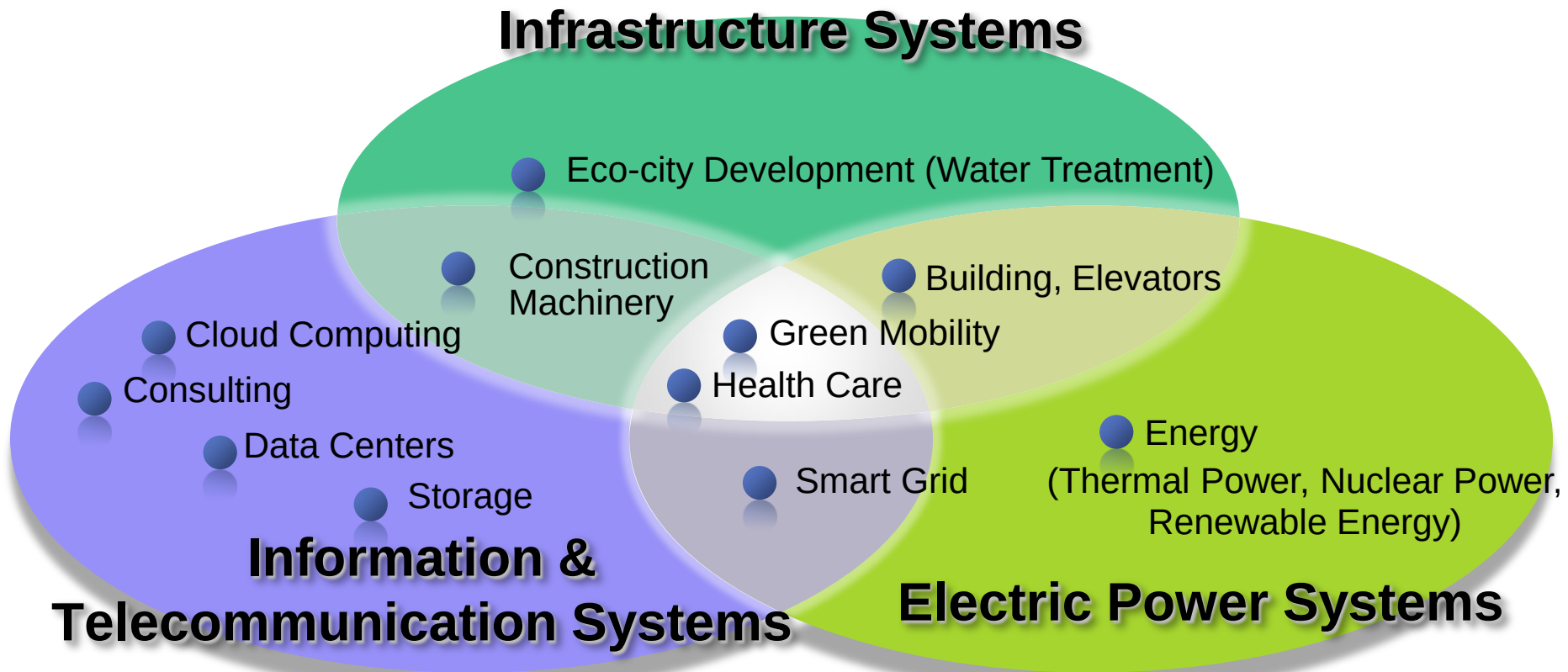
Fumitoshi Emura

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1. Hitachi Group Introduction
2. Hitachi's SC involvement in Europe/America
3. Outline of Smart Project activities in UK
4. Outline of JUMPSmartMaui Project
5. Outline of Malaga Project
6. Outline of Smart Projects activities in Japan

1-1. Hitachi Group Introduction (WW Activities)





As a worldwide leading company, Hitachi promotes the global development of its “Social Innovation Business”.

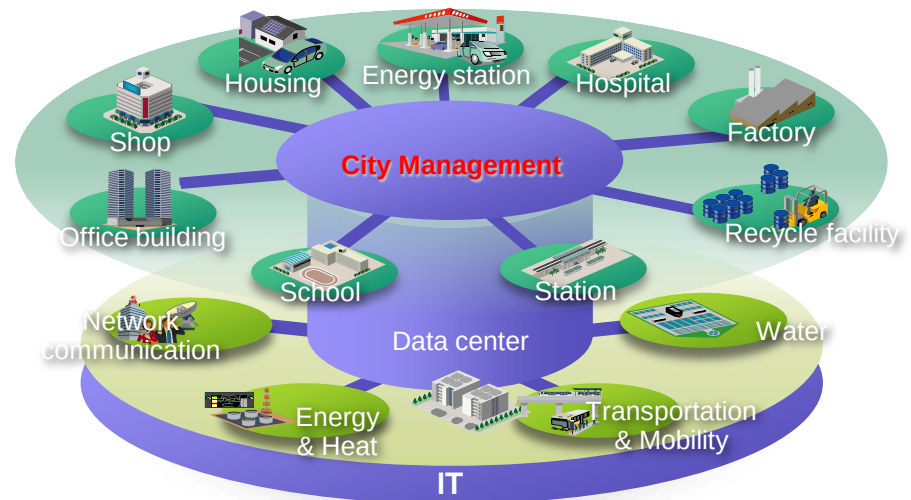
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2-1. What is Smart City Biz.

- Smart City is the city where people live and enjoy their QoL by ,efficiently, operating infrastructure with ICT.
Smart City is a kind of “City Development and Construction”

Various potential businesses are related to Smart City opportunity. It covers wide field from hard oriented area, such as facility building, to soft service, such as smart healthcare service.



Tow main charactors in Smart City development. Brown field requires typical development process to keep and improve efficiencyof system under mixed environment with existing and newly installed technologies.



**Brown Field
& Retrofit**

US, Europe, Japan
(Replace or
redevelopment of
Infrastructure)

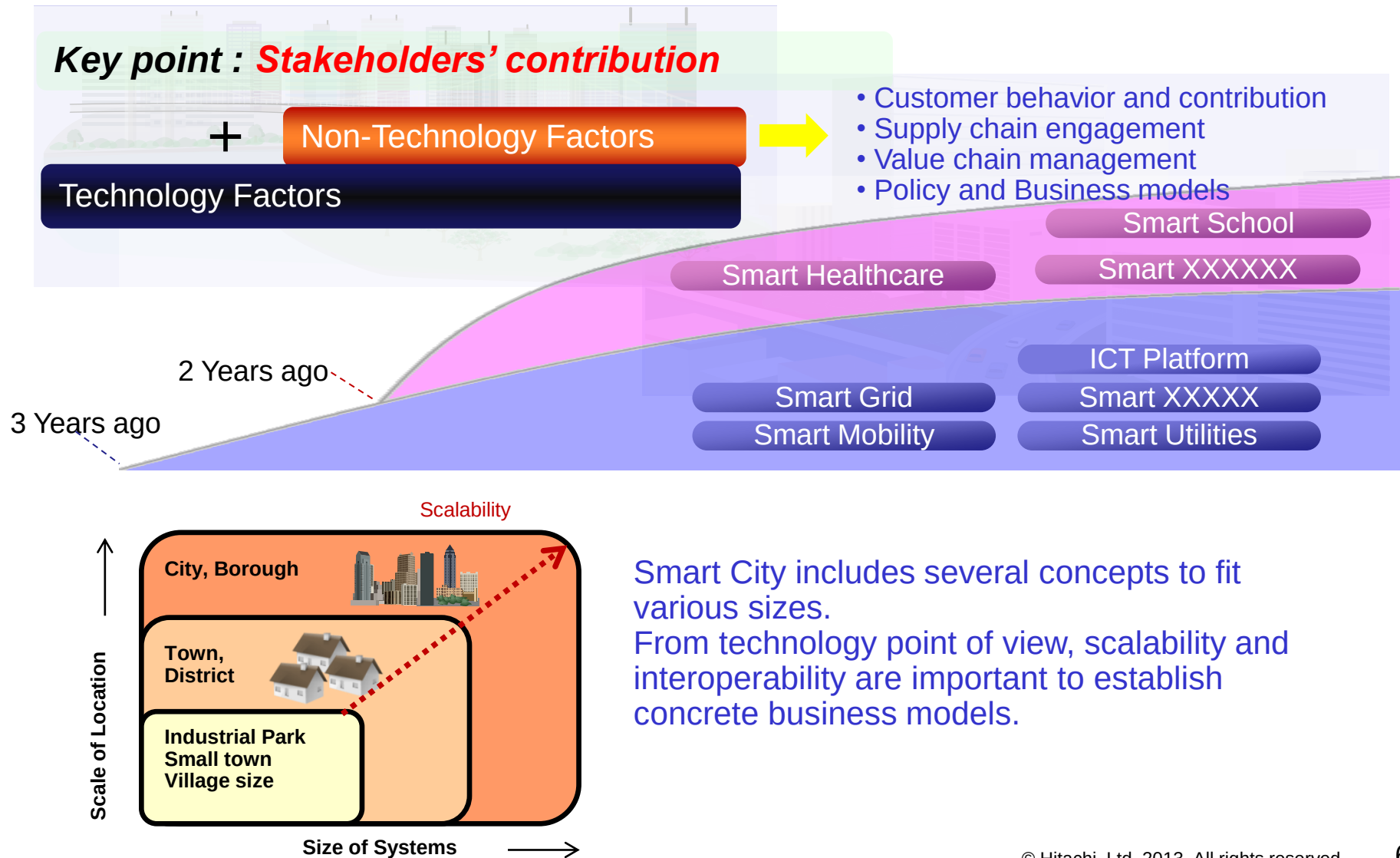


Green Field

SE Asia, China, India,
Africa
(Adapt to increase in
population/demand)

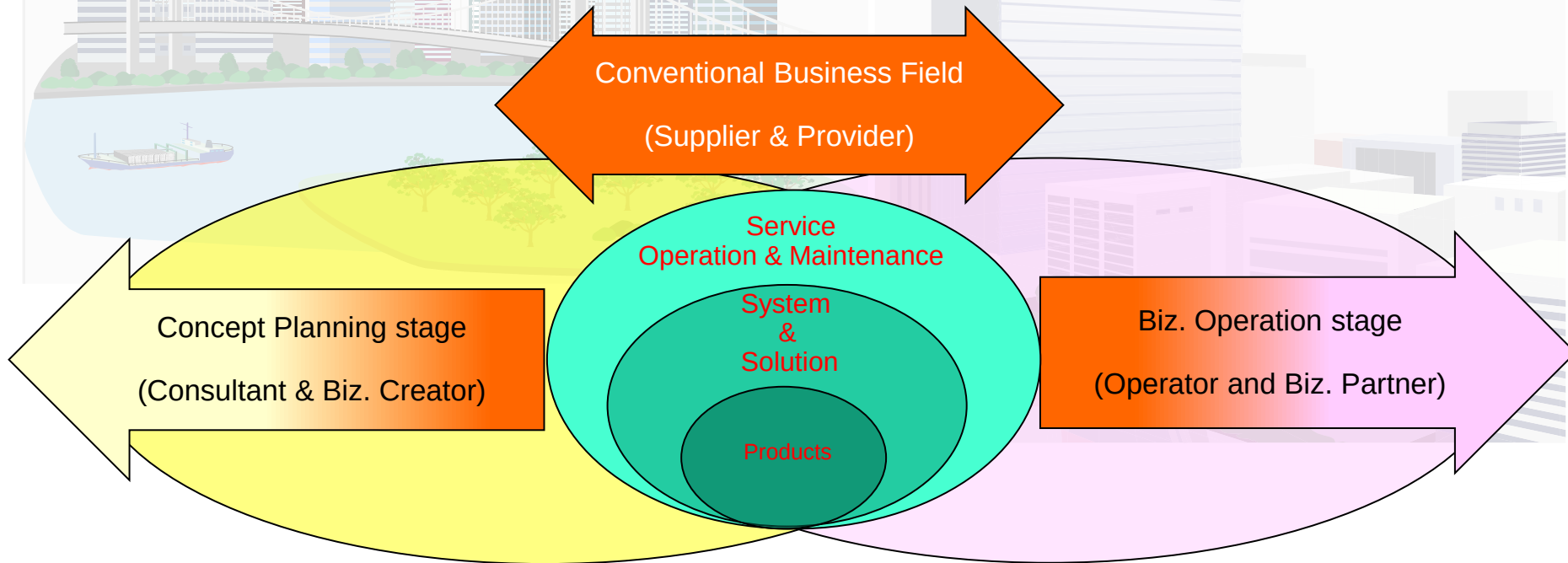
2-2. Smart City Concept

From Public infrastructure to Social infrastructure



2-3. Smart City as Social Innovation Biz.

- Smart City movement is expanding and creating its new business fields. It has several features from city construction to city management service. Players in these markets are required to enhance and stretch their business style.



- Best solution to the stakeholder will be different from others.

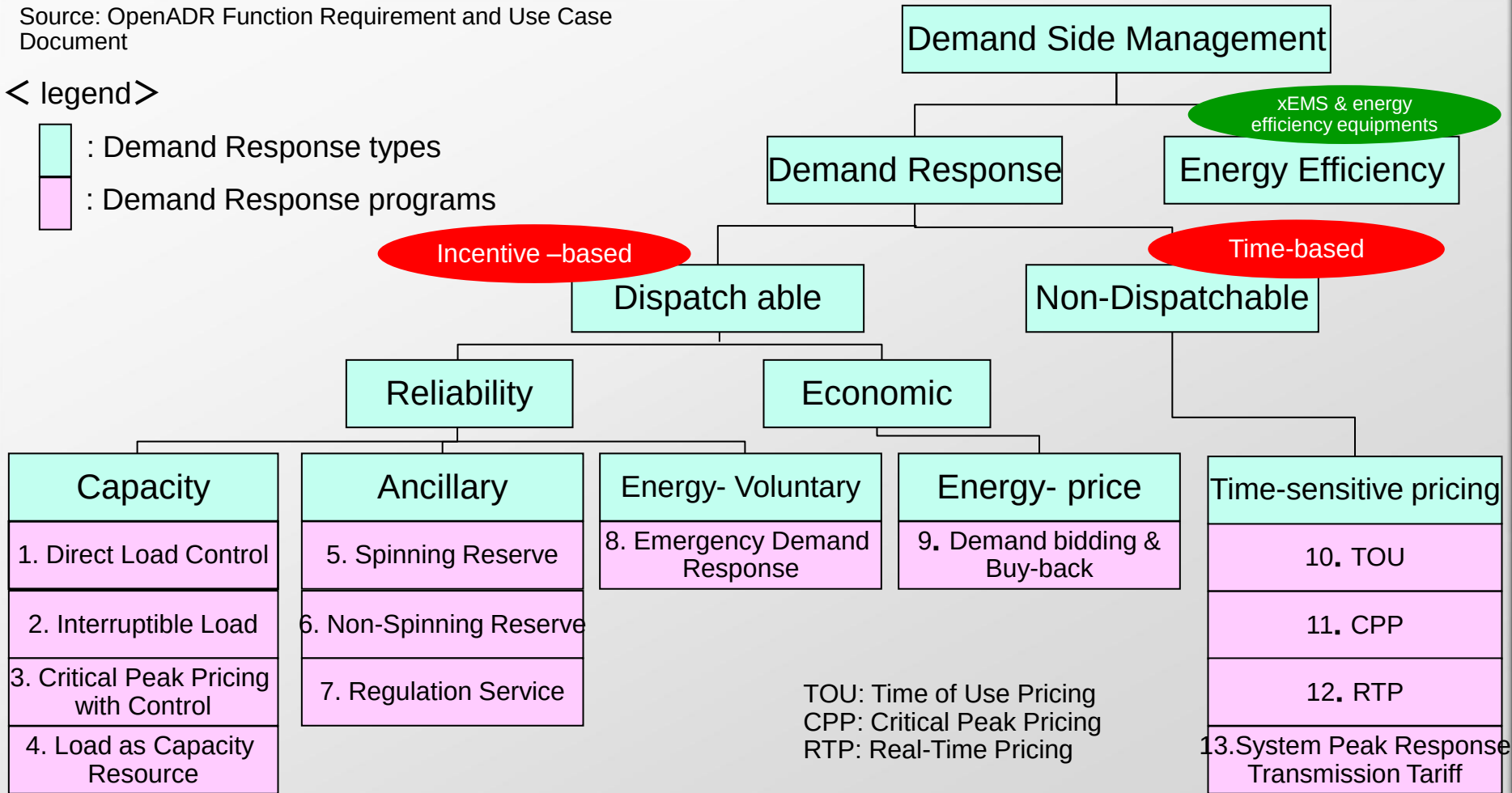
$$\begin{array}{|c|} \hline \text{Existing Infrastructure} \\ \hline \end{array} \times \begin{array}{|c|} \hline \text{Investment cost} \\ \hline \end{array} \times \begin{array}{|c|} \hline \text{Technology Level} \\ \hline \end{array} \times \begin{array}{|c|} \hline \text{Stakeholder contribution} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{Optimum Smart Infrastructure} \\ \hline \end{array}$$

2-4. Demand Response Types and Programs

Source: OpenADR Function Requirement and Use Case Document

< legend >

- : Demand Response types
- : Demand Response programs



Trends

Incorporating resources from consumers to energy system as supplying availability through DR mechanism

- (1) Energy market
- (2) Capacity market
- (3) Ancillary service market

For measures for global warming and reducing CO2, reducing fuel cells

- (1) Active introducing of RE
- (2) Introducing EVs
- (3) Investment for energy efficiency equipments

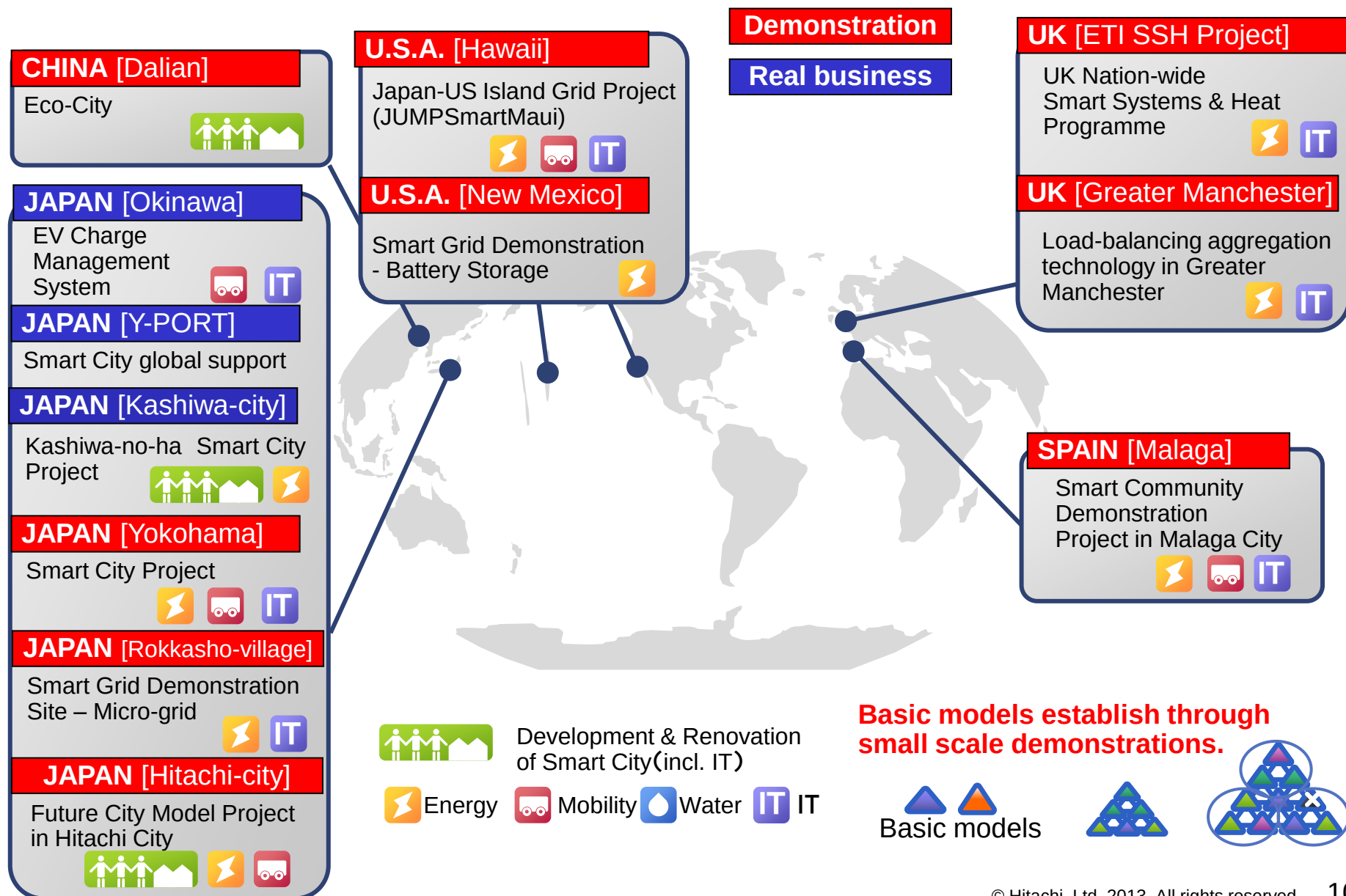
Countermeasure to aging grids & demand increasing
Investment to energy efficiency, energy saving

- (1) Visualization
- (2) Retrofit of aging equipments
- (3) Introducing xEMS

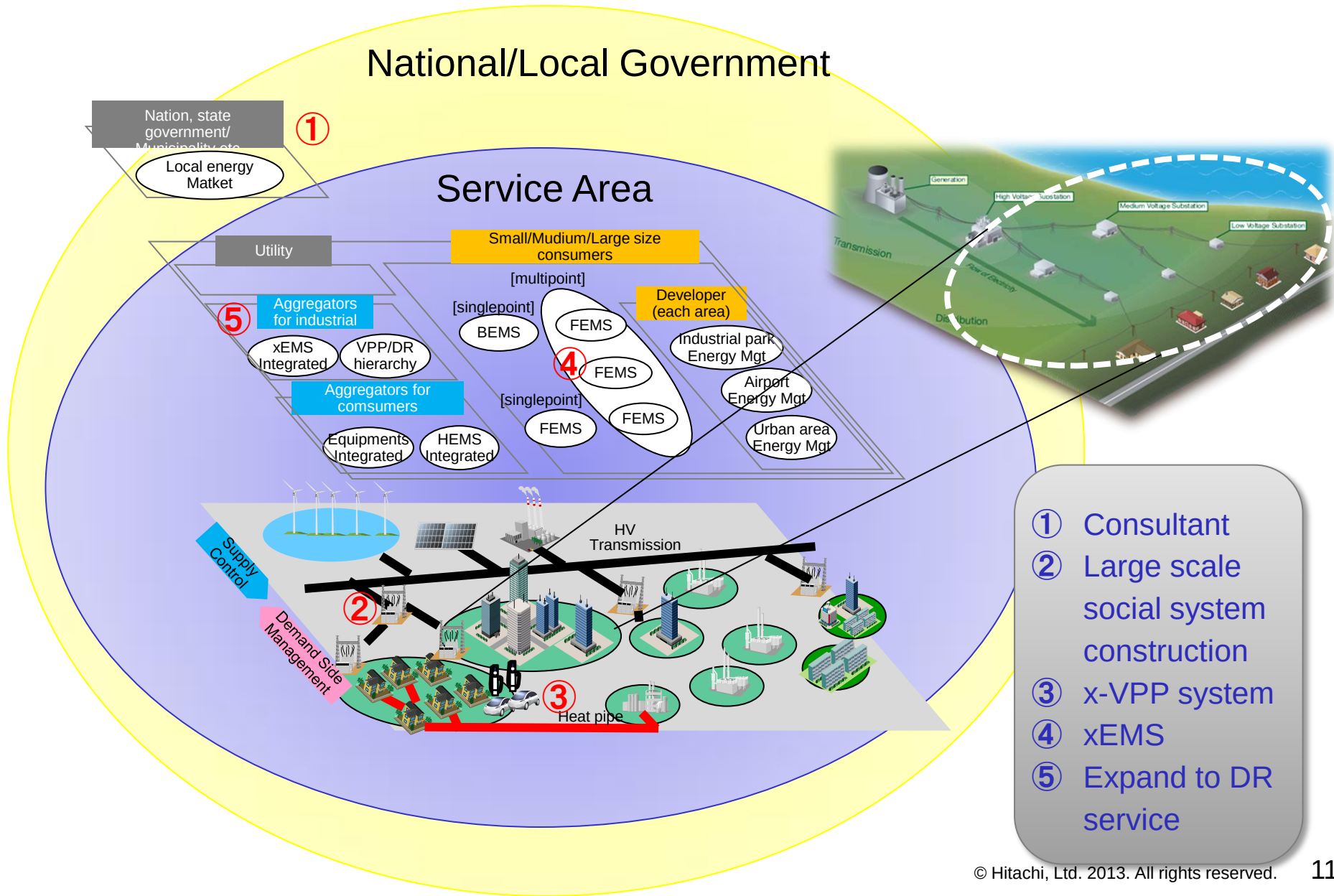
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3-1. Smart Community Solution (Major Activities)



3-2. Customers and Solutions

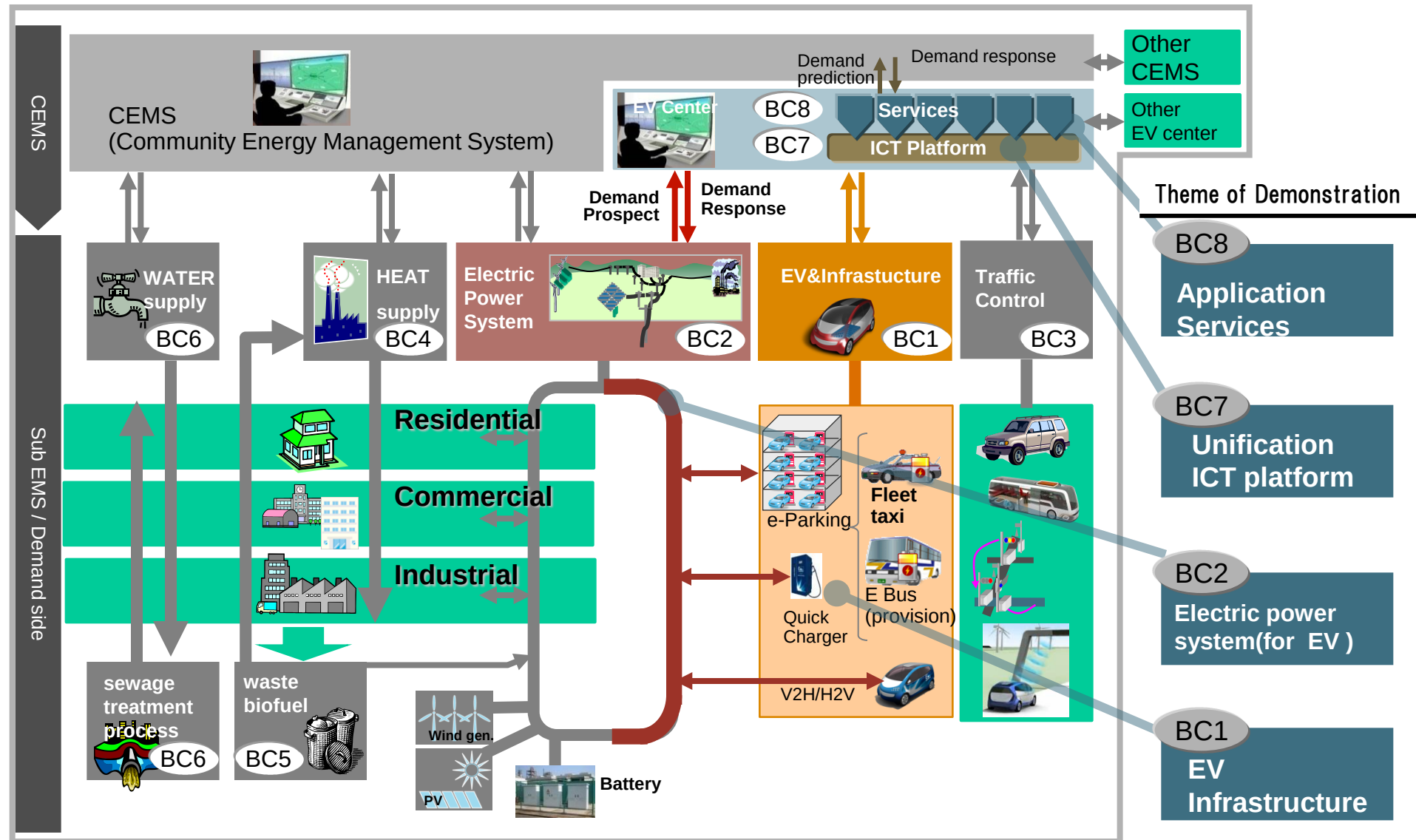


Málaga

- **Population**
City 568,507 (2010) (Rank 6th)
- **Area**
City 395 km²
- **Location**
Málaga is located in southern Spain, on the Costa del Sol (Coast of the Sun) on the northern side of the Mediterranean Sea.
- **Climate**
 - Mediterranean (Köppen climate classification: Csa)
 - average of about 300 days of sunshine
- **Economy**
 - 4th city in Spain
 - Main business sector : tourism (expand technology service)



3-4. Malaga Project (System outline)



3-5. Malaga Project (Step to zero emission mobility)

Phase1

Establish EV charging infrastructure

Phase2

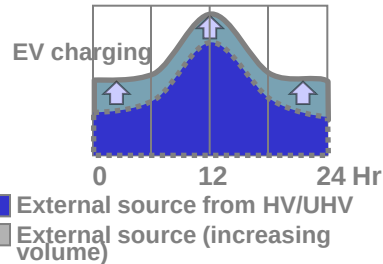
Trial of Power Demand & Supply Managements (Mainly Community Energy Management)

Step-1.Capturing demands side

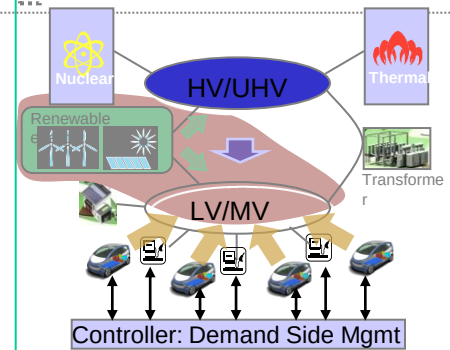
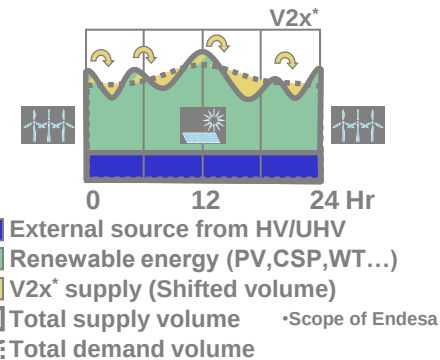
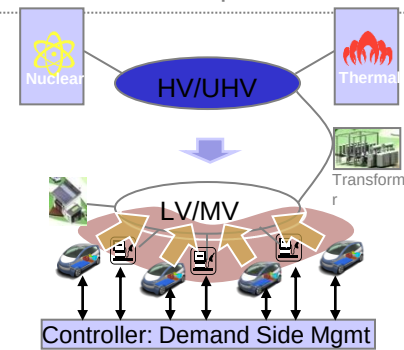
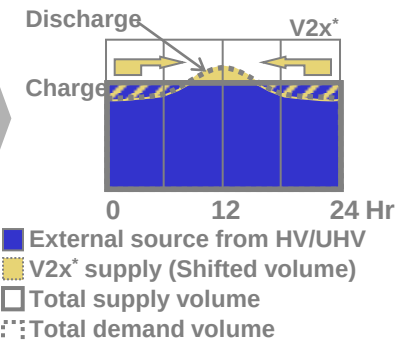
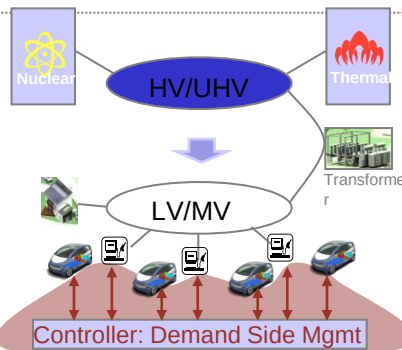
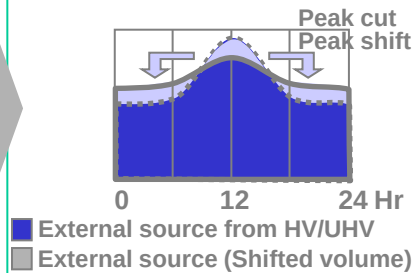
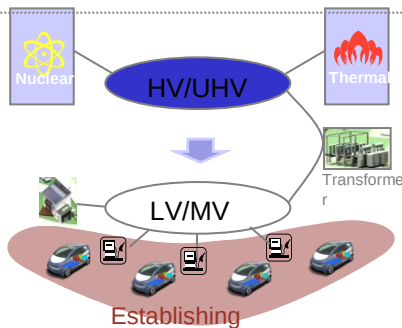
Step-2.Harmonizing V2x supply

Step-3.Harmonizing RE supply

Power curve during a day (MV/LV)



Major Activity



BC1 1) e-Parking, 2)Charging Mgmt, 3)Vehicle Mgmt Energy mgmt (Integrated function)

-1 Rapid Charger allocation guidance ⇒(Tune-up) ⇒(Tune-up) ⇒(Tune-up)

-2 Evaluation of Stabilizing grid method ⇒(Tune-up)

BC2 -3 Integrated DSM

-4 - - -

-5 - - -

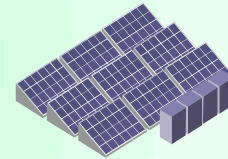
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Achieving 40% renewable energy in Hawaii by 2030

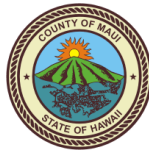
Hawaii has the highest dependence on oil by far among the 50 states. The ratio of oil-fired power generation is more than 70%, about six times of Alaska, the second highest state.

Including fuel use in cars and airplanes, Hawaii has relied on fossil fuels for 90% of its energy consumption. Electricity prices in Hawaii have more than tripled the United States average price due to soaring crude oil prices. By 2030, the state of Hawaii has set a goal to produce 40 percent of its electricity demand by renewable energy resources.



2010	2012	2020	2030
RE ratio: 10% In Maui Wind: 120GWh PV: 10GWh Hydro&Biomass: 51GWh	RE ratio: 21% In Maui Wind: 158GWh (72MW) PV: 32GWh (27MW) Hydro&Biomass: 47GWh (17MW)	25% (Target)	40% (Target)

4-2. JUMPSmartMaui Project Stakeholders



Hawaiian Electric Company



Maui Electric Company, Ltd.



Hawaii Natural Energy Institute



Pacific Northwest
NATIONAL
LABORATORY



NATIONAL RENEWABLE ENERGY LABORATORY



Sandia
National
Laboratories



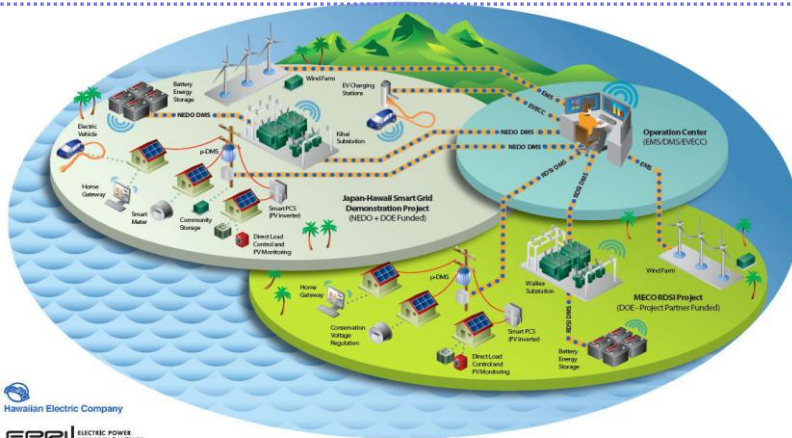
maui economic
DEVELOPMENT BOARD



CyberDefense

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4-3. Outline of JUMPSmartMaui



In Maui, large scale renewable energy resources have been introduced. In addition, PV and EV high penetrations have been expected.

Issues

- Excess Energy
- Influence on frequency
- Influence on distribution line voltage

Six cutting-edge initiatives as solutions

1. Energy Efficiency

Maximum Utilization of Renewable Energy

2. Stabilization/Balancing

DLC and Advanced Load Shift as Demand Response function

3. EV infrastructure & QC stations

EV charger control and Batteries

4. Cyber Security

Ensure adequate security

5. Autonomous System

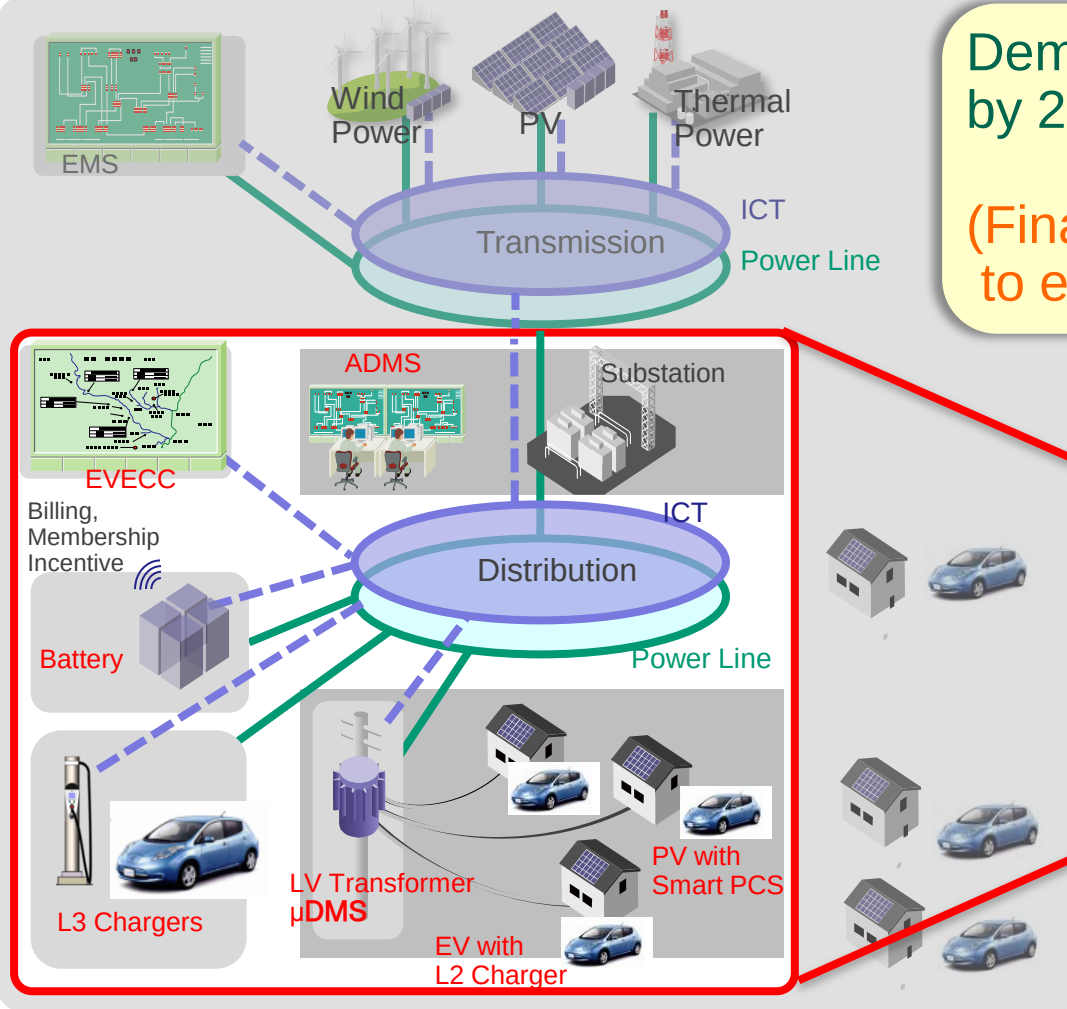
Energy control via Autonomous Decentralized System

6. ICT Technology

ICT technologies to improve Quality of Life

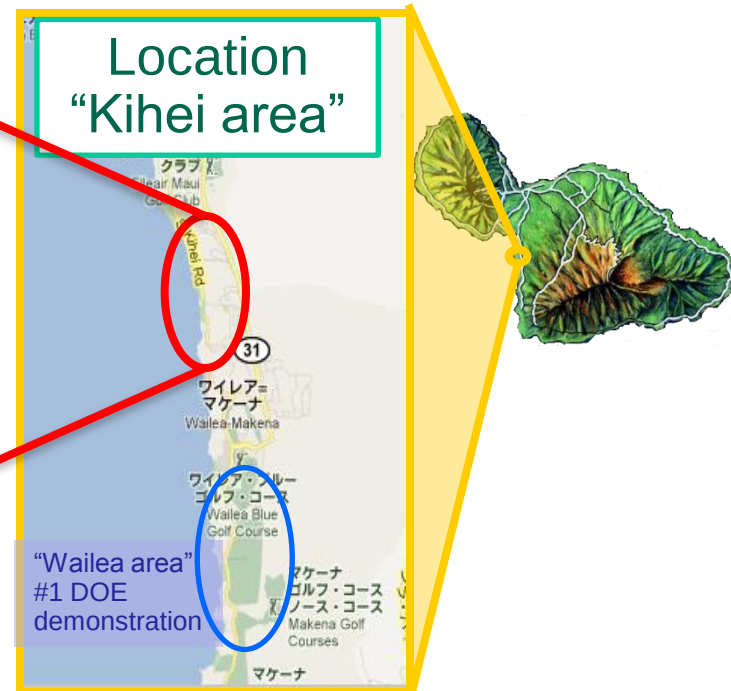
4-4. Systems Overview of JUMPSmartMaui

EV batteries are utilized as stationed Batteries for storing excess energy and controlling frequency fluctuation.



Demonstration will be implemented by 200 EVs and 40 Residences.

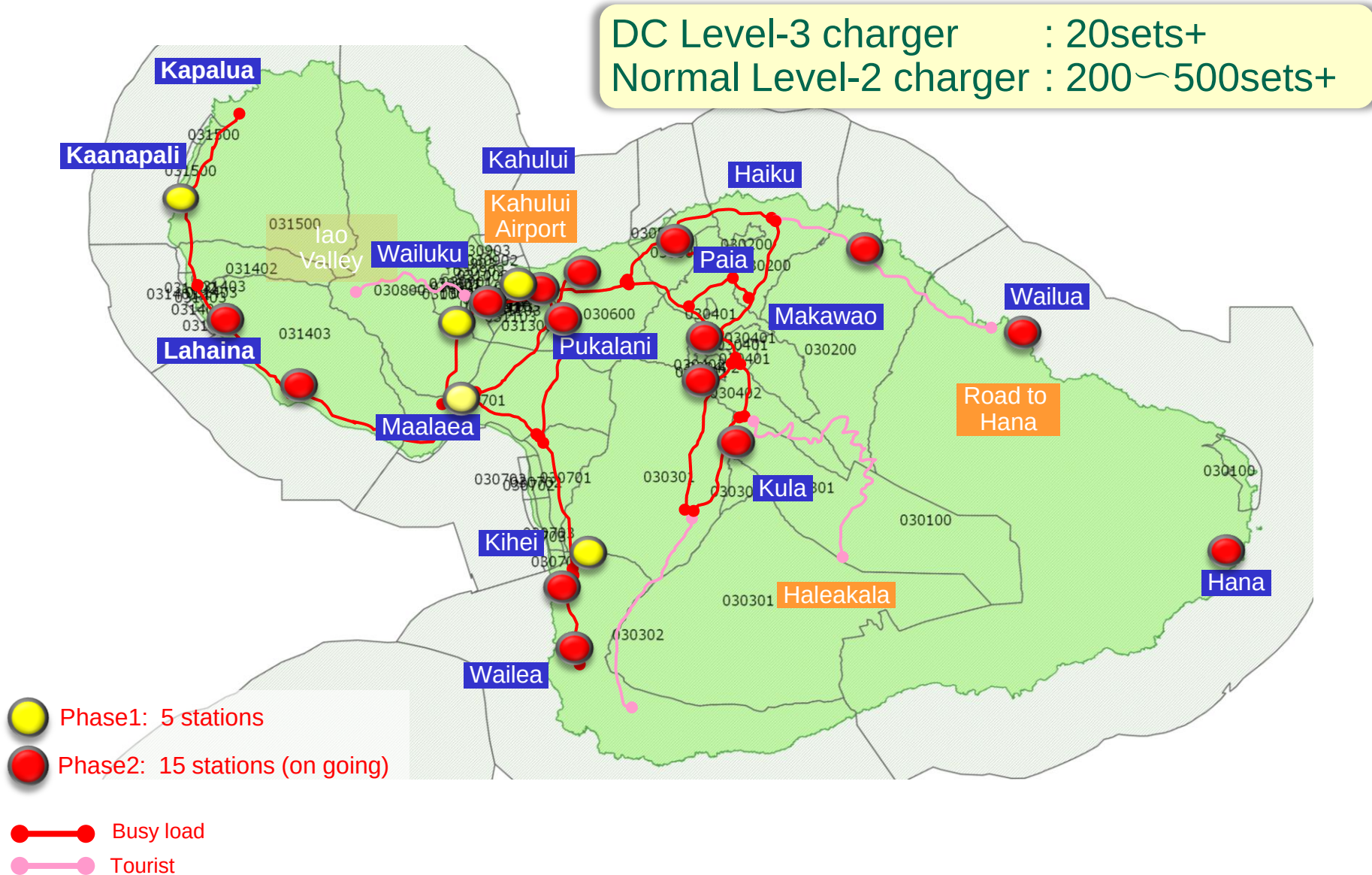
(Final target is more than 500EVs to establish EV-Virtual Power Plant)



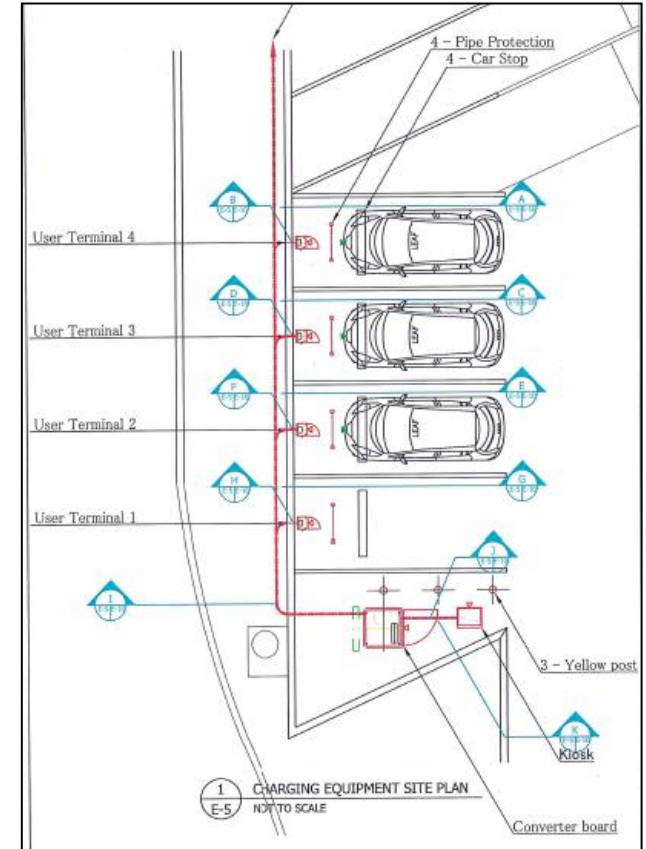
4-5. Locations of DC Fast Chargers

DC: Direct Current

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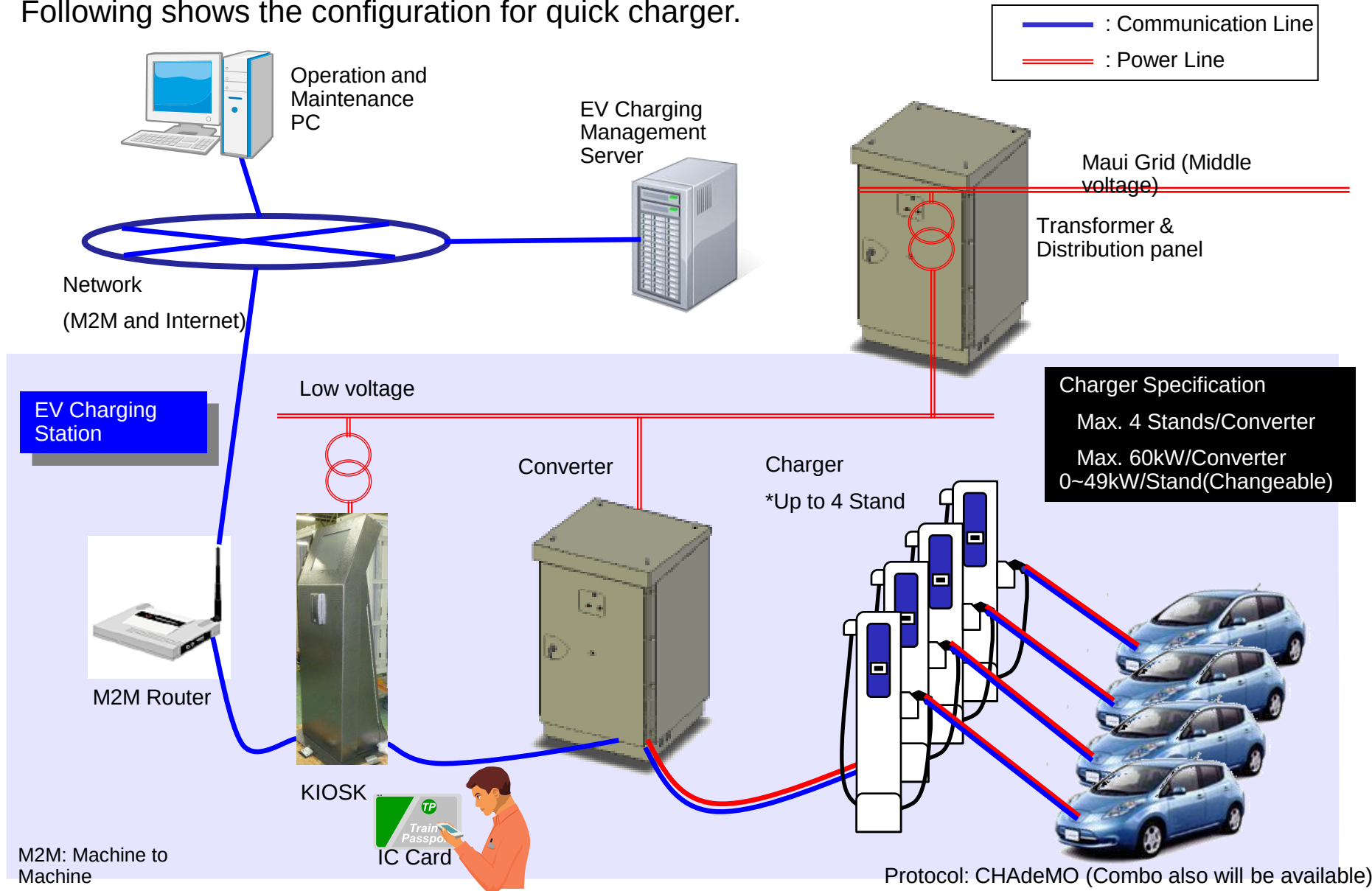


4-6. Queen Ka'ahumanu Shopping Center



4-7. Installation Examples in Maui

Following shows the configuration for quick charger.



4-8. Further Expansion Plan

By demonstration in the high RE penetration area:

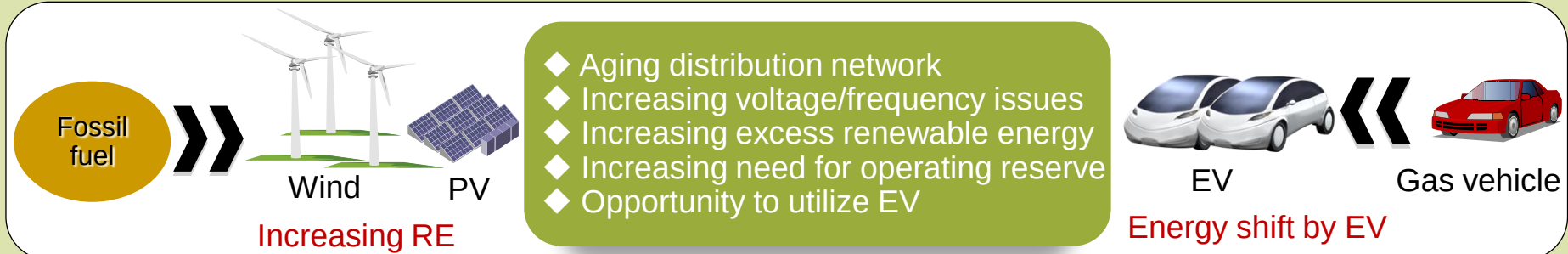
1. Tackle forward looking challenges for future situation in the world
2. Demonstrate and prove out solutions against issues in distribution grid

Background

Massive EV penetration

Stable Power Supply

Maximum RE utilization



Target Objective (idea)

1. Virtual Power Plant

- Integrated control of existing and distributed sources
- Establish DSM/ADR

2. Vehicle to Grid

- Optimum control for Virtual Power Plant

3. Enhanced EV Roll-out

- Expand EV charging infrastructure
- “Big data” analysis of EV use and performance

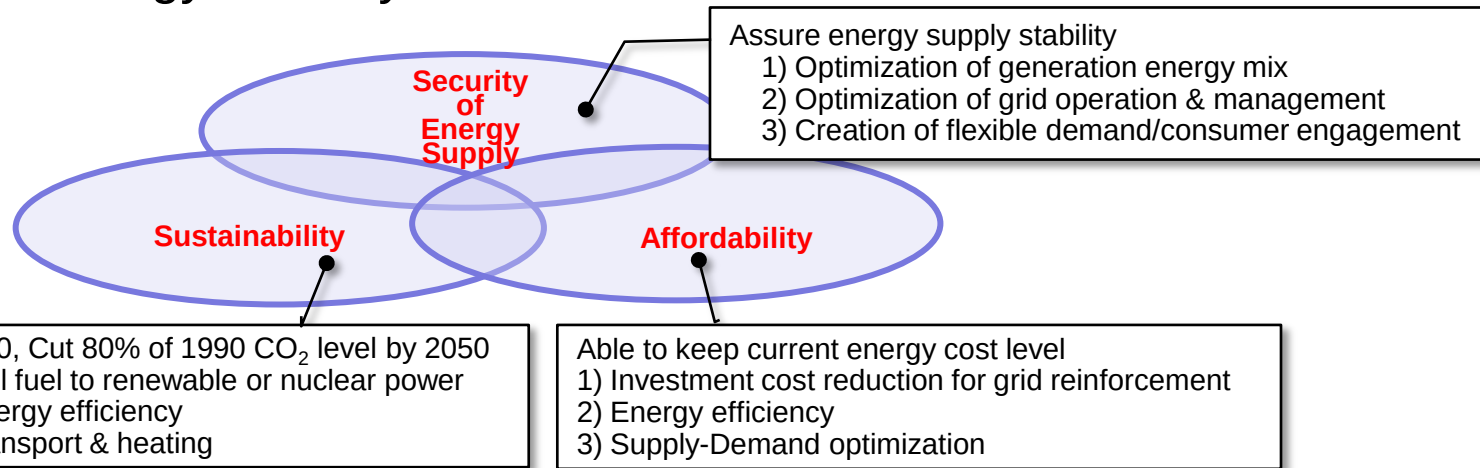
Develop worldwide standard model and global showcase of the most advanced low-carbon system for an island/micro-grid society

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5-1. Challenge in UK

● Policies for the energy delivery network



● EU 20-20-20 directive & the UK target

The climate and energy package is a set of binding legislation which aims to ensure EU meets its ambitious climate and energy targets for 2020.

UK oil and gas output fall set to run into next year

A sharp fall in Britain's oil and gas output is set to persist into next year, as maintenance concerns over ageing infrastructure in the North Sea delay a resurgence in production.

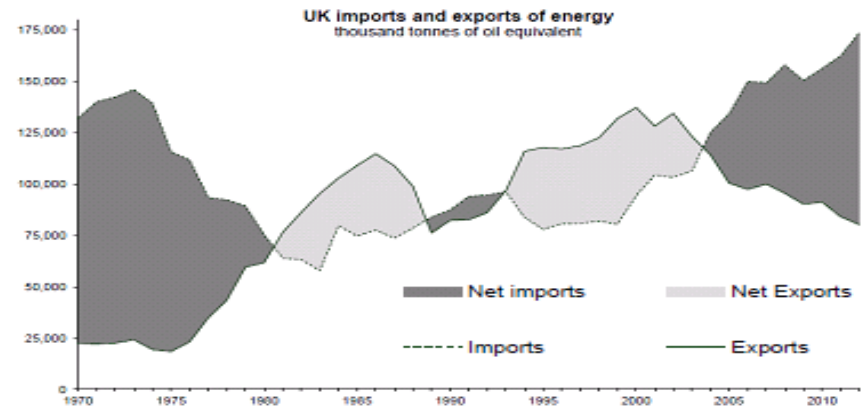
...

Output dropped by nearly a third between 2010 and 2012 to 1.55m boe/d and it is now expected to fall further to between 1.2m and 1.4m boe/d this year.

August 20, 2013

The Financial Times Limited 2013

Decline of domestic fossil fuel reserves



Source: UK Department of Energy & Climate Change

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5-3. Target for Smart Systems and Mechanism in UK

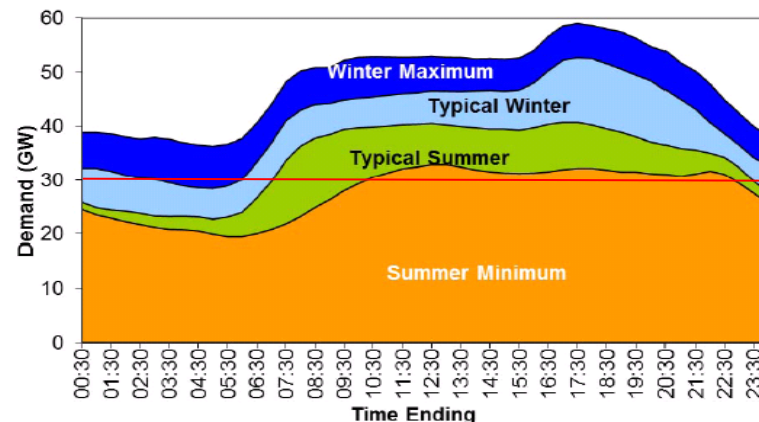
- Reduction of peak load in the winter evening is the key issue to improve the load factor.

- Annual peak demand is in winter caused by heating demand.
- The typical summer demand is around 50-60% of the winter peak demand.

Heat Pump solutions with ICT

- ★ Energy aggregation
- ★ Virtual Power Plant
- ★ Gas and Electricity HEMS
- ★ Total Energy Solution

Summer and Winter Daily Demand Profiles in 2010/11



Source: 2011 National Electricity Transmission System Seven Year Statement

- Impact of intermittent and variable generation

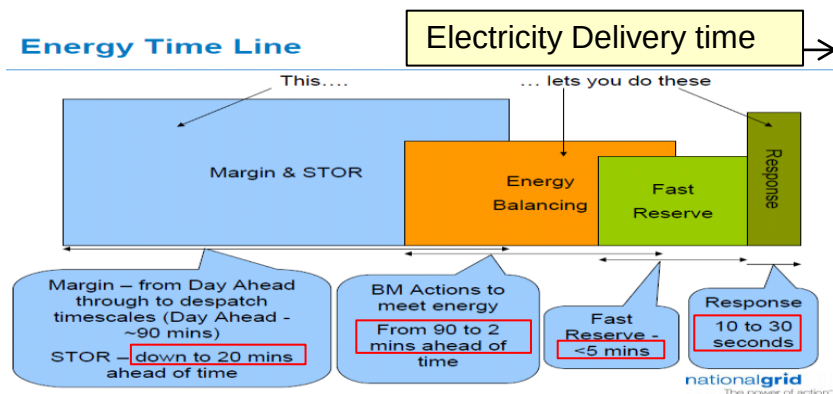
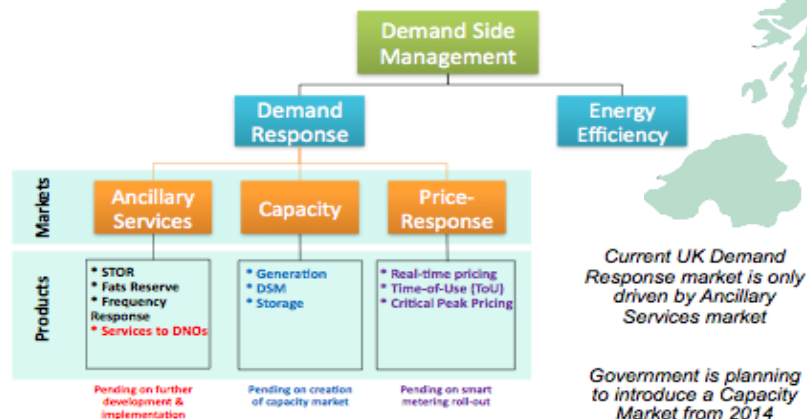
- Sudden ramp-down of wind generation will impact the wholesale price and quality of electricity.
- Covering the drop by peaking plants needs huge investment cost with GHG emission.

Demand Side Management

- ★ Mechanism and Systems
- ★ Remote and Automated
- ★ Demand Response in domestic / household.

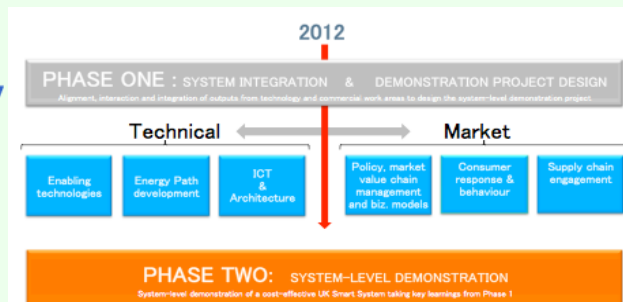
5-4. Hitachi Activities of Smart City Project in UK

Two major demonstration projects which is focused on consumer side in United Kingdom.



Required time to deliver

Smart and Systems Heat Program



NEDO UK Project



独立行政法人
新エネルギー・産業技術総合開発機構



Shift from fossil fuels to electricity due to depletion of North Sea oil

Need to invest largely in facility to supply increasing demand of heater at the peak time

Highest saving cost from using both RE and DSR scenario

5-5. Hitachi Activity in UK: NEDO projects

- Contribute to the UK's transition to a low carbon society with cutting edge technologies including heat pumps and ICT systems

Feasibility study is conducted by December 2013, then Demonstration is expected by March 2016

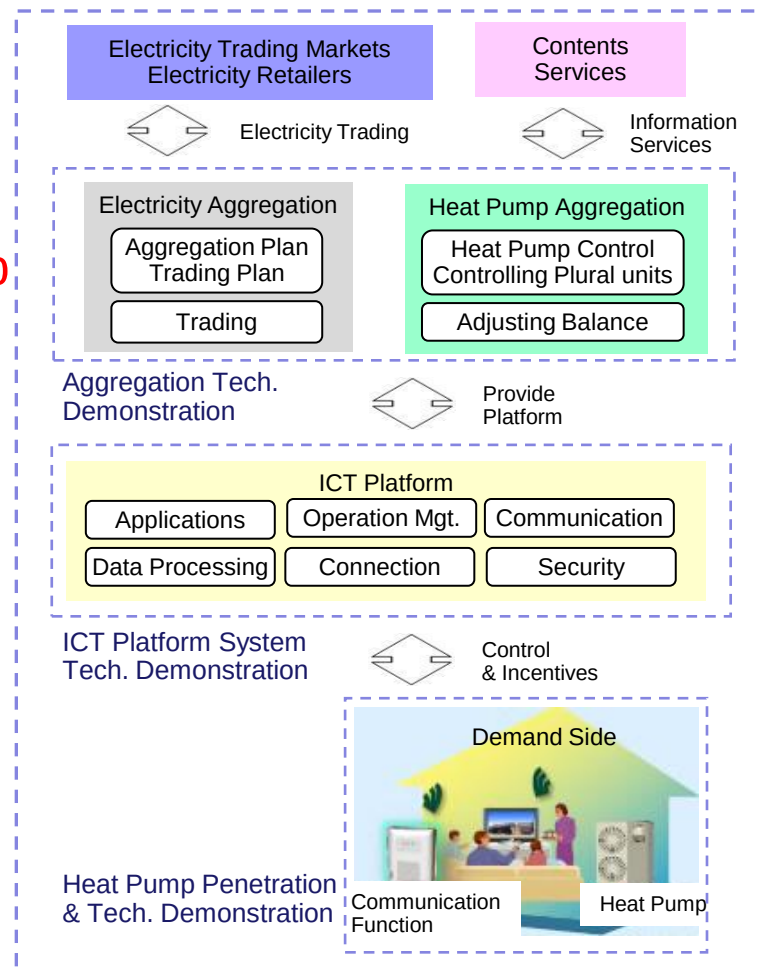


UK's target

2030: Heat Pump penetration: 30%

Theme 1. Demonstration of usability and efficiency of load-balancing aggregation technology and systems for residential power consumption (Daikin, Hitachi)

Theme 2. Establishment of Business Model (to be demonstrated by Mizuho Bank, Mizuho Information & Research Institute, Daikin, Hitachi)



Establishing Business Model

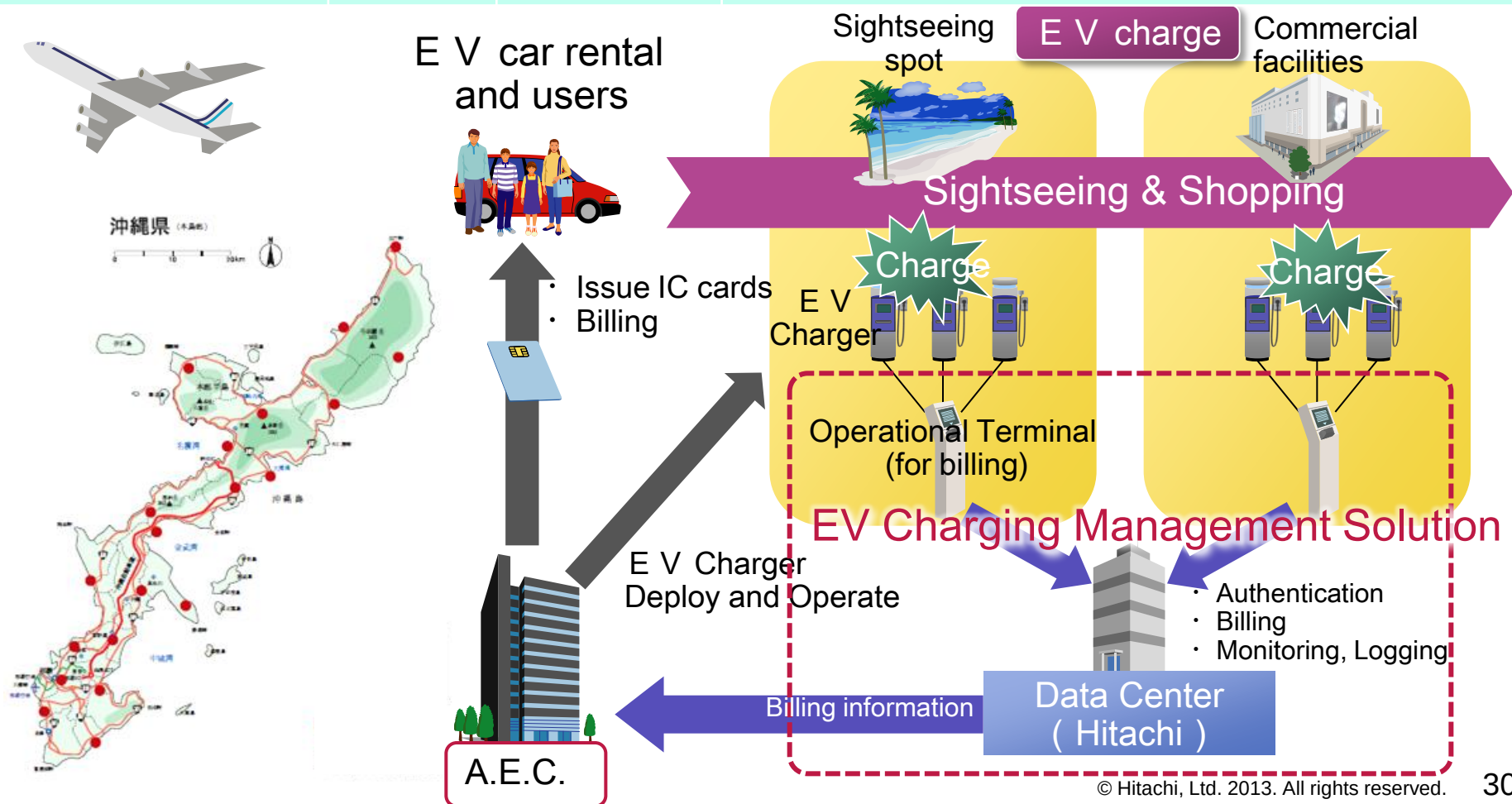
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6-1. EV growth model in Okinawa (The isolated island)

Case : EV car rental growth model in the isolated island for tourists

Charging management company	Operation starting	Area	Content
Advanced Energy Company (A.E.C)	Feb/2011	Okinawa main island (31chargers)	-First Japanese membership system charging service ¥1,000/month, ¥500/using, ¥2,000/rental car -Currently 200 vehicles in operation



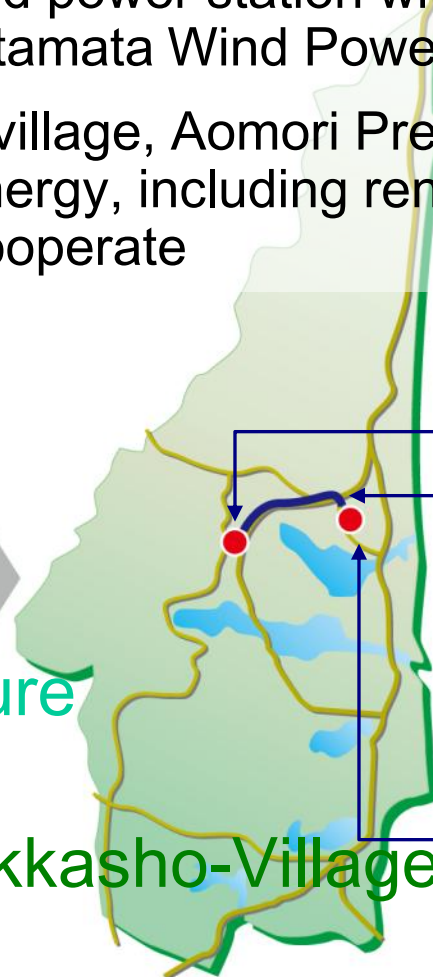
6-2. Regional Characteristics of Rokkasho Village

- Wind conditions are very good leading to a large number of wind power stations being installed in the area
- The world's first wind power station with large-capacity batteries (Rokkashomura-Futamata Wind Power Station) is located here
- Local government (village, Aomori Prefecture) has a deep understanding of energy, including renewable energy in general, and are willing to cooperate

< Project Location >



Rokkasho-Village



Supply side

Rokkashomura-Futamata Wind Power Station (with large-capacity batteries)

Private distribution line

- Approx. 8 km, 6.6 kV power cable and optical fiber for communications

Demand side

the North District of Obuchi Lake Town

Six smart houses in residential and commercial subdivision of Rokkasho Village

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