Contribution for "SMART SOCIETY" ~TEPCO rebirth plan

~We support energy reforms to realize optimal energy usage for our customers and greater society~

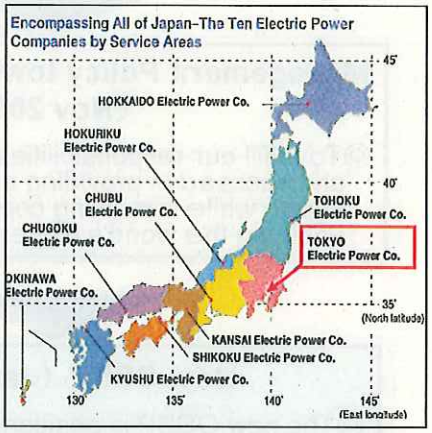
Position of TEPCO

- ◆**Service Area :** **39,000 km²**
  - One-tenth of Japan's land area
- ◆**Population : 45 million**
- ◆**Electricity Sales :** **269 billion kWh** (FY 2012)
- ◆**Peak Demand :** **64.3 GW** (July 2001) 50.8 GW (Aug 2012)
  - One-third of Japan's total demand

February 28, 2014

Hiroshi Yamaguchi

Director,
Executive Vice President,
Tokyo Electric Power Co., Inc.



TOKYO ELECTRIC POWER CO., INC.

~Contents~

でんき家計簿 www.tepco.co.jp/kakeibo/index-j.html

Ⅰ. Aim to realize "Rebirth of TEPCO" based on achieving both "responsibility and competitiveness".

1. Position of New CSBP centered around a raft of measures designed to increase the speed of revitalization.

CSBP※ (May 2012)

◎Collection of initiatives, aimed primarily at financing measures for TEPCO, that included compensation, decommissioning, stably delivering electricity.

Management Policy towards Restoration (Nov 2012)

◎To fulfill our responsibilities from the accident and succeed in providing a stable power supply while remaining competitive and ensuring the world's highest level of safety.

New CSBP (Jan 2014)

◎The new CSBP is positioned as a "TEPCO rebirth Plan" centered around a raft of measures designed to increase the speed of revitalization.

【Changes in the Business environment】

①Environmental change relating to "accountability" as a public utility responsible for the accident
- ＊Prompt and appropriate implementation of compensation payouts
- ＊Stable resolution and decommissioning of the Fukushima Daiichi nuclear power station
- ＊Continuation of low cost stable supply

②Environmental changes relating to "competitiveness" as a private-sector enterprise.
- ＊Reform of the electric system
- ＊Ensuring revenue base needed for stable supply under competitive environment.

2. Initiatives in the New Comprehensive Business Plan

【Policy】

TEPCO will work towards achieving both "accountability" and "competitiveness".
- ＊TEPCO Group as a whole will work to fulfill its obligations with respect to compensation, decommissioning, and the reconstruction of Fukushima.
- ＊The company will, at the same time, also direct its efforts toward delivering a stable supply of electricity, while also working to improve corporate value and provide new energy services.

【Points】

①Compensation for nuclear power damage

②Efforts towards Fukushima revitalization

③Stable resolution and decommissioning of the damaged reactors and nuclear power safety.

④Policies to rationalize management

⑤Directions in business administration under the HD company system.

"Vigilance" necessary for accountability

⇄

"Vitality" necessary for competitiveness

"Competitive" initiatives : F&PC, CSC※
- **Expansion of the business area beyond Kanto.**
- **Provide open platform for saving energy for all users.**

"Neutrality" initiatives : PGC※
- **Provide a stable supply of power.**
- **Actively drive power business and maximize customers' benefit in Kanto area.**

※F&PC : Fuel & Power Company CSC : Customer Service Company PGC : Power Grid Company

■Index to 2020

【PGC (Power Grid Company)】

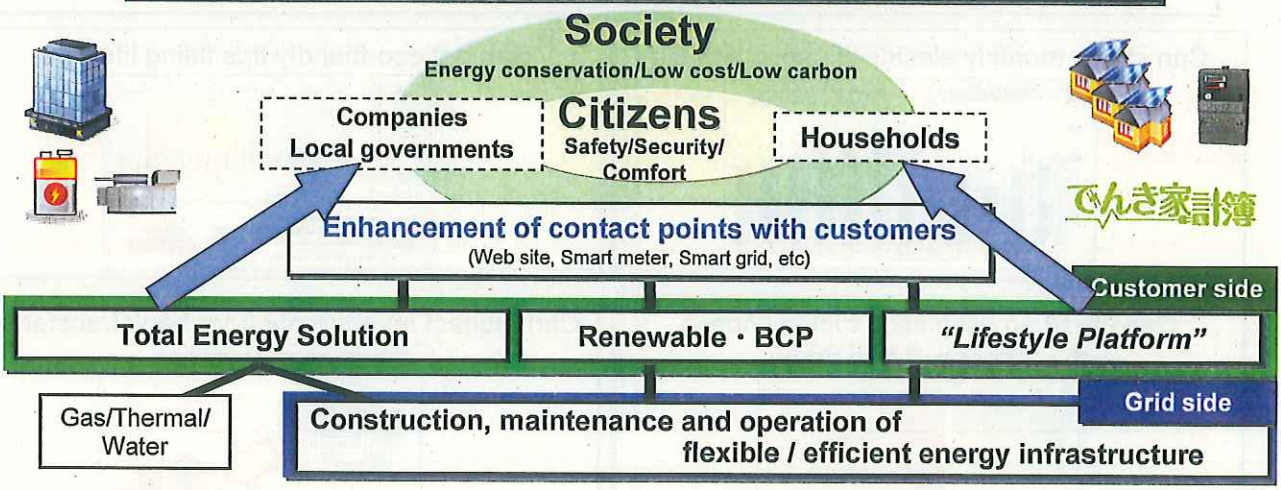
- Lowest level of wheeling cost in Japan.
- Expansion of the amount of Wind Power Interconnection.
- Reinforcement of frequency exchanging facility between east side and west side of Japan. (+900,000kW)
- Smart meter deployment (27 million)
- Overseas business. (Network System Export)

【CSC (Customer Service Company)】

- Demand side development by total energy solution. (400 billion yen)
- Gas, peripherals, lifestyle platform (200 billion yen)
- Nationwide provision of service (170 billion yen)

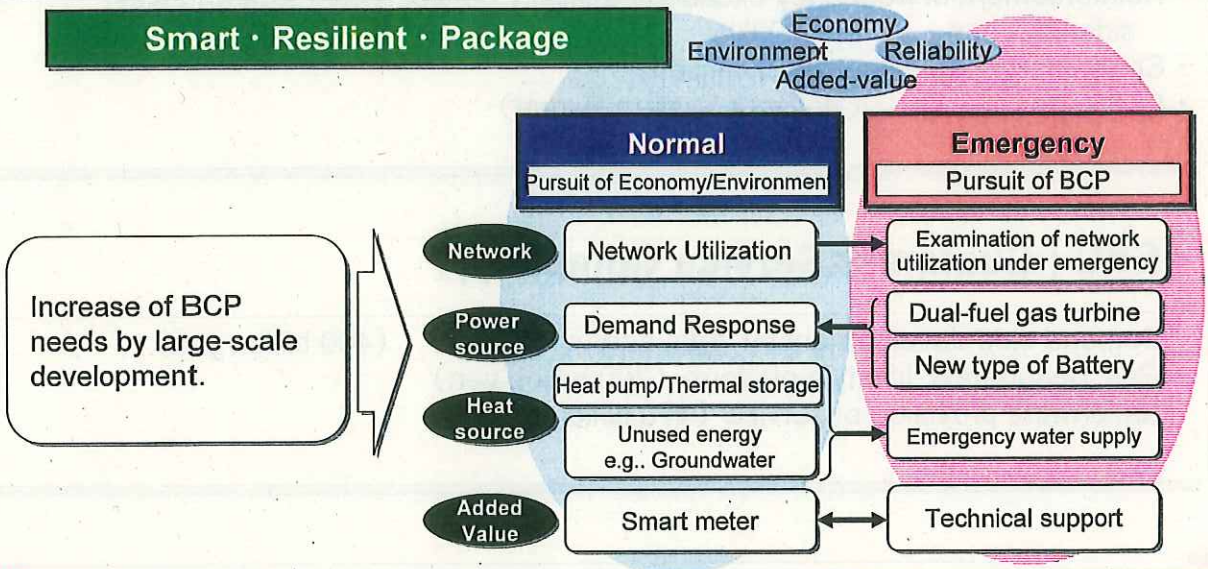
Ⅱ. Contribution to the Smart Society

By proposing the most efficient energy use for each customer and providing services, TEPCO will aim to become a futuristic infrastructure company that contributes to a safe and comfortable smart society.



1. Optimization of energy usage through "Smart Resilient Package".

- **Supply low cost and resilient energy system package.**
- Achieve both minimal cost/environmental load and response in emergency.
- Secure necessary lifelines at times of disaster.
- Expand energy management service by utilizing TEPCO's technology.



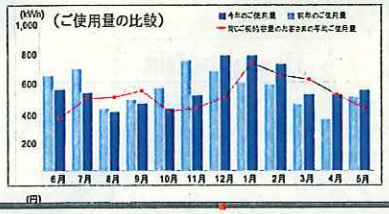
2. Value Creation through TEPCO's Web Services

でんき家計簿

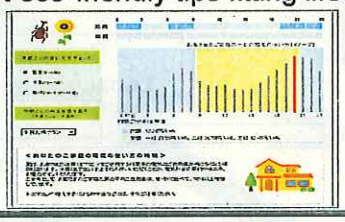
(1) Development of our customer web portal, "Denki Kakeibo"

- In "Denki Kakeibo", registered customers can check their monthly electricity usage, get eco-friendly tips and so on for free.
  → As of the end of 2013, number of registered customers is about 280 thousand.
- TEPCO is still eager to develop services such as "Denki Kakeibo" thorough its alliance with Opower and so forth.

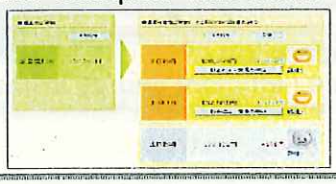
Can check monthly electricity usage and bill



Can get eco-friendly tips fitting lifestyle



Can utilize an estimation tool to choose the "cheapest" rate menu

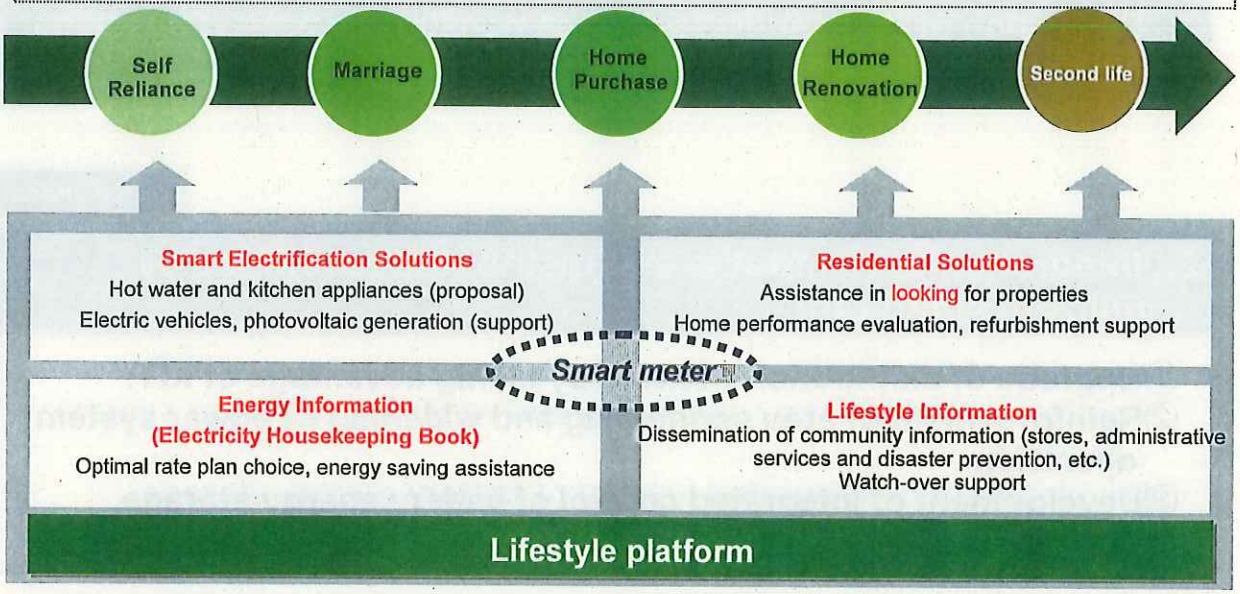


Can request an application for bank transfer or credit card payment

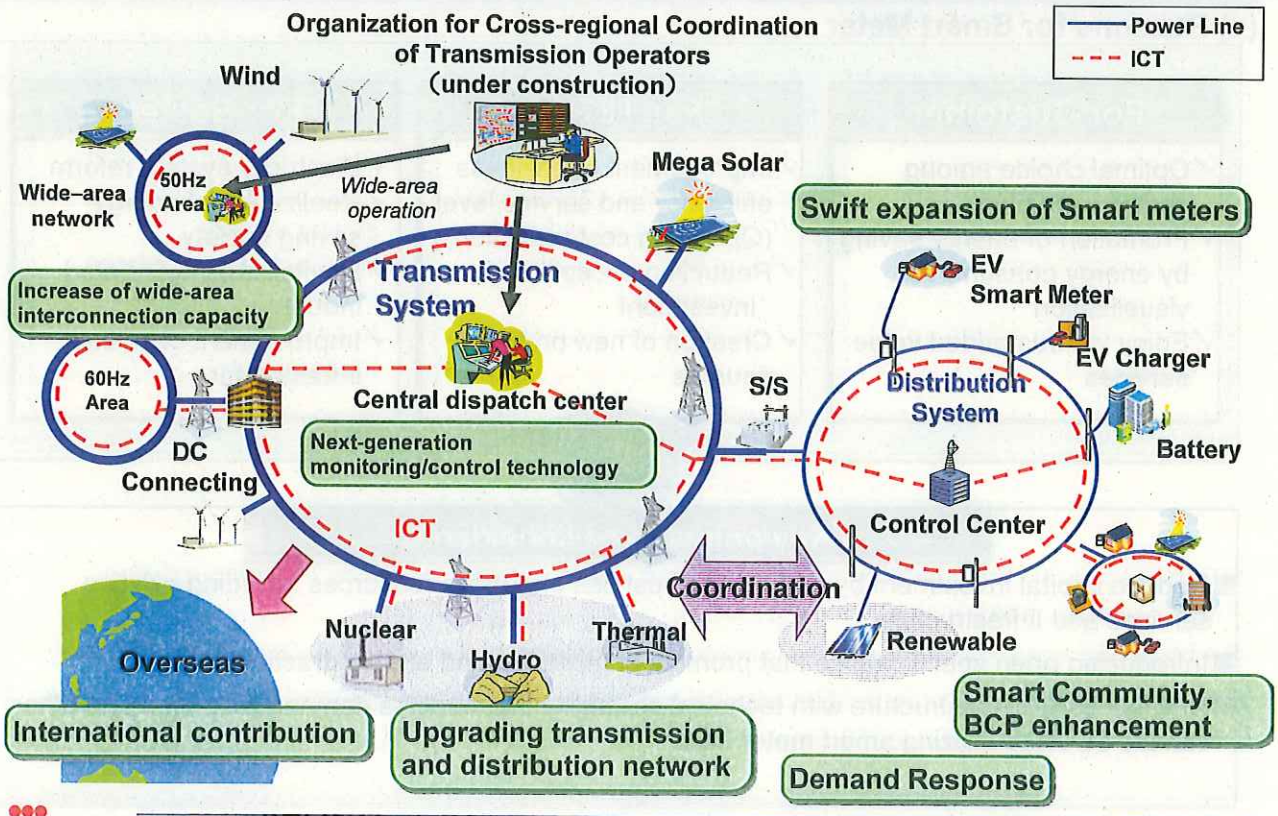
2. Value Creation through TEPCO's Web Services

(2) TEPCO is planning to, in the future, initiate a highly-innovative web portal, "Lifestyle Platform", that can offer a wide range of household services.

For its customers, TEPCO will create value corresponding to their life events.



3. Construct energy foundation to support "Smart Society"



Ⅲ. TEPCO's efforts for "Smart Society".

Customer efforts

1. Early construction of Smart Meters / Creation of new services.
2. Expansion of Demand-Response demonstration project by taking advantage of knowledge inside and outside of Japan.

Grid efforts

2. Integration of renewable and distributed resources by utilizing smart gird.

①Upgrade of distribution network by taking advantage of ICT.
②Reinforcement of area connecting and widening of power system operation.
③Development of integrated control of battery energy storage.

Customer efforts

1. Early construction of Smart Meters. / Creation of new services.

(1) Reasons for Smart Meter

For Customer	For TEPCO	For Society
✓Optimal choice among various rate plans ✓Promotion of energy saving by energy consumption visualization ✓Enjoy various added value services	✓Improvement of business efficiency and service level (Operating cost reduction) ✓Reduction of capital investment ✓Creation of new profit sources	✓Electricity system reform ✓Realization of energy-saving society ✓Revitalization of related industry ✓Improvement of social infrastructure

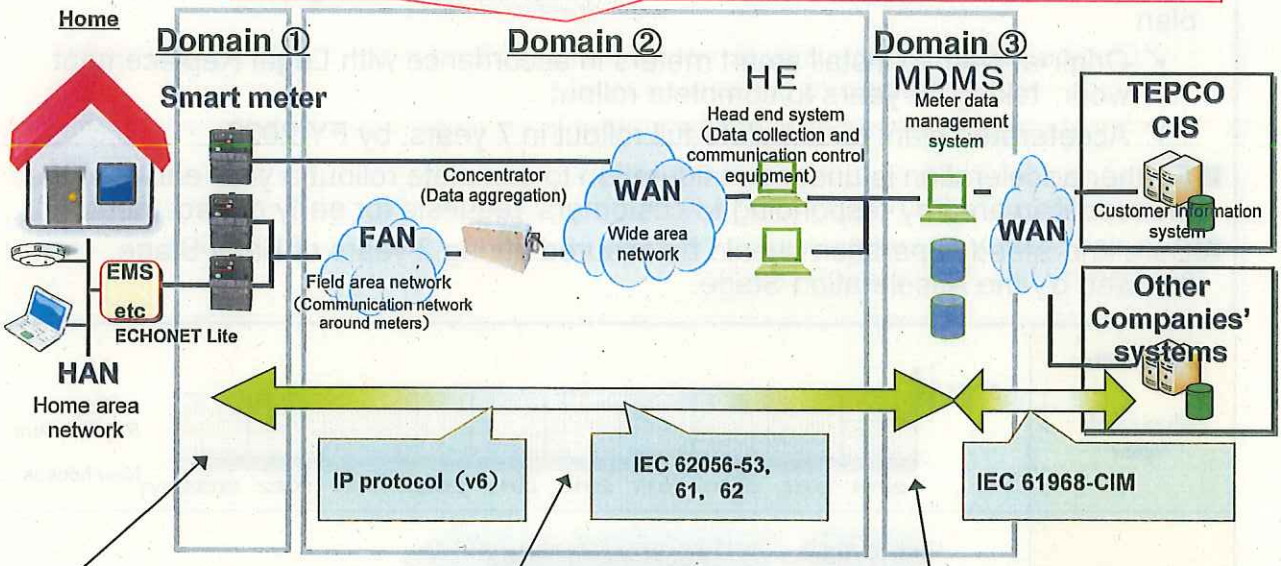
Key points to be considered

- Reduce capital investment by making the best use of outside resources including existing services and infrastructure.
- Introducing open specifications that promote competition and enable drastic cost cuts.
- Building social infrastructure with technical scalability that enables demand response and other various services utilizing smart meter data.

Customer efforts

(2) Smart Meter System Configuration

✓Technical scalability enabled by adoption or international standards
✓Cost-cuts by multi-vendor approach



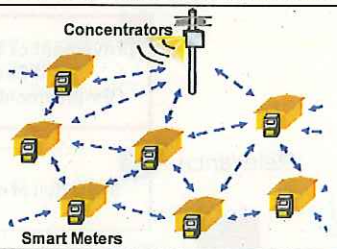
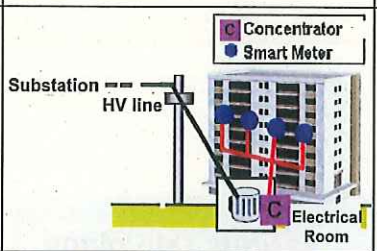
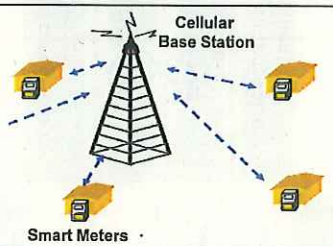
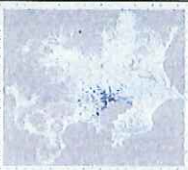
① Meters	② Communications system	③ Construction of an MDMS
• Nov. 2013：60A meter Bid • Dec. 2013：120A meter Bid • Mar. 2014：30A meter Bid	• Dec. 2012 – May 2013 RFP Toshiba was selected	• Jan. 2013 – May 2013 RFP NTT-Data was selected

＊：RFP（Request for Proposal）

Customer efforts

(3) Concept of "Right Technology, Right Place"

～Domain ② FAN (Field area network)～

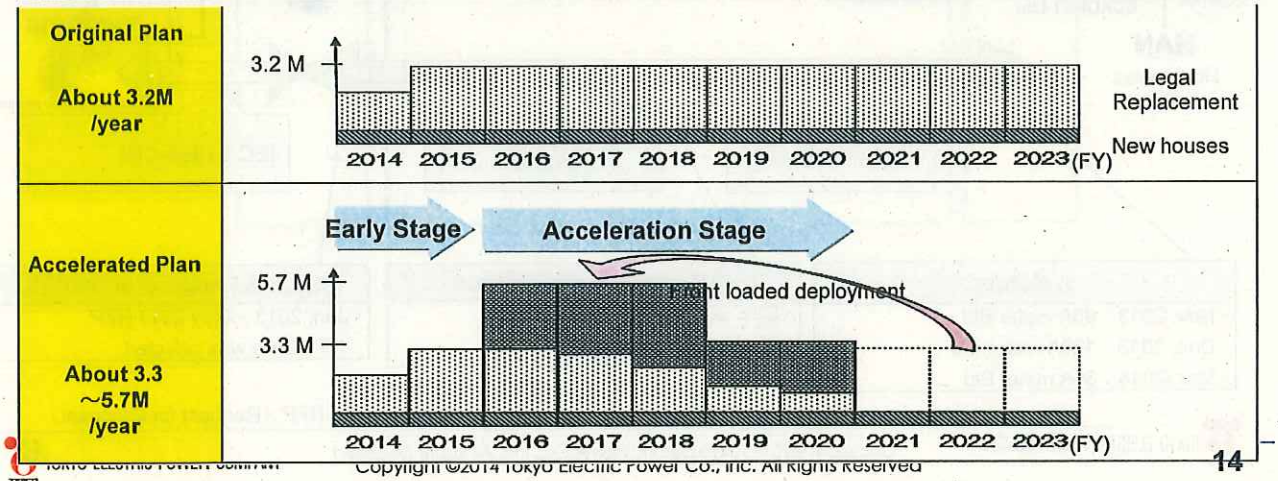
	Wireless Mesh	PLC (Power Line Communication)	Cellular Network
	Mesh created with meters with low cost. Suitable for relatively high-density areas.	Suitable for complex buildings where radio signals are likely to be blocked.	Cellular services such as 3G and LTE. Suitable for low density areas.
			
Proportion	about 70%	about 10%	about 20%
Concept	Where meter density is higher than the defined threshold, including the metropolitan area	For complex buildings where the number of units exceeds defined threshold.	For remaining areas. Deploy in Wireless Mesh Areas to keep 95% of connected ratio at early stage.
Deployment Areas			

□0 □1~9 □10~29 □30~59 □60~99 □100~ [meters / 250m × 400m unit area]

Customer efforts

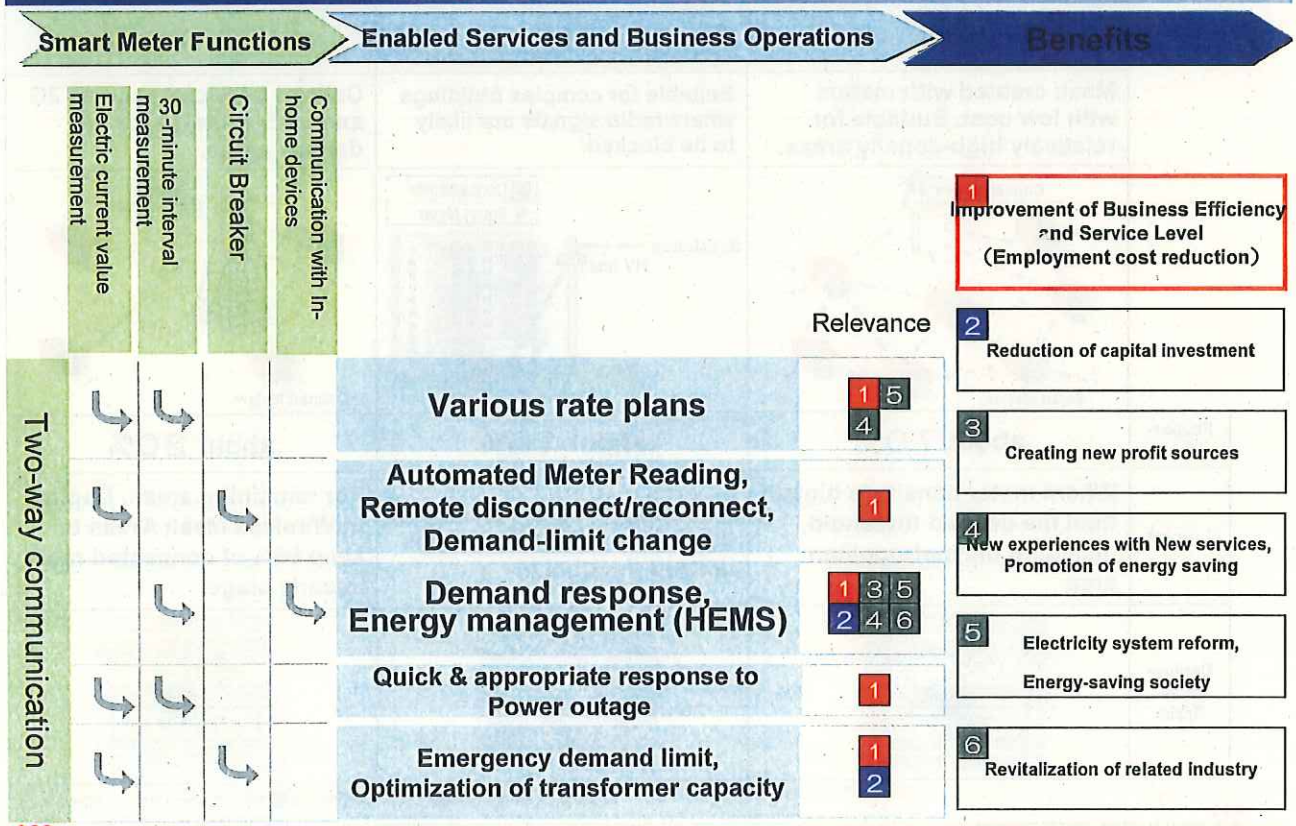
(4) Acceleration of Smart Meter Deployment

- In order to maximize Smart Meter benefits, TEPCO has changed its deployment plan
  - ✓ Original plan: to install smart meters in accordance with Legal Replacement work, taking 10 years to complete rollout
  - ✓ Accelerated plan: to complete full rollout in 7 years, by FY 2020
- Further acceleration is under consideration to complete rollout a year earlier in the metropolitan area by responding to customers' requests for early replacement.
- Sure and steady operation should be assured during 2 years of Early Stage, followed by the Acceleration Stage.



Customer efforts

(5) Expectation for Smart Meters



Customer efforts

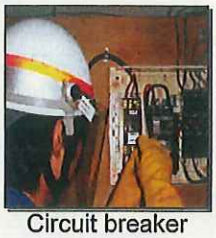
(6) The introductory effect of Smart Meters (1) Increase in business efficiency and new menus

■Drastic business process innovation is expected by eliminating manual meter reading and field visits, and by developing new rate plans and various services.

- ✓ Improve business efficiency by AMR and elimination of field visits
- ✓ Provide various rate plans and service options that fit customers' needs

●Examples of business efficiency improvement

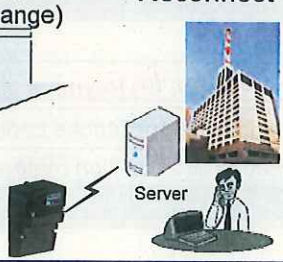
Meter reading



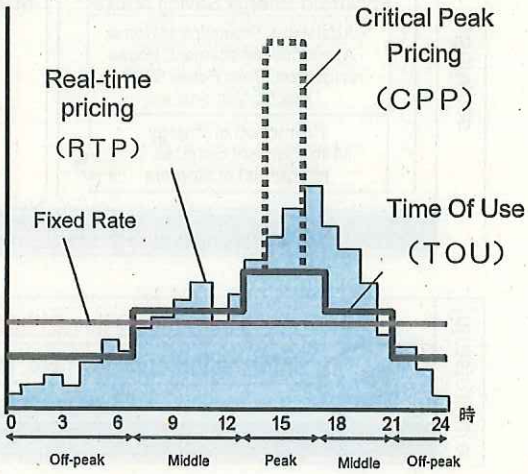
Circuit breaker replacement (Demand limit change)

Disconnect / Reconnect

Automated / Remotely controlled by Smart Meter



●Example of various rate plans



Customer efforts

(6) Benefits of Smart Meters (2) Streamlining Distribution Network

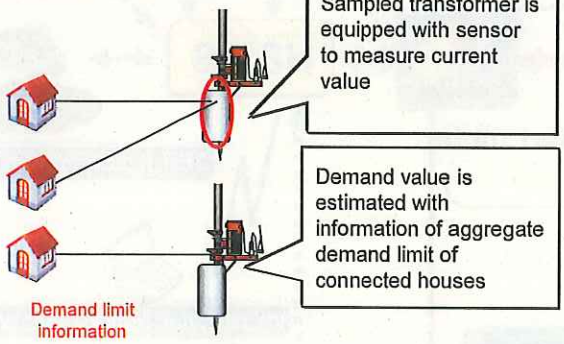
■Today, required capacity of transformer is estimated by information such as demand limit value of connected houses.

■Smart Meters enable us to identify accurate demand value by processing exact 30-minute interval data of the energy consumption of connected houses.

→Calculation of an assumed load current value at a higher precision than at present is possible.
The efficiency of equipment is increased by selecting proper transformer capacity.

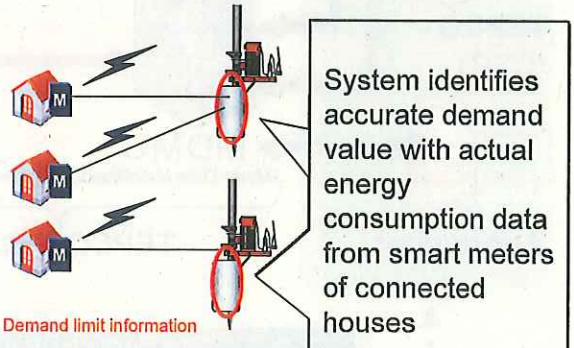
＜Demand assessment of each transformer＞

【Today】



The validity of estimated value is checked by referring to measured value at the sample transformer.

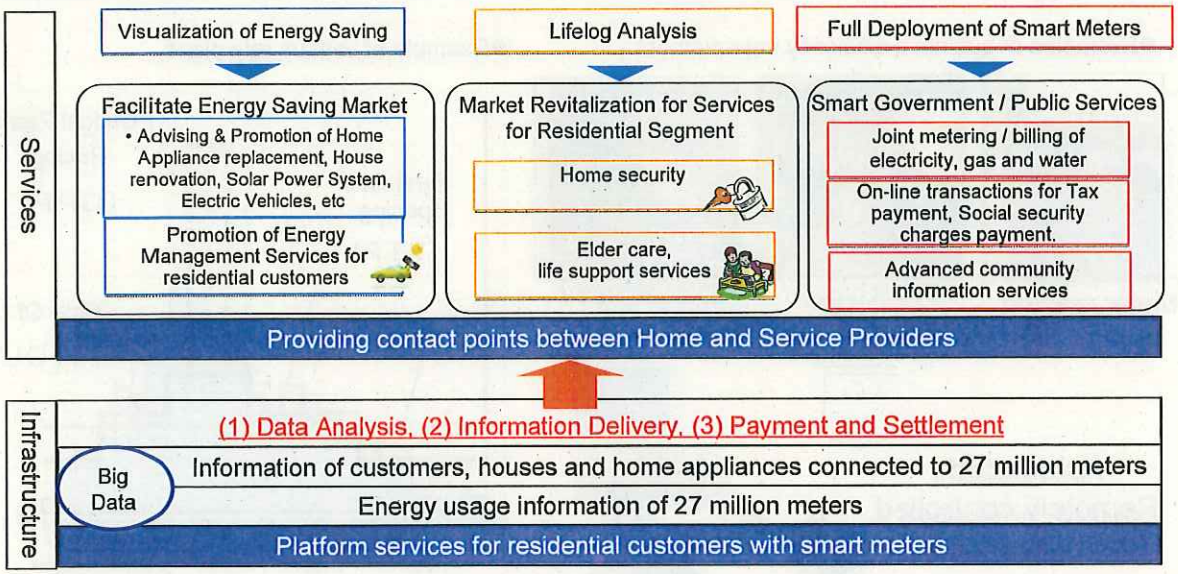
【After installation of Smart Meter】



Customer efforts

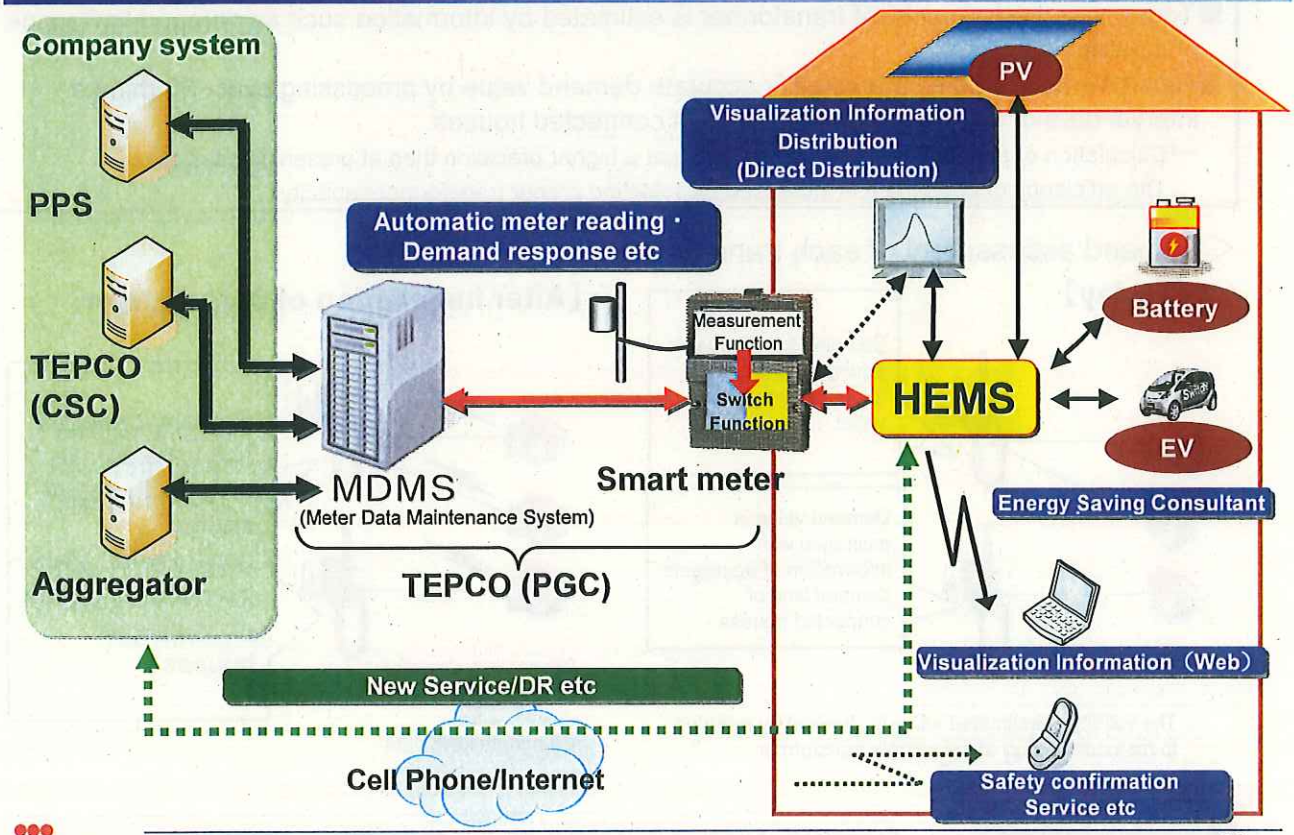
(7) Possibility of new services utilizing Smart Meter data

- Smart meter deployment creates 3 million "Smart Houses" every year, with up to 27 million in total when completed.
- Make whole TEPCO area a "most advanced Smart City", with new services such as power usage visualization, energy saving support, big data analysis, etc. with a platform created with smart meters.



Customer efforts

(8) Illustration of the functions realized by Smart Meter introduction



Customer efforts

3.Good Practices for Market Penetration of HEMS

■On April 2011, 10 Japanese companies (below) established the HEMS Alliance in order to rapidly launch HEMS businesses.

■We strongly believe that creating "HEMS applications" for improvement of quality of life of users is essential, because HEMS & smart appliances only with conventional energy efficiency / energy saving functions will not gain market popularity.

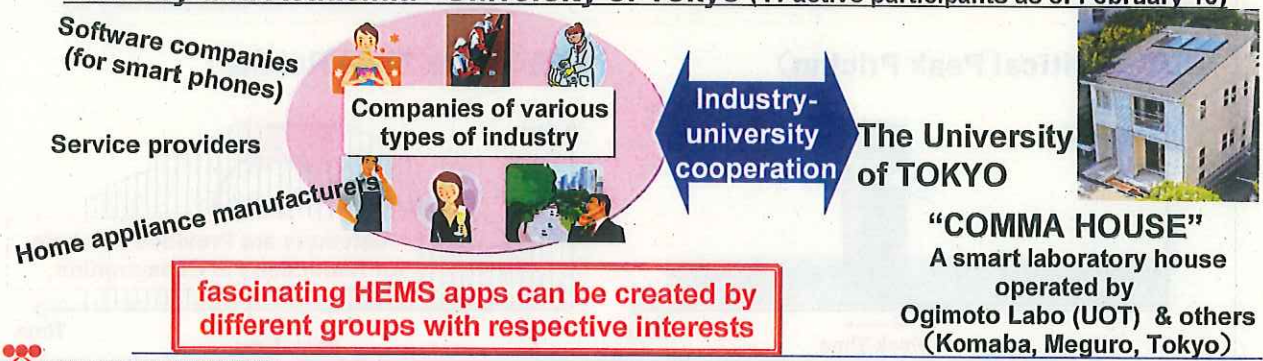
HEMS Dojo (commissioned on 19 February 2013)

An arena where interested firms and organizations can directly participate in creation of fascinating HEMS apps on specific purposes and themes.

HEMS Alliance

KDDI	NEC
SHARP	Panasonic
DAIKIN	HITACHI
TEPCO	Mitsubishi Motors co.
TOSHIBA	Mitsubishi Electric

HEMS Dojo (a training hall) - HEMS Alliance/Collaboration Project between Industry and Academia - University of Tokyo (41 active participants as of February 10)



fascinating HEMS apps can be created by different groups with respective interests

"COMMA HOUSE"
A smart laboratory house operated by Ogimoto Labo (UOT) & others (Komaba, Meguro, Tokyo)

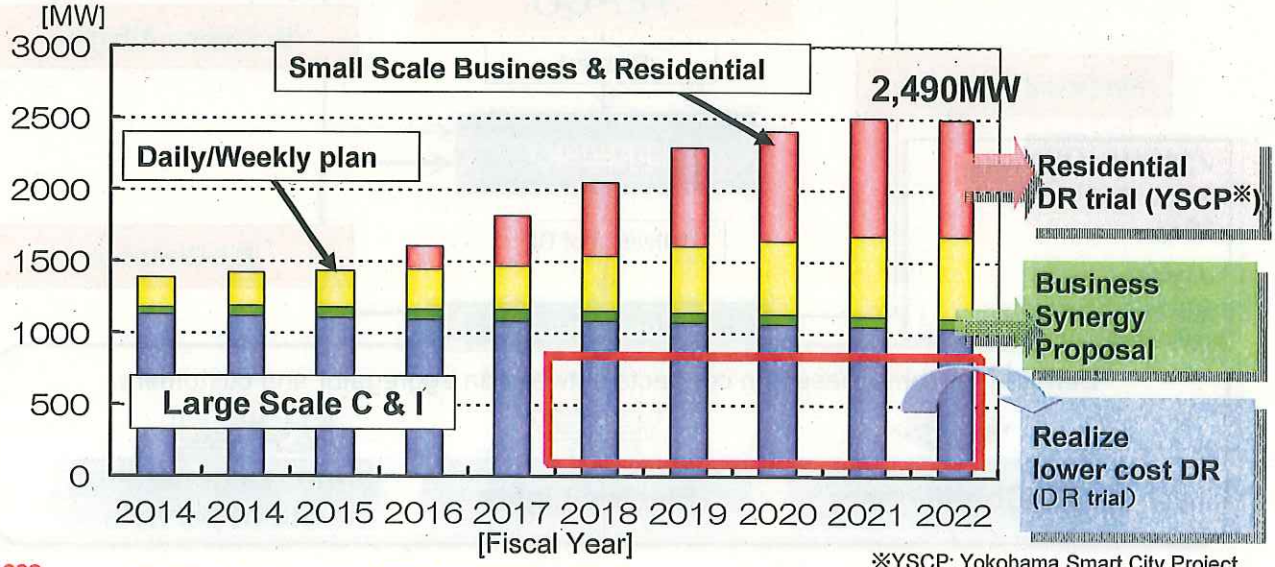
Customer efforts

2. Expansion of Demand-Response demonstration project

(1) Planned Demand Response in Demand-Supply Plan

■Against energy supply shortage, 4-5% of the peak demand is reflected as demand restraint power to secure steady supply while controlling capital spending.

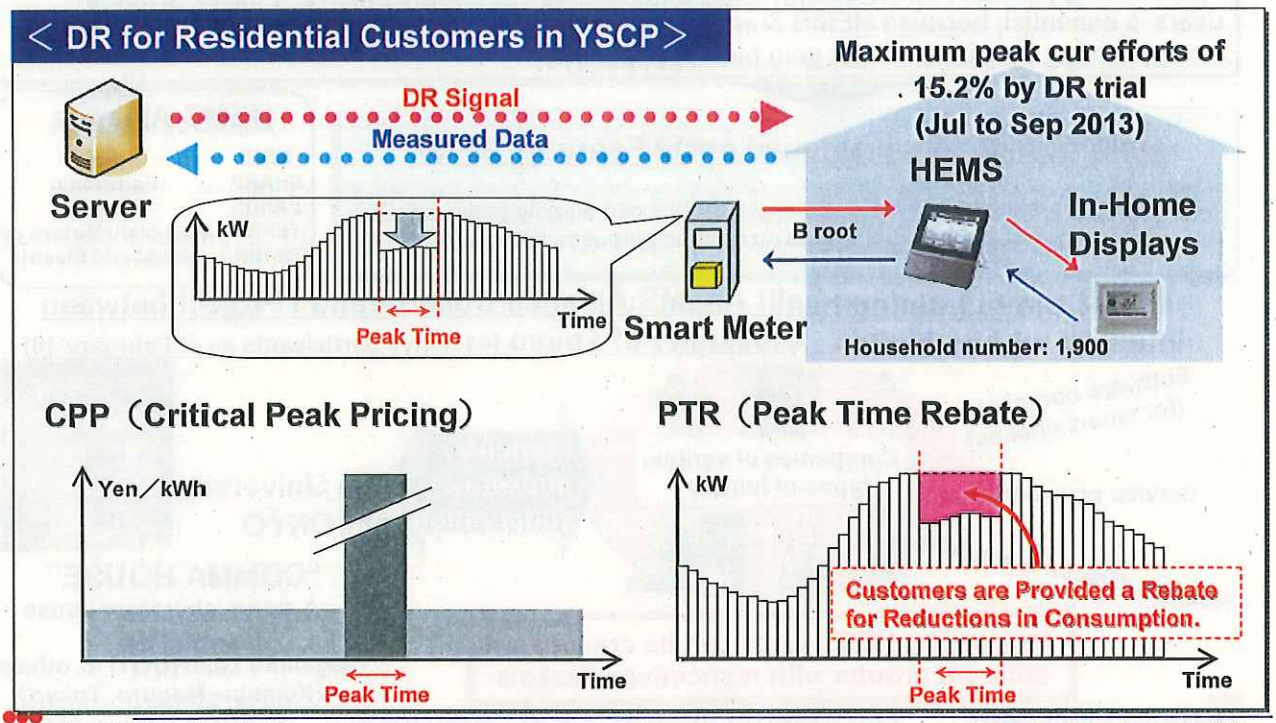
■Examine cost-effectiveness by comparison with thermal energy and the future demand restraint policy based on DR trial.



※YSCP: Yokohama Smart City Project

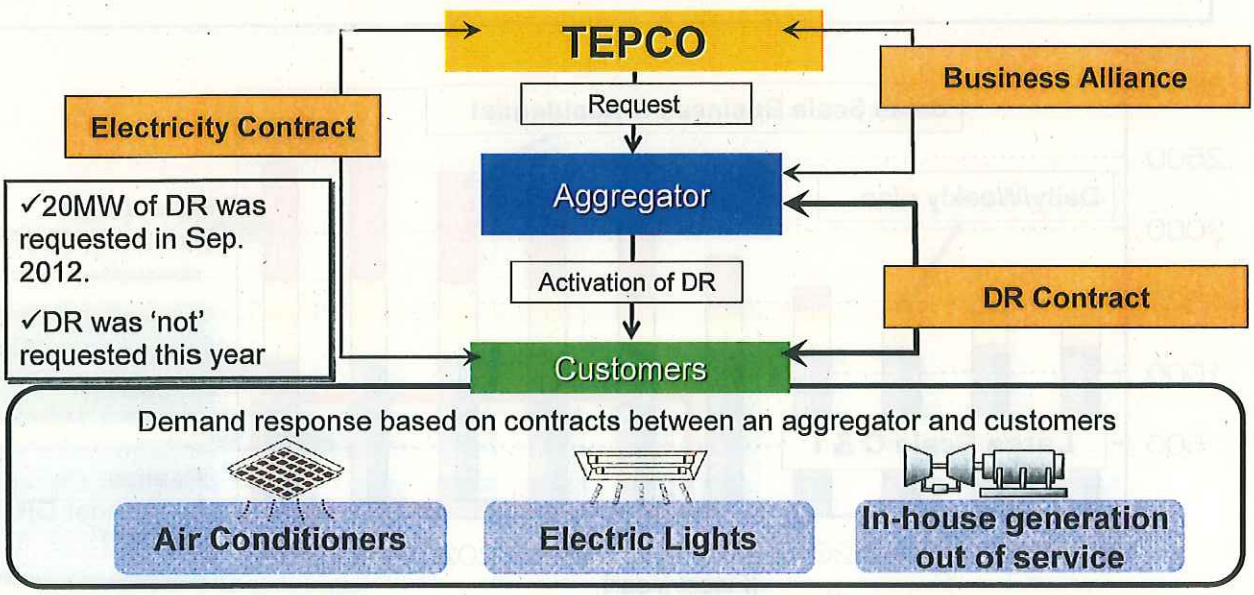
(2) Research on Introducing Dynamic Pricing for Residential Customers

- Measurement and Verification of Demand Response (DR) in the Yokohama Smart City Project (YSCP)



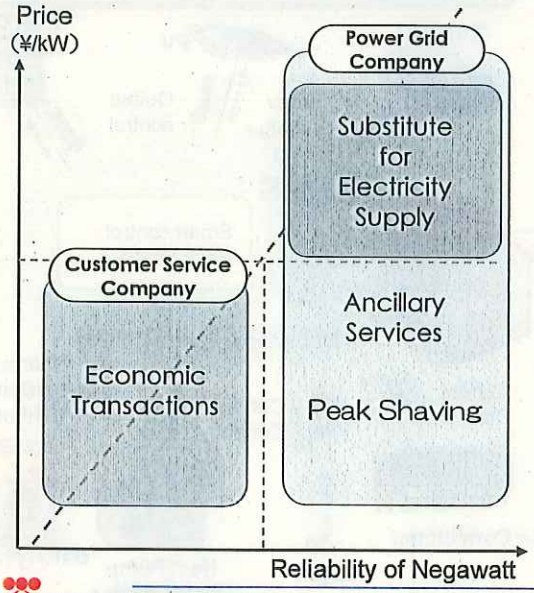
(3) Small Business DR Aggregation (Business Synergy Proposal)

➢ TEPCO has signed contracts with aggregators providing demand response services. The aggregators have DR contracts with customers and reduce demand when requested by TEPCO.

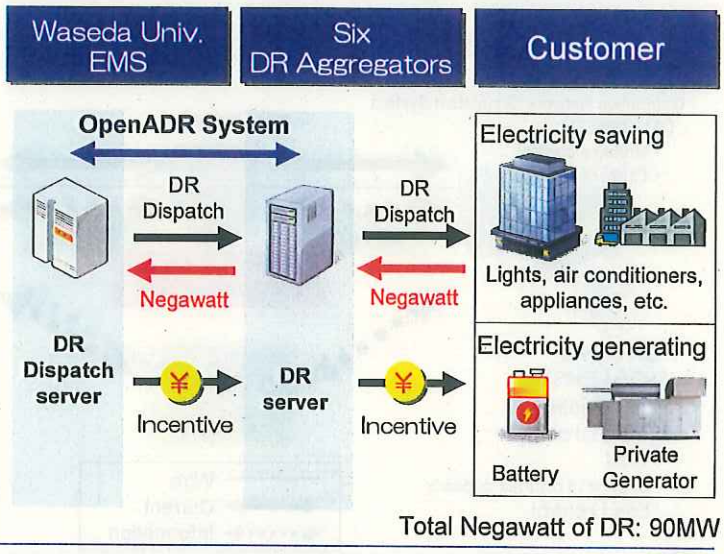


(4) Field Test of Incentivized Demand Response

- For the purpose of evaluating DR, together with METI and six DR aggregators including EnerNOC from the US and Energy Pool from France, TEPCO is now implementing a field test of DR that runs from Dec. of 2013 to March of 2015.
- In this field study, we will explore possibilities of applying DR not only for peak shaving during summer time but also for ancillary services and economic transactions.

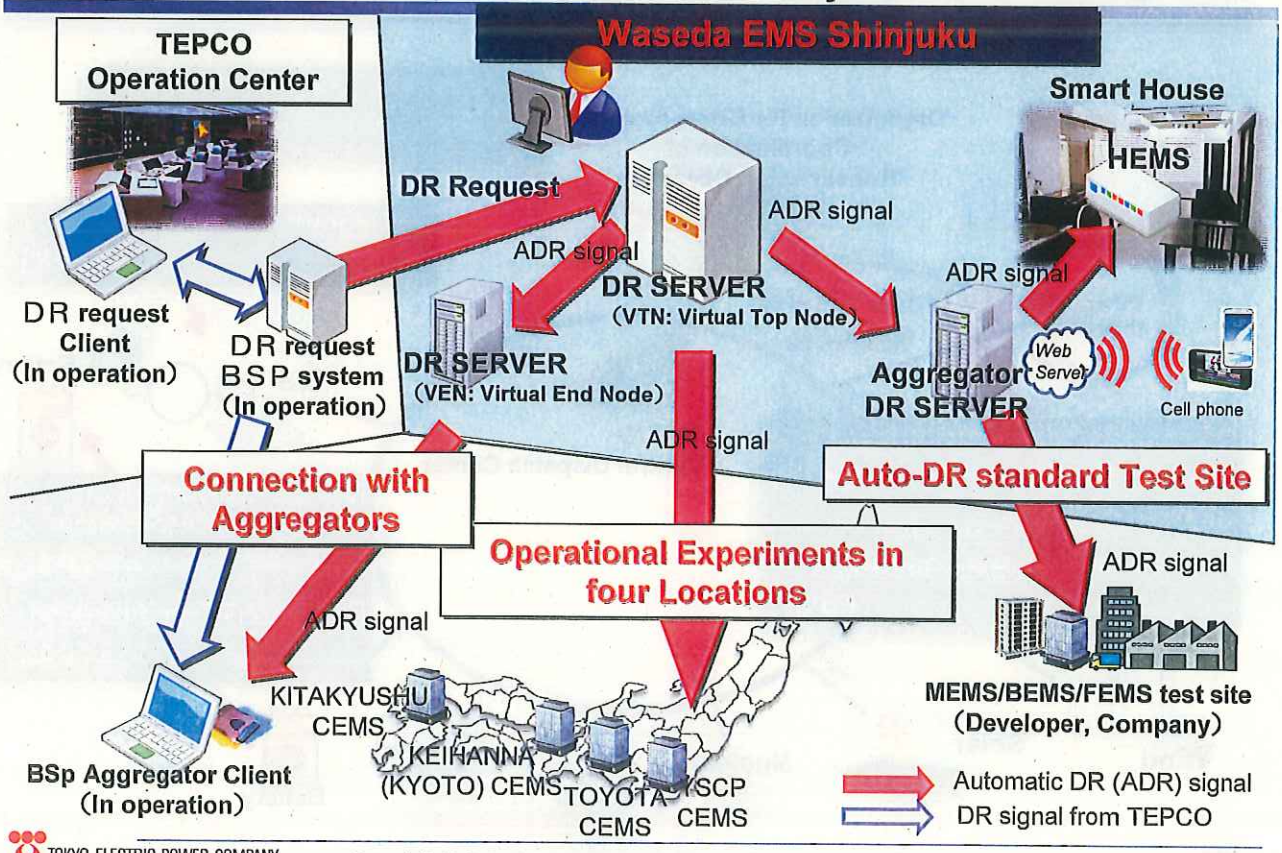


Outline of Incentivized DR Field Study



Total Negawatt of DR: 90MW

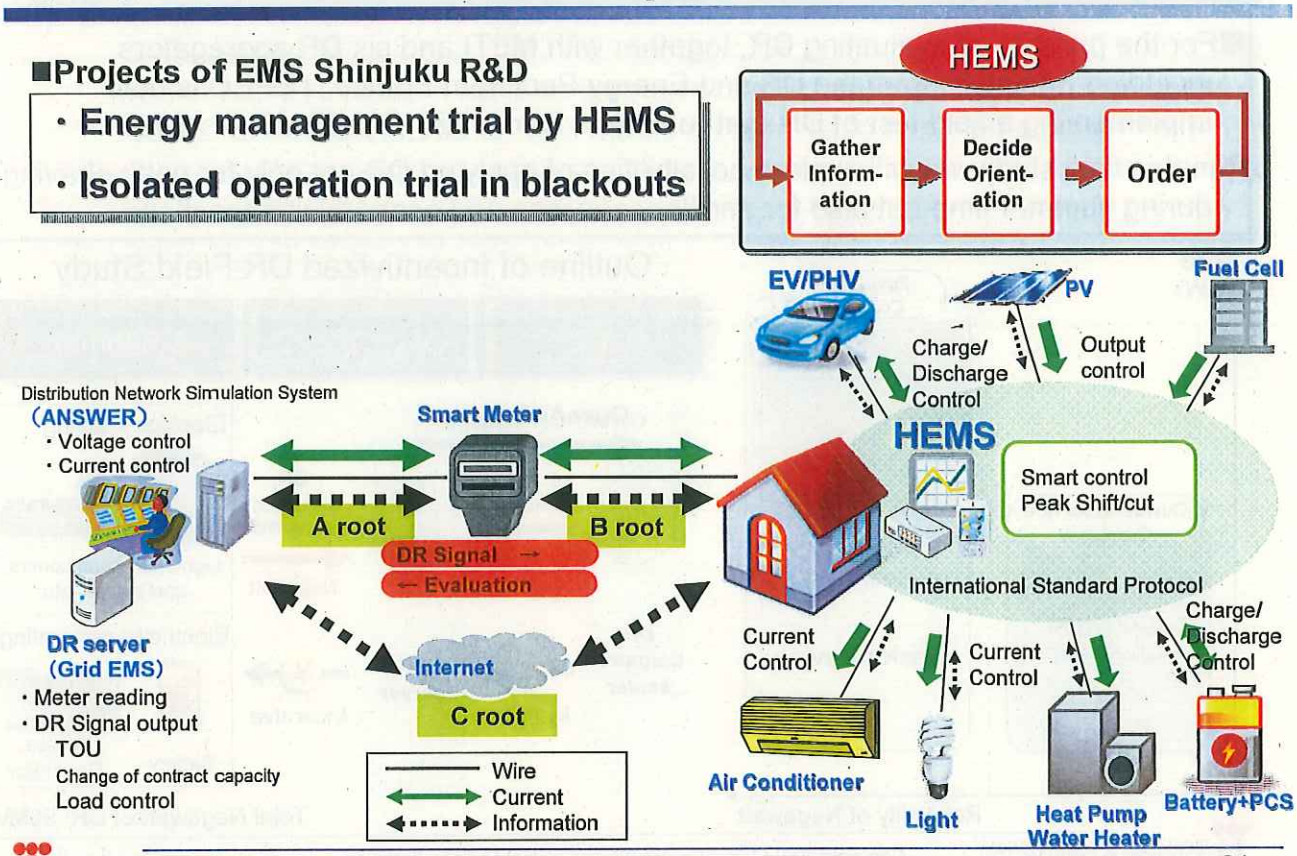
【Ref.】 Auto-DR demo. test at Waseda EMS Shinjuku



【Ref.】 Outline of Waseda EMS Shinjuku

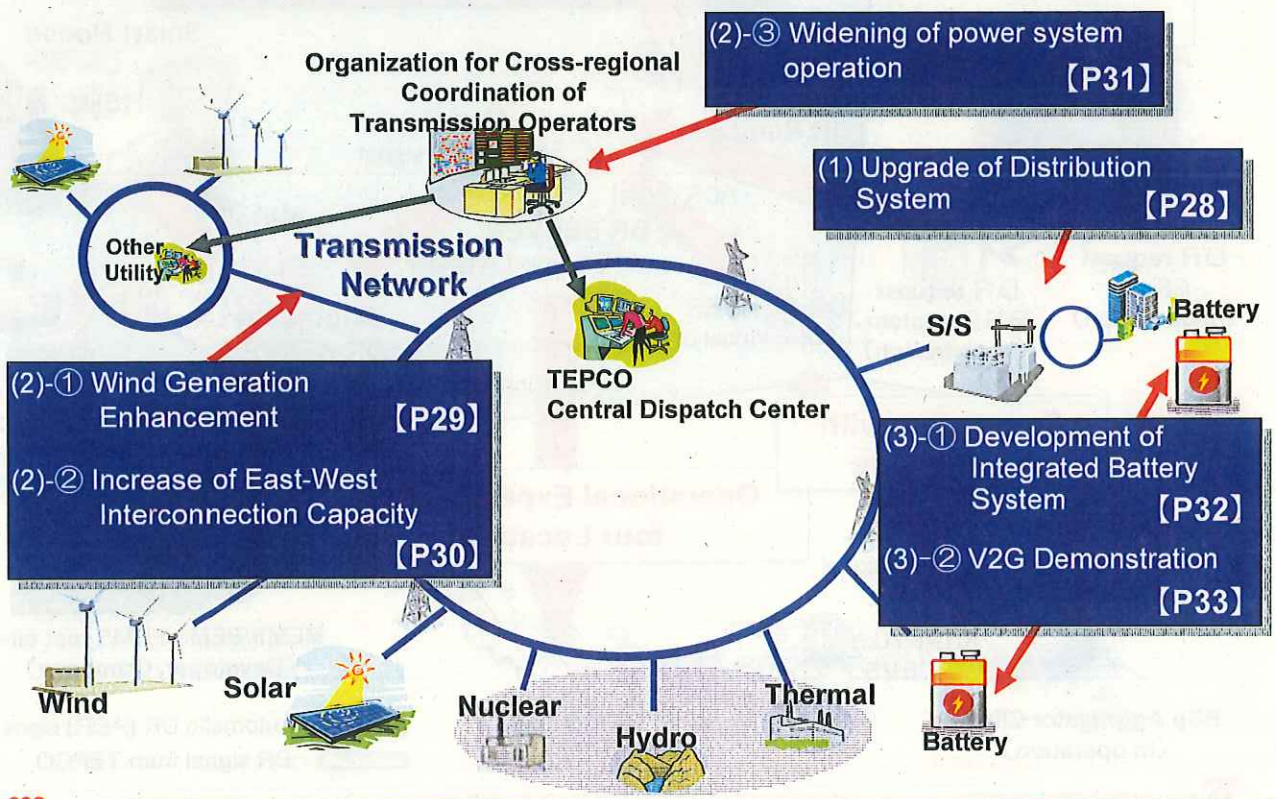
■Projects of EMS Shinjuku R&D

- Energy management trial by HEMS
- Isolated operation trial in blackouts



Grid efforts

3.Integration of renewable and distributed resources

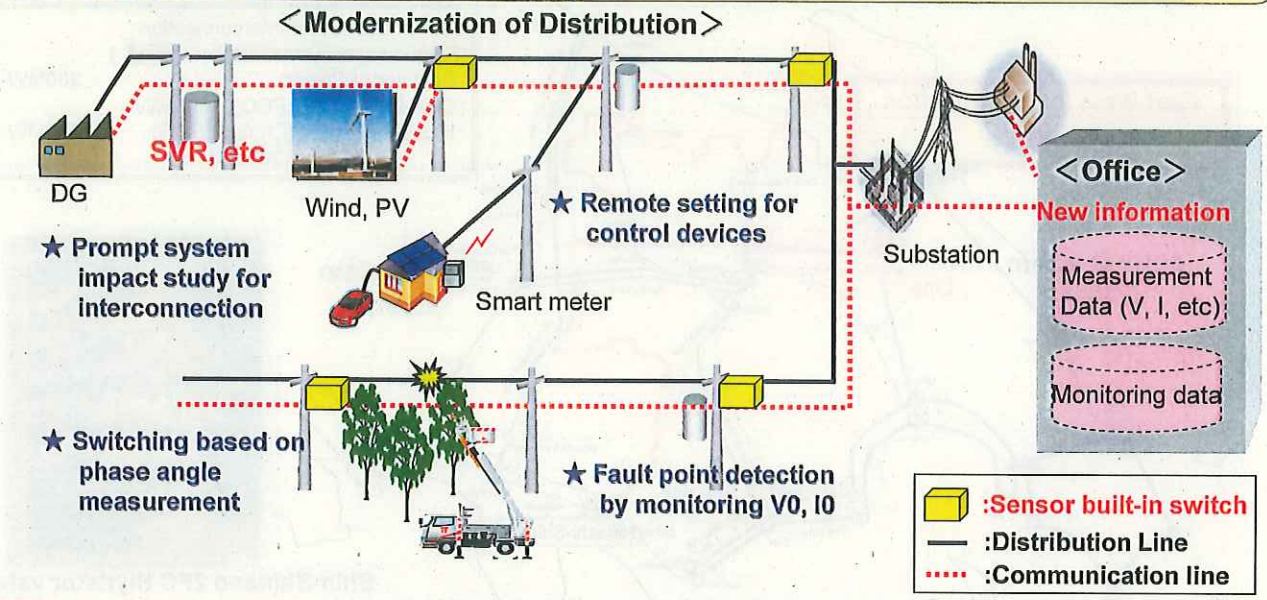


(1) Upgrade of Distribution System

Optimization of Distribution Network Operation

Merits of monitoring and controlling system with sensor built-in switch

- Securing of power quality using measurement data (V, I) for RE integration study
- Quick fault detection and prompt restoration to prevent faults
- Improvement of efficiency using remote control



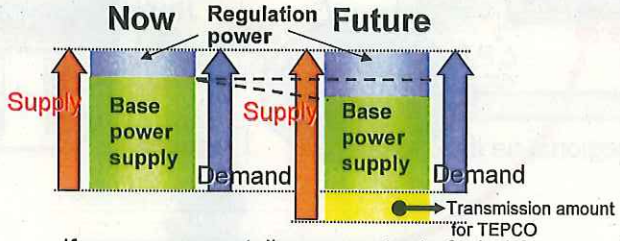
(2)—① Expansion of the amount of wind power interconnection by power system operation in wide area

Background

- Hokkaido: suitable places for wind generation, but the possible installation capacity of wind generation is limited due to the small system capacity
- TEPCO area: large system capacity but limited wind energy resources

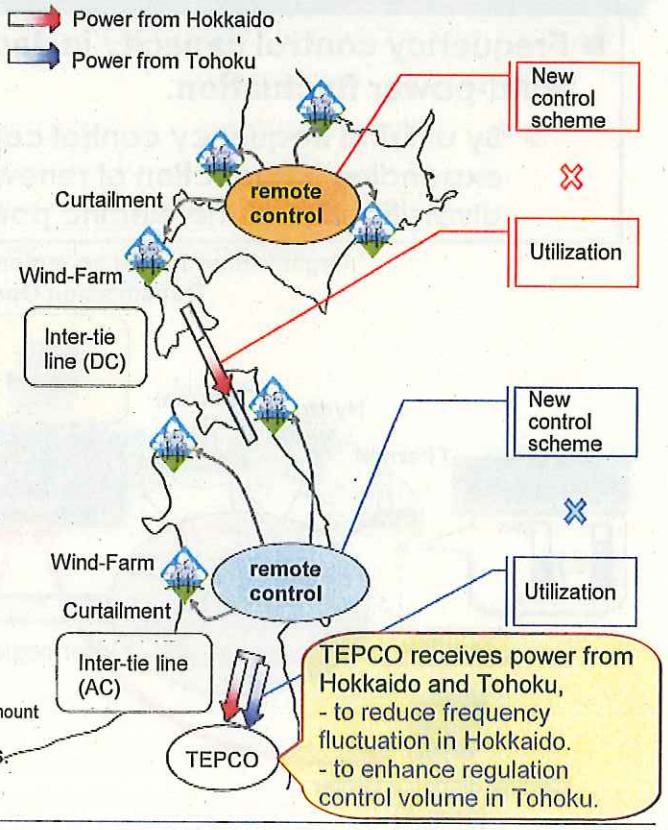
Field tests

- Combination of new control scheme of wind farms and utilization of the DC inter-tie line.
- Make use of TEPCO's frequency adjustability.



- If necessary, curtail power output of wind-farms.

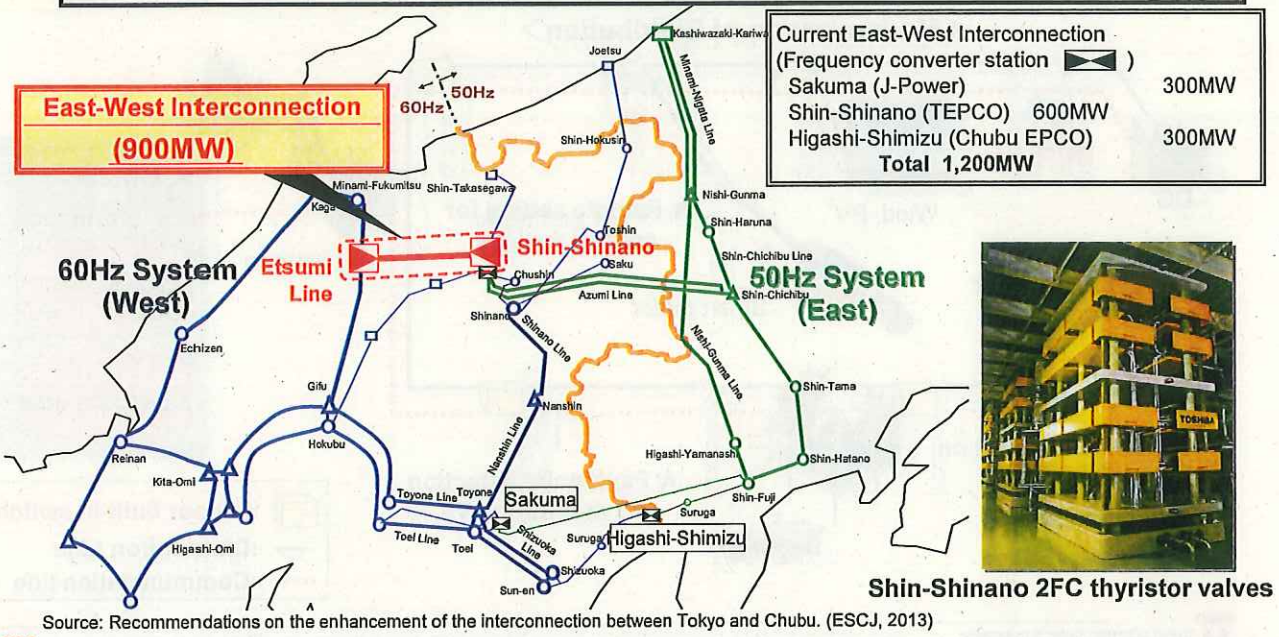
Generation Control of wind power



(2)—②. Increase of East-West Interconnection Capacity by HVDC (900MW)

Grid efforts

- Increase East (50Hz) – West (60Hz) Interconnection capacity by utilizing HVDC technology.
- Increase East – West Interconnection capacity from 1,200MW to 2,100MW.
- New interconnection will commence in FY 2020.



Current East-West Interconnection
(Frequency converter station ⋈)

Sakuma (J-Power)	300MW
Shin-Shinano (TEPCO)	600MW
Higashi-Shimizu (Chubu EPCO)	300MW
Total	**1,200MW**

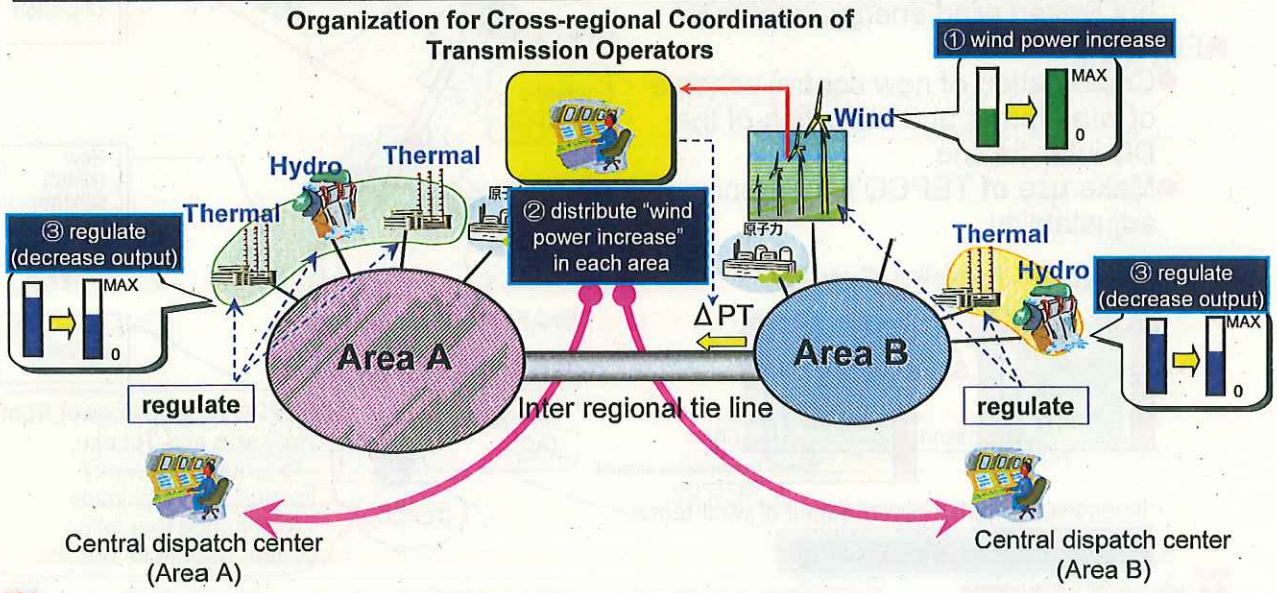
Shin-Shinano 2FC thyristor valves

Source: Recommendations on the enhancement of the interconnection between Tokyo and Chubu. (ESCJ, 2013)

Grid efforts

(2)—③ Widening of power system operation

- **Frequency control capacity in Japan will be maximized to stabilize wind-power fluctuation.**
  - **By utilizing frequency control capacity of two or more areas, while expanding introduction of renewable energy, it can respond also to diversification of the electric power supply menu.**

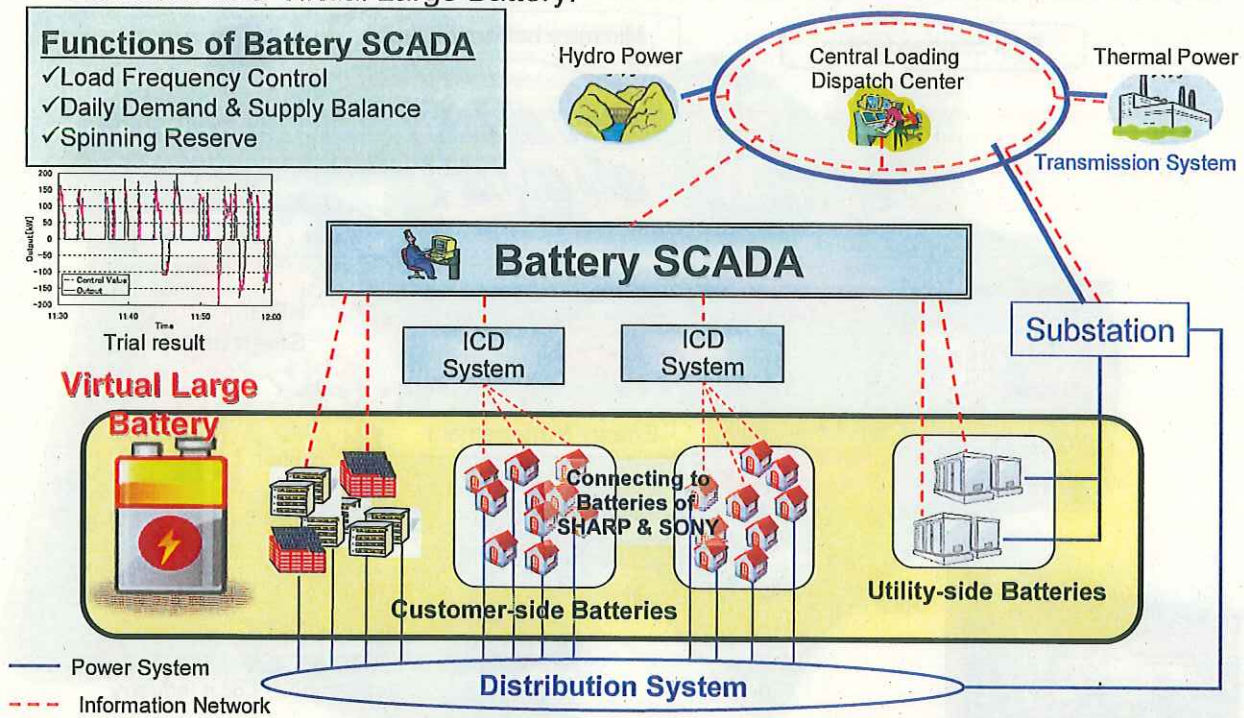


(3)—① Development of integrated control of battery energy storage

Battery SCADA enables the System Operator to control Multiple Dispersed Batteries as a Virtual Large Battery.

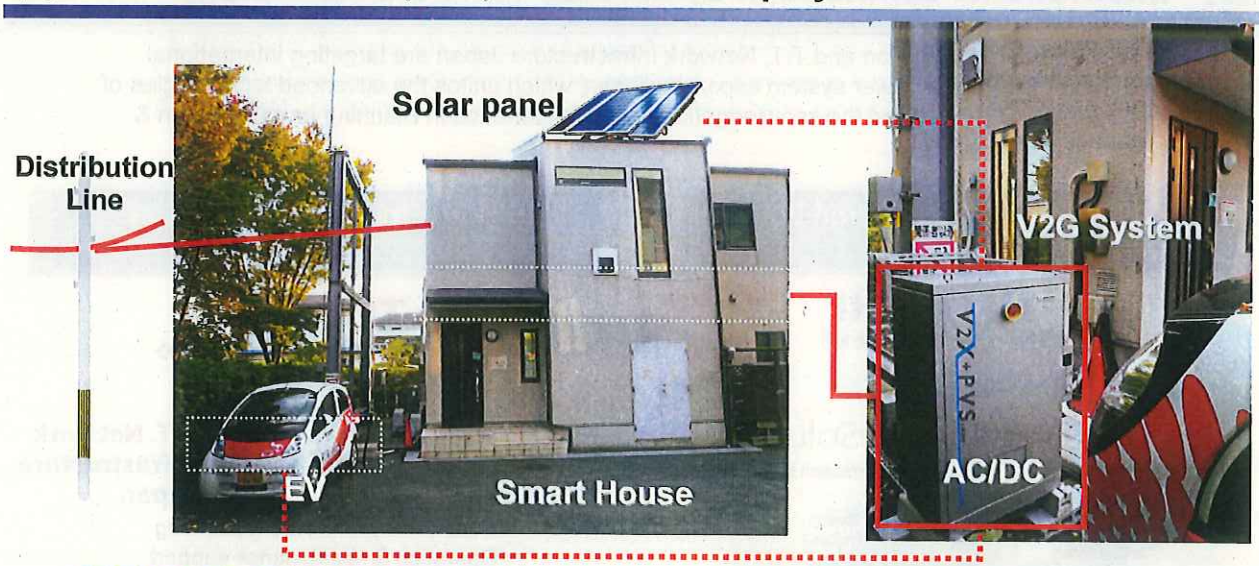
Functions of Battery SCADA
- ✓Load Frequency Control
- ✓Daily Demand & Supply Balance
- ✓Spinning Reserve

Trial result

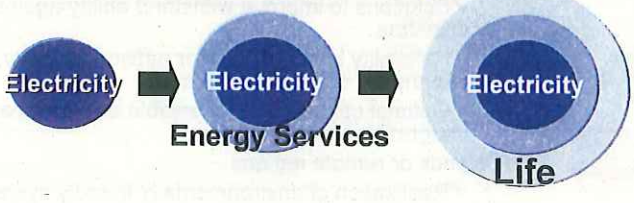


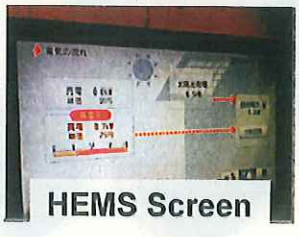
SCADA: Supervisory Control And Data Acquisition, ICD: Information Collection & Distribution

(3)—② Vehicle to Grid (V2G) demonstration project



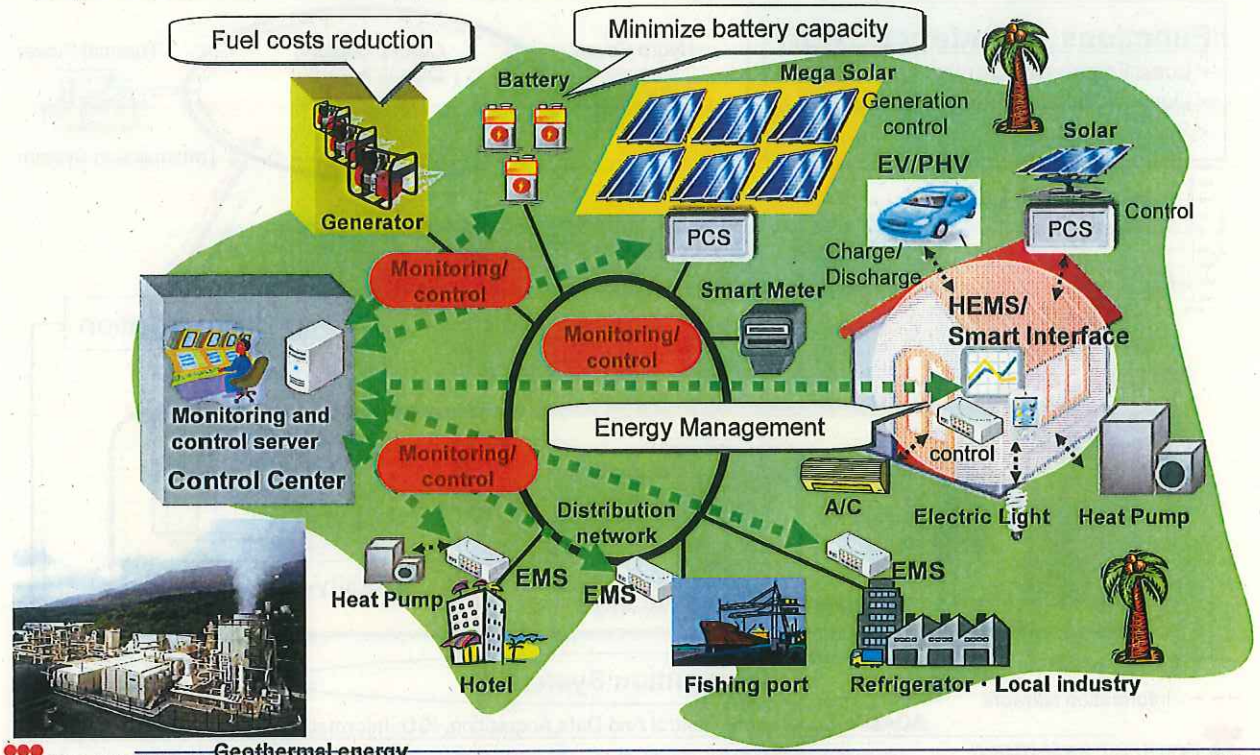
TEPCO's Smart House Concept





Ⅳ. International contribution by utilizing TEPCO's technology

■The cooperative control of power plants and storage batteries and the knowledge of smart grid projects inside and outside Japan are utilized for international contribution.



Ⅳ. International contribution by utilizing TEPCO's technology

Both THE Power Grid Solution and T.T. Network Infrastructure Japan are targeting international contribution through the power system export business, which unites the advanced technologies of HITACHI and TOSHIBA, and the knowledge/know-how/experience in Planning and Operation & Maintenance of TEPCO.

THE Power Grid Solution Ltd.
(2014. APR)

HITACHI
Inspire the Next

TEPCO 東京電力

TOSHIBA
Leading Innovation

THE Power Grid Solution

Consulting and engineering in the power transmission and distribution field.

T.T. Network Infrastructure Japan
(2014. SEP)

T.T. Network Infrastructure Japan

<Main Business Areas>
For developing countries
- ✓Consultancy for network planning
- ✓Operation & maintenance support

For advanced/developed countries
- ✓Solutions to improve withstand ability against disasters
- ✓Reliability improvement for network stability, expansion, connections, etc.
- ✓Optimal utilization of renewable energy through integration solutions

For islands or remote regions
- ✓Realization of environmentally friendly systems

Ⅴ. Conclusion

By proposing the most efficient energy use for each customer and providing services, TEPCO will aim to become a futuristic infrastructure company that contributes to a safe and comfortable smart society.

- Good use of secure infrastructure
- Further value creation of Smart social

Society

Energy conservation/Low cost/Low carbon

Companies Local governments

Citizens Safety/Security/ Comfort

Households

Enhancement of contact points with customers
(Web site, Smart meter, Smart grid, etc)

Customer side

Total Energy Solution | **Renewable・BCP** | ***"Lifestyle Platform"***

Grid side

Gas/Thermal/ Water

Construction, maintenance, operation of flexible and efficient energy infrastructure

Thank you for your attention!