Smart Grid Implementations
- Case of Japan -

Yoshito SAKURAI
(Hitachi, Ltd.)

ITU Centres of Excellence Network for Asia-Pacific Region
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International Telecommunication Union

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- Introduction
- Japan's Electricity Market Deregulation
- Real Use Case of Smart Grid
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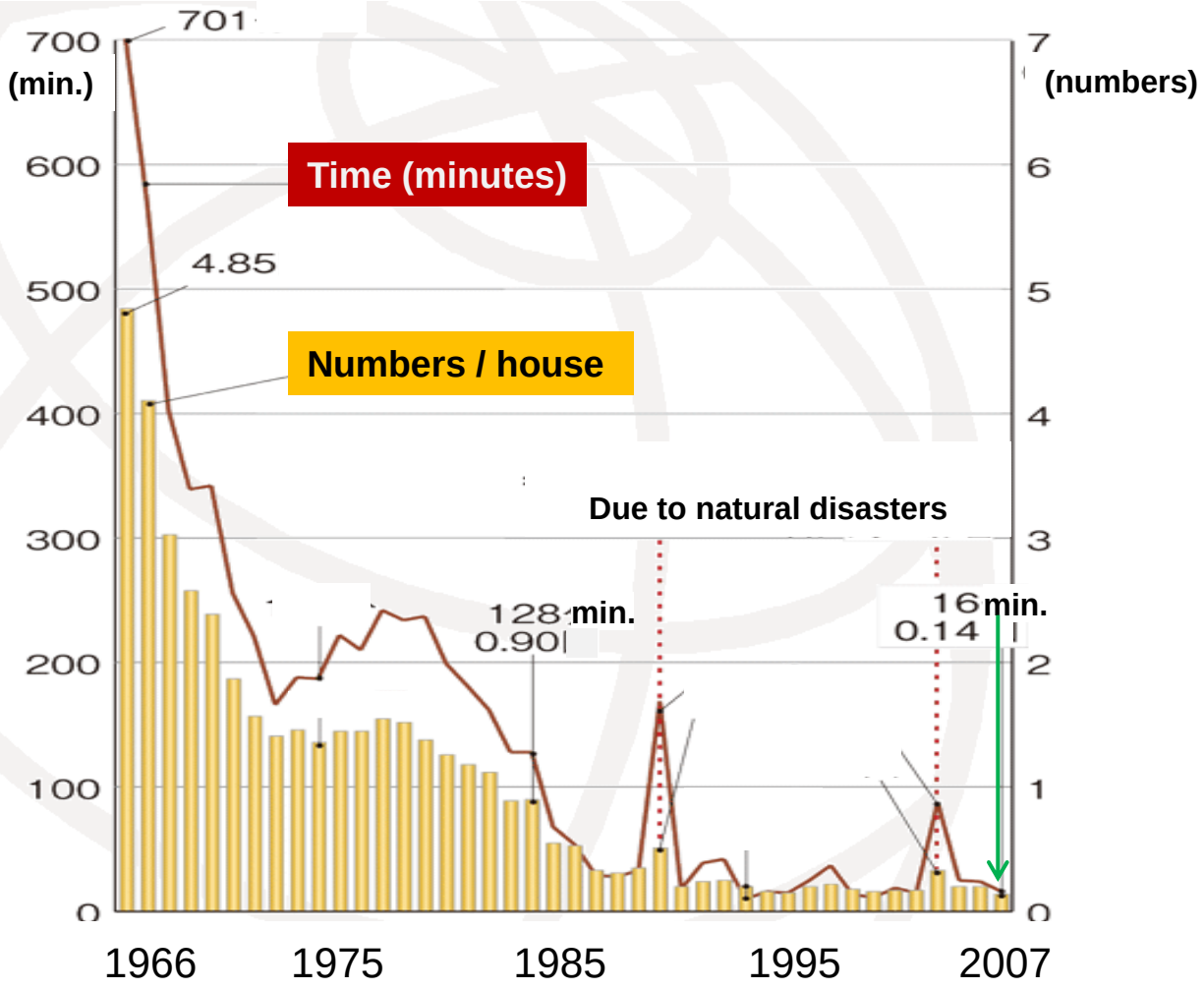
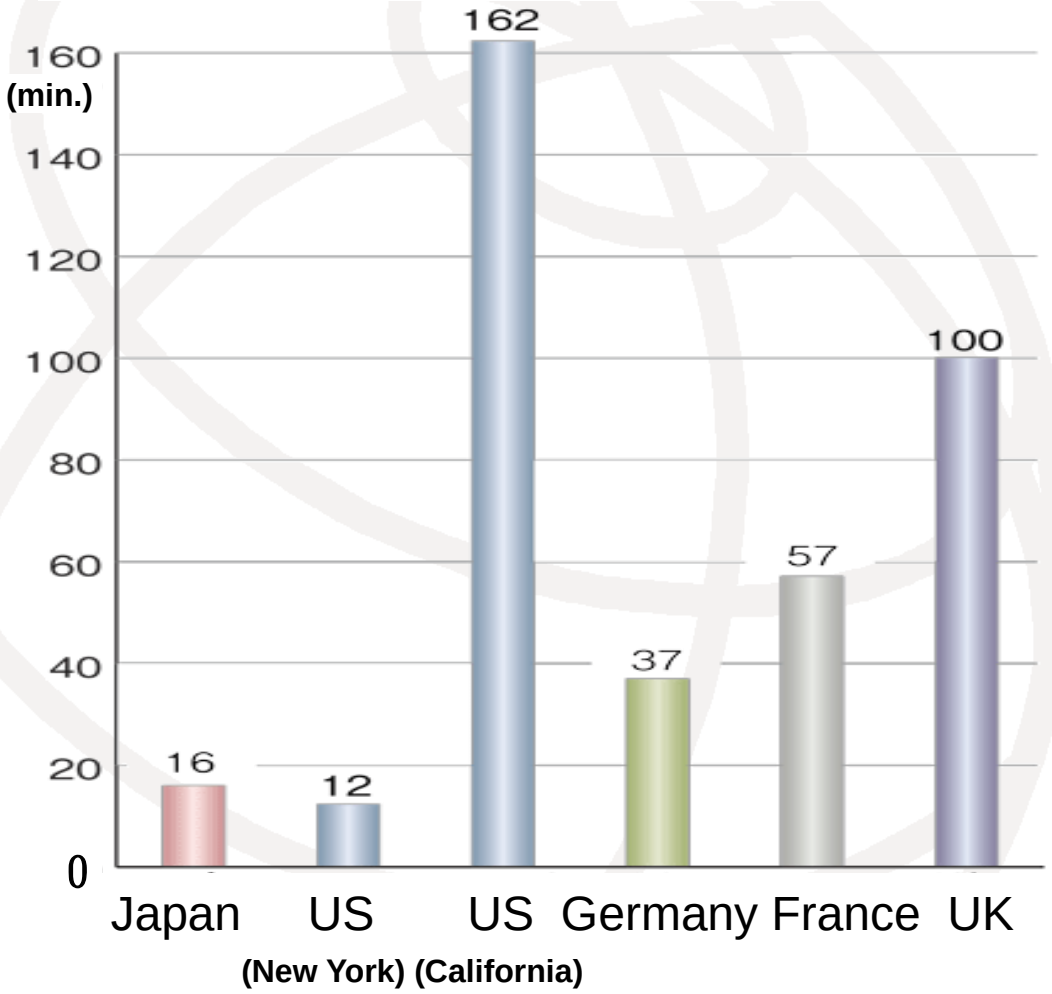
Blackout time/year in Japan



Blackout time/year in the World



Situation in Japan

- The electric supply system in Japan has been already very “Smart” as far as electric transmissions and distributions.
- The smart grid in Japan is not a technology issue but a policy/regulation issue.
- It will re realized by the Market Deregulation that will introduce here after.

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Japan's Electricity Market Deregulation

June, 2015

Electricity and Gas Market Reform Office
Agency for Natural Resources and Energy (ANRE)

Ministry of Economy, Trade and Industry

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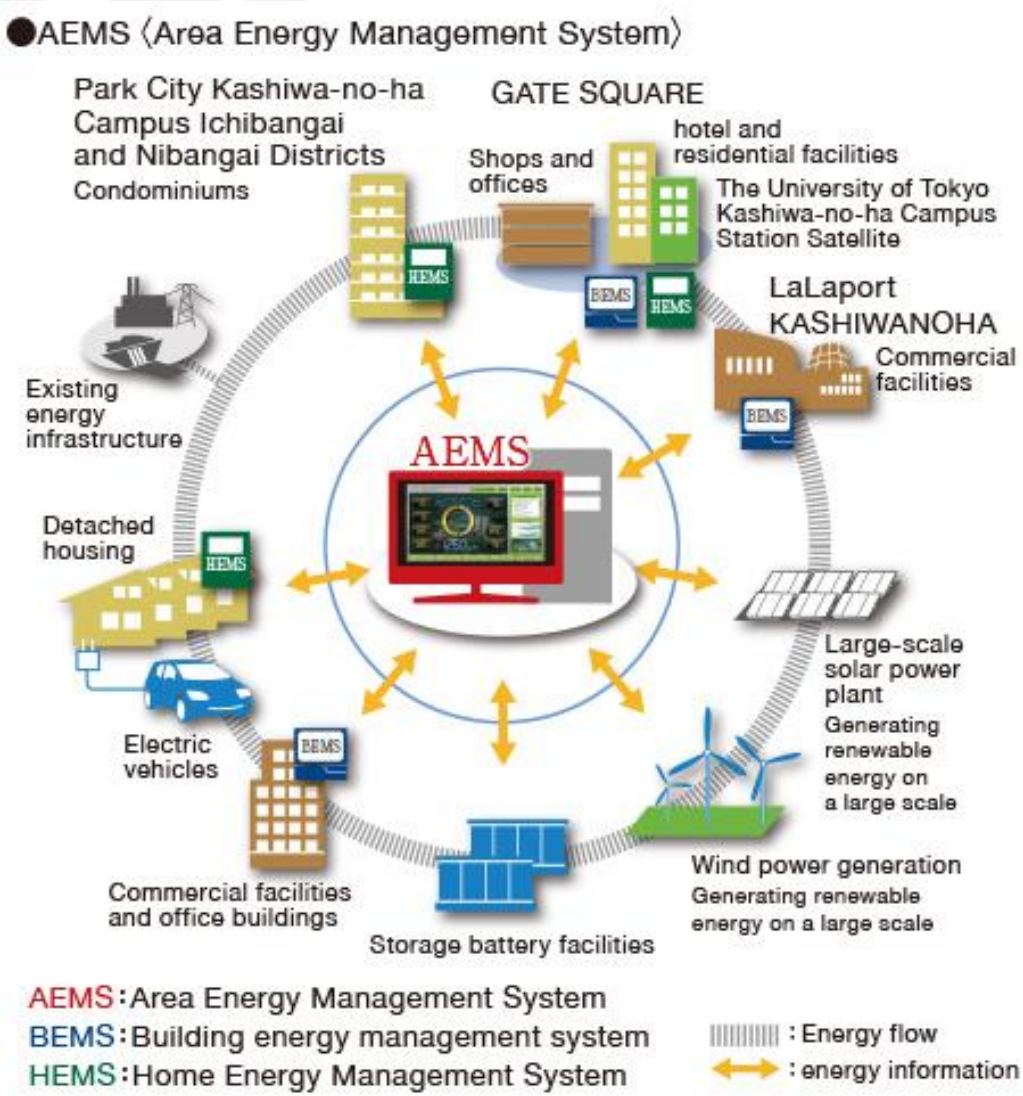
Kashiwa-no-ha Smart City

Kashiwa-no-ha Smart City locates 25km north-east from Tokyo metropolitan area
(It takes about 30 minutes by train)
that is equipped AEMS (Area Energy Management System) etc.
It is a real city people live in. There are residential areas, hospitals, universities, etc.

Area Energy Management System

Kashiwa-no-ha Smart City optimizes energy usage for the entire city. AEMS plays a pivotal role in this setup, drawing on an independently operated power grid and enabling area expansion as well as enhancing functions. This system is designed to contribute to smart grid progress that underpins lifestyles and innovations.

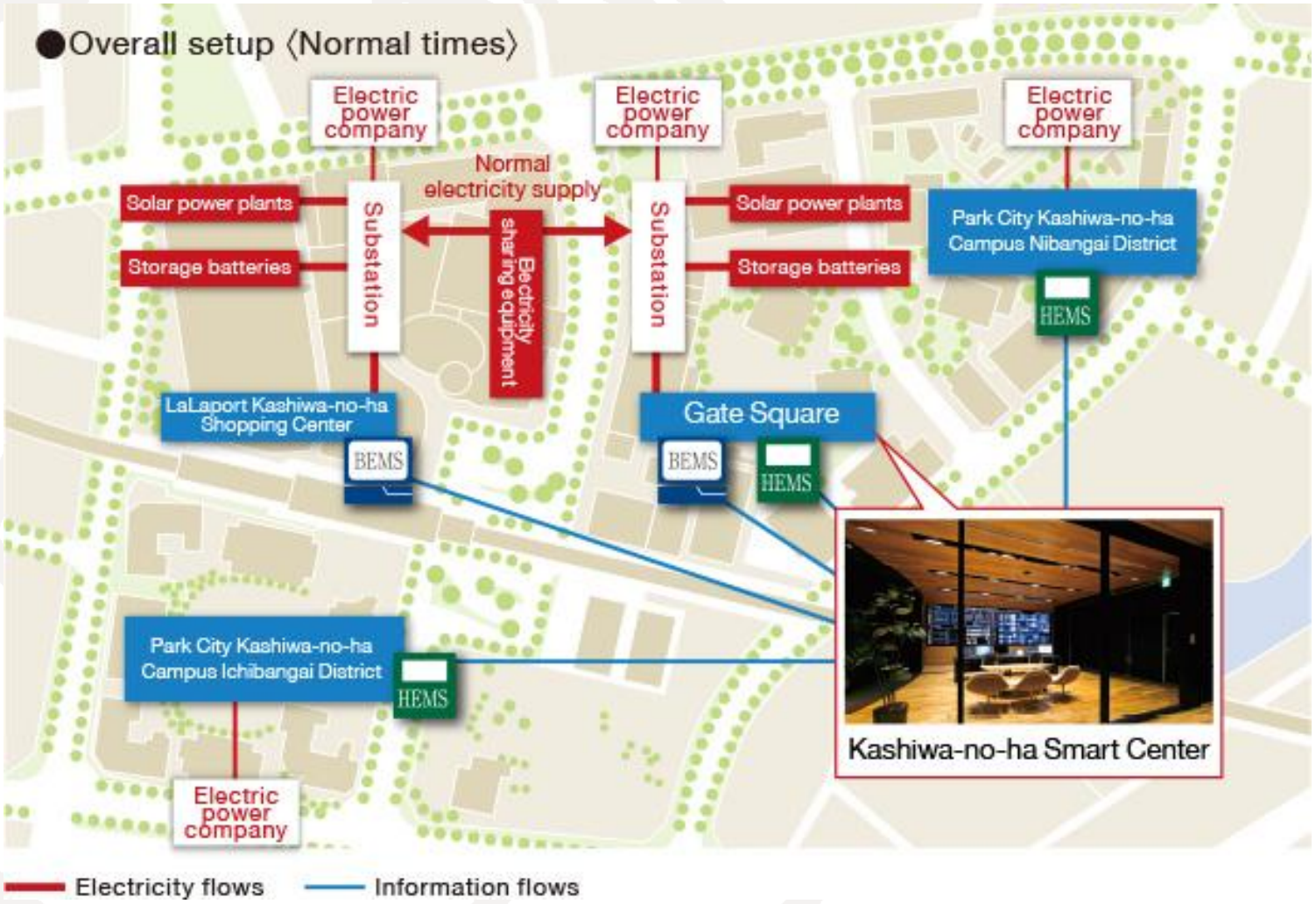


AEMS Operation Center

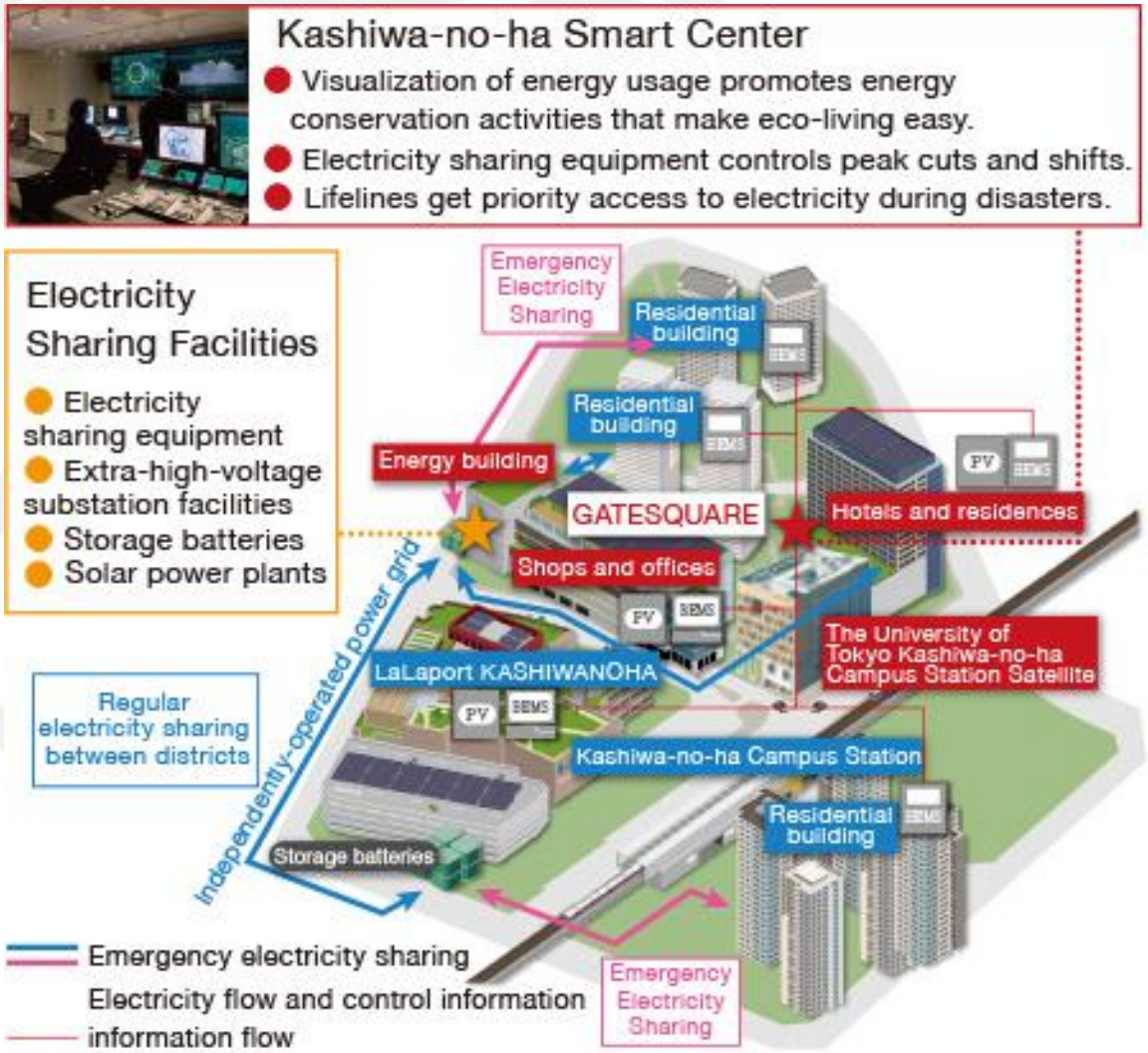
Energy management system that is central to Kashiwa-no-ha Smart City.

The Kashiwa-no-ha Smart Center oversees energy operations, management, and control for the entire town. The center uses wheeling throughout the area to cut peak power consumption by 26%, helping to conserve energy and cut CO_2 emissions.

Japan's first smart grid to use distributed power sources to share electricity in the community



Emergency electricity sharing



Power Generation Facilities

Solar power generation facilities

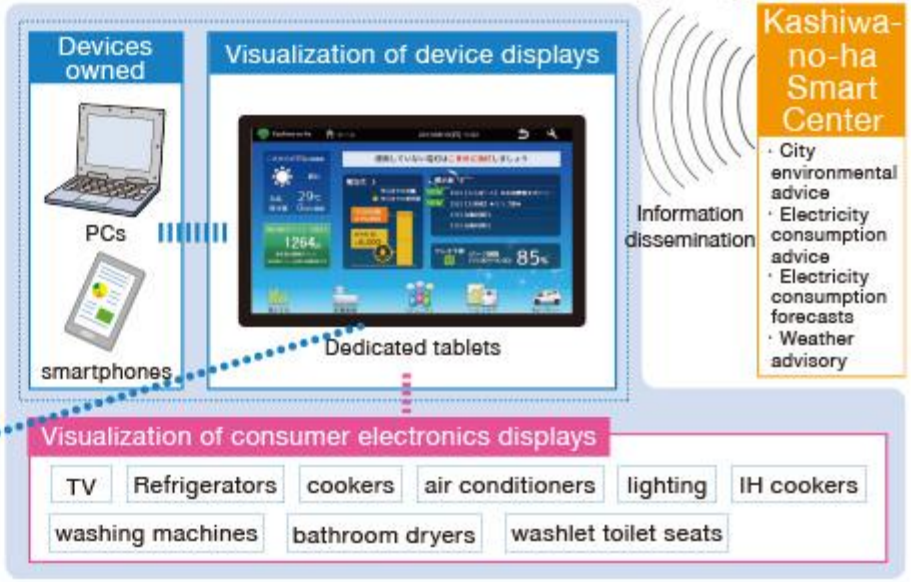
Wind power generation facilities

Transportations

Instead of individually owning electric vehicles, electric scooters, and bicycles, residents share them to help cut overall carbon dioxide emissions and travel more conveniently. During emergencies, residents can share power from electric vehicles.

●Kashiwa-no-ha HEMS/ Screen image

●Kashiwa-no-ha HEMS visualization of energy usage overview



HEMS displays energy consumption so residents can become more aware of their contributions to power conservation, thereby fostering environmentally friendly lifestyles. Dedicated tablets, PCs, smartphones, and other devices show CO2 emissions from residences. This setup uses artificial intelligence for such purposes as advising on energy usage and ranking the effectiveness of energy-saving approaches. HEMS enhances disaster management through its demand response function, which solicits residents help in using less power during emergencies. Residents can control lighting and air conditioning settings while away from home.

Conclusion

The smart grid in Japan will be realized by the policy;

(1) Securing a stable supply of electricity

(2) Suppressing electricity rates to the maximum extent possible

(3) Expanding choices for consumers and business opportunities

Real smart grids are introducing in rather Smart Cities than nation wide such as Kashiwa-no-ha city.

Thank you for your attention

Yoshito Sakurai
Hitachi, Ltd.
Japan
yoshito.sakurai.hn@hitachi.com

Japan's Electricity Market Deregulation

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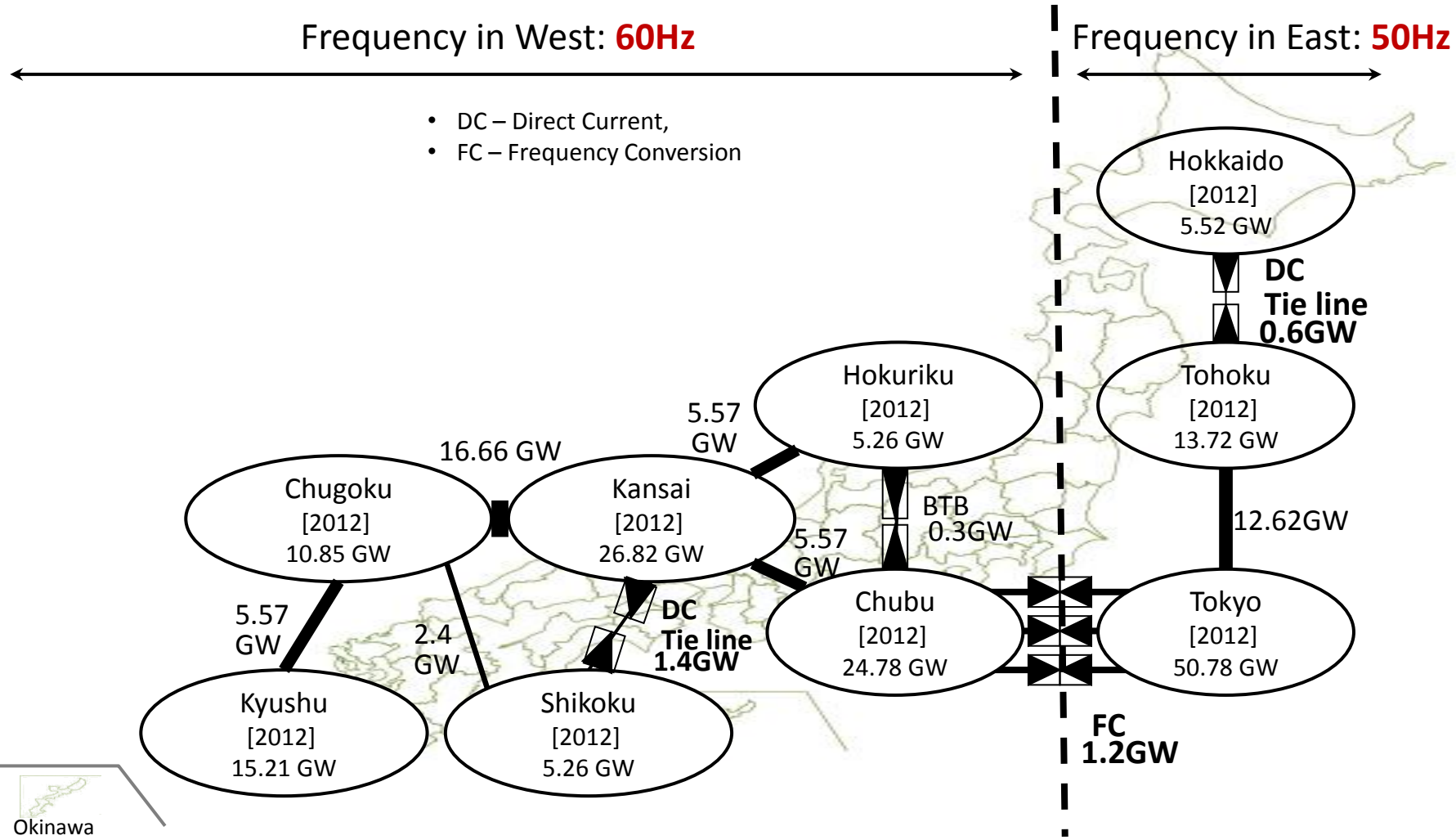
Japan's Electricity Market Outline

- 10 Vertically Integrated Electricity Power Companies (EPCOs)
- TWO frequencies, 50Hz and 60Hz



Japan's Electricity Market Outline (cont.)

- Market volume (Total): 982.4TWh / 289 GW
- Market volume (10 big EPCOs): 848.5TWh / 209GW /
  ¥18.2 trillion (=$ 151.7bn, € 134.8bn) (2013)
- Retail competition for over 50kW customers (62% of the market in 2013)
  - Share of non-EPCOs: 4.2% (2013)
  - 1.3% of the total retail market sales is transacted at JEPX (2013)

*JEPX: Japan Electric Power Exchange

Current retail market

Liberalized Sector
(50kW～)

Market Volume ; ¥10.1 trillion (=$ 84.2bn, € 74.8bn)

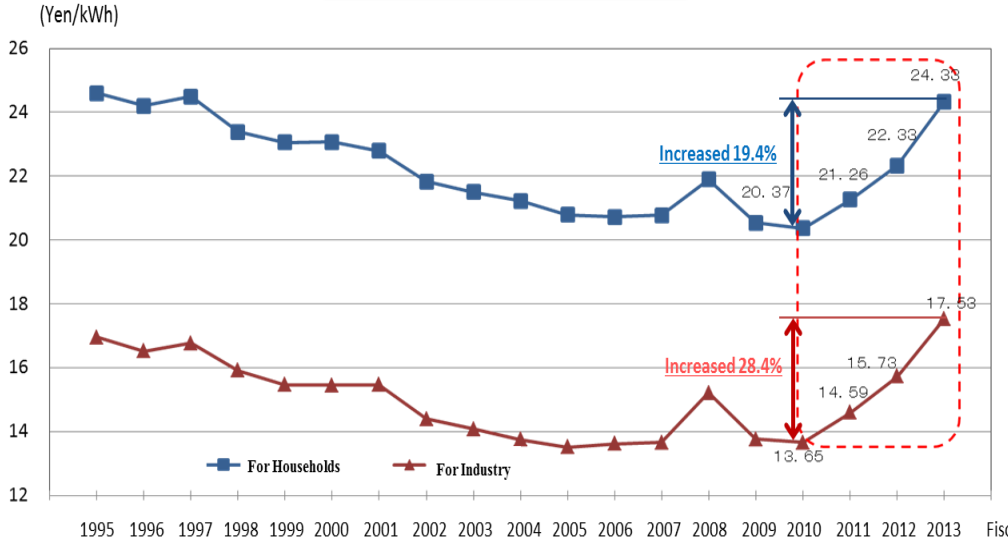
Share of total power: 62%

Regulated Sector
(～50kW)

Market Volume ; ¥8.1 trillion (=$ 67.5bn, € 60.0bn)
Number of contracts
Residential Customers : 77.3m
Small shops and offices: 7.3m

Share of total power: 38%

Changes in Electricity price



[Source] Created based on the "Electricity Demand Report" (Federation of Electric Power Companies in Japan) and the materials concerning the power companies' final settlement reports, etc.

History of Electricity Market Reforms in Japan

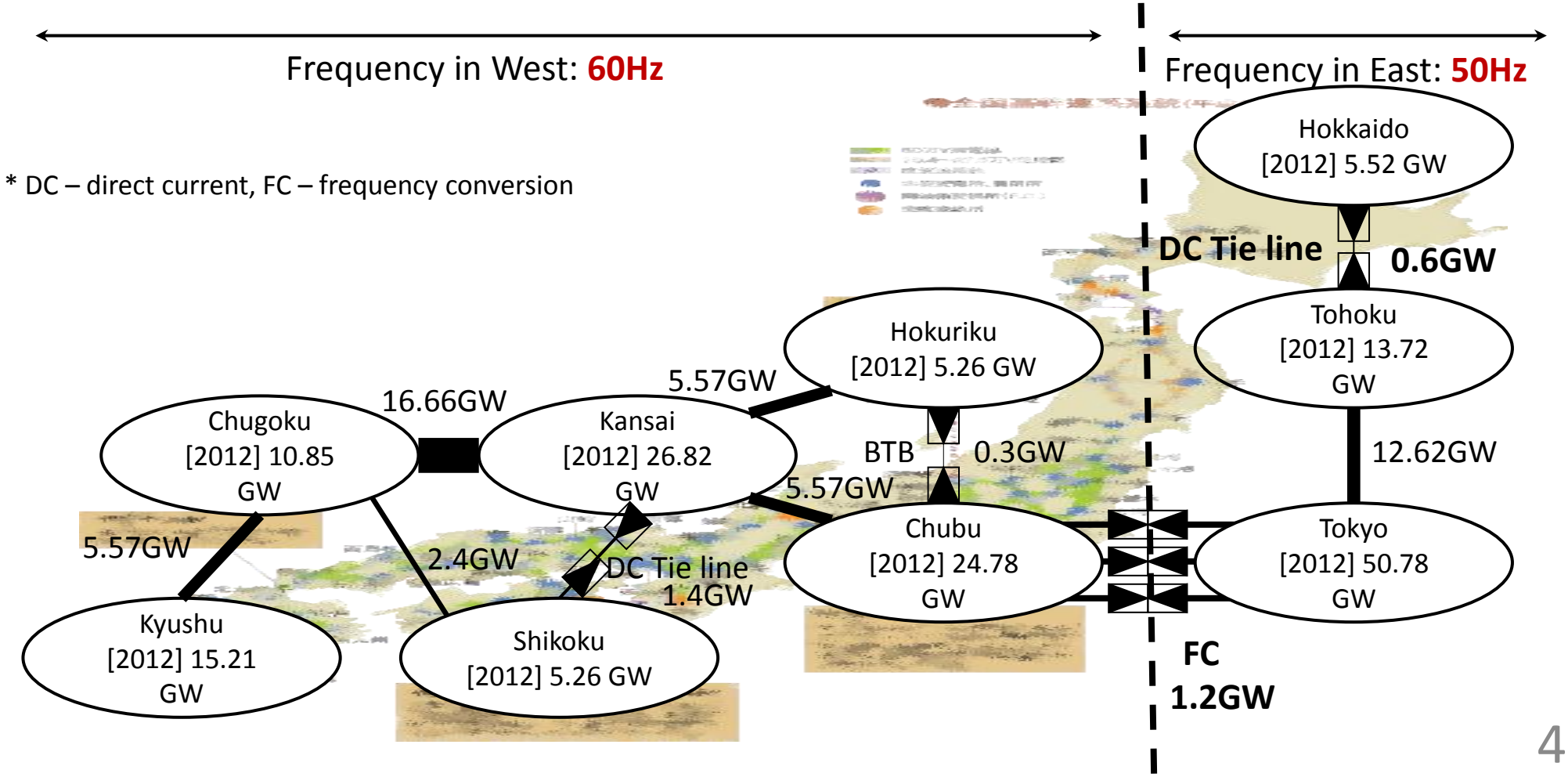
No competition in the electricity market before 1995:
10 vertically integrated EPCOs dominated and controlled the market.

METI embarked on a series of reforms...

No.	Year enforced	Overview
1	1995	• Opened the IPP (Independent Power Producer) market • Allowed specified-scaled and vertically integrated power generators
2	2000	• Introduced partial retail competition (over 2,000kW in 2000 [26%], over 500kW in 2004 [40%]) • Introduced regulation of third party access to grid lines
3	2005	• Expanded retail competition (over 50kW [62%]) • Established the wholesale power exchange (JEPX) and its supporting body for transmission in wider areas • Improved regulation of third party access to grid lines, and introduced accounting separation of transmission/distribution sector
4	2008	• Modified the rule of wheeling rates

Problem revealed by 3.11

- Negative aspects of regional monopoly system with 10 big and vertically integrated EPCOs were revealed in the Great Earthquake on March 11, 2011:
  1. Lack of system to transmit electricity beyond regions
  2. Little competition and strong price control
  3. Limit in handling the change in energy mix including the increase in renewables



Expert Committee on Electricity System Reform

- Agency for Natural Resources and Energy organized the Expert Committee on Electricity System Reform in February 2012.
- Based on the discussions over 12 meetings, the Committee compiled a final report on February 8, 2013.

The Members of the Expert Committee of Electricity System Reform

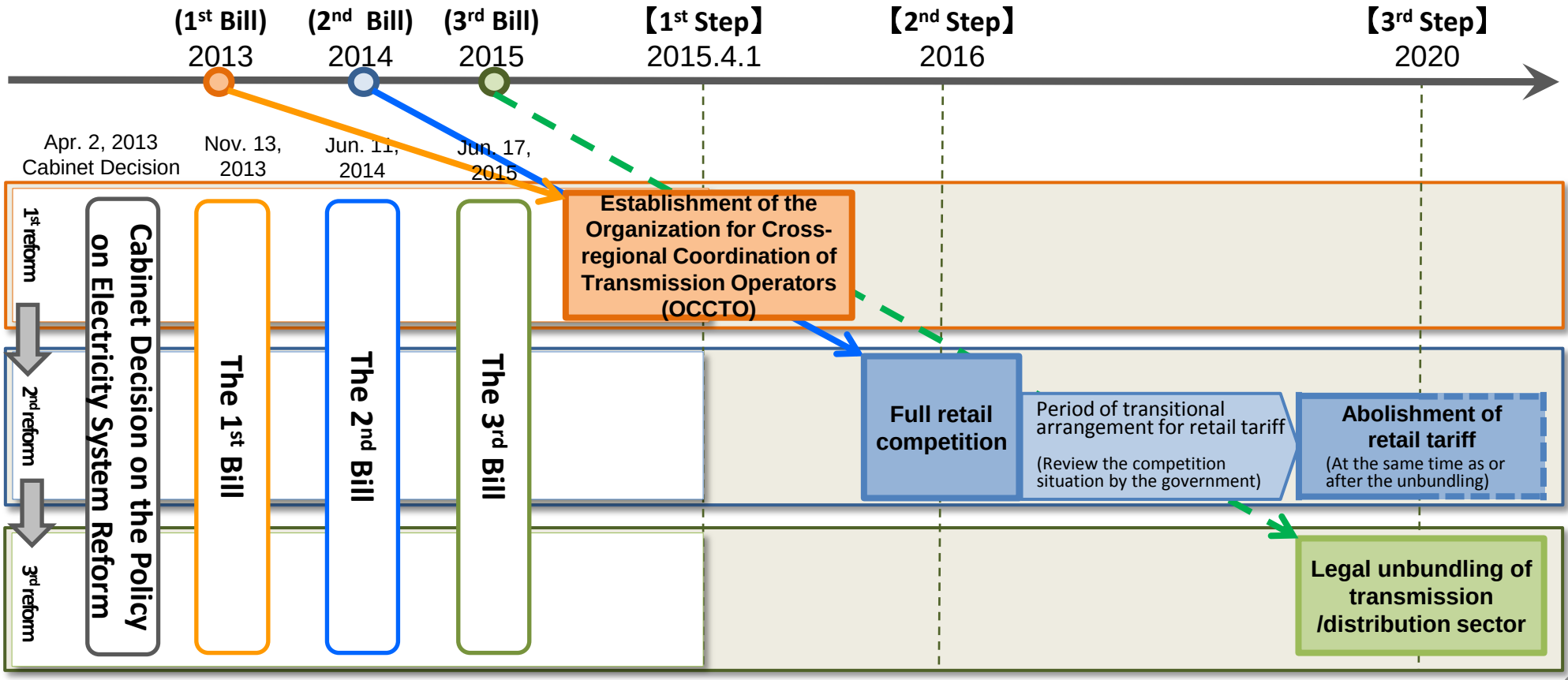
<Chairman>		
	Motoshige Ito	Professor at Graduate school of Economics, The University of Tokyo
<Deputy Chairman>		
	Junji Annen	Professor at Law School Academy, Chuo University
<Members>		
	Toshinori Ito	Representative Director and analyst at Ito Research and Advisory Co., Ltd.
	Hiroko Ohta	Professor, National Graduate Institute for Policy Studies
	Junichi Ogasawara	Chief Research fellow and Manager at The Institute of Energy Economics, Japan, Electric Power Group
	Takao Kashiwagi	Specially appointed professor at Tokyo Institute of Technology
	Hiroshi Takahashi	Chief researcher at Fujitsu Research Institute of Economics Co., Ltd.
	Kikuko Tatsumi	Regular adviser, Public Corporation, Nippon Association of Consumer Specialists
	Tatsuo Hatta	Special visiting professor, Gakushuin University
	Toshihiro Matsumura	Professor at The Institute of Social Science, The University of Tokyo
	Akihiko Yokoyama	Professor at Graduate School of Frontier Sciences, The University of Tokyo

Electricity Market Reform in Japan: Roadmap

- April 2, 2013, Cabinet decided the “Policy on Electricity System Reform” to realize three objectives in Japan’s market with a three-step approach.

3 Objectives

(1) Securing a stable supply of electricity
(2) Suppressing electricity rates to the maximum extent possible
(3) Expanding choices for consumers and business opportunities

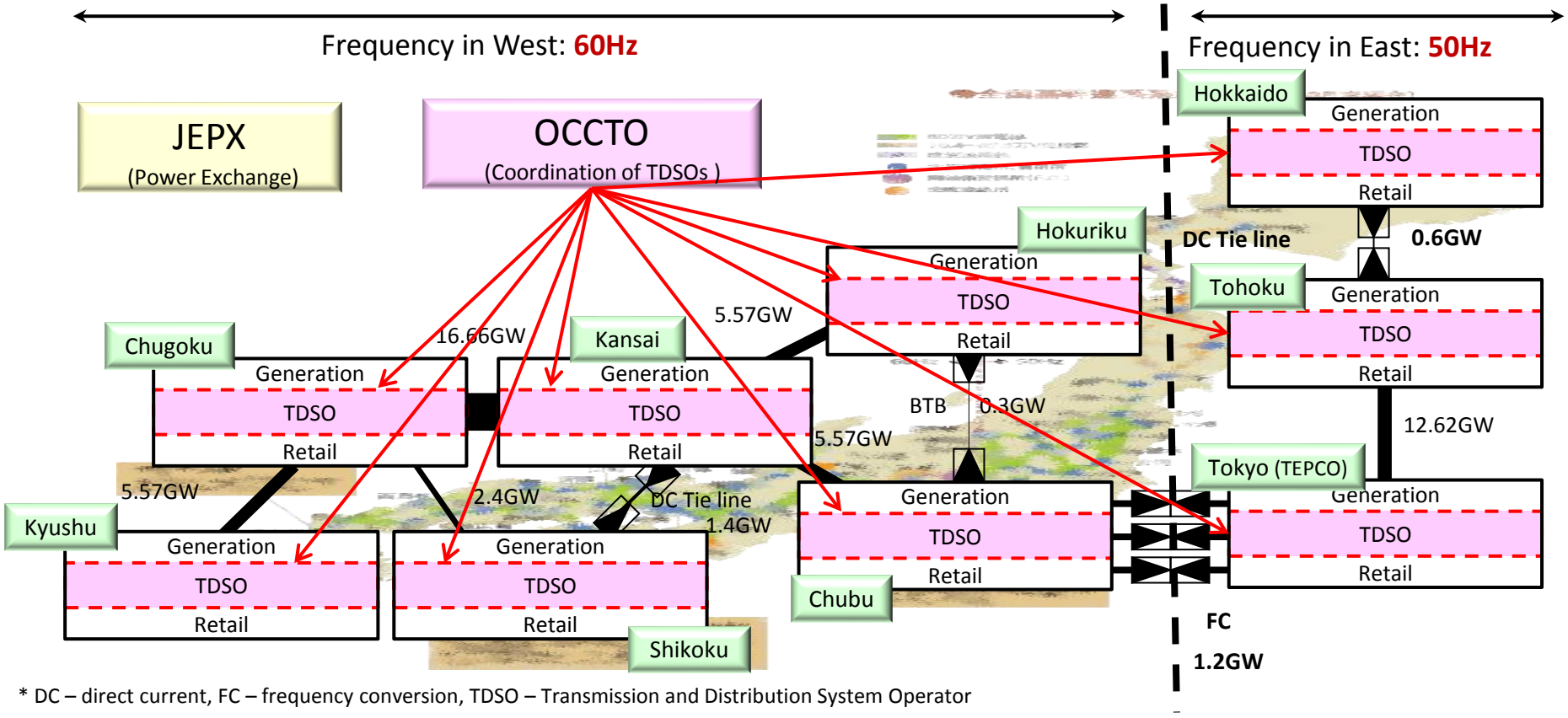


(※At around 2015:Transition to new regulatory organizations)

1st step: Establish the OCCTO

The 1st Bill

- Established the Organization for Cross-regional Coordination of Transmission Operators (OCCTO) in Apr. 2015
  - ➢ Main functions of OCCTO
    1. Aggregate and analyze the EPCO's supply-demand plans and grid plans, and order to change EPCO's plans such as tie lines construction
    2. Order EPCOs to reinforce generations and power interchanges under a tight supply-demand situation



* DC – direct current, FC – frequency conversion, TDSO – Transmission and Distribution System Operator

2nd step: Full Retail Competition

The 2nd Bill

- Expand retail competition to the residential sector in 2016, opening a new market
- Maintain regulated tariffs to 10 big EPCOs until the same time as or after the unbundling

Liberalized Sector
(50kW～)

Market Volume ; ¥10.1 trillion (=$ 84.2bn, € 74.8bn)

Share of total power supply : 62%


Large factory
Large building


Building
Medium factory


Small Factory

Regulated Sector
(～50kW)

Market Volume ; ¥8.1 trillion (=$ 67.5bn, € 60.0bn)
Number of contracts
Residential Customers : 77.3m
Small shops and offices: 7.3m

Share of total power supply : 38%


Small shop


Residential Customer

Revision of Business License Categories

The 2nd Bill

- Business License categories under the Electricity Business Act, such as “General Electricity Utilities (GEU)” and “Wholesale Electricity Utilities”, will be revised in line with the full retail choice.

Current categories	
GEU （10EPCOs）	● Supply for customers, including those in regulated sector with obligation to supply, regional monopoly and rate regulation ● Secure stable frequency and voltage
PPS (Power Producer and Supplier)	● Supply for customers in liberalized sector (more than 50kW)
Wholesale Electricity Utilities , etc	● Supply for GEU

New categories (after 2016)

Obtain 3 licenses
（not necessary to change corporate organization）

Generation	Transmission & Distribution	Retail
Generation		Retail
Generation		

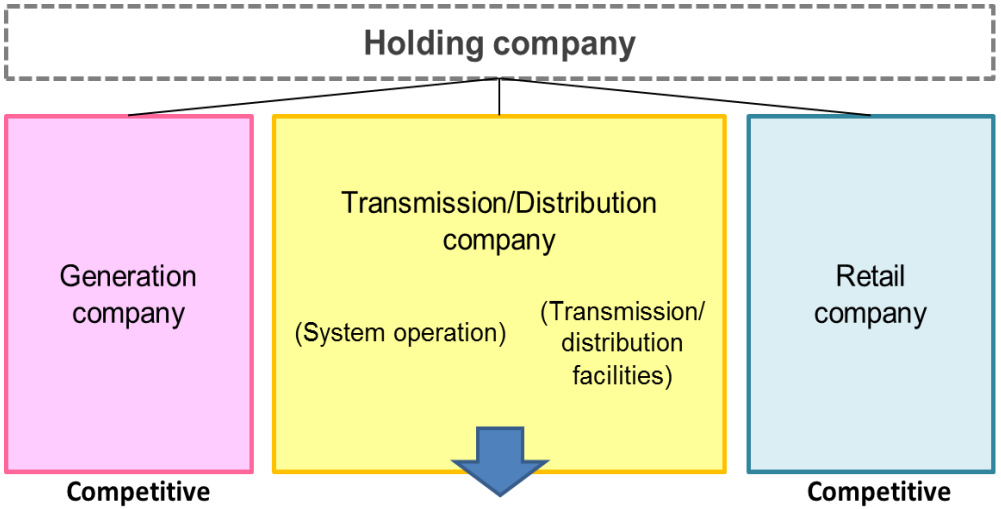
【Notification】	【Permission】	【Registration】
● Regulation based on the level playing field of competition	● Operate and maintain transmission /distribution lines ● Regional monopoly and rate regulation	● Supply for customers ● Obligation to secure the capacity of power supply ● Regulation based on the level playing field of competition

3rd step: Unbundle the T/D sector

The 3rd Bill

- Unbundle the transmission/distribution sectors of big EPCOs by legal unbundling style in 2020

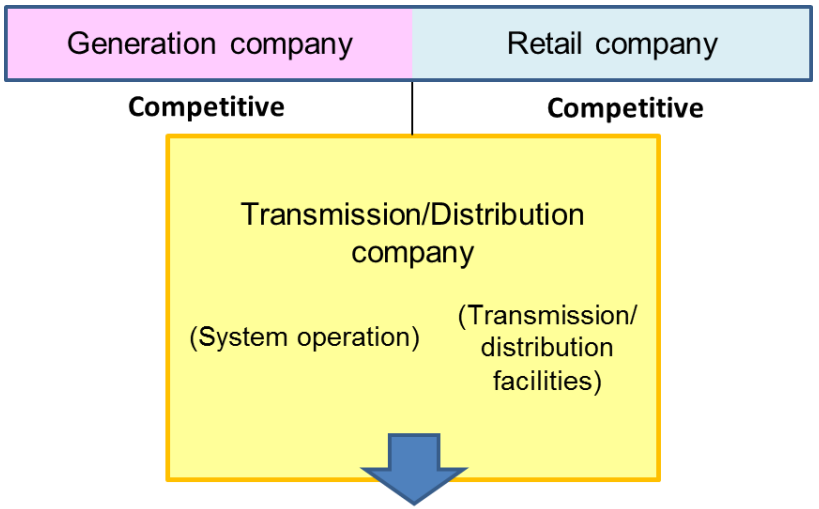
Holding company style



Regulated

- Regional monopoly
- Network tariff
- Responsibility for maintaining frequency & providing LR service
- Code of conduct

Affiliated company style



Regulated

- Regional monopoly
- Network tariff
- Responsibility for maintaining frequency & providing LR service
- Code of conduct

<Note>

✓ Big EPCOs will be required to unbundle transmission and distribution companies from generation ones or retail ones, in “legal unbundling.”

✓ Both the holding company style and the affiliated company style, in which a generation and retail company has a transmission and distribution company as a subsidiary company ,are allowed.

Future Design of Japan's Electricity Market