

Status and Challenges on the Power System in Japan

IRED 2018 Session 1
October, 17th, 2018

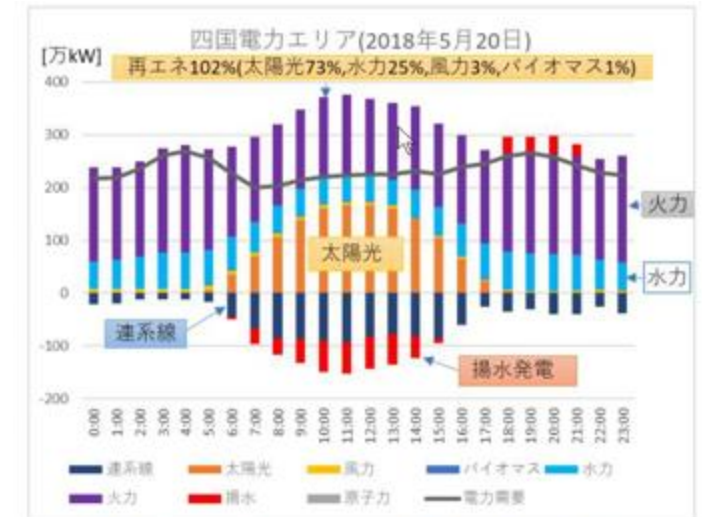
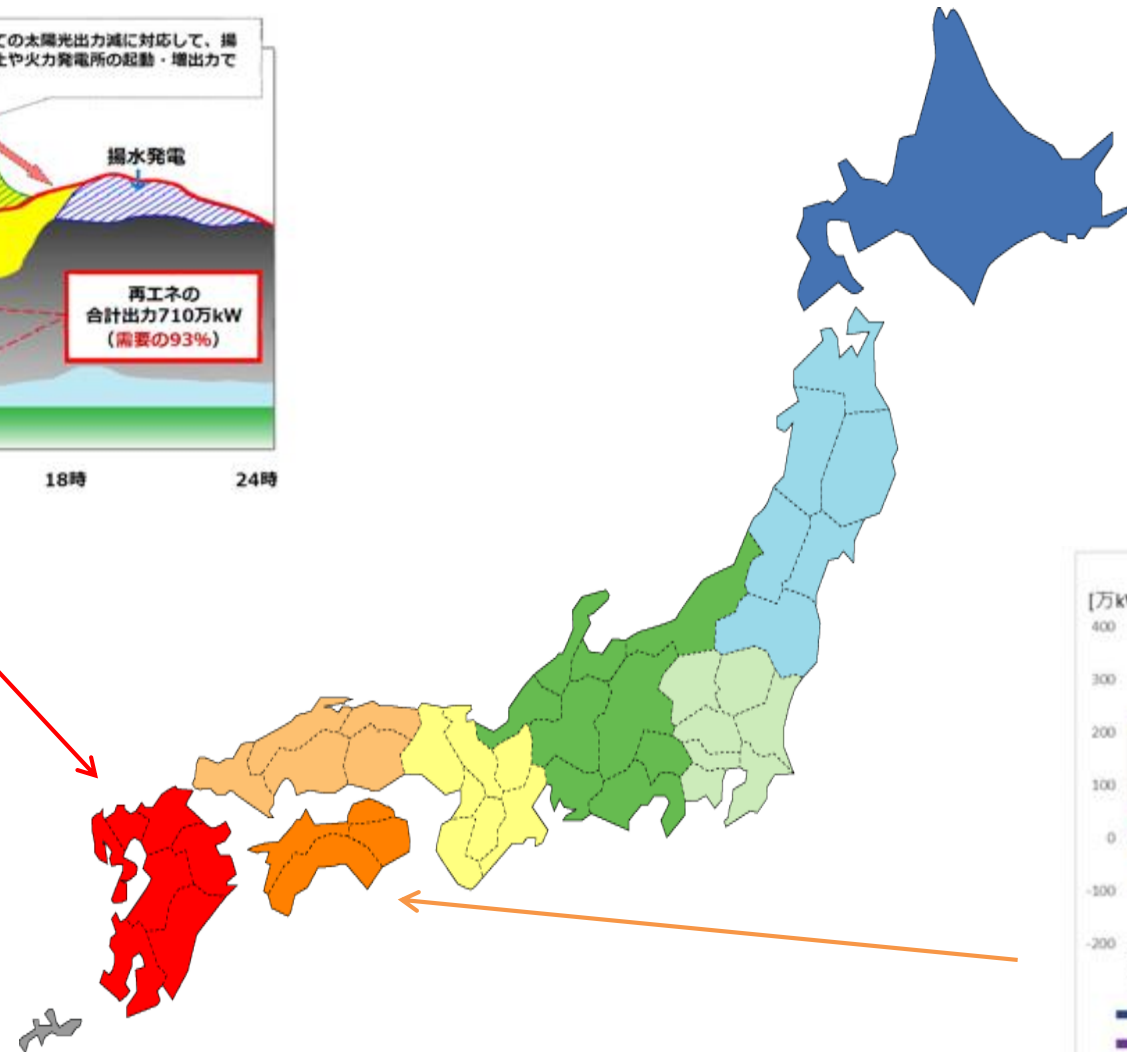
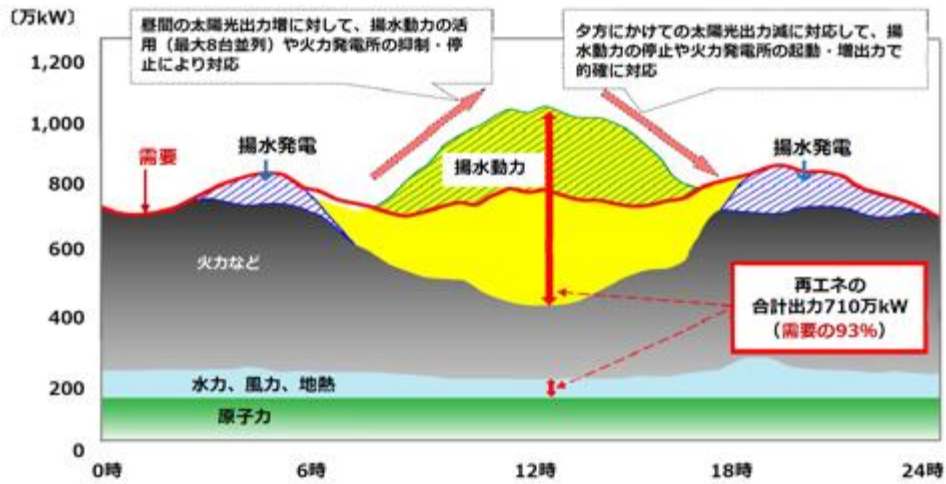
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1. 2018 Key Energy Trends in Japan

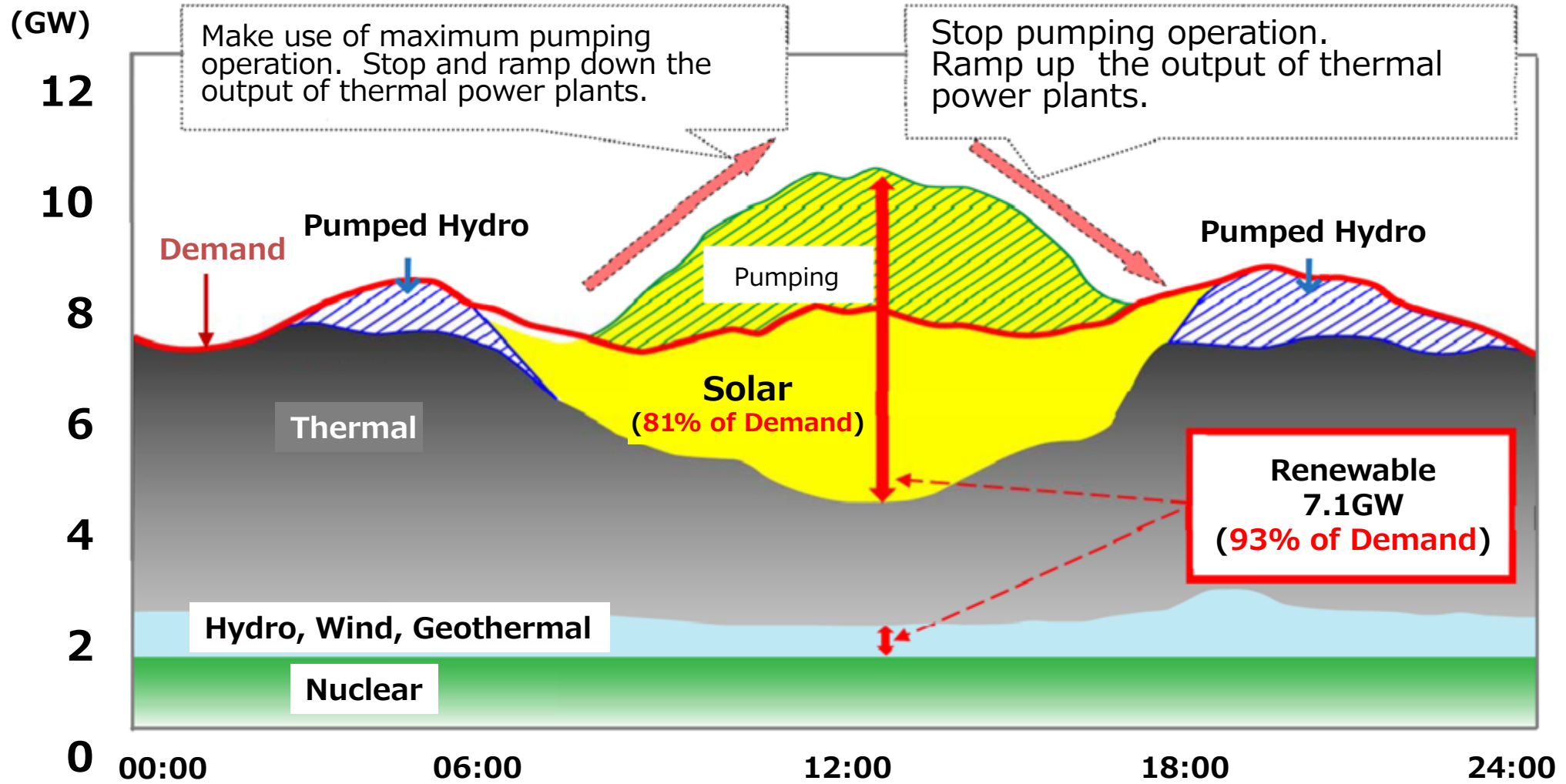
High Penetration of RE in Specific Regions



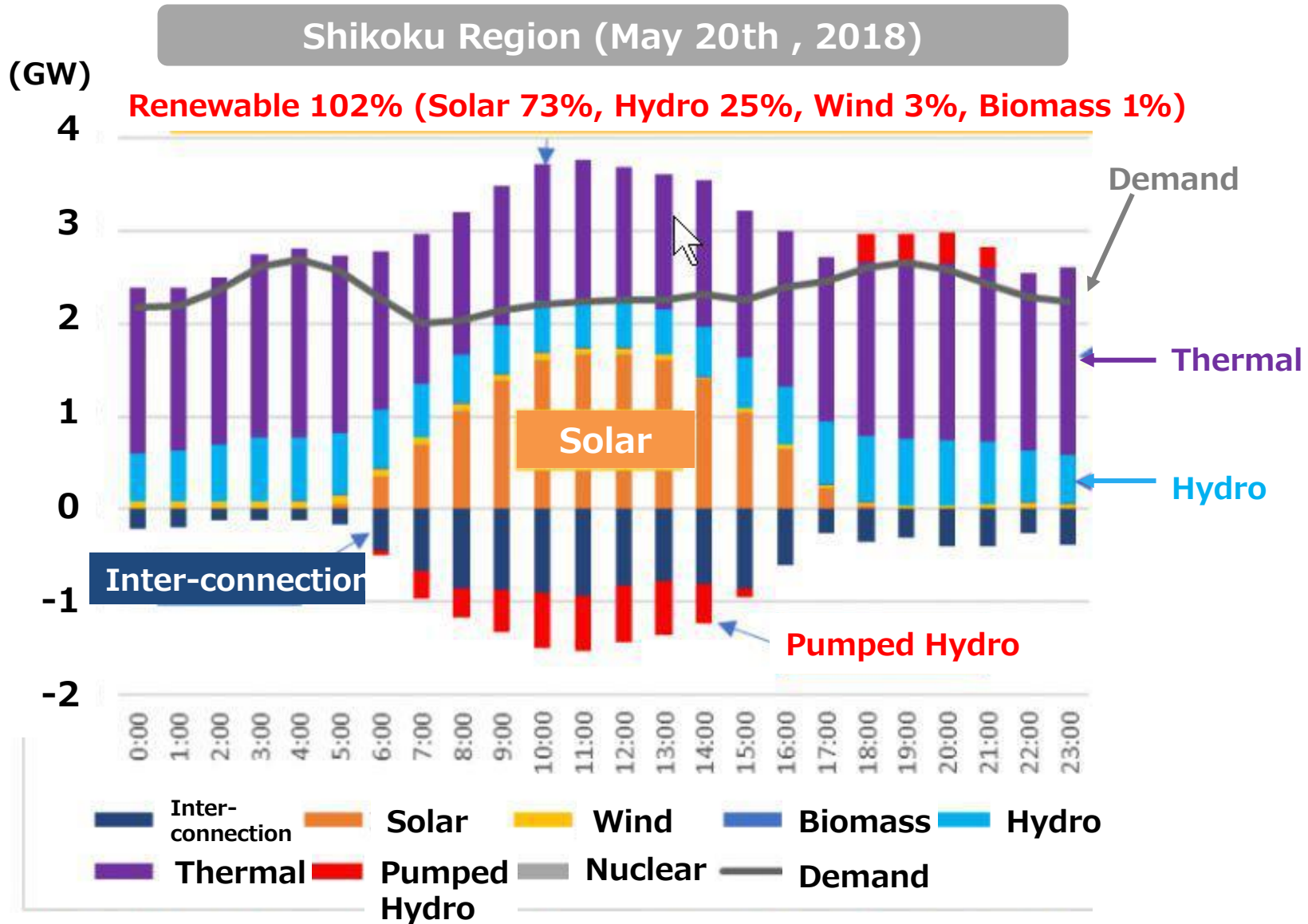
Rapid integration of solar PV in the Kyushu

Kyushu Region (May 3rd , 2018)

May 3rd is in Japanese Holiday Week



100% RE for several hours in Shikoku



Renewable Energy

*“Along with the realization of the energy mix in 2030, prompt actions will be taken towards a major energy source”**

— 5th Strategic Energy Plan, July 2018 —

First-ever Blackout in Japanese History

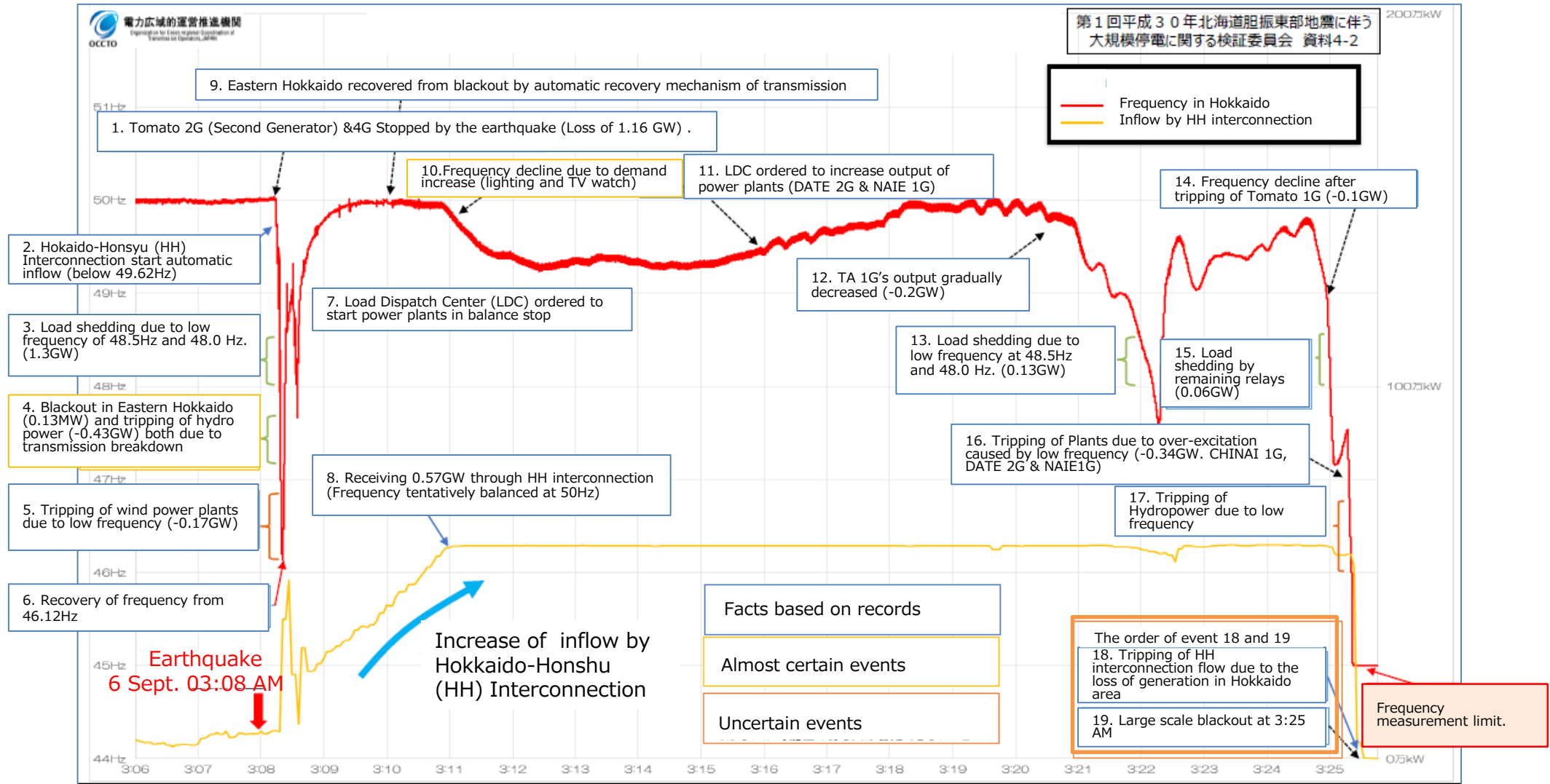
Sep. 6th(THU),2018 at 3:08 a.m.

A magnitude of 6.7 Mj Earthquake

1,650 MW Coal-fired power plants was heavily damaged by earthquake
(**Cover 50% of demand** at 3.08 a.m.)

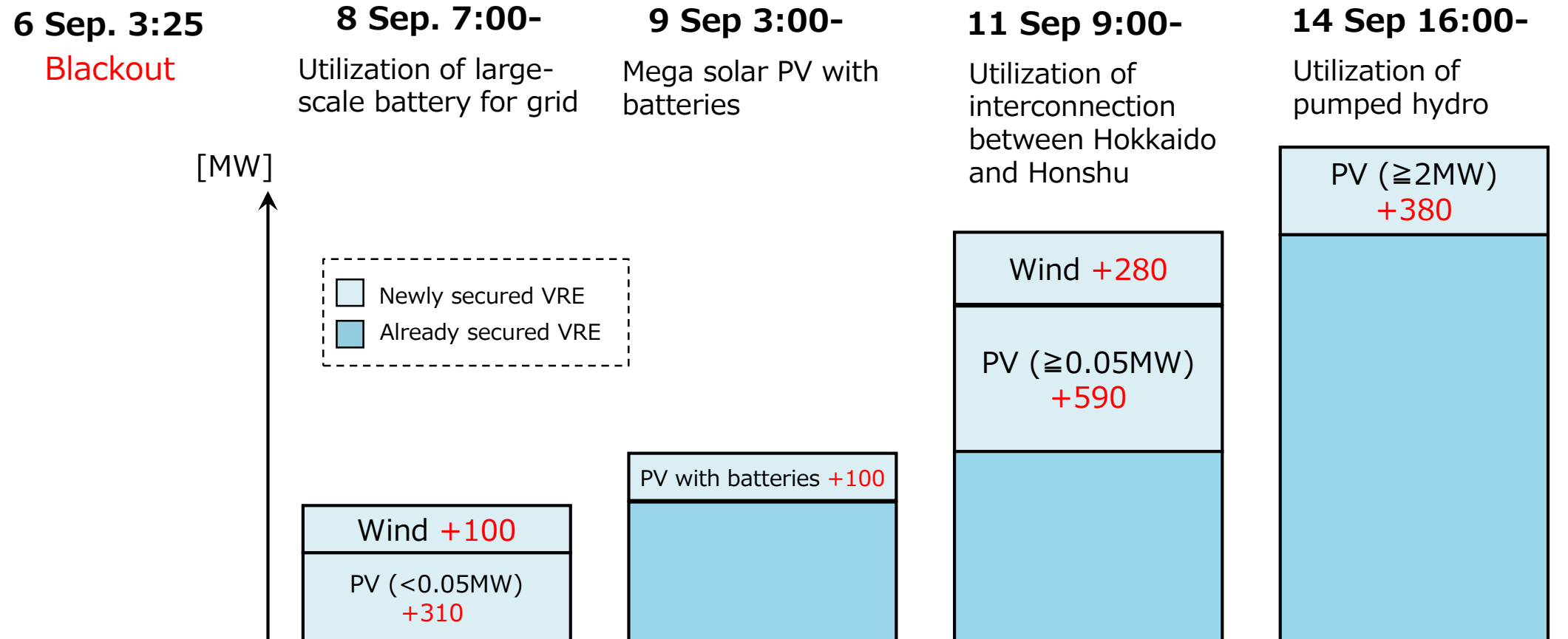
Power cut of **all 2.95 million household** in Hokkaido

18 min Frequency Change Before the Blackout



Reconnection of Wind and Solar PV after the earthquake

- Flexibility is required to address variability of VRE
- Hokkaido was lack of flexibility after the earthquake, and Hokkaido Electric Power Company reconnected VRE in response to securing flexibility



Source: METI, 17th meeting of Working Group on Grid Connection of Renewable Energy (Sep. 2018)
http://www.meti.go.jp/shingikai/enecho/shoene/shinene/shin_energy/keito_wg/pdf/017_06_00.pdf

Typhoon Jebi in the Kansai Region

Sep. 4th (TUE), 2018

The Strongest typhoon since in 1993.

Maximum wind gust speed was 209 km/h (58.1 m/s) at Kansai International Airport

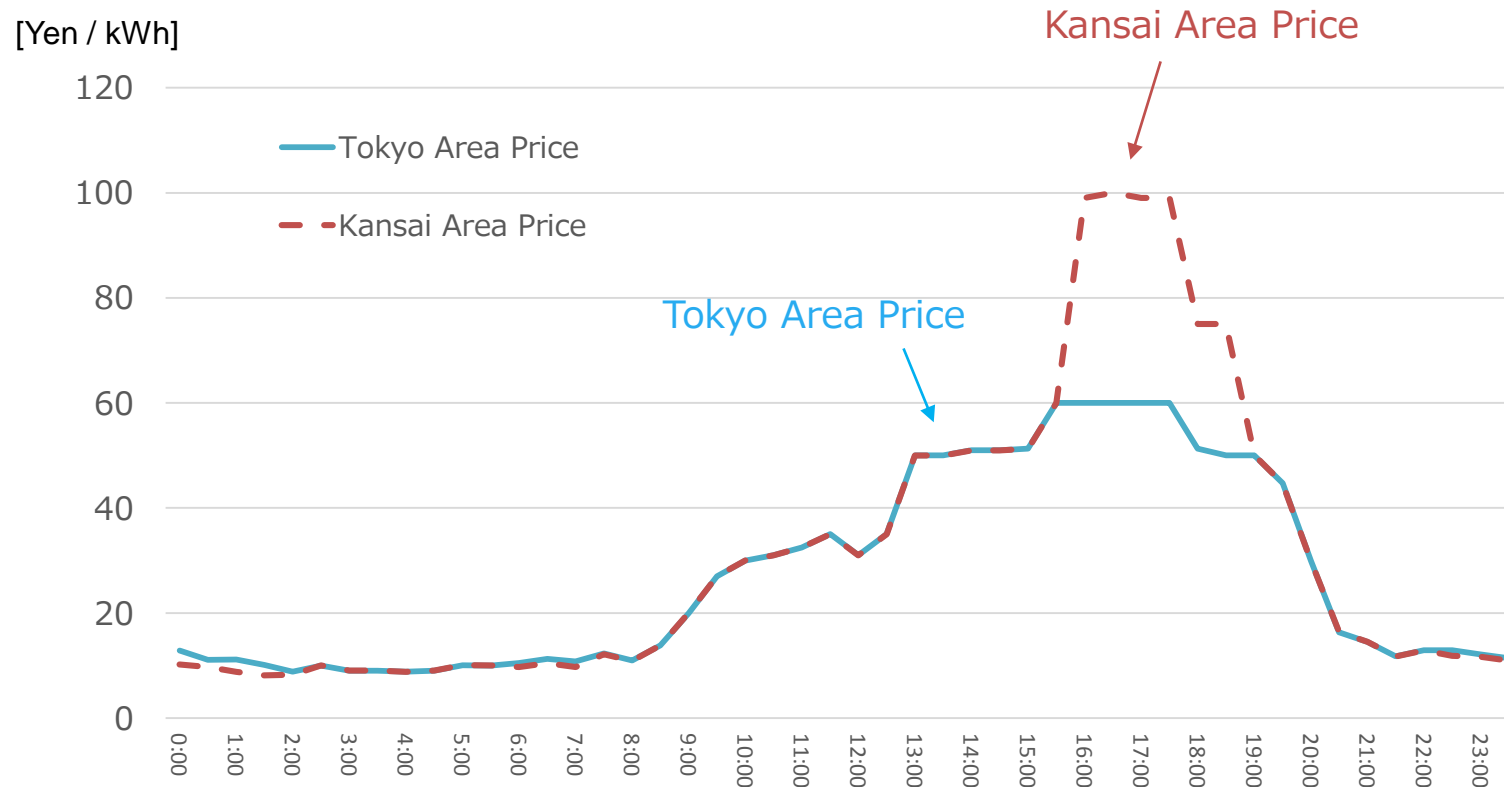
1,100 electric utility poles were blown down

Power cut of **2,25 million household** in total in the Kansai region

JEPX Price Spike in extremely hot July

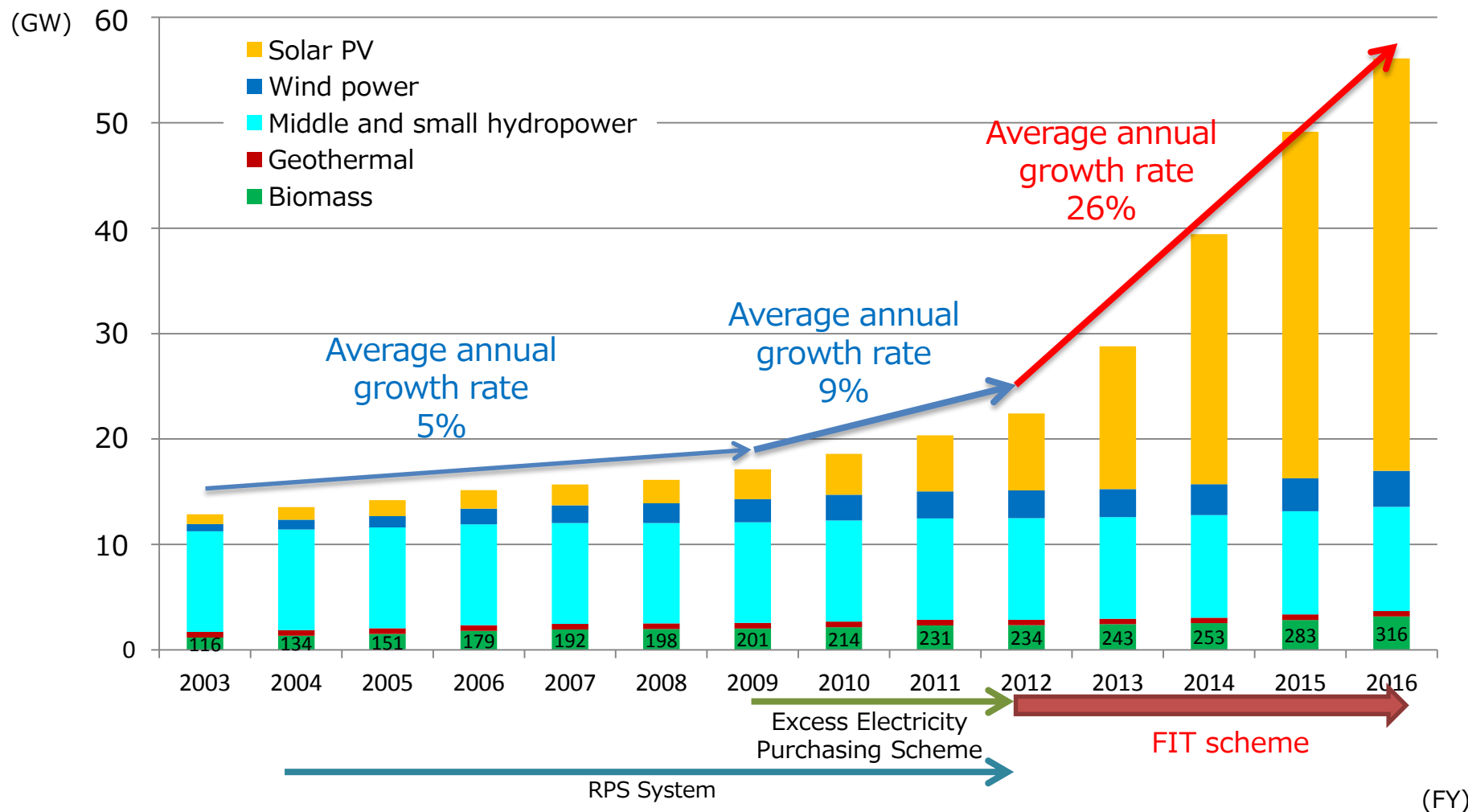
- 99 yen /kWh (approx. 0.76 Euro/kWh) was recorded for more than 2 hours in Kansai (western Japan) area price on July 24th, 2018.
- **100.02 yen / kWh (approx. 0.77 Euro/kWh)** was also recorded on July 25th, 2018.
- The maximum JEPX price before that was 60 yen/kWh (0.46 Euro) in 2007.

JEPX (Japan Electric Power Exchange) Price on July 24th, 2018

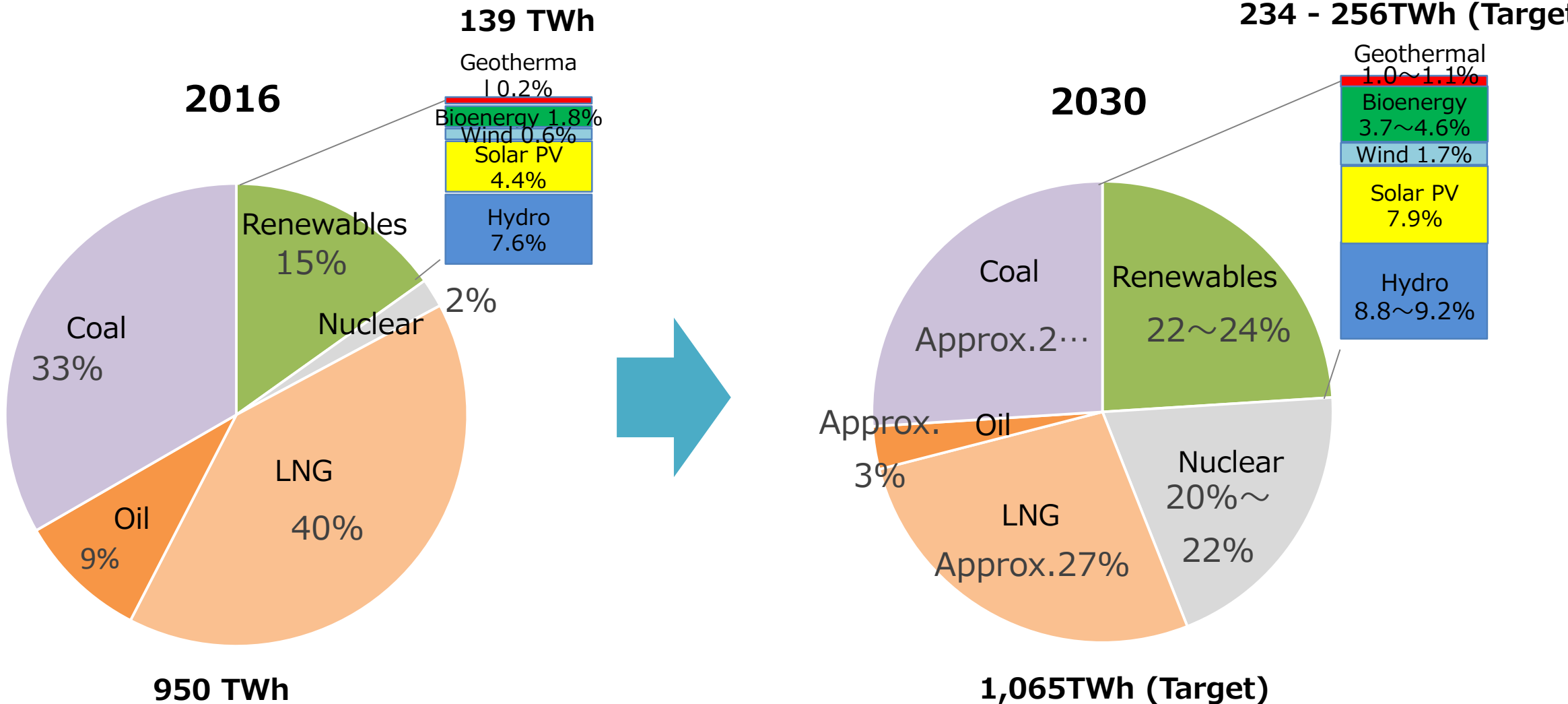


2. Energy Situation in Japan

History of Renewable Energy Introduction in Japan



Electricity Generation Mix from 2016 to 2030

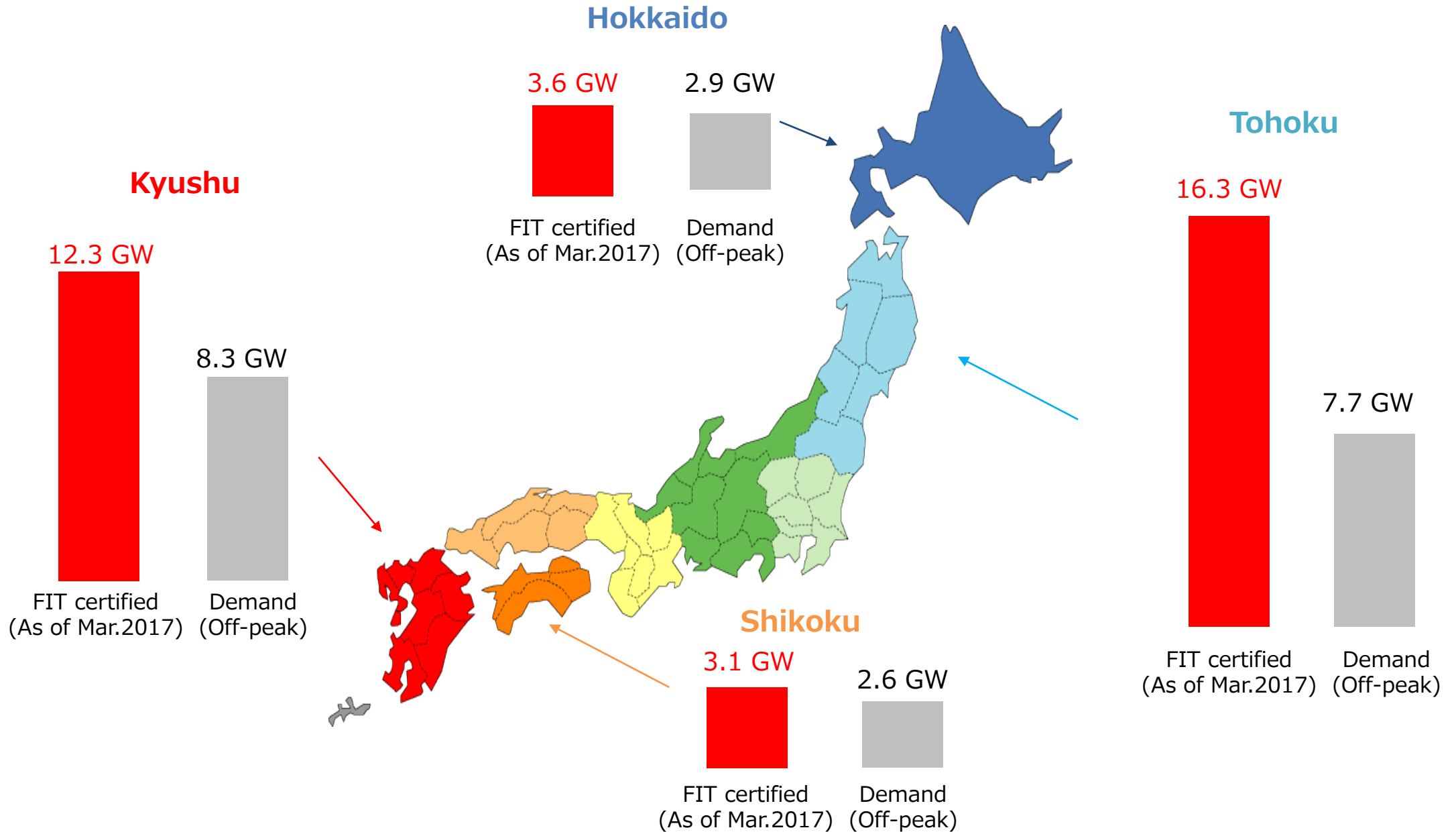


Progress of RE Introduction towards 2030 Target



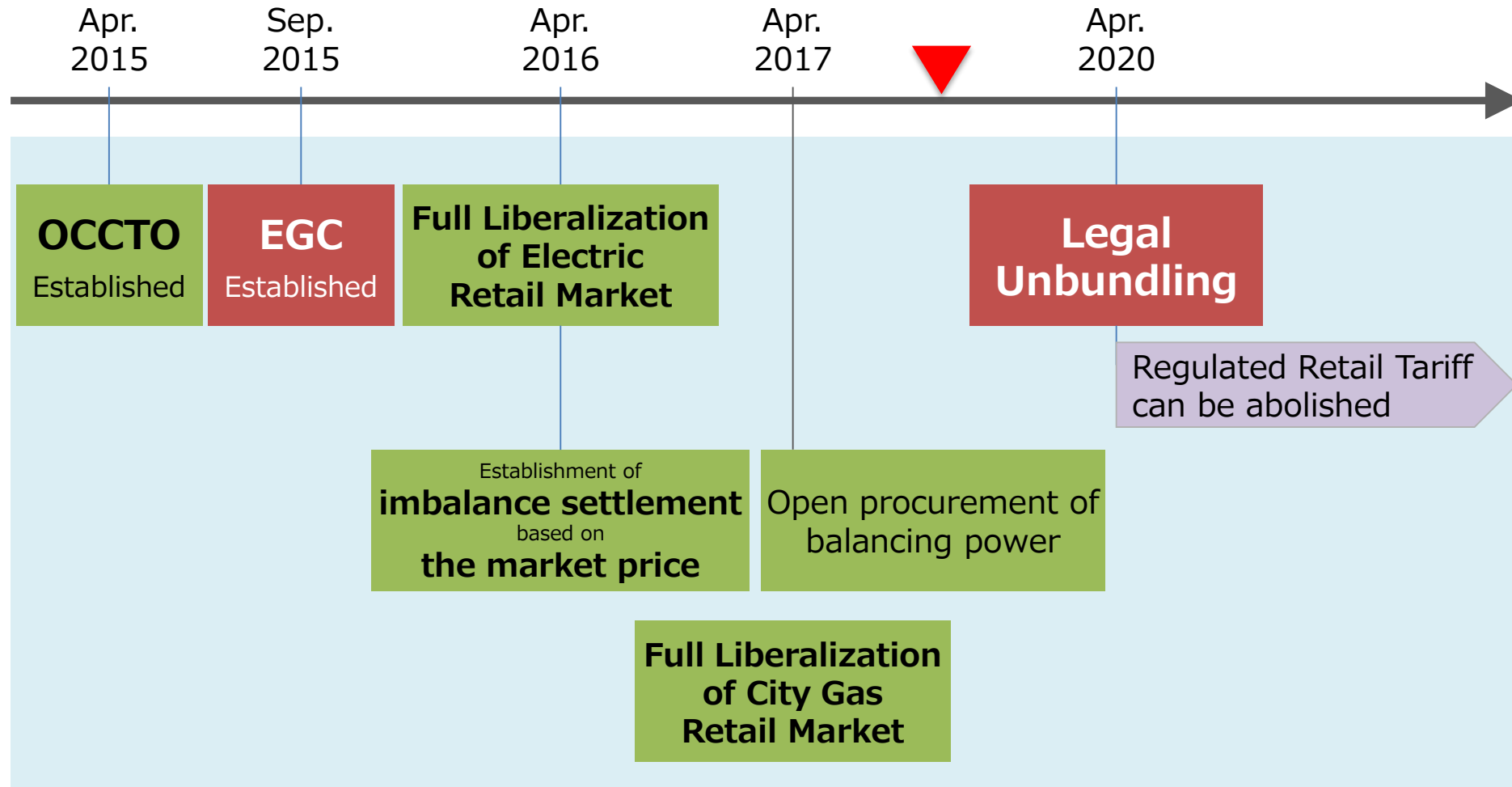
	Before FIT (June 2012)	After FIT [A] (as of March 2018)	Target [B] (FY2030)	Prss [A]/[B]
Geothermal	0.5GW	0.5GW	1.4 - 1.6GW	33%
Biomass	2.3GW	3.6GW	6.0 - 7.3GW	55%
Wind	2.6GW	3.5GW	10GW	35%
Solar PV	5.6GW	44.5GW	64GW	70%
Hydro	48.1GW	48.4GW	48.5 - 49.3GW	99%

Certified Renewable Energy and Demand



Roadmap for Electricity and City Gas Market Reform

Japan is on the way of deregulation of electric and city gas utility business

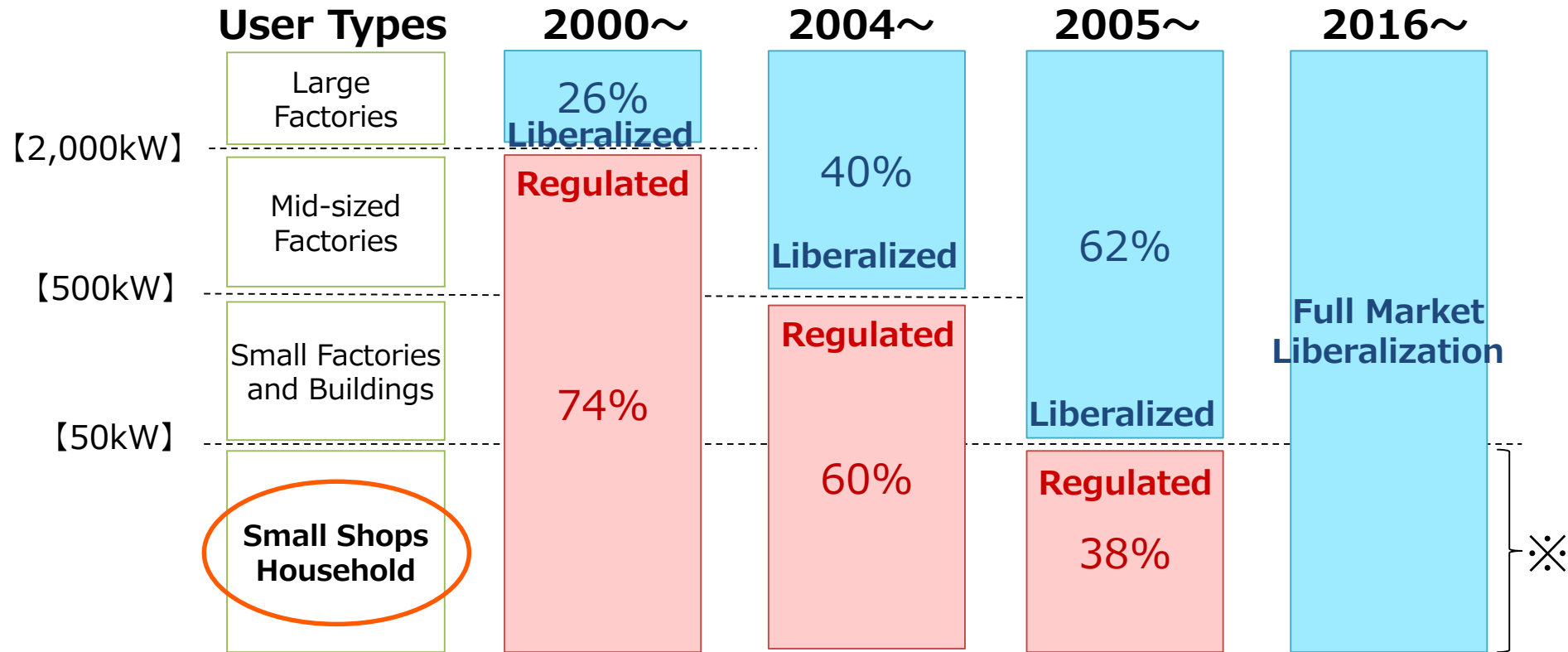


*OCCTO : Organization for Cross-regional Coordination of Transmission Operators

*EGC : The Electricity and Gas Market Surveillance Commission

Electricity Retail Market Liberalization in Japan

- Retail market had been gradually liberalized since 2000.
- **Since April 2016, retail electricity market in Japan has been fully opened up for competition.** But regulated tariffs by GEUs (General Electricity Utilities) are still exist in low voltage consumer for consumer protection.

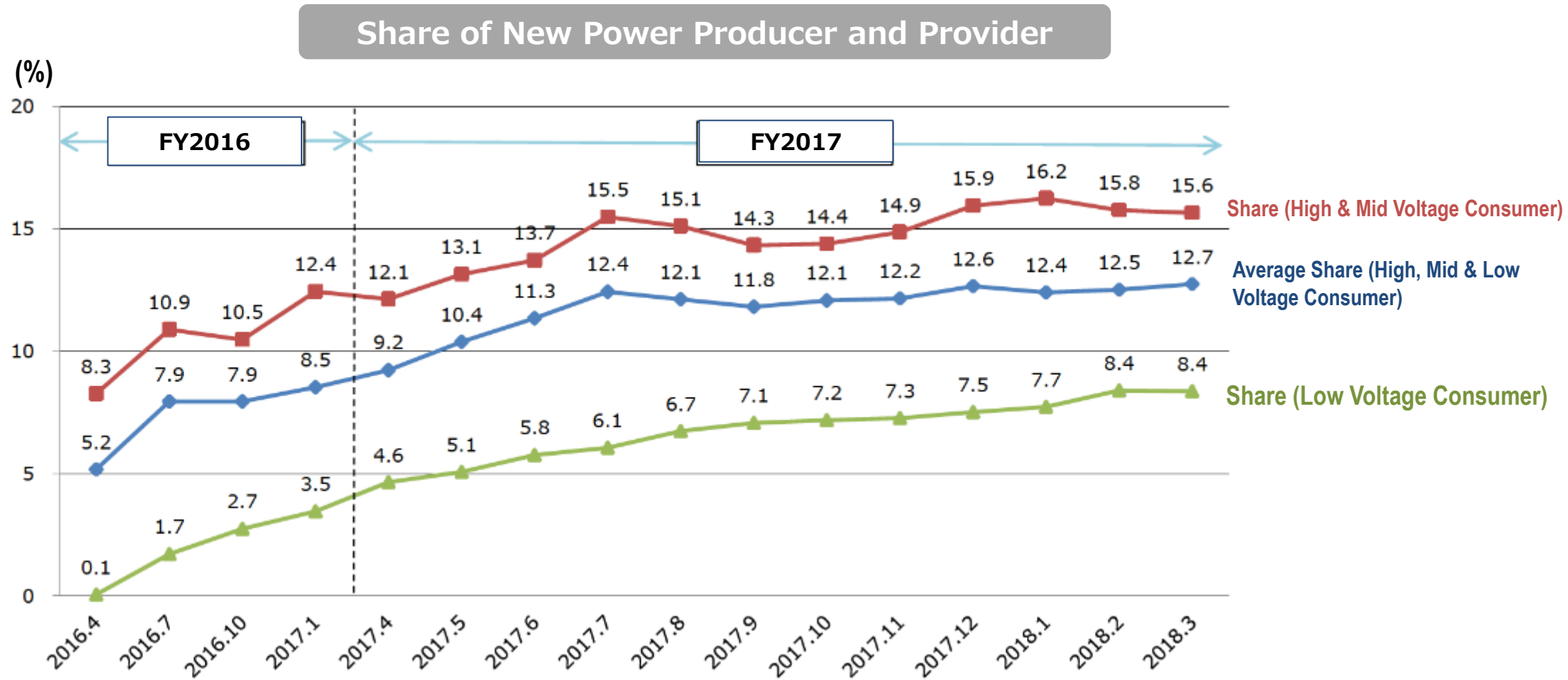


※Regulated tariffs will be abolished in 2020 or later.

Share of New Power Producer and Provider



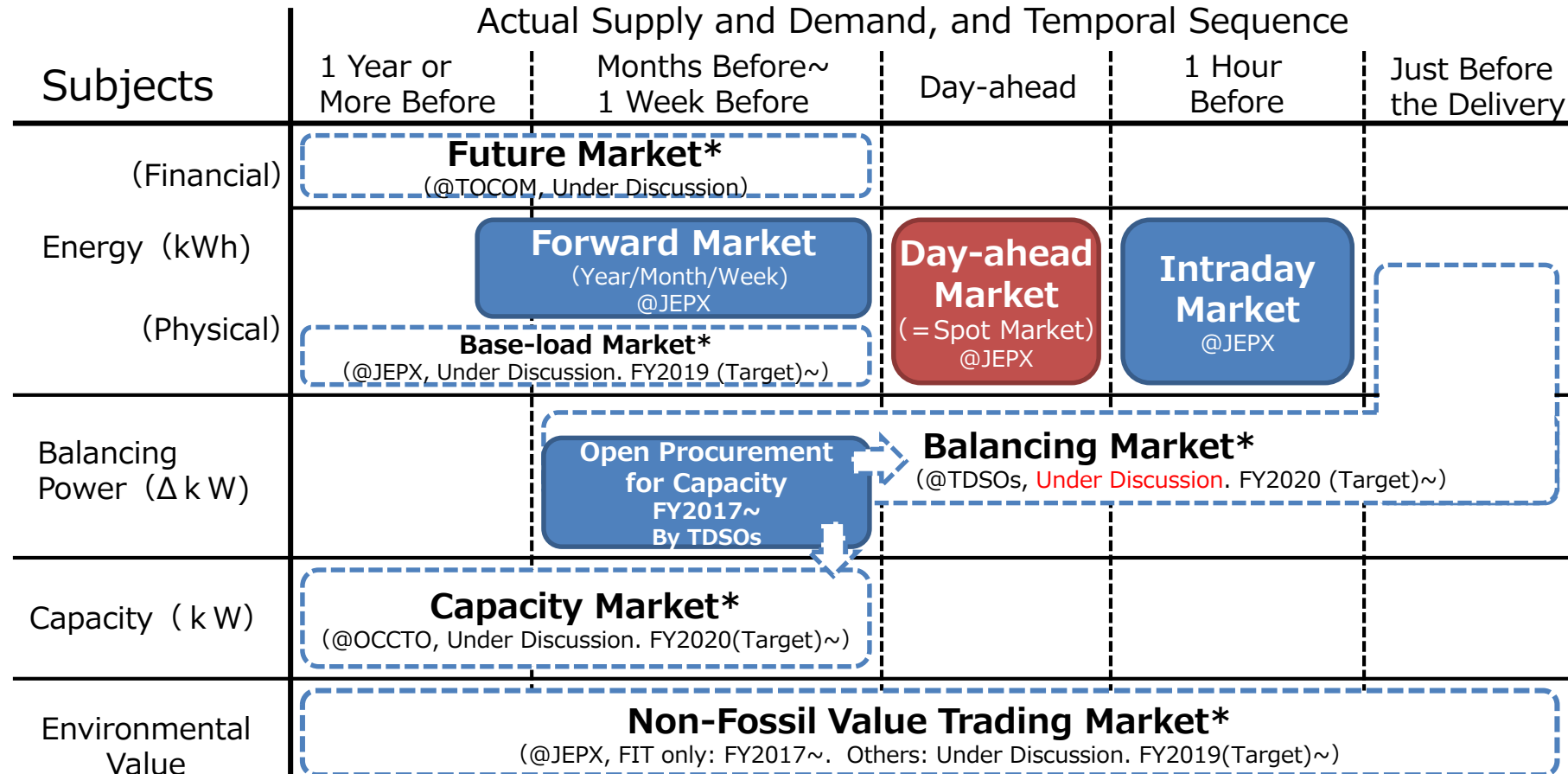
- **Share of New PPS (Power Producer and provider) for low voltage customer becomes 8.4%** (March 2018) two years after the Full Electricity Retail Market Liberalization in April 2016.



Current Discussion for New Power Markets in Japan



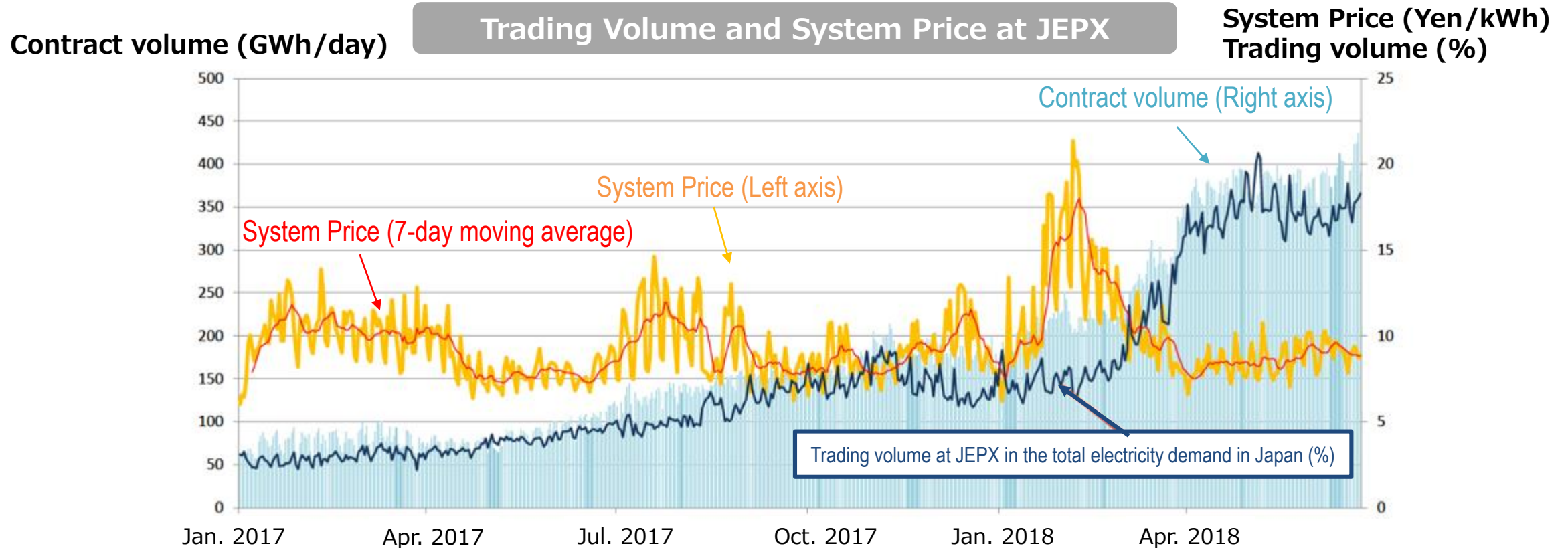
- Forward Market, Day-ahead Market and Intraday Market are operated by JEPX.
- From April 2017, procurement of the Balancing Power has started.
- **Base-load Market, Balancing Market, Capacity Market and Non-Fossil Value Trading Market, and Future transaction are under discussion** for near future establishment.



* The timings of the transactions in the Markets may be changed due to discussions.

Trading Volume at JEPX

- **The share of the trading volume (contract volume) at JEPX (Japan Electric Power Exchange) in the total electricity demand in Japan after April 2018 is 15% - 20%.**
- Compared to the same period of the previous year, the share is more than 2 times higher in the period of July 2017.



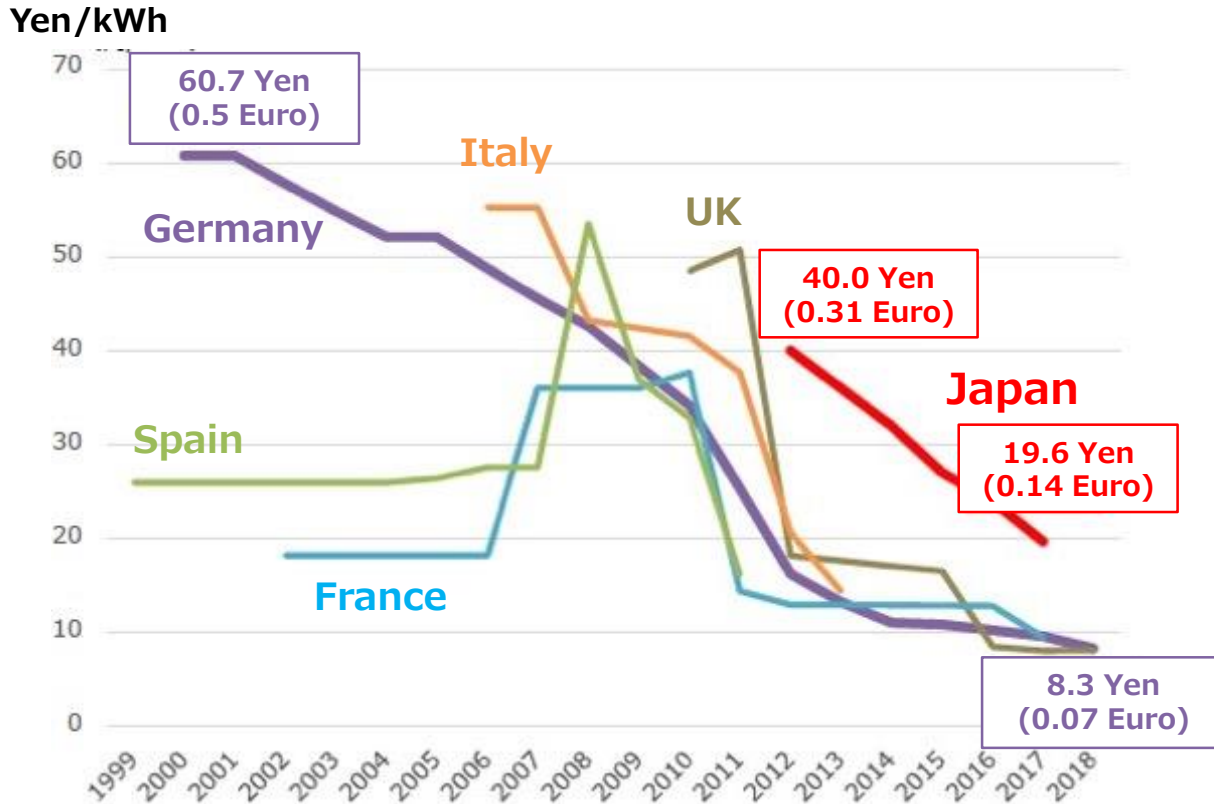
3. Challenges for Further Renewable Energy Integration

Cost of Solar and Wind in Japan is Still High

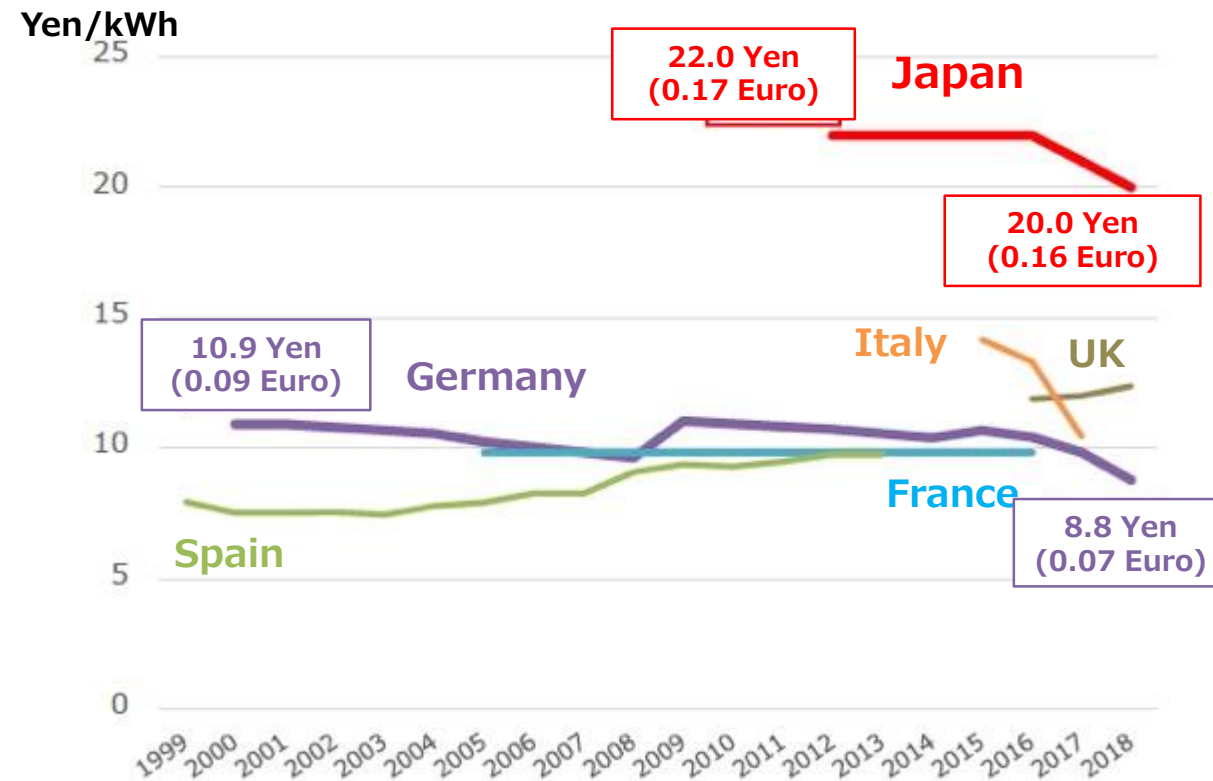


- The procurement cost of solar PV and on-shore Wind have declined in Japan after FIT introduction in 2012.
- Still, **nearly twice as much high cost as compared to the European countries.**

Purchase Price of Solar PV (>2 MW)



Purchase Price of Onshore Wind (>2 MW)



1 € = 120 Yen (10 Yen = 8.3 euro cent)

1 £ = 150 Yen (10 Yen = 6.7 pence)

Maximizing Transmission utilization for RE - Japanese version of Connect & Manage -

1. Rationalization of Anticipated Current

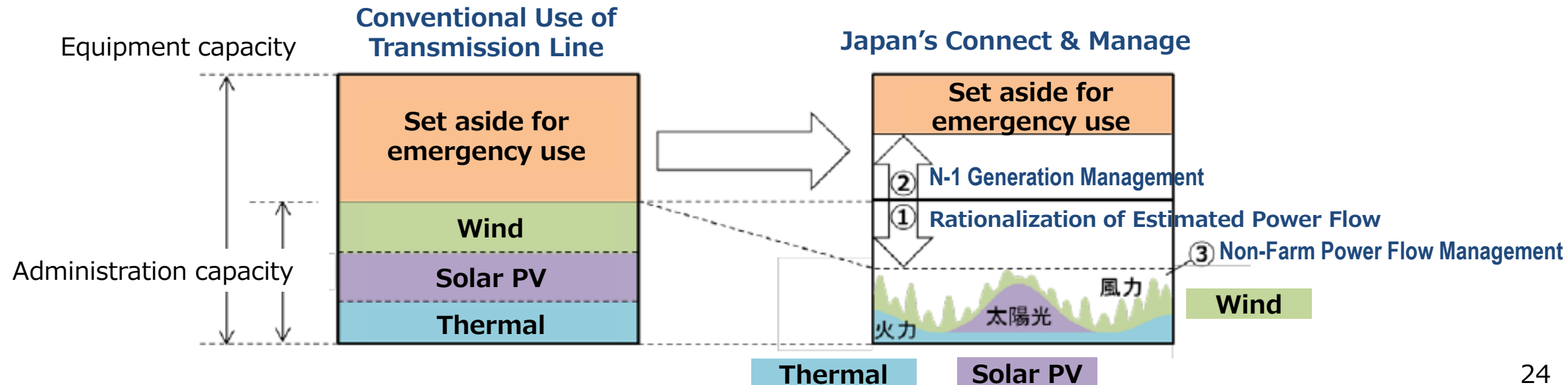
- ✓ Rationalizing and enhancing the accuracy of anticipated current (power flow) by assessment of power source operations and output evaluation of naturally variable power sources whist conventional anticipation based on the power generation at the full power and lowest demand

2. N-1 Generation Control

- ✓ Technology maximizing transmission from renewable energy when accident happened on grid. It is being experienced in NEDO Poland Demonstration, and Starting discussion in Japan.

3. Non-Farm Connection

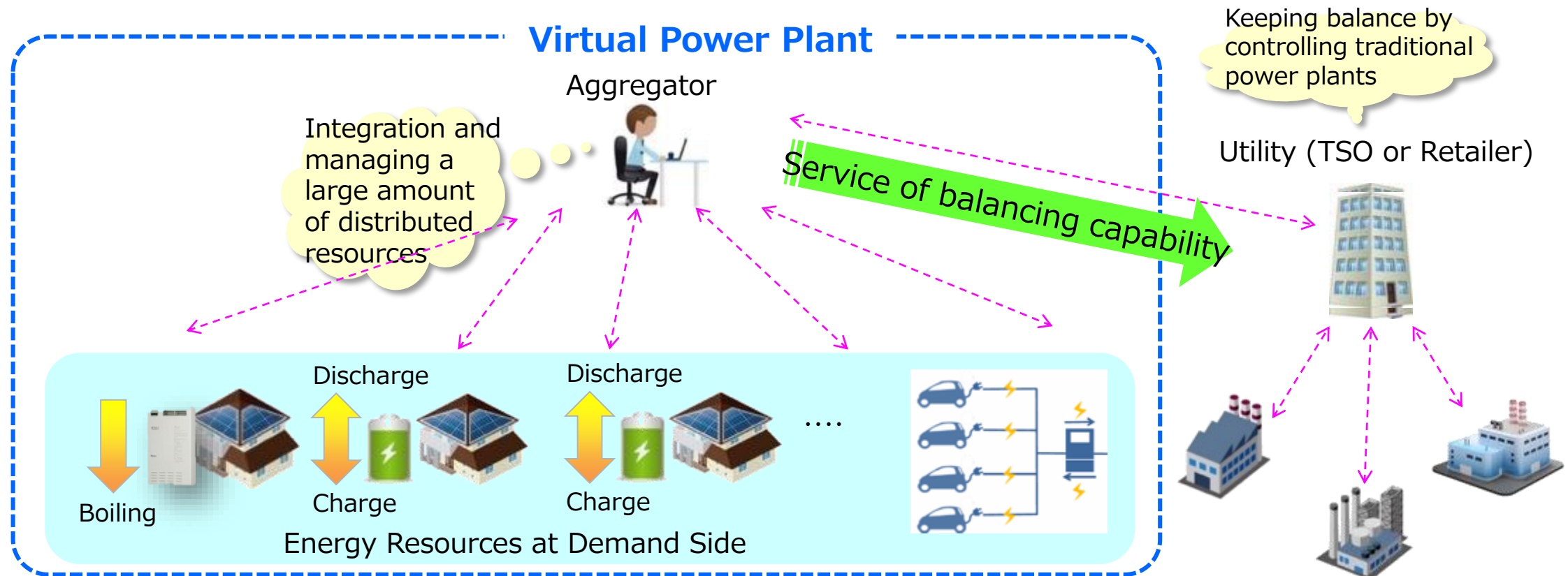
- ✓ Technology maximizing transmission from renewable energy usually. It will be started how to realize this concept of reverse power flow management coming project.



4. Domestic Demonstration Projects and Future Perspective

VPP Demonstration Project (METI)

- **Japan started Virtual Power Plant demonstration (subsidy program) from 2016.**
- Unfortunately, there are not so many available fossil fuel distributed generator which can send electricity to grid. So, Japanese project is especially focusing aggregating battery storage, sleeping generators and AC in 2016-2017.
- Energy Resources for subsidy are expanded including **EV/PHV, Eco-cute (Electric Heat Pump) in 2018.**

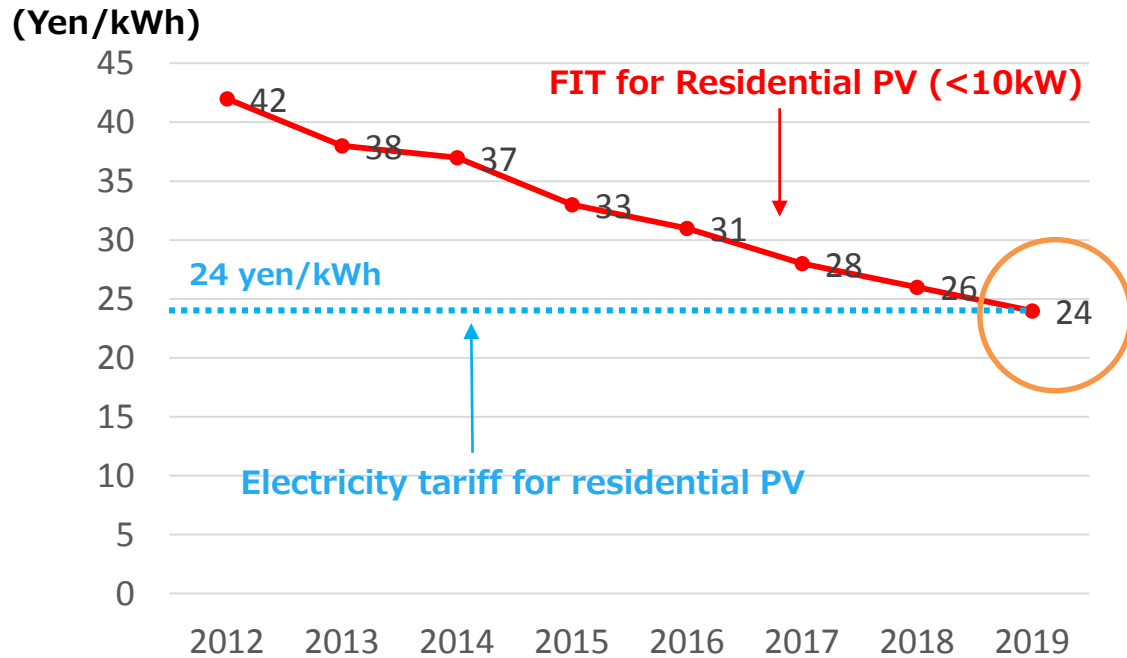


Residential PV Market in Japan after 2019



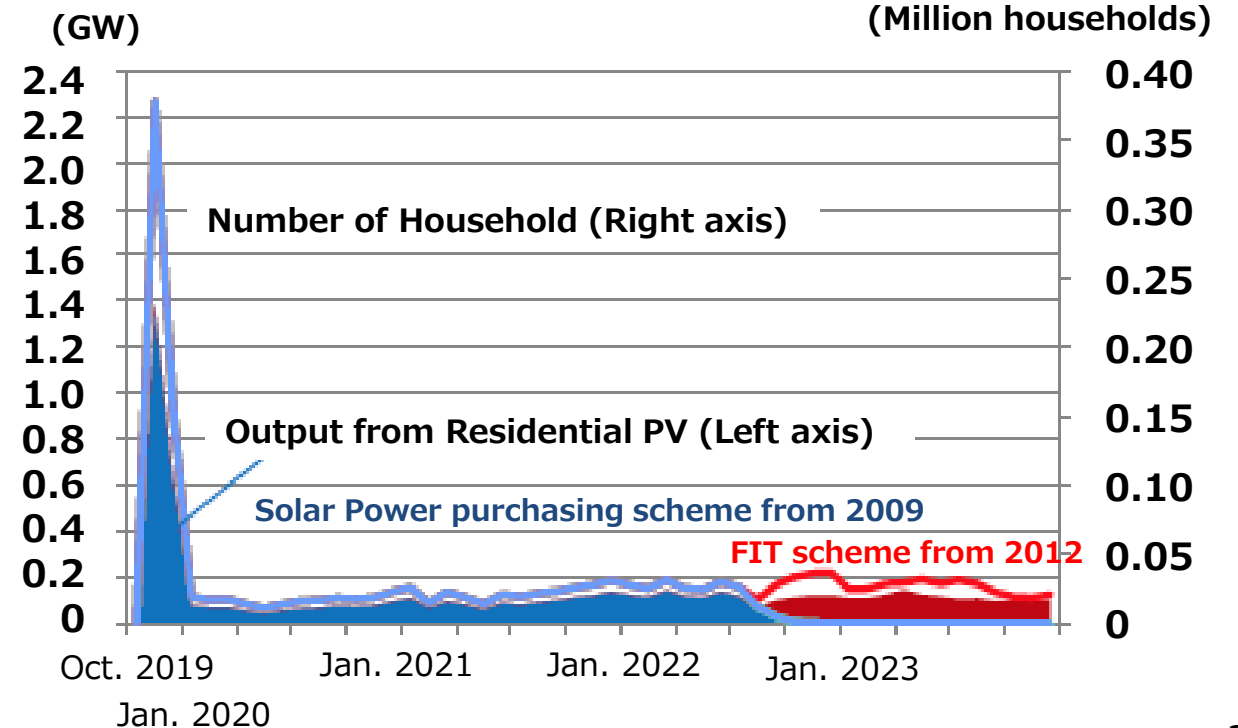
- FIT purchase price of residential PV (<10 kW) in Japan is higher than electricity tariff now.
- After 2019, self consumption needs will increase since...
 1. FIT purchase price becomes equal to Electricity tariff.
 2. 400,000 residential PV will end the surplus electricity purchase period (One million residential PV in total).

Tariff of Residential PV (<10 kW)

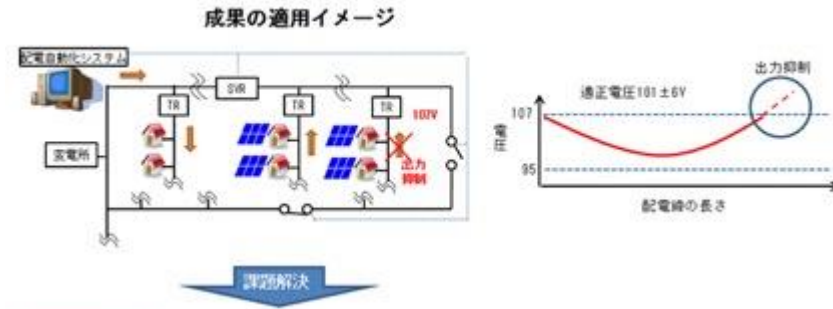


1 € = 120 Yen (10 Yen = 8.3 euro cent)

Purchase Period end of Residential PV (<10 kW) after 2019 - Number of Household and Installed Capacity



Source : METI



Research projects for constructing Next-generation Power Grid with decentralized energy resources



Next Generation Offshore HVDC System Research and Development Project

1. Reactive power/voltage Management

- Several element technology developments were done through NEDO projects. **Next issue will be how to corporate those technologies on actual network.** This will be examined in coming NEDO project.

2. Active Power Management

- **How to manage reverse power flow from renewable energy (Solar PV) installed on distribution system** will be important issue in future discussion. Especially, from the view point of “Connect & Manage” concept in Japan.

3. Shortage of Inertia

- By increasing renewable energy, **future power system will be worried about shortage of inertia** which is very important to keep stability on the grid system. This issues will be discussed in coming NEDO project.

4. Less Synchronous

- **By increasing inverter based resources and demand, it will be difficult to keep synchronous of power system.** It will be also discussed in coming NEDO project.
- NEDO experienced 100% inverter based Micro-Grid about 10 years ago. Character of this system seemed to be DC grid system.

5. Conclusion

- Integration of renewable energy in Japan is increasing and some region experiences the renewable energy electricity generation exceeds the demand at off-peak demand period.
- In the introduction and expansion of renewable energy as a major energy source stated in the 5th Strategic Energy Plan, further cost reduction and creation a new rule and technology development for transmission usage are the major challenges.
- By increasing of renewable energy, not only balancing issue but also more dynamic operation issues will become more serious. Also, current distribution system requires management and control similar to transmission system.
- In addition, creation of stable power supply system resistant to natural disasters is also a big challenge in Japan.

