APEC EGNRET 48, Jeju, Republic of Korea

How to achieve the RE goal in APEC Region:

Long-term energy outlook, FIT and VRE promotion in Japan

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◆Long-term energy outlook

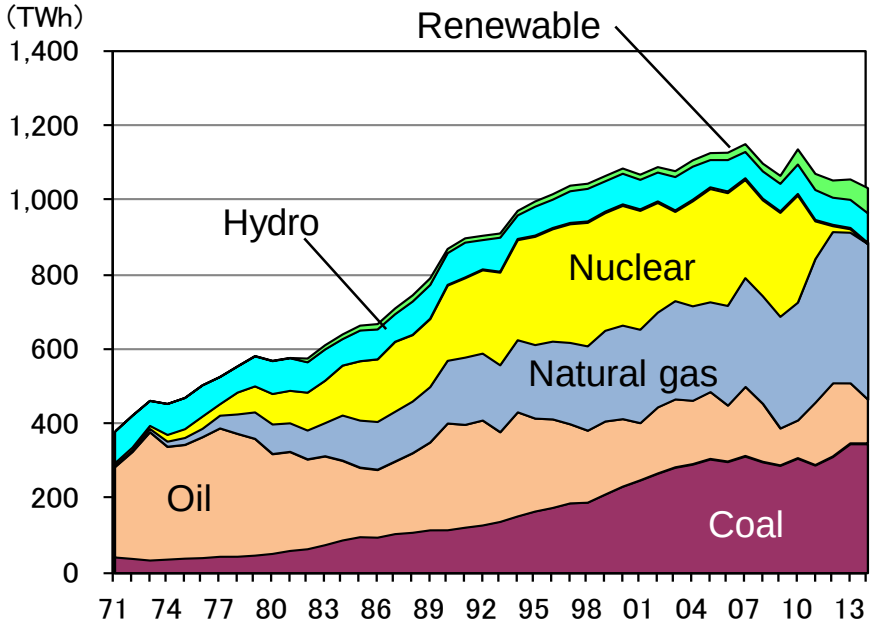
◆FIT revision

◆To promote VRE in Japan

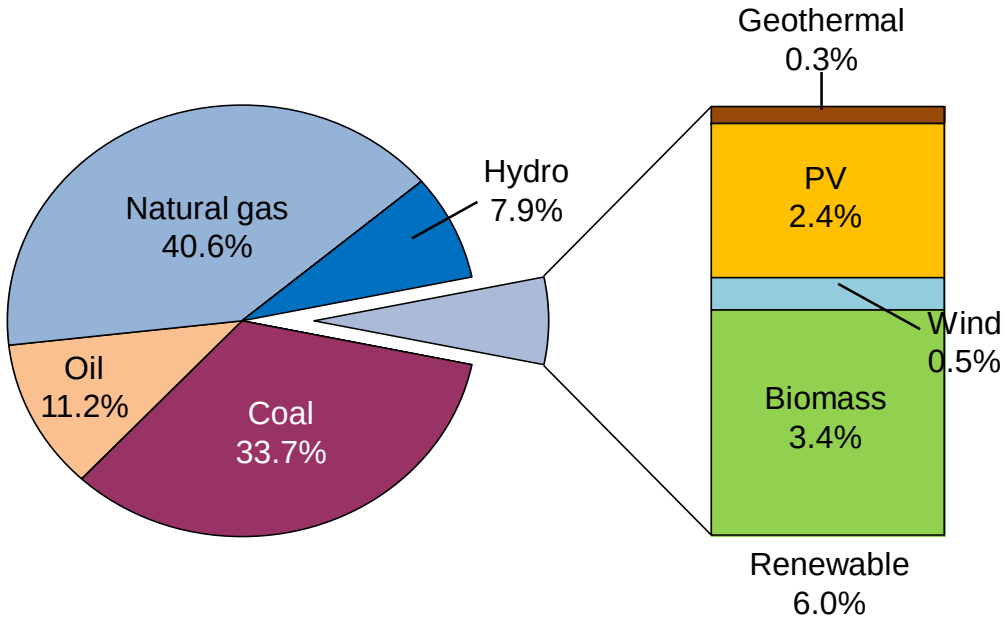
Current Status in Japan (2014)

- Electricity generation mix in Japan
  - Fossil fuels: 85.5%, renewable: 6.0%
  - Solar photovoltaic (PV) is relatively high.
  - Nuclear → Gas (after Fukushima accident)

Electricity Generation



Generation Mix in 2014



Source: IEA, World Energy Statistics and Balances 2016.

Long-Term Energy Supply and Demand Outlook (2015-2030)

- Japanese government has published in July in 2015 "Long-Term Energy Supply and Demand Outlook" (2015-2030)

- This outlook is based on FY2013 data.

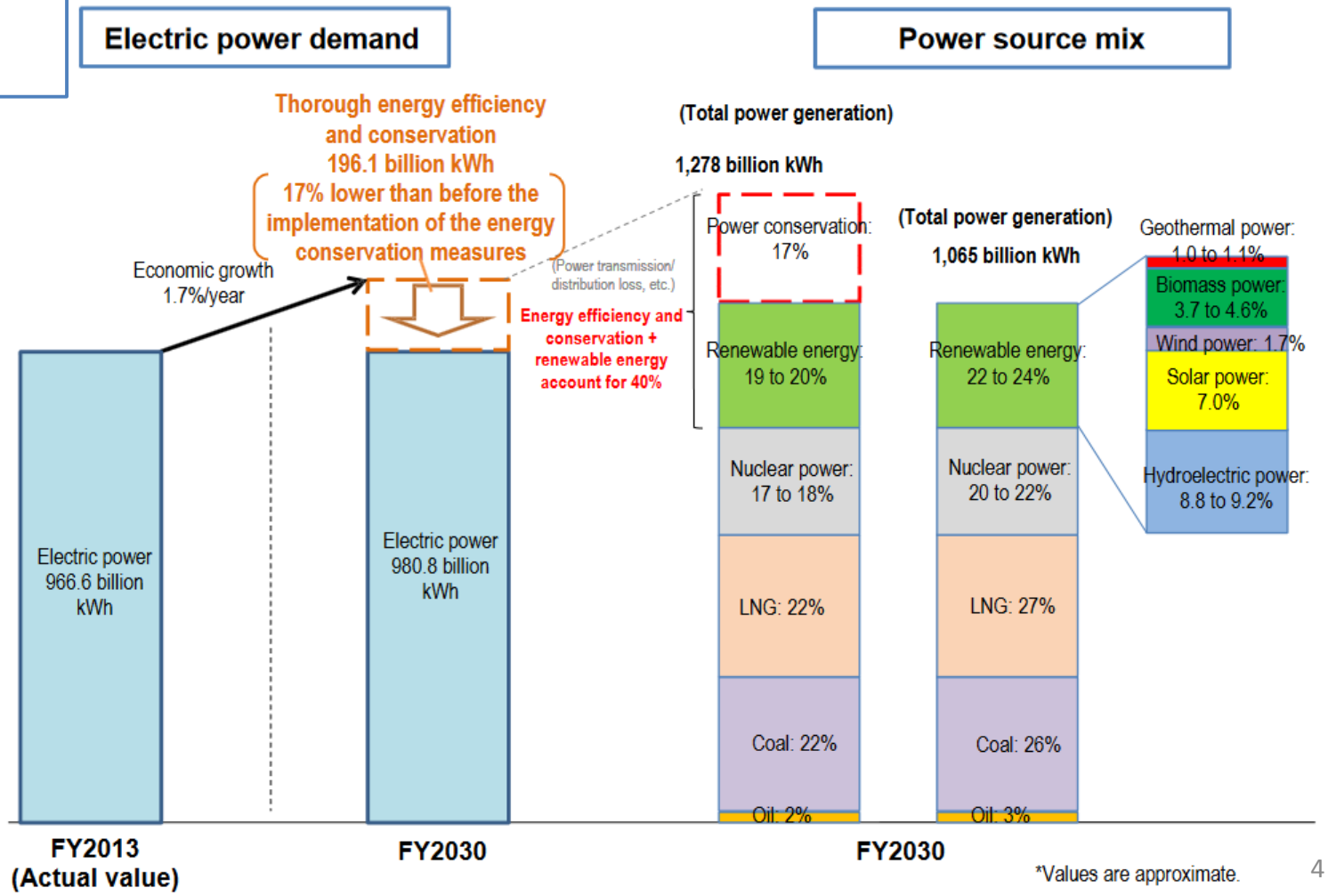
3 objectives for 2030

1. Energy independence	**6% ⇒ 25%**
2. Generation cost reduction	**- 5%** (from 2013)
3. CO_2 emission reduction	**- 26%** (from 2013)

Long-Term Energy Supply and Demand Outlook (2015-2030)

3 measures :

① Energy Saving
② Renewable
③ Nuclear



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FIT Tariff in Japan (FY2012-FY2016)

- FIT rate setting policy:

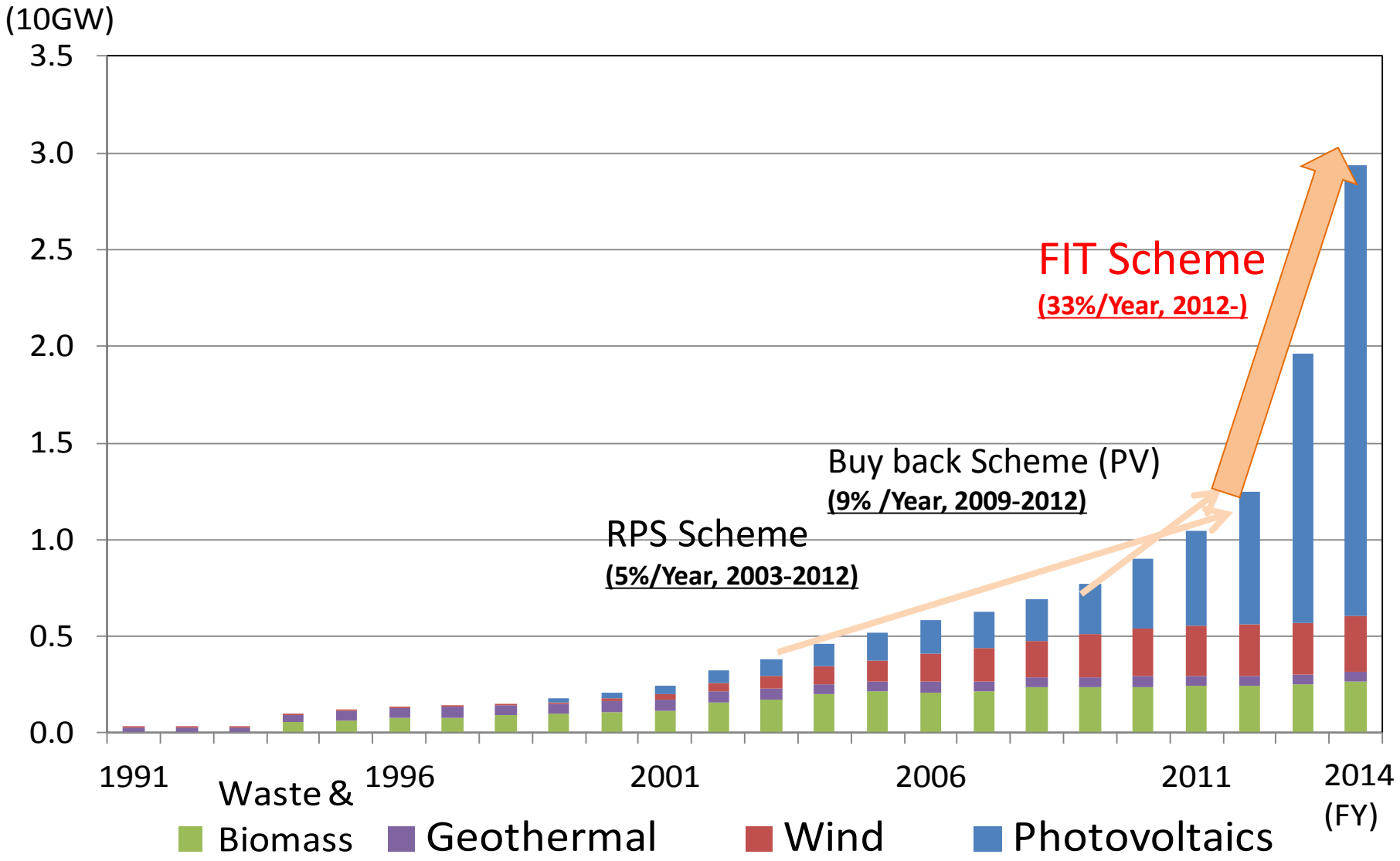
1USD=100.6

Should be generous to the investors for the first 3 years (2012/7-2015/7)

			Purchase prices (JPY/kWh) (tax excluded)						Purchase period
			FY2012	FY2013	FY2014	FY2015 Apr.-Jun.	FY2015 Jul.-Mar.	FY2016	
Solar	Less than 10 kW		42	38	37	33		31	10 years
	Less than 10 kW when output control system are required					35		33	
	Less than 10 kW (+ energy storage system)		34	31	30	27		25	
	Less than 10 kW (+ energy storage system) when output control system are required					29		27	
	10 kW or more		40	36	32	29	27	24	20 years
Wind	Onshore	Less than 20 kW	55	55	55	55		55	20 years
		20 kW or more	22	22	22	22		22	
	Offshore				36	36		36	
Geothermal	Less than 15,000 kW		40	40	40	40		40	15 years
	15,000 kW or more		26	26	26	26		26	
Hydro	Fully new facilities	Less than 200 kW	34	34	34	34		34	20 years
		200-1,000 kW	29	29	29	29		29	
		1,000-30,000 kW	24	24	24	24		24	
	Utilize existing headrace	Less than 200 kW			25	25		25	
		200-1,000 kW			21	21		21	
		1,000-30,000 kW			14	14		14	
Biomass	Wood (general), agricultural residues		24	24	24	24		24	20 years
	Forest residues	Less than 2,000 kW	32	32	32	40		40	
		2,000 kW or more				32		32	
	Wood waste from buildings		13	13	13	13		13	
	Municipal waste		17	17	17	17		17	
	Biogas		39	39	39	39		39	

Source: METI

Installed Capacity of Renewable Electricity



Source: IEEJ " Handbook of Energy & Economic Statistics" etc

FIT Tariff after FY2017

			Purchase prices (JPY/kWh)			Purchase period
			FY2017	FY2018	FY2019	
			Apr.-Sep. / Oct.-Mar.			
Solar	Less than 10 kW		28	26	24	10 years
	when output control system are required		30	28	26	
	Less than 10 kW (+ energy storage system)		25	25	24	
	when output control system are required		27	27	26	
	10-2,000 kW		21			20 years
	2,000 kW or more		Tender			
Wind	Less than 20 kW		55			20 years
	Onshore	20 kW or more	22 / 21	20	19	
		replace	18	17	16	
	Offshore	20 kW or more	36	36	36	
Geothermal	Less than 15,000 kW		40	40	40	15 years
		replace whole equipment	30	30	30	
		replace above-ground equipement	19	19	19	
	15,000 kW or more		26	26	26	
		replace whole equipment	20	20	20	
		replace above-ground equipement	12	12	12	
Hydro	Fully new facilities	Less than 200 kW	34	34	34	20 years
		200-1,000 kW	29	29	29	
		1,000-5,000 kW	27	27	27	
		5,000-30,000 kW	24 / 20	20	20	
	Utilize existing headrace channels	Less than 200 kW	25	25	25	
		200-1,000 kW	21	21	21	
		1,000-5,000 kW	15	15	15	
		5,000-30,000 kW	12	12	14	
Biomass	Wood (general)	Less than 2,000 kW	24	24	24	20 years
		2,000 kW or more	24 / 21	21	21	
	Forest residues	Less than 2,000 kW	40	40	40	
		2,000 kW or more	32	32	32	
	Wood waste from buildings		13	13	13	
	Municipal waste		17	17	17	
	Biogas		39	39	39	

Source: METI

◆Long-term energy outlook

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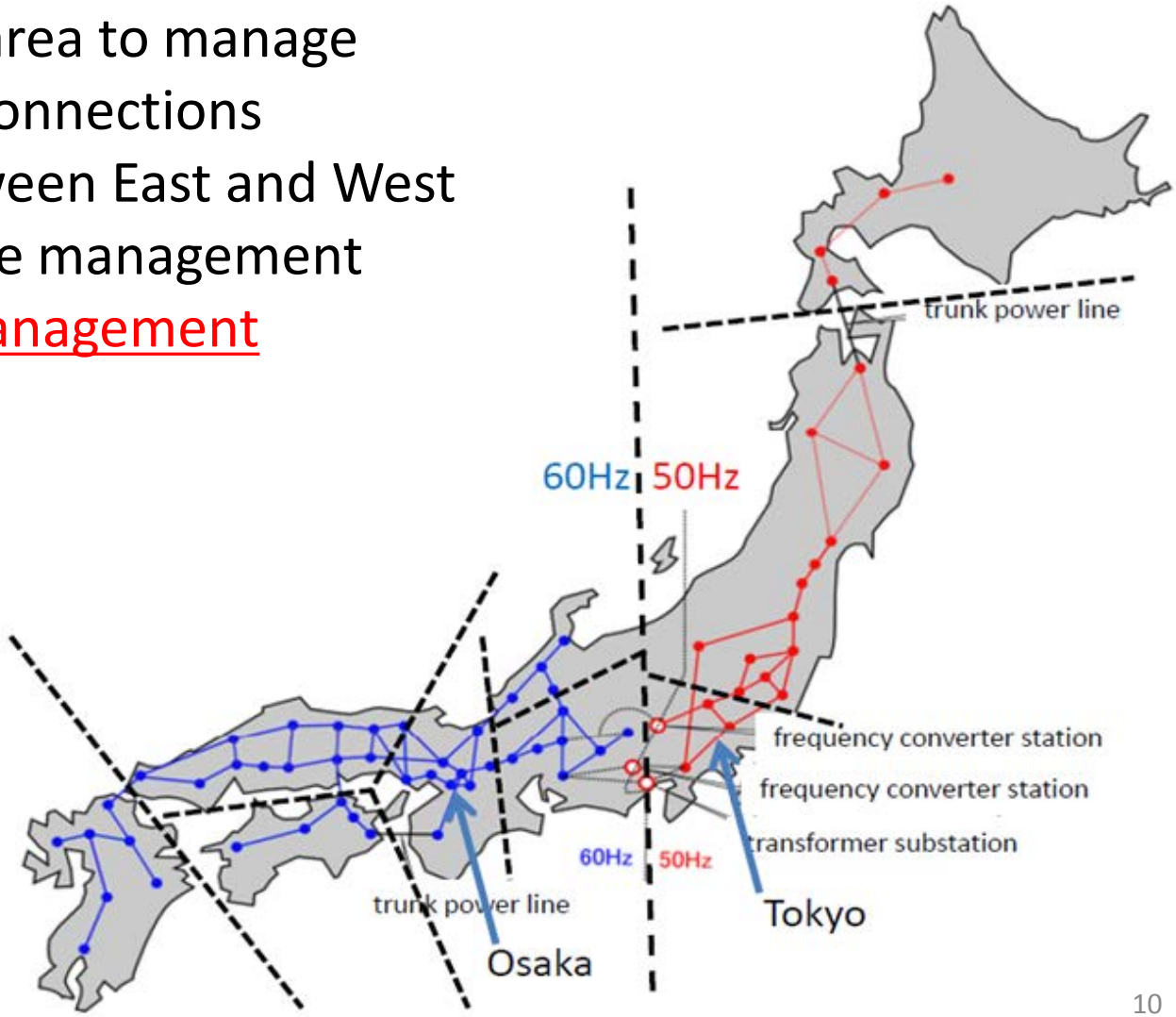
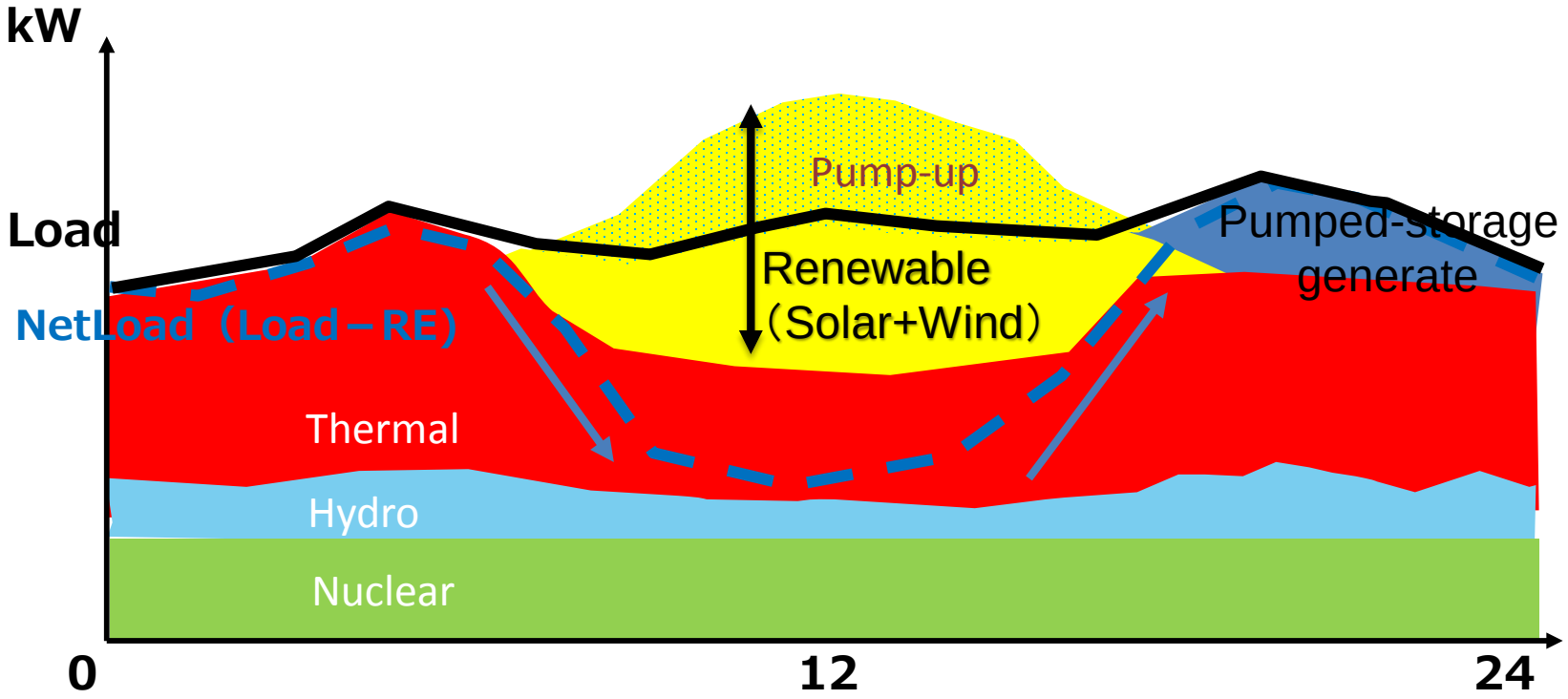
Grid system in Japan

- There are 10 electric power companies in Japan. They are responsible for the electricity supply in each area.
  → Small and narrow land area to manage
- Insufficient interregional connections
- Frequency difference between East and West
  → Difficult nationwide management
  ⇒ Small-scale grid management



Challenges of power supply dispatching for the mass penetration of VRE: Variable Renewable Energy (1)

- Increase in proportion of Solar and wind during light load period
- In the daytime, the supply-demand balance is maintained by the pump-up of pumped-storage power generation. As solar increases further, it is necessary to curtail solar power.
- Net load sharply drops in the morning and rises sharply in the evening. This makes supply / demand balance difficult. (Duck curve problem)

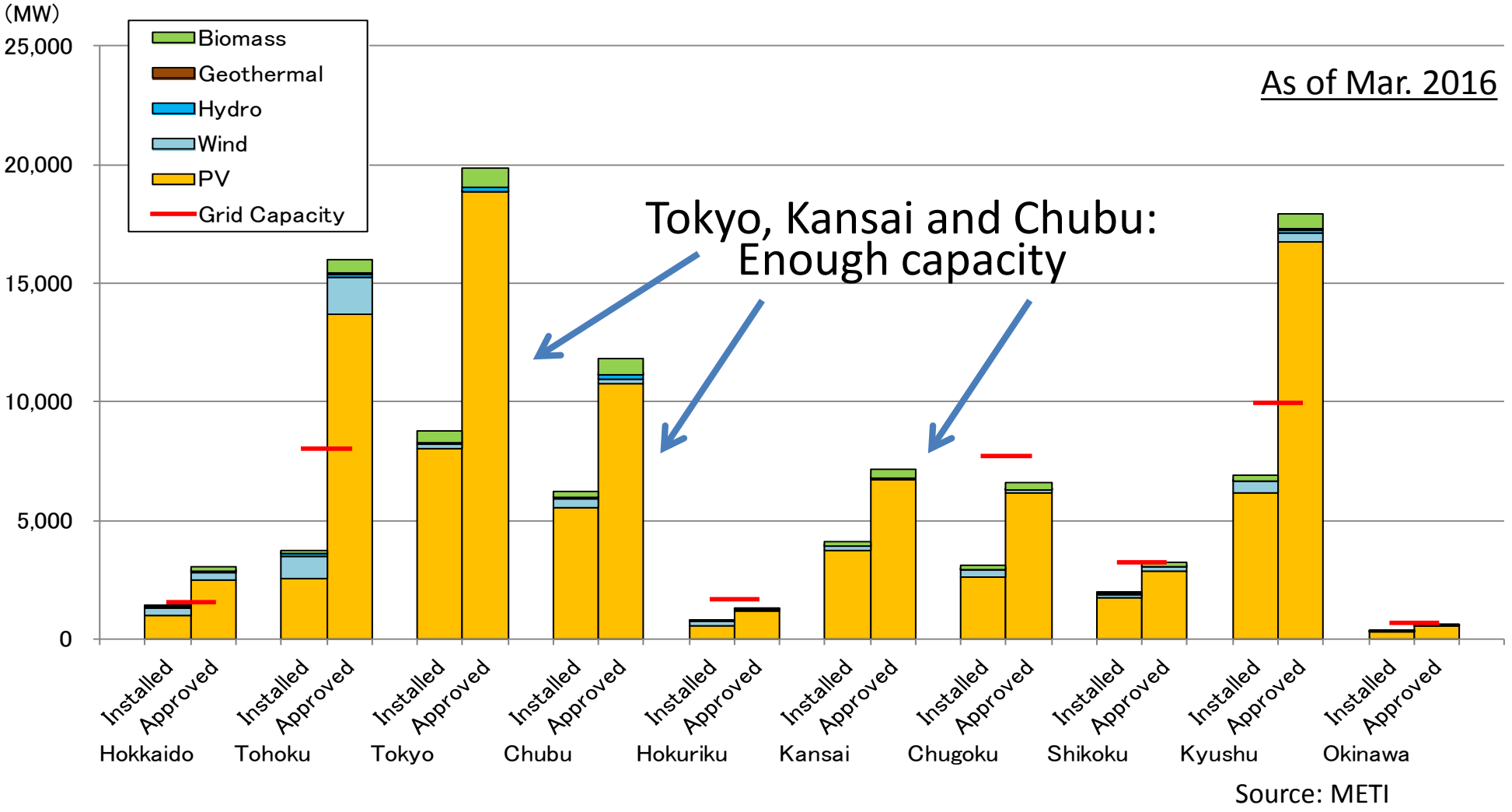


Exmple：Image of supply-demand balance in a day

Source: The Kansai Electric Power Co., Inc.

Challenges of power supply dispatching for the mass penetration of Variable Renewable Energy (2)

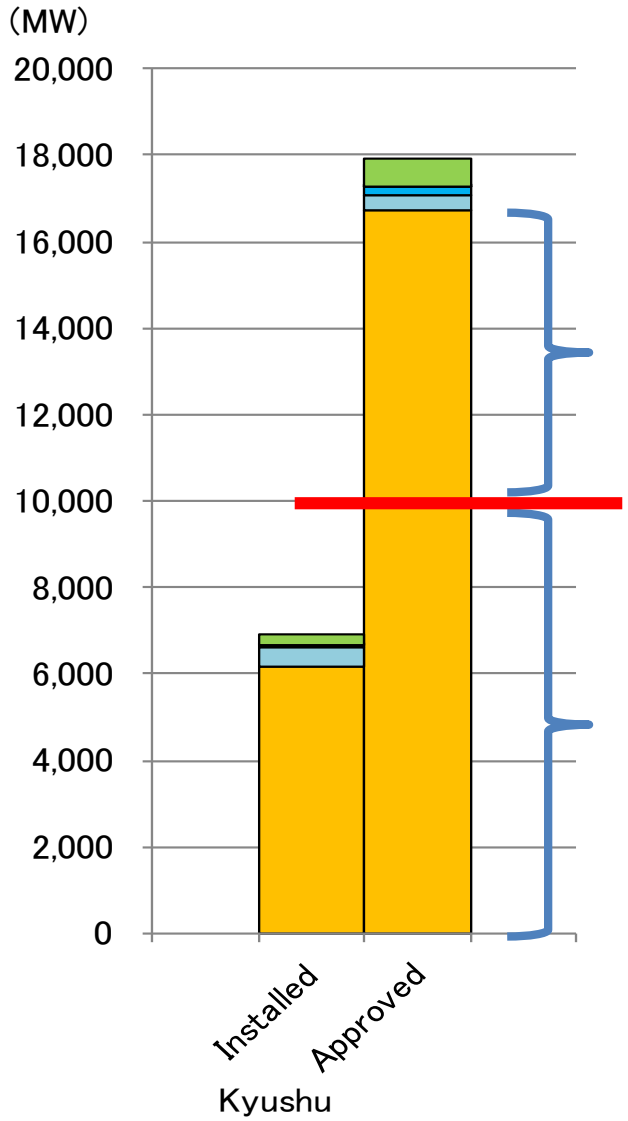
- Each power company (excl. 3) announces its own grid capacity.
- Approved PV projects is going over the grid connection capacity.



Source: METI

Challenges of power supply dispatching for the mass penetration of VRE : Variable Renewable Energy (2)

- Suppression priority: thermal, nuclear, hydro > PV



ex: Kyushu Electric Power

When oversupply occurs,

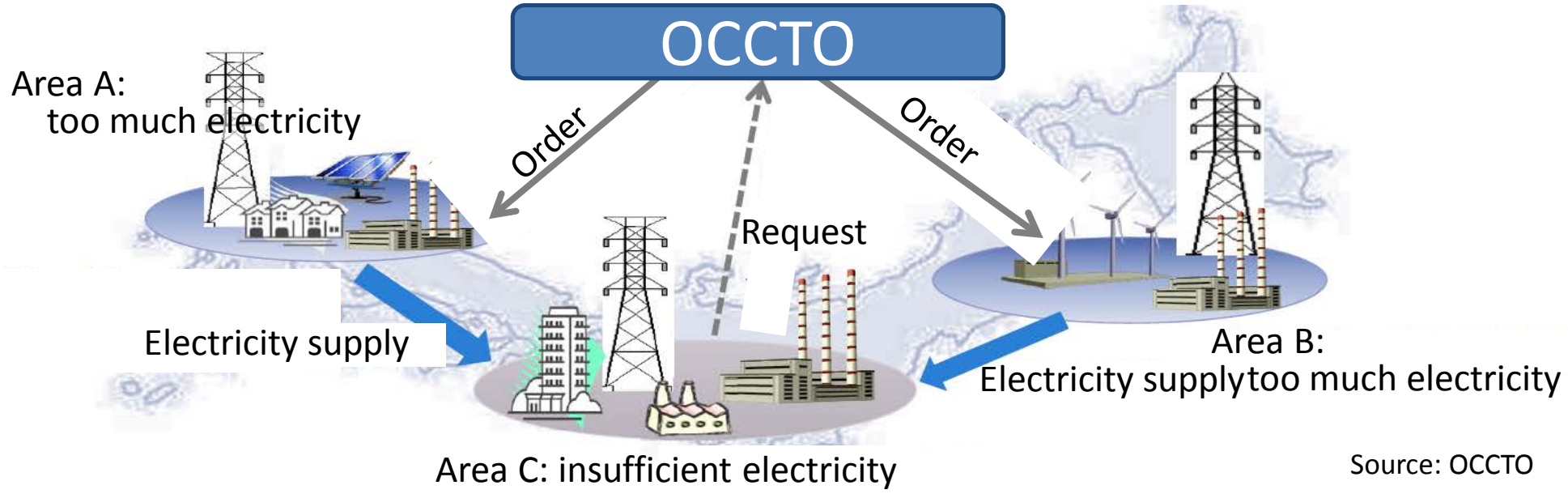
Can be suppressed
unlimited

Can be suppressed
max. 360 hours/year

Nationwide Grid Management (1)

- OCCTO was established in 2015.
  (Organization for Cross-regional Coordination of Transmission Operators, JAPAN)
  - Electricity supply-demand balance
  - Frequency control for cross-regional operation

  ⇒ enables to connect more renewable electricity

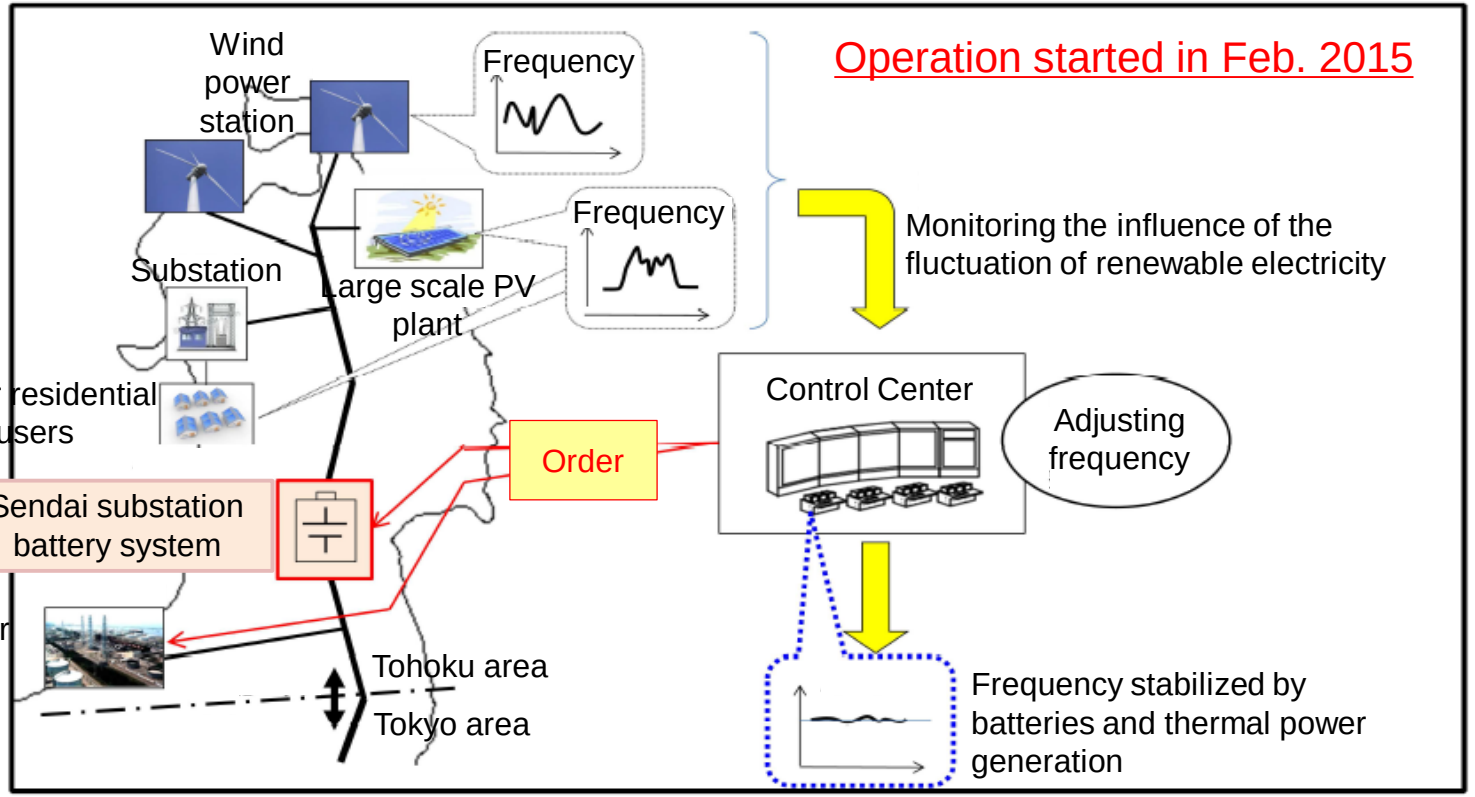


Source: OCCTO

Nationwide Grid Management (2)

- Storage battery can increase the grid capacity, but expensive.
- There are demonstration projects in each part of Japan.

ex. Lithium Ion Battery Demonstration in Tohoku

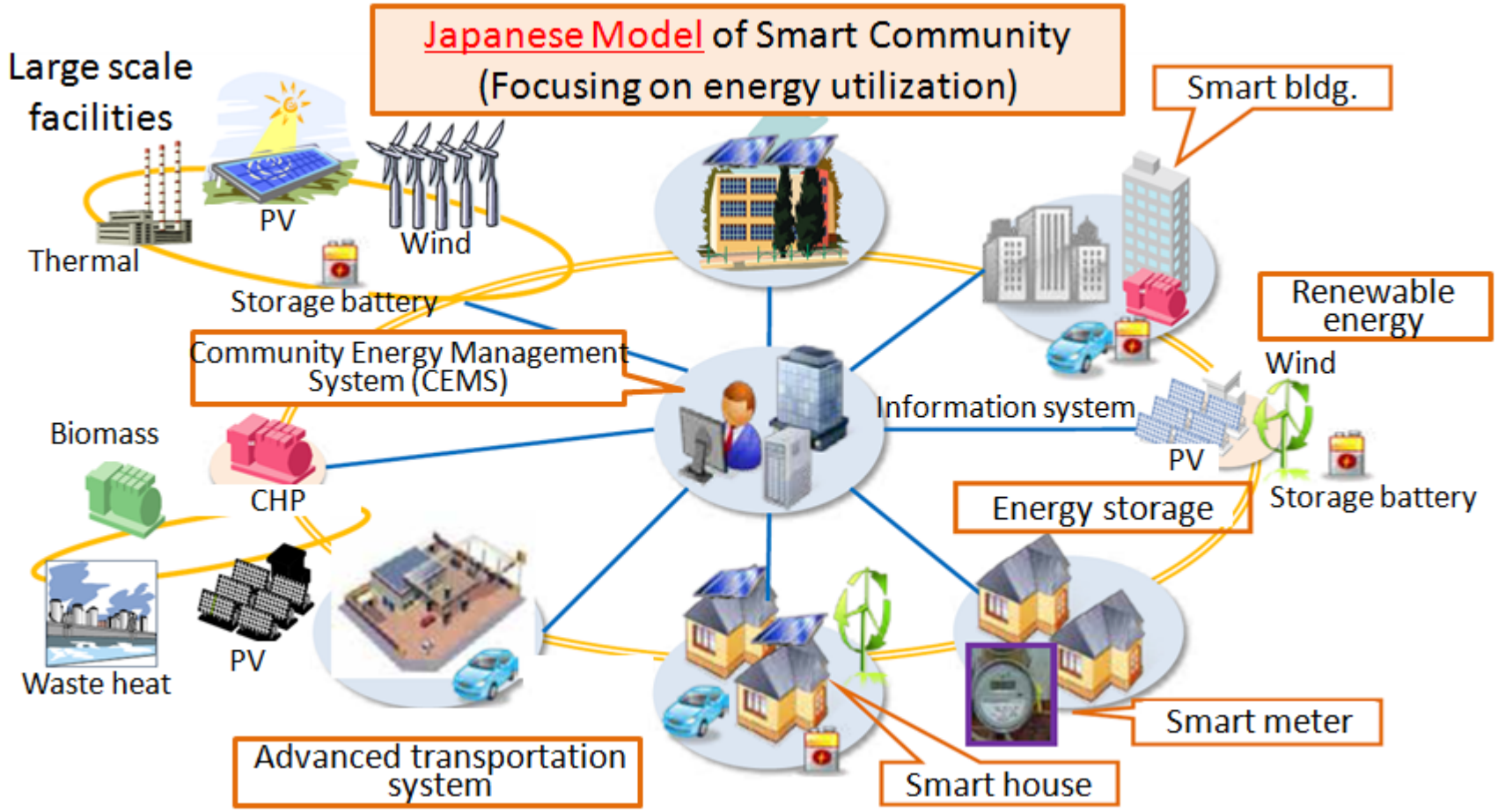


Source: NEPC

Distributed and Smart Energy System
(Smart Community demonstration projects FY2010-2014)

- Distributed renewable energy
- Efficient energy management (IoT, energy storage, etc.)

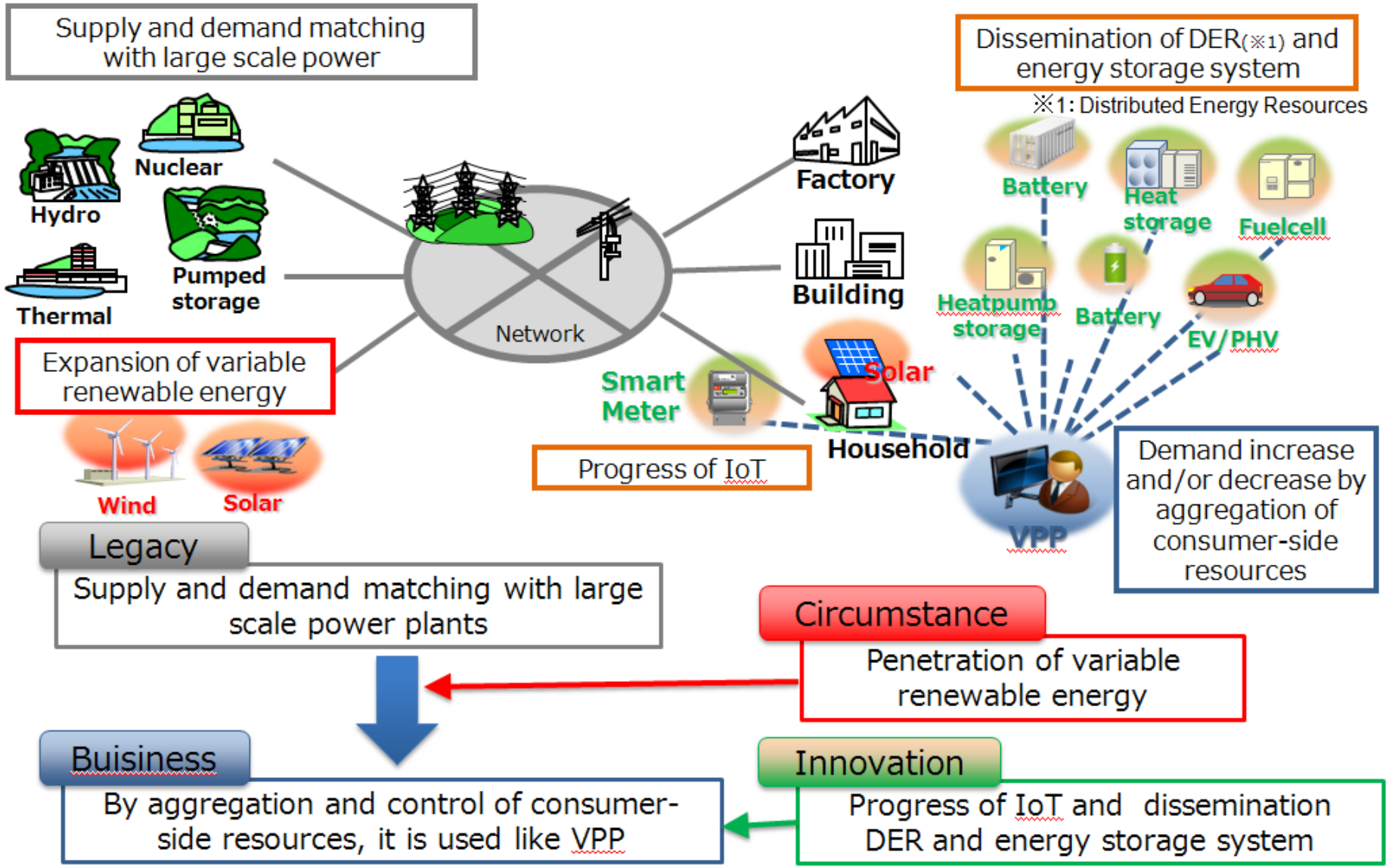
→ Energy system less dependent on nationwide grid



Source: JSCA (modified)

VPP(Virtual Power Plant) demonstration project (FY2016-)

Energy Resource Aggregation Business



Source: The Kansai Electric Power Co., Inc.

Thank you for your attention!