

Energy Security and Nuclear Power

April 2018

Agency for Natural Resources and Energy

Energy Mix

<3E + S Policy Objectives>

Security (Safety)

The fundamental premise

Rate of Self-Sufficiency (Energy Security)

To achieve a level of 25%
(20% before the earthquake)

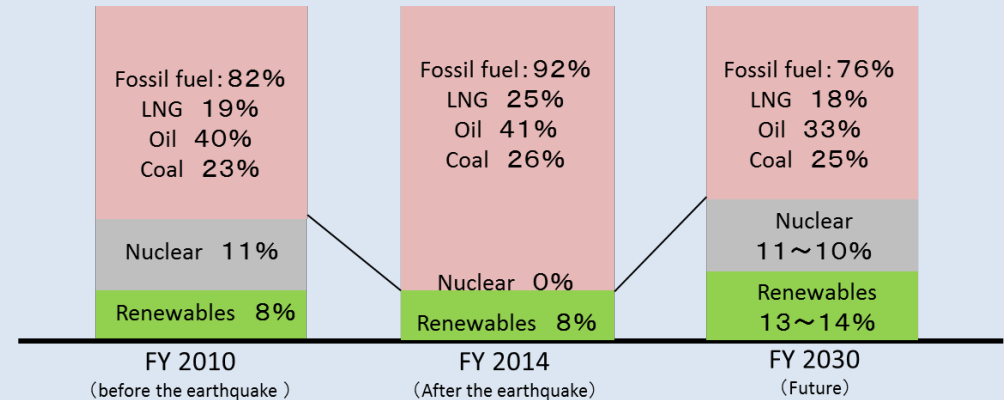
Cost of Electric Power (Economic Efficiency)

To improve the present
state

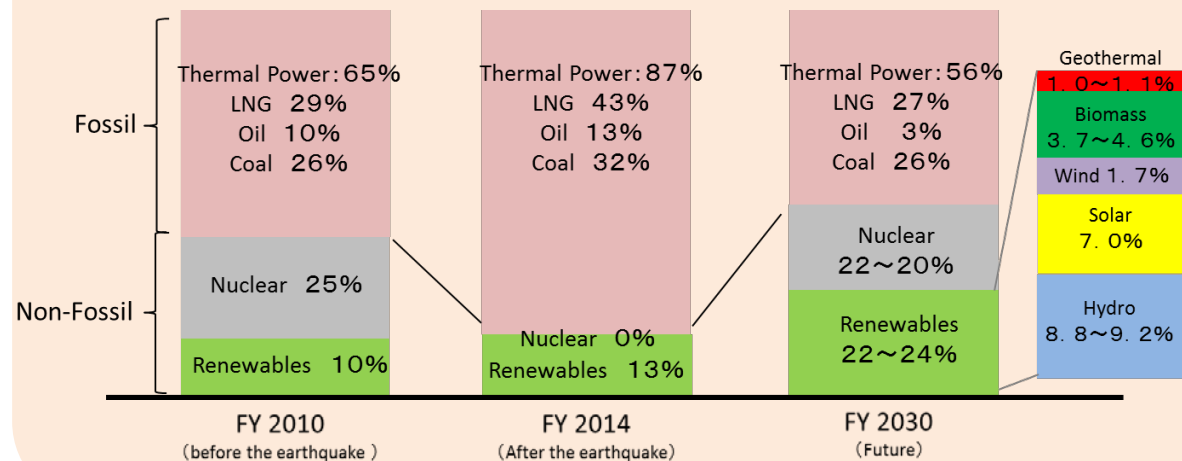
Greenhouse Gas Emissions (Environment)

To reduce greenhouse gas
emissions to levels of Western
nations

Supply of Primary Energy



Power-Source Composition

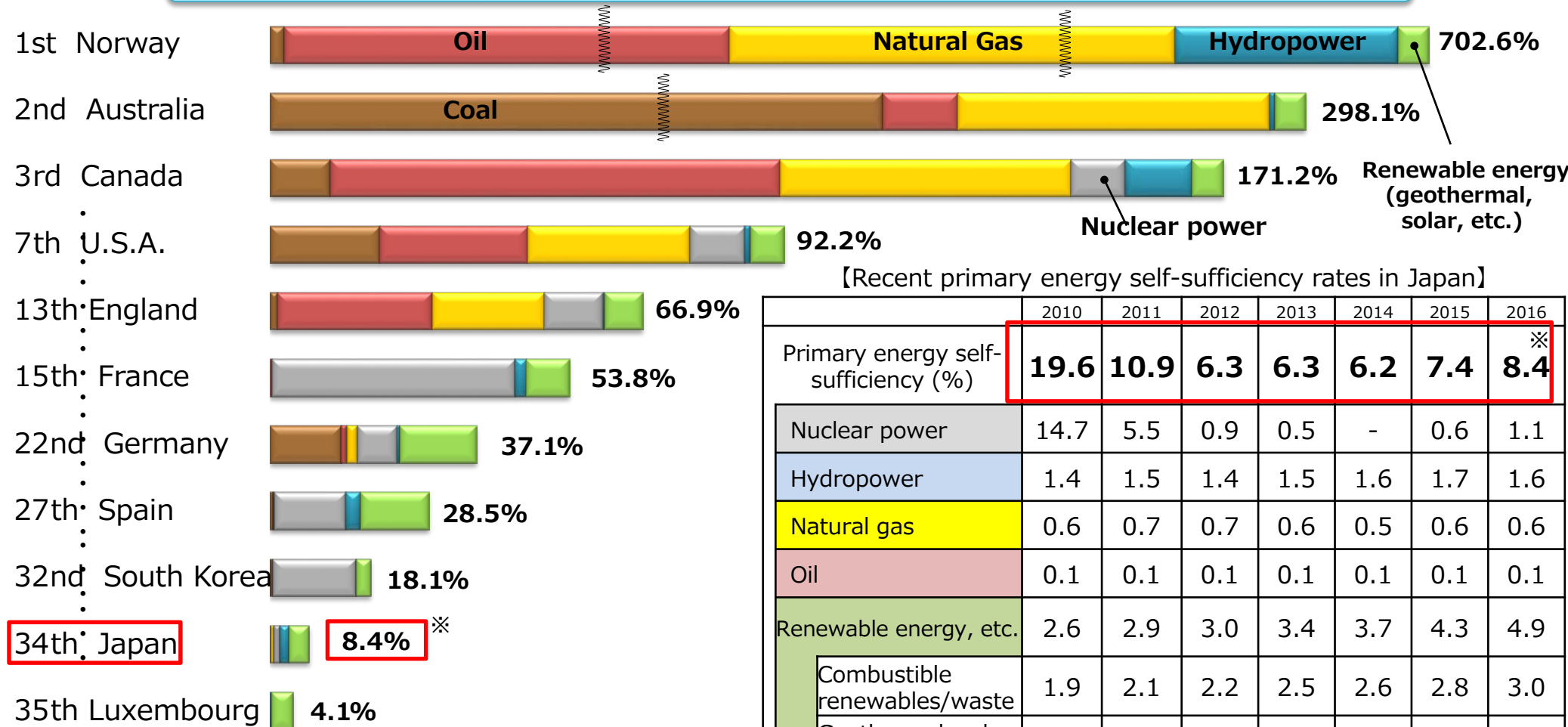


- Significantly lower than before the earthquake (19.6% in 2010).

Second lowest in 34 OECD countries.

※ IEA includes nuclear power in primary energy self-sufficiency rates as a domestic energy.
Japan also positions it as a “quasi-domestic energy” in its Strategic Energy Plan.

Primary Energy Self-Sufficiency Rate of OECD Countries (2016)



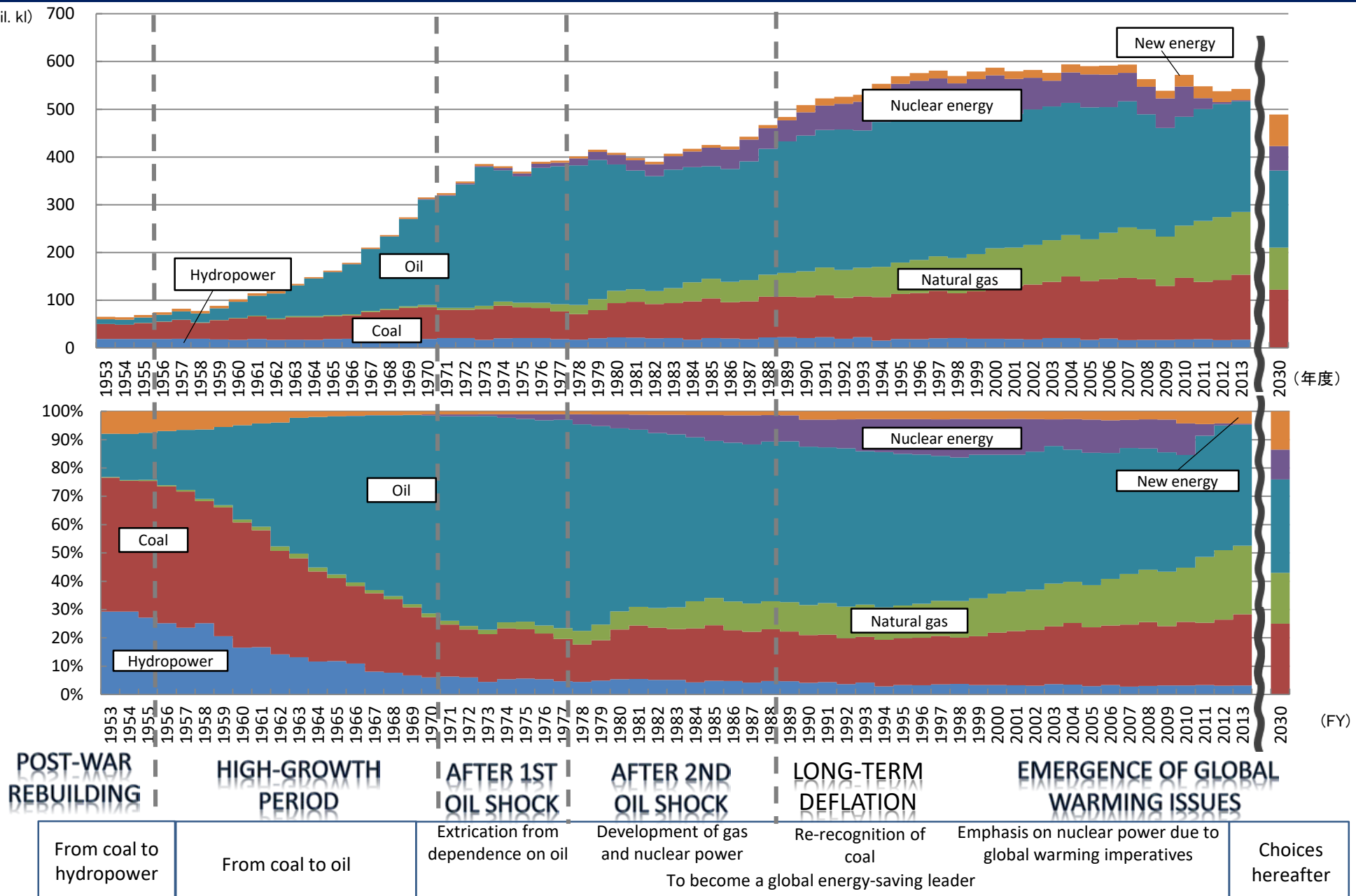
【Recent primary energy self-sufficiency rates in Japan】

	2010	2011	2012	2013	2014	2015	2016
Primary energy self-sufficiency (%)	19.6	10.9	6.3	6.3	6.2	7.4	8.4 ※
Nuclear power	14.7	5.5	0.9	0.5	-	0.6	1.1
Hydropower	1.4	1.5	1.4	1.5	1.6	1.7	1.6
Natural gas	0.6	0.7	0.7	0.6	0.5	0.6	0.6
Oil	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Renewable energy, etc.	2.6	2.9	3.0	3.4	3.7	4.3	4.9
Combustible renewables/waste	1.9	2.1	2.2	2.5	2.6	2.8	3.0
Geothermal, solar, wind and more	0.7	0.8	0.8	0.9	1.2	1.4	1.8

(Source) Prepared based on IEA's "World Energy Balances 2017"

※Preliminary calculations for 2016

History of Japan's Energy Choices



(Note 1) The method of calculating numerical values was changed in FY1990.

(Note 2) The numerical value for "new energy" in 2030 includes hydropower.

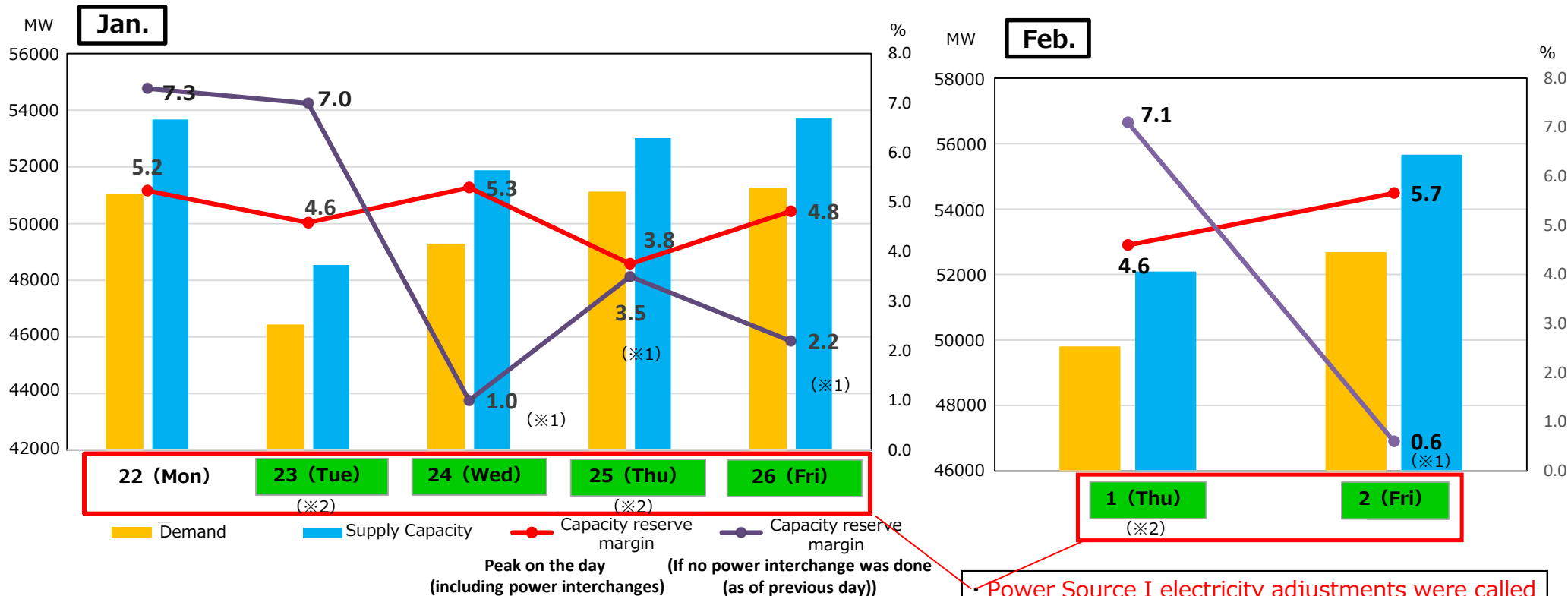
【Source】 Prepared based on ANRE's "Comprehensive Energy Statistics"

Supply and Demand in TEPCO Service Area

- This past winter**, at the end of January and beginning of February, **the supply and demand situation** in the TEPCO service area **became severe** and the capacity reserve margin fell more than expected, partly because of increased power demand due to heavy snowfalls and extreme cold. The TEPCO Power Grid called for **Power-Source I** (※ 1) for the first time. **Power interchanges to the TEPCO PG from other power companies were also implemented.**

(※ 1) The adjustment of imbalances to deal with rapid increases in power demand due to extreme heat or cold, such as at levels experienced once in ten years.

<Supply and Demand in TEPCO Service Area>



(※1) Demand response (DR) was included on Jan. 24, 25, 26 and Feb. 2.

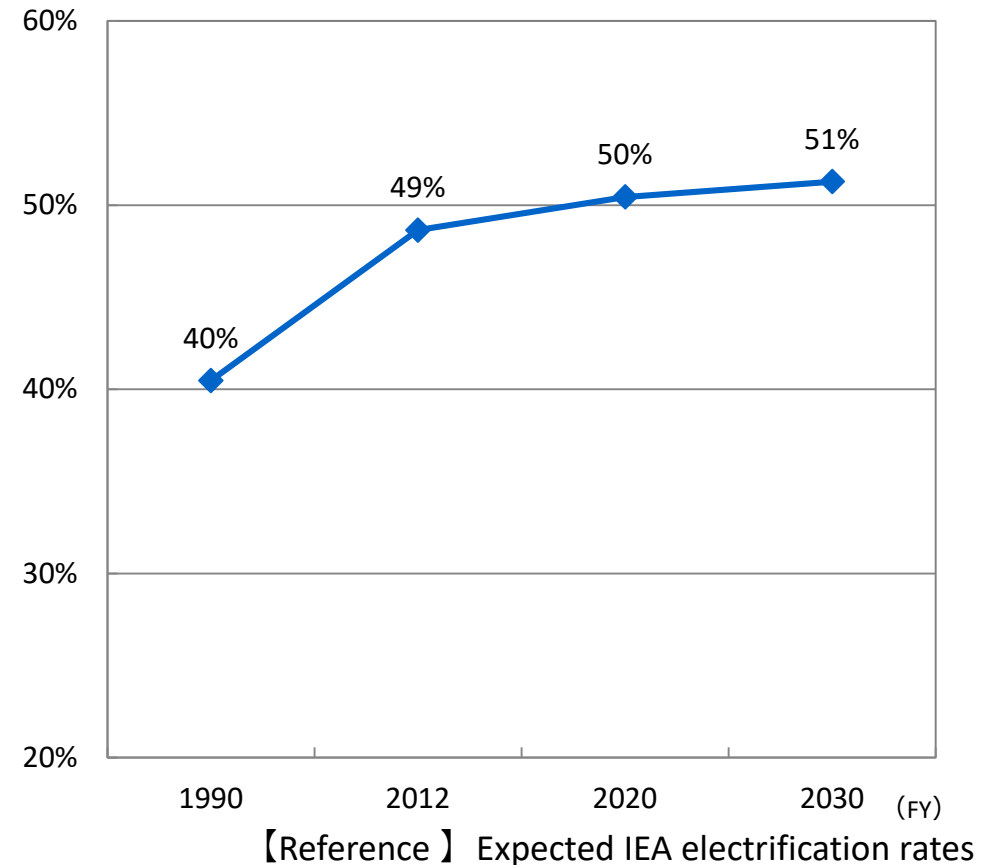
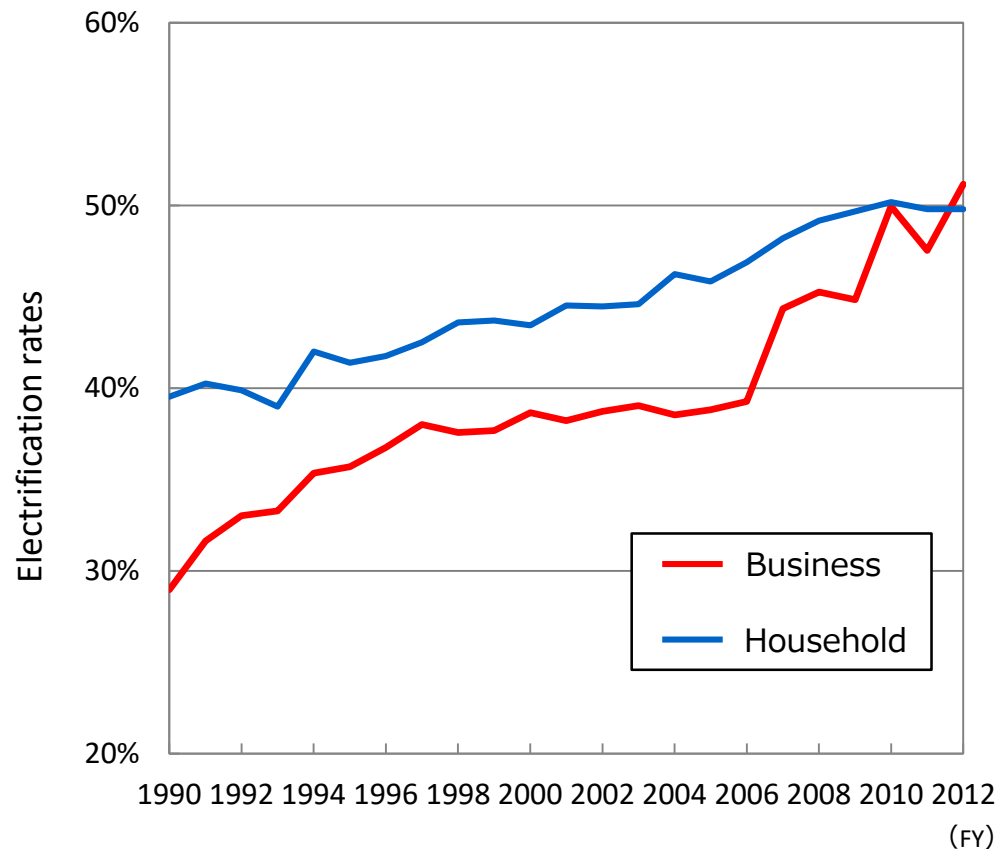
(※2) Power interchanges occurred on Jan. 23, 25 and Feb. 1 based on the expected supply and demand situations on the following days.

Power Source I electricity adjustments were called for during the seven days above.

■ : Days OCTTO ordered power interchanges.

Electrification Rate (Electricity in Final Energy Consumption)

- In the residential sector, **the electrification rate has been rising** due to increased use of OA equipment and home appliances, as well as the aging of the population.
※Electrification rate = Electricity in final energy consumption / total final energy consumption
- According to the IEA World Energy Outlook 2014's New Policy Scenario, **the electrification rate in the residential sector in Japan is expected to exceed 50% by 2030.**



Japan's Standing in Important Energy Technologies

Extracted from materials distributed at the 8th Round Table Studying Energy Situations

Low-Carbon Technologies

Item	Top 3 in global share
Solar panels [2016]	① Jinko Solar (China) [8.9%] ② Trinasolar (China) [8.8%] ③ Canadian Solar (China/Canada) [7.0%]
Wind power generators [2014]	① MHI Vestas (Denmark/Japan) [12.3%] ② Siemens (Germany) [9.9%] ③ GE (U.S.A.) [9.1%]
Highly efficient gas turbines for thermal power [2015]	① GE (U.S.A.) [43%] ② Siemens (Germany) [37%] ③ Mitsubishi Hitachi Power Systems (Japan) [16%]

(Source) Solar panels : Investigation by RTS Corporation

Wind power generators : Bloomberg New Energy Finance

Gas turbines : Prepared by ANRE based on materials provided by MHI

Decarbonization Technologies







Item	Top 3 in global share
Hydrogen (FCV) [2016]	① Toyota Motor (Japan) [86.9%] ② Honda Motor (Japan) [9.1%] ③ Hyundai Motor (South Korea) [4.0%]
Storage batteries for EVs [2017]	① Panasonic (Japan) [16.7%] ② CATL (China) [16.5%] ③ BYD (China) [10.8%]
Nuclear LWRs (operating) [2016] ※Unit based	① Areva (France) + MHI (Japan) [23%] ① WH (U.S.A.) [23%] ③ GE (U.S.A.) + Hitachi (Japan) [12%] . . ⑥ Toshiba (Japan) [4%]

FCV : Prepared by NEDO based on "Prospects for Technology Related to Fuel Cell Batteries and their Markets, 2017 (Fuji Keizai Marketing Research and Consulting Group)

Storage batteries for EVs : SNE Research's Press Release

Nuclear LWRs : Prepared by ANRE based on "World Nuclear Power Plants 2010" (Japan Atomic Industrial Forum)

Energy Resource Producing Countries (Top Ten in 2013) and Nuclear Technology Companies

Coal (Million tons)		Oil (Million tons)		Natural gas (Billion m3)		Uranium (Tons)		Companies with Nuclear Technology
China	3,561	Saudi Arabia	540	U.S.A.	689	Kazakhstan	22,567	<div>  Mitsubishi Heavy Industries Hitachi • Toshiba </div> <div>  GE, Westinghouse </div> <div>  AREVA </div> <div>  Doosan Heavy Industries & Construction </div> <div>  China National Nuclear Corp., China General Nuclear Power Group and more </div> <div>  Rosatom </div>
U.S.A.	904	Russia	525	Russia	671	Canada	9,332	
India	613	U.S.A.	440	Qatar	161	Australia	6,350	
Australia	489	China	208	Iran	159	Niger	4,528	
Indonesia	459	Canada	193	Canada	155	Namibia	4,315	
Russia	347	Kuwait	165	China	115	Russia	3,135	
South Africa	256	Venezuela	155	Norway	109	Uzbekistan	2,400	
Germany	191	UAE	153	Netherlands	86	U.S.A.	1,835	
Poland	143	Iraq	153	Saudi Arabia	84	China	1,450	
Kazakhstan	120	Iran	151	Algeria	80	Malawi	1,132	
World total	7,823	World total	4,117	World total	3,479	World total	59,673	

Prepared based on IEA's "Key World Energy Statistics 2014" and materials from the World Nuclear Association (WNA)

Summary

- **Experiences with energy security crises**, including “oil shocks”
- **New energy security in an electric age**
- **Nuclear power = Technological energy**