

Nuclear in Japan after Fukushima

Jan 6th 2016

CEE Nuclear Round Table

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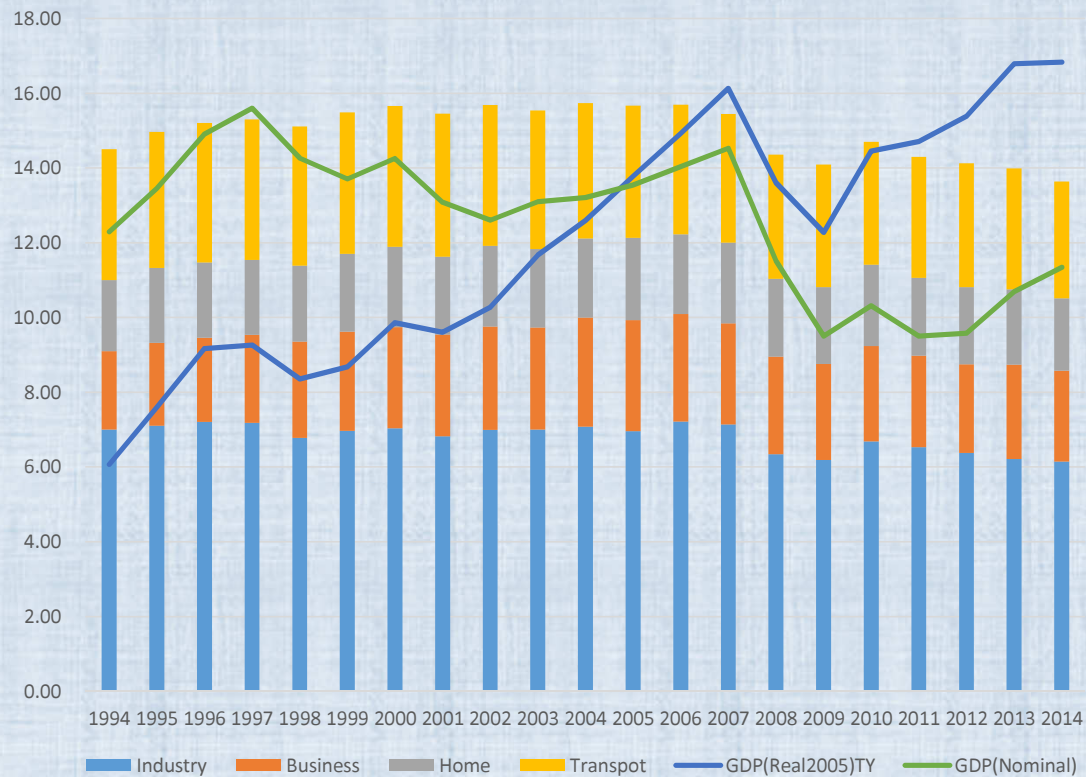
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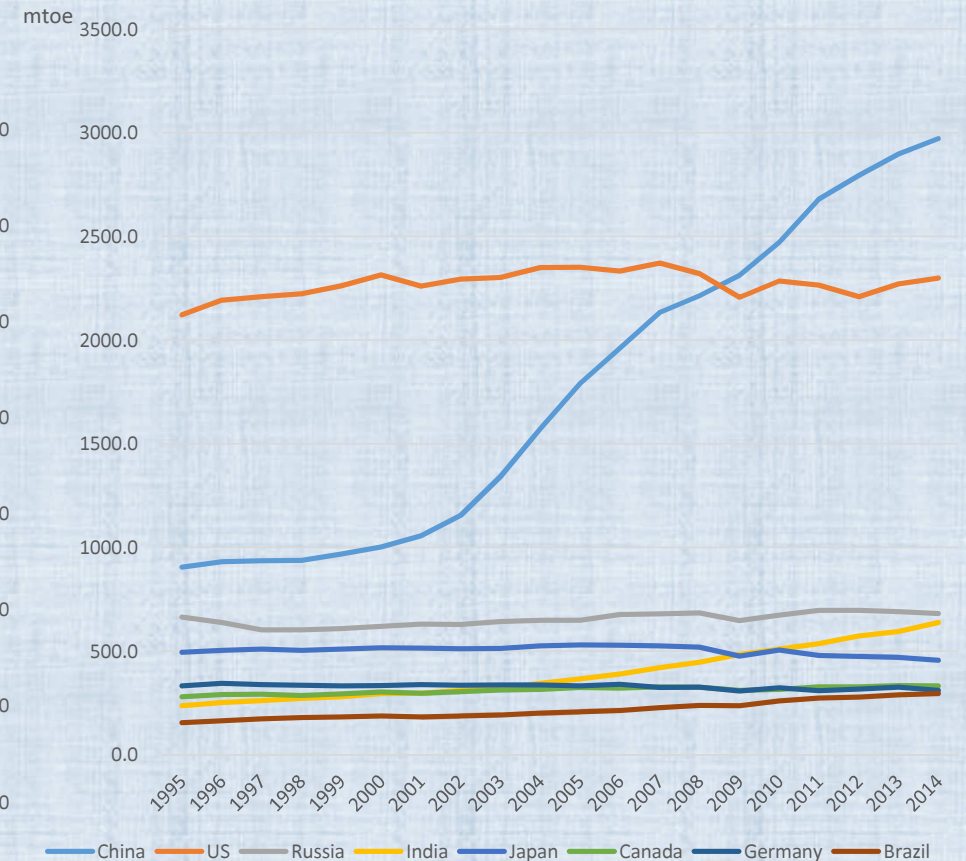
Japan

Japan is the 3rd largest Economy and consuming 5th largest volume of energy
After Fukushima(2011) , energy consumption has decline 4 consecutive years.
Last 3 years , Japanese economy has recovered by the Abenomics
In 2014, House sector shows most rate of reduction in energy demand

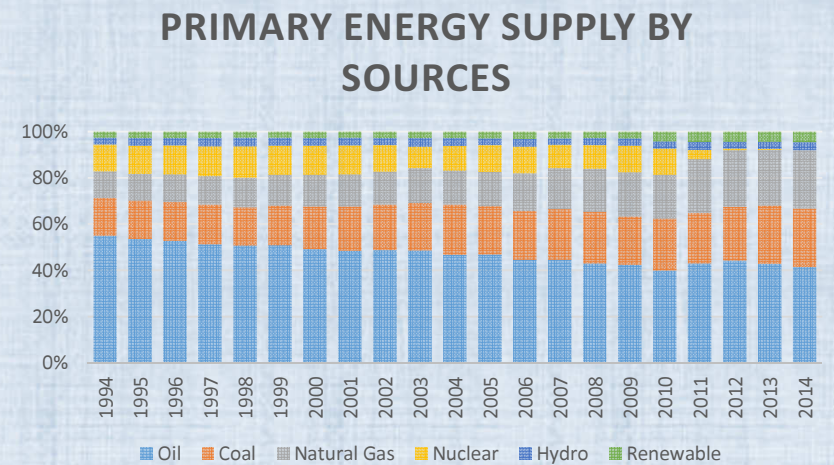
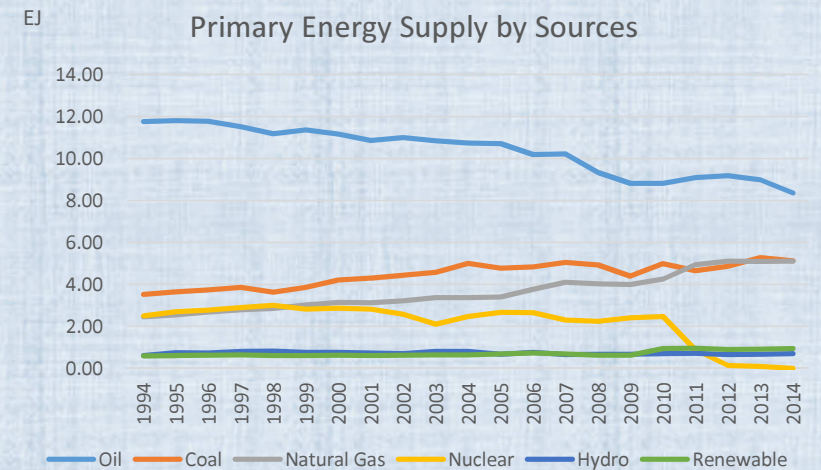
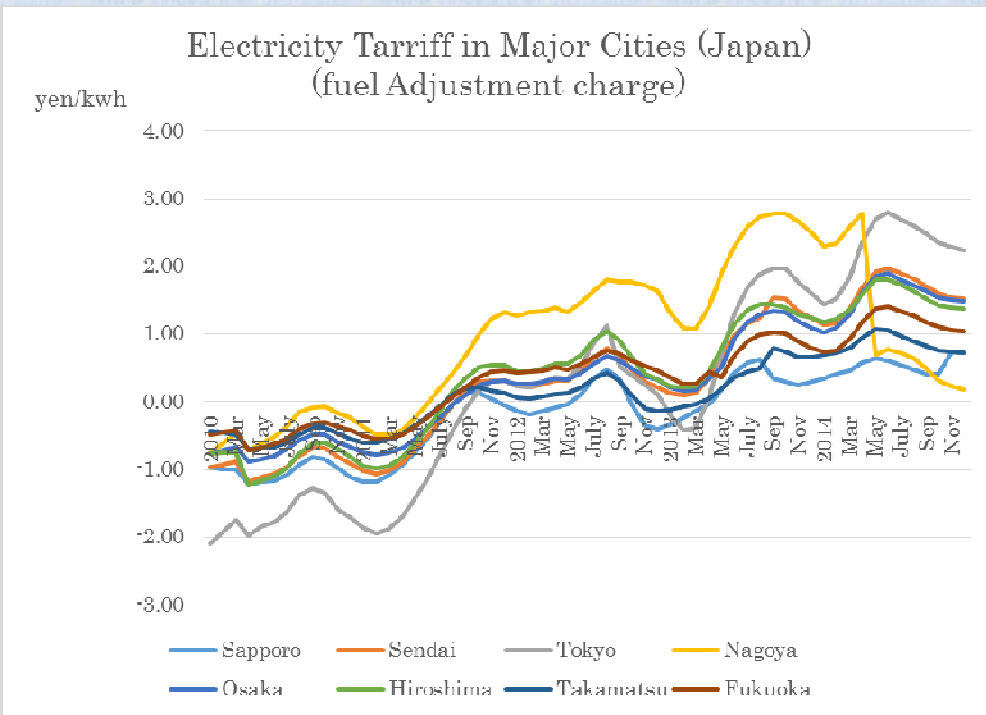
Final Energy Consumption & GDP



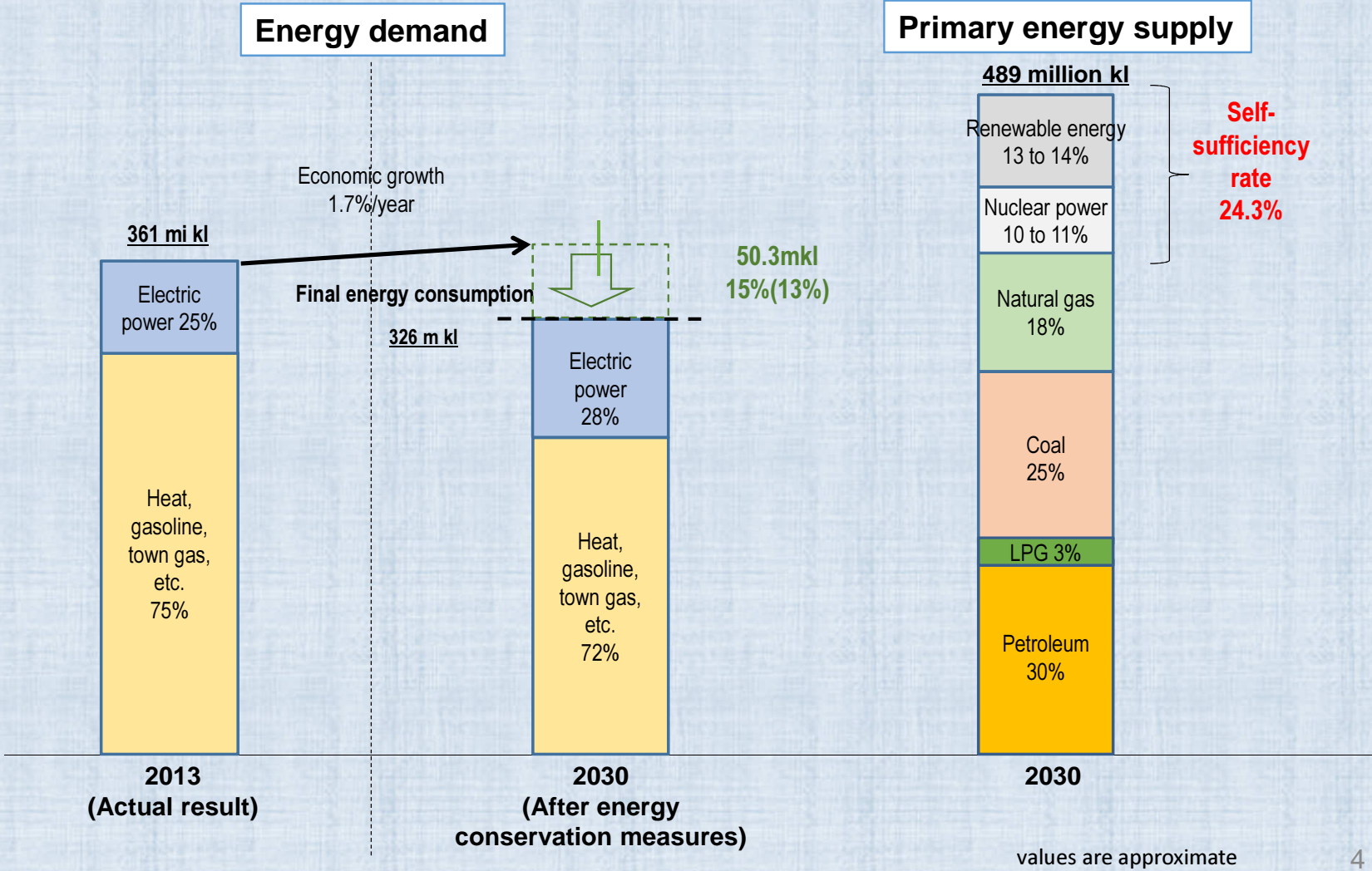
Primary Energy Supply by country



In 2014, we had no nuclear power supply. It's the first time since 1965.
It result in constant increase of electricity tariff.

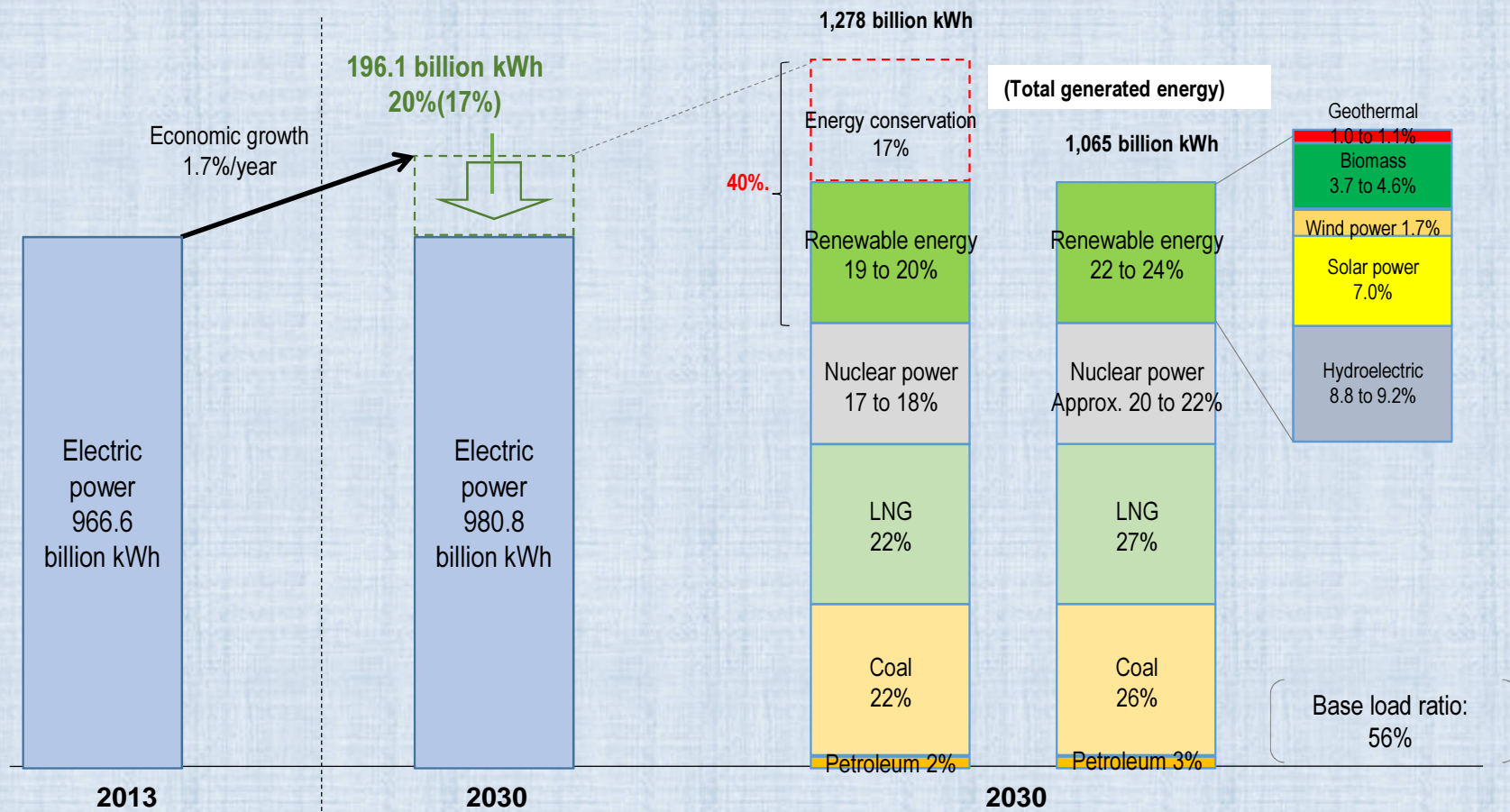


GOJ concluded its energy mix at 2030 (July 2015)



Power demand

Power source composition



values are approximate

After Fukushima, new regulatory system and severer safety standards are implemented.

Reform of Nuclear Regulatory Organization

/Independence

Separate the functions for nuclear regulation and nuclear promotion

Establish the Nuclear Regulation Authority(NRA) as an independent commission body

Amendments to the Nuclear Regulation Act

/New regulation on severe accidents

/Regulation based on the state-of-the art information (backfitting)

/40-years operational limit for NPPs (exceptional less-than-20 years extension)

New Regulatory Requirement

/Strengthening of Design Basis

/Severe Accident Measures

/Enhanced Measures for Earthquake/Tsunami

Principle of Regulation

/Place emphasis of Defense-in-Depth

/Eliminate common cause failure

/Protective measures for extreme natural hazards

Strengthening of Design Basis

/Comprehensive consideration of natural hazards including volcano, tornado and forest fire in addition to earthquake and tsunami, etc

/Reinforcement of fire protection measures

/Enhanced reliability of SSCs important to safety (e.g. Redundancy of piping)

/Reinforcement of off-site power supply (connection to different substations through multiple lines)

/Protection of systems for Ultimate Heat Sink

It has required to the utilities or licensees to do many works. It needs time for several years

There are 100s of mobile equipment provided in NPSs

Resilience for AC power supply



Strengthen Requirement of Counter Measures for Severe Accident (SA)

Prevention of Core Damage (ATWS, Loss of RCF ▪ RDF ▪ RCF ▪ UHF etc.)

Prevention of Containment Failure (CV spray, Filtered venting etc.)

Prevention of hydrogen explosion at reactor building etc.

Cooling at SFP

Prevention of fuel damages during shutdown

Emergency Response Center

Resilience for CV cooling



Resilience for H₂ Accumulation

Hydrogen Passive Autocatalytic
Recombiner



Heated Igniter



Enhanced Measures for Earthquake/Tsunami

Tsunami

More Stringent Standards on Tsunami

/Define “Design Basis Tsunami” – Exceeds the largest in the historical records

Enlarged Application of Higher Seismic Resistance

/SSCs for Tsunami protective measures such as Tsunami Gate are classified as Class S equivalent to RPV etc.

Earthquake

More Stringent Criteria for active faults

/Active faults with activities later than the Late Pleistocene be considered for seismic design
/Active in the Middle Pleistocene be investigated if needed

More Precise methods to define seismic ground motion

/3D observation of geological structure on the site

Displacement and Deformation

Class S buildings should not be constructed on the exposure of active faults

Resilience for Water Injection & Tsunami

Motor driven pump



Water Proof Door



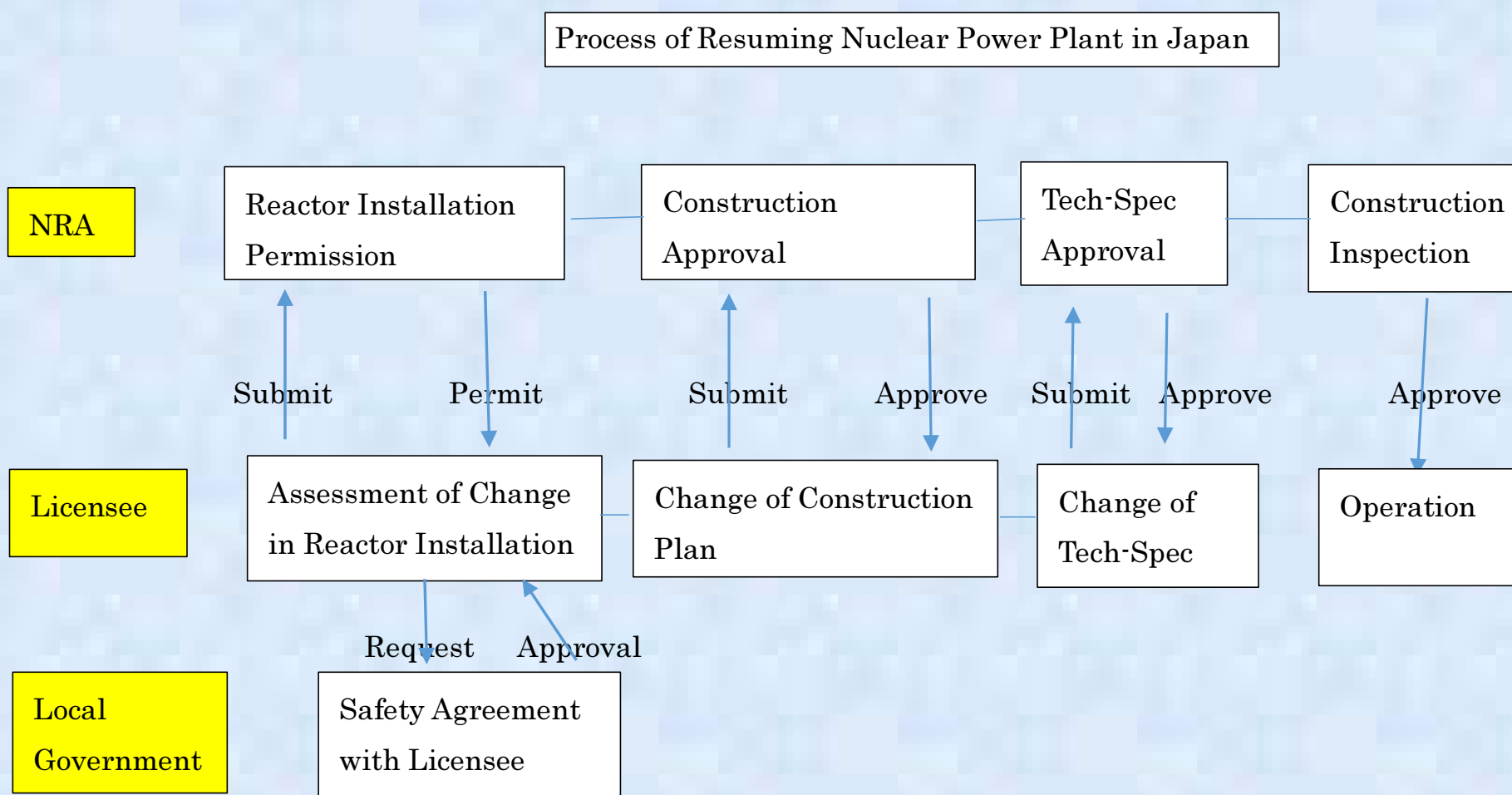
Mobile Water Injection Pump



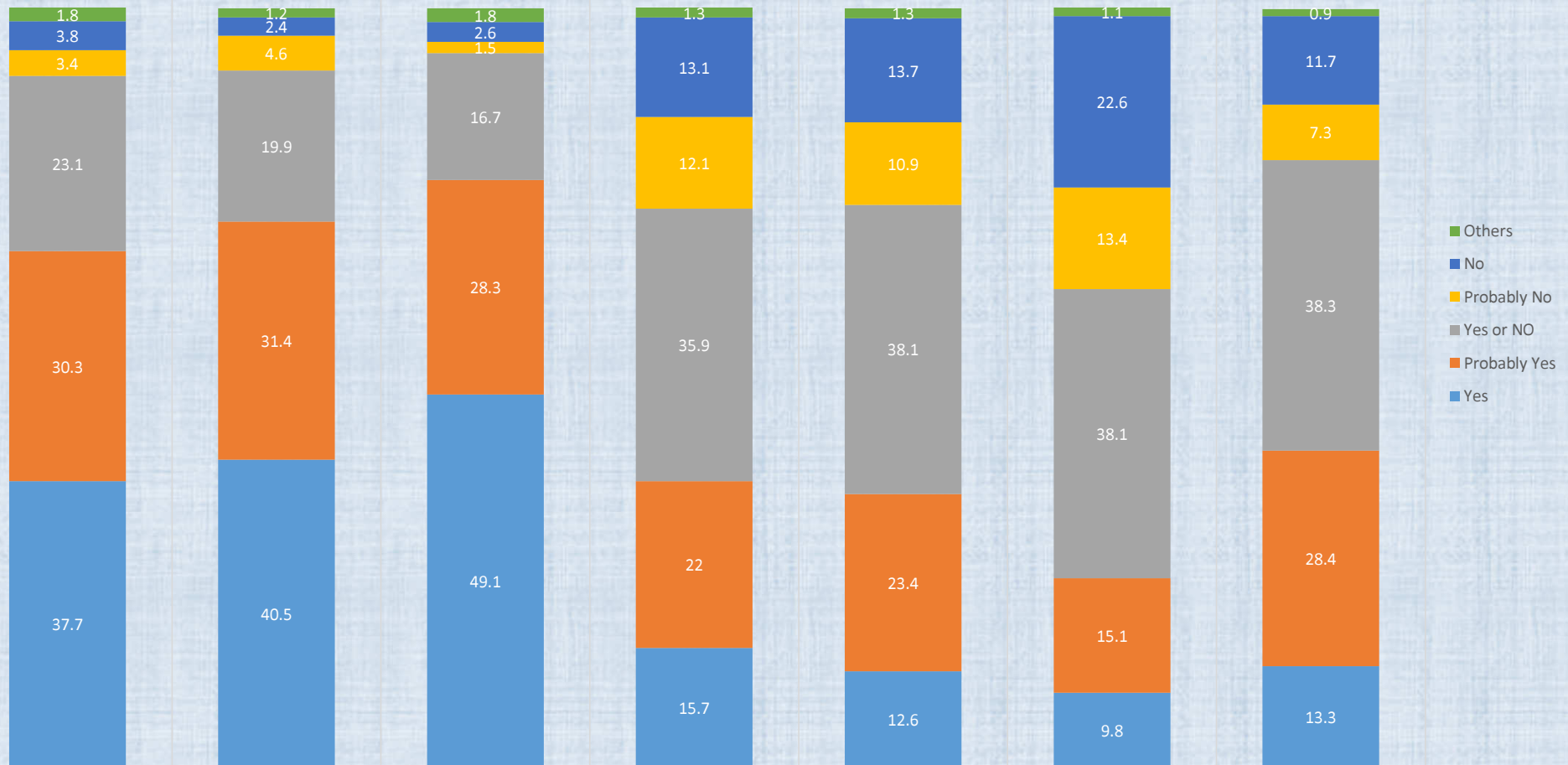
The main process of resuming NPS has not been changed significantly.

/There has been little affection of the result of major elections.

/Poll for Nuclear shows negative since Fukushima accident



Poll for Nuclear shows negative after Fukushima



Shutdown Period in Major NPS troubles shows little difference between Fukushima and the others

/Fukushima Daiichi(2011)

Sendai NPS Unit 1 resuming 25 months after new regulation guideline set ,
36 months after NRA establishment, 36 month

/Kashiwazaki Kariwa(2007)

25 month to 45 month more after the earthquake (Unit 6-7, Unit1, Unit5)

*Unit 2-4 never operated since then

/Shika Criticality event hiding (2007) 25months after stopping for inspection

/Hamaoka & Shika Turbine Missile(2006) 8 month to 20 month after the accident

/Onagawa Earthquake(2005) 7 month to 21 month after the scram

/Mihama Unit 3 accident (2004) 32 month after the accident

/Fukushima Daiichi Falsification (2002) 40 month after stopping for inspection

/Monju (FBR) (1995) 178 month after the accident

There are 43 Units with 42.048 Mkw NPS registered in Japan

NPS total Capacity at the Accident 54 units 48.96Mkw

Fukushima-Daiich 6 units 4.696Mkw in decommission process

5 first generation NPS with) 2.216Mkw in decommission process

25 NPSs in 15 sites submit TA report to NRA 24.838Mkw

Sendai Unit1, 2 resumed 1.78Mkw

Takahama Unit3,4 approved and be resumed quite soon 1.74 Mkw

Ikata Unit 3 approved and be resumed soon 0.89 Mkw

Kashiwazaki Kariwa Unit 6, 7 final process of approval 2.712

Tomari Unit 3 enter the final process of approval 0.912 Mkw

Shimane Unit 2 enter the final process of approval 0.82 Mkw

Genkai Unit 3,4 enter the final process soon 2.36 Mkw

Ohma Unit 3, 4 midst of the process and see others 2.36 Mkw

Hamaoka Unit3, 4 midst of the process and under construction 2.237 Mkw

Onagawa Unit2 midst of the process and under construction 0.825 Mkw

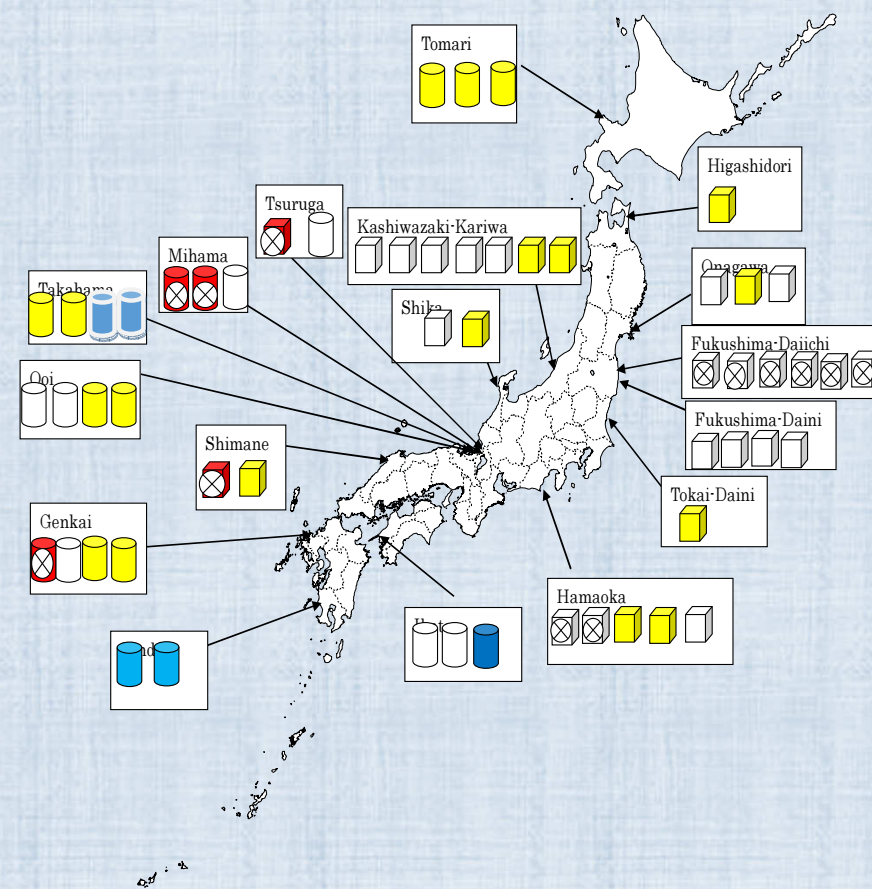
Tokai Daini midst of the process and under construction 1.10 Mkw

Tomari Unit1,2 reviewed after Unit 3 1.158Mkw

Tsuruga Unit 2, Higashi dori Unit1 , Sika Unit 2 fault line issues 3.466Mkw

Takahama Unit1,2 40years review by July 2016 1.652 Mkw

Mihama Unit 3 40years review by Nov. 2016 0.826 Mkw



18 NPSs with 17.209 Mkw not submitted TA to NRA yet

- / Fukushima Daini Unit 1-4 with 4.4 Mkw difficult to get local government approval
- / Kashiwazaki Unit 1-5 with 5.5 Mkw submitted after Unit 6,7 approved
(Unit 2-4 never operated since 2007)
- / Hamaoka Unit 5 with 1.38 Mkw submit soon after fixing sea water contamination
- / Onagawa Unit 1, 3 with 1.348 Mkw submit after Unit 2 approved
- / Shika Unit 1 with 0.54 Mkw submit after Unit 2 approved
- / Ikata Unit 1,2 with 1.132 Mkw submit after Unit 3 resumed
- / Ooi Unit 1.2 with 2.35 Mkw submit and challenge 40 years review after the others
- / Genkai Unit 2 with 0.559 might submit after Unit 3.4 resumed

2 NPS under construction

- / Ohma NPS with 1.383 submitted TA to NRA
- / Shimane Unit 3 with 1.373 Mkw (93% completed) submitted after Unit 2 resumed

After years, power supply by NPS in Japan will recover.

/NRA develops standard review process.

- Sendai Unit1,2 ▪ ▪ ▪ 133 days, 67 public meetings, 593 discussion meetings

- Takahama Unit 3,4 ▪ ▪ ▪ 105days, 62 PM, 413 DM

- For BWR , Kashiwazaki is the model of standard review process

/Major Reason of low capacity ratio in Japan since 2000

- Earth quake ground motion exceed design base 4 times(2004,2006,2007,2009)

- Falsification issues(2002,2006) , Material troubles (2005,2006, 2007-8)

We need to consider next issue challenged by the industry.

/NRA's permission for over 40 Years Operation NPS in 2016

- Takahama Unit 1,2 need to get approval by July 2016

- Mihama Unit 3 by Nov. 2016

- There is no fundamental technical issues to get approved.

- Kansai PC should prioritize

/EDMG facility by 2018

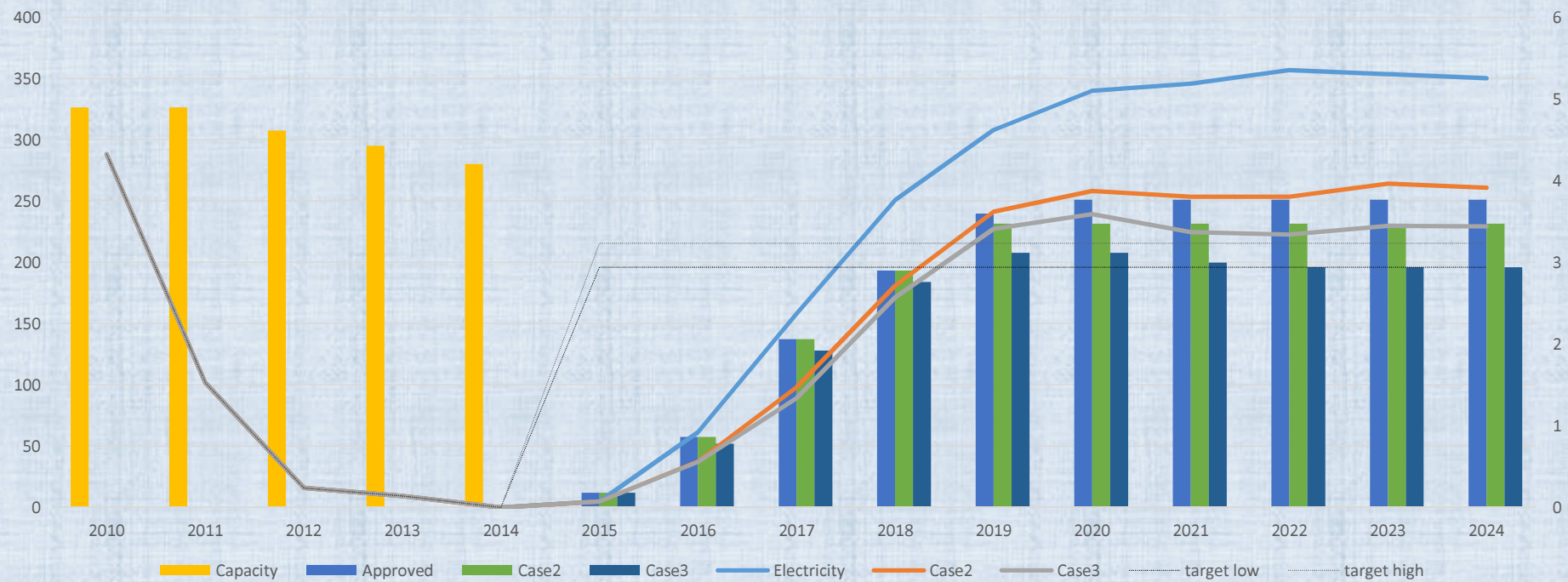
/Longer Post-Outage Period after 2017

/New NPS development

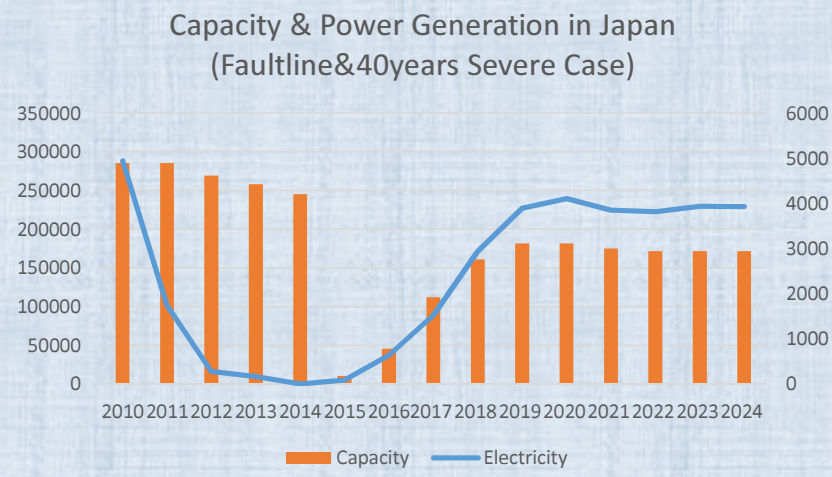
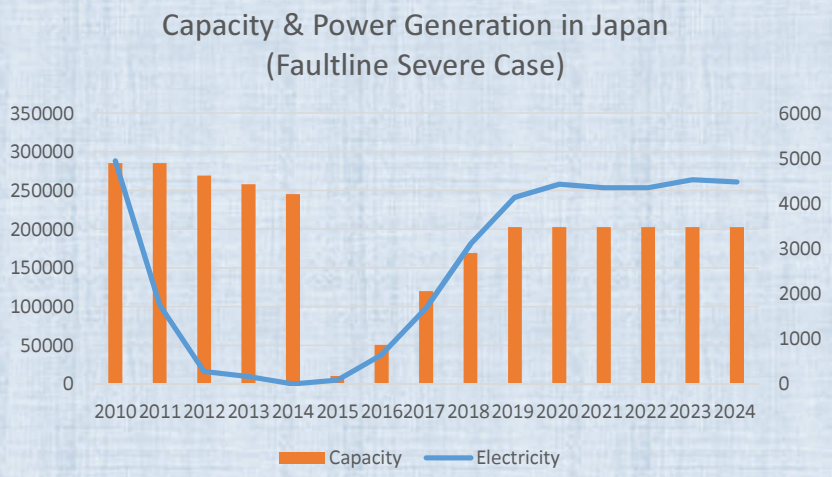
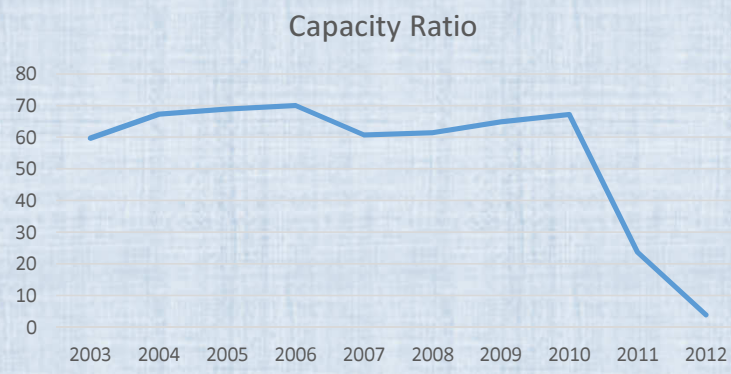
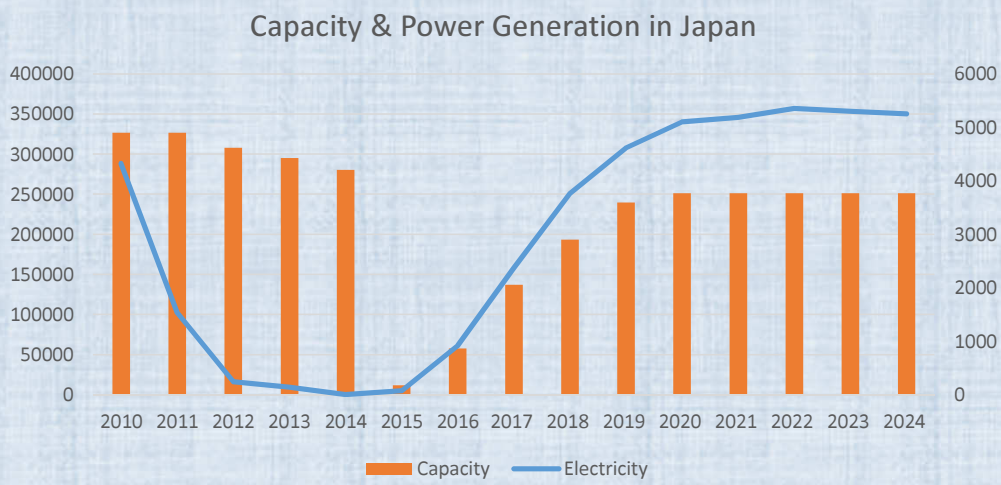
Estimation for NPS supply recovery

- /NPS supply will recover by 2020 exceeding the target of the outlook in 2018
- /If NRA reject the proposed TA related with fault line assessment, it still exceed the target.
- /If NRA agreed the fault line assessment, It will exceed the lever of before the accident

Nuclear Capacity & Electricity Generation



Under the New Regulatory System, after 4 years from now , NPs in Japan have capability to produce more electricity than before the Accident.



NPS Operation and Inspection in Japan

