

**Keio University** 



# Nuclear power in an age of intensive power consumption

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### The environment surrounding the nuclear power industry

- 1. The difficulty in applying new regulatory requirements, the delay in reoperating power plants
  - Increased investment into safety measures (Exceeded JPY4 trillion after mid-2017, figures based on public documents made available by operators), return on investment unclear
- 2. Diminished operation rate, rising costs from the Fukushima accident
  - Relative increase in nuclear power generation costs
- 3. Reforming of the electric power system. Loss of the the fully-distributed cost method.
  - Rising costs for the financing of nuclear operators
- 4. The progress on decommissioning, the increased difficulty of replacement
  - The shrinking of the nuclear power market (approx. JPY1.85 trillion, out of which nuclear reactor manufacturing amounts to JPY580 billion\*. 400 related companies employing approx. 50,000 people) as well as the handing down of expertise and skill coming to an end

# The Re-operating of Japan's Nuclear Power Plants and the application of new regulatory requirements



#### Points of attention regarding energy security

- 1. Delay in restarting, the lowering of energy self-sufficiency  $(\rightarrow 6.3\%)$ 
  - > Overdependence on fossil fuels and geopolitical risks
    - Dependency on the Middle East
    - Halted supply for the seas of East Asia
- 2. Increase in energy consumption due to the fourth industrial revolution
  - > The need for a power source with stable electricity and high conversion efficiency
    - The development and widespread adoption of application services with AI × IoT at its core
    - Automatic driving using EV, increased adoption of car sharing services

#### Japan's Major Procurement of Crude Oil (2016)



#### Japan's Major Procurement of Natural Gas (2016)



\* Drawn based on "Trade Statistics" from the Ministry of Finance and other sources. "Dependency on Hormuz" is the summation of percentages of major exporting countries west of the Straits of Hormuz. 6

### A new crude oil and LNG supply cutoff risk

First Island Chain and Second Island Chain as argued by China



When it is impossible to cross beyond the second island chain, it will be necessary to detour all the way to the south shore of Australia Traffic at the Strait of Hormuz Malacca (global, 2014)

	Crude oil (bbl/day)	LNG (tons/year)
Strait of Hormuz	17 million	81 million
Strait of Malacca	12 million	95 million

Economic damage for Japan if Strait of Malacca cannot be crossed and the Lombok-Makassar Straits (East of the first island chain) must be crossed

- Increase in fuel costs and additional costs for ship replenishment will amount to approximately JPY30 billion (LNG ships will cost about JPY10 million/day). If this rise is transferred to Japan's domestic crude oil price, it will be a rise of JPY230 for each citizen. (In addition, LNG and coal prices will also rise)
- Due to tensions in international affairs, there will be a heightened risk of rising energy prices
- Singapore, China, South Korea and other container hub ports will not be functional and the East Asian economy will be in turmoil.

#### The fourth industrial revolution and energy consumption

- ✓ Energy consumption for devices allowing home automation will increase by 20% annually globally. By 2025, this will amount to 46 terawatt hours, equivalent to the amount consumed in the country of Portugal. (International Energy Agency, 2016)
- ✓ Electric power required for Bit Coin mining has already reached the level of consumption by an American city with a population of 280,000, and by 2020 will be set to rival the total electricity consumed by the country of Denmark (33 terawatt hours). (Boston Consulting Group, 2016)
- ✓ By 2040, 54% of car production and 33% of running cars will be EV. (Bloomberg New Energy Finance, 2017)

## Points of consideration regarding the sustainability of the nuclear power generation industry

1. Can nuclear power reach the 20-22% ratio target for 2030 stated in the Basic Energy Plan?

 $\succ$  30 power plants must be restarted, and the operation rate must be 80%.

- 2. Is replacement possible in a way that after 2050, nuclear power generation can be maintained?
  - The business operations related to replacement must be considered, and the replaced reactor type must be specified
  - > Also necessary to consider policy assistance in terms of funding and other issues
- 3. Can decommissioning be conducted in a stable manner?

> The implementation of decommissioning and restructuring of nuclear operators

- 4. Consistency with TEPCO reform
- 5. The importance of international cooperation for the production of new generation model of small nuclear power reactors

# Trend in energy conservation and the struggling sales numbers amidst heightened competition



#### Capital-to-asset ratio still remaining low



Source: financial statement reports from each company(March, 2017)

### The continued burden of the Fukushima Dai-ichi nuclear power plant accident

Source : Agency for Natural Resources and Energy (millions of yen)

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	Contribution rate (%)	Retail rates with cost inclusion
Hokkaido Electric Power Co., Inc.	3,260	3,803	6,520	6,520	6,520	6,520	4.0	FY 2013~
Tohoku Electric Power Co., Inc.	5,355	6,247	10,709	10,709	10,709	10,790	6.6	FY 2013~
Tokyo Electric Power Company	28,370	38,820	56,740	56,740	56,740	56,740	34.8	FY 2012~
Chubu Electric Power, Co., Inc.	6,210	7,245	12,421	12,421	12,421	12,421	7.6	FY 2014~
Hokuriku Electric Power Company	3,032	3,537	6,064	6,064	6,064	6,064	3.7	_
Kansai Electric Power Co., Inc.	15,762	18,389	31,524	31,524	31,524	31,524	19.3	FY 2013~
Chugoku Electric Power Co.,Inc.	2,095	2,444	4,189	4,189	4,189	4,189	2.6	_
Shikoku Electric Power CO.,Inc.	3,260	3,803	6,520	6,520	6,520	6,520	4.0	FY 2013~
Kyushu Electric Power Co., Inc.	8,460	9,870	16,919	16,919	16,919	16,919	10.4	FY 2013~
The Japan Atomic Power Company	4,262	4,973	8,525	8,525	8,525	8,525	5.2	(included in the electricity
Japan Nuclear Fuel Limited	1,434	1,673	2,869	2,869	2,869	2,869	1.8	charges for each power company)
Total	81,500	100,804	163,000	163,000	163,000	163,000		

#### Conditions for sustaining nuclear power generation

- 1. Continued safety investment and a strong financial basis on which to make preparations for accidents possible
- 2. A long term commitment to energy and nuclear power policy, which would improve the predictability of the business
- 3. A serious discussion about governmental intervention including the possible conversion to public corporations
- 4. A revised Electricity Business Act and the Reactor Regulation Act that would make the restructuring of nuclear power operators possible