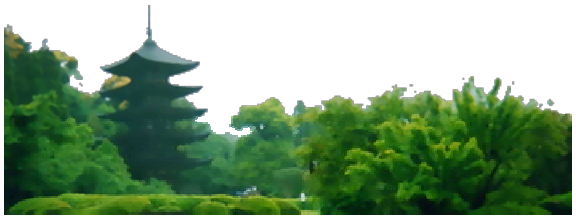
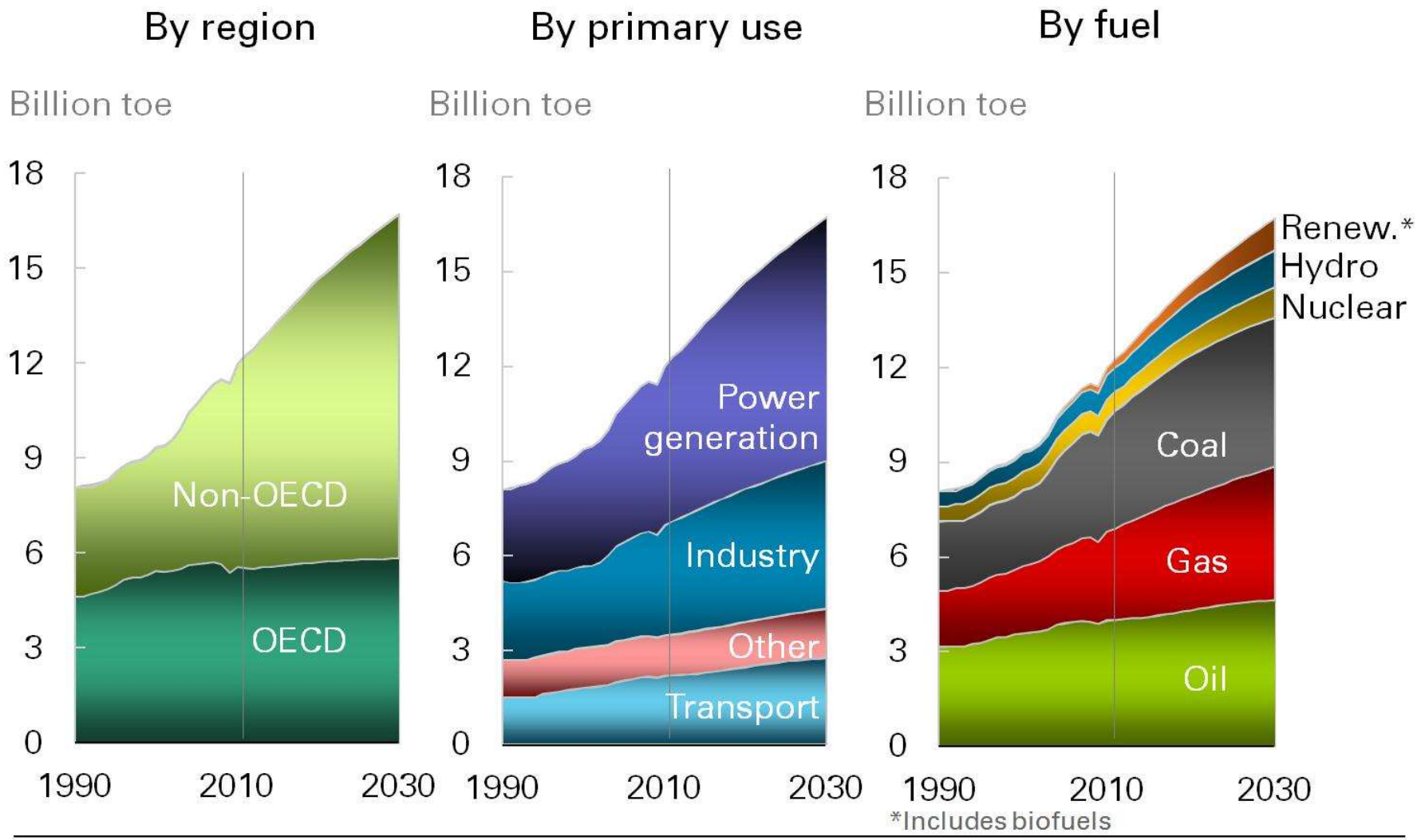
Change in Energy Consciousness and Spread of Photovoltaic Cells after the Great East Japan Earthquake

Kazuhiro FUKUYO, Yamaguchi Univ.



BP predicted like this in the "*Energy Outlook 2030*":

Industrialisation and growing power demand…

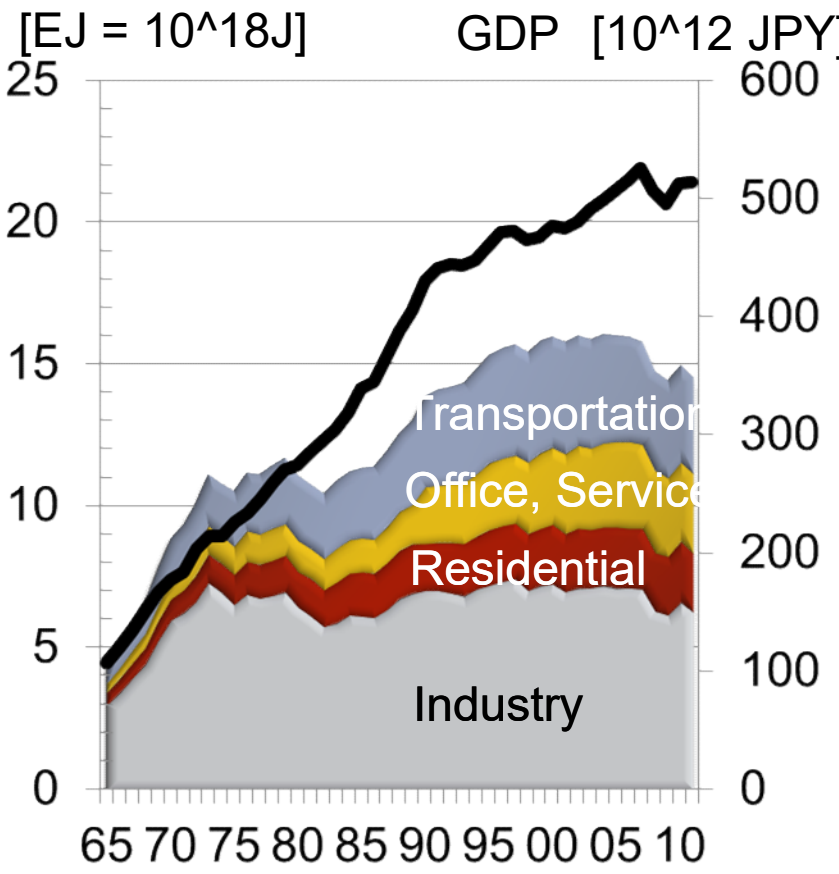


The world energy demand will increased double!

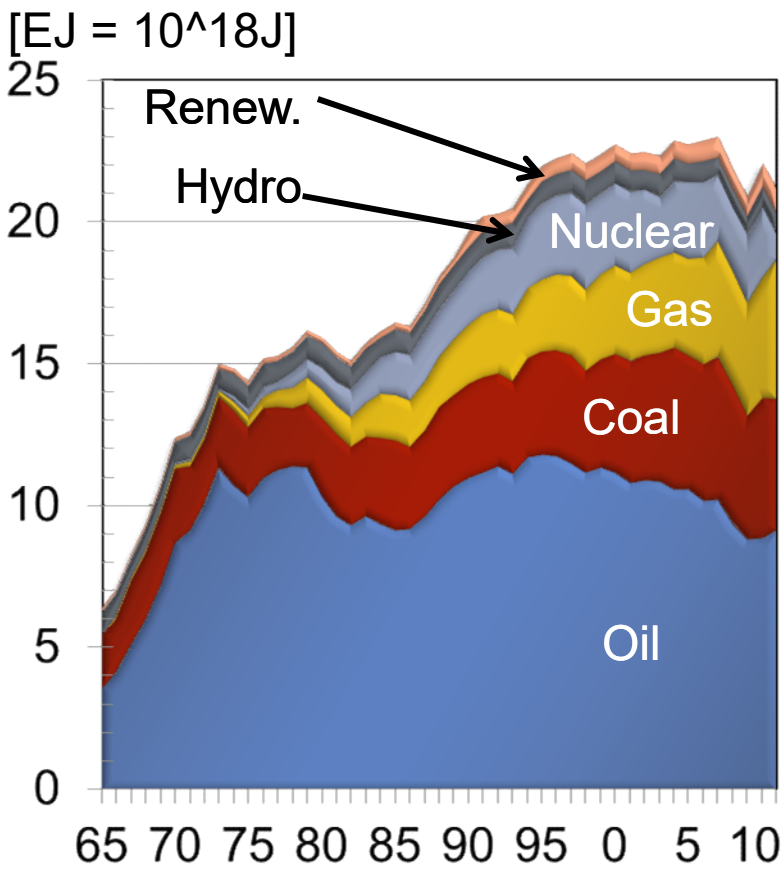
Energy supply and demand in Japan

Japanese energy demand has been stable recently, but dependent on the fossil fuels

Final energy consumption and GDP

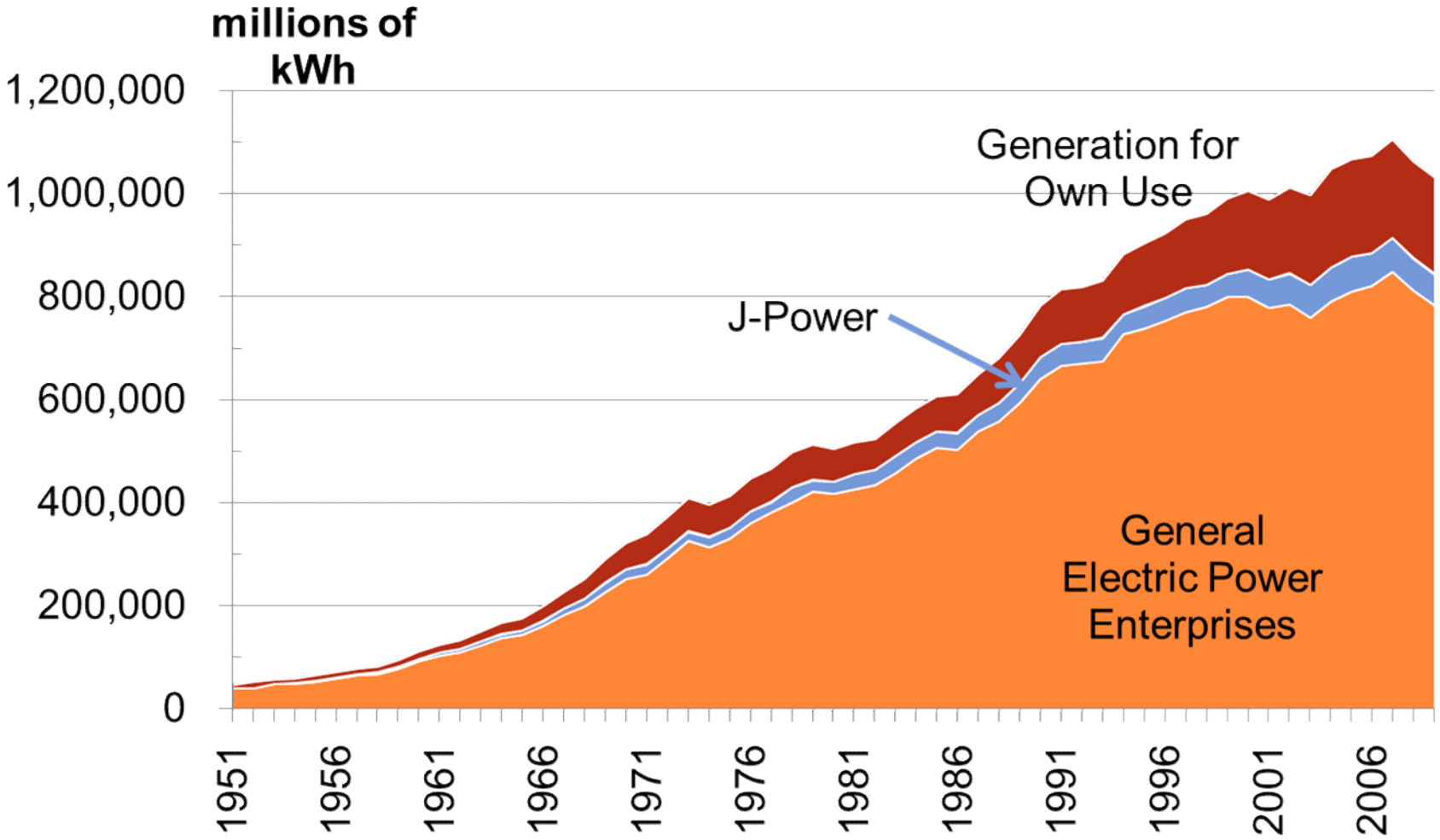


Primary energy supply



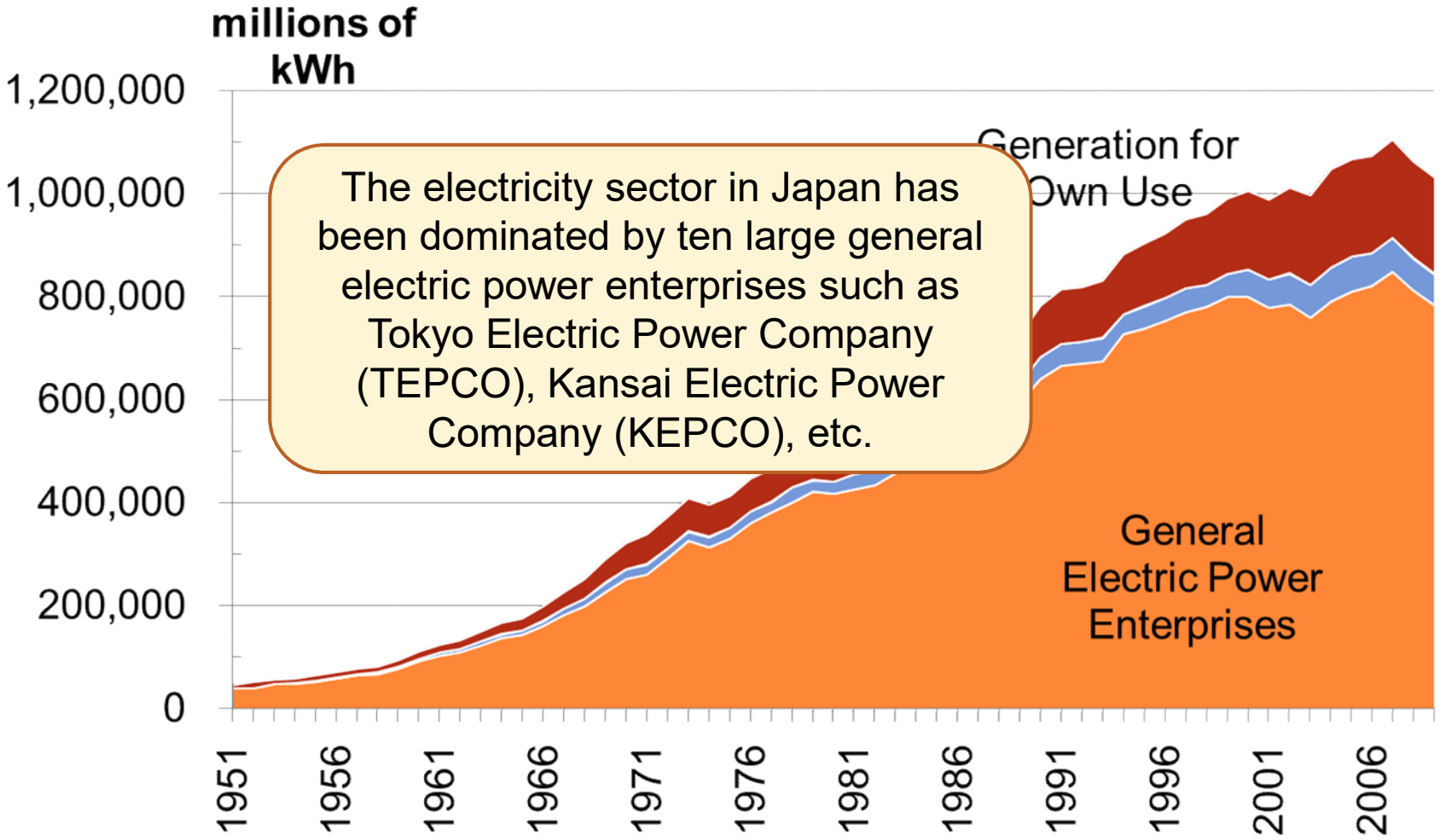
Source: Annual Report on Energy 2013 (Japan's “Energy White Paper 2013”)

Electric Power Generated in Japan, F.Y.1951 - 2009



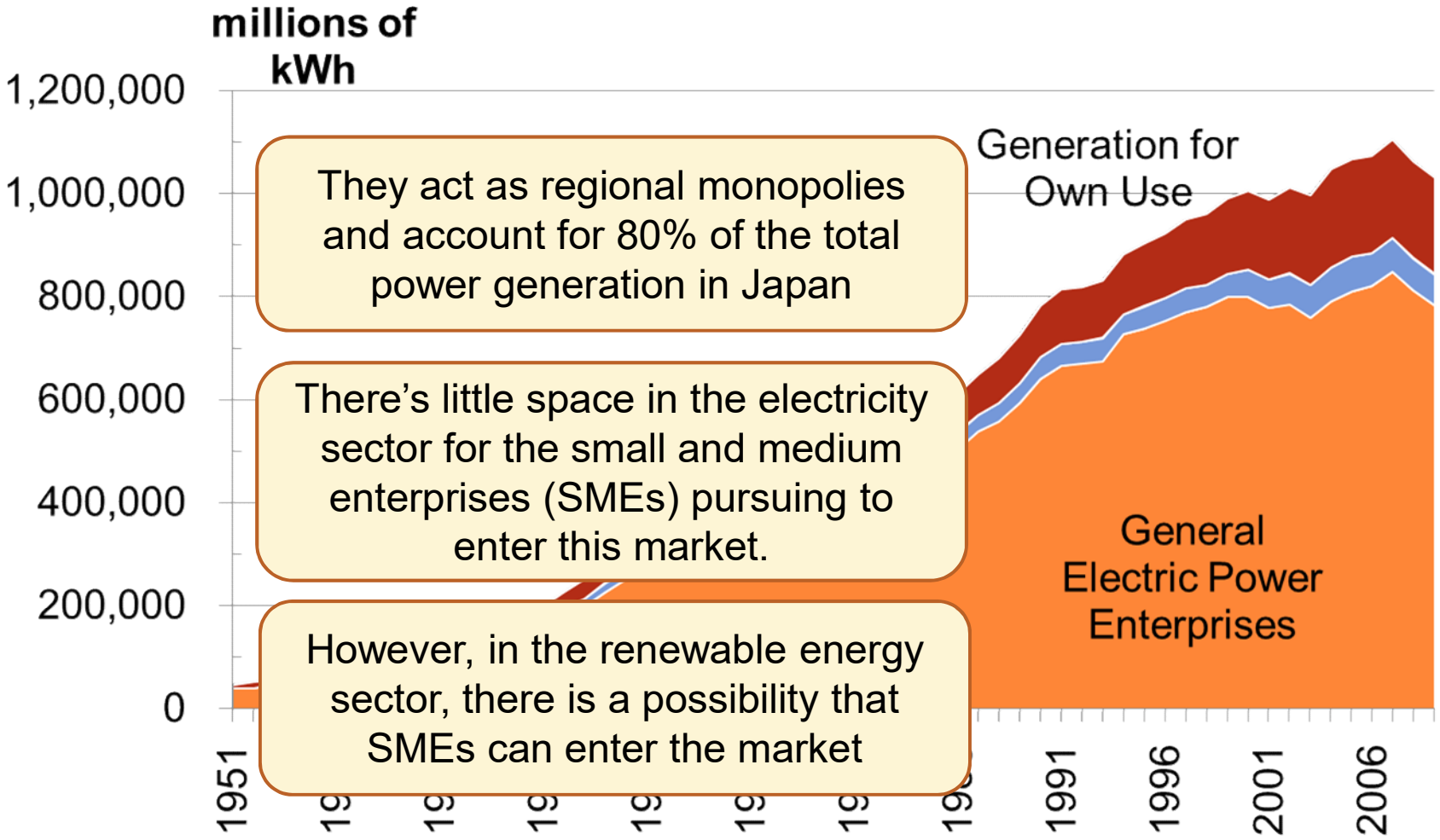
Source: Statistic Bureau, Japan, 2012

Electric Power Generated in Japan, F.Y.1951 - 2009



Source: Statistic Bureau, Japan, 2012

Electric Power Generated in Japan, F.Y.1951 - 2009



Source: Statistic Bureau, Japan, 2012

Difference between the Renewable and conventional energy

Renewable energy

- Wind, hydropower, solar energy, biomass, and geo-thermal
- Many of the renewable energy facilities are small-scale and decentralized (except large hydro dams)

Photo: Pedrojperez, morgueFile

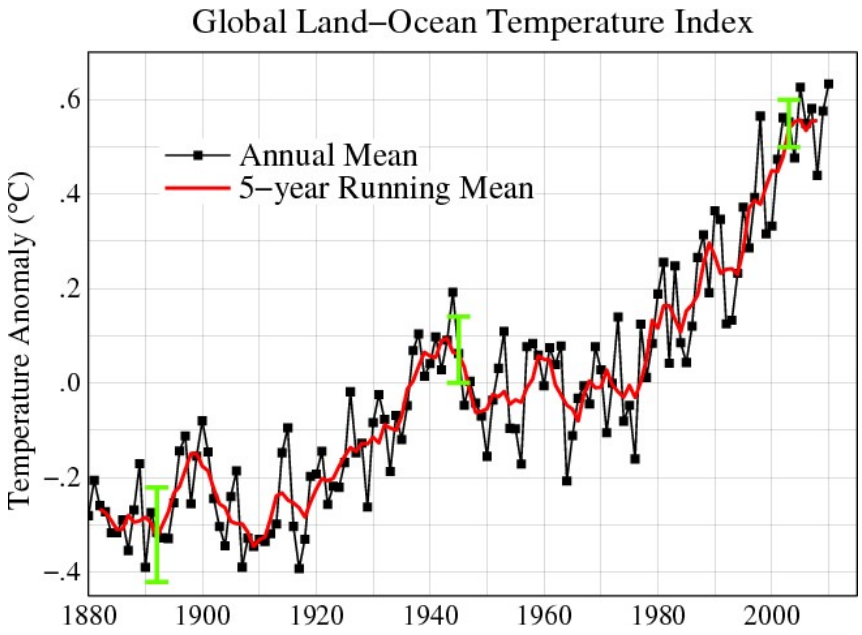
Conventional energy

- Oil, coal, gas, nuclear, and electricity generated by them
- The conventional power stations and energy plants are large-scale and centralized

Photo: MGDboston, morgueFile

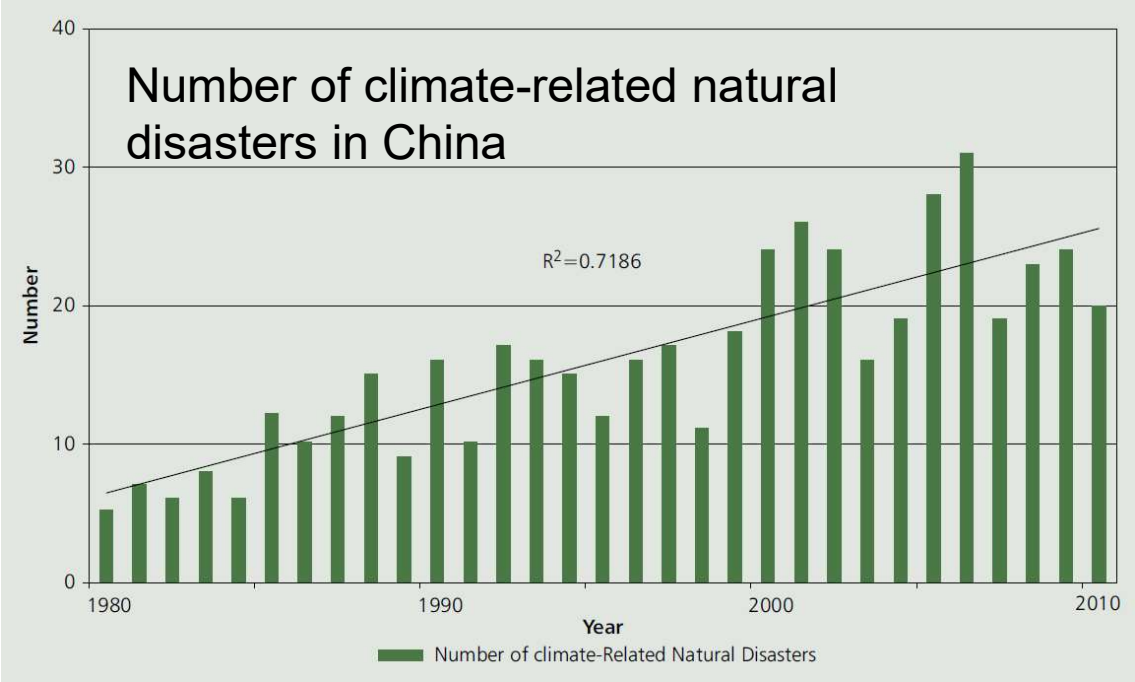
Necessity of the renewable energy: Climate change concerns

- Causes
  - Scientists say global warming is caused by increasing concentrations of greenhouse gases (GHG)
  - GHG are CO2, methane, nitrous oxides, ozone, etc.
  - GHG are produced by human activities such as burning fossil fuels (that is energy consumption) and deforestation (destruction of forests)
- Influences
  - Global warming will cause climate change
    - Sea level rise (lost of the land areas)
    - Expansion of deserts (lost of agricultural lands)



Source: Wikipedia

Results of the climate change



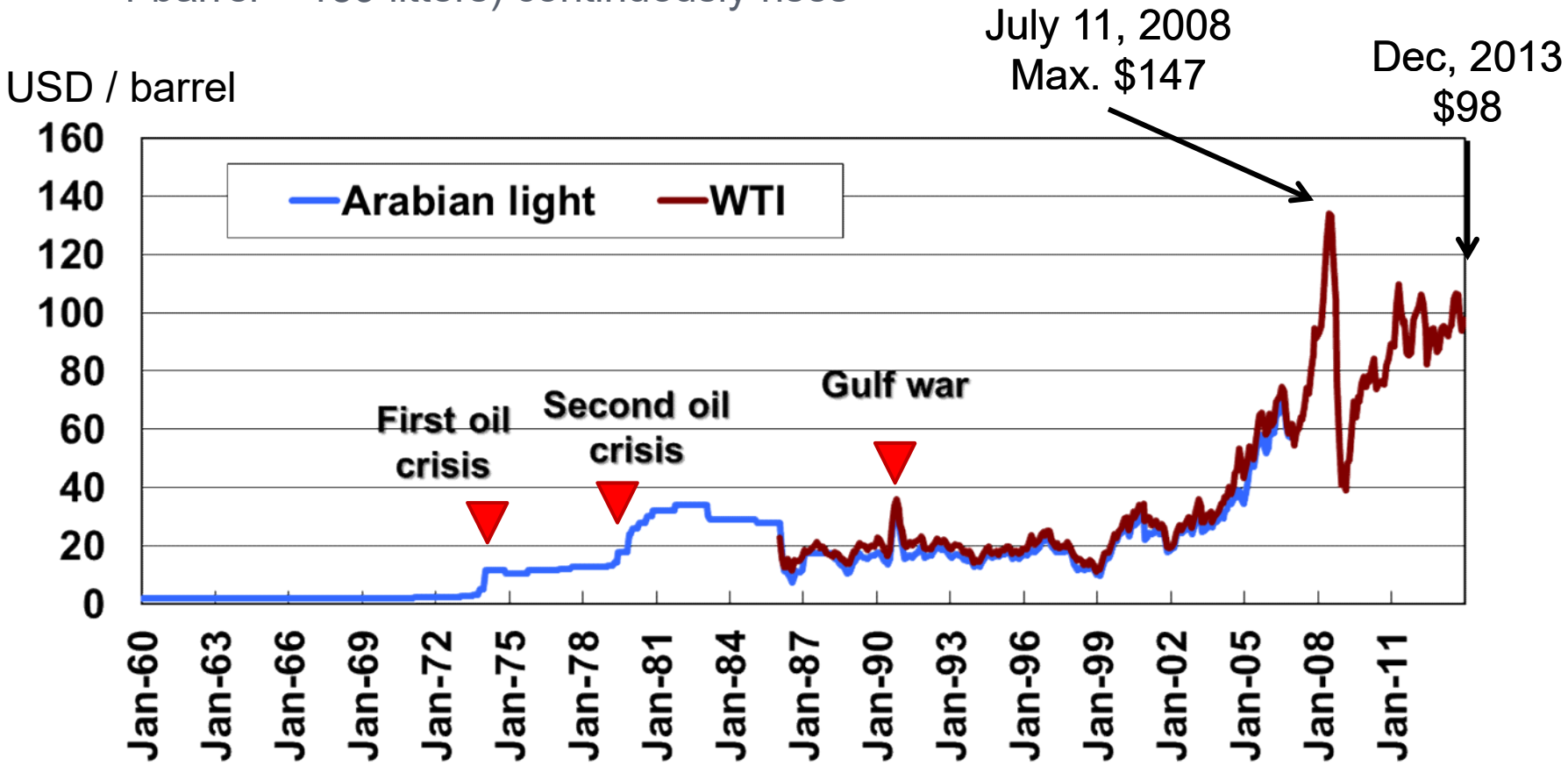
Change in Mean Annual Temperature compared to 1961–1990

	2030	2040	2050
China	1.40	2.30	4.65
Japan	1.33	1.94	3.81
Mongol	1.29	1.94	4.05
S. Korea	1.58	2.56	5.16

Source : ADB, "Economics of Climate Change in East Asia"

Necessity of the renewable energy: High oil prices

- International crude oil price (Arabian light and WTI, Nominal $ per barrel, 1 barrel = 159 litters) continuously rises



Source: DOE, EIA

The renewable energy is required

- The renewable energy is required because of
  - The climate change
  - High oil price
- However the necessity of the renewable energy varies by country
- Walsh (2012) proposed the scheme of the renewable energy technology (RET) environment

RET commercialization environments and classified countries

		Eco-sophistication of the Market	
		Low	High
Demand for Renewable Energy Technology Products	Low	Innovation Wasteland China, India, Mexico, Russia, Turkey	Innovation Push Australia, Canada, Finland, France, *Japan*, Norway, S. Korea, Sweden, Switzerland, U.K., U.S.A.
	High	Innovation Pull Brazil, Czech, Greece, Hungary, Italy, Poland, Slovakia	Innovation Nirvana Austria, Belgium, Denmark, Germany, Iceland, Ireland, Netherlands, New Zealand, Spain

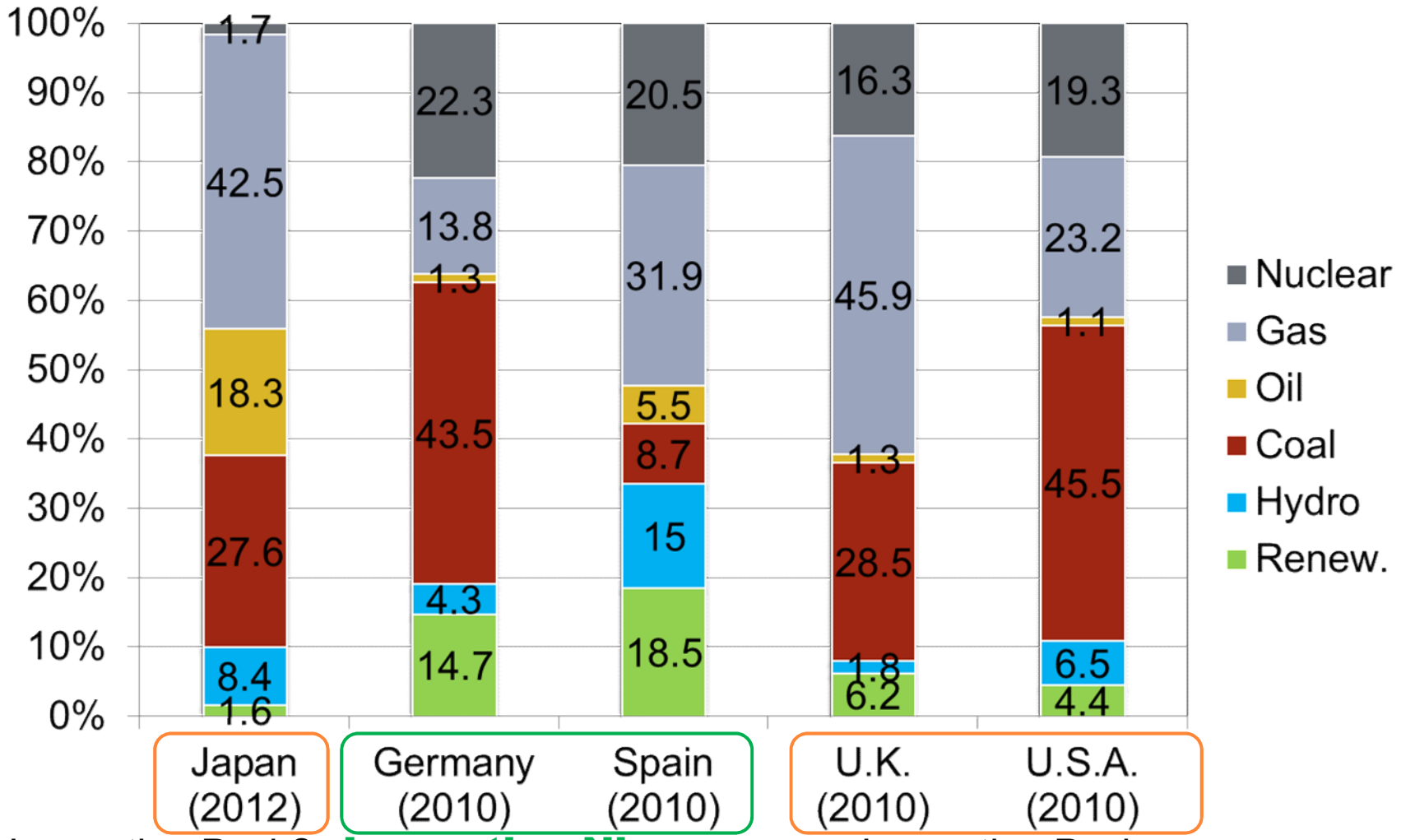
Walsh (2012), *Technovation, 32*, 32 – 42.

RET commercialization environments and related strategies

		Eco-sophistication of the Market	
		Low	High
Demand for Renewable Energy Technology Products	Low	Innovation Wasteland Government Incentives, External R&D contracts, Utility funding	Innovation Push Joint Venture, Strategic Alliance U.K., U.S.A.
	High	Innovation Pull Outsourcing, Licensing	Innovation Nirvana Venture Capital, Equity Financing, Acquisition Zealand, Spain

Walsh (2012), *Technovation, 32*, 32 – 42.

Introduction of the renewable energy for the electricity generation in the developed countries



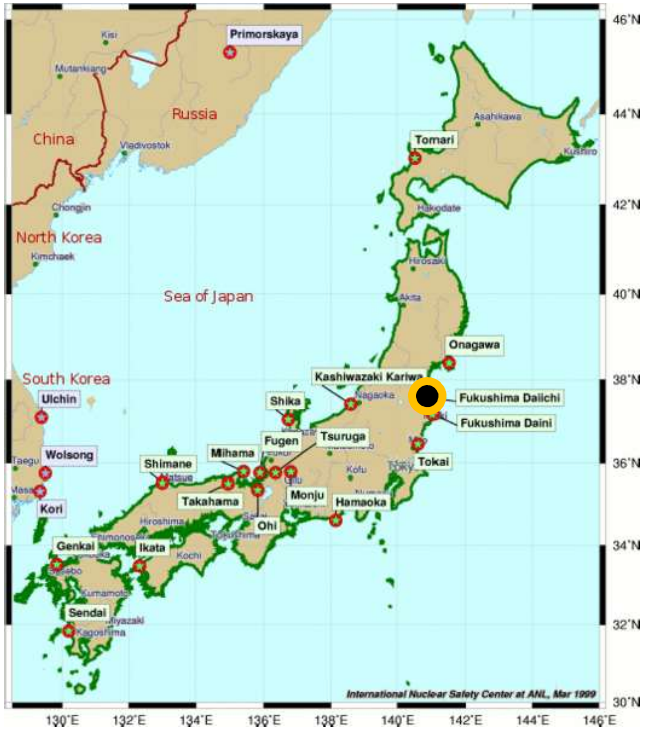
Source: Advisory Committee for Natural Resources and Energy June 27, 2013

Research question

- Walsh's analysis was conducted by using the dataset before 2008
- However, in 2011, Japan faced a serious energy crisis (i.e., the 2011 disaster)
- There is a possibility of increasing the level of RET demand in Japan after that
- Is the Japanese RET commercialization environments shifting from the Innovation Push to the Innovation Nirvana?

March 11, Fukushima Daiichi nuclear disaster

- At 14:46 JST on Friday, 11 March 2011, the Great East Japan Earthquake occurred
- The earthquake and tsunami caused equipment failures, nuclear meltdowns, and release of radioactive materials at Fukushima 1st nuclear power plant.
- The disaster resulted in the evacuation of 300,000 people lived around the power station and a nationwide electricity shortage.



Source: Wikipedia

The aftermath

- The disaster changed the energy consciousness of Japanese people and government
- A few months later, opinion polls conducted by Japanese news agencies showed that 75 to 80 percent of Japanese people said that “they are anti-nuclear” (Gavin Blair, 2011)
- The energy whitepaper 2011 said that
  - “the public confidence in safety of nuclear power was greatly damaged”
  - and “it is essential to thoroughly promote energy saving awareness and the development and popularization of renewable energy.”

The feed-in-tariff (FIT) started

- Against this background, the Japanese government passed a bill to subsidize electricity from the renewable resources in August 2011 and launched a feed-in-tariff (FIT) on July 1, 2012
- The change in the energy policy leads to the change in the business environment in the energy sector
- The governmental support to the renewable energy may give an opportunity not only to large enterprises, but to the small and medium enterprises (SMEs).

* A feed-in tariff is a policy mechanism designed to accelerate investment in renewable energy technologies. It achieves this by offering long-term contracts to renewable energy producers, typically based on the cost of generation of each technology (Wikipedia)

Outsiders cast ambitious eyes to the renewable energy

- The SoftBank Group, the third largest mobile carrier in Japan,
  - Recognizes the energy issue as a challenge to be addressed by the nation,
  - And believes that the promotion and expansion of safe renewable energy is one of the solutions
  - established SB Energy Corp., a wholly-owned subsidiary which produces electricity from renewable energy sources

SoftBank

Source: http://www.softbank.jp/en/corp/csr/future/instance_04/contents_05/

SMEs take advantage of a market opportunity

- Ambitious SMEs take advantage of an opportunity to enter the renewable energy market
- Type of businesses
  - Selling and Setting up the photovoltaic cells on the roofs of the residences
  - Borrowing the roofs of the residences, setting up the PV cells, and selling the generated electricity to the general electric power companies
  - Borrowing a large plot of land, setting up the PV cells or the wind turbines, and selling the generated electricity to the general electric power companies

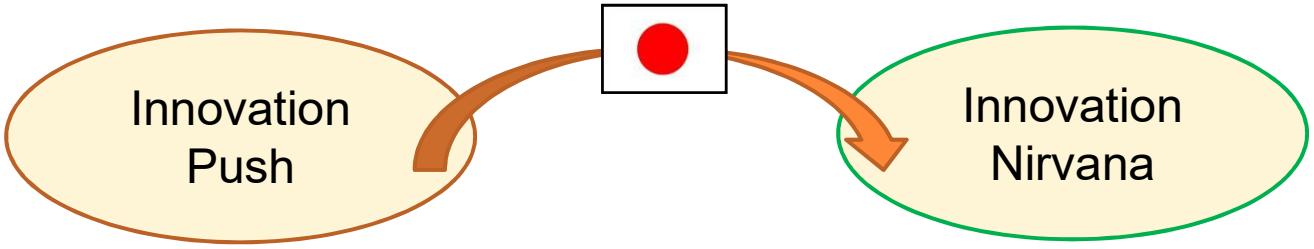
Installed capacity of the renewable energy in Japan before and after the FIT launched

	Before the FIT Cumulative installed capacity to the end of June 2012 [MW]	After the FIT Installed capacity from July 2012 to March 2013 [MW]	After the FIT Installed capacity from April to November 2013 [MW]
PV power (non-residential, 10kW or more)	90	70.4	363.2
PV power (residential, 10kW or less)	470	96.9	95.3
Wind power	260	6.3	0.9
Small and medium hydropower	960	0.2	0.3
Biomass power	230	3.0	8.8
Geothermal power	50	0.1	0.0
Total	2060	176.8	468.5

Increasing at a rapid rate

Research question (again)

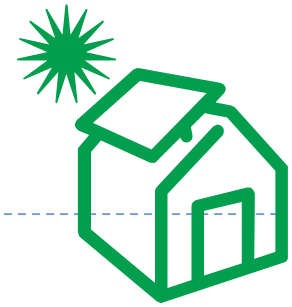
- Is the Japanese RET commercialization environments shifting from the Innovation Push to the Innovation Nirvana?



- The author is going to investigate the RET demand in the recent years by using the internet questionnaires

The Internet Questionnaires

- In order to discover what Japanese households think of the conventional and renewable energy and what they do for energy saving, the author carried out surveys in 2012 and 2013
- Information and data were collected through the website with the respondents (panels) organized by the internet research firm (internet / online surveys)
- The respondents were divided into two groups:
  - PV owners, the members of households, which own residential PV system
  - Non-owners, the member of households, which don't own residential PV system



Summary of the surveys implementation

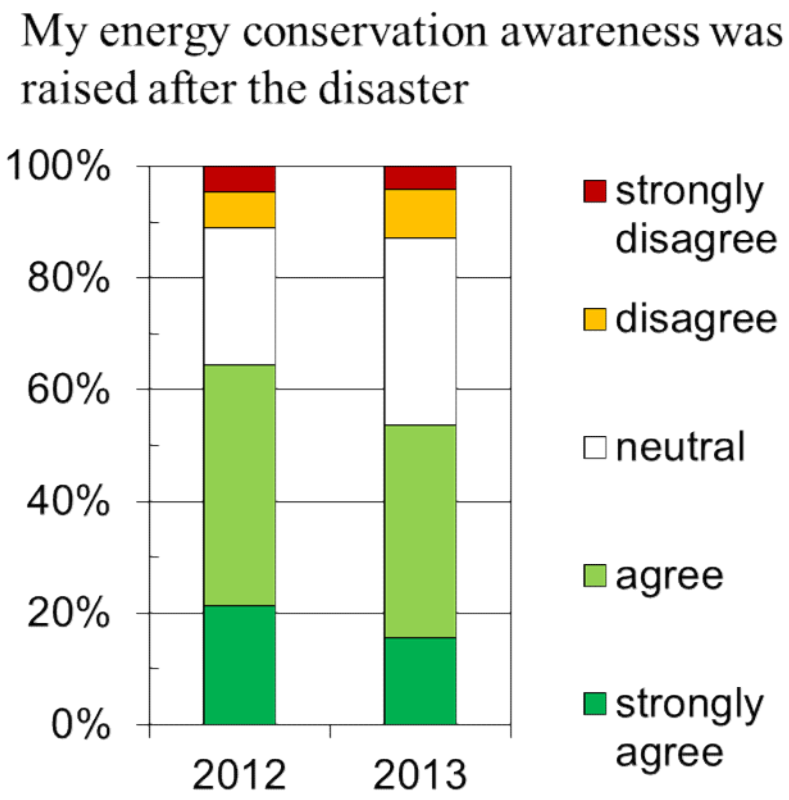
Items	2012 survey		2013 survey	
Implementation period	October 11 – 12, 2012		October 11 – 12, 2013	
Type of respondent	Married females who live in independent (detached) houses			
	PV owners	non-owners	PV owners	non-owners
Target number of the responses	400	400	400	400
Number of the valid responses	406	418	408	416

Energy Consciousness

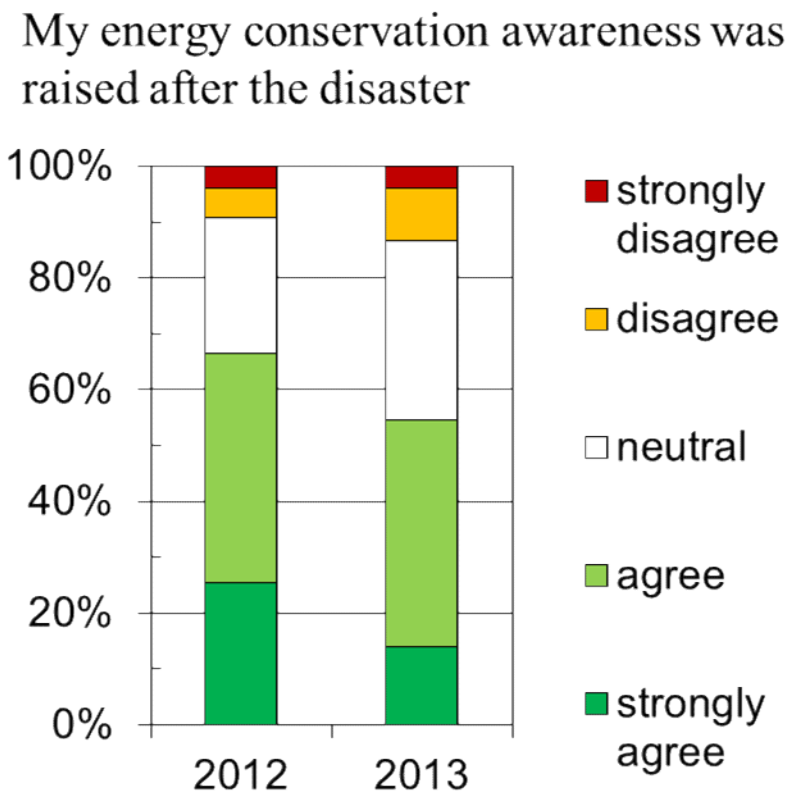
- As to the energy consciousness before and after the 2011 disaster, the PV owners and non-owners were asked whether they agree or disagree with the following eight statements:
  1. I have conserved energy before the disaster.
  2. My electricity conservation awareness was raised after the disaster.
  3. My energy conservation awareness was raised after the disaster.
  4. I have been implementing energy saving activities since the disaster.
  5. I became more interested in the renewable energy.
  6. I can tolerate the inconvenience caused by energy saving.
  7. The nuclear plants should be abolished in the 2030s.
  8. I place emphasis on the argument for and against nuclear power more than the global warming.

Energy conservation awareness

PV owners' awareness



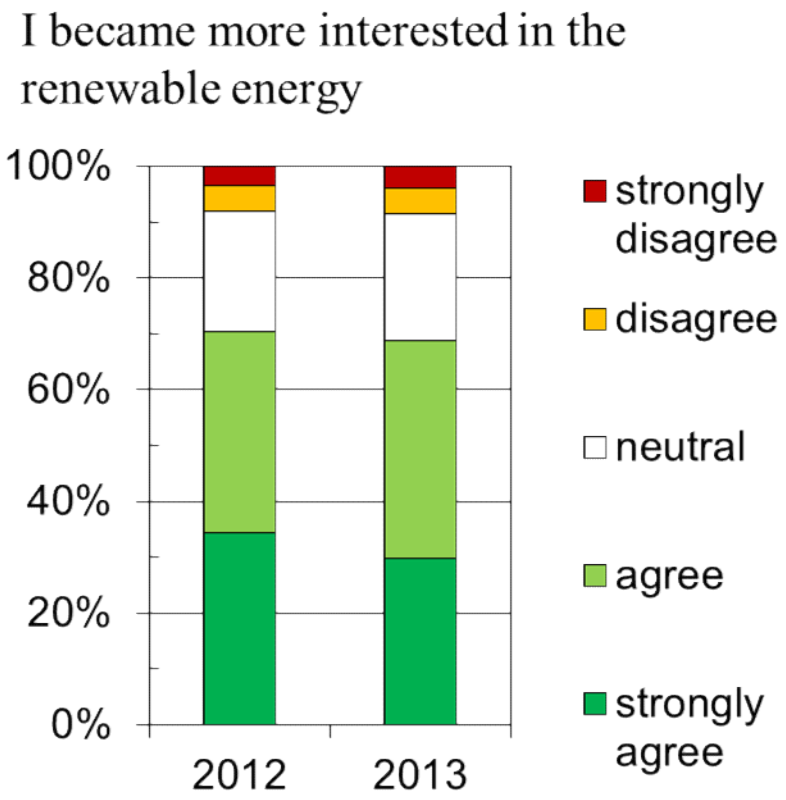
Non-owners' awareness



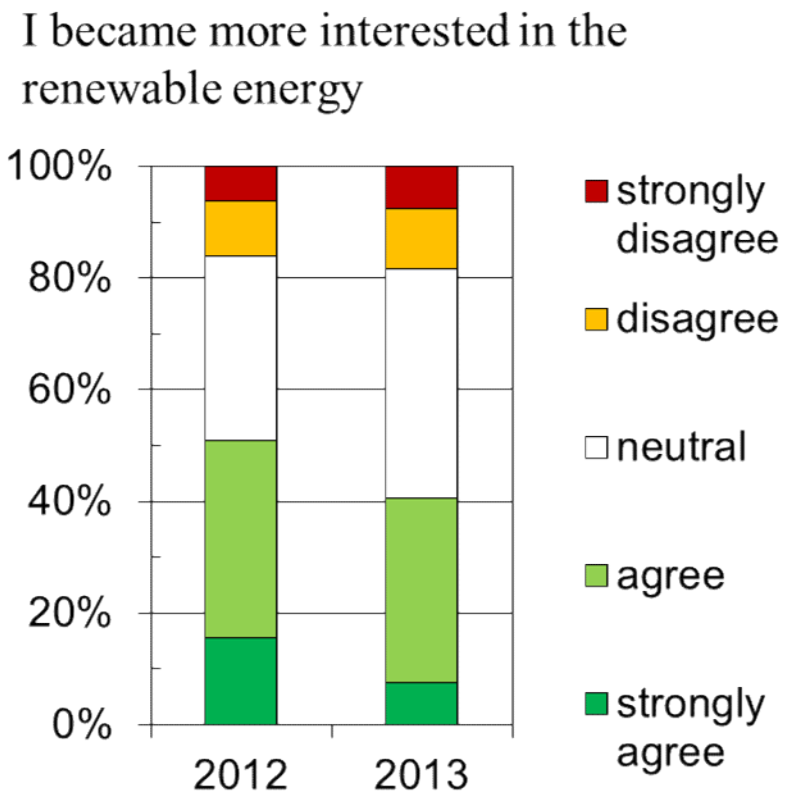
At least 50% of the people have been aware of the energy conservation since the disaster

Concern to the renewable energy

PV owners' concern

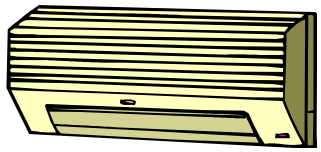


Non-owners' concern

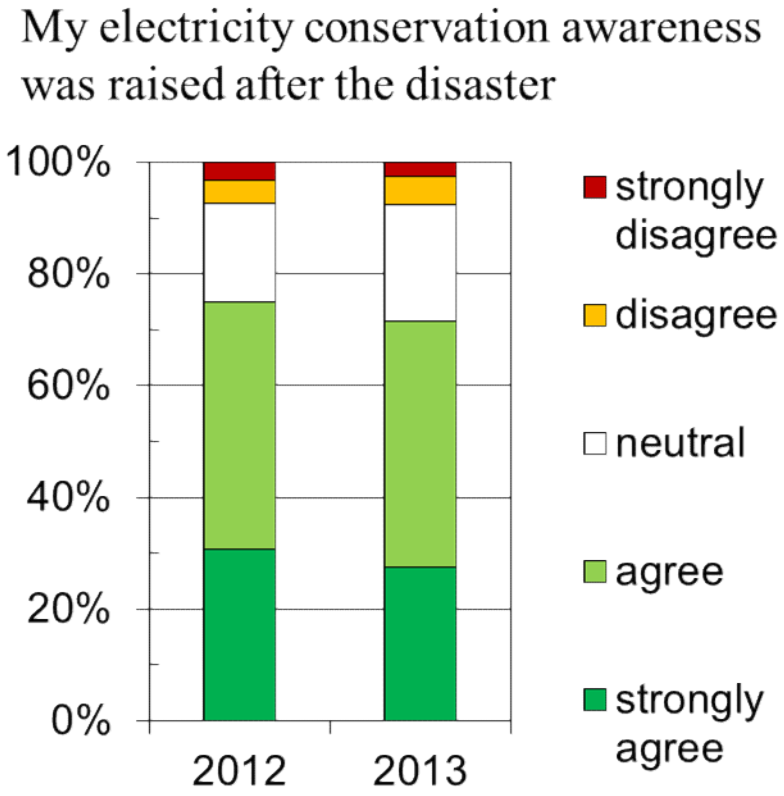


There's a difference between the concern to the renewable energy of the PV owners and the non-owners.

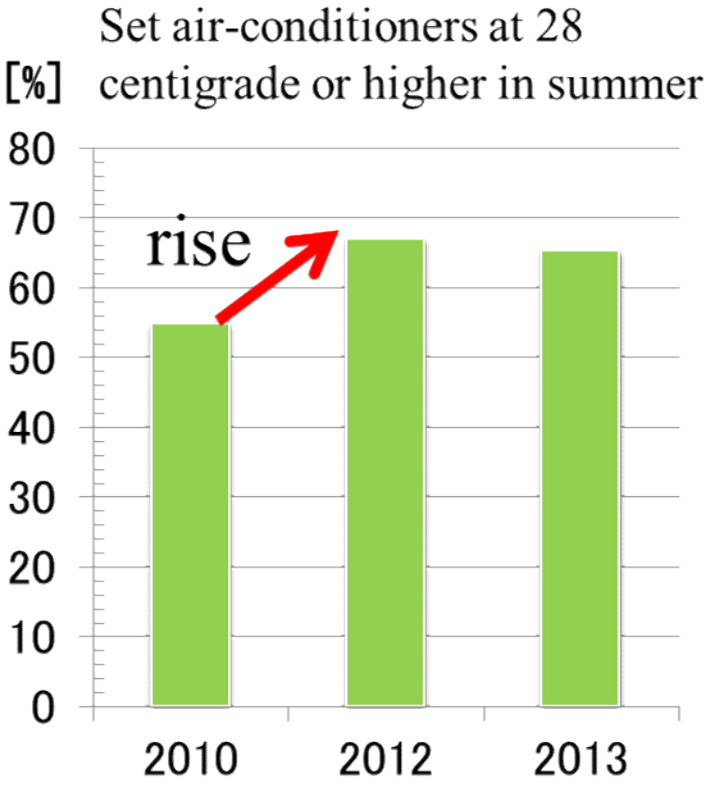
Electricity conservation awareness and temperature adjustment (PV owners)



PV owners' electricity conservation awareness

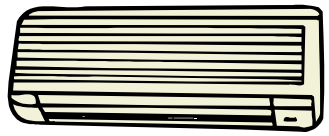


Temperature adjustment of air-conditioners

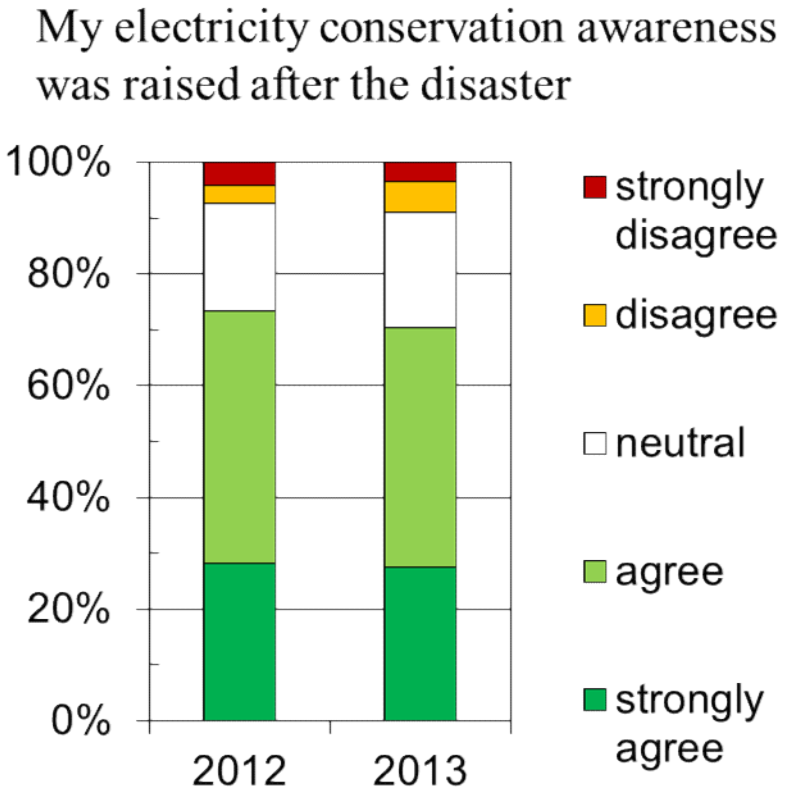


The PV owners' electricity conservation awareness is high and their energy conservation activity has become strengthened.

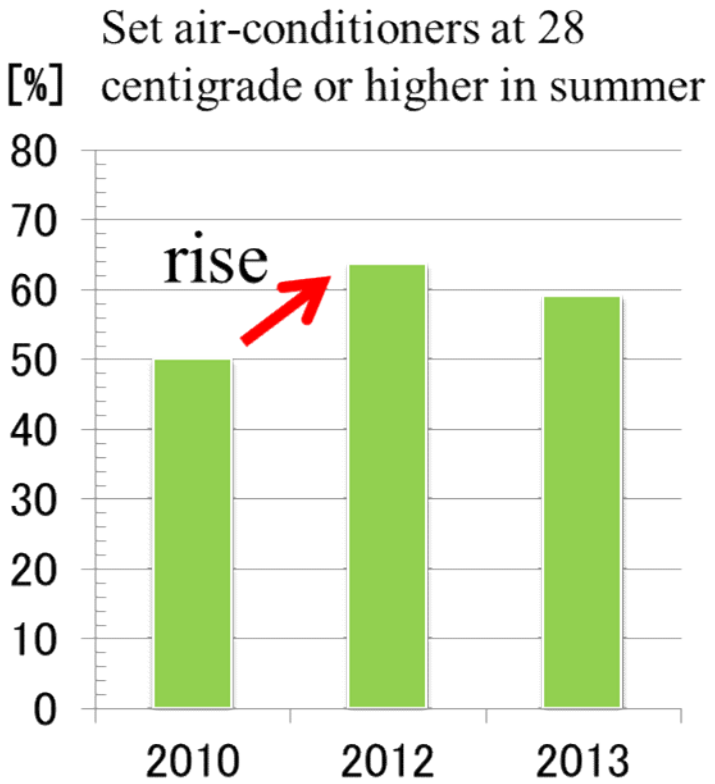
Electricity conservation awareness and temperature adjustment (Non-owners)



Non-owners' electricity conservation awareness



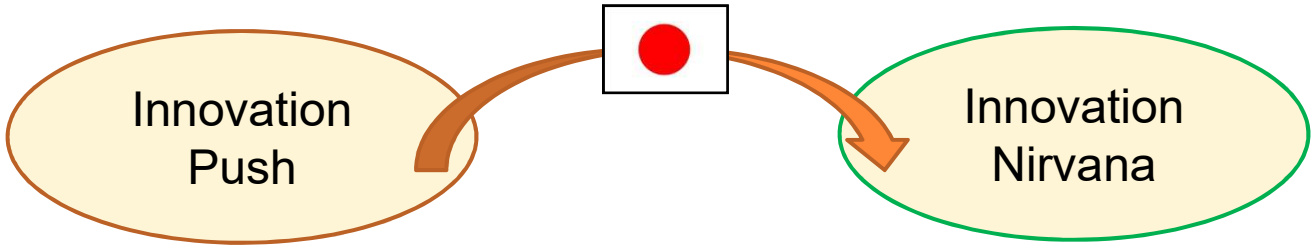
Temperature adjustment of air-conditioners



The non-owners' electricity conservation awareness is also high and their energy conservation activity has also become strengthened.

The survey results show that …

- More than half of the Japanese people have raised their awareness of electricity and energy conservation, and became more interested in the renewable energy after the 2011 disaster
- This tendency is particularly true of the PV owners
- There is a possibility of increasing the level of RET demand and the Japanese RET commercialization environment is moving from the Innovation Push to the Innovation Nirvana.

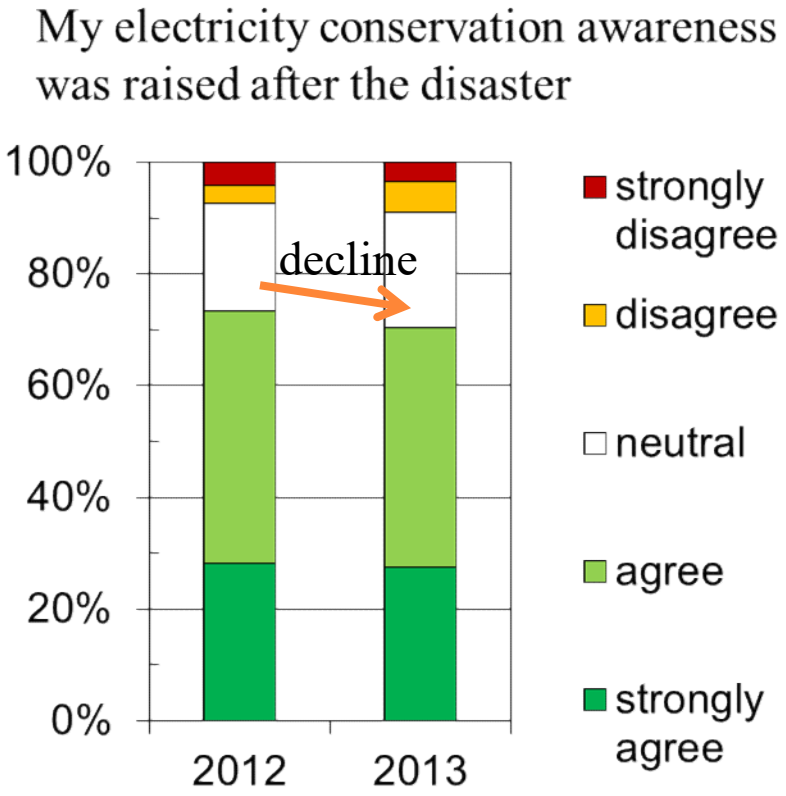


Important reminder

- However, there is also a possibility that this move may just be a temporary trend
- The comparison between the results of the 2012 and 2013 surveys indicates it

Electricity conservation awareness (Non-owners)

Non-owners' electricity conservation awareness



Decline?

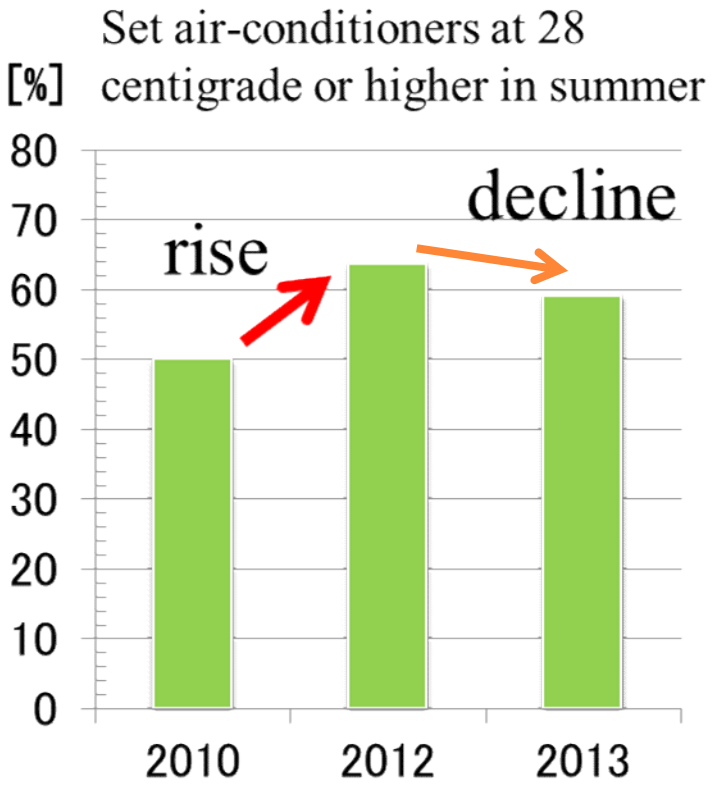
- The percentage of the positive responses to the energy conservation awareness declined from 2012 to 2013

Temperature adjustment (Non-owners)

Decline?

- The percentage of the respondents who do particular energy saving activities also declined from 2012 to 2013

Temperature adjustment of air-conditioners



Future subject

- In order to watch the trend of RET demand in Japan, the author will continue to conduct the survey on the energy consciousness periodically for several years in the future

Thank you!
Terima kasih!