Supplemental online material

Public Opinion Changes After the Fukushima Daiichi Nuclear Power Plant Accident to
Nuclear Power Generation as Seen in Continuous Polls over the Past 30 Years

A. Kitada

Figure S1 Changes in the numbers of media reports on green energy.

Figure S2 Opinions for and against new construction of nuclear power plants in the future.

Figure S3 Opinions for and against the replacement of aging nuclear power plants.

no statistically significant difference

Figure S4 Opinions about the usefulness of NPG for the stable supply of electricity.

Figure S5 Opinions on capacity of electricity generation in Japan 10 years in the future.

stability from the viewpoint of a sufficient number of generating power plants	to have a reserve capacity so as not to cause blackouts due to electricity shortage	
a lower electricity charge by generation cost reduction	to lower the electricity charge by reducing the generation cost as much as possible	
the amount of CO ₂ emission	not to adopt the generating method that emits more CO ₂ which causes global warming	
renewable energies	to adopt the generating method to utilize natural energy sources even if the generating cost is higher or the amount of electricity generation is unstable	
stability from the viewpoint of energy resources	to adopt the generating method which is less affected by international situations like the 1973 oil shock and can provide a stable electricity supply	
the risk of a big accident	not to adopt the generating method which has the risk of causing significant effects to the people and environment if an accident occurs	

Figure S6 Six options and an example of giving the seals.

Figure S7 Important considerations for the utility companies in generating electricity; comparison between the supporting and opposing groups.

Figure S9 The acceptable markup range of electricity charge to promote renewable energies.

Figure S10 Do you think the amount of electricity by NPG in the future is increasing or decreasing worldwide?

Figure S11 Do you think people can utilize NPG well so as not to cause harmful effects on themselves and the environment?

	as an example	Desirable composition of electricity sources 10 years in the future
fossil		
hydro		
nuclear		
solar PV		
wind		
fuel cell power		
geothermal		
waste (biomass)		
nuclear fusion		

Figure S12 Nine options and an example of giving the seals.

Table S1 Continuous Surveys on NPG.

Research organization	region	research method	given answer options
Asahi Shimbun A	nationwide	face-to-face (later surveys by telephone)	supportive of NPG, <u>opposed to NPG</u>
Asahi Shimbun B	nationwide	telephone	better to promote, maintain status quo, <u>better to reduce, should no longer use</u>
NHK	nationwide	face-to-face	should aggressively promote, should carefully promote, <u>should not promote any more, should no longer use</u>
CAO A (before 1984)	nationwide	face-to-face	(percentage of NPG) OK to maintain status quo, better to increase, <u>better to decrease</u>
CAO B* ¹ (after 1984)	nationwide	face-to-face	aggressively promote, carefully promote, maintain status quo, <u>abolish in the future, immediately abolish</u>
JPC* ²	government-designated cities and 23 wards of Tokyo	mail (placement from 1999)	aggressively promote, carefully promote, maintain status quo, immediately <u>reduce, stop all operating nuclear power plants</u> , don't know
EIT* ³	nationwide	placement	aggressively construct (new nuclear power plants), gradually construct, maintain status quo, <u>gradually reduce (the number of nuclear power plants), no longer use</u> , don't know
IAE	within an area 30km from JR Tokyo Station	placement	continue with new construction and expansion of present plants, maintain status quo, don't know, <u>gradually abolish, immediately abolish</u>
JAERO	nationwide	placement	necessary, necessary if anything, neutral, <u>unnecessary if anything, unnecessary</u>

*1 Five options including maintain status quo, but the description differed slightly from year to year

*2 Created in 1994 by merger of the Japan Productivity Center (JPC) and the Social and Economic Congress of Japan (SECJ).

*3 Dissolved on Oct.31, 2011.

Table S2 The research period, sampling method and number of samples in INSS surveys.

Research period	Timing	Sampling method	Number of samples	Number of collected samples
Jan. 1993	regular	A	1500	1138
Feb. 1996	2 months after the Monju Accident* ¹	A	750	562
May 1997	2 months after the Bituminization Facility Accident at Tokai* ¹	A	750	533
Jul. 1998	regular	A	1500	1054
Dec. 1999	2 months after the JCO Criticality Accident in Tokai	A	750	532
Oct. 2000	a year after the JCO accident	A	1500	1056
Nov. 2002	regular (2 months after the Tokyo Electric Power Co., Inc. issue (falsification of inspection data))	A	1500	1061
Sep. 2003	after the issue of an electricity shortage in the metropolitan area occurred	A	1500	1065
Oct. 2004	2 months after the Mihama Unit 3 Accident	A	1500	1060
Oct. 2005	14 months after the Mihama Unit 3 Accident	A	1500	1052
Oct. 2007	regular, random route method	B* ²	—	1010
Oct. 2010	regular, random route method	B* ³	—	1042
Jul. 2011	4 months after the Fukushima Accident	B	—	528
Dec. 2011	9 months after the Fukushima Accident	B	—	529

Sampling method A: chosen from the Basic Resident Register (completed by the random route method)

Sampling method B: random route method

*1 Conducted by the simplified method with 1/3 amount the number of questions.

*2 Conducted simultaneously with other method using the method based on a database for a digital residents map.

*3 Conducted simultaneously with other method using method based on the Basic Resident Register (planned number of samples: 1,800, corrected number of samples: 1,012)

Table S3 The relation between the idea of increasing or decreasing NPG and the opinions on its utilization.

	Supporting group Number of samples (%)	Opposing group Number of samples (%)	total
increasing very much	14 (82%)	3 (18%)	17
increasing a little	48 (69%)	22 (31%)	70
stable	66 (69%)	30 (31%)	96
decreasing a little	134 (60%)	91 (40%)	225
decreasing very much	41 (36%)	73 (64%)	114
total	303 (58%)	219 (42%)	522

$\chi^2=34.86$, df=4, p<0.01.

Table S4 The upsides and downsides of methods of electricity generation.

method of generation	upsides	downsides	actual generation amount in 2008 in Japan: 1 million kWh	rough generation capacity per plant: kw
1. fossil fuel (oil, coal, natural gas)	- power generation is able to follow change of demand - abundance of coal	- anxious about running out of oil and natural gas - anxious about global warming due to CO₂ emission	798,930	1,000,000
2. hydro	- renewable - hydro generation can be multipurpose - almost no CO₂ emission	- scare at desirable locations in Japan - leads to environment destruction (e.g. dam building activities)	83,504	300,000
3. nuclear	- can generate big amounts of power and stable supply - almost no CO₂ emission	- indispensable to manage radiation very strictly - need tightly controlled facilities to secure safety - disposal site of radioactive wastes has not been decided	258,128	1,000,000
4. solar PV	- renewable - almost no CO₂ emission	- need large sites to get large generation capacity - unable to generate power during nighttime and rainy days - higher cost compared with existing generating methods	2,272	Household: 50 mega solar: 1,000 ~ 18,000
5. wind power	- renewable energy - almost no CO₂ emission	- unstable generation due to wind variations - can cause noises and be an obstacle to radio waves and viewing the scenery	3,265	300
6. fuel cells	promising way to get high total energy efficiency using waste heat	higher cost compared with existing generation methods	43	5,000
7. geothermal	- renewable energy - almost no CO₂ emission	- limited good site - possibly cause huge environmental destruction	2,750	50,000
8. biomass (waste) generation	can use waste (trash) which used to be thrown away or biological resources	- generation efficiency is low - costly to collect, transport and manage	6,837	20,000
9. nuclear fusion	inexhaustible resource	no clear prospect for realization	-	-

Appendix

The questions selected for discussion in this report, written in the order that they appeared in the questionnaires

[Question] If there is a shortage of electricity, do you think that you can make a 15% saving of electricity during summer afternoons when the amount of electricity consumption has its peak? Please choose one of the options.

1. Yes, I only need to take care not to waste it.
2. Yes, but I feel it is slightly inconvenient or uncomfortable.
3. Yes, but I feel it is very inconvenient and tries my patience.
4. No.

[Question] How useful do you think the following items are for today's society and your daily life?

- (a) Development of passenger aircraft
  - (b) Treatment of AIDS
  - (c) Nuclear power generation
  - (d) Organ transplantation
  - (e) Environmental protection in your neighborhood
  - (f) Countermeasures against global warming
1. Very useful
  2. Useful
  3. Neither
  4. Not so useful
  5. Not useful

[Question] This is a question concerning the following issues. How anxious do you feel about each issue?

- (a) Road traffic accidents
  - (b) Train accidents (excluding Shinkansen lines)
  - (c) Shinkansen (bullet) train accidents
  - (d) Large aircraft accidents
  - (e) AIDS
  - (f) Nuclear facility accidents
  - (g) Nuclear waste treatment and disposal facilities
  - (h) Environmental destruction in your neighborhood
  - (i) Global environment destruction
  - (j) Large scale electrical blackouts
1. Extremely anxious
  2. Very anxious
  3. Slightly anxious
  4. Not anxious at all
  5. None of the above

[Question] When you think about Japan 10 years in the future, do you think there will have enough capacity to meet the electricity demand? Check one of the following options.

1. I believe there will have enough capacity.
2. I feel a little anxious about the supply capacity.
3. I feel very anxious because today's situation suggests meeting demand is very unlikely.

[Question] It is said that each method of electricity generation has its upside and downside.

Which method do you think Japan should select as the main method? After thinking deeply about their upsides and downsides, write the number of the one method that you think is best. (See Supplemental online Table S4.)

[Question] Concerning generation methods in the list of the former question, when the actual whole amount of generation in Japan is described as 10 seals, that of fossil fire in 2005 is 6 seals, that of nuclear is 3 seals and that of hydro is 1. (Shown as the example below.) What do you think is a reasonable composition of generation methods 10 years from now in Japan? Do not consider your answer to the former question in deciding your reasonable composition.

Put as many seals in the circles below as you think are needed to get a reasonable amount of generation. Use all 10 seals. (One seal is equal to 10%) fossil fuel, hydro, nuclear, solar, wind, fuel cell, biomass (waste), nuclear fusion, example, generation methods in the future in Japan. (See Supplemental online Fig. S12.)

*The respondents were given a commercially available sheet of 10 seals (A1 round label seals in 15mm diameter) with the questionnaire paper. They were told to remove the seals from the sheet and put them in the circles of the question. Adhesiveness of the seals was not so strong that the respondents could not pull off a seal and put it on again to change their answers.

[Question] Do you think NPG is useful to supply electricity stably and without any shortage?

1. Yes, extremely useful
2. Yes, very useful.
3. Yes, slightly useful.
4. No, it is almost useless.
5. No, it is completely useless.

[Question] Do you think people can utilize NPG well so as not to cause harmful effects on themselves and the environment?

1. Yes, they can.
2. I don't know.
3. No, they cannot.

[Question] Do you support construction of new nuclear plants, or oppose it?

1. I support it.
2. I support if anything.
3. I don't know.
4. I oppose if anything.
5. I oppose it.

[Question] Some nuclear power plants will be reaching the end of their life. If they are decommissioned, the supply capacity will drop by that amount. What do you think about constructing new plants to replace aging plants to keep generation capacity?

1. I support it.
2. I support if anything.
3. I don't know.
4. I oppose if anything.
5. I oppose it.

[Question] There is an opinion that "The government and utility companies do not report the reality about NPG safety." What do you think about it?

1. I agree strongly.
2. I agree somewhat.

3. I don't know.
4. I disagree somewhat.
5. I disagree strongly.

[Question] We are asking many questions about NPG. Which is the closest opinion to yours?
Choose one and circle it.

1. I think it is good to utilize NPG though its safety should be taken into consideration.
2. I think it is inevitable to utilize NPG in real life, but I feel uneasy about its safety.
3. I think it is necessary to rely on other generation means which are safer than nuclear power, regardless of the cost or even if it causes destruction of the environment.
4. I think NPG must not be utilized however hard our life becomes.

[Question] The following are typical opinions supporting and opposing NPG. Read each opinion, and circle the numbers of those that you agree with. If you think of other reasons, write them in the space, [Others ( )]. Then write the number of the opinion that you agree with most strongly among those that you circled as supporting or opposing respectively in the blank below.

a) Choose the supporting opinions that you can agree with and circle their numbers.

(The supporting options of this question are omitted because results for this part of the question were not analyzed in this report.)

b) Choose the opposing opinions that you can agree with and circle their numbers.

1. The method to treat the nuclear waste has not been established.
2. Electricity supply is enough without NPG.
3. There is a risk of radioactive contamination.
4. The world trend is toward no longer using NPG.

5. There will be much big damage if an accident occurs.
6. We cannot trust the safety system of NPG and confirmation of security by the government and companies.
7. We must weigh more on the development and promotion of new energy rather than the NPG.
8. No regions are accepting the construction of new nuclear power plants.
9. The generating cost of nuclear power is not so cheap if the cost for treatment and disposition of radioactive waste is considered.
10. I cannot trust the governmental policy on NPG.
11. Because the number of aging nuclear power plants is increasing, safety is declining.
12. Others ( )

[Question] Among the following issues how much do you think are important when utility companies generate electricity? Put as many seals in the circles below as you think are needed to show importance. Use all 10 seals. (One seal is equal to 10%.) (How respondents answered was explained in the main body of this report and is omitted here.)

[Question] Do you think the amount of electricity by NPG in the future is increasing or decreasing worldwide?

1. It is increasing very much.
2. It is increasing a little.
3. It is stable.
4. It is decreasing a little.
5. It is decreasing very much.

[Question] If we stop NPG and change to renewable energies like wind power or solar PV

aggressively as an energy policy, how long do you think it will take to accomplish?

1. Within 5 years
2. 10 years
3. 15 years
4. 20 years
5. 25 years
6. More than 30 years

[Question] If the additional cost to promote renewable energies like wind power or solar PV will to be paid by electricity charges to consumers, how much markup can you accept? Choose one among the following options.

1. Less than 10%
2. 20%
3. 30%
4. 40%
5. More than 50%
6. I can never accept it.

[Question] If we reduce the amount of NPG, some say the following things will happen and others say they will not happen. What do you think about each one? Answer all items (a) to (h).

- (a) The electricity rate will go up.
- (b) The supply of electricity will be unstable.
- (c) Factories will move abroad and jobs will be lost.
- (d) Japan's competitiveness in world markets will weaken and the Japanese economy will go down.

- (e) Comforts of daily life and the standard of living will be lower.
  - (f) International conflicts over natural resources like oil or natural gas will occur.
  - (g) CO2 emission will increase.
  - (h) The local economy and people's lives in regions where nuclear power plants are located will not be able to prosper.
1. I think so (it will happen).
  2. I don't know.
  3. I don't think so (it will not happen).

[Question] Do you think the NPG is effective or not as the countermeasure to global warming?

1. Effective
2. Effective if anything
3. Don't know
4. Ineffective if anything
5. Ineffective