7. Energy and resources field

7.1. Overview

(1) Overview of areas in the field

In the energy and resources field, we established 10 areas, bearing in mind a system structure spanning exploration, conversion, transport and storage, use, and finally waste processing, disposal, and recycling.

First, we set three areas, innovative nuclear power systems, renewable energy, and clean-coal technology, by type of energy. Although it fits the broad category of nuclear power, we established nuclear fusion energy, which is receiving much policy attention, as a single topic in one area. In addition, for resource exploration and mining, we established the resource assessment area. For energy conversion, transport, storage, and use, we designated the areas hydrogen energy systems, fuel cells, and decentralized energy systems, for which recent trends are particularly noteworthy. The remainder we consolidated in the efficient energy conversion and use area. Regarding waste processing and use, we established the recycling systems (including biomass and waste) area. We set 51 topics for these 10 areas to carry out the survey.

(2) Expectations and degree of importance

Comparing areas, expectations are high for hydrogen energy systems, fuel cells, and efficient energy conversion and use, followed by recycling systems (including biomass and waste). Expectations for decentralized energy systems, clean-coal technology, and renewable energy are moderate, while those for innovative nuclear power systems, nuclear fusion energy, and resource assessment are relatively low. The highest expected impacts are for the contribution of the fuel cells area to increased intellectual assets and for the medium- and long-term contribution of the hydrogen energy systems area to the creation of new industries.

Comparing degree of importance to Japan by area, clean-coal technology is the highest and renewable energy is the lowest. Even within a single area, however, degree of importance varies widely by technological topic, and is highly dependent on the specialties of respondents as well.

Looking at the technological topics, technology for geologic disposal of high-level radioactive waste received the highest degree of importance, with recycling systems, gasification power generation and synthetic fuels manufacturing, fuel cells, hydrogen supply infrastructure, and CO_2 separation and storage also receiving high scores. The group with a high degree of expertise assigned fast breeder reactor (FBR) systems, energy management technology, and efficient large combined cycle power generation a high degree of importance, but the average assessment was relatively low. Other technological topics with wide differences in the degree of importance assessment between specialists and non-specialists were ocean uranium extraction, nuclear fusion power generation, production of hydrogen using solar heat, solar power generation systems in space, electric power devices that utilize high-temperature superconductivity, and resource recovery. Of these, ocean uranium extraction technology and production of hydrogen using solar heat differed from the others in that the group with more expertise rated them lower in degree of importance. Such difference is also found in technological topics in the resource assessment area, but caution is needed because of the low number of respondents with a high degree of expertise.

These survey results regarding expected impacts and degree of importance suggest changes in views of the future of energy technology. Rather than emphasizing technologies for separate types of energy such as FBR, nuclear fusion, and various types of natural energy, these views emphasize integrated responses

that combine different types of technologies, such as hydrogen energy systems including fuel cells, efficient use of energy, processing and disposal of radioactive and other waste, and cyclic utilization.

(3) Predicted technological realization and social application

Looking at time of technological realization by area, the overall characteristics were as follows. Early realization was forecast for the recycling system (including biomass and waste) area, with all technological topics expected to be realized by 2010. On the other hand, realization of topics in the innovative nuclear power systems area is seen as far off, with FBR seen as coming after 2020. Realization of nuclear fusion is predicted for after 2035. Most topics in other areas are forecast for realization in the first half of the 2010s, but some topics in the hydrogen energy systems and renewable energy areas are expected to require a long time for realization. About 30 percent of respondents answered that solar power generation systems in space will not be realized, while one-fourth answered "Don't know" for nuclear fusion power generation, and the combined total with those answering "Will not be realized" was over 30 percent.

Area characteristics for time of social application show trends similar to those for time of technological realization. Practical application of the recycling system (including biomass and waste) area is predicted for 2010 to 2020, while it is predicted for 2030 or later for innovative nuclear power systems (2040 or later for nuclear fusion). Social application for other areas is generally predicted for 2015 to 2030. The social application of large-scale hydrogen energy supply infrastructure is expected to take a long time, far beyond the time of technological realization.

Referring to the comments on topics provided by respondents, a scattered lack of knowledge on some points appears to exist among them. We are therefore somewhat reluctant to take the survey results at face value, but there seems to be an aspect of those energy and resources field technologies that require large-scale development to require more time for technological realization and social application than other fields do.

(4) The proper form of government involvement

Government involvement has a variety of aspects, such as human resources development, research infrastructure and funding, industry collaboration, international development, and proper regulation. While it is therefore difficult to summarize the proper form of government involvement for all topics, we can offer the following generalizations.

Regarding the necessity of government involvement for technological realization, it tends to be high for the innovative nuclear power systems and nuclear fusion areas, which are long-term topics seen as having a relatively high degree of importance. Research infrastructure development is emphasized. In addition, necessity of government involvement for the clean-coal technology area is also relatively high, with high demand for expanded research funding.

For social application as well, government involvement is strongly desired for innovative nuclear power systems and nuclear fusion, but with human resources development for practical application tending to be emphasized. Government involvement for social application is characterized by desire for support through aspects such as tax support, industrial collaboration, and relaxed regulation, and this kind of government support is relatively strongly desired in clean-coal technology and in hydrogen energy systems. As for international comparison of technological levels, at least 90 percent of respondents evaluated Japan as leading Europe and the USA in the topics of heat pumps, solar cells, and resource recovery technology. It is important to carefully examine how these technologies developed for considering future research and

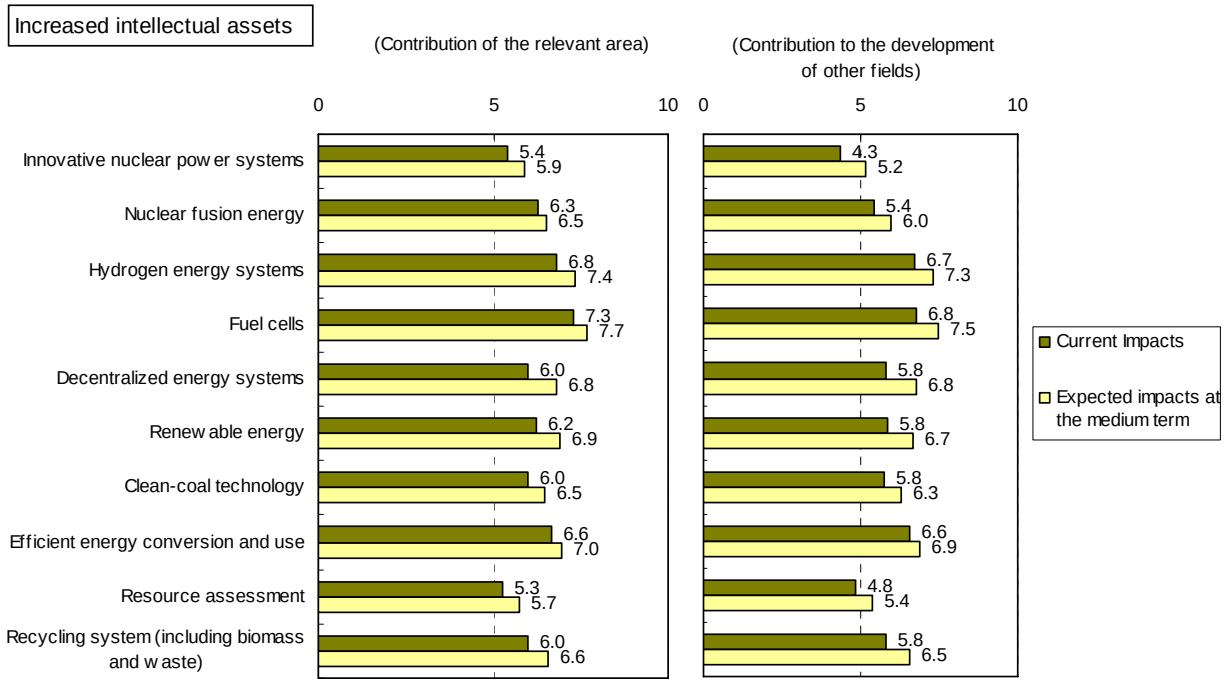
development policy as well as the proper form of government involvement in the process of applying these technological strengths to the real world.

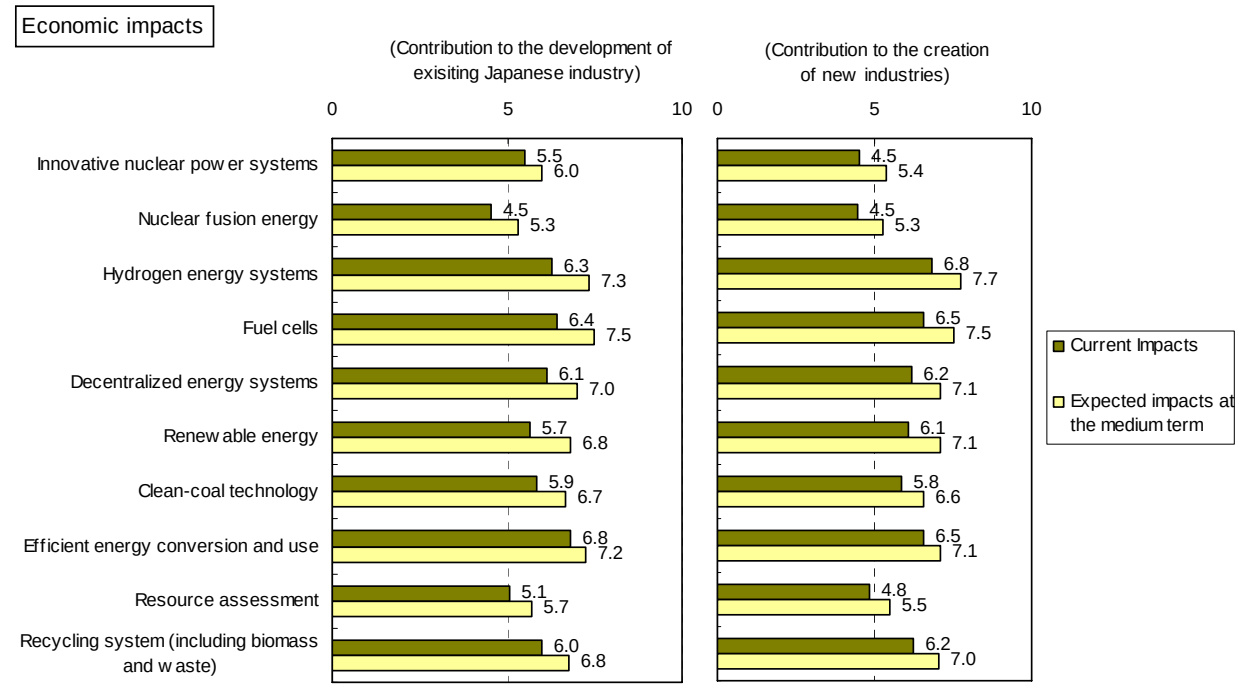
Demand is high for government involvement with energy and resources field technologies that are social infrastructure that will require much time for practical application. It is fair to say that Japanese government support for technological development in the energy field has been heavier than that of other countries, and the survey results demonstrate that continued strong support centered on the nuclear power field is wanted. However, many of the topics in areas that have received such government support are seen as still trailing Europe and the USA in terms of technological level. The proper form of government involvement in the technological development of the energy and resources field needs to be reexamined.

(YAMAJI Kenji)

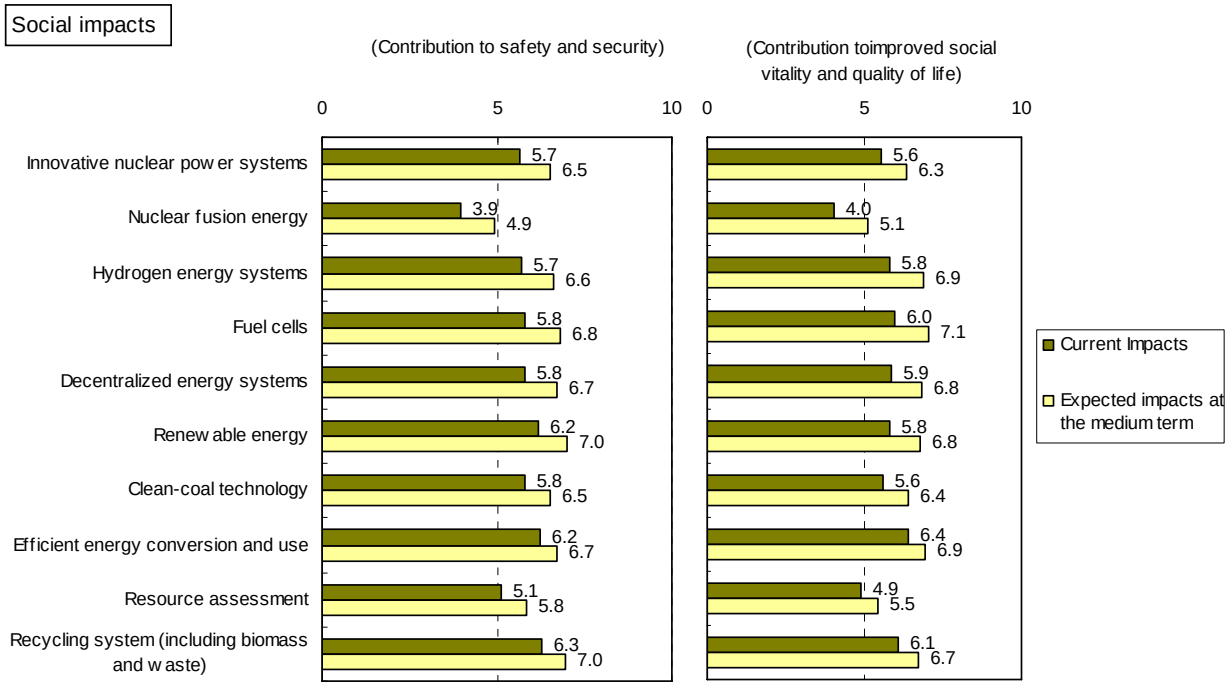
7.2. Main results

A. Impacts



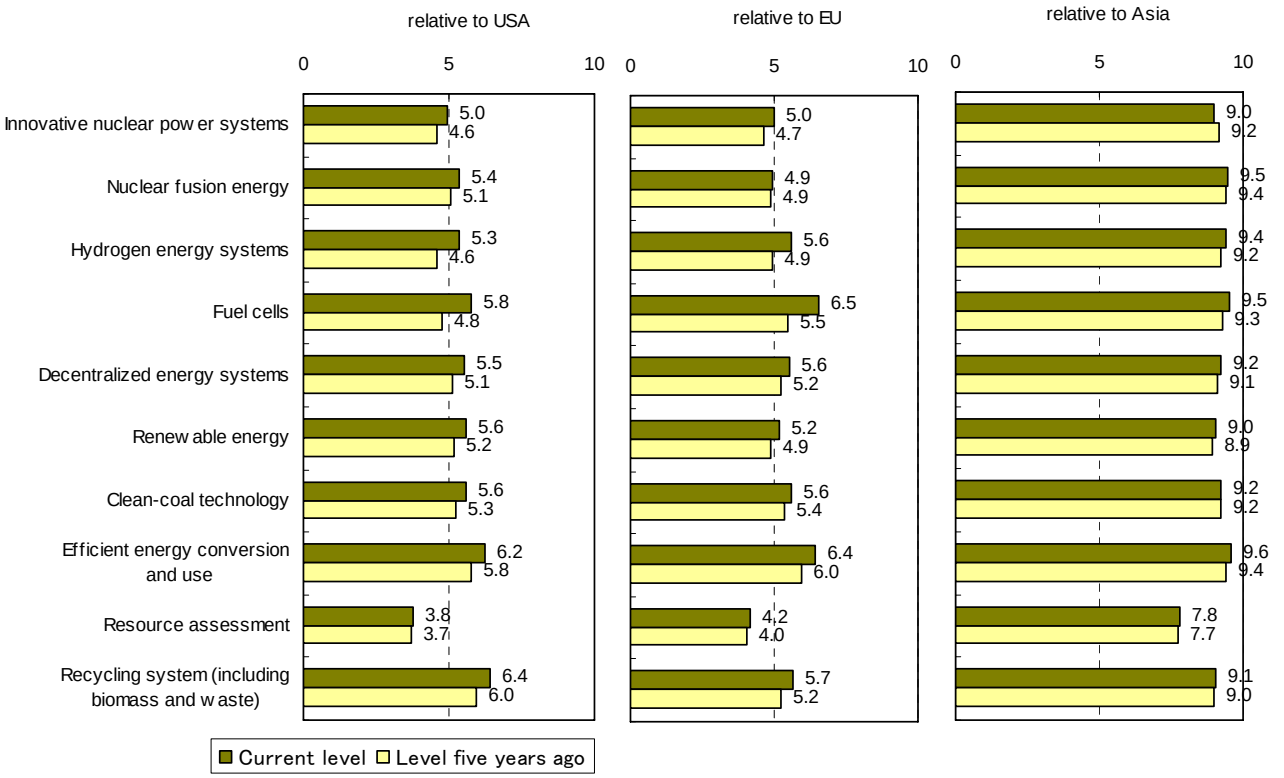


*Responses are indexed on a 10-point scale.



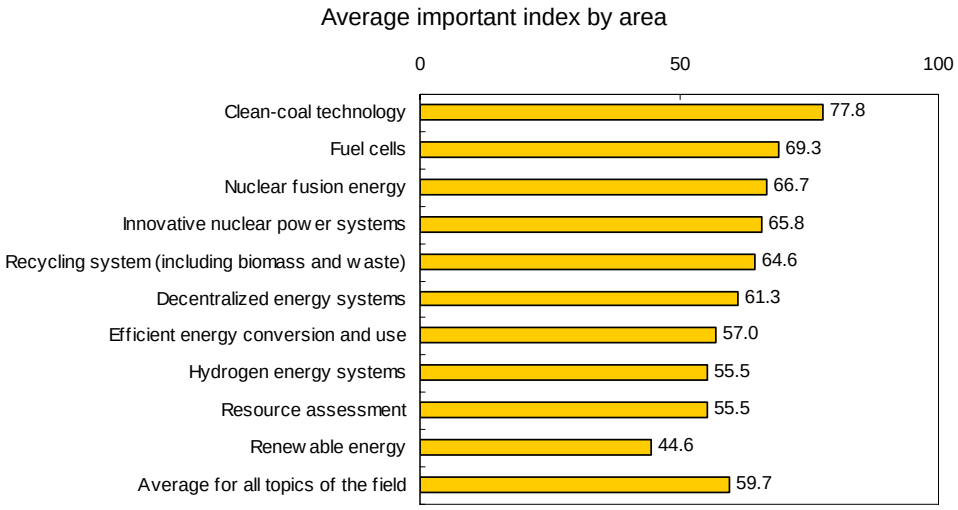
*Responses are indexed on a 10-point scale.

B. Japan's R&D Level



*Responses are indexed on a 10-point scale.

C. Importance to Japan



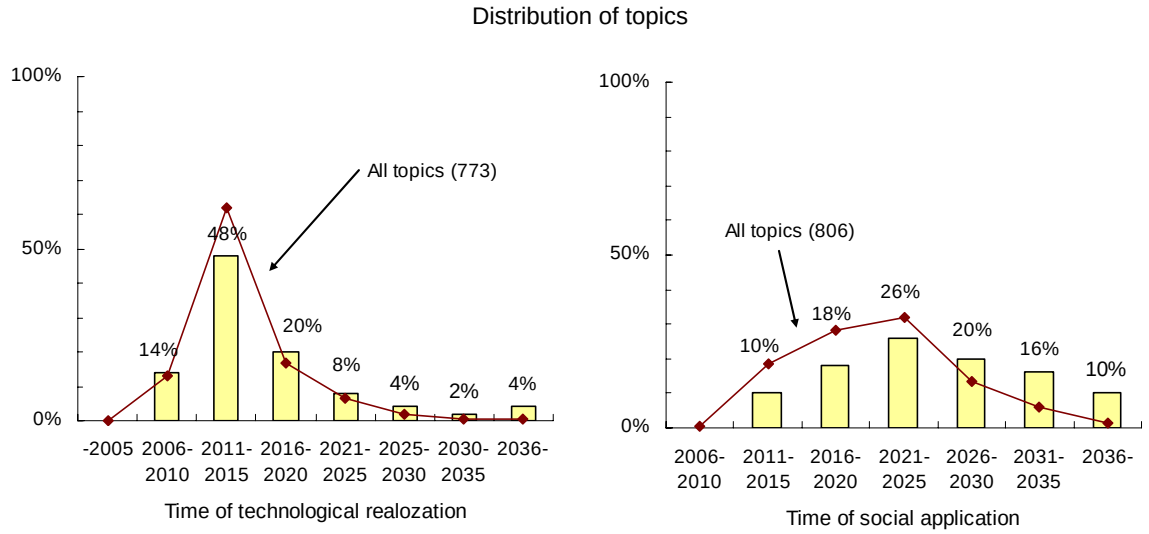
The most important 10 topics

	Topic	Index	Year T*	Year S*
1	04: Geologic disposal technology for high-level radioactive waste.	90	2020	2032
2	47: Recycle systems for the production, distribution, and consumption of recovered materials and products based on new economic criteria/standards.	86	-	2016
3	27: Technology for electric power generation and synthetic fuels manufacturing using the gasification of coal, biomass, and waste.	83	2010	2018
4	13: Polymer electrolyte fuel cells for automobile use.	82	2012	2020
5	10: Hydrogen supply infrastructure networks for fuel cell automobiles.	80	2013	2023
6	29: CO_2 recover, sequestration and storage technology.	77	2015	2027
7	22: Large-area thin-film solar cells with a conversion efficiency of at least 20 percent.	76	2015	2023
8	03: Technology to drastically reduce waste through nuclear transformation of radionuclides in high-level nuclear waste.	74	2032	2039
9	15: Solid oxide fuel cells for stationary use.	74	2013	2022
10	30: Large capacity combined cycle power generation through the use of large scale gas turbines with high efficiency (Turbine inlet temperature higher than 1700°C).	74	2013	2021

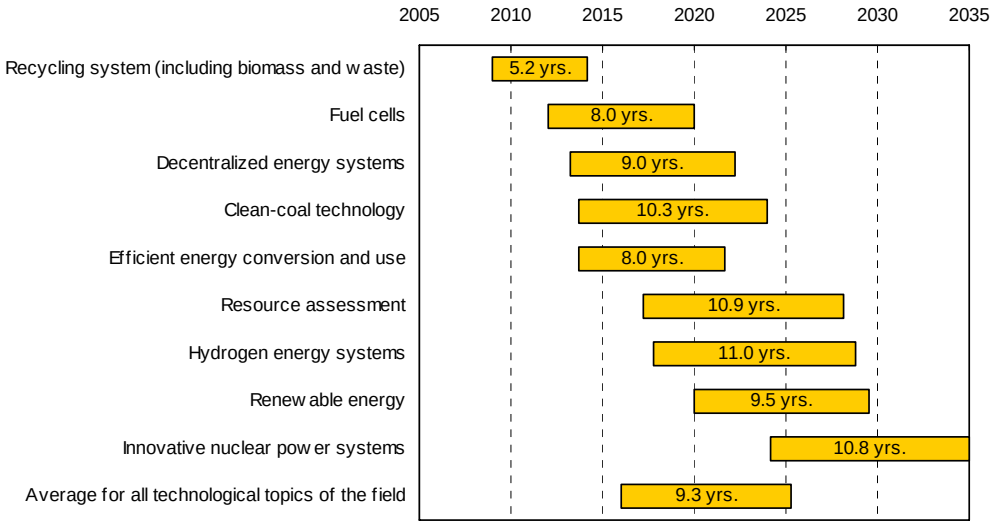
Year T: Time of technological realization Year S: Time of social application

*Responses were indexed on a 100-point scale.

D. Time of realization



Gap between technological realization and social application



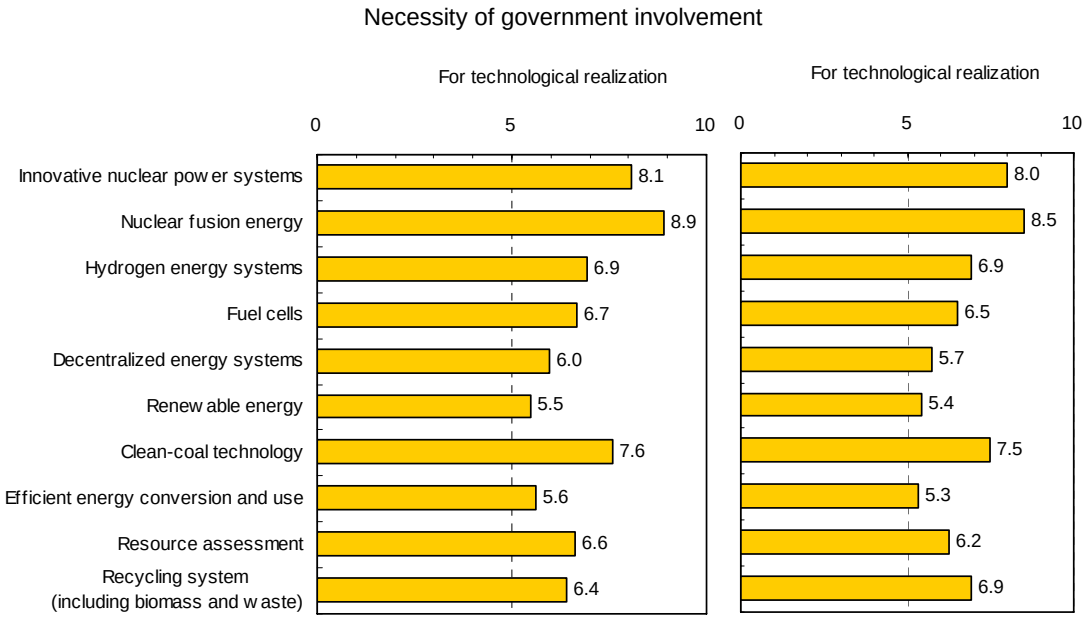
Topics with short or long periods until social application

Topic	Year T*	Period*	Area
23: Ocean-thermal conversion electric power generation.	2014	16	Renewable energy
42: Technology to extract methane hydrate from continental permafrost areas.	2015	14	Resource assessment
02: Medium and small cogeneration nuclear reactors.	2018	13	Innovative nuclear power systems
01: Fast breeder reactor (FBR) systems that include the nuclear fuel cycle.	2023	12	Innovative nuclear power systems
04: Geologic disposal technology for high-level radioactive waste.	2020	12	Innovative nuclear power systems
08: A large-scale hydrogen energy supply system in Japan through hydrogen imports and so on.	2020	12	Hydrogen energy systems
11: Hydrogen production by ultrahigh temperature using solar heat.	2022	12	Hydrogen energy systems
17: 66-77 kV superconducting power cables with capacities equivalent of current 275 kV CV cables.	2014	12	Decentralized energy systems
29: CO_2 recover, sequestration and storage technology.	2015	12	Clean-coal technology
40: Technology to reveal geological structure 100 meters underground using data from aircraft or artificial satellites.	2015	12	Resource assessment
43: Technology to extract methane hydrate from sediments under the deepsea floor.	2020	12	Resource assessment

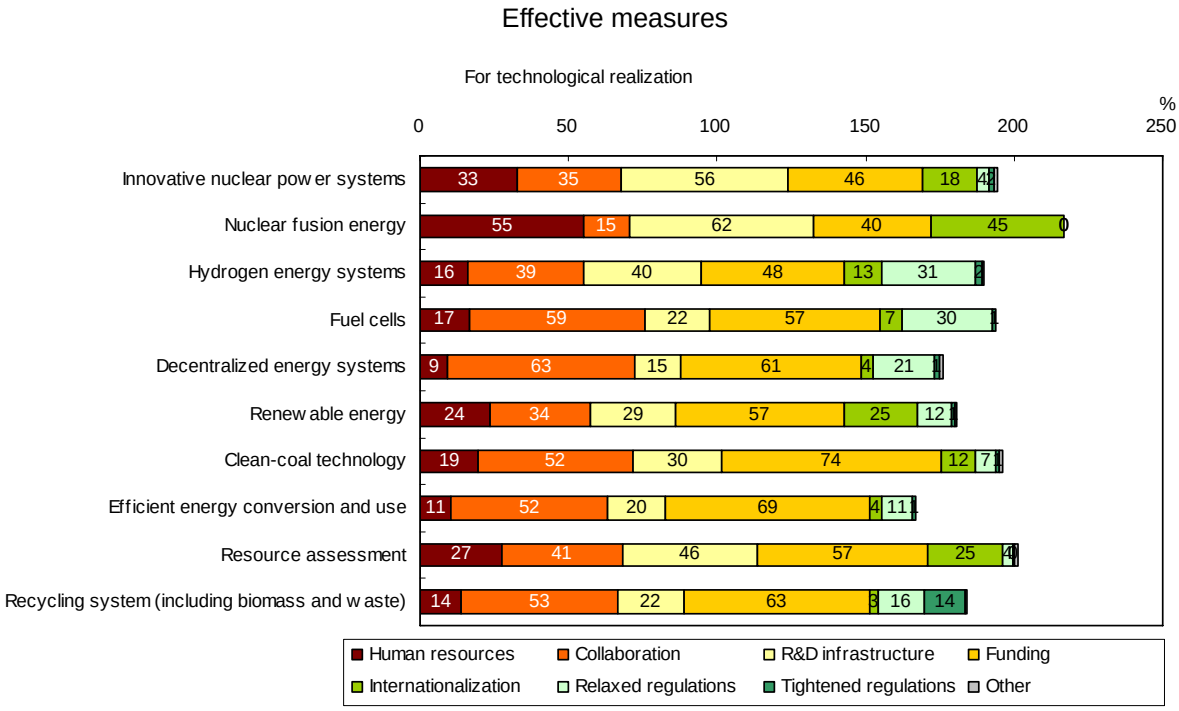
Topic	Year T*	Period*	Area
46: Rational recovery methods for valuable resources in urban garbage.	2010	5	Recycling system
48: Shredder dust disposal technology (energy and resource recovery) for post-consumer automobiles.	2008	5	Recycling system
50: Recovery of rare metals from electronic circuit boards.	2008	5	Recycling system s
51: Recovery of resources from incinerator and fly ash.	2009	5	Recycling system
14: Polymer electrolyte fuel cells for stationary use.	2011	6	Fuel cells
34: Micro cogeneration systems for residential use	2009	6	Efficient energy conversion and use
49: Manufacture of polylactic acid plastics from municipal waste.	2010	6	Recycling system

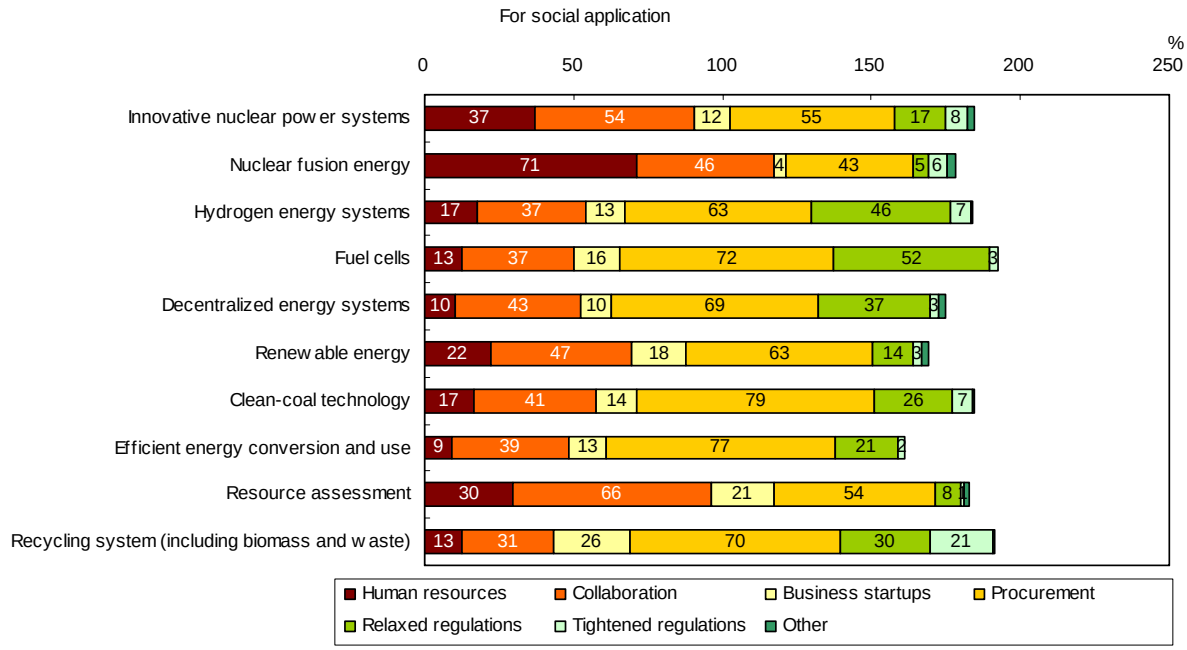
*Year T: Time of technological realization Period: Period until social application (years)

E. Effective measures that should taken by government



*Responses were indexed on a 10-point scale





F. Time-line of topics

Technological realization

year	topic
2008	48: Shredder dust disposal technology (energy and resource recovery) for post-consumer automobiles.
	50: Recovery of rare metals from electronic circuit boards.
2009	34: Micro cogeneration systems for residential use
	51: Recovery of resources from incinerator and fly ash.
2010	27: Technology for electric power generation and synthetic fuels manufacturing using the gasification of coal, biomass, and waste.
	46: Rational recovery methods for valuable resources in urban garbage.
	49: Manufacture of polylactic acid plastics from municipal waste.
2011	14: Polymer electrolyte fuel cells for stationary use.
2012	12: Molten carbonate fuel cells for medium- and large-scale power generation.
	13: Polymer electrolyte fuel cells for automobile use.
	19: Energy management technology that uses electricity storage technology in order to efficiently use distributed generation on the demand side.
	25: Meet 1 percent of the world's primary energy supply with wind power energy.
	33: Heat pump water heaters with COP ratings over 5 (currently the highest on the market is 4.2).
2013	09: Hydrogen fueled automobile engines.
	10: Hydrogen supply infrastructure networks for fuel cell automobiles.
	15: Solid oxide fuel cells for stationary use.
	16: Low cost (about ¥100,000 per kW) secondary batteries for efficient operation of compact fuel cells and stabilization of solar cell output.
	20: New grid technology such as micro grids that expand the stability of distributed generation (giving free access) and efficiently supply it.
	24: Biomass plantations for energy on idle land with high plant production capacity in sunbelts in the tropics and elsewhere that receive much sunlight.
	30: Large capacity combined cycle power generation through the use of large scale gas turbines with high efficiency (Turbine inlet temperature higher than 1700°C).
	35: Ceramic micro gas turbines with thermal efficiency of 40 percent.
2014	17: 66-77 kV superconducting power cables with capacities equivalent of current 275 kV CV cables.
	18: Superconducting magnetic energy storage (SMES) systems of several kWh to several tens of kWh for improved electric stability.

year	topic
	23: Ocean-thermal conversion electric power generation.
	32: Compression coolers with COP ratings over 8 (currently 4.0–6.4).
	36: Wet smelting technology whose extraction rate of copper and precious metals is equivalent to that of the process cimbining ore dressing and dry smelting (e.g. 85% x 98% = 83% approx.).
2015	22: Large-area thin-film solar cells with a conversion efficiency of at least 20 percent.
	29: CO_2 recover, sequestration and storage technology.
	37: High-efficient unmanned mining technology including robotics.
	40: Technology to reveal geological structure 100 meters underground using data from aircraft or artificial satellites.
	42: Technology to extract methane hydrate from continental permafrost areas.
2016	28: Technology to manufacture hydrogen from coal without emitting CO_2 into the environment.
2017	45: Technology to asssess ultimate resereves of conventional resources.
2018	02: Medium and small cogeneration nuclear reactors.
2019	41: Ultra-deep drilling technology whose specifications are for depths of 15 km and temperatures of 400°C.
2020	04: Geologic disposal technology for high-level radioactive waste.
	08: A large-scale hydrogen energy supply system in Japan through hydrogen imports and so on.
	38: Extraction and separation technology of metallic elements based on biotechnology.
	39: Technology to economically extract seafloor metal resources such as manganese nodules, cobalt crusts, heavy metal sludge, and hydrothermal mineral deposits.
	43: Technology to extract methane hydrate from sediments under the deepsea floor.
	44: Discovery of unconventional underground resources such as methane hydrate (energy resources) and seafloor hydrothermal deposits (mineral resources) as a result of changes in economic conditions, advances in earth sciences, and development of exploration technology (improved estimation, development of materials resistant to ultrahigh temperature and pressure, increased exploration depth).
2021	07: Hydrogen production processes by thermochemical method using nuclear heart.
	31: Motors and other industrial electric power apparatuses that utilize high-temperature superconductivity.
2022	11: Hydrogen production by ultrahigh temperature using solar heat.
2023	01: Fast breeder reactor (FBR) systems that include the nuclear fuel cycle.
2028	05: Technology to efficiently extract ocean uranium in an economical way.
2030	26: Artificial photosynthesis technology with a solar energy conversion efficiency of 3 percent or more (vs. about 1 percent in plant photosynthesis).
2032	03: Technology to drastically reduce waste through nuclear transformation of radionuclides in high-level nuclear waste.
2036-	21: Solar electric power generation systems in space.
	06: Nuclear fusion electric power generation furnaces.

Social application

year	topic
2013	48: Shredder dust disposal technology (energy and resource recovery) for post-consumer automobiles.
	50: Recovery of rare metals from electronic circuit boards.
2014	51: Recovery of resources from incinerator and fly ash.
2015	34: Micro cogeneration systems for residential use
	46: Rational recovery methods for valuable resources in urban garbage.
2016	47: Recycle systems for the production, distribution, and consumption of recovered materials and products based on new economic criteria/standards.
	49: Manufacture of polylactic acid plastics from municipal waste.
2017	14: Polymer electrolyte fuel cells for stationary use.
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2019	33: Heat pump water heaters with COP ratings over 5 (currently the highest on the market is 4.2).
2020	13: Polymer electrolyte fuel cells for automobile use.

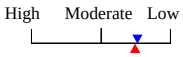
year	topic
	16: Low cost (about ¥100,000 per kW) secondary batteries for efficient operation of compact fuel cells and stabilization of solar cell output.
	19: Energy management technology that uses electricity storage technology in order to efficiently use distributed generation on the demand side.
2020	20: New grid technology such as micro grids that expand the stability of distributed generation (giving free access) and efficiently supply it.
2021	12: Molten carbonate fuel cells for medium- and large-scale power generation.
	30: Large capacity combined cycle power generation through the use of large scale gas turbines with high efficiency (Turbine inlet temperature higher than 1700°C).
	32: Compression coolers with COP ratings over 8 (currently 4.0–6.4).
2022	15: Solid oxide fuel cells for stationary use.
	25: Meet 1 percent of the world's primary energy supply with wind power energy.
	35: Ceramic micro gas turbines with thermal efficiency of 40 percent.
	36: Wet smelting technology whose extraction rate of copper and precious metals is equivalent to that of the process cimbining ore dressing and dry smelting (e.g. 85% x 98% = 83% approx.).
2023	09: Hydrogen fueled automobile engines.
	10: Hydrogen supply infrastructure networks for fuel cell automobiles.
	22: Large-area thin-film solar cells with a conversion efficiency of at least 20 percent.
	24: Biomass plantations for energy on idle land with high plant production capacity in sunbelts in the tropics and elsewhere that receive much sunlight.
2025	18: Superconducting magnetic energy storage (SMES) systems of several kWh to several tens of kWh for improved electric stability.
	37: High-efficient unmanned mining technology including robotics.
2026	17: 66-77 kV superconducting power cables with capacities equivalent of current 275 kV CV cables.
2027	28: Technology to manufacture hydrogen from coal without emitting CO2 into the environment.
	29: CO2 recover, sequestration and storage technology.
	40: Technology to reveal geological structure 100 meters underground using data from aircraft or artificial satellites.
2028	45: Technology to asssess ultimate resereves of conventional resources.
2029	42: Technology to extract methane hydrate from continental permafrost areas.
2030	23: Ocean-thermal conversion electric power generation.
	38: Extraction and separation technology of metallic elements based on biotechnology.
	39: Technology to economically extract seafloor metal resources such as manganese nodules, cobalt crusts, heavy metal sludge, and hydrothermal mineral deposits.
	41: Ultra-deep drilling technology whose specifications are for depths of 15 km and temperatures of 400°C.
2031	02: Medium and small cogeneration nuclear reactors.
2032	04: Geologic disposal technology for high-level radioactive waste.
	07: Hydrogen production processes by thermochemical method using nuclear heart.
	08: A large-scale hydrogen energy supply system in Japan through hydrogen imports and so on.
	31: Motors and other industrial electric power apparatuses that utilize high-temperature superconductivity.
	43: Technology to extract methane hydrate from sediments under the deepsea floor.
2034	11: Hydrogen production by ultrahigh temperature using solar heat.
2035	01: Fast breeder reactor (FBR) systems that include the nuclear fuel cycle.
2036-	05: Technology to efficiently extract ocean uranium in an economical way.
	03: Technology to drastically reduce waste through nuclear transformation of radionuclides in high-level nuclear waste.
	26: Artificial photosynthesis technology with a solar energy conversion efficiency of 3 percent or more (vs. about 1 percent in plant photosynthesis).
	06: Nuclear fusion electric power generation furnaces.
	21: Solar electric power generation systems in space.

Appendix: Results of R1 and R2

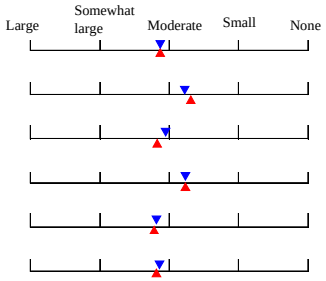
I. Innovative nuclear power systems

1. Questions regarding the relevant area

1) Degree of expertise in the area

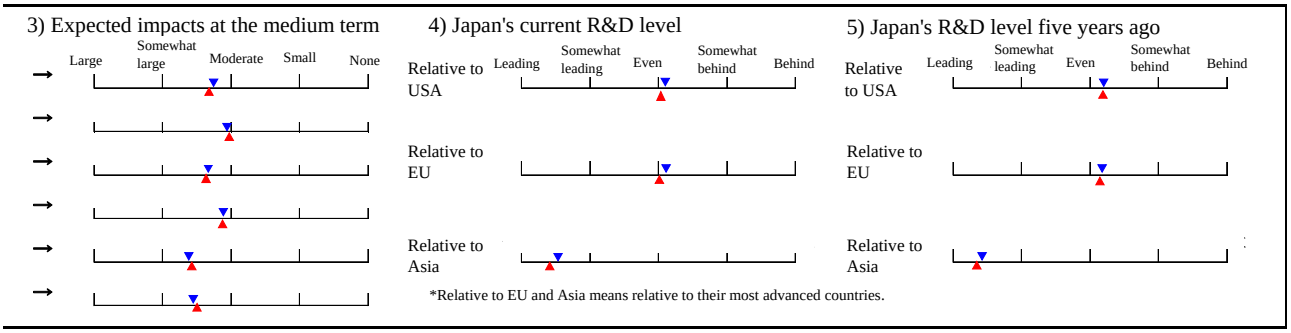


2) Current impacts



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan					Time of technological realization							
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
1	Fast breeder reactor (FBR) systems that include the nuclear fuel cycle.	1	137	20	18	62	-	69	50	32	13	5							7	9
		2	129	17	16	67	-	72	51	35	13	1							6	5
		E	22	100	0	0	-	94	90	5	5	0							9	0
2	Medium and small cogeneration nuclear reactors.	1	119	15	21	64	-	46	16	44	35	5							5	12
		2	112	9	23	68	-	45	6	64	30	0							2	6
		E	10	100	0	0	-	50	10	70	20	0							11	0
3	Technology to drastically reduce waste through nuclear transformation of radionuclides in high-level nuclear waste.	1	100	18	16	66	-	67	47	29	23	1							8	18
		2	99	11	20	69	-	74	57	29	13	1							5	12
		E	11	100	0	0	-	77	64	27	0	9							9	0
4	Geologic disposal technology for high-level radioactive waste.	1	131	14	21	65	-	81	68	21	8	3							2	11
		2	116	9	17	74	-	90	83	11	6	0							0	3
		E	11	100	0	0	-	100	100	0	0	0							0	0
5	Technology to efficiently extract ocean uranium in an economical way.	1	113	10	26	64	-	49	23	37	30	10							16	15
		2	109	5	13	82	-	47	16	46	33	5							10	9
		E	5	100	0	0	-	30	20	0	40	40							40	0

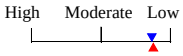


Countries at the leading edge					Regarding technological realization													Time of social application							Regarding social application													
					Necessity of gov't involvement				Effective measures that should be taken by gov't																	Necessity of gov't involvement				Effective measures that should be taken by gov't								
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)							
36	10	52	0	2	77	14	6	3	44	35	41	35	29	9	9	5						11	13	69	21	6	4	40	40	17	40	18	17	11
30	1	69	0	0	81	12	6	1	52	32	60	41	21	4	2	2						7	13	77	17	4	2	54	56	10	57	11	8	3
32	0	68	0	0	90	5	5	0	62	38	76	57	43	0	0	5						9	0	86	9	5	0	68	59	27	77	18	5	9
19	43	25	3	10	32	35	24	9	20	38	37	31	23	16	10	6						14	19	32	34	23	11	21	35	19	31	30	19	9
7	63	22	1	7	27	51	18	4	18	48	51	32	19	7	2	1						6	11	31	50	14	5	22	65	14	41	32	5	1
10	70	0	10	10	22	56	22	0	25	63	38	25	50	0	0	0						0	11	20	60	10	10	11	89	33	67	44	0	0
19	33	45	0	3	58	23	14	5	34	27	42	38	33	2	6	8						8	25	47	33	11	9	37	32	13	45	13	13	8
9	15	75	0	1	74	18	7	1	39	19	67	45	29	1	0	1						8	18	70	22	6	2	52	47	5	53	10	3	2
9	0	91	0	0	60	30	0	10	78	11	67	56	56	0	0	0						18	0	55	36	0	9	90	20	20	70	10	0	0
8	47	45	0	0	76	19	5	0	32	34	31	39	22	17	12	6						3	14	70	25	4	1	28	34	15	42	20	28	9
3	53	44	0	0	90	7	3	0	35	45	44	56	16	5	5	2						2	8	84	13	3	0	38	47	10	63	21	21	2
20	60	20	0	0	90	10	0	0	60	50	80	60	10	0	10	0						0	0	91	9	0	0	91	64	9	73	27	18	0
60	28	7	0	5	28	36	24	12	24	27	38	38	13	3	1	8						15	28	23	33	30	14	18	38	25	46	11	4	6
79	11	8	0	2	22	49	18	11	20	29	59	55	6	2	0	1						13	19	28	36	26	10	19	53	21	63	10	1	3
100	0	0	0	0	25	0	25	50	50	0	0	50	0	0	0	0						40	20	20	20	20	40	33	0	33	67	0	0	0

II. Nuclear fusion energy

1. Questions regarding the relevant area

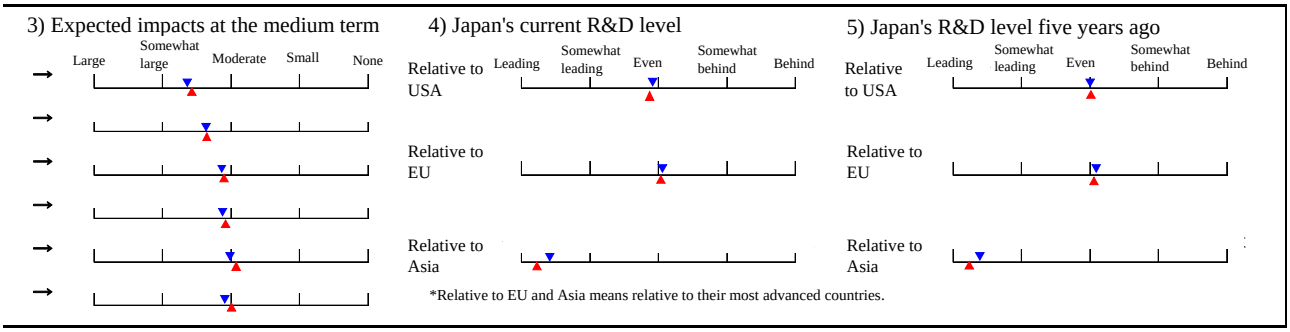
1) Degree of expertise in the area



2) Current impacts

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan (%)					Time of technological realization							
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know
6	Nuclear fusion electric power generation furnaces.	1	125	10	22	68	-	67	43	39	16	2							7	20
		2	121	6	20	74	-	67	41	45	12	2							8	24
		E	7	100	0	0	-	79	57	43	0	0							14	0

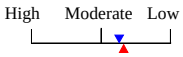


Countries at the leading edge					Regarding technological realization												Time of social application							Regarding social application											
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't							
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)							
27	24	47	0	2	69	18	13	0	40	20	47	41	44	3	4	3						10	30	58	26	13	3	44	42	11	37	9	17	8
17	9	73	0	1	78	11	11	0	55	15	62	40	45	0	0	0						9	31	70	17	10	3	71	46	4	43	5	6	3
43	0	57	0	0	86	14	0	0	29	14	57	71	71	0	0	0						14	29	86	14	0	0	71	43	0	0	0	14	14

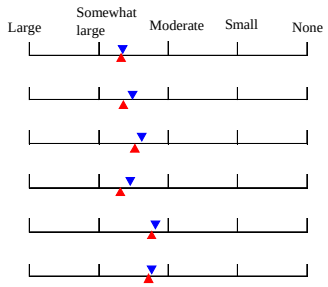
III. Hydrogen energy systems

1. Questions regarding the relevant area

1) Degree of expertise in the area

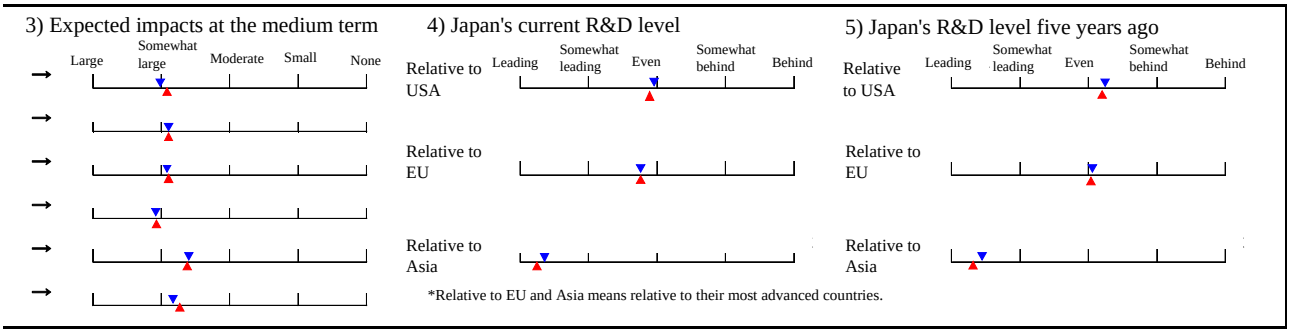


2) Current impacts



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan					Time of technological realization							
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
7	Hydrogen production processes by thermochemical method using nuclear heart.	1	**146**	**10**	**30**	**60**	-	**53**	**28**	**38**	**26**	**8**							**7**	**10**
		2	**136**	**7**	**25**	**68**	-	**48**	**13**	**55**	**29**	**3**							**5**	**7**
		E	**9**	**100**	**0**	**0**	-	**47**	**13**	**61**	**13**	**13**							**22**	**0**
8	A large-scale hydrogen energy supply system in Japan through hydrogen imports and so on.	1	**167**	**11**	**31**	**58**	-	**53**	**27**	**40**	**25**	**8**							**12**	**8**
		2	**160**	**8**	**24**	**68**	-	**49**	**13**	**62**	**21**	**4**							**7**	**3**
		E	**12**	**100**	**0**	**0**	-	**50**	**27**	**37**	**18**	**18**							**17**	**0**
9	Hydrogen fueled automobile engines.	1	**162**	**9**	**26**	**65**	-	**66**	**41**	**43**	**14**	**2**							**4**	**2**
		2	**160**	**7**	**18**	**75**	-	**60**	**30**	**54**	**13**	**3**							**3**	**1**
		E	**11**	**100**	**0**	**0**	-	**61**	**27**	**64**	**9**	**0**							**0**	**0**
10	Hydrogen supply infrastructure networks for fuel cell automobiles.	1	**183**	**16**	**32**	**52**	-	**75**	**55**	**37**	**6**	**2**							**3**	**2**
		2	**167**	**14**	**26**	**60**	-	**80**	**66**	**27**	**5**	**2**							**2**	**1**
		E	**24**	**100**	**0**	**0**	-	**82**	**75**	**13**	**4**	**8**							**8**	**0**
11	Hydrogen production by ultrahigh temperature using solar heat.	1	**117**	**15**	**17**	**68**	-	**45**	**20**	**33**	**36**	**11**							**16**	**21**
		2	**119**	**6**	**11**	**83**	-	**40**	**11**	**35**	**45**	**9**							**13**	**12**
		E	**7**	**100**	**0**	**0**	-	**32**	**14**	**14**	**43**	**29**							**29**	**0**

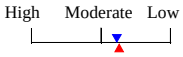


Countries at the leading edge					Regarding technological realization													Time of social application							Regarding social application											
					Necessity of gov't involvement				Effective measures that should be taken by gov't																Necessity of gov't involvement				Effective measures that should be taken by gov't							
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other								High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	
(%)					(%)				(%)														(%)				(%)							
51	32	13	0	4	44	33	14	9	32	38	48	48	19	14	6	5						12	10	43	33	15	9	33	40	23	49	24	21	4
67	28	4	0	1	52	35	11	2	26	32	66	53	8	5	2	1						7	10	53	33	10	4	34	52	10	66	15	5	1
67	33	0	0	0	45	33	11	11	14	57	71	43	43	0	0	0						22	0	56	11	22	11	0	75	13	63	13	0	13
31	29	33	0	7	39	36	16	9	18	34	28	38	30	37	12	3						16	10	39	33	18	10	13	30	18	42	49	18	4
29	24	43	0	4	53	31	10	6	12	43	27	47	29	38	3	0						9	8	53	31	10	6	16	36	10	57	59	9	1
41	17	42	0	0	33	25	25	17	30	40	50	30	40	30	0	0						27	18	55	18	18	9	30	30	20	50	60	0	10
51	18	29	0	2	21	39	34	6	19	38	21	42	12	36	11	1						4	8	23	38	30	9	13	30	22	43	49	20	1
75	1	23	0	1	12	52	32	4	13	49	18	48	9	45	1	1						3	4	15	50	28	7	10	27	16	60	68	8	1
82	0	18	0	0	0	82	18	0	9	73	27	36	0	36	0	0						0	0	9	55	27	9	10	40	0	60	50	10	0
46	20	30	0	4	44	40	14	2	16	42	28	39	11	51	15	2						3	6	48	32	17	3	13	28	21	51	56	23	2
69	6	23	0	2	52	35	12	1	11	49	24	47	7	61	4	0						2	4	57	29	12	2	9	25	16	65	75	10	1
66	17	17	0	0	49	38	13	0	8	50	25	42	21	63	8	0						8	8	50	33	13	4	9	26	9	65	65	22	4
29	37	20	0	14	22	31	31	16	28	29	45	41	22	9	3	2						20	20	22	30	31	17	24	35	20	45	19	13	3
16	69	12	0	3	17	40	33	10	19	21	63	46	12	8	0	0						15	11	15	42	33	10	18	45	13	67	15	2	2
29	57	0	0	14	14	14	43	29	0	20	40	40	20	20	0	0						43	0	14	14	58	14	0	33	17	33	17	33	17

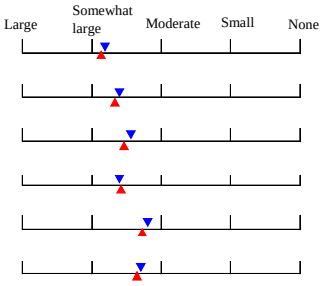
IV. Fuel cells

1. Questions regarding the relevant area

1) Degree of expertise in the area

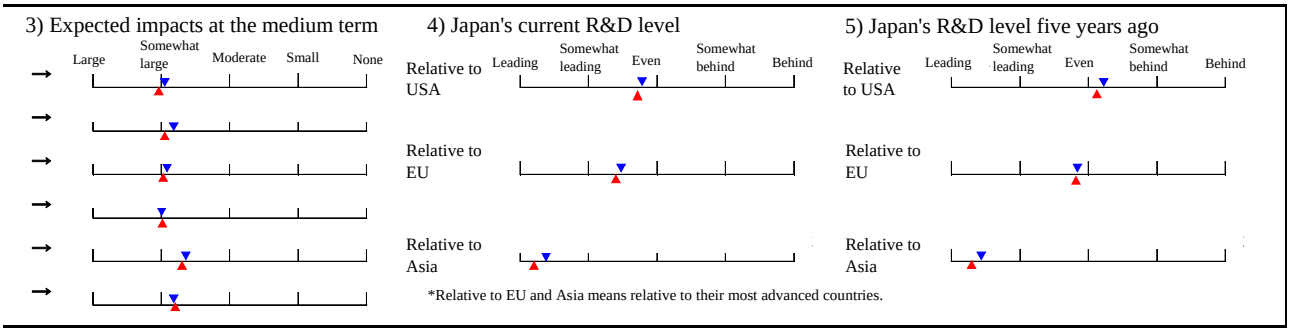


2) Current impacts



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan (%)					Time of technological realization							
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know
12	Molten carbonate fuel cells for medium- and large-scale power generation.	1	**161**	**10**	**36**	**54**	-	**53**	**21**	**51**	**24**	**4**							**7**	**7**
		2	**146**	**7**	**32**	**61**	-	**49**	**10**	**66**	**23**	**1**							**3**	**2**
		E	**10**	**100**	**0**	**0**	-	**55**	**30**	**40**	**20**	**10**							**20**	**0**
13	Polymer electrolyte fuel cells for automobile use.	1	**163**	**17**	**33**	**50**	-	**77**	**60**	**32**	**6**	**2**							**3**	**3**
		2	**149**	**11**	**30**	**59**	-	**82**	**67**	**28**	**4**	**1**							**1**	**1**
		E	**16**	**100**	**0**	**0**	-	**92**	**86**	**7**	**7**	**0**							**7**	**0**
14	Polymer electrolyte fuel cells for stationary use.	1	**167**	**21**	**42**	**37**	-	**69**	**45**	**42**	**11**	**2**							**1**	**4**
		2	**154**	**16**	**38**	**46**	-	**72**	**49**	**41**	**10**	**0**							**1**	**1**
		E	**25**	**100**	**0**	**0**	-	**85**	**75**	**17**	**8**	**0**							**0**	**0**
15	Solid oxide fuel cells for stationary use.	1	**156**	**21**	**37**	**42**	-	**71**	**48**	**41**	**9**	**2**							**2**	**4**
		2	**141**	**14**	**31**	**55**	-	**74**	**51**	**45**	**3**	**1**							**1**	**0**
		E	**20**	**100**	**0**	**0**	-	**80**	**69**	**21**	**5**	**5**							**5**	**0**



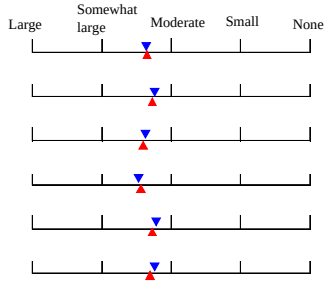
Countries at the leading edge					Regarding technological realization												Time of social application							Regarding social application											
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't							
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)							
39	50	9	0	2	19	39	35	7	23	41	20	45	10	28	7	3						12	11	22	30	34	14	18	33	23	50	36	15	2
16	83	1	0	0	8	60	27	5	16	51	16	58	9	23	1	1						7	3	8	54	31	7	12	37	15	73	42	2	1
30	60	10	0	0	10	50	10	30	57	71	0	43	0	0	0	0						20	10	22	34	33	11	25	38	13	50	25	0	13
49	36	9	0	6	35	33	25	7	24	49	26	44	14	41	9	0						2	6	37	34	23	6	17	33	25	53	49	15	1
75	23	1	0	1	31	48	18	3	18	60	22	50	9	38	1	1						1	3	32	49	16	3	13	35	15	70	60	4	0
81	19	0	0	0	43	44	13	0	44	50	25	63	25	38	0	0						6	0	53	40	7	0	33	40	13	80	53	13	0
51	38	6	0	5	33	37	24	6	21	49	27	52	11	41	9	1						3	7	32	36	23	9	17	37	24	57	50	13	1
76	20	3	0	1	32	45	20	3	15	63	23	56	7	37	1	0						2	3	30	47	20	3	12	36	16	71	59	2	1
83	13	4	0	0	60	24	12	4	22	70	30	57	9	43	0	0						8	0	66	17	13	4	27	36	14	86	59	0	0
40	47	12	0	1	36	38	20	6	26	51	29	57	9	23	6	0						3	5	34	37	23	6	19	40	24	55	40	12	2
29	66	5	0	0	32	51	16	1	18	63	26	66	5	22	1	0						1	1	27	53	18	2	14	40	16	72	49	2	0
35	50	15	0	0	45	40	10	5	32	53	21	68	0	37	5	0						5	5	37	47	16	0	28	11	6	78	72	6	0

V. Decentralized energy systems

1. Questions regarding the relevant area

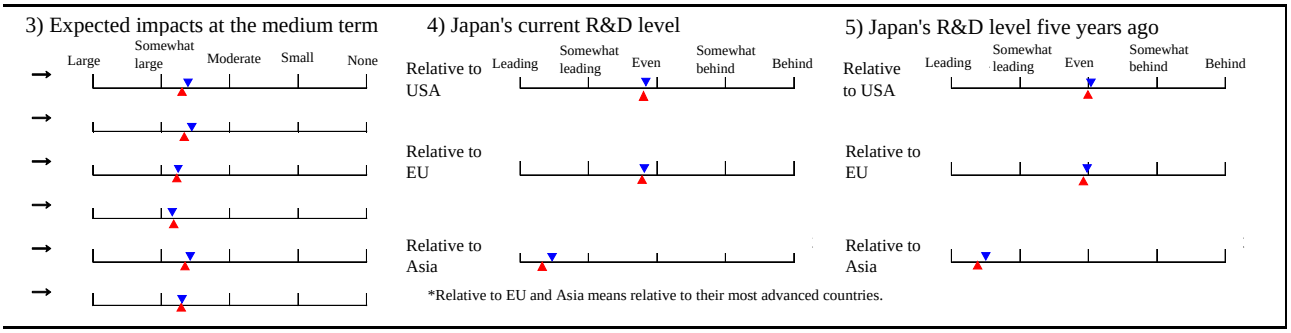
1) Degree of expertise in the area

2) Current impacts



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan					Time of technological realization									
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know		
																				(%)	
16	Low cost (about ¥100,000 per kW) secondary batteries for efficient operation of compact fuel cells and stabilization of solar cell output.	1	**147**	**16**	**35**	**49**	-	**71**	**46**	**46**	**7**	**1**							**1**	**7**
		2	**147**	**11**	**36**	**53**	-	**71**	**45**	**50**	**4**	**1**							**1**	**2**
		E	**16**	**100**	**0**	**0**	-	**77**	**53**	**47**	**0**	**0**							**0**	**0**
17	66-77 kV superconducting power cables with capacities equivalent of current 275 kV CV cables.	1	**92**	**13**	**22**	**65**	-	**48**	**14**	**51**	**33**	**2**							**9**	**13**
		2	**96**	**10**	**14**	**76**	-	**48**	**8**	**70**	**20**	**2**							**3**	**7**
		E	**10**	**100**	**0**	**0**	-	**53**	**20**	**60**	**10**	**10**							**10**	**0**
18	Superconducting magnetic energy storage (SMES) systems of several kWh to several tens of kWh for improved electric stability.	1	**107**	**10**	**27**	**63**	-	**45**	**11**	**53**	**30**	**6**							**7**	**14**
		2	**108**	**9**	**18**	**73**	-	**47**	**8**	**67**	**22**	**3**							**5**	**5**
		E	**10**	**100**	**0**	**0**	-	**50**	**20**	**50**	**20**	**10**							**10**	**0**
19	Energy management technology that uses electricity storage technology in order to efficiently use distributed generation on the demand side.	1	**142**	**19**	**33**	**48**	-	**70**	**48**	**42**	**9**	**1**							**1**	**6**
		2	**140**	**16**	**26**	**58**	-	**72**	**47**	**46**	**7**	**0**							**1**	**3**
		E	**22**	**100**	**0**	**0**	-	**88**	**77**	**18**	**5**	**0**							**0**	**0**
20	New grid technology such as micro grids that expand the stability of distributed generation (giving free access) and efficiently supply it.	1	**127**	**25**	**25**	**50**	-	**67**	**42**	**44**	**11**	**3**							**2**	**6**
		2	**122**	**24**	**22**	**54**	-	**68**	**39**	**55**	**6**	**0**							**0**	**3**
		E	**29**	**100**	**0**	**0**	-	**75**	**54**	**39**	**7**	**0**							**0**	**0**

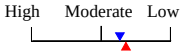


Countries at the leading edge					Regarding technological realization													Time of social application							Regarding social application													
					Necessity of gov't involvement				Effective measures that should be taken by gov't																Necessity of gov't involvement				Effective measures that should be taken by gov't									
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)							
65	23	8	1	3	27	39	27	7	18	48	26	57	5	28	5	2						2	7	27	37	27	9	10	28	21	62	35	7	3
87	11	1	0	1	10	65	19	6	10	60	15	65	2	21	1	1						1	3	13	59	23	5	10	36	11	80	33	2	1
100	0	0	0	0	19	69	6	6	13	67	0	80	0	33	7	0						0	0	31	57	6	6	20	60	0	80	33	7	0
61	30	2	0	7	13	44	30	13	14	39	25	55	11	24	7	3						11	17	14	33	37	16	16	36	12	49	32	9	5
82	15	2	0	1	5	62	28	5	6	55	17	65	7	15	2	1						5	11	6	51	37	6	8	42	9	73	29	2	4
80	20	0	0	0	22	45	33	0	0	33	33	56	11	0	0	0						10	0	10	50	40	0	0	40	0	70	10	0	10
41	47	6	0	6	14	41	34	11	18	44	32	46	10	19	3	3						12	17	11	35	38	16	16	39	15	45	32	8	4
33	64	0	0	3	5	63	26	6	6	58	22	64	5	9	0	2						4	10	4	50	37	9	10	48	11	69	26	2	2
70	30	0	0	0	22	56	11	11	0	50	13	75	13	0	0	0						10	0	10	40	40	10	0	67	0	56	11	0	11
53	30	14	0	3	18	44	30	8	22	54	23	40	3	30	12	2						1	7	26	35	32	7	15	35	22	48	39	12	2
77	18	5	0	0	11	65	20	4	14	73	12	56	3	21	1	1						1	4	11	56	29	4	14	42	12	66	43	5	1
76	24	0	0	0	19	67	14	0	14	76	19	43	0	24	0	0						0	0	24	47	29	0	10	52	0	48	62	0	0
37	42	18	0	3	31	40	21	8	15	52	27	44	2	45	11	2						3	7	34	34	26	6	12	38	19	48	51	17	4
33	61	6	0	0	18	64	15	3	9	70	10	55	2	37	3	1						0	3	23	55	19	3	8	45	8	59	56	5	2
28	55	17	0	0	29	53	11	7	8	69	12	54	0	38	8	0						0	0	46	29	18	7	8	42	4	54	65	4	0

VI. Renewable energy

1. Questions regarding the relevant area

1) Degree of expertise in the area

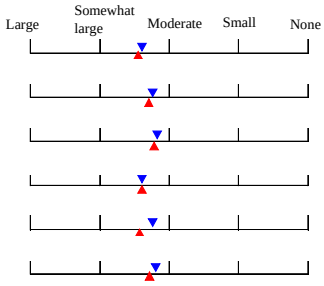


2) Current impacts

[Increased intellectual assets]
- Contribution of the relevant area itself to increased intellectual assets
- Contribution to the development of other fields

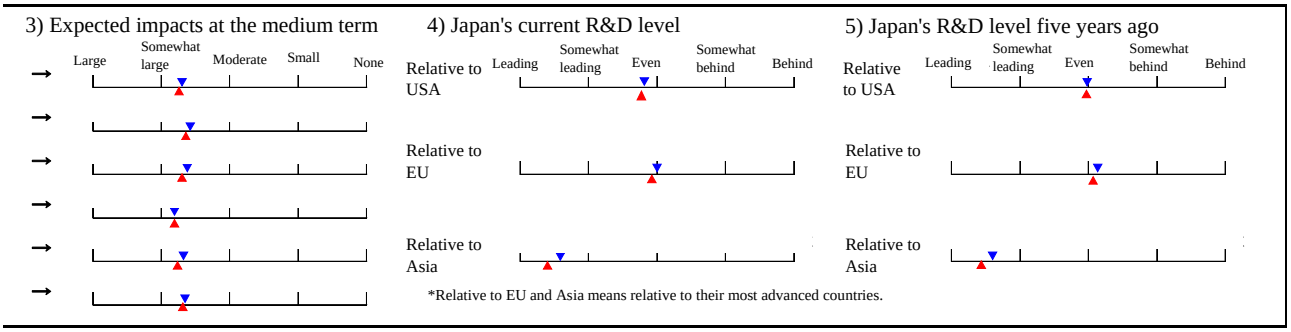
[Economic impacts]
- Contribution to the development of existing Japanese industry
- Contribution to the creation of new industries or businesses

[Social impacts]
- Contribution to safety and security
- Contribution to improved social vitality and quality of life



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan (%)					Time of technological realization							
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
21	Solar electric power generation systems in space.	1	**115**	**11**	**19**	**70**	-	**37**	**11**	**27**	**49**	**13**							**28**	**17**
		2	**114**	**5**	**11**	**84**	-	**31**	**5**	**18**	**65**	**12**							**31**	**10**
		E	**6**	**100**	**0**	**0**	-	**67**	**50**	**17**	**33**	**0**							**0**	**0**
22	Large-area thin-film solar cells with a conversion efficiency of at least 20 percent.	1	**145**	**10**	**26**	**64**	-	**72**	**49**	**40**	**10**	**1**							**3**	**8**
		2	**136**	**7**	**18**	**75**	-	**76**	**54**	**41**	**4**	**1**							**1**	**2**
		E	**10**	**100**	**0**	**0**	-	**85**	**70**	**30**	**0**	**0**							**0**	**0**
23	Ocean-thermal conversion electric power generation.	1	**138**	**5**	**26**	**69**	-	**39**	**10**	**33**	**48**	**9**							**11**	**12**
		2	**129**	**3**	**15**	**82**	-	**33**	**4**	**25**	**65**	**6**							**7**	**3**
		E	**4**	**100**	**0**	**0**	-	**38**	**25**	**0**	**50**	**25**							**75**	**0**
24	Biomass plantations for energy on idle land with high plant production capacity in sunbelts in the tropics and elsewhere that receive much sunlight.	1	**118**	**9**	**24**	**67**	-	**45**	**15**	**42**	**37**	**6**							**6**	**7**
		2	**120**	**3**	**16**	**81**	-	**39**	**6**	**43**	**47**	**4**							**5**	**3**
		E	**3**	**100**	**0**	**0**	-	**42**	**34**	**0**	**33**	**33**							**33**	**0**
25	Meet 1 percent of the world's primary energy supply with wind power energy.	1	**163**	**13**	**28**	**59**	-	**50**	**20**	**46**	**30**	**4**							**5**	**8**
		2	**148**	**9**	**22**	**69**	-	**44**	**8**	**52**	**38**	**2**							**3**	**2**
		E	**13**	**100**	**0**	**0**	-	**50**	**15**	**54**	**31**	**0**							**0**	**0**
26	Artificial photosynthesis technology with a solar energy conversion efficiency of 3 percent or more (vs. about 1 percent in plant photosynthesis).	1	**102**	**9**	**17**	**74**	-	**50**	**21**	**42**	**31**	**6**							**10**	**20**
		2	**106**	**3**	**15**	**82**	-	**45**	**11**	**53**	**32**	**4**							**4**	**14**
		E	**3**	**100**	**0**	**0**	-	**50**	**33**	**0**	**67**	**0**							**33**	**0**

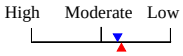


Countries at the leading edge					Regarding technological realization													Time of social application							Regarding social application											
					Necessity of gov't involvement				Effective measures that should be taken by gov't																	Necessity of gov't involvement				Effective measures that should be taken by gov't							
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)							
24	72	2	0	2	31	23	30	16	28	25	44	42	40	5	3	1						35	27	30	21	24	25	35	46	16	36	13	6	8
9	87	1	0	3	25	20	41	14	27	24	52	48	43	4	1	0						39	15	29	19	35	17	31	69	9	41	14	3	7
33	67	0	0	0	83	0	17	0	67	50	67	100	50	33	0	0						17	0	100	0	0	0	50	67	17	83	67	17	0
79	15	4	0	2	25	36	35	4	25	43	25	63	8	7	0	2						1	11	27	35	32	6	19	34	20	65	19	5	2
94	5	1	0	0	12	61	26	1	19	57	23	70	8	8	0	1						1	4	13	60	23	4	15	44	19	78	10	1	0
100	0	0	0	0	0	70	30	0	40	70	40	70	10	20	0	0						0	0	0	70	30	0	30	50	30	80	20	0	0
59	28	12	0	1	18	29	41	12	21	32	42	44	19	8	1	2						22	19	18	28	37	17	21	36	30	47	14	8	4
80	13	7	0	0	4	31	59	6	18	30	41	55	15	5	0	1						13	10	6	32	53	9	15	41	22	66	8	4	2
75	0	25	0	0	25	0	50	25	33	33	0	67	67	0	0	0						75	0	25	0	50	25	33	67	33	33	0	0	33
10	38	25	6	21	17	43	32	8	26	26	22	29	59	6	2	0						7	14	24	40	28	8	24	38	30	38	14	4	3
4	69	15	6	6	14	51	28	7	30	23	15	35	64	5	1	0						6	3	12	53	26	9	24	50	28	58	12	1	2
0	34	33	0	33	67	0	0	33	0	0	0	0	50	50	0	0						33	0	67	0	0	33	0	50	0	0	50	0	0
3	10	87	0	0	19	35	32	14	19	27	19	40	21	30	13	3						3	17	22	36	32	10	12	25	23	60	37	15	3
1	3	96	0	0	12	49	33	6	13	26	11	59	8	43	5	2						3	4	15	48	31	6	8	22	16	79	33	5	2
8	0	92	0	0	23	47	15	15	30	40	10	50	0	60	30	10						0	0	31	31	23	15	9	55	27	73	45	9	0
25	55	12	0	8	20	43	28	9	34	38	37	52	16	6	1	2						9	24	19	33	38	10	35	43	24	40	15	6	1
14	80	4	0	2	12	60	21	7	35	42	29	73	8	6	0	0						8	21	10	43	38	9	42	56	15	56	4	2	0
34	33	33	0	0	34	33	0	33	0	50	0	0	50	0	0	0						33	0	34	33	0	33	50	50	0	0	0	0	0

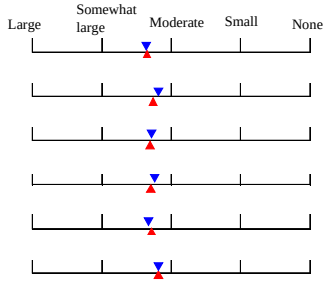
VII. Clean-coal technology

1. Questions regarding the relevant area

1) Degree of expertise in the area



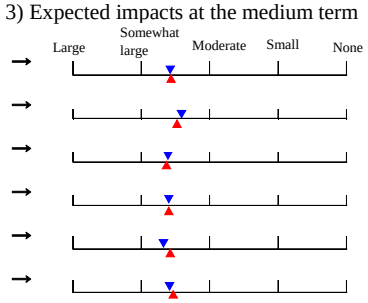
2) Current impacts



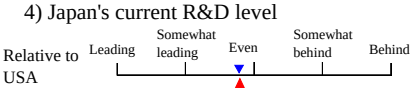
2. Questions regarding topics

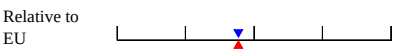
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan					Time of technological realization							
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized (%)	Do not know (%)
27	Technology for electric power generation and synthetic fuels manufacturing using the gasification of coal, biomass, and waste.	1	**166**	**30**	**31**	**39**	-	**77**	**59**	**34**	**7**	**0**							**1**	**2**
		2	**154**	**23**	**31**	**46**	-	**83**	**68**	**29**	**3**	**0**							**0**	**1**
		E	**36**	**100**	**0**	**0**	-	**89**	**78**	**22**	**0**	**0**							**0**	**0**
28	Technology to manufacture hydrogen from coal without emitting CO_2 into the environment.	1	**152**	**21**	**26**	**53**	-	**67**	**44**	**37**	**16**	**3**							**10**	**7**
		2	**144**	**19**	**28**	**53**	-	**73**	**55**	**35**	**6**	**4**							**5**	**1**
		E	**27**	**100**	**0**	**0**	-	**68**	**49**	**35**	**4**	**12**							**11**	**0**
29	CO_2 recover, sequestration and storage technology.	1	**164**	**19**	**27**	**54**	-	**71**	**51**	**34**	**12**	**3**							**7**	**6**
		2	**153**	**13**	**25**	**62**	-	**77**	**62**	**26**	**9**	**3**							**5**	**3**
		E	**20**	**100**	**0**	**0**	-	**82**	**73**	**11**	**11**	**5**							**5**	**0**

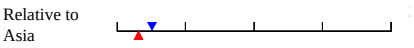
3) Expected impacts at the medium term



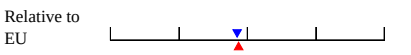
4) Japan's current R&D level

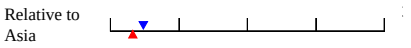






5) Japan's R&D level five years ago





*Relative to EU and Asia means relative to their most advanced countries.

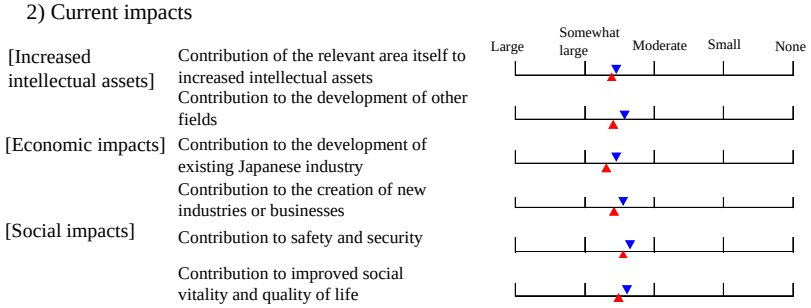
Countries at the leading edge					Regarding technological realization													Time of social application							Regarding social application													
					Necessity of gov't involvement				Effective measures that should be taken by gov't																	Necessity of gov't involvement				Effective measures that should be taken by gov't								
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)							
42	32	24	1	1	36	46	17	1	24	50	28	61	15	14	4	1						1	4	38	43	18	1	16	34	31	64	33	11	0
62	24	14	0	0	27	63	9	1	17	61	21	70	9	13	1	1						0	3	30	61	8	1	13	36	18	81	34	4	0
64	33	3	0	0	47	47	6	0	28	53	19	72	14	22	0	0						0	0	47	47	6	0	20	31	23	74	43	6	0
35	44	15	0	6	38	36	18	8	28	43	40	64	19	4	4	1						9	10	33	38	22	7	23	46	23	54	22	10	0
23	71	5	0	1	40	47	9	4	20	52	32	76	8	3	1	1						5	4	35	52	9	4	20	45	11	77	23	5	1
37	55	4	0	4	49	31	12	8	21	42	21	83	8	8	0	0						15	0	46	42	4	8	21	42	4	75	29	4	0
37	41	20	0	2	48	31	15	6	22	41	38	58	24	11	7	1						10	11	44	37	13	6	19	41	21	53	29	20	5
28	64	7	0	1	57	31	9	3	21	44	35	76	18	5	1	1						5	6	56	31	7	6	17	42	12	80	22	12	1
45	50	5	0	0	79	16	5	0	26	42	32	84	11	5	5	5						5	5	85	5	5	5	24	35	18	76	24	24	0

VIII. Efficient energy conversion and use

1. Questions regarding the relevant area

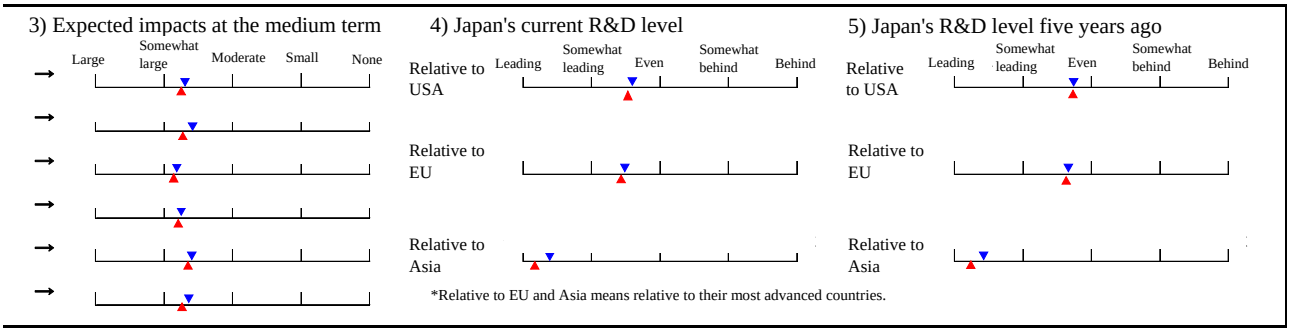
1) Degree of expertise in the area

2) Current impacts



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan					Time of technological realization								
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know
																			(%)	
30	Large capacity combined cycle power generation through the use of large scale gas turbines with high efficiency (Turbine inlet temperature higher than 1700°C).	1	**133**	**17**	**32**	**51**	-	**73**	**48**	**47**	**5**	**0**							**1**	**6**
		2	**140**	**8**	**29**	**63**	-	**74**	**49**	**47**	**4**	**0**							**0**	**1**
		E	**11**	**100**	**0**	**0**	-	**91**	**82**	**18**	**0**	**0**							**0**	**0**
31	Motors and other industrial electric power apparatuses that utilize high-temperature superconductivity.	1	**108**	**12**	**27**	**61**	-	**53**	**21**	**49**	**28**	**2**							**6**	**11**
		2	**115**	**5**	**18**	**77**	-	**48**	**8**	**68**	**23**	**1**							**3**	**5**
		E	**6**	**100**	**0**	**0**	-	**63**	**33**	**50**	**17**	**0**							**17**	**0**
32	Compression coolers with COP ratings over 8 (currently 4.0–6.4).	1	**96**	**16**	**28**	**56**	-	**61**	**31**	**54**	**13**	**2**							**1**	**9**
		2	**110**	**7**	**18**	**75**	-	**59**	**21**	**73**	**6**	**0**							**2**	**2**
		E	**8**	**100**	**0**	**0**	-	**72**	**49**	**38**	**13**	**0**							**13**	**0**
33	Heat pump water heaters with COP ratings over 5 (currently the highest on the market is 4.2).	1	**107**	**14**	**30**	**56**	-	**60**	**29**	**54**	**15**	**2**							**0**	**8**
		2	**110**	**9**	**20**	**71**	-	**57**	**19**	**73**	**6**	**2**							**0**	**2**
		E	**10**	**100**	**0**	**0**	-	**65**	**40**	**40**	**20**	**0**							**0**	**0**
34	Micro cogeneration systems for residential use	1	**161**	**21**	**27**	**52**	-	**58**	**31**	**42**	**24**	**3**							**1**	**4**
		2	**148**	**15**	**32**	**53**	-	**57**	**21**	**64**	**14**	**1**							**0**	**1**
		E	**22**	**100**	**0**	**0**	-	**68**	**41**	**50**	**9**	**0**							**0**	**0**
35	Ceramic micro gas turbines with thermal efficiency of 40 percent.	1	**130**	**14**	**22**	**64**	-	**50**	**18**	**50**	**29**	**3**							**2**	**12**
		2	**133**	**7**	**25**	**68**	-	**47**	**6**	**72**	**20**	**2**							**2**	**5**
		E	**9**	**100**	**0**	**0**	-	**56**	**45**	**11**	**22**	**22**							**22**	**0**



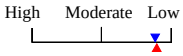
*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge					Regarding technological realization												Time of social application							Regarding social application											
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't							
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)							
33	62	4	0	1	27	38	26	9	25	43	26	61	10	6	3	1						3	7	24	31	29	16	18	32	20	60	16	6	3
14	86	0	0	0	13	63	22	2	15	53	17	73	6	6	0	1						0	1	13	55	29	3	8	42	10	78	13	1	0
36	64	0	0	0	36	46	18	0	18	55	18	82	18	9	0	0						0	0	46	36	18	0	9	64	9	73	9	0	0
50	42	4	0	4	21	41	30	8	25	40	43	47	12	5	1	1						7	15	21	35	32	12	19	38	26	50	16	7	1
60	38	2	0	0	6	70	19	5	16	46	33	65	8	4	0	0						4	6	5	60	30	5	14	49	16	72	11	1	1
17	83	0	0	0	33	50	17	0	20	20	0	60	20	0	0	0						20	0	17	33	50	0	0	33	0	50	0	0	17
73	17	8	0	2	14	39	36	11	14	49	27	58	2	6	5	1						3	13	13	35	39	13	13	31	16	59	19	7	1
92	7	0	0	1	6	60	30	4	6	58	12	77	2	3	1	0						2	2	6	47	42	5	8	38	10	79	12	4	0
74	13	0	0	13	13	25	37	25	0	83	0	67	0	0	0	0						13	0	13	37	25	25	0	67	17	50	17	33	0
79	9	9	0	3	12	36	41	11	13	48	32	51	3	10	4	2						0	10	11	38	37	14	12	28	18	63	24	11	1
94	4	2	0	0	5	52	37	6	7	56	18	65	3	5	2	0						0	2	5	47	40	8	9	37	14	75	17	3	0
100	0	0	0	0	10	30	50	10	22	56	11	67	0	11	11	0						0	0	10	30	50	10	22	44	22	44	22	11	0
58	22	19	0	1	20	36	31	13	17	38	27	43	7	40	5	2						3	4	21	34	32	13	10	25	24	67	44	13	1
86	10	4	0	0	8	56	29	7	8	51	16	57	2	38	2	1						0	3	11	55	27	7	7	25	15	80	47	2	0
86	9	5	0	0	18	63	14	5	19	62	14	62	5	38	10	5						0	5	14	63	18	5	19	29	5	76	52	10	0
35	54	8	0	3	10	42	37	11	14	41	33	51	8	15	2	1						3	9	7	38	39	16	12	37	25	53	27	9	1
16	82	1	0	1	5	53	37	5	11	50	22	74	3	8	0	0						4	3	3	44	45	8	9	43	13	76	26	1	0
33	56	0	0	11	22	11	45	22	29	57	14	71	0	14	0	0						22	0	22	11	45	22	29	71	14	43	14	14	0

IX. Resource assessment

1. Questions regarding the relevant area

1) Degree of expertise in the area

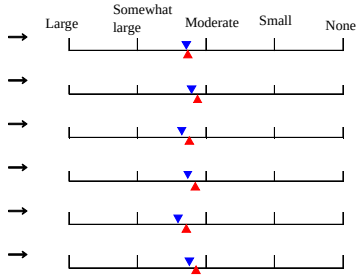


2) Current impacts

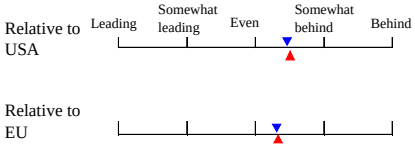
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan					Time of technological realization							
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know
36	Wet smelting technology whose extraction rate of copper and precious metals is equivalent to that of the process cimbining ore dressing and dry smelting (e.g. 85% x 98% = 83% approx.).	1	**52**	**10**	**13**	**77**	**-**	**51**	**18**	**50**	**30**	**2**							**4**	**16**
		2	**61**	**8**	**15**	**77**	**-**	**44**	**2**	**73**	**23**	**2**							**0**	**8**
		E	**5**	**100**	**0**	**0**	**-**	**45**	**0**	**80**	**20**	**0**							**0**	**0**
37	High-efficient unmanned mining technology including robotics.	1	**66**	**2**	**17**	**81**	**-**	**44**	**11**	**43**	**44**	**2**							**2**	**14**
		2	**74**	**0**	**14**	**86**	**-**	**39**	**3**	**51**	**45**	**1**							**0**	**3**
		E																		
38	Extraction and separation technology of metallic elements based on biotechnology.	1	**74**	**7**	**18**	**75**	**-**	**48**	**15**	**52**	**29**	**4**							**7**	**15**
		2	**80**	**4**	**9**	**87**	**-**	**44**	**3**	**68**	**26**	**3**							**4**	**3**
		E	**3**	**100**	**0**	**0**	**-**	**42**	**0**	**67**	**33**	**0**							**0**	**0**
39	Technology to economically extract seafloor metal resources such as manganese nodules, cobalt crusts, heavy metal sludge, and hydrothermal mineral deposits.	1	**83**	**5**	**25**	**70**	**-**	**65**	**40**	**44**	**15**	**1**							**2**	**15**
		2	**85**	**1**	**16**	**83**	**-**	**60**	**27**	**60**	**12**	**1**							**1**	**4**
		E	**1**	**100**	**0**	**0**	**-**	**100**	**100**	**0**	**0**	**0**							**0**	**0**
40	Technology to reveal geological structure 100 meters underground using data from aircraft or artificial satellites.	1	**73**	**8**	**16**	**76**	**-**	**57**	**28**	**47**	**24**	**1**							**1**	**14**
		2	**80**	**5**	**6**	**89**	**-**	**55**	**17**	**69**	**14**	**0**							**3**	**5**
		E	**4**	**100**	**0**	**0**	**-**	**100**	**100**	**0**	**0**	**0**							**0**	**0**
41	Ultra-deep drilling technology whose specifications are for depths of 15 km and temperatures of 400°C.	1	**59**	**10**	**15**	**75**	**-**	**58**	**26**	**57**	**14**	**3**							**4**	**9**
		2	**72**	**3**	**10**	**87**	**-**	**51**	**13**	**72**	**11**	**4**							**0**	**6**
		E	**2**	**100**	**0**	**0**	**-**	**100**	**100**	**0**	**0**	**0**							**0**	**0**
42	Technology to extract methane hydrate from continental permafrost areas.	1	**107**	**5**	**22**	**73**	**-**	**53**	**24**	**46**	**23**	**7**							**2**	**12**
		2	**108**	**4**	**15**	**81**	**-**	**49**	**15**	**57**	**23**	**5**							**3**	**4**
		E	**4**	**100**	**0**	**0**	**-**	**50**	**25**	**50**	**0**	**25**							**0**	**0**
43	Technology to extract methane hydrate from sediments under the deepsea floor.	1	**124**	**6**	**20**	**74**	**-**	**70**	**50**	**34**	**13**	**3**							**3**	**13**
		2	**119**	**4**	**16**	**80**	**-**	**71**	**51**	**34**	**10**	**5**							**3**	**5**
		E	**5**	**100**	**0**	**0**	**-**	**70**	**60**	**20**	**0**	**20**							**0**	**0**

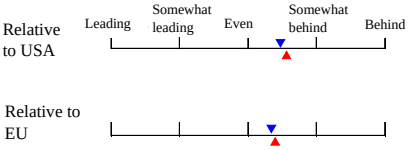
3) Expected impacts at the medium term



4) Japan's current R&D level



5) Japan's R&D level five years ago



*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge					Regarding technological realization													Time of social application							Regarding social application											
					Necessity of gov't involvement				Effective measures that should be taken by gov't																	Necessity of gov't involvement				Effective measures that should be taken by gov't							
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)							
30	58	5	0	7	12	39	43	6	30	50	39	37	22	7	0	0						4	18	8	45	41	6	38	44	18	31	11	7	4
8	89	0	0	3	3	45	49	3	22	67	34	34	12	5	0	3						0	10	2	62	31	5	30	73	18	43	4	0	4
40	60	0	0	0	0	40	60	0	40	60	0	20	20	0	0	0						0	0	0	60	20	20	50	75	0	25	0	0	0
26	62	7	0	5	11	40	39	10	29	39	38	43	16	4	0	0						2	17	10	37	40	13	27	40	27	38	6	2	0
13	86	1	0	0	3	45	46	6	26	51	37	54	15	1	0	1						1	4	1	39	53	7	24	62	32	52	6	0	2
16	66	11	0	7	11	46	37	6	32	35	42	41	14	6	0	2						9	21	10	45	39	6	32	43	33	38	8	5	3
4	93	0	0	3	4	64	28	4	29	44	48	53	17	5	0	0						5	8	4	57	34	5	25	63	30	52	10	3	1
0	100	0	0	0	0	67	33	0	0	33	67	33	33	0	0	0						0	33	0	33	67	0	0	100	0	33	0	0	0
30	58	7	0	5	41	34	20	5	32	52	41	55	27	9	3	0						3	19	29	43	24	4	35	51	27	41	15	5	4
9	89	1	0	1	33	51	14	2	21	50	39	71	23	5	1	1						2	5	20	64	14	2	27	69	20	57	7	2	2
0	100	0	0	0	0	100	0	0	100	100	100	100	0	0	0	0						0	0	0	100	0	0	100	100	0	100	0	0	0
3	92	3	0	2	30	38	26	6	31	38	40	52	34	8	2	0						1	16	29	40	27	4	29	46	29	45	8	3	3
1	99	0	0	0	19	64	16	1	27	42	47	68	31	4	0	1						3	6	16	67	16	1	29	62	26	59	9	1	3
0	100	0	0	0	100	0	0	0	100	50	75	100	25	0	0	0						0	0	75	25	0	0	75	50	50	100	25	0	0
9	77	8	0	6	31	41	24	4	29	33	42	54	33	8	2	2						5	15	23	41	32	4	25	45	21	47	15	6	6
1	97	1	0	1	13	68	15	4	21	37	49	68	22	6	0	0						1	8	11	68	17	4	22	63	19	62	13	1	1
0	100	0	0	0	100	0	0	0	100	0	0	100	0	0	0	0						0	0	100	0	0	0	0	0	100	100	0	0	0
14	55	11	0	20	34	34	26	6	29	38	41	47	47	4	1	1						4	19	33	36	21	10	39	55	28	38	11	7	5
5	86	1	0	8	23	53	19	5	18	27	39	58	53	3	0	1						3	7	22	55	17	6	26	68	21	51	9	0	0
25	75	0	0	0	50	25	0	25	33	33	67	33	100	33	0	0						0	25	25	50	0	25	67	67	33	67	33	0	0
32	56	5	0	7	49	31	16	4	31	38	51	58	28	4	1	2						6	16	43	36	13	8	38	49	27	48	16	7	5
14	82	1	0	3	55	33	9	3	20	31	54	71	25	5	0	1						3	8	50	36	10	4	25	65	17	68	12	3	1
60	40	0	0	0	60	20	0	20	75	50	100	75	50	50	0	0						0	20	60	20	0	20	75	100	25	75	25	0	0

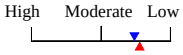
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise				Importance to Japan					Time of technological realization								
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know
				(%)					(%)											(%)	
44	Discovery of unconventional underground resources such as methane hydrate (energy resources) and seafloor hydrothermal deposits (mineral resources) as a result of changes in economic conditions, advances in earth sciences, and development of exploration technology (improved estimation, development of materials resistant to ultrahigh temperature and pressure, increased exploration depth).	1	**90**	**4**	**24**	**72**	**-**	**67**	**43**	**39**	**17**	**1**							**3**	**22**
		2	**100**	**3**	**16**	**81**	**-**	**72**	**51**	**39**	**8**	**2**							**1**	**11**
		E	**3**	**100**	**0**	**0**	**-**	**100**	**100**	**0**	**0**	**0**							**0**	**0**
45	Technology to asssess ultimate resereves of conventional resources.	1	**90**	**7**	**24**	**69**	**-**	**64**	**41**	**36**	**19**	**4**							**5**	**22**
		2	**95**	**4**	**17**	**79**	**-**	**70**	**45**	**44**	**10**	**1**							**0**	**12**
		E	**4**	**100**	**0**	**0**	**-**	**100**	**100**	**0**	**0**	**0**							**0**	**0**

Countries at the leading edge					Regarding technological realization												Time of social application							Regarding social application											
					Necessity of gov't involvement				Effective measures that should be taken by gov't															Necessity of gov't involvement				Effective measures that should be taken by gov't						
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)						
14	**76**	**5**	**0**	**5**	**42**	**32**	**21**	**5**	**43**	**42**	**44**	**43**	**36**	**2**	**0**	**0**																		
4	**92**	**2**	**0**	**2**	**58**	**35**	**5**	**2**	**38**	**33**	**59**	**53**	**24**	**1**	**0**	**0**																		
33	**67**	**0**	**0**	**0**	**100**	**0**	**0**	**0**	**100**	**67**	**100**	**100**	**67**	**33**	**0**	**0**																		
4	**82**	**10**	**0**	**4**	**36**	**31**	**26**	**7**	**49**	**32**	**42**	**41**	**38**	**2**	**0**	**4**						**5**	**23**	**34**	**33**	**26**	**7**	**55**	**54**	**15**	**34**	**8**	**3**	**4**
1	**98**	**1**	**0**	**0**	**48**	**41**	**10**	**1**	**51**	**25**	**51**	**42**	**27**	**1**	**0**	**1**						**0**	**13**	**38**	**44**	**17**	**1**	**60**	**71**	**9**	**42**	**7**	**1**	**0**
0	**100**	**0**	**0**	**0**	**100**	**0**	**0**	**0**	**100**	**50**	**50**	**75**	**25**	**0**	**0**	**0**						**0**	**0**	**50**	**50**	**0**	**0**	**100**	**50**	**25**	**50**	**25**	**0**	**0**

X. Recycling systems (including biomass and waste)

1. Questions regarding the relevant area

1) Degree of expertise in the area

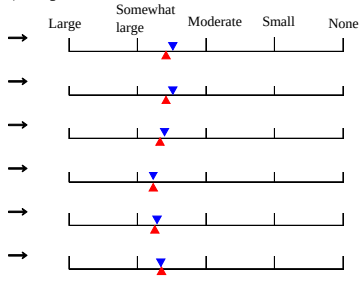


2) Current impacts

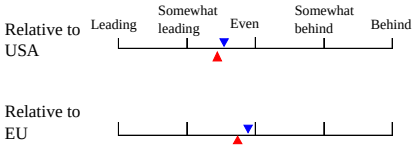
2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise (%)				Importance to Japan					Time of technological realization									
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be realized	Do not know
46	Rational recovery methods for valuable resources in urban garbage.	1	**129**	**21**	**17**	**62**	-	**67**	**43**	**42**	**13**	**2**							**0**	**9**
		2	**123**	**15**	**16**	**69**	-	**74**	**50**	**44**	**6**	**0**							**0**	**2**
		E	**18**	**100**	**0**	**0**	-	**83**	**67**	**33**	**0**	**0**							**0**	**0**
47	Recycle systems for the production, distribution, and consumption of recovered materials and products based on new economic criteria/standards.	1	**124**	**19**	**23**	**58**	-	**75**	**54**	**39**	**6**	**1**								
		2	**109**	**16**	**10**	**74**	-	**86**	**75**	**21**	**3**	**1**								
		E	**17**	**100**	**0**	**0**	-	**97**	**94**	**6**	**0**	**0**								
48	Shredder dust disposal technology (energy and resource recovery) for post-consumer automobiles.	1	**117**	**21**	**18**	**61**	-	**67**	**40**	**48**	**10**	**2**							**0**	**2**
		2	**112**	**16**	**13**	**71**	-	**61**	**25**	**68**	**7**	**0**							**0**	**3**
		E	**18**	**100**	**0**	**0**	-	**67**	**33**	**67**	**0**	**0**							**0**	**0**
49	Manufacture of polylactic acid plastics from municipal waste.	1	**100**	**13**	**20**	**67**	-	**49**	**19**	**45**	**30**	**6**							**5**	**6**
		2	**95**	**9**	**17**	**74**	-	**51**	**15**	**61**	**23**	**1**							**1**	**3**
		E	**9**	**100**	**0**	**0**	-	**53**	**22**	**45**	**33**	**0**							**11**	**0**
50	Recovery of rare metals from electronic circuit boards.	1	**114**	**11**	**23**	**66**	-	**62**	**34**	**48**	**16**	**2**							**0**	**5**
		2	**103**	**10**	**14**	**76**	-	**61**	**26**	**64**	**10**	**0**							**0**	**2**
		E	**10**	**100**	**0**	**0**	-	**85**	**70**	**30**	**0**	**0**							**0**	**0**
51	Recovery of resources from incinerator and fly ash.	1	**126**	**16**	**24**	**60**	-	**55**	**24**	**49**	**24**	**3**							**0**	**6**
		2	**121**	**15**	**16**	**69**	-	**54**	**17**	**67**	**16**	**0**							**0**	**2**
		E	**18**	**100**	**0**	**0**	-	**74**	**50**	**44**	**6**	**0**							**0**	**0**

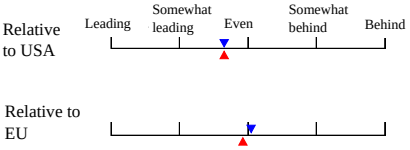
3) Expected impacts at the medium term



4) Japan's current R&D level



5) Japan's R&D level five years ago



*Relative to EU and Asia means relative to their most advanced countries.

Countries at the leading edge					Regarding technological realization													Time of social application							Regarding social application											
					Necessity of gov't involvement				Effective measures that should be taken by gov't																Necessity of gov't involvement				Effective measures that should be taken by gov't							
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006–2010	2011–2015	2016–2025	2026–2035	2036–	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)													(%)		(%)				(%)							
53	8	38	0	1	33	43	22	2	24	46	38	52	7	27	25	1						0	9	32	50	16	2	19	34	34	56	37	38	0
80	1	19	0	0	23	67	8	2	18	53	29	59	2	23	19	0						0	3	25	69	5	1	12	35	22	75	37	26	0
83	0	17	0	0	41	59	0	0	12	47	24	47	6	35	24	0						0	0	44	56	0	0	11	39	22	72	39	33	0
																						0	5	49	42	9	0	24	44	28	47	40	35	2
																						0	4	61	32	5	2	19	38	17	68	38	23	0
																						0	0	82	12	6	0	19	38	19	56	31	25	0
66	5	28	0	1	25	47	23	5	21	38	30	46	7	29	25	1						0	2	32	42	23	3	16	28	33	45	34	33	2
93	0	7	0	0	15	66	15	4	12	50	17	61	3	22	17	0						0	2	21	61	15	3	12	27	26	67	35	25	0
94	0	6	0	0	35	59	0	6	6	56	19	63	0	13	19	0						0	0	39	49	6	6	6	35	18	65	47	47	0
63	10	24	0	3	24	39	30	7	25	42	29	56	8	14	18	2						8	11	20	47	26	7	15	34	41	46	25	24	2
86	10	3	0	1	15	56	24	5	12	48	23	64	1	8	10	1						5	3	14	61	22	3	9	27	30	71	19	14	2
100	0	0	0	0	34	33	22	11	0	50	25	50	13	0	0	0						22	0	22	56	11	11	13	38	13	75	13	25	0
68	7	24	0	1	24	41	29	6	24	45	29	43	8	16	21	1						0	6	24	44	30	2	19	34	38	42	28	28	1
91	2	6	0	1	12	64	21	3	15	61	20	61	4	9	11	2						0	2	12	69	18	1	14	31	34	65	25	18	0
100	0	0	0	0	20	60	10	10	22	44	22	33	0	0	22	11						0	0	20	70	0	10	11	22	22	44	33	22	0
68	6	24	0	2	23	49	25	3	18	41	31	48	5	25	18	3						1	8	24	51	22	3	16	32	34	47	36	25	0
91	2	7	0	0	13	69	15	3	12	52	22	70	3	16	10	0						0	3	15	69	14	2	10	26	26	75	29	22	0
100	0	0	0	0	31	50	13	6	20	53	20	47	0	13	27	0						0	0	33	50	11	6	12	29	24	76	35	47	0