The topics of Environment, Resources and Energy results in the 10th S&T Foresight Survey

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Topics of “Environment”, ”Resources”, ”Energy” by each Survey

The 8th Survey	The 9th Survey	The 10th Survey
Clean tech. for Fossil Fuel	Fossil Energy	① Energy Production
Renewable Energy	Renewable Energy	
Advanced Nuclear system	Nuclear Energy	
Nuclear Fusion Energy	Nuclear Fusion Energy	
Distributed Energy System	Energy Management	② Energy Consumption
Efficiency of energy conversion and utilization	Saving Energy	
	Solar power, Space Radiation / Low carbon Energy Storage / Low carbonated mobile	③ Energy distribution, conversion, Storage, and Transportation
	Energy Transportation	
Hydrogen Energy system	Hydrogen	
Fuel Cell	Fuel Cell	
Resources reuse	Hydrogen Carbon Resources, Natural Resources and CCS (Carbon dioxide Capture and Storage)	④ Resources
Efficiency of energy conversion and utilization	Nonuse Resources	
	Manufacturing technology with low carbon emission, co-production	⑤ Reuse, Recycle
	Others Evaluation of Technology development etc.	
Resources reuse	Environment, Reuse, Resources, Recycle, LCA (Life Cycle Assessment)	
Resources Assessment	Resources Base Technology, Reunited area and human resources for Natural Resources	
Water Resources	Water Resources	⑥ Water
Earth Level Environment	【Counter measure Tech.】Evaluation and Countermeasure tech. of Global Warming	⑦ Global Warming
	【Mechanism, basic Environment monitoring（ground measurement）	
Efficiency of energy conversion and utilization	【Counter measure Tech.】Reduction of multiple waste Tech. / Environment Protection materials Cycle Tech. / Saving Resources, Saving Energy production	⑧ Environmental Conservation
Resources Reuse	【Counter measure Tech.】Protection technology for Air, Water and Soil Environment / Water Resources reuse and recycle Tech.	
Earth Level Environment	【Mechanism, Basic】Environment evaluation, Environment prediction, Environment simulation Tech.	⑨ Environmental Analysis and Evaluation
Environment Economy Indicator	【Social】Environment economy Policy / Environment economy evaluation / Environment economy Indicator / Environment management methods	
Life style with Environment	【Social】Life style and Environment（Environment Ethics）	
Metropolitan Level Environment	【Counter measure Tech.】Urban, Rural Environment（Local Environment Protection）	⑩ Environmental System Development
Elucidation and measures of ecological impact area	【Counter measure Tech.】Bio, Landscape / Species, habitat / Coexistence approach of the diversity conservation, restoration, evaluation and policy / Wildlife at each level of the gene	
Environment accident	【Social】Environment Risk evaluation / Risk manegement / Risk communication	⑪ Risk Management

The 10th S&T Foresight Survey
- Environment, Resources, Energy -

Area 11, Topics 93

Field	Area	Contents	number
Energy	01. Energy Production	Hydrogen, Solar Heat, Geothermal, Wind Power, Space Energy, Ocean Temperature Difference, Nuclear Fusion, Nuclear Reactors, Power Generation	15
	02. Energy Consumption	CO2, Saving Energy, Energy Management	10
	03. Energy Distribution, Conversion, Storage and Transportation	Fuel Cell, Hydrogen, Cogeneration, Power Transmission, Storage, Fuel, Battery, Wastes	11
Resources	04. Resources	Mineral, Hydrocarbon, Unused	9
	05. Reuse, Recycle	Reuse, Recycling, Co-Production	7
	06. Water	Water Resources, Water Environment	11
Environment	07. Global Warming	Evaluation and Measures of Global Warming, Environment Monitoring	7
	08. Environmental Conservation	Air pollution, Chemicals, Cleaning	4
	09. Envi. Analysis and Evaluation	Monitoring, Simulation, Native Species, Environment Economy	5
	10. Envi. System Development	Ecology, Biodiversity, Greening, Regional Development	9
	11. Risk Management	Environment Risk Assessment, Risk Control, Risk Communication	5

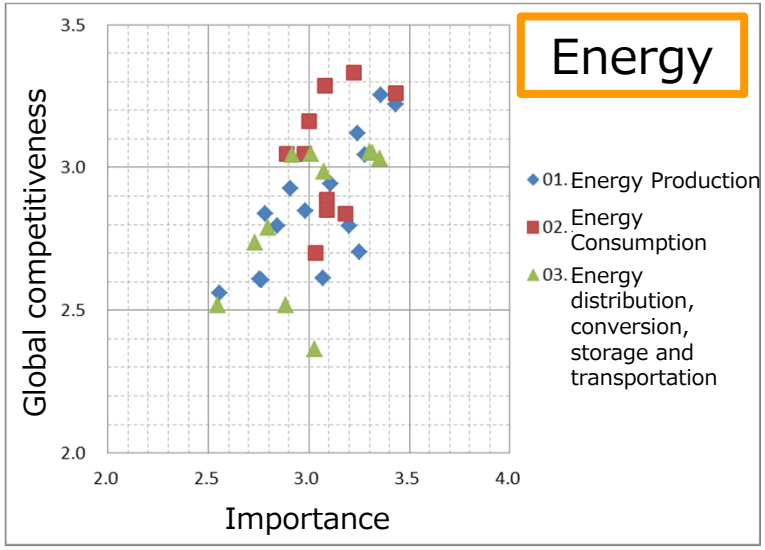
R&D Characteristics - Importance

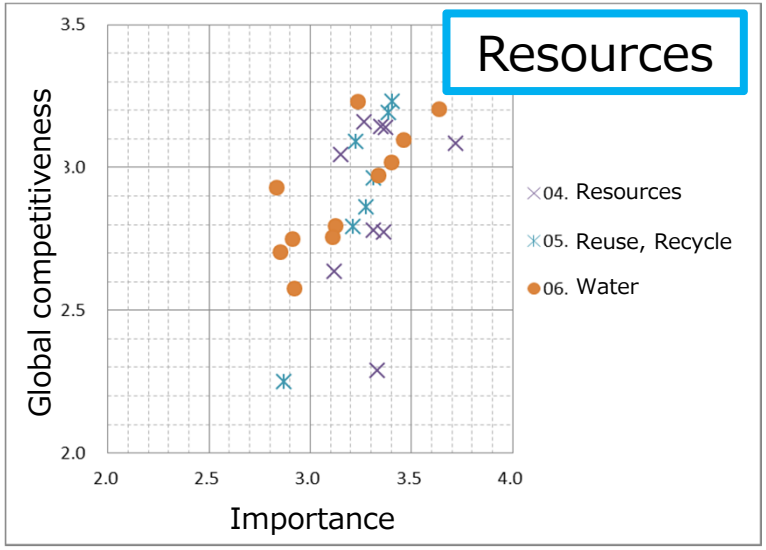
- “Resources” ranked high.
- “Environment” is most important than the others.

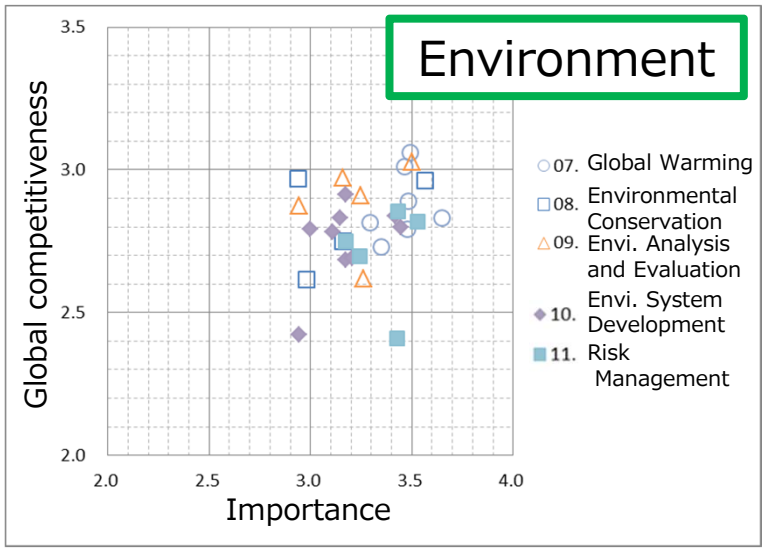
Area	Topics	Importance	Un-certainty	Non-continuity	Ethics	Strategy for Tech. realization	strategy for Social realization
Resources	Mineral extraction and mining technology needed for extracting ocean mineral resources	3.7	2.9	2.7	2.5	Budget	Budget
Global Warming	Predictive technology to assess the impact of climate change on food production	3.6	2.9	2.4	2.4	Human Resources	Collaborations
Water	Technology for the purification and recycling of contaminated water that is economical and generally available in developing countries	3.6	2.3	2.1	2.4	Budget	Collaborations
Environmental Conservation	Reliable decontamination technology for removing radioactive materials from soil and water	3.6	2.8	2.6	2.8	Budget	Budget
Risk Management	Establishment of consensus formation methods regarding the risk of low dosages of radiation	3.5	2.9	2.4	3.4	Human Resources	Collaborations

Importance/Global competitiveness：
（4：very high, 3：high, 2：low, 1： very low）

R&D Characteristics
Importance v.s. Global competitiveness





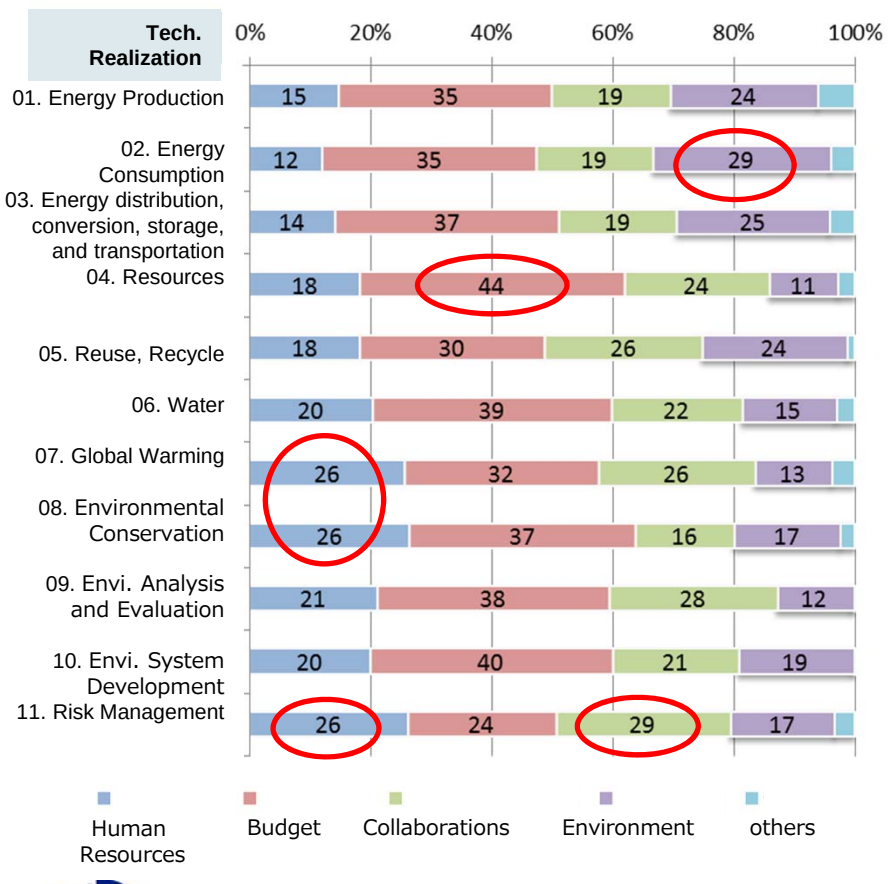


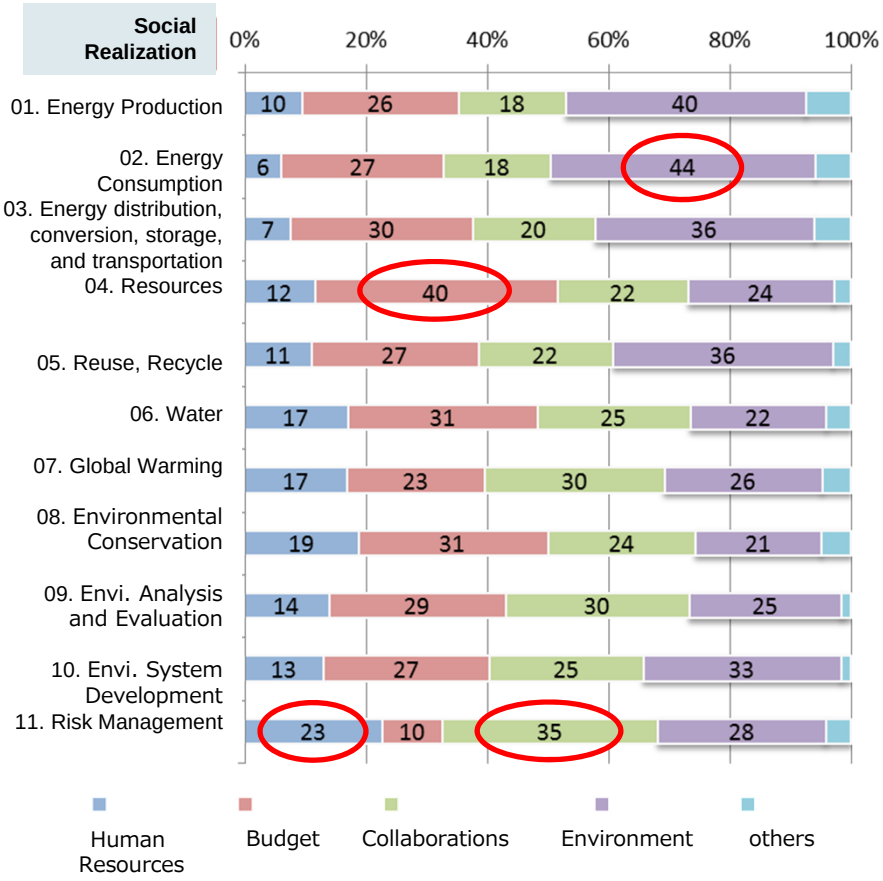
- Importance and Global competitiveness is seen correlation overall.
- Global competitiveness is high at “Energy consumption”.
- Importance of “Resources” is especially high.
- Global competitiveness and Importance are high at “Global Warming”.
- “Risk Management” indicate high Importance but Global competitiveness is not too high.

Importance/Global competitiveness：
（4：very high, 3：high, 2：low, 1： very low）

Characteristics of the priority measures

- “Budget” is most important to realizing of any area at any stage.
- Especially “Human Resources” and “collaborations” are important key in Environment area and Risk Management.





Challenging topics – realize by 2025

- “Environment”, ”Global Warming”, ”Water” will be realizing by 2025 if it can keep “Budget”, “Human Resources” and collaborations.

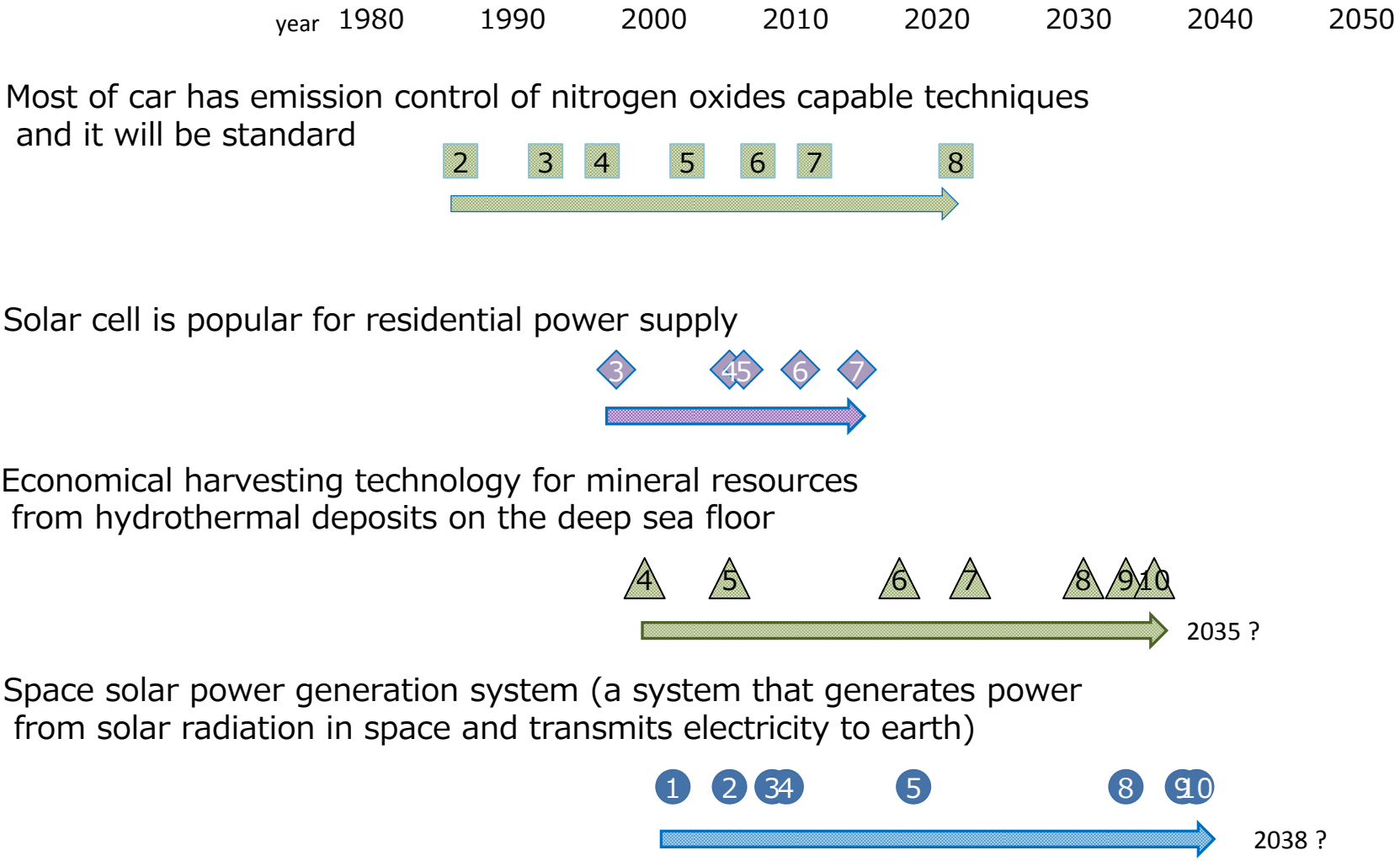
Area	Topics	Year/ Lab	Year/ Social	Strategy for Tech. realization	Strategy for Social realization
Water	Technology for the purification and recycling of contaminated water that is economical and generally available in developing countries	2020	2025	Budget	collaborations
Environmental Analysis and Evaluation	Accurate and rapid detection system for extremely minute amounts of explosives, narcotics, radioactive materials, and infectious microorganisms in public infrastructure facilities where the public gathers such as airports, seaports, and railroads	2020	2030	Budget	Budget
Global Warming	Technology of forecasting sudden, localized rainstorms with a 100m mesh observation network	2022	2025	Budget	Budget
Water	Integrated water management technology to deal with urban flooding, storm surges, land subsidence, etc. in areas with densely populated areas	2025	2025	Human Resources	Environment arrangement
Risk Management	Establishment of consensus formation methods regarding the risk of low dosages of radiation	2025	2027	Human Resources	collaborations
Environmental Conservation	Reliable decontamination technology for removing radioactive materials from soil and water.	2025	2029	Budget	Budget
Resources	Mineral extraction and mining technology needed for extracting ocean mineral resources	2025	2030	Budget	Budget
Global Warming	Measures and selection method for reducing greenhouse gas emissions that take into account various economic efficiency and tradeoffs	2025	2030	collaborations	collaborations

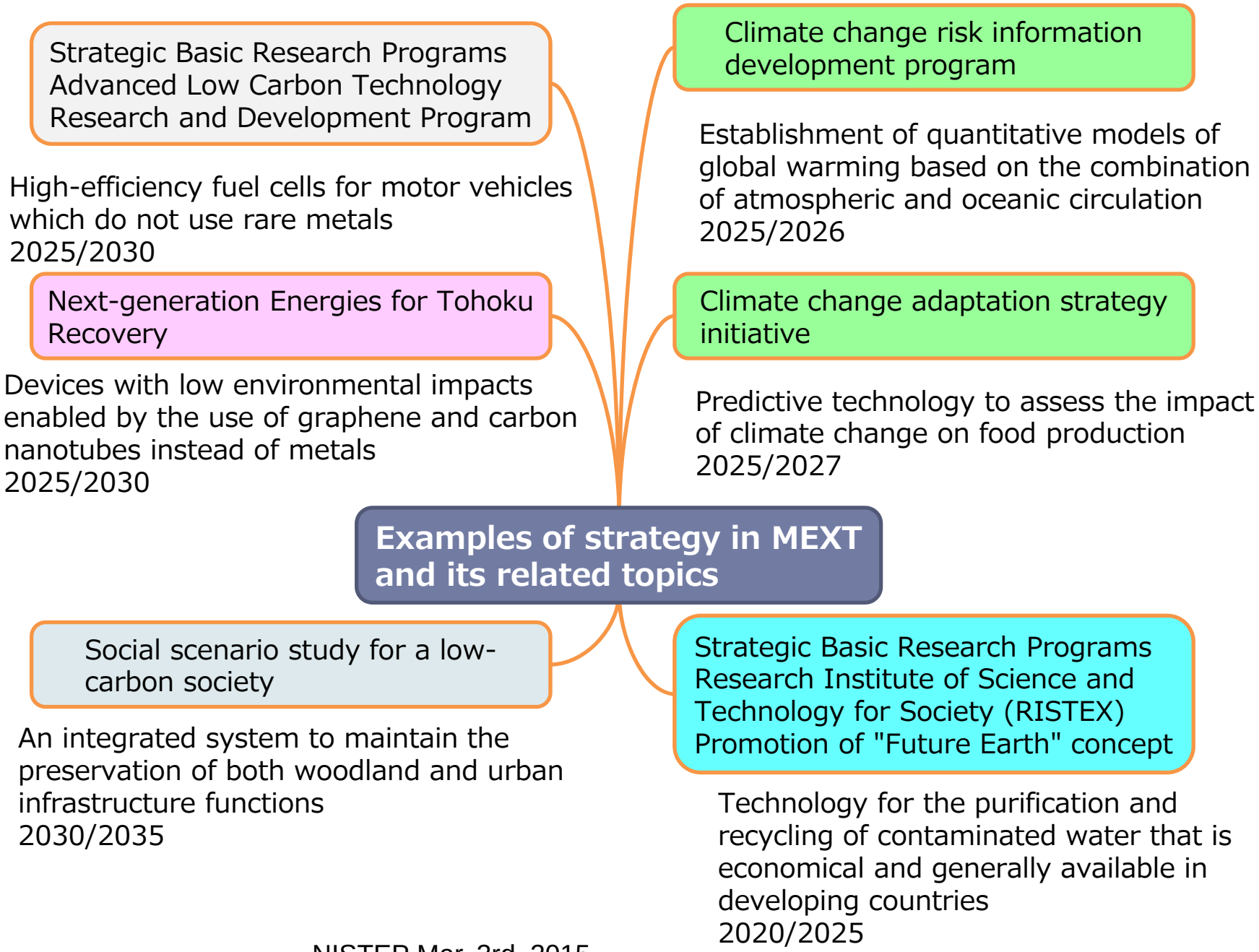
Challenging topics – realize after 2025

- “Environment” and “Resources” are taking time to realizing and require budget. Especially, “Human Resources” and “Environment arrangement” will be key of realization for most of cases.

Area	Topics	Year/ Lab	Year/ Social	Strategy for Tech. realization	Strategy for Social realization
Envi. System Development	Technology for mitigating heat island effects, desertification, and habitat loss	2026	2030	Environment arrangement	Environment arrangement
Resources	Technology to recover rare metals such as uranium economically from seawater	2026	2035	Budget	Environment arrangement
Envi. System Development	Technology to manage the reproduction and maintenance of vegetation in arid and desert areas	2028	2033	Budget	Collaborations
Resources	Economical harvesting technology for mineral resources from hydrothermal deposits on the deep sea floor	2030	2035	Budget	Budget
Envi. System Development	An integrated system to maintain the preservation of both woodland and urban infrastructure functions	2030	2035	Budget	Environment arrangement
Reuse, recycle	Technology to dramatically reduce the amount of radioactive isotopes contained in high-level radioactive waste through transmutation using a particle accelerator	2030	2040	Human Resources	Environment arrangement
Energy production	Nuclear fusion power generation	2040	2050	Human Resources	Budget

An example of a realization foresight year by each survey




Strategic Basic Research Programs
Advanced Low Carbon Technology
Research and Development Program
High-efficiency fuel cells for motor vehicles which do not use rare metals
2025/2030
Next-generation Energies for Tohoku Recovery
Devices with low environmental impacts enabled by the use of graphene and carbon nanotubes instead of metals
2025/2030
Social scenario study for a low-carbon society
An integrated system to maintain the preservation of both woodland and urban infrastructure functions
2030/2035
Climate change risk information development program
Establishment of quantitative models of global warming based on the combination of atmospheric and oceanic circulation
2025/2026
Climate change adaptation strategy initiative
Predictive technology to assess the impact of climate change on food production
2025/2027
Strategic Basic Research Programs
Research Institute of Science and Technology for Society (RISTEX)
Promotion of "Future Earth" concept
Technology for the purification and recycling of contaminated water that is economical and generally available in developing countries
2020/2025
Examples of strategy in MEXT and its related topics

Summary
- Environment, Resources, Energy -

- The relating with “Saving energy” and “CO_2 reduction technology” topics indicated that “Global competitiveness” is very important as usual.

- In compared with other fields, the results show that no specific strategy require to enhancing all topics.

- For technology realization
  - Budget is most important strategy except Risk Management.

- For social realization
  - Budget and Environment arrangement is key to making realization.

- For Human Resources strategy
  - Global Warming and Environmental Protection required international collaboration so that those topics indicated un-certainly.
  - Therefore human resources strategy is key of this matter.