Research & Coordination Group

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Research of the Decarbonized Society to Achieve Carbon Neutrality

The Research and Coordination Group aims to i) searching for new research topics that enhance the research potential of RITE, proposing and implementing new research themes, ii) government support for the relation with international organizations such as IPCC (Intergovernmental Panel on Climate Change), ISO (International Standard Organization), iii) dissemination of RITE's technologies and Human development of the future generation iv) practical application of technology through industrial collaborative R&D, together with the research groups/center. These efforts lead to a creation of new policy implementation, R&D and innovation aiming at the global environment and the economy[1].

In 2021, the Cabinet approved the Sixth Strategic Energy Plan to show the approach to energy policy toward achieving carbon neutrality by 2050, so it is outlined at first.

1. Cabinet Decision on the Sixth Strategic Energy Plan

In October 2020, Prime Minister Suga declared the goal of realizing a carbon-neutral, decarbonized society by 2050 at the 203rd extraordinary Diet session[2]. In April 2021, the Plan for global Warning Countermeasures[3] was revised and announced to reduce greenhouse gas emissions by 46% in FY 2030 from its FY 2013 levels, while continuing strenuous efforts in its challenge to meet the lofty goal of cutting its emission by 50%.

In October 2021, the Sixth Strategic Energy Plan[4] has been formulated, showing the approach to energy policy toward achieving carbon neutrality by 2050 and presenting initiatives to ensure stable supply and reduce energy costs based on the major premise of ensuring safety, in order to solve challenges facing Japan's energy supply and demand structure while taking action against climate change (Fig.1).

In December 2021, while realizing carbon neutrality by 2050 and the reduction of greenhouse gas emissions by 46% in FY 2030, Ministry of Economy, Trade and Industry (METI) started to discuss "the Clear Energy Strategy"[5] to describe the feasible pass in not "a point" but "a line" in addition to finding the stable, cheap energy supply for the future. It is being formulated in about June 2022.

In the Clean Energy Strategy, the agenda for discussion is securing stable, cheap energy supply for the future and changing energy contents of each field of demand side including industry as well as the supply side.

・In the light of new GHG emission reduction target inFY2030, this outlook shows **energy supply and demand on the ambitious assumption that various challenges in both aspects of supply and demand** in promoting thorough energy conservation and expansion of non-fossil energy **will be overcome**.

・In implementing the measures towards this ambitious outlook, **degree and timing of implementation of the measures need to be carefully for stable supply of energy not to be impaired.**(e.g. If fossil fuel power sources are immediately curtailed at a stage prior to full introduction of non-fossil fuel power sources, stale supply of electricity can be impaired.)

	(FY2019⇒ previous energy mix)		Energy mix in FY2030 (ambitious outlook)	
Energy efficiency improvement	(16.55 million kl ⇒ 50.30 million kl)		**62million kl**	
Final energy consumption (without energy conservation)	(350 million kl ⇒ 377 million kl)		350 million kl	
Renewable energy	(18% ⇒ 22～24%)	solar 6.7% ⇒ 7.0% wind 0.7% ⇒ 1.7% geothermal 0.3% ⇒ 1.0～1.1% hydropower 7.8% ⇒ 8.8~9.2% biomass 2.6% ⇒ 3.7~4.6%	**36～38%** ※If progress is made in utilization and implementation of R&D of renewable energy currently underway, 38% or higher will be aimed at.	
Power generation mix Electricity generated : 10,650 TWh ⇒ Approx. 934 TWh				
Hydrogen/Ammonia	(0% ⇒ 0%)		**1%**	(details of renewable) solar 14～16% wind 5% geothermal 1% hydropower 11% biomass 5%
Nuclear	(6% ⇒ 20-22%)		**20-22%**	
LNG	(37% ⇒ 27%)		**20%**	
Coal	(32% ⇒ 26%)		**19%**	
Oil, etc.	(7% ⇒ 3%)		**2%**	
(+ non-energy related gases/sinks)				
GHG reduction rate	(14% ⇒ 26%)		**46%** Continuing strenuous efforts in its challenge to meet the lofty goal of cutting its emission by 50%	

(Source) Outline of the Sixth Strategic Energy Plan (October, 2021 Agency for Natural Resources and Energy)

Fig.1 The Sixth Strategic Energy Plan － Points of outlook for energy supply and demand in FY2030(1)

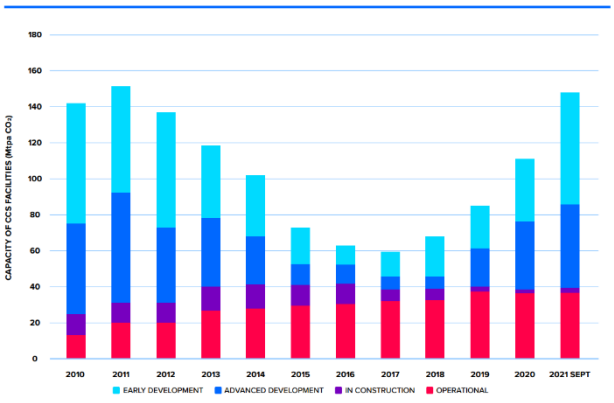
2. Research Activities

Last year, RITE studied the CCS (Carbon dioxide Capture) investigation research[6] entrusted by METI which was the research related to the system design and business conditions for CCS industrialization, so it is outlined in the below.

2.1. The Trend of Commercial CCS projects in the world

Fig. 2 showed the trend of the facilities capacity (CO_2 possibility quantity) of the world's commercial CCS projects published by GCCSI (Global CCS Institute)[7]. The quantity increased from 2010 to 2011, but decreased the half of 2011 in 2017.

The CCS projects need relatively big investment and a long time, so were postponed or stopped by various reasons before the last investment decision. Since 2018, they have increased again. It is guessed to be the influence of the Paris Agreement that took effect in 2016. The future reduction target became clear and each country recognized the large cut of CO_2 discharged by human and the importance of CCS projects to achieve the target. In 2021, the capacity increased to the same level in 2011.

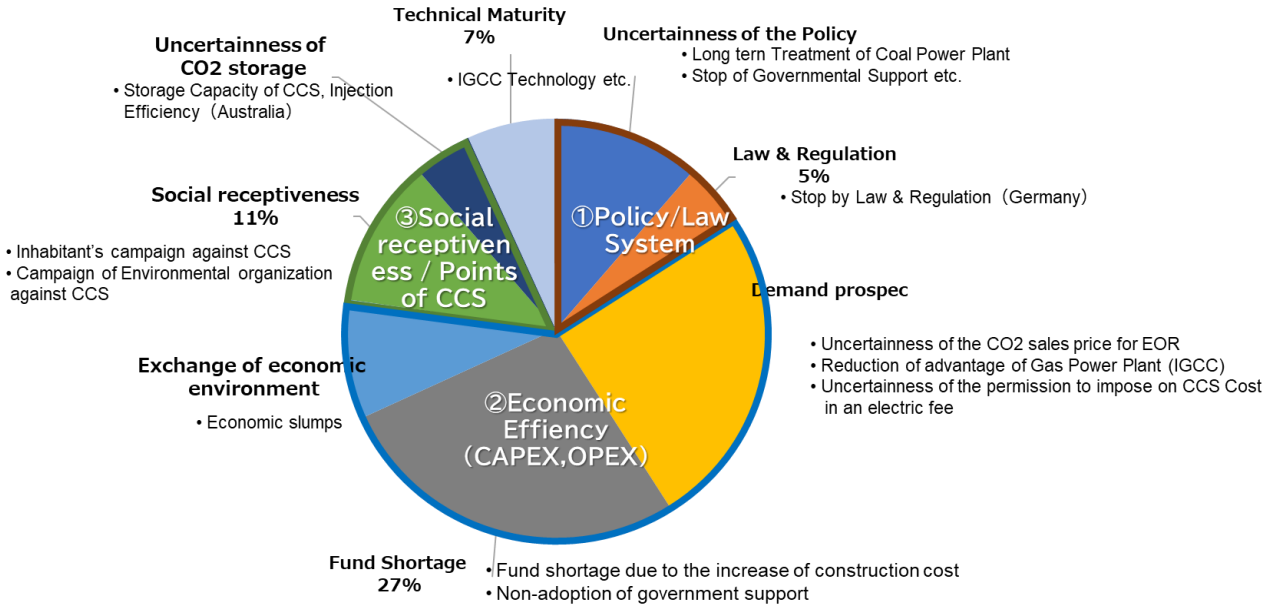


(Source) GCCSI, The Global Status of CCS 2021, P14, FIGURE 7 PIPELINE OF COMMERCIAL CCS FACILITIES FROM 2010 TO SEPTEMBER 2021 BY CAPTURE CAPACITY

Fig.2 The trend of commercial CCS projects in the world

2.2. Introduction Barrier of CCS

32 CCS projects were investigated and arranged that stopped abroad in the past to examine the framework of CCS's industrialization. According to 32 main cancellation reasons, the introduction barrier of CCS was ① Policy and Law Problem (16%), ②Economic Problem (61%) and Social Acceptability & Storage Points (16%).



(Source) METI's research report in 2020 https://www.meti.go.jp/meti_lib/report/2020FY/000266.pdf

Fig.3 The Barrier of CCS Introduction

2.3. Framework of the Business Environment for CCS Introduction

The introduction barrier of CCS projects was ①Policy and Law Problem, Economic Problem and Social Acceptability & Storage Points as mentioned above. It is important to lower the business risk with the uncertainty. Therefore, the business environments of CCS introduction showed ①CCS's Significance/Licensing, ② the Outlook of CCS Business and ③CCS business Precondition.

①Significance / Licensing of CCS（Correspondence of Policy/ Law System）:

a) The roadmap showing the clear policy, CCS introduction time, CCS cost target and etc. is necessary.
b) The comprehensive legal system corresponding to the life cycle of CCS (Survey, Injection, Management of Abandoned Mine, Responsibility Transfer etc.) is necessary.

②Outlook of CCS business (Correspondence of Economic Problem):

a) The earnings structure that profit is provided in consideration of additional cost and framework of financing (business model) is necessary.
b) Examination of Enforcement of CCS and the Clarification of the responsibility range of the CCS's company is necessary.

③CCS business Precondition（Correspondence Social Reception& Storage points）:

a) If people don't recognize the ccs as the rational technique for global warming measures, it may become negative to give CCS public support (subsidies) and social implementation. Therefore, the frame about the social acceptability improvement is necessary.

b) The performance uncertainty of storage quantity becomes the premise of the CCs introduction enforcement judgement. The framework to evaluate the exploration of storage points is necessary.

The CCS projects need long lead-time. It is necessary to early consider and build the CCS's framework to utilize the global warming measures technology.

3. Promotion of international partnership

3.1. IPCC

IPCC (Intergovernmental Panel on Climate Change) has been established in 1988 with a view to conducting a comprehensive assessment from a scientific, technical and socioeconomic standpoint on climate change, impact, adaptation and mitigation measures by anthropogenic sources, jointly by the United Nations Environment Program (UNEP) and by the World Meteorological Organization (WMO). IPCC examines scientific knowledge on global warming and makes the reports contributing to three WGs, Physical Science Basis (WG1), In-fluence and Adaptation (WG2), Mitigation Measures (WG3).

In IPCC, the experts chosen among each country make the report, based on the dissertation or the scientific observation data and evaluate / examine the scientific analysis, social economic influence and countermeasures to control climate change. This outcome is to have a high influence on inter-national negotiations because the scientific basis is also given to the policies of each country.

RITE plays the central role of domestic support secretariat of mitigation measures (WG 3) (Fig. 4). IPCC published WG1's report on the physical science basis in August 2021 and is going to publish WG2's report in February 2022, WG3's report in April 2022 and the integrated report in September 2022. RITE has also been supporting METI through information collection / analysis / report / advise etc.

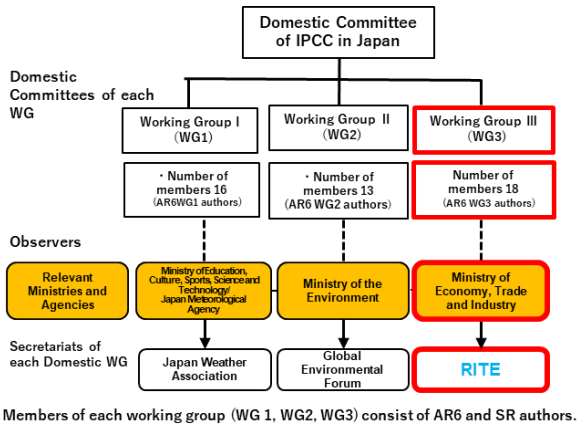


Fig.4 Committee structure and RITE

3.2. ISO

ISO (International Standard Organization) is an organization composed of 167 standardization bodies of various countries that gives the common standards and promotes global trade. It can provide safe, reliable and high-quality products/service to utilize ISO standards.

Carbon dioxide capture and storage (CCS) is one of the important options for global warming countermeasures because it has a great effect of reducing CO_2 emissions into the atmosphere. In the world, a number of CCS verification projects on a commercial scale are also implemented, and international collaboration is under way. The international standard plays an important role, contributing to the widespread use of safe and appropriate CCS technology.

RITE is a domestic deliberation organization on ISO / TC 265 (collection, transportation, and storage of CO_2) and is in charge of a secretariat of WG 1 (collection). Through these activities, we are conducting international standardization on design, construction, operation, environmental planning and management, risk management, quantification, monitoring and verification, and related activities in the CCS field through international standardization (Fig. 5).

In January, 2022, twelve standards related to the CCS

field have been published from ISO / TC265. The new WG related to CO_2 transshipment is established and is going to start the standard consideration next year. And Seven ones are under development including the present consideration.

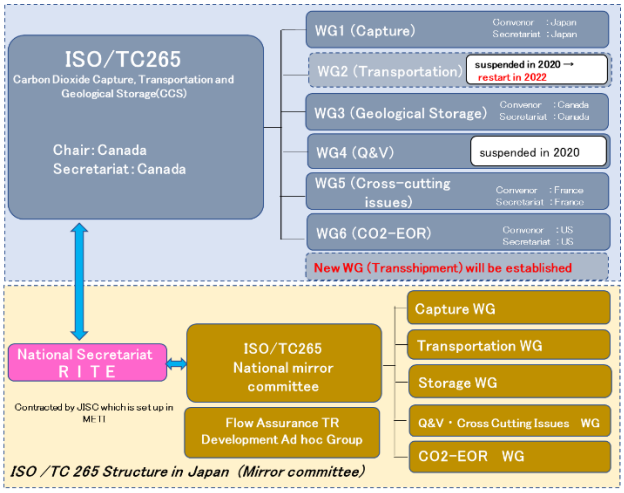


Fig.5 ISO/TC265 structure

4. Human development and industry collaboration

4.1. Human development

<Elementary and high school students>

RITE promotes extracurricular learning using research facilities for elementary, junior and senior high school students. And RITE also welcomes teaching requests where staff members visit schools using teaching materials and equipment. Such demands for human development are growing year by year. For example, we picked up CCS technology from RITE's research and explained the global warming mechanism. We are conducting activities based on the learning cycle such as deepening understanding through discussion and exchange of views (Fig. 6).

But because of Novel Coronavirus, we held classes and workshops for 54 students in 2021 (37 students in 2020, and 397 students in 2019). RITE wants to restart a class and a workshop as soon as the situation is improved.

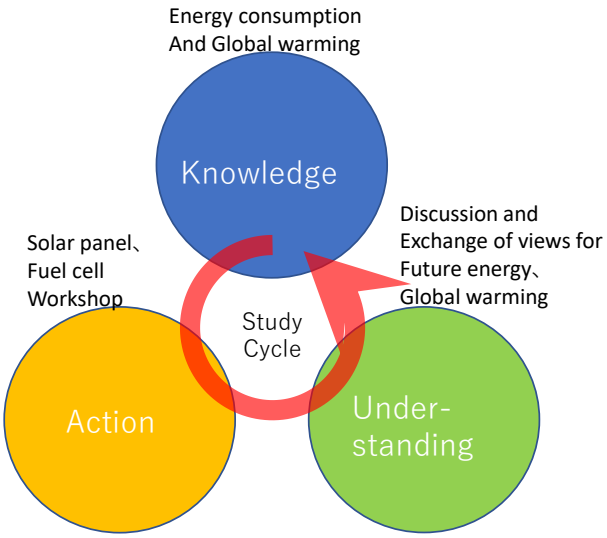


Fig.6 RITE and environment education (Elementary, middle and high school students)

<University / Postgraduate student>

RITE is promoting collaboration of education with universities as part of human development sup-porting the next research and technology. We are accepting young talented people, mainly graduate students, to the research site. Here, we are developing education at the university and research guidance at the laboratory (Fig. 7). RITE established a university collaborative laboratory in the field of bioscience with Nara Institute of Science and Technology. Here we are conducting research and education aimed at realizing a recycling-type and low-carbon society by using renewable resources effectively using biomass as a raw material.

Also, RITE has established a university collaborative laboratory in the field of CO_2 capture with Nara Institute of Science and Technology.

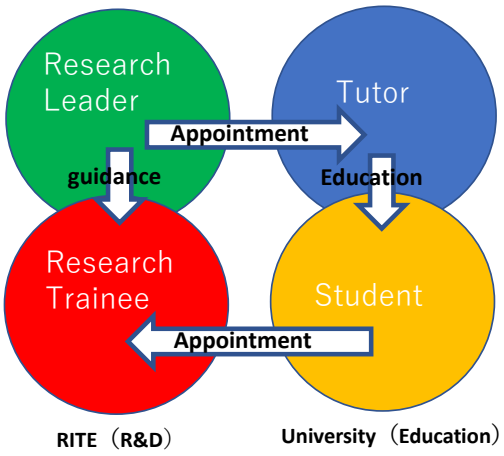


Fig.7 RITE and environment education (University / Post graduate student)

4.2. Intellectual property and industry collaboration

RITE acquires and manages intellectual property rights such as patents and know-how strategically and efficiently on results obtained in R&D.

To acquire patent rights brings up the opportunity which RITE cooperates with industries. As a result, it is possible to accelerate industrialization and simultaneously promote public interest and innovation as a public research institution. Intellectual property brings up opportunities to cooperate with industries. It is expected that a virtuous circle is created based on appropriate information management and contracts to create further intellectual property. It is also expected that the aspect of the intellectual property that enables related technologies to be used to support standards, such as collaboration with international standards (such as section 3.2). Based on the market and other re-search and development trends, RITE promotes intellectual property strategically.

RITE has established the IP management Committee which consists of RITE's leaders and the committee discusses and decides Invention certification, patent application to domestic and foreign, request for patent examination, patent maintenance and the approval of license contract.

As of the end of 2021, the patents during application and examination are 24 domestic and 21 foreign, and the patents owned by RITE are 98 domestic rights (11 of which are licensed to companies) and 53 foreign rights (13 of which are li-censed to companies). (Fig. 8).

As the example to licensed RITE's Intellectual property, the GEI company (cf. refer to biotechnology group 5.3) listed on the Tokyo Stock Exchange Mothers market in December, 2021 which gives the license fee related to the amino acid to RITE.

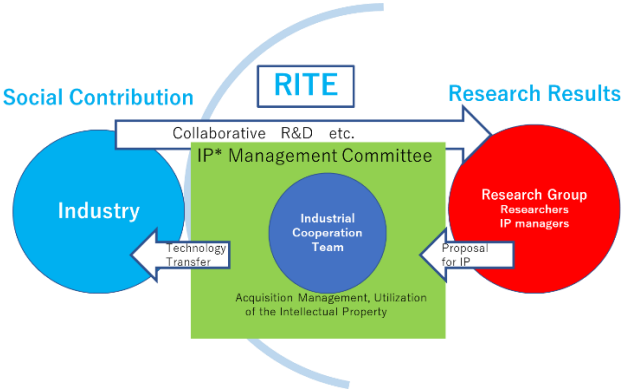


Fig.8 Strategic IP management and industrial collaboration

5. Conclusion

This year (2021) marked on the 10th anniversary of the Great East Japan Earthquake and the accident at the Tokyo Electric Power Company (TEP-CO)'s Fukushima Daiichi Nuclear Power Station.

In October, 2021, the Government of Japan decided the Sixth Strategic Energy Plan, in order to solve challenges facing Japan's energy supply and demand structure while taking action against cli-mate change.

To realize 2050 Carbon neutrality, Japan needs to establish and diffuse the innovative technology that isn't realized at the present, and the RITE's CO_2 Capture technologies are one of the most necessary technologies. But to realize 2050 Carbon neutrality is almost impossible only by remarkable efforts. It is necessary that RITE also promotes the social implementation proactively.

Reference

1) RITE, "The Role of RITE" (https://www.rite.or.jp/about/).
2) "Prime Minister Suga's Policy Speech at the 203rd extraordinary Diet session (https://www.kantei.go.jp/jp/99_suga/statement/2020/1026shoshinhyomei.html)
3) Plan for Global Warming Countermeasures (Cabinet Approval on October 22, 2021) (https://www.env.go.jp/earth/onanka/keikaku/211022.html)
4) Cabinet Decision on the Sixth Strategic Energy Plan (https://www.enecho.meti.go.jp/category/others/basic_plan/pdf/20211022_01.pdf)
5) Clean Growth Strategy (https://www.meti.go.jp/shingikai/sankoshin/sangyo_gijutsu/green_transformation/pdf/001_02_00.pdf)
6) RITE's CCS research report entrusted by METI (2020) (https://www.meti.go.jp/meti_lib/report/2020FY/000266.pdf) (https://www.meti.go.jp/meti_lib/report/2019FY/000145.pdf)
7) GCCSI, The Global Status of CCS 2021 (https://www.japanccs.com/wp/wp-content/uploads/2021/10/0-4-GCCSI_Jarad-Daniels.pdf)