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 2020, Japan declared the goal of realizing a carbon-neutral, decarbonized society by 2050, so it is outlined at first.

1. Actions towards achieving 2050 carbon neutrality

In 2020, Paris Agreement, the International Framework on Climate Change, started the full implementation. Therefore, Japan formulated "Environmental Innovation strategy"[2] in January, 2020, which aims at the establishment of the "Beyond Zero" Technologies in 2050 to reduce CO_2 that were emitted in the past and promote the social implementation clarified for the long-term strategy, so as to achieve the carbon neutrality as early as possible in the second half of this century.

"The Moonshot Research and Development Program, Goal 4：Realization of sustainable resource circulation to recover the global environment by 2050"[3] was started and RITE's proposal was selected, too.

In October 2020, Prime Minister Suga declared the goal of realizing a carbon-neutral, decarbonized society by 2050 at the 203rd extraordinary Diet session[4], so the action to achieve the carbon neutrality was accelerated. The Minister of Economy, Trade and Industry Kajiyama explained," The challenging goal of achieving carbon neutrality by 2050 is the new growth strategy in Japan and METI will implement every possible policy measure to create a virtuous circle of economy and environment."

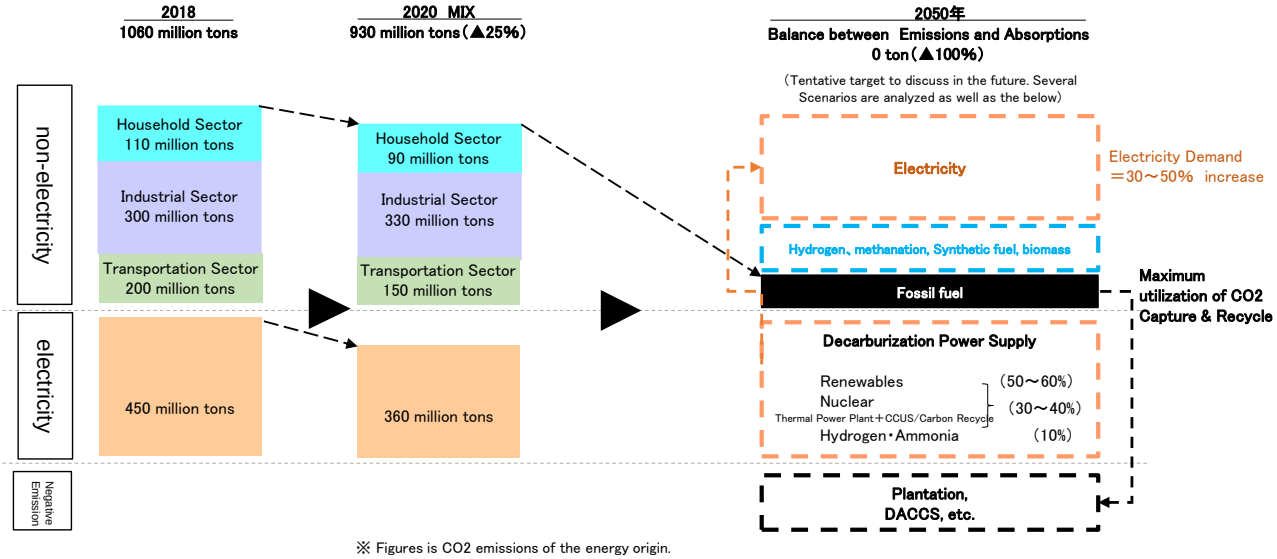
The idea that to cope with global warming is the constrains and the cost of economic growth should be switched and to positively take the countermeasures leads to the reforms of the industrial and social structure and promotes towards the next growth. And "Green Growth Strategy towards 2050 Carbon Neutrality"[5] was formulated in October 2020 as an industrial policy to aim toward a positive cycle of economic growth and the environmental protection.

The Strategy towards 2050 Carbon neutrality indicates the tentative goal of the 2050 Energy Demand and Supply as a reference figure, in order to discuss Energy Policy and the future goal of energy demand and supply as it is important to reduce the emission of greenhouse gases in energy sector which occupies more than 80% of total amount (Fig.1).

The Strategy determined 14 priority fields to achieve 2050 carbon neutrality (Fig.2) and formulated "action plans" covering comprehensive policies in areas such as ①goals scheduled towards 2050, ②research & development and demonstration, ③regulation reforms and standardization, ④ international collaboration, etc. (Fig.3).

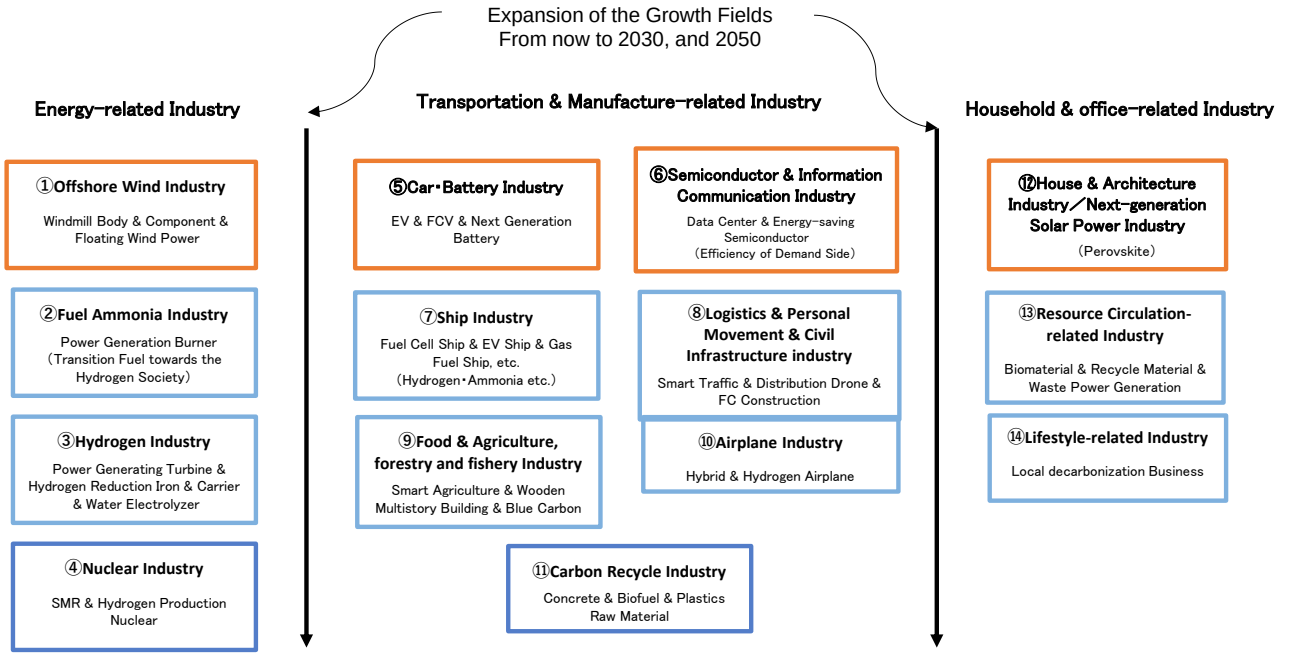
This strategy will be reviewed about the implementation of action plans in a steady manner and the improvement of goals and measures, in order to revise the strategy in the future.

The Research and Coordination Group aims to early establish the innovative technology mentioned "Environmental Innovation Strategy" with the research groups & center to achieve 2050 carbon neutrality.



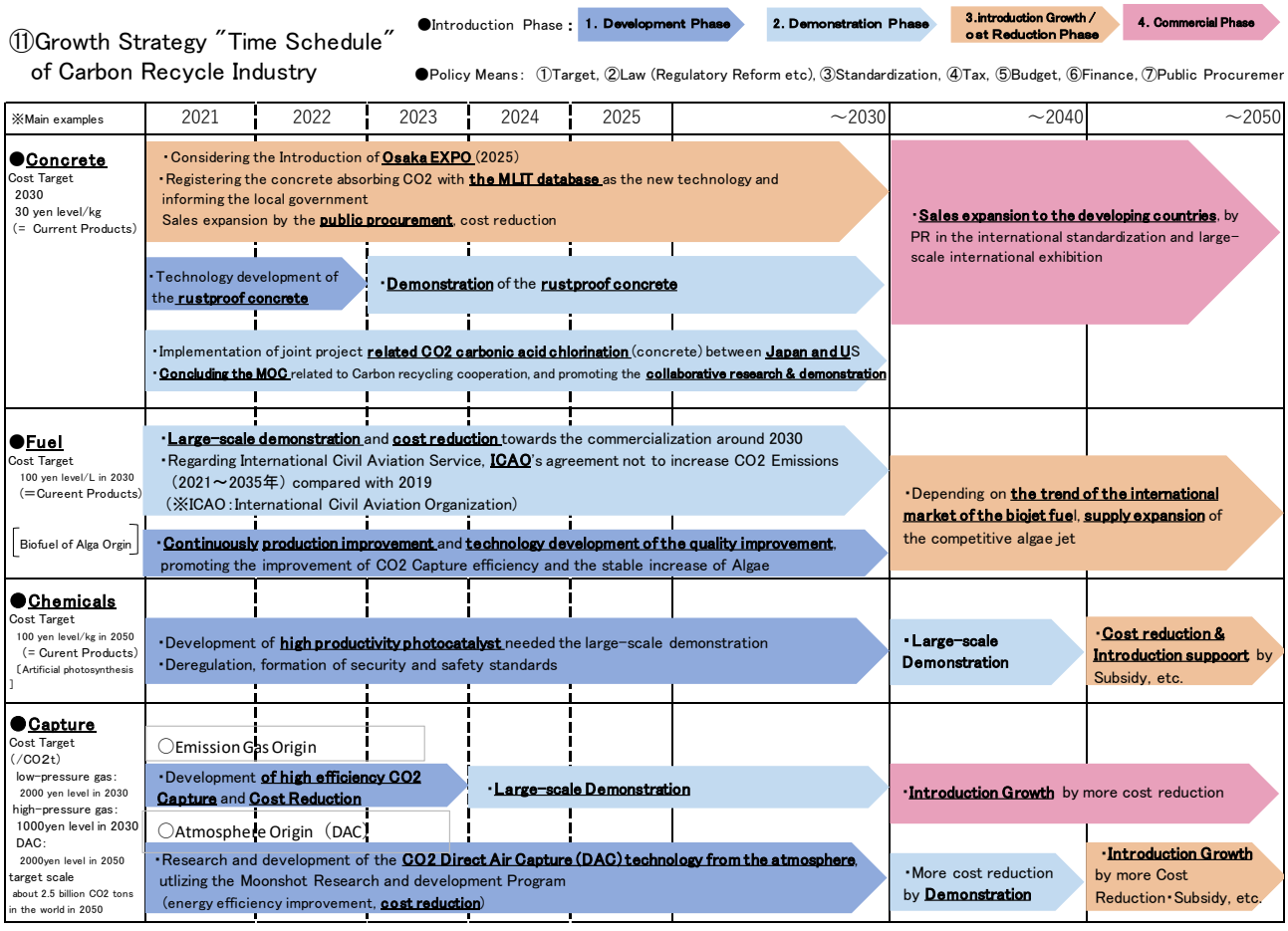
(Source) "Green Growth Strategy towards 2050 Carbon Neutrality" (Dec. 2020)

Fig.1 Image towards carbon neutral



(Source)"Green Growth Strategy towards 2050 Carbon Neutrality" (Dec, 2020)

Fig.2 Arranged figure of important industry



(Source)"Green Growth Strategy towards 2050 Carbon Neutrality" (Dec, 2020)

Fig.3 Example of "Time Schedule" of time schedule

2. Research activities

It is expected that the CO_2 reduction effect of CCUS (Carbon dioxide Capture, Utilization and Storage) technology would be 9% by 2050 in the IEA's World Energy Outlook 2019[6] (Fig. 4).

RITE studied the investigation of CCS introduction entrusted by METI which was the investigation research related to the global warming & resources circulation measures[7], so it is outlined in the below.

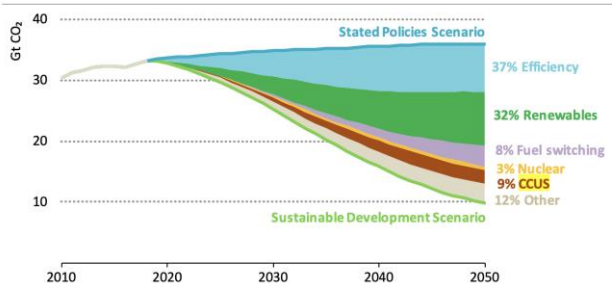


Fig.4 Estimated CO_2 reduction by CC(U)S technology

2.1. Global large commercial CCS projects

Global CCS Institute (GCCSI)[8] counted 21 operations and 4 constructions as large CCS projects in June, 2020 (Fig.5). GCCSI defines the large project as more than about 400,000 tons/year in the Capability of CO_2 Capture. (At present, GCCSI changed the definition and classifies CCS project as operation or not.)

Many large projects use the captured CO_2 as EOR (Enhanced Oil Recovery) and the CO_2 come from the production process of Natural Gas refinery, Fertilizer, Hydrogen production etc. The total amount of CO_2 permanently stored by the operation projects is about 37 million tons a year and it is estimated at about 40 million tons a year, adding the capacity of the construction stage.

2.2. Problem arrangement and future challenges

Regarding 21 large CCS projects operating in the world, the implementation bodies are all private companies except state-owned companies in China and Saudi Arabia. There are some requirements that these CCS projects are established, and they are pointed out as follows. At first, if CO_2 is captured in the existing process, the addition cost to be necessary on performing CCS is only investment to modify the transportation and the Injection, so they are the relatively low-cost projects. Also, the CCS projects which are able to get the profit by EOR or the natural gas production, and which get a subsidy, tax credit, etc. are economically realized. In other words, it says that their projects are the examples of Low-hanging fruits which can easily start like the low-cost realizable ones or the profitable EOR.

In addition, the system framework of CCS introduction overseas is considered, assuming the implementation of private sector. It is to make the business model, which have various incentives (subsidy, tax credits, debt guarantee, etc.) and the systems, including the transfer to the Government about the long-term responsibility after the Injection.

The mass transportation of the CO_2 is considered as pipeline or ship transportation, but ship one needs the technology developments such as the optimization of liquefaction facilities, etc. Also, it is better that the demonstration is early started because of the expectation of the cost reduction up-sizing in the future.

Also, many sites of the large-scale CO_2 Storage are essential for 100 million tons quantity a year needed the future CO_2 injection in Japan, so Japan CCS Co., Ltd. (JCCS) performed the research to select prospective sites for CO_2 Storage. According to the research, they are estimated as about 7 billion tons in the 3D exploration area and about 46 billion tons (3 billion tons in the detail investigation and 43 billion tons in the rough investigation) in the 2D exploration area.

Though the injection quantity was uncertain, Japan has enough potential quantity for CO_2 storage. But it is necessary to evaluate the potentiality of the geological layer, total economic efficiency including the emission

source, and the safety, in order to select the potential sites for CO_2 Storage.

The most reasonable policy is the scenario that firstly starts the project of the Low-hanging Fruits and gradually promotes cost reduction and then begins the larger CCS projects, in order to promote CCS.

Both public and private sectors need to start to formulate the practicable roadmap and the action plan immediately, and it is important that public and private sectors share the responsibility to implement them.

Phase	Country	Title	Industry	Facility Storage Type	Operational Date	Facility Capture Rate
Operational	USA	Terrell Natural Gas Processing Plant	Natural Gas Processing	EOR	1972	0.4～0.5
		Enid Fertilizer	Fertiliser Production	EOR	1982	0.7
		Shute Creek Gas Processing Plant	Natural Gas Processing	EOR	1986	7
		Century Plant	Natural Gas Processing	EOR	2010	8.4
		Air Products Steam Methane Reformer	Hydrogen Production	EOR	2013	1
		Coffeyville Gasification Plant	Fertiliser Production	EOR	2013	1
		Lost Cabin Gas Plant	Natural Gas Processing	EOR	2013	0.7
		Illinois Industrial Carbon Capture and Sequestration	Ethanol Production	Onshore deep saline formation	2017	1
		Petra Nova Carbon Capture	Power Generation	EOR	2017	1.4
	Canada	Great Plains Synfuels Plant and Weyburn Midale	Synthetic Gas Processing	EOR	2000	3
		Boundary Dam Carbon Capture and Storage	Power Generation	EOR	2014	1
		Quest	Hydrogen Production	Onshore deep saline formation	2015	1
		Alberta Carbon Trunk Line with Agrium C0	Fertiliser Production	EOR	2020.6	0.3
		Alberta Carbon Trunk Line with North West Sturgeon Refinery	Oil Processing	EOR	2020.6	1.6
	Brazil	Petrobras Lula Oil Field	Natural Gas Processing	EOR	2013	1
	Norway	Sleipner CO_2 Storage	Natural Gas Processing	Offshore deep saline formation	1996	1
		Snøhvit CO_2 Storage	Natural Gas Processing	Offshore deep saline formation	2008	0.7
	Saudi Arabia	Uthmaniyah CO2-EOR	Natural Gas Processing	EOR	2015	0.8
	UAE	Abu Dhabi CCS	Steel production	EOR	2016	0.8
	China	CNPC Jilin Oil Field CO_2 EOR	Natural Gas Processing	EOR	2018	0.6
	Australia	Gorgon CO_2 Injection Project	Natural Gas Processing	Onshore deep saline formation	2019	3.4～4
21 large-scale CCS projects (CO_2 Capture quantity(tCO_2／year))						36.8～37.5 million
In construction	China	Yanchang Integrated Carbon Capture and Storage	Fertiliser Production	EOR	2020～2021	0.41
		Sinopec Qilu Petrochemical CCS	Fertiliser Production	EOR	2020	0.4
	USA	The ZEROS Project	Power Generation	EOR	2020	1.5
	Norway	Langskip CCS - Brevik Norcem	Cement Production	Offshore deep saline formation	2024	0.4

Fig.5 The situation of the large-scale CCS projects in the world

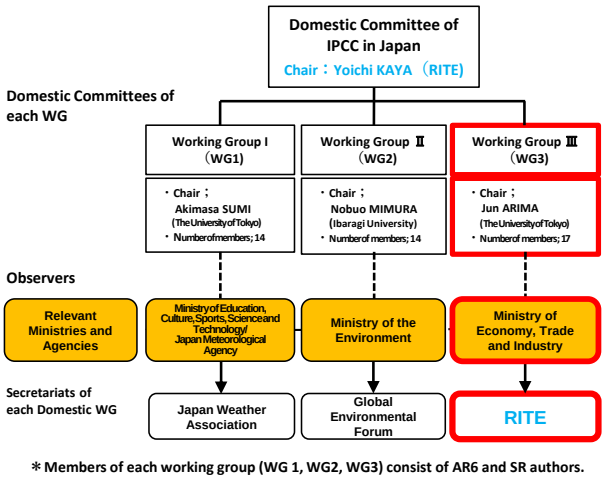
3. Promotion of international partnership

3.1. IPCC

IPCC (Intergovernmental Panel on Climate Change) has 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, the United Nations Environment Program (UNEP), and the United Nations Environment Program (UNEP), and by the World Meteorological Organization (WMO).

IPCC examines scientific knowledge on global warming with three WGs, a global warming prediction (WG1), influence and adaptation (WG2), mitigation measures (WG3).

RITE plays the central role of domestic support secretariat of mitigation measures (WG 3) (Fig. 6). This outcome is to have a high influence on international negotiations because the scientific basis is also given to the policies of each country. IPCC published the special report 'Global Warming of 1.5℃', 'Climate Change and Land', 'The Ocean and Cryosphere in a Changing Climate' from 2018 to 2019. For 2022 'Sixth Assessment Report (AR6)' has been steadily prepared in the IPCC global researcher network. The report is expected to be a source of knowledge on climate change, its causes, potential impacts and response options.



＊Members of each working group (WG 1, WG2, WG3) consist of AR6 and SR authors.

Fig.6 Committee structure and RITE

3.2. ISO

ISO (International Standard Organization) is an organization composed of 165 standardization bodies of various countries. 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. 7).

In December, 2020, nine standards related to the CCS field have been published from ISO / TC265, and six are under development. Of the standards under development, two in the CO_2 collection and storage fields are being developed by Japan.

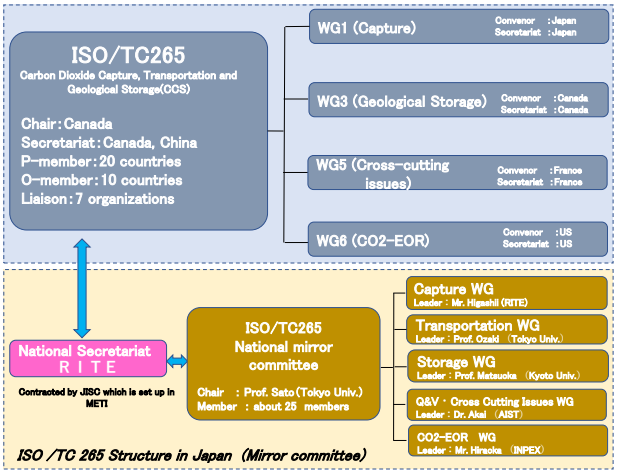


Fig.7 ISO/TC265 structure

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 high and 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. But because of Novel Coronavirus in 2020, we held classes and workshops for 37 students only in January and February 2020 compared with 397 students in 2019. 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. 8).

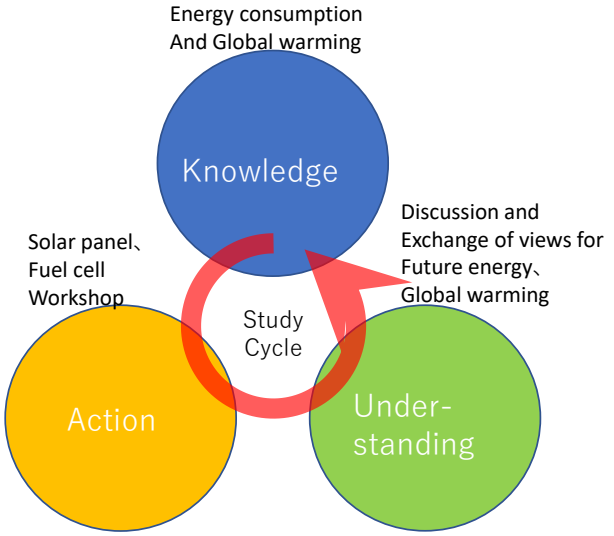


Fig.8 RITE and environment education
(Elementary, middle and high school students)

<University / Postgraduate student>

RITE is promoting collaboration of education with universities as part of human development supporting 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. 9). 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.

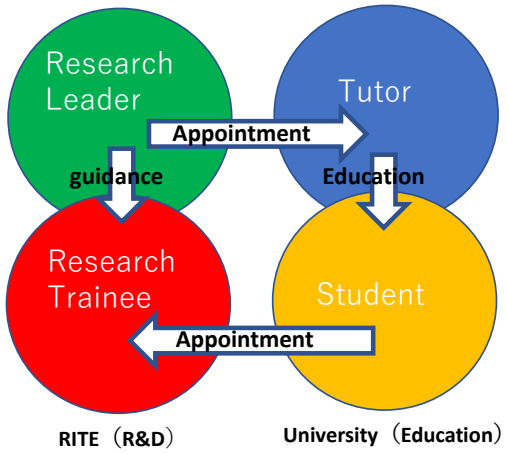


Fig.9 RITE and environment education
(University / Post graduate student)

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. As of the end of 2020, the patents owned by RITE are 106 domestic rights (11 of which are licensed to companies) and 49 foreign (13 of which are licensed to companies). RITE has established an IP management Committee and operates it with intellectual property experts (Fig. 10).

In order to develop academic research, it is important to create knowledge as a public property of the world by publishing research papers. In addition, we have patented inventions of researchers' creation and granted licenses to challenging enterprises. 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 research and development trends, RITE promotes intellectual property strategically.

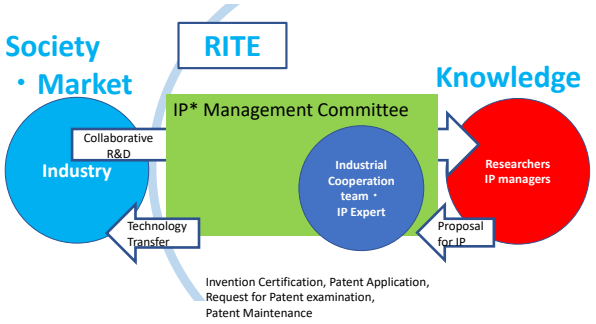


Fig.10 Strategic IP management and industrial collaboration

5. Conclusion

In 2020, Japan declared the goal of realizing 2050 Carbon Neutrality, and It is 30th years since RITE was established whose functions are to aim the achievement of a balance between Global environmental protection and economic growth. To realize 2050 Carbon neutrality, Japan needs to establish the innovative technology showed by" environmental innovation strategy" and the RITE's CO_2 Capture technology is one of the necessary technologies. But to realize 2050 Carbon neutrality is impossible by remarkable efforts. It is necessary that RITE also promotes the social implementation proactively.

The Research and Coordination Group not only collects domestic & foreign policy and technology information, but promotes the technology development in order to aim the social implementation in 2050 with Research Group/Center. Thereby, RITE can contribute to the achievement of "a balance between the global environmental protection and economic growth".

Reference

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