Research Planning Group

Recent Activities and Challenges on Innovative Mitigation Technologies to Prevent a Global Warming

1. Introduction

A drastic cut in CO_2 emissions is required to prevent a global warming. According to "Energy Technology Perspective 2010"[1] issued by International Energy Agency (IEA), emissions of CO_2 should be decreased by 14Gt CO_2/yr to achieve 50% reduction in global CO_2 emissions by 2050. Considering economical progress of developing countries, this means that 48GtCO_2 /yr is necessary to reduce from the baseline emissions (Figure 1). Such a drastic reduction cannot be achieved by a sole technology but a combination of many useful technologies is needed. In this context, some innovative mitigation options like "Carbon Dioxide Capture and Storage (CCS)" or "Biomass Utilization" becomes remarkable. Estimated costs of these two technologies are shown in Figure 2. Both are relatively cheep and generated power from these is stable compared to the case of photovoltaic or wind power.

Prior to reports from research groups of RITE, I would like to survey trends in CCS and biomass utilization, on which RITE has been focusing for many years. I would add that some results used in this report were given in NEDO's research program, "Total System of Zero-emission Coal-fired Power Generation Project".

2. CCS

2-1. CCS Project

Global CCS Institute (GCCSI) published "The Global Status of CCS: 2011"[2] in autumn, 2011, which summarizes CCS projects activities in the world. There, projects are classified into the following 6 stages based on degree of progress: Identify, Evaluate, Define, Execute, Operate, and Closure. The first "Identify" is the stage of site screening, "Evaluate" is site assessment and pre-feasibility study, "Define" is site selection and feasibility study, "Execute" is project execution, design and installation, and "Operate" means asset operation. The final "Closure" is the stage that injection is completed and asset is decommissioned. Based on the project lists made by GCCSI, I reconfigure the start year of project /capture volume relations by capture options (emission sites and capture technology; Figure 3) and storage options (EOR, EGR, and saline aquifer etc.; Figure 4).

First, Figure 3 shows that emission sites of "Operation" staged projects are mainly a natural gas processing. CCS projects in power generation and synthetic fuel production will start in 2014. Post combustion and pre combustion are appeared in the same proportion but Oxyfuel is low. When synthetic gas production is included, pre combustion becomes the largest.

Next, figure 4 shows that a major storage part of many CCS projects is EOR. Storage projects using sa-

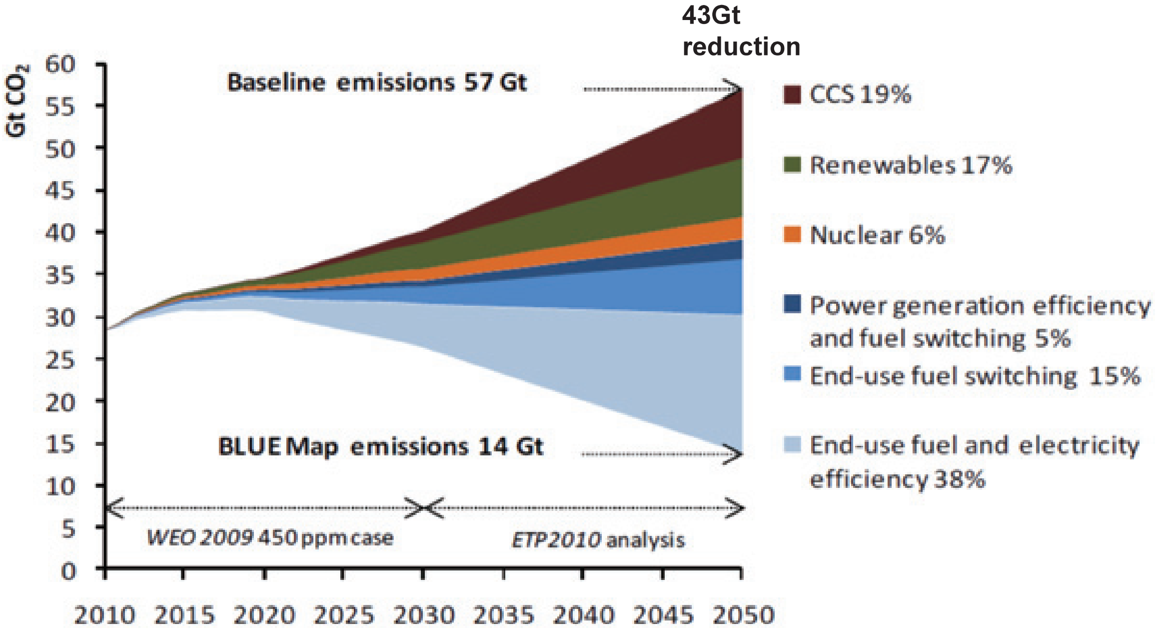


Figure 1 Contribution of mitigation technologies (IEA, Energy Technology Perspective 2010)

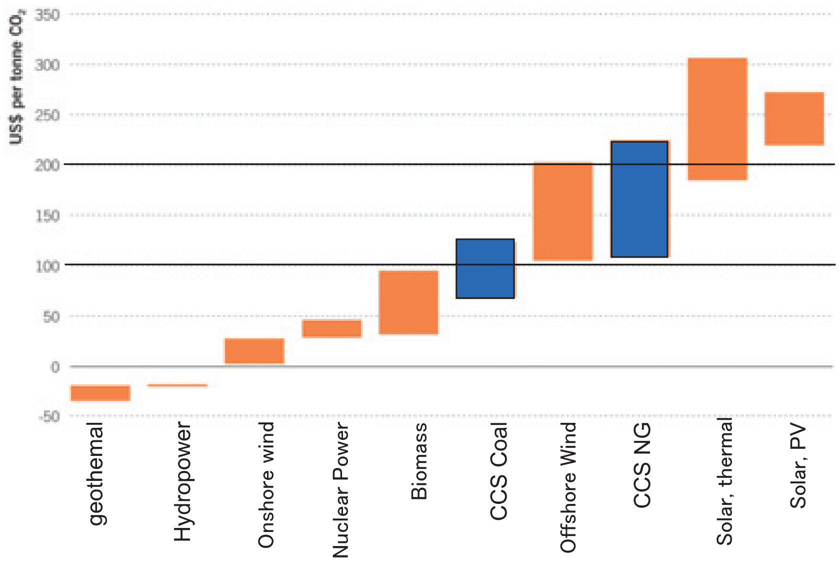


Figure 2 Comparison of CO_2 reduction cost (GCCSI "The Global Status of CCS:2011")

line aquifers like Sleipner, In Salah, and Snohvit are famous but storage amounts of CO_2 are small. In CCS projects in synthetic gas production or power plants which will start from 2014, EOR is also major. Storage projects in depleted gas fields or saline aquifers appear in 2015 and then the proportion of these grows gradually.

Project trends are changeable under the influence of political or economical changes. As already described, earlier CCS projects are combination of capture in natural gas processing and EOR. This is mainly an economical reason. In natural gas processing, CO_2 removal is already included in the process and there is no use to newly build a capture plant. In addition, EOR gains profits derived from increase in oil production. These factors make a project be sustainable without carbon price or governmental subsidies. Expecting a stable carbon market and large monetary support from government, power sector plans CCS projects from 2014. However carbon policy has not been established yet in the world and such large assistances are not promising because of economical crises. Recently Logannet Project in UK was reported to be suspended. Such suspend of project seems to be often occurred in the future. We need to establish worldwide policies for stable CCS implementation. In order to implement CCS sustainably, the following three are necessary; 1) enough, timely and stable support from government (incentives and regulations), 2) R&D to decrease cost, energy penalty, and risks, 3) community engagements in an earlier stage.

2-2. International standardization on CCS

International standardization is also an important factor to expand CCS in the world. For capturing CO_2, three different procedures, Post, Pre and Oxyfuel have been developed and they contain many separation technologies like absorption, adsorption, and membrane etc. Technology comparison is needed to choose the best-matched technology, but there is no common word at present. We also have to answer the following questions to start geological storage: How safely we store CO_2 into underground? How we account amount of reduced CO_2 ? But procedures to answer these questions are not established yet.

In this context, Canada proposed to establish a new Technical Committee (TC) of CCS in International Organization for Standardization (ISO). After voting, Technical Management Board decided to establish the following new TC:

Technical Committee ISO/TC 265 (provisional)

- Title -provisional: Carbon capture and storage (CCS)
- Scope -provisional: Standardization of materials, equipment, environmental planning and management, risk management, quantification and verification, and related activities in the field of carbon dioxide capture and storage (CCS).
  Excluded: equipment and materials used in drilling, production, transport by pipelines already covered by ISO/TC67.
- Central secretary: Canada SCC
- Members (October, 2011)
  - P-members; Australia, Canada, China, France, Germany, Italy, Japan, Korea Republic of, Netherlands, Norway, South Africa, Switzerland, United Kingdom
  - O-members: Argentina, Brazil, Czech Republic, Egypt, Finland, India, Iran, Islamic Republic of , New Zealand, Serbia, Spain, Sweden, USA

Title and Scope are provisional at present and TC is required to decide them and elaborate a draft business plan in 18 months.

In accordance with establishment of new TC, a na-

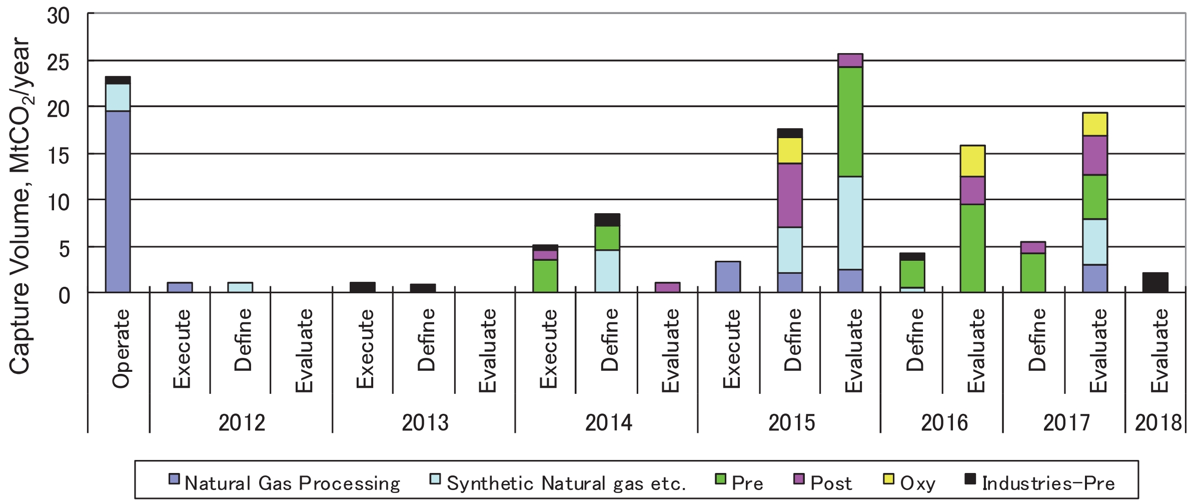


Figure 3 CCS Projects (classified by emission sites and capture technologies)

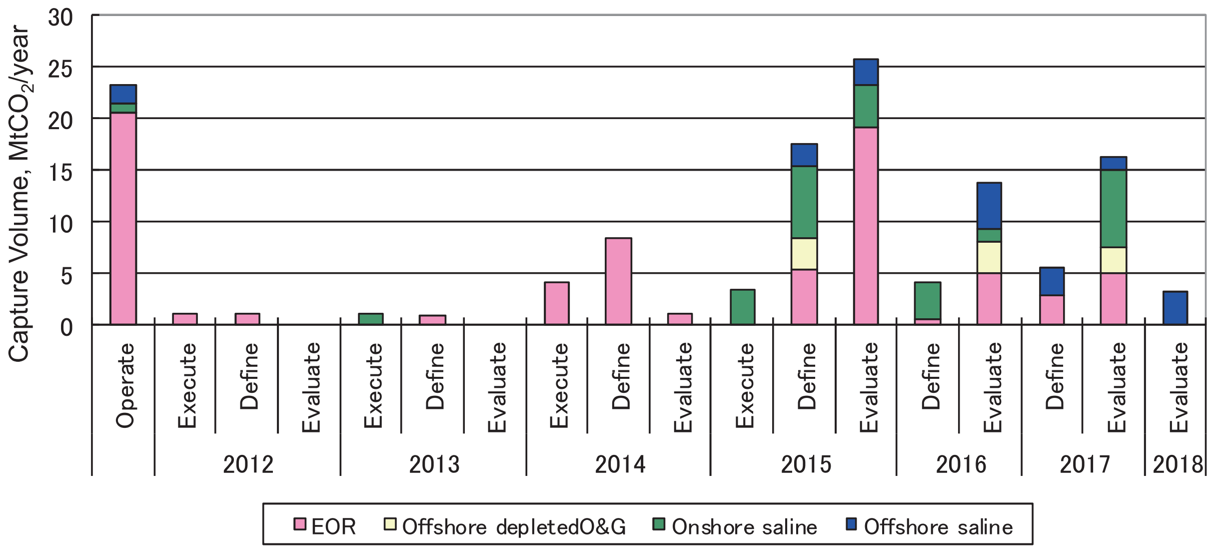


Figure 4 CCS Projects (classified by storage options)

tional mirror committee is required to be established. RITE received a commission of National Committee Secretariate from Japanese Industrial Standard Committee (JISC) in December 2011 and started working for CCS standardization.

3. Biomass utilization

Recent activities in biomass utilization are described in detail in “Special Report on Renewable Energy Sources and Climate Change Mitigation”[3] published by IPCC in 2011. Figure 5 shows a comparison of lifecycle CO_2 emissions between bioenergies and conventional fossil energies. In many cases bioenergies can reduce CO_2 emissions compared to the case of corresponding fossil energy use. Among bioenergies, use of lignocellulose is attracting a lot of attention from the aspect of non-competitiveness with foods.

Figure 6 shows IEA roadmap of biofuels for transport[4] to achieve 50% reduction in CO_2 emissions in the world. Advanced bioethanol production and development of BTL becomes a central issue. As aircraft fuels are difficult to be replaced by other technologies, use in this field will be important.

Problems in biomass use are in difficulty in supply of widely-spread biomass, low productivity in conversion processes, and higher cost. The roadmap shows milestones which contains demonstration of reliable, commercial-scale production of cellulosic ethanol, BTL diesel, HVO and bio-SG in 2010-2015 and demonstration of economically feasible production of algae-derived biofuel and other novel biofuel routes in 2020-2030.

4. Conclusion

At the end of 2011, we see slump of nuclear power after accidents of Fukushima nuclear power stations, remarkable progress of shale gas, and expectations on renewable energies. World economy is not good as Euro crisis symbolizes and progress of CCS seems to be slow down. Japanese government plans to present an energy best-mix after 3.11 by this summer. Japan was decided not to join a second round of carbon cuts under the Kyoto Protocol but continues own efforts for reducing CO_2 emissions. It is not easy to forecast the future figure of energy or economy but the only a certain way is to go forward R&D for the future. We are required to develop and use practically innovative technologies described above as soon as possible.

References

1. IEA, "Energy Technology Perspective 2010" (2010)
2. GCCSI, "The Global Status of CCS: 2011" (2011)
3. IPCC, "Special Report on Renewable Energy Sources and Climate Change Mitigation" (2011)
4. IEA, "Technology Roadmap, Biofuels for Transport" (2011)

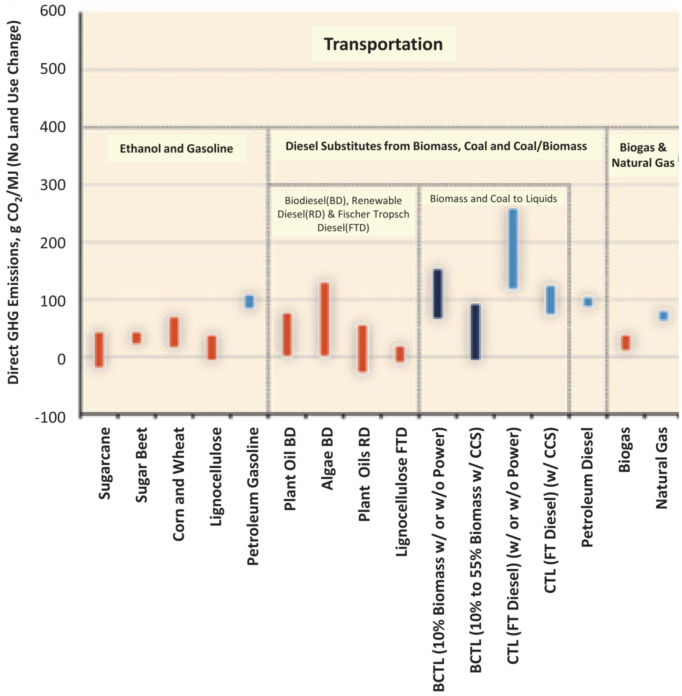
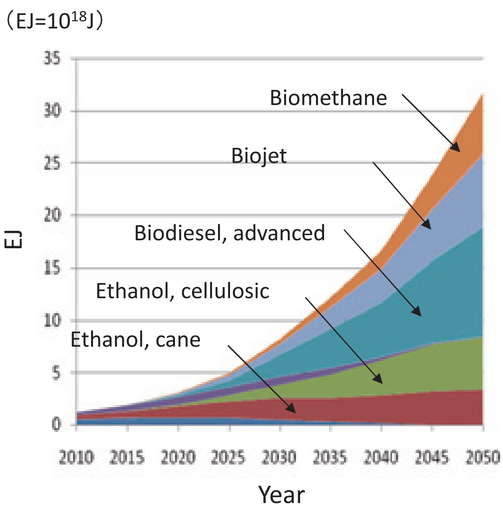


Figure 5 Life-cycle CO_2 emissions of Transport fuels (IPCC, SRREN 2011)



Demand of Biofuels

Milestones for Technical Improvements	Dates
Demonstrate reliable, commercial-scale production of cellulosic-ethanol, BTL-diesel, HVO and bio-SG.	2010-2015
All biofuels to reach >50% life-cycle GHG-emission reductions.	2015-2020
Demonstrate economically feasible production of algae-derived biofuel and other novel biofuel routes.	2020-2030
Integrate biofuel production in innovative biorefinery concepts.	2015-2025

Figure 6 Roadmap of Biofuels (Technology Roadmaps - Biofuels for Transport- 2011)