June 2019

Expectations for CO_2 capture, utilization, and storage (CCUS) are at stake.

Cannot be a pillar of climate change action due to both cost and technology

In order to achieve the 1.5° C target under the "Paris Agreement," a transition to a decarbonized society is required as soon as possible. In June 2019, the Japanese government launched the Long-Term Strategy as a Growth Strategy Based on the Paris Agreement (hereinafter referred to as the "Long-Term Strategy")[i] , which emphasizes CO_2 capture, utilization, and storage (CCUS) as a climate change policy while continuing to promote coal-fired power generation. The CCUS refers to a technology to capture, use, or store carbon dioxide (CO_2) in exhaust gas from thermal power plants. This

The paper identifies the evaluation of the CCUS, technical challenges, barriers to practicality, and questions of effectiveness.

This is a step forward in the discussion of the position of the CCUS in the long-term strategy in this country.

Domestic and international background and evaluation of CCS

(1) Policy position of CCS in Japan

Government and industry have been working together to combat climate change by developing a carbon dioxide

Carbon capture and storage (CCS) and carbon dioxide capture and utilization

(CCU), which focuses on the promotion of technology.

The Basic Energy Plan (July 2018) and the Long-Term Strategy (June 11, 2019) clearly position CCS and CCU along with high-efficiency coal-fired thermal power. The "Full-scale social implementation and consideration of CCS introduction after 2030" and "Consideration of exporting commercialized CCS/CCU to the world" are also included in the "Energy Basic Plan (July 2018)" and the "Long-Term Strategy (June 11, 2019)".

(Long-term strategy)". In addition, at the Davos Forum in January 2019, Prime Minister Abe said that now is the time to consider the use of CCS and

The company has indicated its direction to expand globally with[ii] .

In addition, in February 2019, the Carbon Recycling Office was established in the Agency for Natural Resources and Energy, and the term carbon recycling is defined as "a series of flows to reduce CO_2 emissions through the efficient separation and recovery of CO_2, its reuse as fuel and material, and its use in plant factories," and the necessary Innovation is needed to achieve these goals.

The company says it will promote the project in a proactive manner. [iii]

On the other hand, the "Potential and Actual Performance of Energy and Environmental Technologies" released on June 10 by the Ministry of Economy, Trade and Industry (METI) and the Ministry of Education, Culture, Sports, Science and Technology

(MEXT), was a significant step forward in the development of energy and environmental technologies.

In the report of the "Study Group on Evaluation of Commercialization for Utilization"[iv] , the status of research and development and commercialization of CCUS and the bottleneck issues for social implementation are extracted. In the report, for example, the existing coal-fired power plant

The government has shown various problems that are far from practical application, such as the fact that the cost of converting the power plant and storing the CO_2 in the aquifer is estimated to be 12,400 yen/t-CO_2, and that enormous energy is required for power and heat generation in each process of CO_2 separation and recovery, transportation, and injection. Nevertheless, the government has concluded that it will seek long-term research and development with a view to practical application in order to overcome these problems.

(2) Goals set in the past not achieved

Going back in time, about 10 years ago, in July 2008, the

The Action Plan for Creating a Low Carbon Society states that innovative technologies will be developed to achieve the goals of halving global greenhouse gas emissions and reducing CO2 emissions by 60% to 80% by 2050. The company also stated at the time that it would develop innovative technologies to achieve the target of "reducing CO

The aim was to "commercialize CCS".[v] In addition, in April 2015, "TEPCO's Director-General Meeting on Bidding for Thermal Power Sources"[vi] states that "TEPCO will consider introducing CCS into coal-fired power generation by 2030 on the assumption that it will be commercialized. However

and as of 2019, the cost target has not been met at all, and

Potential and Actual Energy and Environmental Technologies" presented earlier.

In the report of the "Study Group on the Evaluation of the Utilization of Energy", the long-term target is set to be reduced again to 2,000 yen.

The government is spending more money on technologies that are unprofitable and not available to the private sector, without assessing the failure to meet past goals such as cost reduction and commercialization, and without any prospect of commercialization.

(3) Evaluation of CCS Demonstrations

In Japan, the CCS demonstration was conducted by the Global Environment Industrial Technology Research Institute of Innovative Technology and Innovation (RITE) conducted a CO_2 demonstration injection test in Nagaoka City, Niigata Prefecture, over a period of one and a half years from 2003, and 10,000 tons of CO

In[vii] 2008, Japan CCS Research Co., Ltd. was established by major private companies with expertise in various fields of CCS, including electric power, petroleum refining, oil exploration and production, plant engineering, etc., and large-scale CCS demonstration tests have been conducted as government-subsidized or commissioned projects. Large-scale CCS demonstration tests are being conducted as government-subsidized and commissioned projects. The offshore Iwaki in Fukushima Prefecture, Tomakomai in Hokkaido, and Hibikinada in Kitakyushu City were selected for the large-scale demonstration test, and injection of 100,000 tons per year was planned. The project off the coast of Iwaki in Fukushima Prefecture has been suspended after the Great East Japan Earthquake, but other projects have been verified.

It is reported that "steady progress is being made."[viii] . However, there is no objective evaluation of cost-effectiveness and it has not been verified.

The CCS demonstration tests were conducted in the aftermath of the Niigata Chuetsu Earthquake (October 2004) and the Niigata Chuetsu Offshore Earthquake (July 2007), the Great East Japan Earthquake (March 2011), and the Hokkaido Bold Earthquake (March 2011), and the CCS demonstration tests were conducted in the aftermath of the Great East Japan Earthquake (March 2012).

In the case of the Hokkaido Bold and East Japan Earthquake, the implementing agency immediately announced that there was no causal relationship, but there was no objective scientific verification by experts, and there was a series of large-scale earthquakes near the demonstration site. Although the implementing agency immediately announced that there was no causal relationship at the time of the Hokkaido Bold and Fast Earthquake, there was no objective scientific verification by experts, and since large-scale earthquakes have occurred in succession near the demonstration site, residents and citizens have no small concerns about the safety. There are many issues to be addressed for the full-scale introduction of CCS from the viewpoint of public acceptance.

(4) Contribution in the scenario

The IEA report states that energy-saving rules as a means of reducing CO

CCUS, along with energy and renewable energy, are mentioned and acknowledged to have a certain role. However, in the Sustainable Development Scenario (SDS), the contribution of energy conservation and renewable energy in the 2040 Outlook is 42% and 34%, respectively, which is a higher percentage than in past scenarios and expands

is the CCUS contribution is only 7%[ix] .

The Intergovernmental Panel on Climate Change (IPCC) has announced that the 2018

In the 1.5° C Special Report released in October, the following is an example of biomass power generation with recovery and storage using biomass fuels.

(The scenario options include technologies to reduce negative emissions by using Bioenergy with Carbon Capture and Storage (BECCS) and BECCS is more difficult to commercialize in the future than CCS because of concerns that securing fuel for BECCS may cause extensive deforestation.

Problems of CCS (1) Technical issues

(1) There is no suitable site for safe long-term storage.

CCS implementation requires a firm foundation for sufficient sequestration of CO

However, Japan is an earthquake-prone country with many active faults, and there is little land suitable for stable storage over a long period of time, from several hundred to a thousand years. In addition, since there are almost no petroleum development areas, it is also difficult to implement EOR (Enhanced Oil Recovery), one of the CO_2 storage methods in practical use, in various fields.

Not expected. It is also difficult to find aquifers as storage sites.

(2) Risks in transportation, operation and monitoring phases

Leakage risk during transport and operation, storage, CO_2 injection and storage

In addition, the monitoring method to detect leakage has not been established, and it is difficult to predict the risk qualitatively and quantitatively.

Problems of CCS (2) Barriers to practical application and diffusion

(1) CCS is expensive compared to renewable energy, which is declining in price.

Coal-fired power generation, which emits large amounts of CO

In addition to the high cost of construction for material measures, etc., fuel costs will continue to be incurred while the plant is in use. According to estimates by a METI panel in 2018, the cost per kWh of a coal-fired power plant with CCS would be about $3.5.

The cost of solar power is estimated to be 15.2 to 18.9 yen per kWh.[x] On the other hand, commercial solar PV and onshore wind power are estimated to be 17.7 yen and 15.8 yen per kWh, respectively, in 2017, which is comparable to coal-fired thermal power with CCS, and are expected to further decline to 5.1 yen and

The price is expected to fall to around 7.9 yen.[xi] In other words, by 2030, when the government aims for commercialization, coal-fired power generation with CCS will be a renewable energy source with significantly lower prices.

The cost of the technology is projected to be completely expensive relative to energy, and there is little likelihood that it will be economically advantageous.

(2) Challenges in obtaining social consensus

In recent years, the situation regarding electric power has changed rapidly, and coal

There have been protests and lawsuits against thermal power generation by local residents in the areas where the plants were built. Banks and insurance companies have also recognized the problems of coal-fired power generation and have begun to limit their investments. Many companies around the world are moving to generate all of their electricity from renewable energy sources. The movement towards a decarbonized society is unstoppable. In such a situation, there is no economic rationale for building new coal-fired power plants that emit large amounts of CO_2 or extending their lives, and introducing CCS at an additional cost. It is highly doubtful that a social consensus will be reached on CCUS, which is fraught with various risks.

Problems with CCS (3) Doubts about its effectiveness

(1) Not yet reached the practical stage, too late as a countermeasure

CCS research has been conducted since the 1980s when the former Ministry of International Trade and Industry (MITI) was in charge.

The goal was to commercialize CCS by around 2020. However, there are currently only two power plants with CCS in operation in the world, and even in Japan, it has not yet left the small-scale demonstration stage. The possibility of commercialization in 2020 has already disappeared, and the current target is 2030, ten years later than the current schedule. However, based on the situation to date, the possibility of practical application by 2030 is also considered to be extremely low.

On the other hand, in order to limit the temperature rise to the 1.5° C target of the Paris Agreement, it is necessary to take effective measures immediately, and in particular, it is critically important to make significant reductions by 2030. Under these circumstances, placing too much emphasis on technologies that "may" be available after 2030 is not only unrealistic as a measure against climate change, but may also lead to the postponement of other measures that should be taken under this pretext.

(2) We're not going to get to zero emissions.

CCS will not reduce CO_2 emissions to zero.

The following is an example of a case in point. CO

Energy is required in any of the processes of separation and capture, CO_2 compression, and transport. For example, it is said that 3 GJ/t-CO_2 is emitted in the process of separation and recovery and boosting pressure when the separation and recovery equipment of the scientific absorption method is installed in a new coal-fired power plant. Furthermore, it is difficult to install CCS in mobile sources such as automobiles, and the cost hurdle is high for small-scale emission sources. Even if the spread of CCS is assumed to be substantial, decarbonization will not be achieved.

(3) U: Use" is the picture.

Japan, which has few suitable sites for CO_2 storage, will use CO

The possibility of ″concrete products using carbonate chloride as a substitute for chemicals and fuels derived from fossil resources″ has been raised as a possibility for large-scale use of CO

The following is a list of some of the most important technologies that can be used to achieve this goal.[xii] Carbon recycling, in which CO_2 produced by burning fossil fuels is reduced with hydrogen and synthesized again as fuel, is technically feasible. However, when reducing a stable substance like CO_2 with hydrogen, a large amount of energy input is required. To use an analogy, it is like pouring hot water over ice, and then using a large amount of energy to turn it back into ice and hot water again.

As for CCUs, it is said that the study of life cycle assessment (LCA) analysis has not even started worldwide. The Government of Japan has been working on ″a new social system with innovation

In the name of ″creation″, Japan says that it is important to promote R&D with LCA perspective in mind, but time and budget should not be wasted on irrational things.

Conclusion CCS/CCU cannot be a climate change measure -

Adoption of renewable energy and progress in energy conservation

As discussed above, the CCUS is a valid, economical, and environmental impact

They are uncertain technologies with multiple concerns and technical risks, and their practical application has not yet been established. These technologies, which do not contribute to current global efforts to raise targets and actions towards 2030 and limit temperature rise to 1.5° C, are not only inadequate for climate change action, they are inappropriate to focus policy attention on and rely on.

In the field of nuclear power, we have continued to use nuclear power generation on the basis of the nuclear fuel cycle, which has been completely useless despite huge national budgets, and there is a danger that CCUS technology could follow in its footsteps. Continued investment in the CCUS technology is a major obstacle to the future of fossil fuel-related power generation.

It is only a life extension measure to pour subsidies to businesses, and this

This will only make it more difficult to achieve the Paris Agreement by unnecessarily delaying the necessary measures, such as the elimination of coal.

Instead of promoting coal-fired power generation and CCS, which further drives up the cost of coal-fired power generation, it is clearly more rational to promote grid reinforcement and system reforms to make more effective use of renewable energy, which is becoming less expensive. What is needed now is a rapid shift away from the use of fossil fuels such as coal-fired thermal power, and the focus of policy should be on energy conservation to ensure reductions in energy consumption and CO_2 emissions, and on renewable energy, whose costs have been falling rapidly in recent years and whose introduction is accelerating. emissions, and renewable energy, whose costs have been falling rapidly in recent years and whose introduction is accelerating.

[i] The Long-Term Strategy as a Growth Strategy under the Paris Agreement″ (11.6.2019)
https://www.kantei.go.jp/jp/singi/ondanka/kaisai/dai40/pdf/siryou1-2.pdf

[ii] Prime Minister Abe's Speech at the World Economic Forum Annual Meeting (2019.1.23)
https://www.kantei.go.jp/jp/98_abe/statement/2019/0123wef.html

[iii] Agency for Natural Resources and Energy press release (2019.2.1)

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[ix] IEA, Carbon capture, utilisation and storage, https://www.iea.org/topics/carbon-capture-and-storage/[x] From Ministry of Economy, Trade and Industry, "Situation surrounding CCS," June 11, 2018, slide 9 https://www.meti.go.jp/committee/kenkyukai/sangi/ccs_jissho/pdf/001_05_00.pdf

[xi] Agency for Natural Resources and Energy, "Future Discussion Points for Making Renewable Energy a Major Power Source," August 29, 2018, https://www.meti.go.jp/shingikai/enecho/denryoku_gas/saisei_kano/pdf/007_01_00.pdf

[xii] From "Study Group on Evaluation of Potential and Practical Application of Energy and Environmental Technologies" (10.6.2019), p27 CCU: https://www.meti.go.jp/press/2019/06/20190610002/20190610002.html