国立国会図書館 調査及び立法考査局

Research and Legislative Reference Bureau
National Diet Library

論題 Title	Summary
他言語論題 Title in other language	—
著者 / 所属 Author(s)	国立国会図書館 調査及び立法考査局
書名 Title of Book	脱炭素社会の技術と諸課題　科学技術に関する調査プロジェクト報告書（Technologies for Decarbonized Society and Related Issues）
シリーズ Series	調査資料 2021-5（Research Materials 2021-5）
編集 Editor	国立国会図書館 調査及び立法考査局
発行 Publisher	国立国会図書館
刊行日 Issue Date	2022-03-29
ページ Pages	157-163
ISBN	978-4-87582-892-1
本文の言語 Language	英語（English）
摘要 Abstract	国立国会図書館の調査及び立法考査局が実施している「科学技術に関する調査プロジェクト」の報告書『脱炭素社会の技術と諸課題』の英文概要。

Science and Technology Research Project 2021

Technologies for Decarbonized Society and Related Issues

Published by the National Diet Library (NDL), Japan
Edited by the Research and Legislative Reference Bureau (RLRB), NDL

March 2022

Summary

I Overview

Trends and Issues of “Decarbonization”

ISHIWATARI Hiroko

(Senior Specialist, Chief of Education, Culture, Science and Technology Research Service, Research and Legislative Reference Bureau, National Diet Library)

The Parties of the Paris Agreement, which was adopted at the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21) in 2015, are obliged to hold the increase in the global average temperature to below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels. The Intergovernmental Panel on Climate Change concluded that CO_2 emissions would need to reach net zero by 2050 to hold the temperature increase below 1.5°C. With various countries declaring they would target carbon neutrality by 2050, Japan also proclaimed in October 2020 that it would aim to realize a carbon-neutral and carbon-free society by 2050. Efforts toward decarbonization include, for example, the electric power industry seeking to make renewables the main energy source, the steel industry developing CO_2 separation and capture technologies, the automobile industry promoting conversion to electric vehicles and fuel cell vehicles, and the construction industry aiming to save energy. Social acceptance of decarbonization technology requires assessment of its impact on the community and society, and while discussions between experts and citizens are necessary, measures against unquestionable global warming need to be taken as much as possible.

Why Is Decarbonization Necessary? Current State and Future Outlook for Climate Change

EMORI Seita

(Deputy Director, Earth System Division, National Institute for Environmental Studies)

This report is an overview of the current state and future outlook for climate change based on the 6th Assessment Report of Working Group 1 of the Intergovernmental Panel on Climate Change (IPCC). There is no doubt that the earth is warming due to the influence of the increase of greenhouse gases in the atmosphere such as carbon dioxide (CO_2) originated from human activities. The world average temperature has already risen by about 1.1°C since before the Industrial Revolution, and in order to stop the increase at around 1.5°C in the future, it is necessary to decarbonize the world in the middle of this century, but the current pace of reduction of CO_2 emissions in the world has not attained the level required to do so. The frequency and intensity of extreme phenomena such as heat waves and heavy rains are increasing as the average temperature rises, and will increase further if the temperature continues to rise. It should be noted that there is a risk of causing enormous damage such as the destabilization of the Antarctic ice sheet, of which the possibility is low but cannot be ruled out. When discussing the necessity of decarbonization and

how to realize it, it is important to understand not only the natural science aspects but also other aspects such as social justice.

II Technologies and Policy Issues

R&D Policy for Low-Carbon Technologies in the EU and the US

OKAMURA Koichiro

(Professor, School of Business Administration, Kwansei Gakuin University/
Senior Consultant, Education, Culture, Science and Technology Research Service,
Research and Legislative Reference Bureau, National Diet Library)

The European Union (EU) is promoting research and development (R&D) and utilization of low-carbon technologies under the European Strategic Energy Technology Plan (SET-Plan), a comprehensive and basic R&D framework for low-carbon technologies, and the EU Framework Programmes that have covered R&D and innovation activities for the entire EU. These efforts have led to widespread collaborations across countries, regions, and sectors in the EU. In the United States, the Department of Energy plays a central role in the R&D of low-carbon and other energy technologies. Although recent US administrations have had different attitudes toward climate change and placed different degrees of priority on various low-carbon technologies, the R&D and utilization of low-carbon technologies have been steadily advanced.

Carbon Dioxide Capture, Utilization and Storage (CCUS)

SHIMOTA Akiro

(R&D Manager, Central Research Institute of Electric Power Industry)

Under the Paris Agreement adopted at the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21) held in Paris in 2015, a goal was set to hold the increase of global average temperature within 2°C from pre-industrialization and to pursue further efforts to limit the rise to 1.5°C. To achieve this goal, it is necessary for greenhouse gas emissions to be virtually zero worldwide in the second half of the 21st century, and all kinds of measures for emission reduction need to be mobilized. Carbon dioxide capture and storage (CCS) that captures CO_2 from sources such as the industrial sector and thermal power generation sector, and isolates and stores it underground, is one of the technology options for drastic emission reduction.

CCS is expected to be a technology capable of large-scale reduction of CO_2, but it has not spread as expected due to barriers such as uncertainty, economic efficiency, and social acceptability of storage. On the other hand, carbon dioxide capture and utilization (CCU), which can be expected to reduce CO_2 and compensate for costs by converting the collected CO_2 into valuable materials such as fuel and chemical products, has begun to attract attention, but most of the relevant technologies are still in the development phase.

Trends of Development of Advanced Reactors and Relevant Policies in Foreign Countries

KIMURA Kenji

(Senior Researcher, Nuclear Energy Group, Strategy Research Unit,
The Institute of Energy Economics, Japan)

In recent years, advanced reactors such as the Generation IV reactor and the small modular reactor (SMR) have been attracting attention as reactors designed differently from the large-scale light water reactors that have been used so far. Various countries around the world, including the United States, the United Kingdom, and Canada, are developing new reactors, and especially in these three countries where private companies are the main developers, there is an appealing environment for businesses and regulatory measures are being taken. Though it is certain that expectations for new types of reactors are increasing, the fact that these reactors have not reached the stage of practical application for decades should be conceded. If sincerely aiming for practical use of this technology, it is necessary for the development side to analyze and reflect on the cause seriously before promoting the introduction of this technology in the future. In addition, policy makers must improve the environment of the power generation business itself, given that the nuclear power business is facing a difficult situation, especially in regions and countries where the electricity market has been liberalized.

Hydrogen Technologies and Issues for Their Future Widespread Use

HAGIWARA Mayumi

(Researcher, Economy, Trade and Industry Division,
Research and Legislative Reference Bureau, National Diet Library)

Hydrogen has been attracting attention in recent years as a next-generation energy source for realizing a decarbonized society. This paper provides an overview of the basics of hydrogen, including related technologies and trends in Japan and abroad, and outlines issues for expanding its use in the future. Hydrogen has the advantage of not emitting greenhouse gases when used. However, it is essential to reduce their emissions throughout its life cycle by adopting low-carbon technologies at each stage of production, storage and transportation. Various issues remain for hydrogen to be widely used in society, such as technology establishment, cost reduction, institutional development, and public understanding. With future uncertainty, it is desirable to design an energy system where hydrogen has the opportunity to fulfil its potential effectively, through a comprehensive study of other decarbonization technology options, both new and existing, including energy conservation and renewable energy.

Issues of Increased Energy Efficiency of Houses in Japan: Actions by Public and Private Sectors to Increase Energy Efficiency of Houses

ASAI Kazuo

(Researcher, Research Planning Division,
Research and Legislative Reference Bureau, National Diet Library)

In Japan, about 30% of CO_2 is generated by the use of houses and other buildings (FY2019). This paper deals with increasing the energy efficiency of houses and other buildings in Japan, especially focusing on small detached houses. First, Japan's legal framework surrounding energy saving in houses and other buildings is explained. Then, recent updates after the "realizing a decarbonized society" declaration by former Prime Minister Yoshihide Suga are mentioned. Second, important actions to increase the energy efficiency of houses and other buildings by the public and private sectors are introduced. Finally, major challenges to achieving energy saving in houses and other buildings are discussed.

III Approaches for Evaluation

Life Cycle Assessment of Decarbonization Technologies

GENCHI Yutaka

(Director, Research Laboratory for IDEA, Research Institute of Science for Safety and Sustainability)

This article surveys the concepts and methodologies of life cycle assessment (LCA) used to calculate greenhouse gas (GHG) emissions and their reduction, with a particular focus on the ISO14040 (2006) series. Decarbonization technology is evaluated on the basis of calculations made per ISO and other forms of guidance for estimating GHG emissions and their reduction as well as comparative assertions, but the proper understanding of such calculations as well as their application to communication and policymaking requires an understanding of the basics of LCA. Significant advances in LCA methodology, standards, and guidance can be expected in the future, and attention should also be paid to how these advances relate to the evaluation of decarbonization technologies.

Challenges in Bridging Gap between Decarbonization Technologies and Society

KISHIMOTO Atsuo

(Professor, Institute for Datability Science, Osaka University /
Director, Research Center on Ethical, Legal and Social Issues, Osaka University /
Senior Consultant, Education, Culture, Science and Technology Research Service,
Research and Legislative Reference Bureau, National Diet Library)

In response to the strong social demand for a decarbonized society, it is expected that various decarbonization technologies will be implemented in society and that regulatory measures aimed at decarbonization will be introduced. In anticipation of these trends, the gaps between technology and society, and between technology and policy were visualized, and the social technologies to fill them were surveyed. Social technologies includes various tools and approaches. Life cycle assessment (LCA), which measures whether or not decarbonization technology is really decarbonization and to what extent, is one of them. This paper focuses on finding and responding to ethical, legal, and social issues (ELSI) risks of emerging decarbonization technology at an early stage, with methods such as horizon scanning. In the risk trade-off analysis of occupational health and safety and solar radiation modification (SRM) technology as examples, the necessity to consider the framework of risk governance is illustrated. Regulatory impact assessment (RIA) required when using regulatory measures is also considered. Regarding greenhouse gas emission control regulations, though there are issues such as the scope and discount rate, a “cost per 1 ton of emission reduced” can be characterized as an effective index.