

Research and development creating and utilizing "comprehensive knowledge" for carbon neutrality in 2050,
Science and Technology Committee for Environment and Energy,
January 27, 2023

1. Introduction

As an increasing number of countries and regions announce carbon-neutral targets and the momentum for decarbonization increases worldwide, Japan has also made an international declaration to reduce by 2030 greenhouse gas emissions by 46% and to achieve carbon neutrality by 2050. Japan has expressed strong determination to deal with the challenge on a national scale.

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) promotes basic and foundational research and development that contributes to carbon neutrality and supports research on the impacts of climate change, energy-saving semiconductor technology, and research on regional decarbonization planning. In addition, in 2023, the MEXT plans to strengthen research and development of next-generation GX technologies such as storage batteries, hydrogen, and bio-manufacturing. Moreover, the MEXT supports major activities of the University Coalition established in 2021 which aim to achieve carbon neutrality including zero-carbon campuses, zero-carbon communities, innovation, human resource development measures, and international cooperation with overseas university coalitions.

On regional decarbonization, the Ministry of the Environment is selecting advanced decarbonization regions. With more and more model regions implementing advanced measures for decarbonization, how to spread these models to municipalities nationwide, and the social implementation of new technologies are challenges. In December 2022, the MEXT and the University Coalition collaborated to investigate issues that universities should prioritize toward materializing carbon neutrality in 2050. Interviews were conducted with private companies, citizen groups, municipalities, relevant ministries and others about the issues faced by each stakeholder. Challenges toward carbon neutrality are not limited to individual technology development but require a comprehensive analysis of complex issues such as regulations, systems, and consensus building with relevant parties. It is necessary to integrate the knowledge of natural sciences, humanities and social sciences and implement them in society¹². The Science and Technology Committee for Environment and Energy, while referring to the issues identified by the University Coalition, discussed the issues that should be prioritized in the future and the direction of research and development and system development to utilize comprehensive

knowledge to solve these issues. Based on the following issues and directions, it is recommended that the MEXT will take necessary measures for research and development and human resource development in cooperation with related ministries and agencies including the Ministry of the Environment and the Ministry of Economy, Trade, and Industry.

2. Priority Issues

(1) Regional planning

According to estimates by the International Energy Agency (IEA), in achieving carbon neutrality by 2050, more than 50% of the carbon dioxide emissions will come from emerging technologies, while the remaining 50% will come from the social implementation of existing technologies³. Therefore, to achieve carbon neutrality in 2050, it's necessary to promote research and development of new technologies such as hydrogen energy, and to analyze how to combine existing technologies to implement them in society. While referring to Japan's nationwide roadmap⁴, it is necessary to calculate how close each region can be to carbon neutrality with existing technologies while identifying industrial fields and businesses that are difficult to achieve carbon neutrality with existing technologies. In addition, when considering decarbonization plans for local industries, it is necessary not only to analyze broad issues by industry type but also to conduct a detailed life cycle assessment (LCA) according to their role in the supply chain and business type. As social infrastructure has a long lifespan, new social infrastructure built in the future will be used until 2050. It is necessary to accelerate the introduction of carbon-neutral technologies after conducting the above analysis. When considering a decarbonization plan for carbon neutrality, it is necessary to consider how to utilize natural resources in each region. In addition to promoting decarbonization efforts in each region, it is necessary to consider measures that can achieve carbon neutrality through cooperation among regions while considering the socioeconomic optimization of Japan as a whole.

(2) Regulations/Systems

To achieve carbon neutrality, it is necessary to create an environment in which various regulations and systems can be organically coordinated and all concerned parties can efficiently work to reduce carbon dioxide. Since regional decarbonization projects involve various sectors such as energy, industry, transportation, agriculture, forestry and fisheries, and

construction, it is necessary to consider a system that enables them to provide integrated support to the involved parties.

It is also necessary to internalize external diseconomies, such as passing on the cost (impact) of carbon dioxide emissions to final product prices. On the other hand, when considering carbon pricing, it is necessary to examine mechanisms and economic models that will lead to strengthening Japan's international competitiveness, rather than simply passing it on to final product prices.

In addition, since there is greater potential for increasing renewable energy in rural areas where it is easier to find land than in urban areas, it is necessary to establish a mechanism that allows necessary capital to flow back to rural areas where efforts are being made to reduce net carbon dioxide emissions.

In addition, in order to contribute to the reduction of greenhouse gas emissions throughout the product lifecycle and the stable supply of scarce resources such as rare earth necessary for decarbonization and the reduction of economic security risks⁵, it is necessary to examine technologies, regulations and systems necessary to shift to a circular economy.

(3) Communication

In order to have stakeholders cooperate toward carbon neutrality, it is necessary to share policies toward carbon neutrality in the region. To encourage citizen participation, it is necessary to clarify and share a vision of a society that will be realized through carbon-neutral efforts. In recent years, the improvement of well-being (people's satisfaction and quality of life)⁶ has been emphasized by private companies. Hence, efforts toward carbon neutrality must not only lead to reducing carbon dioxide but must help improve citizens' quality of life which will help solve social issues such as regional revitalization.

In addition, for citizens to contribute to the reduction of carbon dioxide, consumers should be able to check carbon dioxide emissions related to consumer products so that they can ascertain their own CO₂ emissions as consumers. Moreover, there is a need to understand the carbon footprint of the entire supply chain to make it easier for stakeholders to work toward carbon neutrality.

As similar efforts toward carbon neutrality are being made internationally, it is necessary to collect and analyze information on overseas efforts and disseminate domestic efforts internationally.

(4) Human resources

To achieve carbon neutrality by 2050, it is necessary not only to raise awareness in the short term but also to foster leaders who will lead the next generation of society. In recent years, education about carbon neutrality is spreading, such as the SDGs being incorporated into elementary school education. In the future, it will be necessary to work to cultivate students with the ability to analyze various information scientifically, make judgments and take action. As university students are expected to play an important role in the collaboration between local communities and universities, it is necessary to examine ways for students to gain the experience to solve issues together with regional communities.

For the industry sector, in order to support carbon neutrality efforts by SMEs which account for a majority of regional communities, it's important to foster human resources that can offer advice on carbon neutrality measures to local financial institutions that do business with SMEs. As such, universities need to support local financial institutions and businesses through recurrent education, reskilling and personnel exchanges.

(5) Others

Although the whole of society aims to achieve carbon neutrality, it may be difficult for some industries to achieve even by 2050. Therefore, it is necessary to advance research and development of technologies required by these industries and examine measures so that the whole of society can compensate for the carbon dioxide emitted by these industries. In addition, it will be necessary to introduce new equipment at the household level, while taking care not to leave behind any household that faces difficulty buying such equipment. To realize a “just transition”⁷, which is an important perspective when transitioning to a carbon-neutral society, it is necessary to support the low-carbon transition of existing industries, protect the human rights of workers involved the supply chain of renewable energy, and advance measures to promote conservation of the local environment.

3. The direction of future efforts

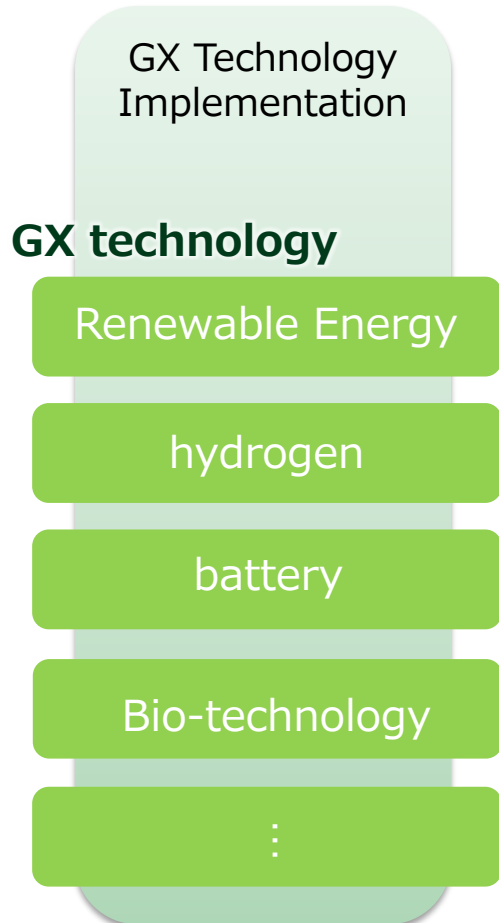
Working together with local stakeholders is crucial to solve the aforementioned issues. Since the University Coalition has already established a network for sharing information on cooperation measures with local communities, it will be effective to develop necessary bases while utilizing the network of the University Coalition. On the other hand, in universities, etc., in addition to existing educational and research activities, it is necessary to support the above activities with

research funds. In addition, universities must be informed of issues that should be prioritized for carbon neutrality, so that each university can work together to tackle the above issues even in voluntary research.

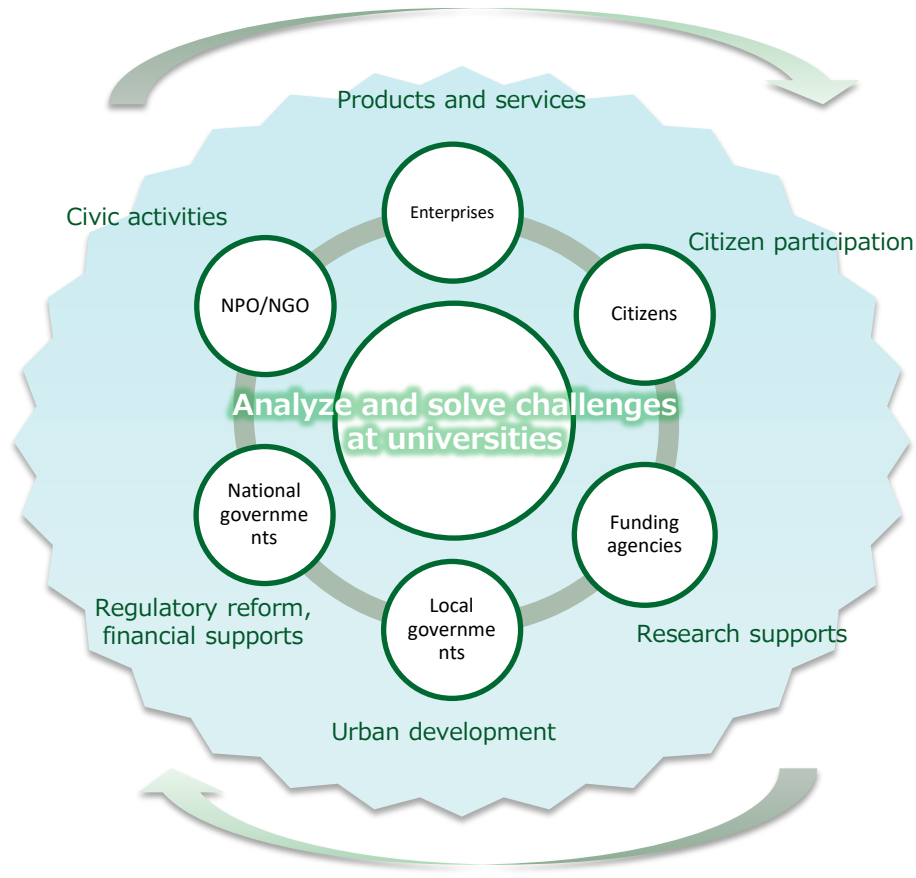
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- ¹ “Intermediate Summary of the Basic Concept of 'Comprehensive Knowledge' and Measures to be Strategically Promoted” (March 2022) https://www8.cao.go.jp/cstp/sogochi/honbun_print.pdf.
 - ² "Addressing societal challenges using transdisciplinary research, OECD Policy Paper" <https://doi.org/10.1787/0ca0ca45-en>.
 - ³"An updated roadmap to Net Zero Emissions by 2050." (November 2022) <https://www.iea.org/reports/world-energy-outlook-2022/an-updated-roadmap-to-net-zero-emissions-by-2050>.
 - ⁴ “Roadmap for Transition Finance in Power, Gas, and Oil Sectors” (February 4, 2022) <https://www.meti.go.jp/press/2021/02/20220204001/20220204001.html>.
“2050 Green Growth Strategy for Carbon Neutrality” (June 18, 2021) <https://www.meti.go.jp/press/2021/06/20210618005/20210618005-3.pdf>.
"Basic policy (draft) reference material for realizing GX" (December 22, 2022) https://www.cas.go.jp/jp/seisaku/gx_jikkou_kaigi/dai5/siryoushu.pdf.
“Regional Decarbonization Roadmap” (June 9, 2021) https://www.cas.go.jp/jp/seisaku/datsutanso/pdf/20210609_chiiki_roadmap.pdf.
 - ⁵ “Results of the Second Progress Check and Circular Economy Roadmap” (September 2022) <https://www.env.go.jp/content/000083903.pdf>.
 - ⁶ “What is the meaning of [well-being], which is attracting more attention now? Explains the correlation with business” (May 2021) <https://panasonic.co.jp/ew/pewnw/switch-times/well-being/501001.html>.
 - ⁷ "What is the Just Transition necessary to achieve carbon neutrality in 2050? " (May 2021) <https://www2.deloitte.com/jp/ja/blog/d-innovation-perspectives/2021/what-is-just-transition-1.html>.

Policies for Carbon Neutrality by 2050

- To achieve carbon neutrality by 2050, it is necessary to create a network for sharing, analyzing, and solving challenges with stakeholders.
- Carbon neutrality will also improve people's satisfaction and well-being, as well as regional revitalization (e.g., industrial development, job creation, health promotion, and fiscal consolidation).



CN links to well-being and regional revitalization



- People's satisfaction and quality of life
- Industrial promotion
- Job creation
- Health promotion
- Fiscal consolidation

Expanded understanding and participation in CN