ISSN 1880-9286

IEEJ Energy Journal

Vol.19, No.4 2024

The Institute of Energy Economics, Japan

Contents

Japan on Track in FY2022 to Achieve Energy Consumption Reduction Target While Falling Behind in Cutting Energy Intensity

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1. Final energy consumption in FY2022 (revised report) was the lowest since FY2013, making smooth progress in achieving the FY2030 target

Japan's final energy consumption in FY2022 declined by 3.3% from the previous year to 11,842 PJ (306 million kl oil equivalent), the lowest since FY1990, according to the revised Comprehensive Energy Statistics released on April 12 (Figure 1). The decline was the first in two years. Energy consumption, though increasing by 4.0% in the transportation sector due to traffic volume recovery from the COVID-19 disaster, decreased by 6.4% in the industrial sector, by 5.3% in the commercial sector, and by 2.3% in the residential sector.

Japan's final energy consumption target for FY2030 is set at 280 million kl in the Outlook for Energy Supply and Demand in FY2030 released in October 2021 together with the Sixth Strategic Energy Plan. This is based on the assumption that energy efficiency improvement will make progress from the base year of FY2013, when final energy consumption totaled 363 million kl. Energy consumption in FY2022 represented a decrease of 57 million kl or 69% from FY2013, against a decline of 83 million kl from FY2013 to the FY2030 target. If energy consumption is assumed to decrease at an equal annual pace from FY2013 to FY2030, a decline from FY2013 to FY2022 comes to 53%, compared with the actual decrease of 69%, indicating that Japan was well on track to achieving the FY2030 target. By sector, the transportation and residential sectors in FY2022 posted respective energy consumption cuts of 48% and 31% from FY2013, falling behind the target reduction of 53% for overall energy consumption. However, the industry and commercial sectors reduced their energy consumption below their respective FY2030 target levels as of FY2022.

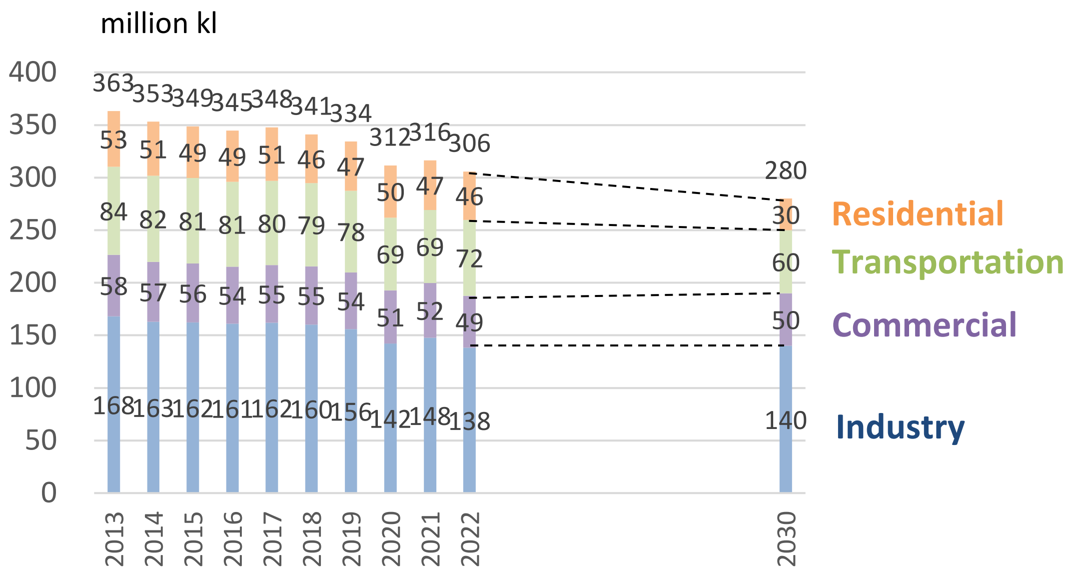

Figure 1: Trends in final energy consumption and targets

Source: Ministry of Economy, Trade and Industry "Comprehensive Energy Statistics"

Note: Actual figures for FY2013 to FY2022 and targets for FY2030 in the Outlook for energy Supply and Demand in FY2030

2. Energy consumption intensity reduction falls short of achieving the target

However, the low energy consumption in FY2022 is attributable to a delay in the achievement of economic activity targets. Therefore, the decline in final energy consumption intensity from FY2013 to FY2022 was limited to 50%, slipping below 53% as assumed for the case where

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the intensity will be reduced at an equal annual pace from the FY2013 level to the FY2030 target (Figure 2). Although the industry sector reduced its energy consumption intensity by 63% from FY2013 to FY2022, production per GDP for raw materials (including crude steel, ethylene, and cement while excluding paper/paperboard) slipped far below the levels required for achieving the FY2030 target, indicating that the intensity reduction was attributable primarily to industrial structure changes (Figure 3). The commercial sector posted a 99% reduction in energy consumption intensity on a floor area basis as the floor area continued to increase amid GDP's recovery from the COVID-19 disaster. On a GDP basis, the reduction in the sector's energy consumption intensity was limited to 61%. The transportation and residential sectors reduced energy consumption intensity by 14% and 46%, respectively, from FY2013 to FY2022, indicating that they fell behind in making progress toward achieving energy consumption intensity reduction targets.

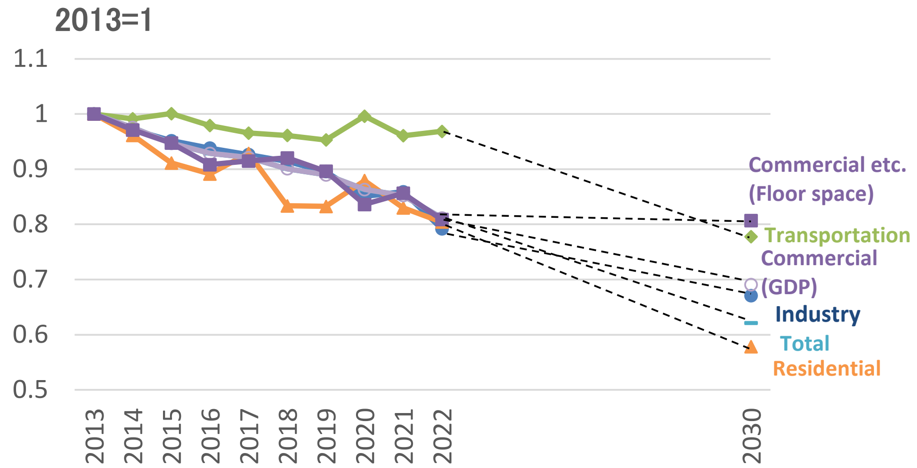

Figure 2: Changes in final energy consumption intensity and targets

Sources: Ministry of Economy, Trade and Industry, "Comprehensive Energy Statistics"; Cabinet Office, "National Accounts"; Ministry of Internal Affairs and Communications, "Basic Resident Register"; Institute of Energy Economics, Japan, "Handbook of Japan's and World Energy and Economic Statistics."

Note 1: Data represent historical between FY2013 and FY2022 and estimates for FY2030 based on targets in the Outlook for Energy Supply and Demand in FY2030.

Note 2: Activity indicators are GDP for total final energy consumption and the industrial sector, floor area and GDP for the commercial sector, ton-kilometers for the transportation sector, and the number of households for the residential sector. Passenger-kilometers were converted to ton-kilometers under the assumption of 0.065 tons/person.

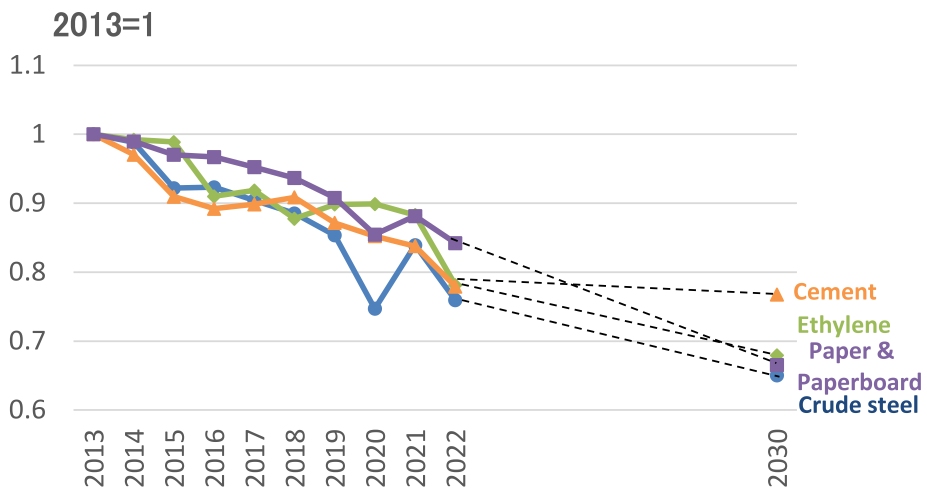

Figure 3: Trends and targets for raw materials production per GDP

Sources: Ministry of Economy, Trade and Industry, "Current Survey of Production"; Cabinet Office, "National Accounts."

Note: Data represent historical between FY2013 and FY2022 and estimates for FY2030 based on targets in the Outlook for Energy Supply and Demand in FY2030.

3. Promote energy efficiency in all sectors

Although Japan in FY2022 was on track to achieve its final energy consumption reduction target for FY2030, the reduction in FY2022 was primarily attributable to a slowdown in economic activities mainly in industrial materials industries. Japan was thus falling behind in cutting its energy consumption intensity. In the Outlook for Energy Supply and Demand in FY2030, the economy is expected to become active towards FY2030. In addition to the transportation and residential sectors that lagged behind other sectors in making progress towards achieving energy consumption reduction targets, the industrial and commercial sectors should be prepared to see energy consumption increasing due to economic recovery. In order to achieve the FY2030 energy consumption reduction target, Japan is required to cut energy consumption intensity through comprehensive efforts, including the appropriate utilization of the amended Act on Temporary Measures for Promotion of Rational Uses of Energy and Recycled Resources in Business Activities, the Japan Climate Transition Bond, and carbon pricing.

How to synthesize or decompose IIPs to compute user-defined series indices

Ryohei Ikarii *, Akira Yanagisawa **

1. Introduction

The Indices of Industrial Production (IIPs) have the advantage of being able to sensitively reflect economic trends and of becoming available more frequently and earlier than national economic accounting data. They are important indicators for grasping the economic situation and are actually used in various economic analyses. The IIPs are created not only for the most commonly used industrial averages, but also for each industry and good. There are quite a few official IIP series that have been published. By synthesizing or decomposing these official series, we can compute indices for industries and goods that official series have failed to cover. However, correct methods for long-term comparison of the user-defined series are not necessarily recognized. Sometimes, inappropriate methods or analyses are conducted among researchers. In this paper, we show the method for computing connected indices for the user-defined series in an easy-to-understand manner using computation examples, so as to contribute to the effective and appropriate implementation of economic, energy supply/demand, and other analyses using IIPs.

2. Computation of user-defined series IIPs

Added value may be used as a weight to compute weighted averages of indices as user-defined series of IIPs. For instance, the index for “chemical industry (excluding pharmaceuticals) (1110000000)” may be subtracted from the index for “chemical industry (1109000000)” to compute the index of pharmaceuticals for which there is no official series.[1]

Table 1: Production indices for chemical Industry and chemical industry (excluding pharmaceuticals) (1Q2022)

(100 for 2020)	Weight (added value)	1Q2022
Chemical industry	1233.0	104.9
Chemical industry (excluding pharmaceuticals)	1014.3	103.7

Note: The pharmaceutical production index in the first quarter of 2022 can be computed as (104.9*1233.0-103.7*1014.3)/(1233.0-1014.3)=110.5.

3. Connection coefficients and connected indices[2]

However, the IIP standard is updated every five years to reflect the latest industrial structure. In the latest update, the 2020 standard was adopted in June 2023. Based on each standard, official series for up to 10 years are published. As a matter of course, however, indices based on different standards cannot be compared. On the other hand, indices that are comparable over 10 years may not be sufficient for long-term analysis. Used in such a case is a connected index obtained by converting the old-standard index to the new-standard index.

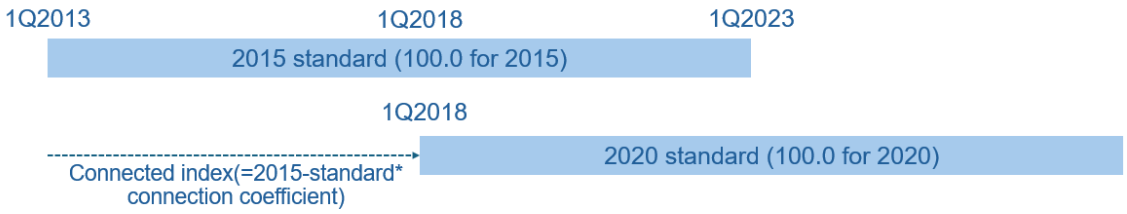

Figure 1: Illustration of connection coefficient and connected index

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[1] IIPs include production, shipment, inventory, production capacity, and capacity utilization rate indices. In the following, however, production indices alone are used.

[2] See “Outline of IIPs (2020)” by the Economic Analysis Office, Research and Statistics Department, Minister's Secretariat, Ministry of Economy, Trade and Industry, at https://www.meti.go.jp/statistics/tyo/iip/gaiyo.html#cont3 (accessed on April 3, 2024), and “Structure and Interpretation of IIPs (2014)” by the Economic Analysis Office, Research and Statistics Department, Minister's Secretariat, Ministry of Economy, Trade and Industry, at https://www.meti.go.jp/statistics/tyo/iip/pdf/b2010_mechanism_iipj.pdf (accessed on April 3, 2024)

A connection coefficient is used to adjust the index under the old standard to the new standard to compute a connected index. The old-standard index is multiplied by the connection coefficient computed with the following equation to determine the connected index comparable to the new-standard index.[3] When either the original index or the seasonally adjusted index is connected, the seasonally adjusted index is used to compute the connection coefficient.

$$\text{Connection coefficient} = \frac{\text{New-standard Jan-Mar average index 2 years before a new standard year}}{\text{Old-standard Jan-Mar average index 3 years after an old standard year}}$$

A connection coefficient to convert a 2015-standard index to a 2020-standard index is computed from the index for the first quarter of 2018.[4] For example, the connection coefficient for converting the 2015-standard index for the chemical industry to the 2020-standard index is 109.8/104.3 = 1.053 as shown in the table below:

Table 2 Chemical industry index (1Q2018)

	1Q2018
2015 standard (100 for 2015)	104.3
2020 standard (100 for 2020)	109.8

For representative industries and goods, however, connected indices have been published for a certain period of time. If they are sufficient, there is no need for analysts to compute connection coefficients or connected indices by themselves.

4. Computing connected indices for user-defined series

When user-defined series indices computed according to Section 1 are used for long-term comparison, their connected indices may have to be created. In this regard, a common mistake is to synthesize or decompose published connected indices to compute user-defined connected indices. For instance, the connected index for the chemical industry under the 2020 standard in the first quarter of 1978 is published as 44.4 and that for the chemical industry (excluding pharmaceuticals) as 65.9. If the weight under the 2020 standard is mistakenly used to compute the connected index for pharmaceuticals, a negative figure ((44.4*1233.0-65.9*1014.3)/(1233.0-1014.3)=-55.3) may be produced as an incomprehensible value.

When a user-defined connected index is created, the same procedures as those for using a connection coefficient for a user-defined index may be taken as follows:

(1) Create a new-standard user-defined index
(2) Create an old-standard user-defined index
(3) Compute a connection coefficient from the new- and old-standard user-defined indices shown in (1) and (2)
(4) Compute a user-defined connected index from the old-standard user-defined index in (2) and the connection coefficient in (3)

[3] However, it should be noted that the connected index is only for convenience.
[4] While connection coefficients for IIPs are described above, it should be noted that connection coefficients for consumer price and other indices are different from them. (See: https://www.stat.go.jp/data/cpi/2020/kaisetsu/pdf/3-6.pdf)

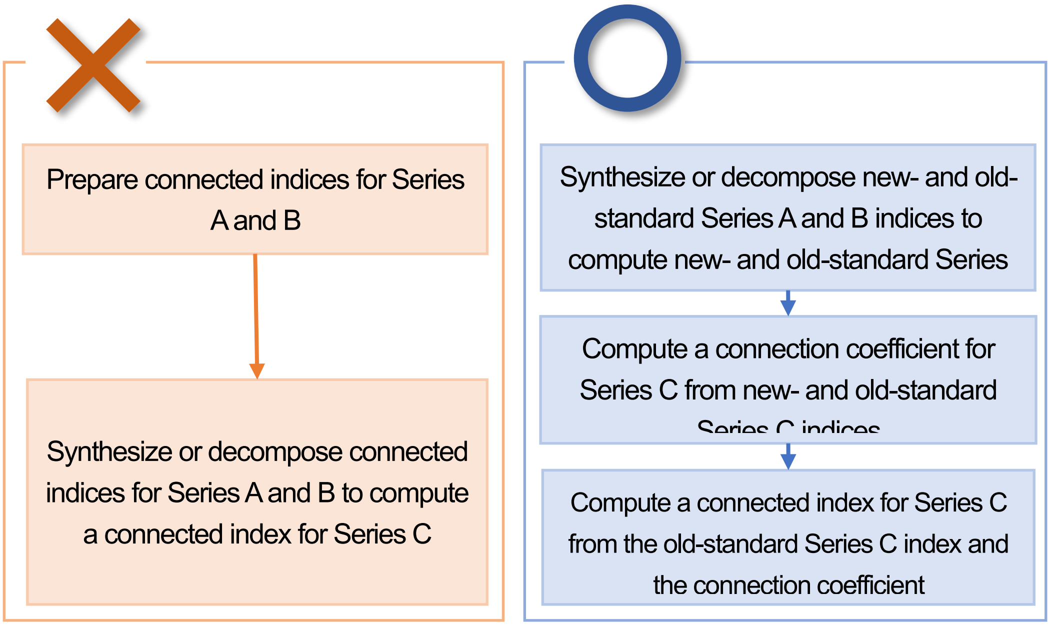

Figure 2 Procedures to compute the connected index for a user-defined series from Series A and B

The following case is for computing a 2020-standard connected index for pharmaceuticals in the first quarter of 2013:

(1) Create a 2020-standard index for pharmaceuticals

Table 3: 2020-standard indices for the chemical industry and chemical industry (excluding pharmaceuticals) (1Q2018)

(100 for 2020)	Weight (added value)	1Q2018
Chemical industry	1233.0	109.8
Chemical industry (excluding pharmaceuticals)	1014.3	114.0

The 2020-standard index for pharmaceuticals in 1Q2018 is computed as (109.8*1233.0-114.0*1014.3)/(1233.0-1014.3)=90.3.

(2) Create a 2015-standard index for pharmaceuticals

Table 4: 2015-standard indices for the chemical industry and chemical industry (excluding pharmaceuticals) (1Q2013, 1Q2018)

(100 for 2015)	Weight (added value)	1Q2013	1Q2018
Chemical industry	1093.0	97.8	104.3
Chemical industry (excluding pharmaceuticals)	856.0	97.1	107.0

The 2015-standard index for pharmaceuticals in 1Q2018 is computed as (104.3*1093.0-107.0*856.0)/(1093.0-856.0)) = 94.5. Similarly, the index in 1Q2013 is computed as 100.3.

(3) Compute a connection coefficient

Based on the 1Q2018 indices in (1) and (2), the connection coefficient for pharmaceuticals is computed as 90.3/94.5 = 0.955.

(4) Compute the connected index from the 2015-standard index and the connection coefficient

A 2020-standard connected index for pharmaceuticals in the first quarter of 2013 is computed as 100.3*0.955=95.8, which is obtained by multiplying the 2015-standard index in (2) by the connection coefficient in (3).

5. Cases for utilization of user-defined series connected indices

By creating user-defined series connected indices, we can find the long-term trends of various industries and goods. For instance, let us take up a 2020-standard connected index for pharmaceutical production. In the fourth quarter of 2020 amid the COVID-19 pandemic, the index plunged 10.3 points from the previous quarter to 94.9. In the fourth quarter of 2008, just after the bankruptcy of U.S. investment bank Lehman Brothers, which triggered the global financial crisis, the index posted a far slower decrease of 1.0 points from the previous quarter. Even given that the production level at the time of the Lehman bankruptcy was 20-30% lower than the current level, the quarterly fall of 1.0 points is far slower than in the fourth quarter of 2020. The index trend in 2008 indicates that the pharmaceutical industry is less susceptible to economic fluctuations than generally believed, while that in 2020 demonstrates how serious supply chain disruptions under the COVID-19 pandemic were.

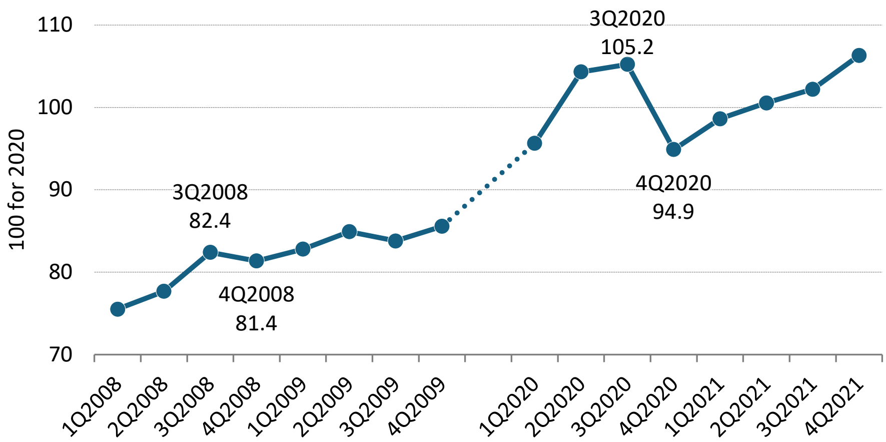

Figure 3 2020-standard index for pharmaceuticals

6. Conclusion

Although we computed seasonally adjusted quarterly indices in this paper, the same computation method can be used to calculate connected indices for original indices, as well as calendar-year, fiscal-year, and monthly series. It would be beneficial to use the method summarized above to create user-defined series connected indices for finding long-term trends for industries and goods for which no official indices have been published and for analyzing economic, energy supply/demand, and other trends.

Thoughts on Natural Gas in Japan's Energy Strategy

Taiju Morimoto *

1. Positioning of natural gas in the 6th SEP

Discussions towards the formulation of the 7th Strategic Energy Plan (SEP) have begun. In this paper, I would like to focus on natural gas, which is expected to play a role in the transition to carbon neutrality, taking up what to expect from natural gas in the 7th SEP, based on the positioning of natural gas in the 6th SEP and the current situation.

Figure 1 shows natural gas supply and demand in Japan in FY2022 and projections under the 6th SEP, the IEEJ Outlook 2024 of the Institute of Energy Economics, Japan (IEEJ), and the World Energy Outlook (WEO) 2023 of the International Energy Agency (IEA).[1] The IEEJ and IEA scenarios presented in this paper suggest that natural gas demand will exist even in 2050, including that in the power generation sector, although projections vary. For 2030 in the transition to 2050, the 6th SEP projection is characteristically different from other projections.

Specifically, the primary natural gas supply projection for 2030 in the 6th SEP is relatively high, somewhere between those in the IEEJ Reference Scenario (REF) and Advanced Technologies Scenario (ATS), while the 6th SEP natural gas power generation projection is as low as the projection in the IEA's Announced Pledges Scenario (APS). The 6th SEP was formulated when the 2050 carbon neutrality goal gained global momentum. In particular, renewable energy such as solar photovoltaics and wind was spotlighted for the power generation sector, leading to a power generation mix in which shares for natural gas and other fossil fuels decline toward the accelerated expansion of renewable energy shares (Figure 2). As a result, the position of natural gas in Japan's energy mix for 2030 in the 6th SEP receded relatively.

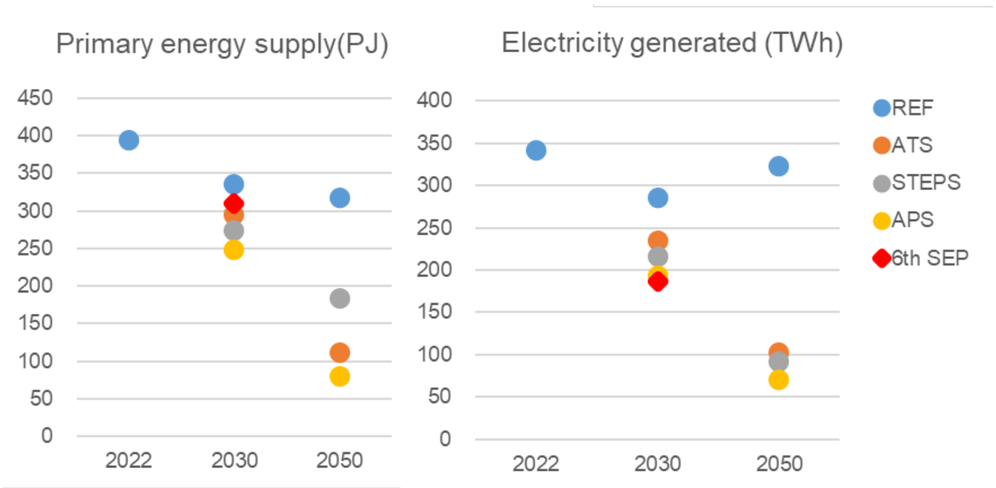

Figure 1: Comparison of primary natural gas supply and electricity generated from natural gas in Japan

Source: Prepared from the Comprehensive Energy Statistics, IEEJ Outlook 2024, IEA World Energy Outlook 2023, 6th SEP

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[1] Citing four scenarios: the Reference Scenario (REF) and Advanced Technologies Scenario (ATS) of the IEEJ Outlook 2024, and the Stated Policies Scenario (STEPS) and the Announced Pledges Scenario (APS) of the IEA WEO 2023

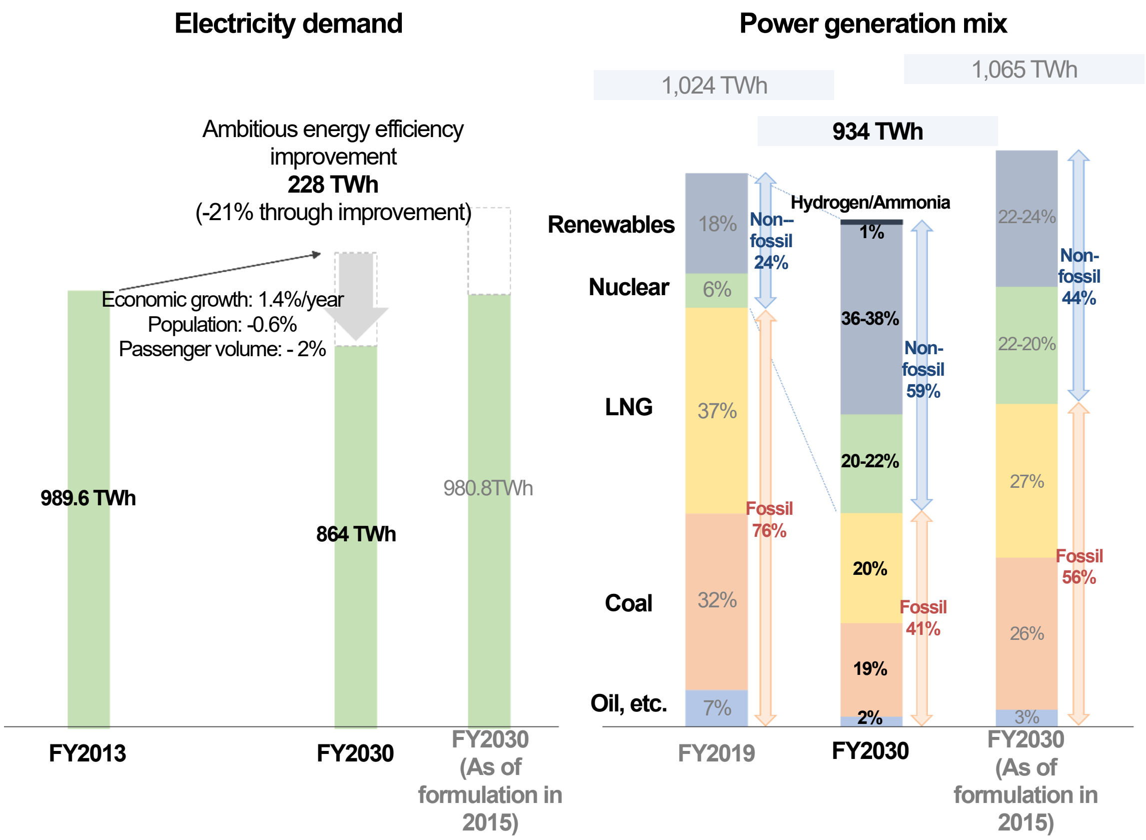

Figure 2: Electricity demand and power generation mix under 6th SEP

Source: "Outlook for Energy Supply and Demand in FY2030"

2. Current natural gas demand trend

Figure 3 shows changes in natural gas demand since FY2010. This indicates that natural gas demand since FY2010 has been affected by changes in power generation natural gas demand. Power generation natural gas demand grew significantly to cover nuclear power generation losses caused by the shutdown of nuclear power plants in the wake of the 2011 Great East Japan Earthquake. However, it peaked at 3,328 PJ in FY2014 and has been on a downward trend since then. In FY2022, it decreased to 2,304 PJ, below the FY2010 level before the Great East Japan Earthquake. This downtrend is apparently attributable to the restart of nuclear power plants and the expansion of solar and other renewable energy, as well as a decline in electricity demand (Figure4).

Figure 4 for a comparison between power generation mix shares for natural gas and coal shows that the natural gas share posted a decrease of 9.2 percentage points from the peak of 43.0% in FY2014 to 33.8% in FY2022, while the coal share registered a slower decline of 3.4 points from the peak of 34.2% in FY2015 to 30.8% in FY2022. This may be because relatively inexpensive coal-fired power generation has increased as natural gas prices have continued to soar due to the acceleration of global decarbonization efforts and Russia's invasion of Ukraine after the announcement of the 6th SEP. According to an advisory panel report,[2] installed power generation capacity decreased by about 3 million kW from FY2016 to FY2023 for natural gas, while increasing by about 9 million kW for coal. Although the utilization of natural gas, known as the lowest-carbon fossil fuel, has been required for the transition to carbon neutrality, natural gas has become a power source that is easy to reduce due to relative cost hikes.

[2] 74th Meeting of the Basic Policy Subcommittee on Electricity and Gas, "Future Thermal Power Generation Policy" https://www.meti.go.jp/shingikai/enecho/denryoku_gas/denryoku_gas/pdf/074_10_00.pdf

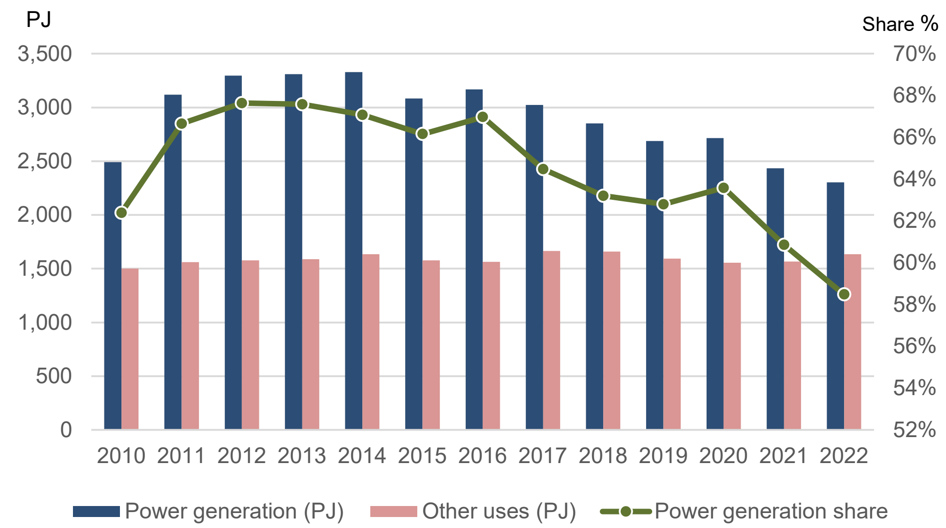

Figure 3: Domestic demand for natural gas and its share of power generation

Source: Prepared from the Comprehensive Energy Statistics

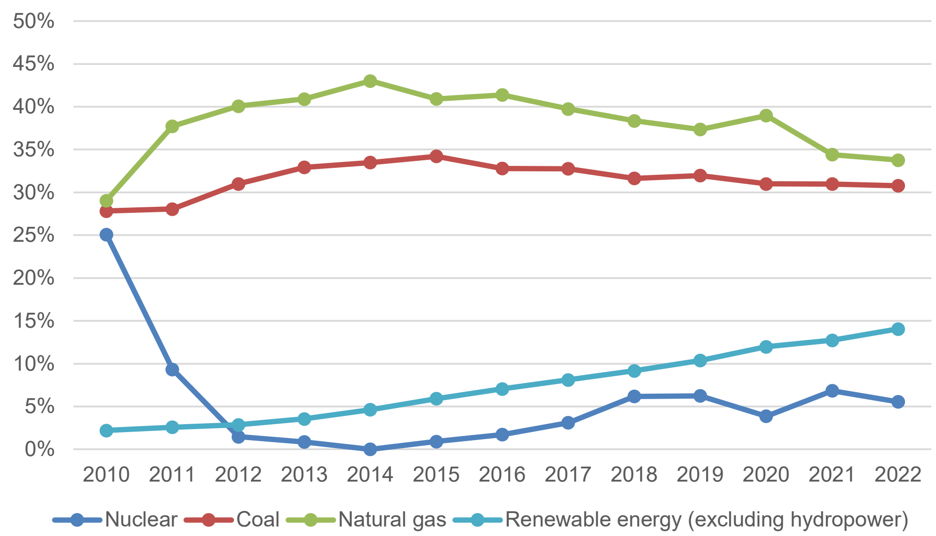

Figure 4: Power generation mix (excerpt)

Source: Prepared from the Comprehensive Energy Statistics

3. OCCTO assumption of natural gas-fired power generation

The Organization for Cross-regional Coordination of Transmission Operators, Japan (OCCTO), has released the Aggregation of Electricity Supply Plans for FY2024,[3] indicating installed power generation capacity and transmission-end electricity supply for each power source through FY2033. According to Figure 5 for excerpts from the aggregation for natural gas and coal, it is assumed that installed capacity for natural gas-fired power plants will increase toward FY2033, while their transmission-end electricity supply decreases. On the other hand, transmission-end electricity supply from coal-fired power plants is assumed to exceed supply from natural gas-fired power plants from FY2024 to FY2033, although installed capacity for coal-fired plants will decrease. Transmission-end electricity supply is estimated under the assumption that operational priority will be given to lower-cost power sources. As a result, the capacity factor for natural gas-fired power plants is estimated to plunge from 42.9% in FY2023 to 34.0% in FY2033. While it is predicted that it will become even more difficult to recover costs for natural gas-fired power plants, the recent supply-demand trend shown in Section 2 indicates that it is doubtful whether capital investment in natural gas power

[3] OCCTO, "Aggregation of Electricity Supply Plans for FY2024" https://www.occto.or.jp/kyoukei/torimatome/files/240329_kyokei_torimatome.pdf

generation capacity will be carried out as planned.

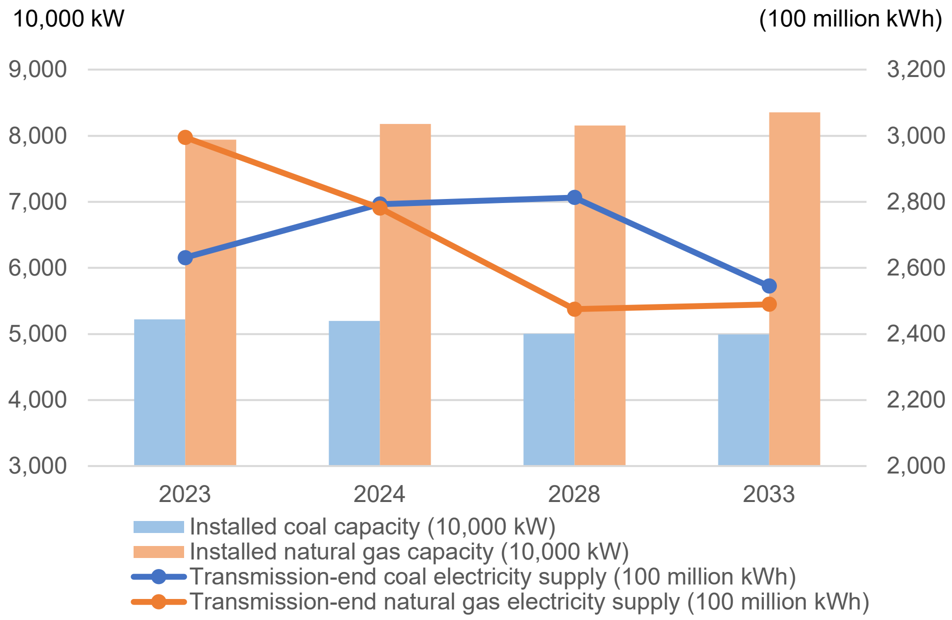

Figure 5: Assumed installed power generation capacity and transmission-end electricity supply for natural gas-fired and coal-fired power plants

Source: Prepared from the OCCTO, "Aggregation of Electricity Supply Plans for FY2024"

4. Current challenges and expectations for the 7th SEP

There have been various comments on the description of natural gas in the 6th SEP since its formulation. In particular, experts pointed out that the significant decline in the natural gas share of the power generation mix in FY2030 from the current level could have a negative impact on natural gas procurement after the formulation of the 6th SEP.[4] In fact, Russia's invasion of Ukraine in early 2022 and the subsequent global surge in natural gas spot and short-term contract prices have once again highlighted the importance of low-cost and stable long-term contracts for natural gas.

As noted in Section 2, the natural gas share of the power generation mix has declined significantly in the past. As described in Section 3, it is assumed that the capacity factor of natural gas-fired power plants is assumed to decrease from the current level by around FY2030 in line with a decline in natural gas-fired power generation, if based on the merit order. Demand for natural gas for power generation seems to continue to decline. It may seem strange that natural gas, which emits less carbon dioxide than coal, maybe the first to become subject to the reduction of consumption at a time when Japan pursues carbon neutrality. After all, costs seem to be a major challenge. Although policy measures have recently been put in place to recover costs through long-term decarbonized power auctions,[5] facilities subject to the auctions are required to have hydrogen and other decarbonization technologies in the future. Therefore, it is important to develop technologies for the decarbonization of natural gas-fired power plants to secure their utilization.

My impression has so far been that there is a lack of reality-based discussion on how to treat natural gas and other fossil fuels during the transition to carbon neutrality and how to seamlessly transition to carbon neutrality based on reality. Therefore, the following points are considered important for the 7th SEP.

The first point is to specify the use of natural gas during the transition period. It is important to secure and maximize the economically rational and stable use of natural gas as the most low-carbon fossil fuel in order to achieve carbon neutrality. To this end, a well-balanced procurement portfolio is necessary. In particular, medium- to long-term contracts at low prices are of great significance for securing a stable supply of natural gas in Japan. To natural gas-producing countries, Japan should demonstrate its stance on utilizing natural gas during the transition period and

[4] Takeo Kikkawa, "Inevitable Revision of the Strategic Energy Plan" http://www.world-economic-review.jp/impact/article2777.html

[5] OCCTO, "What is a Long-Term Decarbonized Power Auction?" https://www.occto.or.jp/capacity-market/decarbonation_know

continuing government support for business operators' natural gas procurement.

The second is to promote international efforts to decarbonize existing natural gas-fired power plants. Such efforts currently include a transition from co-firing natural gas with hydrogen to future hydrogen-only combustion. It is necessary to emphasize progress in such efforts after the 6th SEP, the current state of relevant international cooperation, and future prospects. In particular, it is important to clearly state that Japan will work with current natural gas exporters such as North America, the Middle East, and Australia to develop and introduce technologies for cleaner and decarbonized natural gas.

The third point is how to present the future outlook based on the two points above. When carbon neutrality is achieved, natural gas may be completely replaced by zero-carbon energy. Given that the current and future stable supply is the top energy policy priority, however, it will be difficult to smoothly achieve the replacement. It is important for the 7th SEP to pave a seamless way for a stable energy supply from the transition period to carbon neutrality achievement. The 7th SEP will discuss energy supply and demand, and a power generation mix for FY2040. A major challenge for the 7th SEP may be how to present a roadmap towards carbon neutrality in addition to measures for reducing fossil fuel consumption, based on changes and discussions after the 6th SEP formulation. The next SEP should provide a scenario to indicate how natural gas and other fossil fuels would be used and decarbonized. It may be effective to provide multiple scenarios.

The 7th SEP will be prepared on the premise of changes in the global situation after the formulation of the 6th SEP and future uncertainties. I look forward to future discussions on how to chart a path towards carbon neutrality by 2050 on the premise of a stable supply of natural gas and other energy sources that are indispensable to society.

Voluntary Carbon Credit Trends (January-March 2024) Tech Industry Initiatives and New Draft on SBTi Standards

Mai Kojima * Soichi Morimoto ** Keita Katayama ***

1. Introduction

This report introduces a new voluntary credit market trend from January to March 2024. In the United States, leading tech industries such as Google Inc. and Microsoft Corp. have begun to purchase credits. Moreover, a statement announced by the Science Based Targets initiative (SBTi), which allows carbon credits to be used for Scope 3 emissions reductions. New specific SBTi standards are planned to be published in July 2024 and are expected to have a significant impact on the credit market in the future.

2. Trends in the Private Sector

(1) Google participates in the U.S. CO2 Removal Purchasing Challenge

The U.S. Department of Energy's (DOE) Office of Fossil Energy and Carbon Management (FECM) issued a notice of intent for the Voluntary Carbon Dioxide Removal Purchasing Challenge on March 14, 2024.[1] The Challenge, following the Carbon Negative Shot and the Carbon Dioxide Removal Purchase Pilot Prize, is a DOE program that aims to promote the purchase of high-quality CO_2 removal credits and improve their transparency through public-private partnerships. Credit suppliers are also expected to increase their contact with credit buyers through the Challenge.

The table below shows the carbon removal programs provided by the DOE:

Table : DOE Carbon Removal Programs

Program	Carbon Negative Shot	Carbon Dioxide Removal Purchase Pilot Prize	Voluntary Carbon Dioxide Removal Purchasing Challenge
Launch year	2021	2023	2024
Funding	$100 million	$35 million	None
Eligible entities	Individuals, organizations, and local governments	Private sectors (profit/non-profit) and academic institutions	Organizations dealing with carbon removal
Target areas	DACS, biomass, oceans, forests, etc.	DACS, biomass, geology, subsurface storage	N/A

Sources: The DOE website2, etc.

Although the Voluntary Carbon Dioxide Removal Purchasing Challenge has no federal funding, it is designed to allow participating organizations to use a special website to access useful materials such as templates for credit agreements.[2]

On the same day the Challenge was announced, Google declared that it would purchase $35 million in carbon removal credits over the next 12 months, becoming the first company to meet the requirements for the challenge.[3] The company intends to use nature-based and technology-

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[1] U.S. Department of Energy, Office of Fossil Energy and Carbon Management. (2024, March 14). *U.S. Department of Energy Announces Intent to Launch Voluntary Carbon Dioxide Removal Purchasing Challenge.* https://www.energy.gov/fecm/articles/us-department-energy-announces-intent-launch-voluntary-carbon-dioxide-removal.

[2] U.S. Department of Energy, Office of Fossil Energy and Carbon Management. (2024, March 14). *DOE is Helping YOU Buy Good Carbon Dioxide Removal Credits.* https://www.energy.gov/fecm/articles/doe-helping-you-buy-good-carbon-dioxide-removal-credits.

[3] Spock Randy. (2024, March 14). *Our pledge to support carbon removal solutions.*

based solutions.[4] Google has invested in Frontier, the organization funded by several tech companies aiming at an advanced market commitment for carbon removal credits.[5]

The DOE accepts inquiries about participation in the Voluntary Carbon Dioxide Removal Purchasing Challenge until May 15. It is expected that other companies will follow Google in investing in this Challenge.

(2) Microsoft strengthens its purchase of carbon dioxide removal credits

Grassroots Carbon, a company selling carbon removal credits generated from grasslands, announced on January 30, 2024, that it had entered into a soil carbon credit agreement with Microsoft. The credits are created by storing carbon in the soil over 30 years. The agreement represents Microsoft's first investment in carbon removal credits generated from regeneratively managed grasslands.[6]

The Next 150, a carbon removal venture founded in 2022 in Switzerland, announced in March 2024 that it had signed a six-year agreement with Microsoft to supply 95,000 tons of carbon dioxide removal credits[7].

The Next 150 established General Biochar Systems (GBS) in Guanajuato, Mexico, in May 2023 to produce 18,000 tons of biochar per year. In cooperation with local governments and civic organizations, the company currently aims to supply biochar to about 23,000 local farmers. While credit delivery to Microsoft commences in the middle of this year, biochar is expected to be used for reducing reliance on chemical fertilizers and improving crop yields.

According to the Intergovernmental Panel on Climate Change (IPCC), biochar is "a solid material generated by heating biomass to a temperature in excess of 350°C under conditions of controlled and limited oxidant concentrations to prevent combustion."[8] Although trees photosynthesize will absorb carbon dioxide and release oxygen during their growth, dead trees left untreated may release the absorbed CO_2 due to the action of microorganisms. Therefore, biochar is expected to be an effective means of carbon removal, as carbonizing the trees to trap carbon allows carbon to be stored while contributing to amending soil. The global biochar market is expected to expand in the future.

According to CDR.fyi, an information platform for the carbon removal market, Microsoft has purchased about 3.3 million tons of credit so far, ranking first ahead of other companies.[9] Microsoft's future carbon credit initiatives should be closely watched.

3. Trends in Private Sector Initiatives

The SBTi announces a statement to allow credit use for Scope 3 emissions reductions

The SBTi, which sets standards for corporate climate targets, has announced a statement for the first time that it will allow the use of credits for Scope 3 emissions reductions, in response to companies' call for allowing the use of credits for meeting their emission targets. The SBTi previously allowed companies to *neutralize* their residual emissions (less than 10% of base year emissions) with carbon removal credits when achieving net zero emissions including Scope 3. Based on the SBTi standard, the Voluntary Carbon Markets Integrity Initiative (VCMI) also assumed that the interim target to reach net zero emissions should be achieved without credit before the residual emissions are partially offset with emission reduction credits. The latest SBTi decision allows companies to use emissions reduction credits only for Scope 3 emissions reductions to meet their interim targets.

On January 30, 2024, the Climate Board[10] and VCMI released "Corporate Engagement with Voluntary Carbon Market Claims," which covers the views of 145 global companies on the voluntary credit market.[11] While only 14% of the companies in the survey said that they had SBTi-validated short-term targets and were making progress on both Scope 2 and 3 targets, 70% responded that they would be more likely to set

[4] Spock Randy's LinkedIn post. https://www.linkedin.com/posts/randall-spock_thrilled-to-share-that-today-google-has-pledged-activity-7174044192287928320-8aIm?utm_source=share&utm_medium=member_desktop.

[5] Frontier, a company founded by Alphabet, Meta, Stripe, and others, aims to purchase more than $1 billion in carbon removal credits between 2022 and 2030. See Frontier. (n.d.). *Home*. Retrieved May 7, 2024, from https://frontierclimate.com/.

[6] Grassroots Carbon. (2024, January 30). *Grassroots Carbon to provide Microsoft with soil carbon storage credits*. https://grassrootscarbon.com/press-release/microsoft-buys-soil-carbon-credits/.

[7] The Next 150. (March 21, 2024). *The Next 150 inks 6-year agreement with Microsoft for 95,000 high-quality biochar carbon removal credits*. https://thenext150.com/the-next-150-inks-6-year-agreement-with-microsoft-for-95000-high-quality-biochar-carbon-removal-credits/.

[8] IPCC. (2023). 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Agriculture, Forestry and Other Land Use. "Appendix 4: Method for Estimating the Change in Mineral Soil Organic Carbon Stocks from Biochar Amendments: Basis for Future Methodological Development."

[9] CDR.fyi. (n.d.). *Leaderboards*. Retrieved May 7, 2024, from https://www.cdr.fyi/leaderboards.

[10] A Washington-based company that provides research and information services related to climate change.

[11] The Climate Board. (2024, January 30). *The Climate Board & VCMI Publish Report Showcasing Corporate Perspectives on Carbon Credits*. https://www.theclimateboard.com/2024/01/30/the-climate-board-vcmi-publish-report-showcasing-corporate-perspectives-on-carbon-credits/.

and maintain their emissions reduction targets if they could use credits to meet their targets. Furthermore, 41% of the respondents purchased credits in the last two years, 19% had plans to participate in carbon markets before 2030, and 40% had no such plan or were undecided about participation.

In March 2024, the We Mean Business Coalition,[12] a non-profit organization, published "Accelerating Corporate Climate Finance through Carbon Markets: Overcoming the Challenges,[13]" covering a survey of 180 executives in 27 countries on their attitudes toward the voluntary credit market, with a collaboration with Intercontinental Exchange (ICE) and Bain & Company. According to the survey, more than half of the companies participating in the voluntary credit market said the market plays an important role in achieving decarbonization targets. Those cited as barriers to participation in the voluntary credit market included SBTi and other corporate climate target standards' lack of awareness of credits, uncertain labeling and claims, risks accompanying uncertainties, lack of transparency, complexity of standards and accounting principles, and lack of specific business incentives. The survey found that if SBTi and other standards allow credits to be used to achieve targets, annual spending on credits may increase by an average of 9% over the next two years[14] and 50% of companies that do not currently have short-term targets will likely set such targets.[15]

On November 28, 2023, the VCMI announced a beta version of the Scope 3 Flexibility Claim, a new guideline that allows the partial use of credits to achieve Scope 3 emission reduction targets, in addition to the existing guidelines. Then, there were concerns about the VCMI's inconsistencies with the SBTi on how credits should be used. The new guideline is expected to be finalized by the third quarter of 2024.

Following the VCMI announcement, the SBTi Board of Trustees on April 9, 2024, issued a statement to the effect that it would change its mindset to allow the use of credits only for Scope 3 emissions reductions under appropriate policies, standards, and procedures.[16] Proposed changes to the standards will be presented in July 2024. The VCMI and other stakeholders welcomed the statement. On the other hand, the decision by the Board of Trustees seems to have been received with surprise even within the SBTi. According to media reports, SBTi staff members have issued a letter calling for the Board of Trustees to rescind the decision and dismiss the chief executive officer, citing a lack of sound scientific evidence for the decision,[17] which may lead to turmoil.

The SBTi announcement can stimulate potential demand for voluntary credits. It is necessary to pay close attention to the specific standards that the SBTi will announce in the future.

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[12] A non-profit organization that works with global companies to take action on climate change. It has seven NPOs, including CDP, as coalition partners.
[13] We Mean Business Coalition. (2024, March). *ACCELERATING CORPORATE CLIMATE FINANCE THROUGH CARBON MARKETS: OVERCOMING THE CHALLENGES.* https://www.wemeanbusinesscoalition.org/accelerating-corporate-climate-finance/.
[14] If credit use is not allowed, it will decrease by an average 1% per year.
[15] 32% at the moment.
[16] SBTi. (2024, April 9). *Statement from the SBTi Board of Trustees on use of environmental attribute certificates, including but not limited to voluntary carbon markets, for abatement purposes limited to scope 3.* https://sciencebasedtargets.org/news/statement-from-the-sbti-board-of-trustees-on-use-of-environmental-attribute-certificates-including-but-not-limited-to-voluntary-carbon-markets-for-abatement-purposes-limited-to-scope-3.
[17] Reuters. (2024, April 17). *Climate target group in turmoil over carbon offsetting plan.* https://www.reuters.com/sustainability/companies-get-green-light-use-offsets-supply-chain-emissions-2024-04-10/.

Attention-Attracting Support for Clean Cooking Penetration in Africa

Ryohei Ikarii *

1. Introduction

In developing countries, traditional biomass, such as firewood, wood chips, and animal dung are often used as cooking fuel in the household sector. This is a serious problem. According to the International Energy Agency (IEA), 60% of young deaths in Africa are related to smoke aspiration and indoor air pollution. A total of 2.3 billion people around the world still use traditional biomass, including about 1 billion people in Africa. This challenge has been recognized in the past, leading to attempts to popularize clean cooking using electricity, liquefied petroleum gas (LPG), biogas, charcoal, etc. In this paper, I would like to confirm that support for the penetration of clean cooking in Africa is attracting renewed attention as indicated by the latest developments regarding the Group of Seven (G7) countries and the IEA. I would also like to review energy sources used for such support considered or implemented for specific African countries based on recent academic papers.

2. Latest Developments Regarding G7 and IEA Support for Clean Cooking Penetration

(1) G7 Leaders' Communiqué[1] and G7 Climate, Energy and Environment Ministers' Meeting Communiqué[2]

From June 13 to 15, 2024, Italy hosted the annual G7 summit in Puglia. G7 chair Italy, which has been plagued with the social issue of a rapid increase in the number of refugees accepted from sub-Saharan African countries and announced the Mattei Plan for assistance to Africa, took up support for Africa (and artificial intelligence countermeasures) as a main topic for the G7 summit. The G7 Leaders' Communiqué issued on June 14 clearly stated support for clean cooking in Africa as follows:

"We [(G7)] are determined to ensure affordable, reliable, sustainable, clean, and modern energy in developing countries, particularly in Africa, recognizing the opportunity that the clean energy transition presents to spur a new era of productivity, industrial growth, and economic development, and to advance the priority of clean cooking in the [African] continent."

The G7 Climate, Energy, and Environment Ministers' Meeting, which preceded the summit, also issued its communiqué on April 30, committing to contribute to achieving net zero emissions by promoting sustainable energy access, including clean cooking in African and other developing countries.

(2) IEA Summit on Clean Cooking in Africa[3] and Vision for Clean Cooking Access for All[4]

Meanwhile, the IEA, which emphasized the importance of clean cooking at the Italy-Africa Summit held in Rome on January 29, 2024, held the Summit on Clean Cooking in Africa in Paris on May 14, between the G7 Summit and the G7 Climate, Energy, and Environment Ministers' Meeting. The main session was co-chaired by the IEA executive director, the president of Tanzania, the prime minister of Norway, and the president of the African Development Bank. IEA Executive Director Faith Birol explained the reason for giving priority to clean cooking in Africa as follows:

"[Clean cooking] was a global problem but it is becoming a problem more and more focused on sub-Saharan Africa. According to our numbers, today, still four out of five families use open fire or basic stoves for preparing a meal, and the fumes and toxins coming from those cooking practices are causing respiratory diseases, especially for women and children. And each year, more than 500,000 people, mainly women and children, die prematurely because of respiratory diseases because of these cooking practices. For us, for IEA, I am sure for all of you, this is not acceptable. This is not acceptable today in this century, in the 21st century. And to fix this problem, to solve this problem, you don't need to discover new technology. You don't need a huge amount of budget. You need good financial resources and the right policies to implement."

At this summit's public sector session, presentations were made by the presidents of African countries such as Sierra Leone and Togo, and dignitaries of international organizations such as the European Commission, the United Nations and U.N. agencies, and the World Health Organization. Presentations were also made by ministers, deputy ministers, and ambassadors from Azerbaijan—host of the 29th Conference of

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1 https://www.g7italy.it/wp-content/uploads/Apulia-G7-Leaders-Communique.pdf
2 https://www.env.go.jp/content/000224818.pdf
3 https://www.iea.org/events/summit-on-clean-cooking-in-africa
4 https://www.iea.org/reports/a-vision-for-clean-cooking-access-for-all

Parties to the United Nations Framework Convention on Climate Change—, France, Denmark, the Netherlands, the United Kingdom, and the United States, a former Chilean president, and others. Developed countries pledged financial assistance. At the private sector session, the Chairman of the Board and CEO of TotalEnergies, the CEO of Vitol, the COO of Eni, the Vice President of Shell, and others pledged investment. Dr. Birol emphasized that the summit alone secured $2.2 billion in new investment and loans.

In July 2023, the IEA released "A Vision for Clean Cooking Access for All" as a special report of the "World Energy Outlook 2023" to support the penetration of clean cooking in Africa. As for the reason for assistance required especially for Africa, the IEA noted that the number of people with no access to clean cooking, though falling in Asia and Latin America, was continuing to increase in sub-Saharan African countries as the penetration of clean cooking was failing to catch up with population growth.

3. Recent African Clean Cooking Research in Academia

As shown above, there are industry and government movements to support the penetration of clean cooking in Africa through the G7, IEA, and other organizations. Since resources such as people, goods, and money are required for support, the attitude of entities that can mobilize these resources will determine whether or not the actual support can be provided. On the other hand, it is important to formulate support measures without being (overly) bound by political and business perspectives that tend to accompany aid and cooperation, and to shed light on the penetration of clean cooking in countries that lack attractive resources, markets, or international political power. For this reason, I would like to summarize recent academic papers on how academia in addition to industry and government is considering and implementing support for what countries using what energy sources.[5]

Using the "ScienceDirect"[6] database, I selected 60 academic papers on clean cooking in African countries among those published since 2021, including the impact of the COVID-19 pandemic.[7] My analysis of these papers found that many of the academic studies targeted East and West African countries in the sub-Saharan region (Figure 1).[8]

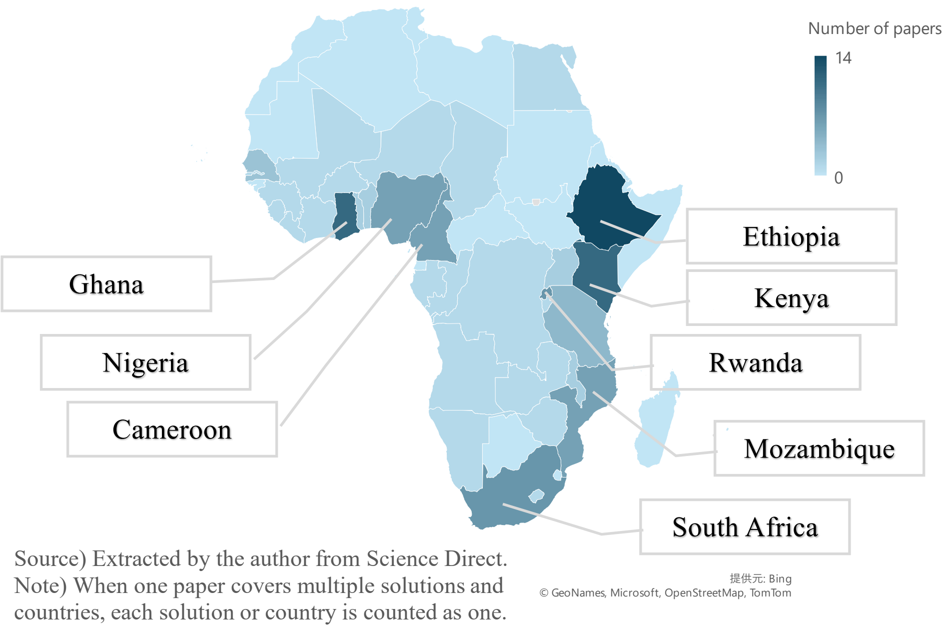

Figure 1 Number of papers on support for clean cooking penetration (by country)

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5 Academic papers are less politically influenced than grey literature published by multilateral development banks and bilateral development finance institutions. They are generally considered to be more objective because they are published through a peer review process.

6 ScienceDirect is a website operated by Dutch publisher Elsevier since March 1997. It provides high-quality peer-reviewed literature on a platform with access to more than 2,200 academic journals and more than 25,000 e-books. (https://www.sciencedirect.com/)

7 After extracting 579 papers published from 2021, including the impact of the COVID-19 pandemic, through a keyword search on June 5, 2024, I narrowed them down by title, abstract, and text, selecting 60 academic papers on clean cooking in African countries. I checked only papers that could be viewed free of charge, and read the text of paid papers to the extent that they could be viewed on the web.

8 The 60 academic papers consisted of 17 in 2021, 16 in 2022, 17 in 2023, and 10 in 2024 (as of June 5), indicating the possibility of an increase in 2024 and beyond.

Eight countries were each included in five or more papers: Ethiopia (14 papers), Ghana (11), Kenya (11), Rwanda (seven), South Africa (seven), Cameroon (six), Mozambique (six), and Nigeria (six).

Among energy source solutions for support in the eight countries, many papers focused on LPG, electricity, charcoal, biogas, and biochar in that order (Table 1). The order remains unchanged even when all countries in Africa are covered. Papers on other solutions (determinants, etc.) found that household income, householders' education levels, and gender were determinants of cooking energy sources and equipment.

Table 1 Number of papers published in 8 representative countries on support for clean cooking penetration (by country and by energy source for support)

Solution	LPG	Electricity	Charcoal (improved stoves)	Biogas	Biochar	Others (determinants, etc.)	Total
Ethiopia	1	6	3	3	0	1	14
Ghana	7	1	2	0	0	1	11
Kenya	6	0	3	0	0	2	11
Rwanda	5	0	2	0	0	0	7
South Africa	1	2	0	1	0	3	7
Cameroon	4	1	0	1	0	0	6
Mozambique	2	1	1	0	0	2	6
Nigeria	2	1	0	0	0	3	6
Total	28	12	11	5	0	12	68

Source) Extracted by the author from ScienceDirect

Note) When one paper covers multiple solutions and countries, each solution or country is counted as one.
Biochar, though used only in Senegal, is left as a support measure.

4. Features of Solutions to Support Clean Cooking Penetration

The IEA report and academic papers indicate that the current solutions to support clean cooking penetration have the following characteristics:

1) Regarding the definition of clean cooking, both the IEA and academic papers recognize that clean cooking includes not only cooking equipment that uses solar, wind, and other zero-emission electricity, but also equipment that uses LPG. In addition, especially in rural areas, the use of improved stoves using charcoal as a transitional energy source is included in clean cooking.
2) As a solution to support clean cooking penetration, the overwhelming majority of the academic papers in 3. above cite LPG. One of the main reasons for this is that solar, wind, and other on/off-grid electricity, though effective for lighting and mobile phone charging applications, is still expensive for cooking applications.
3) Despite the global trend in which subsidies for fossil fuels are regarded as environmental evils, as well as many European governments and companies participating as clean cooking supporters in the IEA Summit in 2. (2), there is a tendency to endorse LPG subsidies in the household sector in sub-Saharan countries. According to the IEA, this is because the use of LPG has a smaller burden on the environment than methane emissions or deforestation.

5. Conclusion

This paper confirmed that support for the penetration of clean cooking in Africa is attracting much attention, mainly in Europe, as indicated by the latest G7 and IEA trends. It found that the IEA report and academic papers published after the outbreak of the COVID-19 pandemic identify the proactive household use of LPG, especially in sub-Saharan African countries.

Support for the penetration of clean cooking is an extremely important humanitarian challenge. However, it is not difficult to imagine that the support is not only for spreading clean cooking but also for securing natural gas and critical minerals as well as African business opportunities for developed European countries. For example, natural gas reserves total 200Tcf in Nigeria and

100Tcf in Mozambique.[9] South Africa accounts for 70% of the global production of platinum, a critical mineral.[10] There is a possibility that new natural mineral resources will be discovered in African countries in the future.

Why don't the Japanese government and companies consider the enhancement of support for clean cooking penetration as an international assistance measure to complement investment and loans that contribute to the economic development of countries in Africa, Asia, Latin America, and other regions? Although it may not be easy to build supply chains in other countries, the support for clean cooking penetration may become a new business opportunity for LPG business operators. At the abovementioned IEA Summit, the IEA sought to "Make 2024 a Turning Point for Clean Cooking."

9 https://oilgas-info.jogmec.go.jp/info_reports/1009226/1009412.html
10 https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions

IEEJ Energy Journal Vol. 19, No. 4 2024

Editor: Yoshihiko Omori

Publisher: The Institute of Energy Economics, Japan

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