Position Paper 2024

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Kiko Network

Synthetic methane is greenwashing

Increases public costs, is not consistent with 1.5°C target

Summary

Japan is currently considering injecting synthetic methane into city gas (a type of natural gas that is supplied to homes in urban areas in Japan. Its main component is natural gas or methane.) as a means of moving toward carbon neutrality by 2050. However, the reality is that synthetic methane should not be considered an effective technology to achieve carbon neutrality, and it does not merit the allocation of significant resources. Synthetic methane comes with the following issues.

1. Problems with feedstock: Carbon dioxide (CO_2)
2. Problems with feedstock: Hydrogen (H_2)
3. Difficulties with CO_2 re-capture during synthetic methane use
4. High costs
5. Long lead time to develop the technology
6. Problems with energy security

To mitigate the problem of climate change, the world must transition away from fossil fuels as quickly as possible. If support is given to synthetic methane, major CO_2 emitters may use "carbon recycling" as a pretext to neglect serious efforts to reduce CO_2 emissions, with the result being the worsening of climate change. Promoting synthetic methane as being "decarbonized" or "carbon neutral" is equivalent to greenwashing.

Japan is showing an aggressive stance toward the promotion of synthetic methane. One example is its inclusion in the provisions of the Hydrogen Society Promotion Act, which among other things aims to compensate for price differentials versus other fuels. If large sums are dedicated to synthetic methane, the public burden will increase. Does this technology, which is ineffective as a measure to address climate change, really merit the allocation of precious funds, societal resources, human resources, and institutional/regulatory infrastructure?

What we really need are powerful actions to reduce emissions and a strong shift toward renewable energy. We call on all stakeholders to devote their resources, human resources, and efforts toward institutional improvements to this end.

1. What is synthetic methane?

Synthetic methane is attracting increasing attention as a means of decarbonization[1 2]. This is a form of methane (CH_4) artificially produced mainly from hydrogen and CO_2 (by the Sabatier reaction)[3]. Innovative technologies such as the manufacture of synthetic methane from water and CO_2 are also being considered.

As described below, CO_2 as a feedstock to produce synthetic methane is to be recovered from the industrial and power generation sectors. Additionally, the use of feedstock from low-carbon processes is also being studied for hydrogen.

In Japan, the injection of synthetic methane into city gas lines is being considered as a method to decarbonize the heating sector.

The government states in its 6th Strategic Energy Plan that its aim for 2030 is to inject 1% synthetic methane into existing infrastructure to make the gas 5% carbon-neutral, and for 2050, to inject 90% synthetic methane to make gas fully carbon-neutral (both in combination with other measures)[4]. The gas industry aims to achieve carbon neutrality by 2050 by injecting 1% e-methane (see next section) into city gas pipelines by 2030, replacing 90% of city gas with synthetic methane by 2050, and for the final 10%, to use biogas and other means (CCU/CCS, Carbon-neutral LNG (CNL), credits for overseas contributions on decarbonization, direct air capture with storage (DACCS), afforestation)[5].

In the Act on Promotion of Supply and Utilization of Low-Carbon Hydrogen and its Derivatives for Smooth Transition to a Decarbonized, Growth-Oriented Economic Structure (commonly known as the Hydrogen Society Promotion Act) enacted in May 2024, synthetic methane is categorized under

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1 The Japan Gas Association refers to synthetic methane produced from non-fossil energy “e-methane.” It says that in the future, green hydrogen will be used, and during the transition, blue hydrogen (produced from natural gas, with CO_2 generated in the process being captured and stored underground). https://www.gas.or.jp/gastainable/e-methane/, https://www.gas.or.jp/newsrelease/20221122.pdf

2 In its “Carbon Neutral Challenge 2050 Action Plan” in 2022, the Japan Gas Association switched from the use of the term “carbon neutral methane” when referring to synthetic methane.

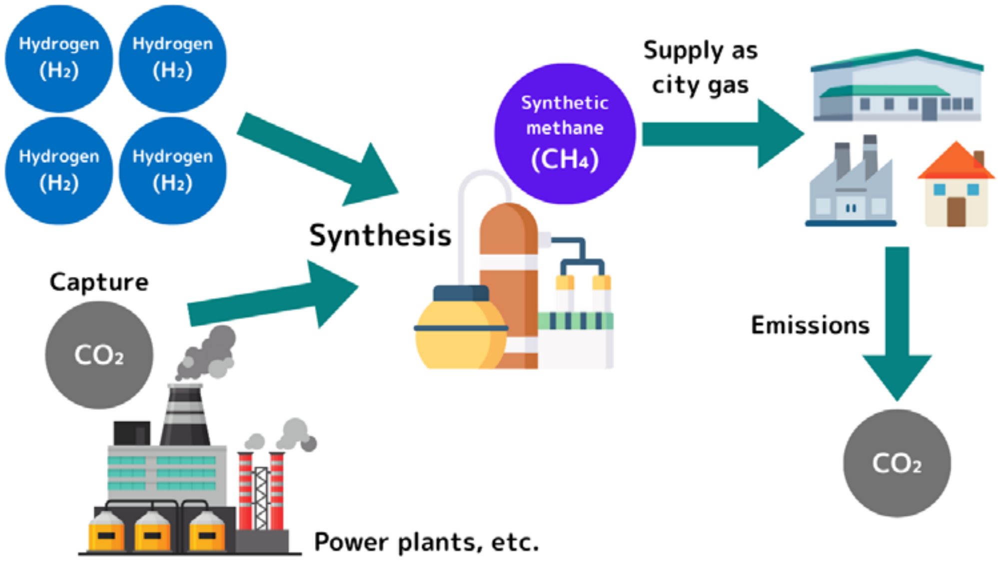
3 Various synthesis methods other than the Sabatier reaction are referred to as “innovative methanation,” but not discussed here because of the long path ahead before they can find practical applications.

4 A 1% injection mix of synthetic methane by 2030 would require 280,000 tons per year, and 90% by 2050 would require 25 million tons per year. https://www.enecho.meti.go.jp/about/special/johoteikyo/methanation.html

5 Japan Gas Association, “Carbon Neutral Challenge 2050 Action Plan.” https://www.gas.or.jp/gastainable/CNAP/CNAP.pdf

"hydrogen and its derivatives (assumed to be ammonia, synthetic methane, and synthetic fuels) as specified by ordinance of the Ministry of Economy, Trade and Industry (METI)[6]."

Figure 1: The flow from production to use of synthetic methane



Source: Prepared by Kiko Network based on Agency for Natural Resources and Energy materials

2. Is synthetic methane carbon neutral?

Synthetic methane can only be called "carbon neutral" if the processes from production of feedstock to transportation and use achieve net zero greenhouse gas emissions. Synthetic methane as it is currently being considered in Japan does not meet this requirement. Therefore, if synthetic methane is advertised as being carbon neutral or statements are made that carbon-free alternative to natural gas, it would currently be considered greenwashing (a public relations tactic that misleads consumers and aims to enhance corporate and product image by claiming to have environmental features but does not reflect actual conditions)[7].

The Japan Gas Association actually labels synthetic methane produced from non-fossil energy as "e-methane." However, it is not so easy to distinguish between synthetic methane and "e-methane." For example, the terms are often used together as "synthetic methane (e-methane)" in materials from an advisory council under the METI. This becomes even more difficult to comprehend for hydrogen

6 Subcommittee on Hydrogen and Ammonia Policy. https://www.meti.go.jp/shingikai/enecho/shoene_shinene/suiso_seisaku/pdf/014_01_00.pdf

7 Kiko Network (Brochure) "What is Climate Greenwashing?" https://kikonet.org/content/32015

and ammonia, which are differentiated by assigning colors such as green and blue. Lumping everything together under the label of “e-methane” makes it very difficult for the demand side to determine how the synthetic methane is made, what kind of hydrogen and CO_2 it is made from, and whether it really has reduced impacts on the environment. This is a significant issue. For example, even if the CO_2 is derived from coal-fired power generation, if that feedstock is used to produce synthetic methane, demand-side stakeholders will be unable to determine its origin.

Exactly what kind of synthetic methane is considered “e-methane”? This needs clear definitions and standards.

The following sections examine the problems with the claims that synthetic methane is an effective method to address climate change.

(1) Problems with feedstock: Carbon dioxide (CO_2)

We begin with the problems with CO_2 as a feedstock. It is assumed that CO_2 emitted in the power generation and industrial sectors will be recovered. This is referred to as carbon recycling. At first glance, this may appear to be good for the environment, but there are many problems in relation to mitigating climate change.

- When synthetic methane is produced from CO_2 captured at a thermal power plant or factory, the maximum possible recovery rate is 90%, but 60-70% is considered more realistic. This means that not all CO_2 can be recovered. It is therefore incorrect to assert that capture and re-use mean atmospheric CO_2 does not increase.
- Large emitters may be tempted to use the pretext of CO_2 resource recycling for synthetic methane as an excuse to avoid fundamental efforts to reduce CO_2 emissions.

For synthetic methane to be truly carbon neutral, it must be produced using green hydrogen generated using renewable energy and CO2 directly captured from the atmosphere (not from exhaust gases). However, direct air capture (DAC) technology is expensive and takes a long time to use in large-scale commercialization. It is not likely to be a reality any time soon.

With synthetic methane, there is great risk that the pretext of carbon recycling will be used to justify not making the efforts required to reduce CO_2 emissions on the emitter side. Claims that synthetic methane is good for the environment while failing to take fundamental actions to reduce emissions would fall into the realm of greenwashing.

Furthermore, the use of CO_2 as feedstock for synthetic methane blurs responsibility for the original CO_2 emissions, making it unclear who was the original emitter. This is why it is sometimes criticized as “CO_2 laundering”.

⑵ Problems with feedstock: Hydrogen (H_2)

Hydrogen is required as feedstock for methanation by the Sabatier reaction, a conventional technology. Hydrogen is generally classified by “color” as gray, blue, green and others depending on differences in the production process[8], but of these, only green hydrogen emits no greenhouse gas during the production process.

Table: Types and features of main hydrogen and ammonia production methods, by color

Color	Feedstock	Production method	CO2 emissions	Current cost	Issues
Gray	Fossil fuels (coal, natural gas, oil)	Combustion / gasification	High	About 100 yen/m3 (hydrogen station) 97 yen/kWh (hydrogen power generation)	High CO_2 emissions
Brown	Coal	Combustion / gasification	High	Same as gray	High CO_2 emissions
Blue	Fossil fuels (coal, natural gas, oil)	Combustion/gasification (+CCS)	Low to medium (impossible to bury in ground)	Gray + CCS cost	No suitable sites for CCS Limited even if found Future leakage risk, etc.
Yellow	Water	Nuclear electrolysis	Low (not zero)	Unknown	Nuclear power risks Nuclear dependency
Green	Water	Renewable energy electrolysis	Low	5-10 times gray?	Not suited to large-scale production High cost

Source: Prepared by Kiko Network based on Japan Beyond Coal Fact Sheet. - “Hydrogen and ammonia fuels: An option that is not a solution.”

However, due to costs and other factors, the initial emphasis in Japan is on the use of blue hydrogen for synthetic methane production[9][10]. Below are some of the main problems with blue hydrogen.

8 Gray hydrogen is produced from natural gas, blue hydrogen is produced from natural gas but also involves storing underground of CO_2 generated during the production process, and green hydrogen is produced by electrolysis of water using renewable energy.

9 The Japan Gas Association says that “during the transition, we will use blue hydrogen and other technologies to expand the use of e-methane, and in the future we will use green hydrogen produced from electricity derived from renewable energy (electro).” https://www.gas.or.jp/gastainable/e-methane

10 The Hydrogen Society Promotion Act formulated by the Japanese government also defines low-carbon synthetic methane as “about 70% reduction in the hydrogen production portion compared with fossil fuel-derived gray hydrogen,” which is thought to assume hydrogen that takes into account the CO_2 recovery rate by CCS, that is, blue hydrogen. https://www.meti.go.jp/shingikai/enecho/shoene_shinene/suiso_seisaku/pdf/014_01_00.pdf

- Blue hydrogen may be less costly than green hydrogen, but its production still involves significant costs.
- Since it is produced from fossil fuels, it is necessary to store CO_2 generated in the manufacturing process underground. However, not all CO_2 can be recovered at the point it is generated, and the possibility of leakage during delivery to the storage site cannot be ruled out. In addition, availability of suitable CO_2 storage sites is limited. Furthermore, since there is a risk of leakage even after storage, long-term monitoring is required.
- Transportation from manufacturing sites (mainly overseas) is costly, and shipping also emits CO_2. Energy is also required for extremely low temperature storage at domestic terminals and for delivery to the point of use.
- Additionally, because blue hydrogen is difficult to produce domestically, Japan would ultimately have to rely on imports, making it an incompatible solution in terms of energy security.

It is worth noting that during the carbon capture and storage (CCS) stage of blue hydrogen production, there is also a historical context in which injecting CO_2 into the ground has been used to facilitate crude oil recovery[11] [12]. In other words, it must be recognized that CCS is part of the fossil industry's business model and may actually increase dependency on fossil fuels. Given this, synthetic methane cannot be described as carbon neutral when blue hydrogen is used.

Green hydrogen is likely to be produced overseas where renewable energy can be supplied at low cost, but even so, costs are high. Since the synthesis of methane requires four times the hydrogen per unit volume of methane, experts have pointed out that even if a hydrogen cost target of 30 yen/Nm^3 is achieved by 2030, the feedstock cost of just the hydrogen for producing synthetic methane would be 120 yen/Nm^3. [13]

(3) Difficulties with CO_2 re-capture during synthetic methane use

Even if synthesized methane is produced using captured CO_2, again CO_2 is generated when the synthetic methane is combusted by the user. If synthetic methane is injected into city gas pipelines, it is extremely difficult to recover all the CO_2 emitted (from gas consumption), especially in the residential and commercial sectors, and in small- and medium-sized factories. In practice, this would mean that a large amount of CO_2 would be released into the atmosphere. The same is true for usage of synthetic methane in ships and aircraft. Therefore, synthetic methane produced from fossil fuel will not

11 IEEFA, "The carbon capture crux: Lessons learned." https://ieefa.org/resources/carbon-capture-crux-lessons-learned

12 CCS Redux: "Best" Carbon Capture Facility in World Creates 25x More CO_2 from Use of Product https://cleantechnica.com/2024/02/15/ccs-redux-best-carbon-capture-facility-in-world-creates-25x-more-CO_2 -from-use-of-product/

13 Japan Renewable Energy Institute "Synthetic methane with large energy loss and no contribution to carbon neutrality." https://www.renewable-ei.org/activities/column/REupdate/20230301.php

reduce CO_2 emissions over its life cycle.

Furthermore, if synthetic methane is manufactured overseas, CO_2 would be expected to be captured on-site locally, so that would not lead to domestic CO_2 recycling in Japan.

(4) High cost

Synthetic methane could be described as very expensive. The cost of synthetic methane is expected to be around 40 to 50 yen/Nm^3 by 2050 (roughly equivalent to the current import price of LNG)[14], and the supply cost of synthetic methane is estimated to be around 130 to 145 yen/Nm^3 in 2030[15] [16]. It is questionable whether enough hydrogen, which is expected to be used in hard to abate sectors, could be obtained in a competitive international context to be diverted to the production of synthetic methane.

The Hydrogen Society Promotion Act, enacted by the government in May 2024, includes provisions for synthetic methane under “hydrogen, etc.” Although this legislation includes measures to support price differentials relative to existing fuels (fossil fuels), there is some concern that if synthetic methane receives government support, it would mean dual subsidies (for both hydrogen and synthetic methane).

In addition, to achieve the target of 1% synthetic methane injection into existing infrastructure by 2030, regulations and frameworks to achieve short-term targets (around 2030) would be needed. This has led to consideration of a Wheeling Charge system[17]. The proposition is to use distribution charges to recover synthetic methane’s higher procurement costs, but as mentioned above, the cost of synthetic methane (still at the demonstration stage) is very high compared to existing fuels. This means that an attempt to introduce synthetic methane would mean an increased cost burden on consumers. A working group studying the matter also pointed out that unless costs go down, an injection rate of synthetic methane at about 5% could mean an increase of about 10% in wheeling charges.

Is synthetic methane really worth such increases in cost for the public?

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14 “Green Growth Strategy for Carbon Neutrality by 2050” https://www.meti.go.jp/press/2021/06/20210618005/20210618005.html

15 6th Meeting of the Green Transformation Promotion Subcommittee, Industrial Technology and Environment Subcommittee, Industrial Structure Council / Basic Policy Subcommittee, Advisory Committee for Natural Resources and Energy Joint Meeting https://www.meti.go.jp/shingikai/sankoshin/sangyo_gijutsu/green_transformation/pdf/006_01_00.pdf

16 Report of the Study on Measures to Advance the Energy Supply and Demand Structure of FY2021 (commissioned Study on the State of CO_2 Counting, etc., with a focus on methanation). https://www.meti.go.jp/meti_lib/report/2021FY/000671.pdf

17 Gas Industry Institutional Review Working Group, Electricity & Gas Basic Policy Subcommittee, Advisory Committee on Natural Resources and Energy. https://www.meti.go.jp/shingikai/enecho/denryoku_gas/denryoku_gas/gas_jigyo_wg/pdf/036_04_00.pdf

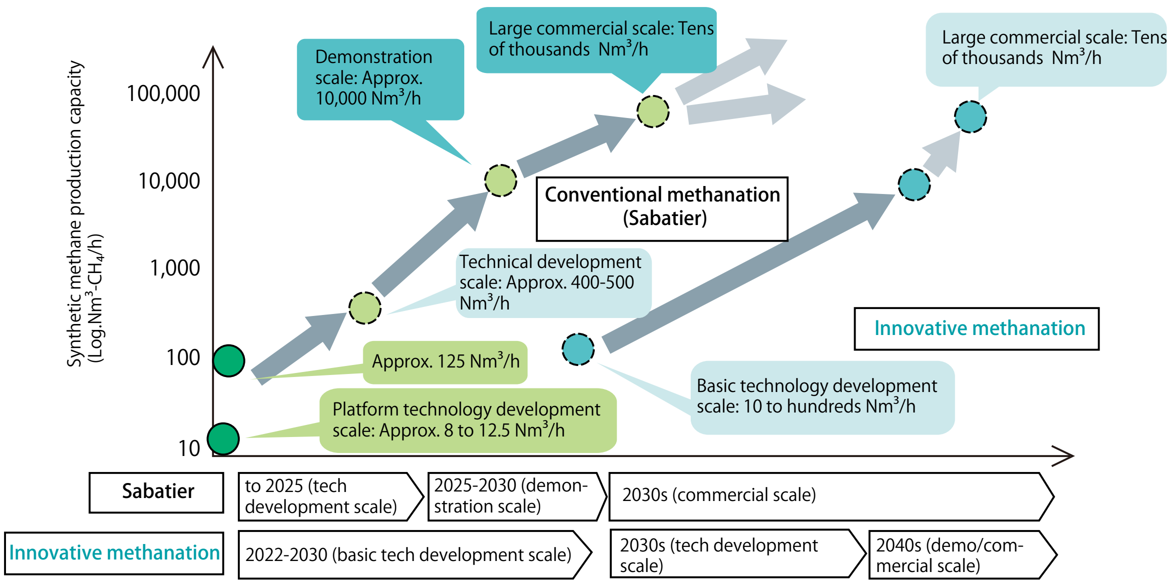
(5) Problems with technology development and lead times: Large-scale applications are still far off in the future

Many of the key conditions required for large-scale synthetic methane production are still at the demonstration stage, whether it is CO_2 recovery, the production of blue hydrogen as feedstock, or the production of synthetic methane from the feedstock. It is anticipated that commercialization of synthetic methane will be achieved by the Sabatier reaction in the 2030s, and by innovative technologies in the 2040s, but quantities for both of these would be far from enough to replace conventional city gas (see Figure 2 below).

Waiting for these technical and financial hurdles to be resolved would simply mean further acceleration of climate change. Experts say that the next decade is crucial in the battle to achieve the 1.5°C target, so the world does not have the luxury of waiting for the technology to be ready.

Looking at current policy on synthetic methane, one gets the impression that synthetic methane is being used as a pretext for the continued use of existing fossil fuel infrastructure. Promoting synthetic methane means that low-cost, effective and more reliable emission reduction measures will not move ahead, and if the development of synthetic methane does proceed in the ways anticipated, the reliance on fossil fuels in the heating sector will remain high.

Figure 2: Roadmap for methanation technology development



Source: Prepared by Kiko Network based on Agency for Natural Resources and Energy.

(6) Problems with energy security

To secure large and low-cost quantities of synthetic methane, Japan would have to import synthetic methane produced overseas. In that case, it will be necessary to find suitable sites that can produce low-cost hydrogen, are close to sites that produce CO_2 emissions, and have LNG plants for liquefaction and transport. The United States, Australia, countries in the Middle East, China, India, and other countries could be considered suitable locations, but they would raise energy security issues, depending on conditions overseas.

In addition, we must not forget that when importing from overseas, a large amount of energy is required for liquefaction and transport.

3. Hydrogen Society Promotion Act: Supporting greenwashed technology?

So far, this paper has confirmed that there are many problems with synthetic methane. Nevertheless, legislation to financially support this synthetic methane was passed in May 2024 in the form of the Hydrogen Society Promotion Act[18].

The Hydrogen Society Promotion Act establishes a “low-carbon” standard for hydrogen and its derivatives including synthetic methane. According to the standard, synthetic methane can be considered low-carbon if the carbon intensity of the entire supply chain is equal to 49.3 g-CO_2e/MJ or less.

This standard figure is a base value for the entire supply chain, with a reduction of about 70% compared to the production of hydrogen from fossil fuels (gray hydrogen) as feedstock, and includes energy used for methane synthesis and transport. The carbon intensity of 49.3 g-CO_2e/MJ is about 70% that of natural gas[19]. It is problematic to be considering fuels that have not achieved significant CO_2 emission reductions as being “low-carbon” and to be promoting them, because it delays the realization of a decarbonized society.

In addition, as mentioned in relation to the problem of costs, to cover synthetic methane’s higher costs relative to natural gas (see figure below) legislation stipulates that the government is to provide financial support from taxes through the Japan Energy and Metals National Corporation (JOGMEC).

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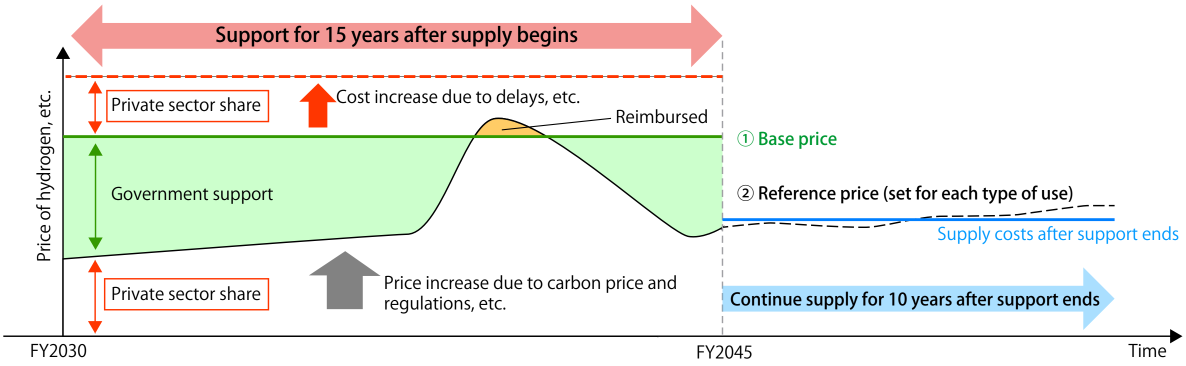
18 Subcommittee on Hydrogen and Ammonia Policy. https://www.meti.go.jp/shingikai/enecho/shoene_shinene/suiso_seisaku/PDF/014_01_00.PDF

19 CCR Study Group, “Study on Carbon Intensity of Synthetic Methane (e-methane).” https://www.meti.go.jp/shingikai/energy_environment/methanation_suishin/PDF/012_05_01.PDF

Figure 3: Concept of support system to address price differentials



Source: Subcommittee on Hydrogen and Ammonia Policy, "About the Hydrogen Society Promotion Act"

The system is intended to compensate for the differential between the reference price of natural gas, the existing fuel, and the strike price of synthetic methane, for a period of 15 years, but the high cost of synthetic methane is as mentioned above. This strike price can be calculated by the business operator, rather than by an independent body. All costs can be included, including feedstock development projects, as well as construction, electricity, fuel, consulting, and labor costs, etc. If this is the case, it is difficult to dispel concerns that public costs will be inflated by the prices set by companies.

Even more problematic, although there are standards for carbon intensity, support is not conditional on meeting these standards. Two evaluation categories (support focusing on price differentials, and support for hub development) are the basis for subsidies under the Hydrogen Society Promotion Act, but with wording such as "relatively low carbon intensity," the only conditions stated are ambiguous, and there is no requirement to meet low-carbon standards. The level of the "low-carbon" standard figure is also low, but even this standard is not a mandatory for businesses and the requirements is very lax.

This legislation, which can only be described lenient for businesses, needs to be reviewed as soon as possible.

4. Summary

Industry groups and advocates say that they have been lobbying for many things, including exemptions from customs duties; exemptions from Japan's Petroleum and Coal Tax; exclusion from the application of fossil fuel levies; exemptions for users from carbon pricing in the SHK system (a system of GHG emissions accounting, reporting, and disclosure under Japan's Act on Promotion of Global Warming Countermeasures) regardless of place of production and whether or not hydrogen and CO_2 are used as feedstock; and consideration of e-methane as being carbon-neutral under the Greenhouse Gas Protocol[20]. However, as described above, e-methane is not actually carbon neutral.

Despite so many unresolved issues, significant funds are being allocated through various programs, and efforts are underway seeking to have synthetic methane accepted under international rules. However, it is difficult not to feel skeptical about all of this.

The introduction of synthetic methane into the city gas supply would involve significant volumes of feedstock, and it would be very costly. Besides increasing public costs, it is expected that CO_2 and hydrogen as the feedstock for synthetic methane will be derived from fossil fuels. On top of that, CO_2 is difficult to capture at the time of use. Synthetic methane should not be considered carbon neutral and should not be promoted. Proponents should stop using synthetic methane as a pretext for the utilization of CO_2, and instead prioritize drastic reductions in CO_2 emissions.

The underlying principle is that no matter what path forward is considered, there is no escaping the need for a significant amount of renewable energy in Japan. Basically, it is essential to promote electrification with renewable energy, and in sectors where electrification is difficult, to the extent possible, policies and measures should be adopted to use green hydrogen produced in Japan.

Synthetic methane may be useful in industrial sectors that require high-temperature heat, but in such cases, companies should make the greatest possible effort to re-capture any CO_2 emitted after use. In addition, regulations should be established to limit feedstock to green hydrogen produced using CO_2 derived from biomass or captured directly from the atmosphere (DAC), and from surplus electricity generated from renewable energy, so that only synthetic methane that does not negatively impact the environment is being distributed[21].

The use of synthetic methane should be explicitly excluded from the power generation sector where renewable energy, which is the real decarbonization technology, is well established. With regard to the use of low- to medium-temperature heat in the residential and commercial sector and industrial sector, it is important to take measures to promote electrification rather than the use of gas. The greatest possible use of biogas and biomethane, which are being promoted in Europe and North America more than synthetic methane, is desirable because their use has the potential to contribute to the reduction of regional waste while also reducing greenhouse gas emissions[22].

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20 Japan Gas Association, "Necessary institutional measures for social implementation of e-methane (SHK system, tax system, etc.)." https://www.meti.go.jp/shingikai/energy_environment/methanation_suishin/kokunai_tf/pdf/004_03_02.pdf

21 However, it is necessary to fully recognize that there are issues with both biomass and DAC.

22 Japan Renewable Energy Institute, "Practical use of Biogas and Green Hydrogen Scope 1 Reduction Effects and challenges." https://www.renewable-ei.org/activities/reports/20231214.php

Rather than starting with the assumption that synthetic methane is one of the solutions, Japan should fundamentally reconsider the best approach to energy supply and implement policies from a long-term perspective to protect people’s lives from climate change.

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