MHI: The wrong kind of transition

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Ammonia co-firing, in which ammonia 'dilutes' coal during power generation, forms an important part of Japan's transition plan for net-zero[1]. The technique is regularly included as a 'use-of-proceeds' by issuers of transition bonds - debt instruments developed to support companies' moves towards an improved environmental impact.

With the news that Japan's Mitsubishi Heavy Industries (MHI) has just launched a transition bond (MITHI 0.31 09/27, ISIN JP390000AN97) that includes ammonia co-firing among its potential uses, we revisit the transition bond label in this context.

Our view is that there is a significant risk for investors in transition bonds that ammonia co-firing will not reduce emissions but rather prolong and lock-in the use of coal plants. Recent research has stressed that to have a positive impact on carbon emissions, co-fired ammonia must be delivered using green hydrogen throughout the production cycle. Yet there is a global lack of technical capacity to produce ammonia based on renewables.

We encourage investors to engage specifically around the accounting of upstream emissions, when looking at these 'transition' proposals. Japan is the world's fifth biggest GHG emitter and currently generates more than 30% of its electricity with coal.[2] The country is expected to raise up to YEN20trn in a government transition bond at some point in the future.[3] While the forthcoming MHI deal is expected to be small at around YEN10bn (~USD75mn), investor engagement now could help to improve future issuances at a much larger scale by ensuring solid credentials.

Furthermore, we would advise against providing bond-related documentation with diverging meanings on key terms between different language versions. "Coal-fired power" should not translate into "steam power" when going from Japanese to English, as is the case in the second-party opinion on the MHI transition bond.[4]

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[1] "Japan's roadmap to 'Beyond Zero' carbon", Japan government web-page, accessed 6 Sep 2022.
[2] We note that there are important strategic considerations on energy going on in the country right now, c.f. "Japan turns back to nuclear power in post-Fukushima shift", Financial Times, 24 Aug 2022, which further strengthens the opportunity for investors to engage.
[3] "Japan lays out plan to issue $157 bn in 'green transition' bonds", Reuters, 19 May 2022.
[4] For the avoidance of doubt, AFII is not providing legal advice. The statement is based on issuers' likely need to maintain good relations and trust with investors. In our experience, altering the meaning of documents in different language versions is not conducive to that.

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Ammonia co-firing: unlikely to reduce GHG emissions

According to IRENA[5], "the ammonia production industry produces annual emissions of 0.5 gigatonnes (Gt) of carbon dioxide (CO_2), representing around 1% of global CO_2 emissions and 15-20% of the chemical sector's CO_2 emissions." Making green ammonia remains a technological challenge. All raw materials, including the energy used, must be renewable for ammonia to be truly "green".

Researchers have found that "without policy settings that ensure emissions are accounted for across the supply chain, the co-combustion of ammonia could result in little to no benefit in reducing global greenhouse gas emissions."[6] Only the use of expensive carbon capture technologies (CCS) or renewable electricity use for hydrogen production yields a substantial reduction in GHG emissions across the supply chain.[7] CSS in particular appears to encounter technological difficulties, making a cost-efficient achievement of 100% capture unlikely in the foreseeable future.[8] It seems reasonable that any downstream power generation – such as the case in ammonia use – should factor in the probability of the technology not being available when looking at upstream carbon emissions.

According to energy research company Wood Mackenzie, the assumption behind cost-effective ammonia co-firing[9] is that green ammonia becomes cost competitive soon enough to achieve a viable alternative and this assumption is in turn based on a high carbon price. It requires that the investment planned to ramp up production will be sufficient to deliver the quantities needed to meet global demand and that Japan will maintain enough supply from far-away sources (such as Australia, Canada, Chile and the Middle East). It also requires that other, more immediate uses of green ammonia (e.g., shipping, fertilizers) will leave a sufficient supply for co-firing purposes.

Another risk factor is that ammonia co-firing is successful in its stated intention to prolong the life span of coal plants - so called 'lock-in' effects. There will be capital expenditure on combined plants and, if the ammonia reductions fail to materialize, what will remain are refurbished coal plants. This is a clear downside risk to investors, especially those with "no-coal" funding restrictions.

Lastly, investors should recognize Japan's important role in terms of the energy transition across South Asia, both in terms of providing technology and manufacturing capacity as well as in terms of funding. Our view it that the track record is not consistent,[10] and investors should seek out better climate alignment going forward. A push for ammonia together with coal runs the risk of crowding out renewable power development and funding, even in areas where the latter might be better suited.[11]

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[5] "Innovation Outlook: Renewable Ammonia", IRENA, May 2022.

[6] "Global emissions implications from co-combusting ammonia in coal fired power stations: an analysis of Japan-Australia supply chain", Journal of Cleaner Production 336:130092, December 2021,

[7] CCS technology is lagging and among the carbon capture technologies of today, most CO_2 is used for enhanced oil recovery, see "The carbon capture crux: Lessons learned", IEEFA, 1 Sep 2022.

[8] For example, there has been recent pursuits of litigation around the use of CCS – a requirement for making carbon-reductive ammonia viable – in Australia: "Australasian Centre for Corporate Responsibility expands landmark Federal Court case against Santos", ACCR web-site, 25 Aug 2022.

[9] "Ammonia co-firing in power plants could be worth $100bn in 2050", EnergyVoice, 18 May 2022.

[10] "The Reformed SSA Trader: 'Be aware of' ideas of March", AFII, 21 Mar 2021, discusses JICA funding of development of coal in Bangladesh, and JBIS's funding of the Vung An II coal expansion in Vietnam.

[11] See for example "Japan's IHI starts ammonia co-firing study in Indonesia", Argus, 25 Apr 2022.

Transition bonds in the Japanese market

According to a government statement, "Japan will strive for cooperative decarbonization across Asia by promoting joint demonstrations, international investment, and establishing standards for zero-emission technologies for biomass, hydrogen, ammonia, carbon capture, utilization and storage (CCS) and so forth, while utilizing the region's credit markets." [12]

The reference to technologies including ammonia and CCS, together with the outright mention of credit markets, indicate a desire by the Japanese government to use the transition bond label in forthcoming financings.

It is becoming clear to the bond market that ammonia co-firing will indeed play a central role. In Table 1, we highlight transition-labelled bond deals that have come in the Japanese Yen market to date. 2022 has brought a batch of deals where ammonia co-firing is included in the use-of-proceeds. Given purportedly successful results of recent trials on the technology,[13] this is not so surprising; one would expect a ramping up of finance to start running the technology at scale.[14]

Table 1. Issuance of transition bonds in Japan. Source: AFII, Bloomberg.

Issuer	Issuance	Size	Coupon	Maturity	Ammonia co-firing	ISINs
Government of Japan	TBD	JP20trn	TBD	TBD	TBD	TBD
Kyushu Electric Power Co.	May-22	JPY30bn	0.35%	5 years	Ammonia co-firing	JP324640AN50
Kyushu Electric Power Co.	May-22	JPY25bn	0.644%	10 years	Ammonia co-firing	JP324640BN59
Jera Co. Inc	May-22	JPY12bn	0.42%	5 years	Ammonia co-firing	JP338672AN51
Japan Airlines Co. Ltd.	Mar-22	JPY10bn	0.70%	5 years	No	JP370520AN33
Nippon Yusen Kaisha	Jul-21	JPY10bn	0.26%	5 years	Ammonia for vessels	JP375300AM70
Nippon Yusen Kaisha	Jul-21	JPY10bn	0.38%	7 years	Ammonia for vessels	JP375300BM79
Idemitsu Kosan Co. ltd.	Jul-22	JPY10bn	0.48%	5 years	Ammonia co-firing	JP314250AN78
Idemitsu Kosan Co. ltd.	Jul-22	JPY10bn	0.88%	10 years	Ammonia co-firing	JP314250BN77
JFE Holdings	Jun-22	JPY25bn	TBD	5 years	No	TBD
JFE Holdings	Jun-22	JPY5bn	TBD	10 years	No	TBD
Osaka Gas	TBD	JPY10bn	TBD	TBD	Natural Gas co-firing	TBD

Another perspective on the ammonia co-firing debate comes from GPIF, Japan's Government Pension Fund, which is one of the key investors in the domestic Yen market.[15] GPIF holds 26% of its total portfolio in Japanese domestic bonds. As the ESG reporting of GPIF is very extensive,[16] making use of abundant independent data to measure the GHG footprint of the four categories of its holdings across two axes, domestic/foreign and equity/bonds, GPIF gives considerable weight to the technologies expected to contribute to the reduction of GHG emissions by 2030 and 2050.

In GPIF's ranking of expected contributing technologies to carbon reduction, hydrogen/ammonia power generation does features among the 'top 10', see Figure 1. However, among the top 10, it is the technology with lowest expected implementation rate and total GHG reduction potential in 2050 (and a de minimis reduction expected in 2030). Of course, these rates do not appear out of a

[12] "Clean Energy Strategy to Achieve Carbon Neutrality by 2050", The Government of Japan, 23 Jun 2022.
[13] "Success" here refers to the capacity to actually burn ammonia together with coal; to our knowledge, these trials have not proven a full value-chain carbon reduction capacity.
[14] "JERA, IHI move up demonstration of co-firing ammonia at coal power plant", Reuters, 31 May 2022.
[15] According to Bloomberg, GPIF holds around 7.6% of the outstanding bonds of MHI, including its green bond discussed below.
[16] "ESG Report 2020", Government Pension Investment Fund, 30 Sep 2022.

vacuum: we would expect investor demand and engagement to be persistent to drive implementation rates to the expected numbers.

Figure 1. Top ten technology fields expected to contribute to GHG reduction by 2025 (in GPIF's portfolio). Source: GPIF.

Industries	Technology Fields	Present	2030			2050		
		GHG Emissions of Target Segment (a)	GHG Reduction Rate (b)	Implementation Rate (c)	GHG Reduction Contributions (a × b × c)	GHG Reduction Rate (d)	Implementation Rate (e)	GHG Reduction Contributions (a × d × e)
		billion tons	%	%	billion tons	%	%	billion tons
Energy	Hydropower energy, small and medium hydroelectric power generation	10.02	100%	65%	6.51	100%	65%	6.51
Chemicals	CCS from large emitters	8.00	90%	5%	0.36	90%	85%	6.12
Energy	Marine energy	6.64	100%	15%	1.00	100%	85%	5.65
Energy	Solar power generation, solar cells, solar thermal power generation	6.64	99%	50%	3.29	99%	85%	5.59
Energy	Bioenergy (power generation, fuel)	11.48	55%	15%	0.95	55%	85%	5.37
Telecommunications	Power semiconductors	7.27	71%	50%	2.58	71%	100%	5.16
Chemicals	Methanol production	8.83	65%	15%	0.86	65%	85%	4.88
Social Infrastructure	Power generation by anaerobic digestion of waste biomass	6.64	15%	15%	0.15	85%	85%	4.80
Energy	Green hydrogen	8.43	100%	0%	0.00	100%	50%	4.21
Energy	Hydrogen/ ammonia power generation	10.02	79%	5%	0.40	79%	50%	3.96

(Source) Prepared by GPIF based on Astamuse analysis

The MHI transition bond deal

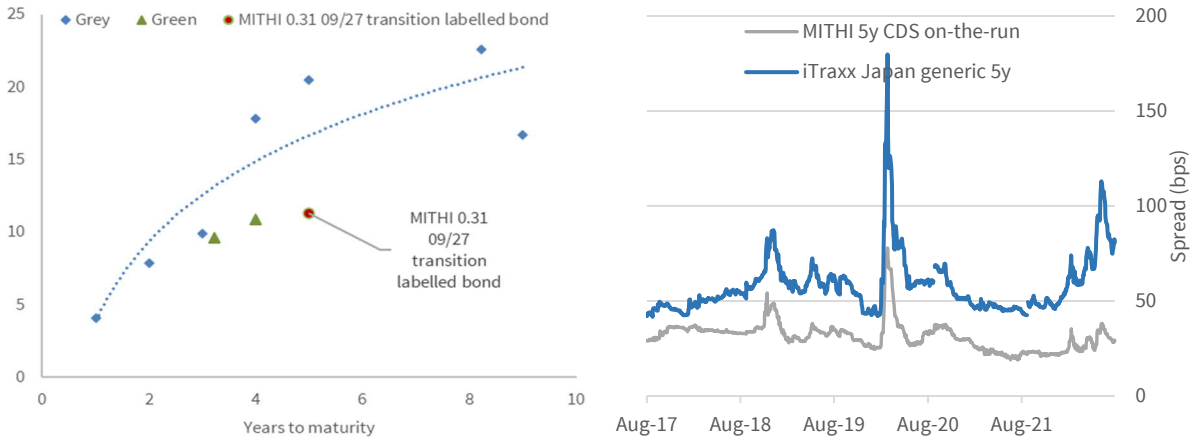
Mitsubishi Heavy Industries (MHI, corporate ticker: MITHI) is a multinational Japanese corporation, part of the Mitsubishi Group, and involved in aerospace, defence, energy, ship building and power generation. MHI is a regular issuer of corporate bonds in the Japanese markets and has ten bonds outstanding with maturities ranging from 2022 to 2031. It is rated at BBB+ by S&P and AA- by the Japan Credit Rating Agency (JCRA). It has no USD-denominated bonds outstanding currently, although its parent company, Mitsubishi Corporation, has issued several USD-denominated bonds, including the $500m 3.375% Jul-2024 bond (XS1086900898). MHI is a constituent of the current iTraxx Japan index (ticker: ITXAJ537, 40 members; MHI CDS trades under corporate ticker MITHI).

In Sep 2021, MITHI issued a JPY15bn 5-year 0.09% green bond to finance new or existing projects in the renewable energy or clean energy sectors, with a second party opinion provided by Sustainalytics. That bond as well as the earlier issued MITHI 0.14 11/25 (JP390000ALB7) appear in Figure 2 to price as a few basis points inside the grey curve. This is a potential indicator to the issuer of lower cost-of-capital being achieved through labelled bond issuance. Looking at the recently issued MITHI 0.31 09/27 transition-labelled bonds, this indeed seems to be the case, with the bond pricing almost flat (at z+11.3) to the shorter green bonds and significantly inside the almost identical grey MITH 0.33 08/27 (at z+20.5).

In the context of the national strategy's application for individual corporates, Mitsubishi Heavy Industries has set a 50% reduction of its Scope 1 and 2 emissions,[17] relative to 2014, and a 50% reduction of its Scope 3 emissions (customer Scope 1 and 2 emissions), relative to 2019, by 2030, plus a Net Zero target for Scope 1, 2 and 3 by 2040. It plans an investment of JPY180bn by 2023 to grow decarbonization projects.

[17] Refer to "What are Scope 1, 2 and 3 Emissions?", Persefoni, 13 Jun 2022, for a brief overview of Scope 1, 2 and 3 emissions. AFII discusses the central role of Scope 3 for carbon intensive firms in "SLB bond radar: Eni (potentially) coming to market", AFII, 19 Jul 2022.

Figure 2. MITHI bond curve and CDS. Source: AFII, Refinitiv, Bloomberg. Pricing as of 1 Sep 2022.



MHI's transition framework has received a second party opinion from DNV Japan (Figure 3), which has also provided a similar service to several of the other Japanese issuers of "transition" bonds. MHI will rely on ammonia co-firing in its coal thermal plants to achieve a substantial reduction in greenhouse gas emissions.[18]

To be clear, MHI has set a 2030 target of a 50% cut in its Scope 3 emissions "across MHI's value chain" to achieve 'net zero' by 2040.[19] Digging into the details however, we find that **when defining Scope 3 emissions, MHI states: "These targets include the reduction in emissions attributed to our customers' use of our products and services."**

This is not, from our perspective, aligned with the definition of Scope 3 emissions. According to the GHG Protocol: "Scope 3 emissions are all indirect emissions (not included in Scope 2) that occur in the value chain of the reporting company, **including both upstream and downstream emissions**."[20] MHI seems to avoid accounting for the upstream GHG emissions of its ammonia co-firing upgrades.

This is in line with an earlier transition bond from JERA, that includes ammonia co-firing in its use-of-proceeds (see Table 1, and the comments from the Climate Bonds Initiative: "the production of ammonia and hydrogen both require high levels of energy and release CO_2, all while there is no commitment from JERA to only use green ammonia or hydrogen.")

As highlighted above, the questions to be raised around ammonia co-firing relate to how it is produced. Green ammonia is expensive to produce and subject to high levels of competition from other buyers: ship operators, the agricultural sector, et cetera. If upstream emissions are not accounted for in terms of use-of-proceeds or GHG accounting, then the choice between green or grey ammonia may become a simple cost basis one. Everything else equal, this makes it more likely that MHI will choose to use fossil fuels-based ammonia as the company potentially would be able to do so without reneging on its 'net zero' target.

[18] "JERA and MHI Start a Demonstration Project to Develop Technology to Increase the Ammonia Co-firing Rate at Coal-fired Boilers", MHI website, 7 Jan 2022. "MHI Commences Feasibility Studies on Use of Ammonia for Power Generation in Indonesia", MHI website, 7 Jun 2022.
[19] "Mission net zero: MHI sets bold targets to achieve carbon neutrality by 2040", MHI website, 29 Oct 2021.
[20] "Greenhouse gas protocol: FAQ", GHG protocol website, undated.

Could it be that the above discrepancy on upstream Scope 3 emissions is based on a simple oversight? We find that unlikely, given the similarity with the JERA case. But to give the benefit of a doubt to MHI's transition bond, we note that coal thermal power is referred to as "steam power" in the English version of the SPO but as "coal-fired power" in the Japanese-language version (highlighted in the figure). If such mistakes appear on simple terminology, perhaps missing on the upstream Scope 3 measurement is not so surprising.[21]

Figure 3. MHI use-of-proceeds for green and transition bonds, English and Japanese language versions. Inconsistencies in "Steam power" (English version) and "Coal-fired power" (Japanese version) highlighted. Google translation at the bottom. Source: DNV second opinion, Google translate. Accessed 2 Sep 2022.

Table 1: Green Projects*1

Eligible Businesses and/or Projects	Eligibility Criteria
Renewable energy	· Wind power (wind power plants) · Geothermal power (geothermal power plants)
Clean energy	· Hydrogen gas turbine (hydrogen power generation businesses and/or projects for 100% hydrogen firing) · Ammonia gas turbine (ammonia power generation businesses and/or projects for 100% ammonia firing) · Hydrogen/ammonia production (blue) · Steam power (conversion to 100% ammonia firing) · Gas engine for power generation (100% hydrogen firing)
Related SDGs	

*1Projects that qualify as green projects can be incorporated as green projects in future green bond issues. Green projects are also permitted within the CTFBG to be incorporated as part of a transition bond issue.

Table 2: Transition Projects*2

Eligible Businesses and/or Projects	Eligibility Criteria
Decarbonize existing infrastructure	· Hydrogen gas turbine (co-firing) · Ammonia gas turbine (co-firing) · LNG-fueled high-efficiency gas turbine · Steam power (conversion to ammonia co-firing) · Gas engine for power generation (hydrogen co-firing) · Material Handling (high efficiency and fuel cell powered)
Build a hydrogen solutions ecosystem	· Hydrogen production (blue or turquoise, etc.) · Ammonia production (blue or turquoise, etc.) · Hydrogen compressors (for hydrogen production, transport and storage, etc.) · Metals machinery (hydrogen-reduced ironmaking, etc.)
Build a CO_2 solutions ecosystem	· CO_2 capture and storage · CO_2 transport (liquefied CO_2 carries, etc.)
Related SDGs	

*2 Some projects classified as transition projects at this time may become green projects through the application/applied of future technological innovations. (e.g., application of green fuels/production processes, achieving performance that meets CO_2 emission standards as green projects, etc.).

表 1：グリーンプロジェクト*1

適格事業・プロジェクト	適格クライテリア
再生可能エネルギー	· 風力発電(風力発電プラント) · 地熱発電(地熱発電プラント)
グリーンエネルギー	· 水素焚きガスタービン(水素発電の場合、100%水素発電にむけた事業・プロジェクトであること) · アンモニア焚きガスタービン(アンモニア発電の場合、100%アンモニア発電にむけた事業・プロジェクトであること) · 水素／アンモニア製造(グリーン) · 石炭火力(アンモニア専焼改造) · 発電用ガスエンジン(水素専焼)
関連するSDGs	

*1 グリーンプロジェクトとしての適格性が確認されたプロジェクトは、今後グリーンボンドを発行する際のグリーンプロジェクトとして組込むことが可能です。また、グリーンプロジェクトは、トランジションボンド発行においてもその一部として組込むことが CTFBG の中で認められています。

表 2：トランジションプロジェクト*2

適格事業・プロジェクト	適格クライテリア
既存インフラの脱炭素化	· 水素焚き(混焼)ガスタービン · アンモニア焚き(混焼)ガスタービン · LNG 焚き高効率ガスタービン · 石炭火力(アンモニア混焼改造) · 発電用ガスエンジン(水素混焼) · 物流機器(高効率化・燃料電池化)
水素エコシステムの実現	· 水素製造(ブルー、ターコイズなど) · アンモニア製造(ブルー、ターコイズなど) · 水素コンプレッサ(水素製造・輸送・貯蔵用など) · 製鉄機械(水素還元製鉄など)
CO_2 エコシステムの実現	· CO_2 回収・貯留 · CO_2 輸送(液化 CO_2 船など)
関連するSDGs	

*2 現時点でトランジションプロジェクトに分類されるプロジェクトの一部は、将来的な技術革新の適用・応用によりグリーンプロジェクトとなる場合があります（例：グリーン燃料/製造プロセスの適用、グリーンプロジェクトとして CO_2 排出基準を満たす性能の達成等）。

石炭火力(アンモニア混焼改造) × Coal-fired power (modification with ammonia co-firing)

Conclusion: An unsuitable example of 'transition'

MHI's transition bond framework that relies too heavily on ammonia co-firing development that does not, in our view, deliver a good balance between potential decarbonization benefits versus risks of fossil fuel lock-ins.

MHI is promoted as an example to follow in Japan under a national transition strategy that still relies on fossil fuels. Its decarbonization strategy remains 'best in class', under Japan's decarbonization plans.[22] This is setting the wrong precedent in Japan and for other Asian nations that will find it more acceptable to continue relying on fossil fuel assets. MHI is also a member of several ESG indices, making it more likely that its securities will be owned by a large number of passive investors, including in offshore markets:

- Dow Jones Sustainability Index (equity)
- MSCI Japan ESG Select Leaders Index (equity)

[21] An alternative explanation would be that there is extreme attention to detail, such that the 'translation' would cater to English-speaking/international investors' general dislike of coal-fired power. The avoidance of such terminology in English-language material could then, hypothetically, be intended for attracting more investors.

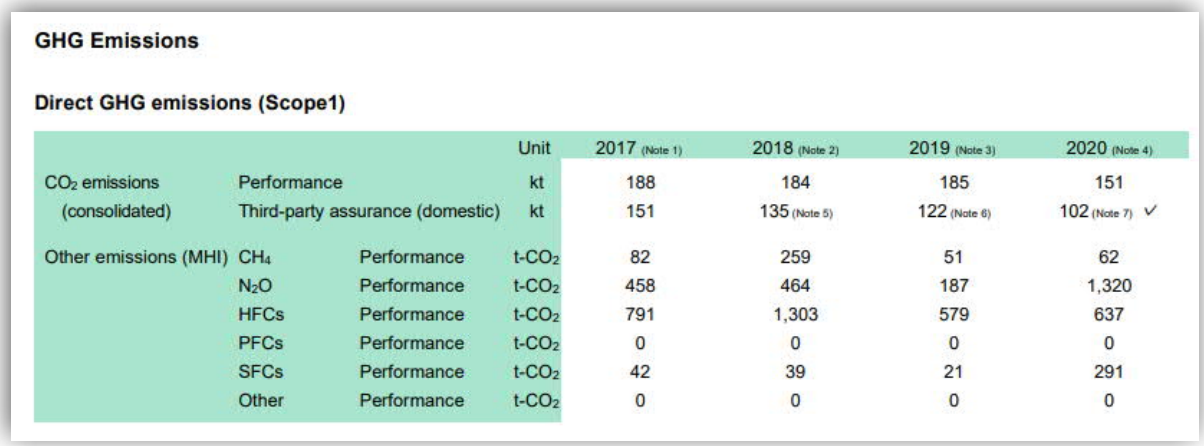
[22] For example, the Ministry of Economy, Trade and Industry (METI), states "MHI is a company with Japanese cutting edge technology, and without their decarbonization technologies for plant/energy, decarbonization of other sectors will be more challenging. Thus, projects and initiatives of MHI are of extreme importance." "Transition Finance: Case Study 11: Mitsubishi Heavy Industries, Ltd.", METI, undated.

- S&P/JPX Carbon Efficient Index (equity)
- Sompo Asset Management Sustainability Index (equity)

In addition, MHI has been selected as one of the model examples for the Climate Transition Finance Model (METI). It will serve as a beacon for Japanese industry on its pathway towards decarbonization. Yet, MHI is underperforming Japan's national average in terms of the share of renewable energy generation: while more than 20% of Japan's total annual electricity demand was covered by renewable energy in 2021, it accounts for only 6.3% of MHI's total energy consumption, as of 2020.

On other metrics, while MHI's CO_2 emissions are expected to halve by 2030, the company has seen its N_2O and SFC emissions jump multiple fold, as a result of the conversion towards other supposedly "transition" technologies, and despite a 20% reduction in the amount of electricity generated between 2017 and 2020.

Figure 4. MHI GHG Scope 1 emissions data. Source: MHI ESG data.



GHG Emissions

Direct GHG emissions (Scope1)

			Unit	2017 (Note 1)	2018 (Note 2)	2019 (Note 3)	2020 (Note 4)
CO_2 emissions (consolidated)	Performance		kt	188	184	185	151
	Third-party assurance (domestic)		kt	151	135 (Note 5)	122 (Note 6)	102 (Note 7) ✓
Other emissions (MHI)	CH_4	Performance	t-CO_2	82	259	51	62
	N_2O	Performance	t-CO_2	458	464	187	1,320
	HFCs	Performance	t-CO_2	791	1,303	579	637
	PFCs	Performance	t-CO_2	0	0	0	0
	SFCs	Performance	t-CO_2	42	39	21	291
	Other	Performance	t-CO_2	0	0	0	0

In summary, we recommend investors take an inquisitive stance toward any transition bonds involving structures such as the one put forward by MHI:

First, ammonia co-firing's potential with arguably uncertain carbon reduction effects should be weighted versus the lock-in effects on coal-fired power plants.

Second, there should be transparency and accountability in Scope 3 accounting, in line with international definitions to ensure the credibility of the issuer's net zero commitments.

Third, altering translations in various languages of bond related documents in ways that could be construed as an attempt to appease (international) investors, reduces the credibility of the bond issuance and those parties backing it.

Last, Japanese funding and industrial engagement in the region has global ramifications and it would be desirable to see it adhering to the highest standards in the context of transition.

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