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Hidden Methane Emissions, Tangible Economic Costs

Methane Emissions from Japan's Imported Fossil Fuel Supply Chains: Lost Fuel Value and Heatwave-Related Climate Damages

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Author	**Jeongho Jo** | Researcher, Methane&HFCs, Solutions for Our Climate
Advisor	**Jinsun Roh** | Head, Methane & HFCs Team, Solutions for Our Climate

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Executive Summary

Summer heatwaves bring the climate crisis into sharp focus. The scientific consensus is clear: greenhouse gases released by human activities are the primary driver of the rapid rise in global temperatures. Methane alone is responsible for approximately 30% of the warming observed since the Industrial Revolution. Regardless of where it is emitted, methane increases atmospheric greenhouse gas concentrations and amplifies climate risks worldwide.

Japan imports most of the energy it consumes. Methane released during the production, processing, and transport of fossil fuels consumed in Japan also adds to global atmospheric concentrations. Methane management in Japan therefore cannot be limited to asking how much is emitted within its borders; it must also account for the methane emissions driven by Japan's energy consumption across global supply chains.

This analysis estimates two dimensions of the economic burden associated with methane. First, using Japan's 2024 LNG import price as a benchmark, it estimates the fuel value of methane released during fossil fuel production. As the principal component of natural gas, methane emitted to the atmosphere represents energy that could otherwise have been put to productive use. This is an estimate of the energy value and economic scale of wasted methane—not a claim about actual trading losses or fully recoverable revenue. Second, the analysis estimates the heatwave-related climate damage costs that methane emissions impose on Japanese society. Together, the two costs amount to approximately USD 3.29 billion (JPY 526.3 billion) per year.

To reduce this wasted methane, Japanese importers of oil, gas, and coal should first disclose methane emissions arising at the production stage. Companies and the government should then establish targets and standards for managing methane across entire supply chains. Finally, fossil fuel importers should require producers to implement methane-abatement measures. Japan has already helped launch the Coalition for LNG Emission Abatement toward Net-zero (CLEAN) Initiative to manage methane emissions associated with LNG supply. The next step is to translate this approach into procurement standards and corporate disclosure, and to extend it beyond LNG to imported crude oil and coal.

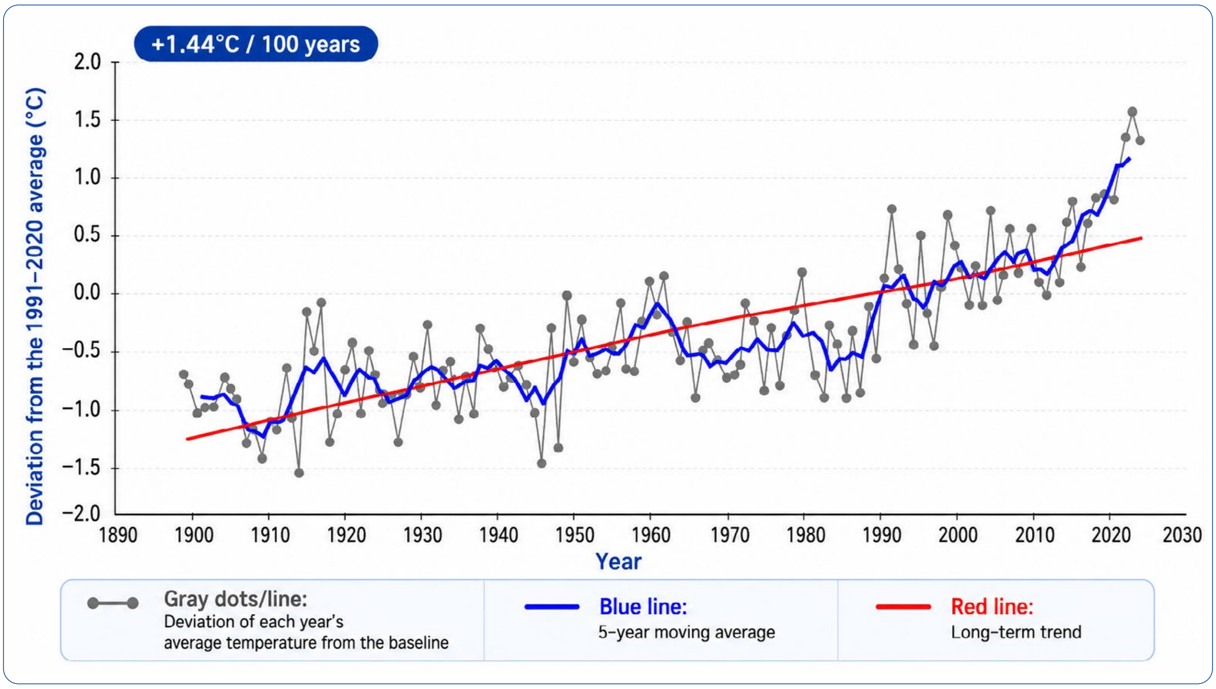
As summers grow hotter, Japanese companies and the government have an opportunity to demonstrate broader climate leadership.

1. Heatwaves are already imposing costs on Japanese society

Summer, when heatwaves peak, is the season in which the climate crisis is felt most directly. A "hot summer" may once have been regarded mainly as a seasonal discomfort. Today, heatwaves are a socioeconomic risk that threatens lives and health, raises electricity demand, and reduces labor productivity.

The Japan Meteorological Agency reports that Japan's annual mean temperature has risen at a long-term rate of 1.44°C per century. The year 2024 was the warmest since records began in 1898, and 2025 was the third warmest. These recent extremes are not random anomalies; they are among the clearest real-world manifestations of climate change in Japan

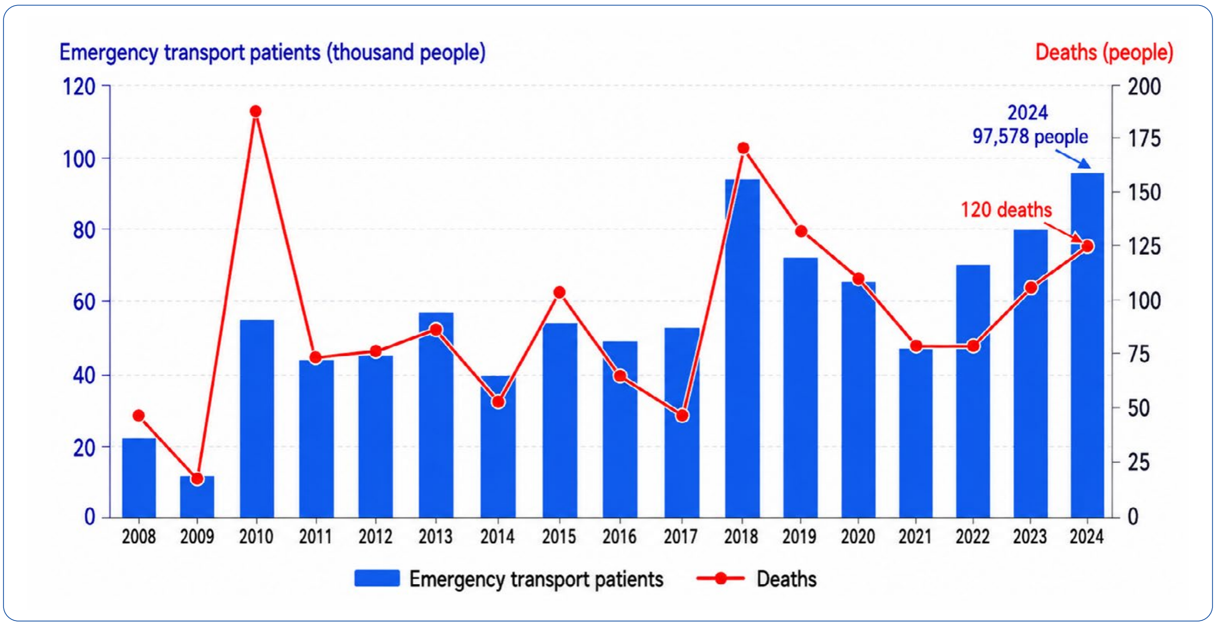
[Figure 1] **Long-term trend in annual mean temperature anomalies in Japan**



Source: Japan Meteorological Agency.

The human toll is already visible in official statistics. Japan's Fire and Disaster Management Agency reported that 97,578 people were transported by ambulance for heatstroke nationwide from May to September 2024—the highest number since data collection began in 2008. During the same period, 120 people were classified as deceased at the time of medical diagnosis. These figures clearly demonstrate that heatwaves are already causing tangible harm.

[Figure 2] Trends in heatstroke-related ambulance transports and deaths in Japan (2008–2024)

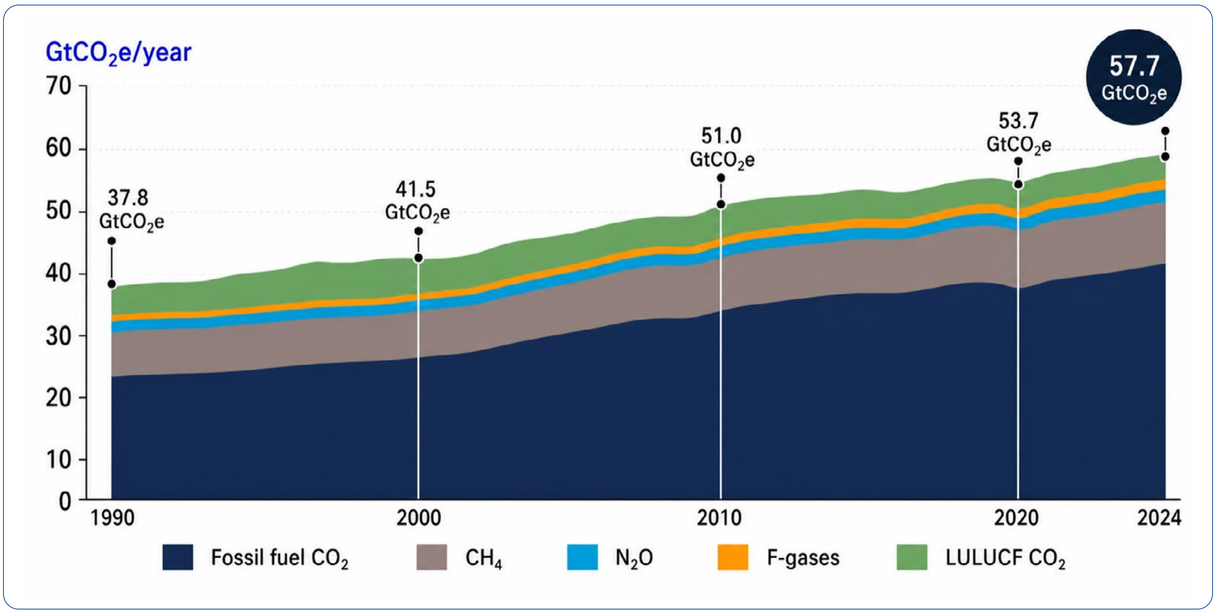


Source: SFOC analysis based on Fire and Disaster Management Agency & 2024 Annual Report on Heatstroke Emergency Transport.

A fundamental driver of heatwave risk is the rising concentration of greenhouse gases in the atmosphere. Yet global emissions are not declining at all. The United Nations Environment Programme (UNEP) reported that global greenhouse gas emissions reached 57.7 $GtCO_2e$ in 2024—52.6% above the 1990 level.

Reducing heatwave risk requires cuts not only in carbon dioxide emissions but also in methane. According to the IPCC's global warming potential (GWP) metrics, methane has roughly 28 times the warming impact of carbon dioxide over 100 years and roughly 84 times over 20 years. The IEA estimates that methane has contributed around 30% of the rise in global temperatures since the Industrial Revolution and emphasizes that rapid, sustained reductions are critical to limiting near-term warming.

[Figure 3] Long-term trend in global greenhouse gas emissions (1990–2024)



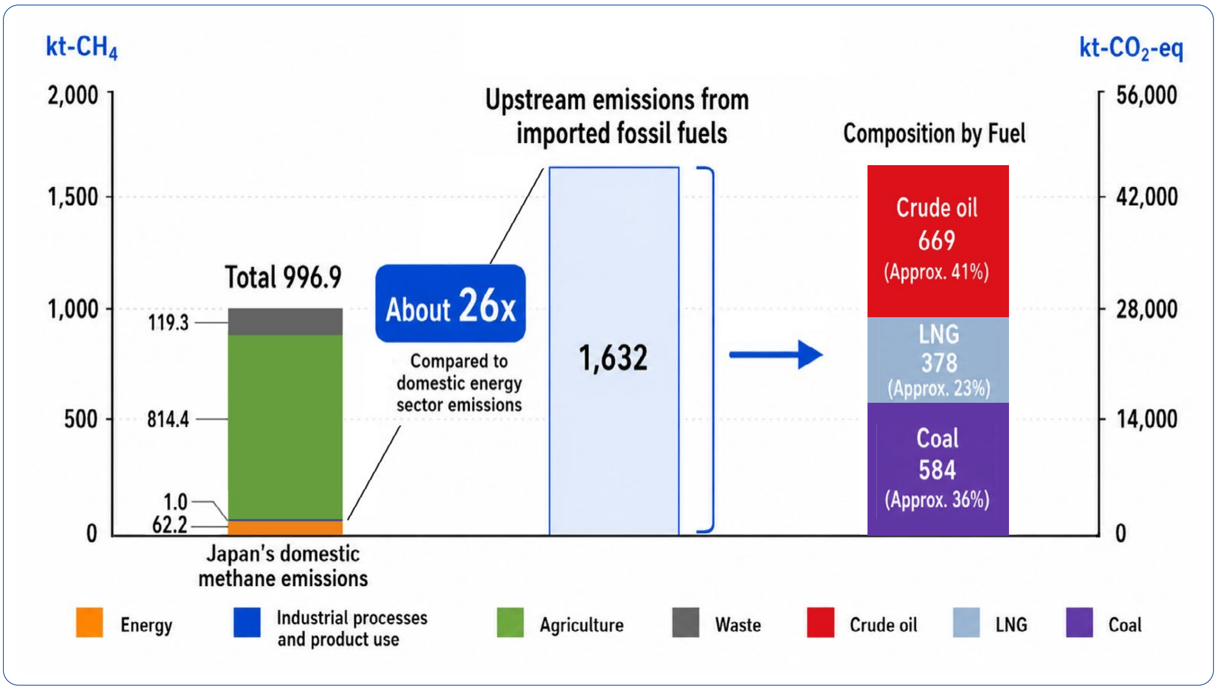
Source: UNEP, Emissions Gap Report 2025.

2. Japan's dependence on imported fossil fuels—and the hidden emissions it creates

Japan is a major energy importer. Most of the crude oil, gas, and coal it consumes is produced overseas. Substantial greenhouse gas emissions occur at the oil and gas fields, coal mines, processing and liquefaction facilities, and transport systems that supply fossil fuels to Japan. The country's approach to supply-chain emissions therefore cannot stop at emissions produced domestically; it must also account for emissions driven by Japanese energy consumption across global supply chains.

Global energy markets also remain exposed to persistent supply insecurity. Renewed tensions in the Middle East in 2026 again highlighted uncertainty in global energy prices and oil & gas supply. Unpredictable geopolitical shocks, disruptions to production facilities, rapid growth in energy demand, and competition among countries to secure fuel supplies make it difficult to eliminate these risks from an energy-security perspective.

[Figure 4] Japan's domestic methane inventory and upstream methane emissions from imported fossil fuels



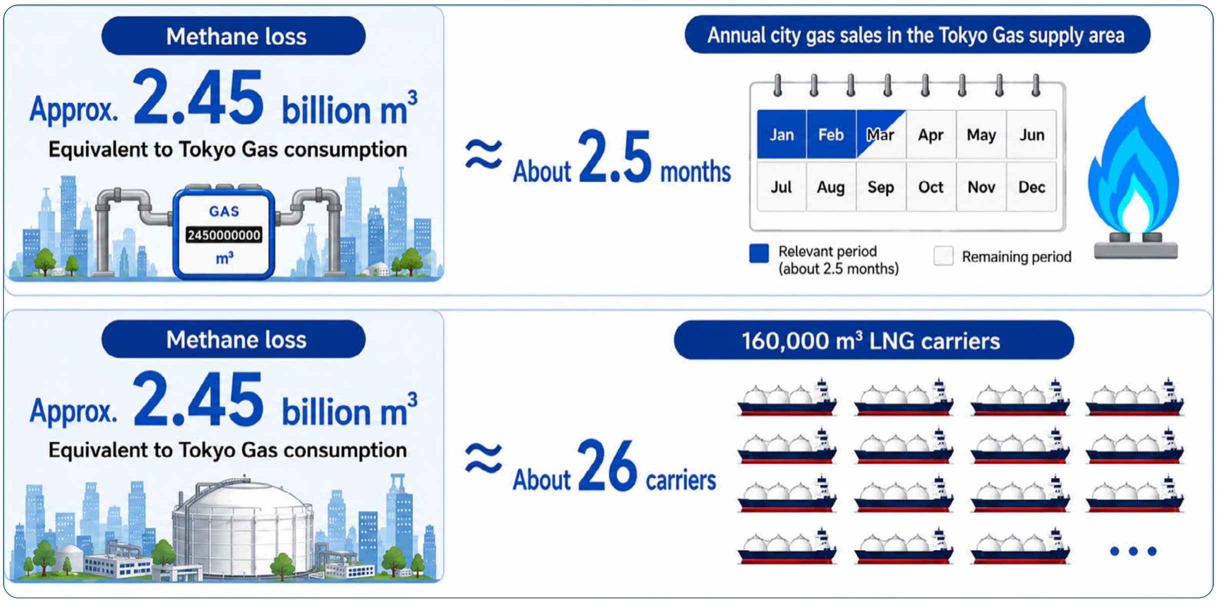
Source: SFOC analysis based on Japan's National GHG Inventory Document 2026 and the IEA Global Methane Tracker.

3. What is the fuel value of methane lost during production?

Upstream methane emissions from imported fossil fuel supply chains are more than a climate problem; they also represent the loss of a valuable resource. Methane is the principal component of natural gas, so methane released to the atmosphere—whether through leaks or other operational sources—can be understood as energy that could otherwise have been sold or used. In Global Methane Tracker 2026, the International Energy Agency (IEA) notes that reducing methane emissions from fossil fuel supply chains would advance climate action while also supporting gas-market stability and energy security during supply crises.

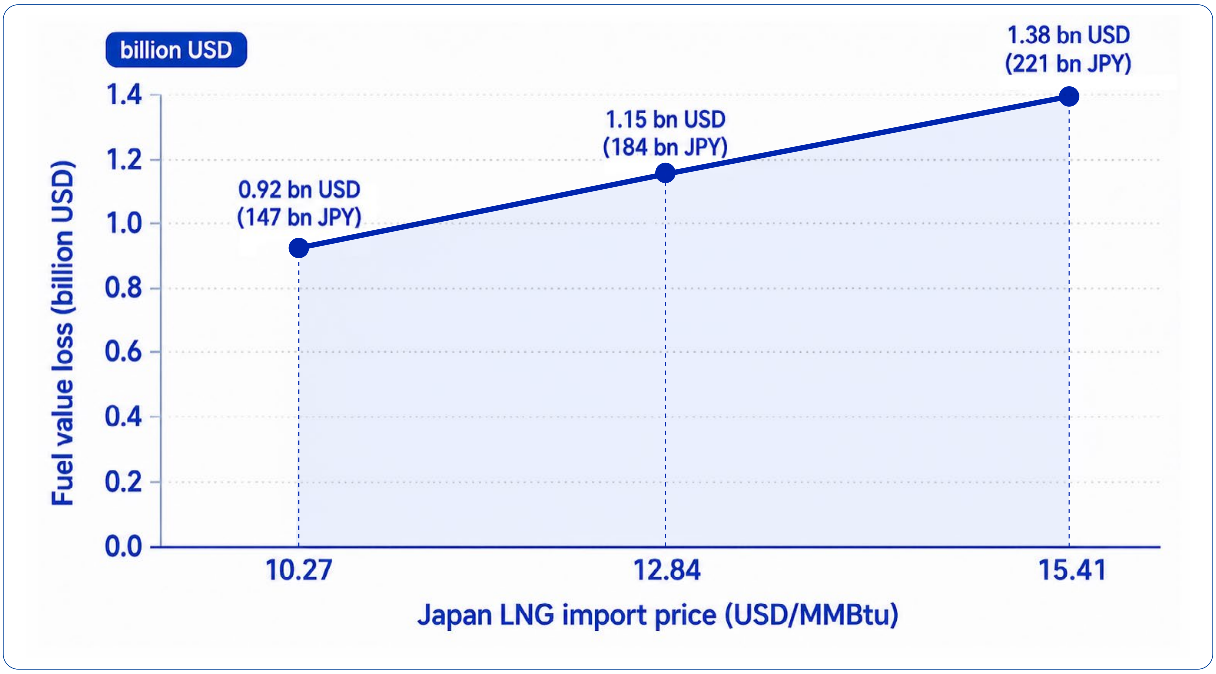
This report estimates lost fuel value by converting upstream methane emissions associated with imported fossil fuels into an equivalent gas volume and applying Japan's 2024 LNG import price. The 1,632 kt-CH_4 emitted at the production stage of Japan's imported fossil fuel supply chains corresponds to an estimated USD 1.15 billion (JPY 184.0 billion) in lost fuel value at the 2024 import price of USD 12.84/MMBtu. The methane volume—about 2.45 billion m^3—is equivalent to 2.5 months of annual city-gas sales across the broader Tokyo Gas service area. It also corresponds to roughly 26 standard 160,000 m^3-class LNG carriers.

[Figure 5] Energy equivalent and economic scale of upstream methane emissions from Japan's imported fossil fuels



Source: SFOC analysis based on the IEA Global Methane Tracker, Japan's average LNG import price, and Tokyo Gas city-gas sales.

[Figure 6] Sensitivity of lost fuel value under LNG price scenarios



Source: SFOC analysis based on Japan's LNG import price.

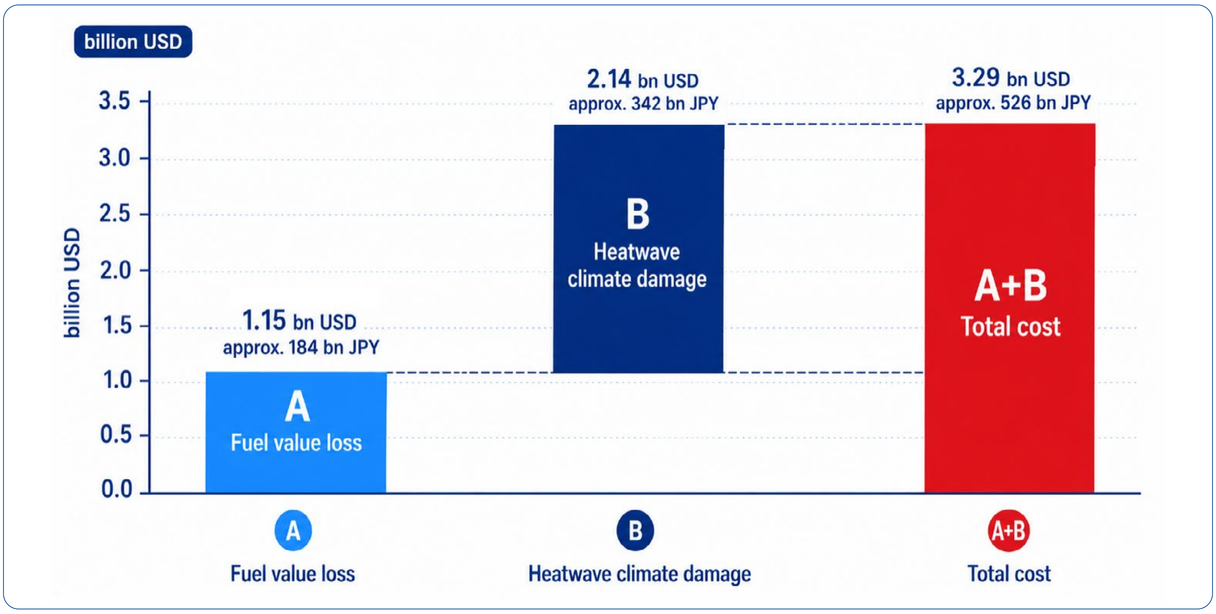
4. Estimating heatwave-related climate damage costs

Methane emissions increase atmospheric greenhouse gas concentrations and amplify climate risks worldwide, regardless of where they occur. Methane released during the production, processing, and transport of fossil fuels consumed in Japan contributes to global warming and rising temperatures. The resulting impacts can include not only direct climate damages such as heatwaves, but also economic losses from reduced labor productivity and higher cooling demand.

This report estimates the social cost of methane emissions using heatwave-related damages only. It excludes floods, droughts, wildfires, typhoons, sea-level rise, and other climate impacts. The estimate should therefore be understood as a conservative, partial measure—not the full climate damage attributable to methane emissions.

The coefficient used in this analysis represents the estimated heatwave-related economic damage associated with each tonne of CO_2-equivalent emissions. Applying it to the combined total of Japan's domestic methane inventory and upstream methane emissions from imported supply chains yields estimated annual climate damage costs associated with heatwaves of approximately USD 2.14 billion (JPY 342.3 billion).

[Figure 7] **Combined annual lost fuel value and heatwave-related climate damage costs**



Source: SFOC analysis.

5. Conclusion

In sum, methane emissions associated with Japan’s imported fossil fuel supply chains are not merely an environmental issue. They carry two distinct economic costs: the value of methane lost as fuel and the climate damages imposed on Japanese society as methane increases heatwave risk.

The policy priorities are clear. First, Japanese importers of oil, gas, and coal should disclose methane emissions across their supply chains. Second, companies and the government should establish targets and standards for managing methane across the entire supply chain. Third, importers should require producers to measure, report, and verify methane emissions; detect and repair leaks; and reduce unnecessary venting and flaring.

Japan has already launched the CLEAN Initiative to manage methane across the LNG supply chain. The next step is to connect reduction commitments to procurement standards, corporate disclosure, financial-institution assessments, and supply-contract terms. This approach should not be seen simply as regulation that shifts costs onto companies and industry. It is a practical response that can reduce wasted energy, lower supply-chain risks, and mitigate social costs such as heatwave damages.

By actively managing methane in imported fossil fuel supply chains, companies and policymakers can strengthen energy security, economic efficiency, public health, and climate leadership at the same time.

Appendix

A. Estimating lost fuel value

[Appendix Table 1] Estimation of lost fuel value

Item	Value	Unit	Note
Imported supply-chain methane	1,631.72	kt-CH_4	Crude oil + LNG + coal
Methane density	0.667	kg/m³	At 20°C
Converted volume	2.446	bcm	Mass ÷ density
Energy equivalent	89.54	million MMBtu	1,000 m³ = 36.6 MMBtu
Base price	12.84	USD/MMBtu	Japan LNG CIF, 2024
Lost fuel value	1.15 / 184.0	bn USD / bn JPY	1 USD = 160 JPY

Calculation method: methane mass (kg) → methane volume (m³) = mass ÷ density → energy (MMBtu) → lost fuel value = energy × Japan's LNG import price

[Appendix Table 2] Methane emissions and lost fuel value by imported fossil fuel

Fuel	Methane emissions kt-CH_4	Gas equivalent (bcm)	Lost fuel value (USD / JPY)
Crude oil	669	1.00	0.471 bn USD / 75.4 bn JPY
LNG	378	0.57	0.267 bn USD / 42.7 bn JPY
Coal	584	0.88	0.412 bn USD / 65.9 bn JPY
Total	1,632	2.45	1.15 bn USD / 184.0 bn JPY

Lost fuel value is calculated using Japan's 2024 LNG import price. Because methane emissions from crude oil and coal supply chains are also valued at the LNG price, the results do not represent actual trading losses or fully recoverable revenue. They estimate the energy value and economic scale of wasted methane.

[Appendix Table 3] Lost fuel value under LNG price scenarios

Scenario	Price USD/MMBtu	Loss USD	Loss JPY
Low (−20%)	10.27	0.92 bn	147.2 bn
Base (2024 average)	12.84	1.15 bn	184.0 bn
High (+20%)	15.41	1.38 bn	220.7 bn

B. Estimating heatwave-related climate damage costs

[Appendix Table 4] Estimation of heatwave-related climate damage costs

Item	Value	Unit
Imported supply-chain methane	1.632	Mt-CH_4
GWP100	28	-
Imported supply-chain CO_2e	45.69	MtCO_2e
Domestic methane inventory (FY2024)	27.912	MtCO_2e
Combined emissions	73.60	MtCO_2e
Heatwave damage coefficient (α_{1990})	29.07	USD/tCO_2e
Climate damage cost	2.14 / 342.3	bn USD / bn JPY

The coefficient represents the estimated heatwave-related economic damage associated with each tonne of CO_2e. Calculation method: heatwave-related climate damage cost = [(imported supply-chain methane × GWP100) + domestic methane inventory] × heatwave damage coefficient

C. LNG price benchmarks

[Appendix Table 5] LNG price benchmarks

Price benchmark	Use in analysis	Assessment
Japan LNG CIF	Base case	Consistent with Japan's import price
JKM spot	Supplementary scenario	Can reflect market stress
IGU Asia Pacific	Supplementary scenario	Regional average; relatively broad

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