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Issue Brief

Hidden Methane Emissions, Tangible Economic Costs

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

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Solutions for Our Climate (SFOC) is an independent nonprofit organization that works to accelerate global greenhouse gas emissions reduction and energy transition. SFOC leverages research, litigation, community organizing, and strategic communications to deliver practical climate solutions and build movements for change.

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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.

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

This analysis estimates two dimensions of the economic burden associated with methane. First, using South Korea's average 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 South Korean society. Together, the two costs amount to approximately USD 3.51 billion (KRW 5.30 trillion) per year.

To reduce this wasted methane, South Korean 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. South Korea has already joined the Global Methane Pledge and established a domestic methane-reduction target. 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, South Korean companies and the government have an opportunity to demonstrate broader climate leadership.

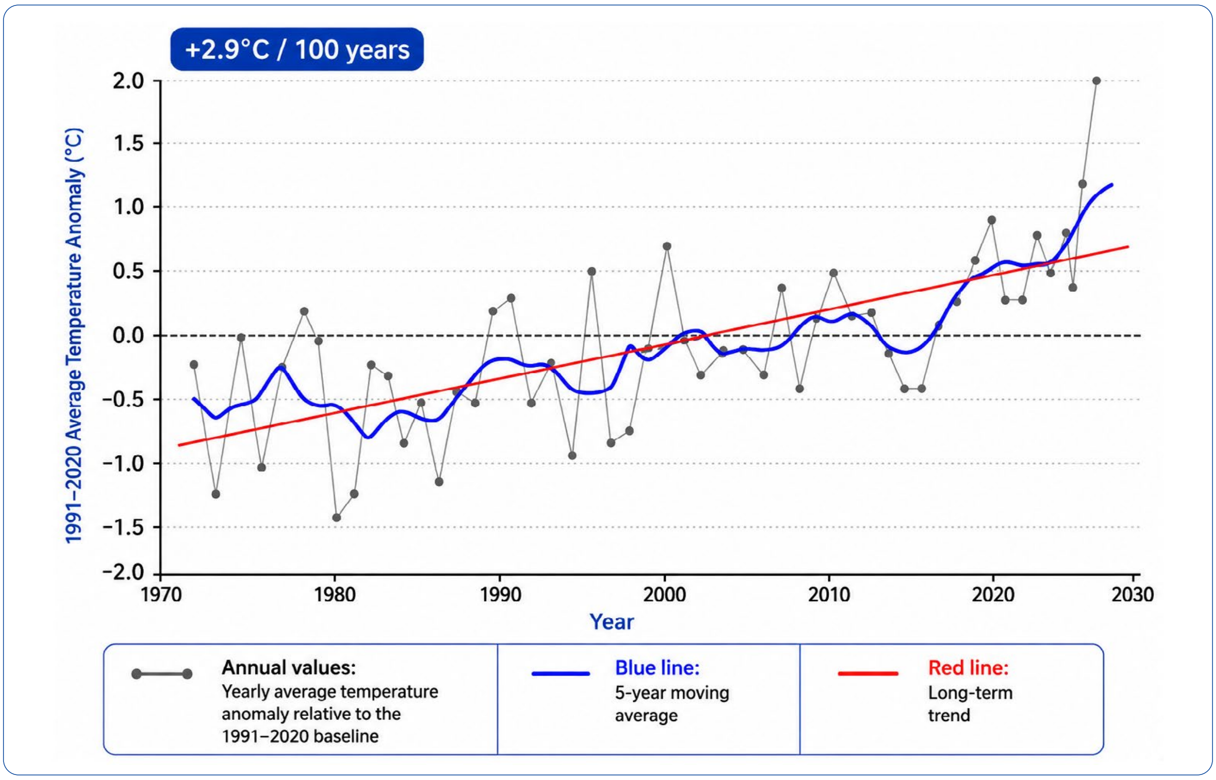
1. Heatwaves are already imposing costs on South Korean society

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 Korea Meteorological Administration reported that South Korea's annual mean temperature in 2024 was 14.5°C, 2.0°C above the climatological normal and the highest since nationwide observations began in 1973. It was also 0.8°C higher than the previous record of 13.7°C in 2023. The country recorded 24.5 tropical nights—3.7 times the normal 6.6 days and the highest on record.

Based on annual mean temperature data for 1973–2024, the long-term trend is approximately +2.9°C per century. Recent extremes are not random anomalies; they are among the clearest real-world manifestations of climate change in South Korea.

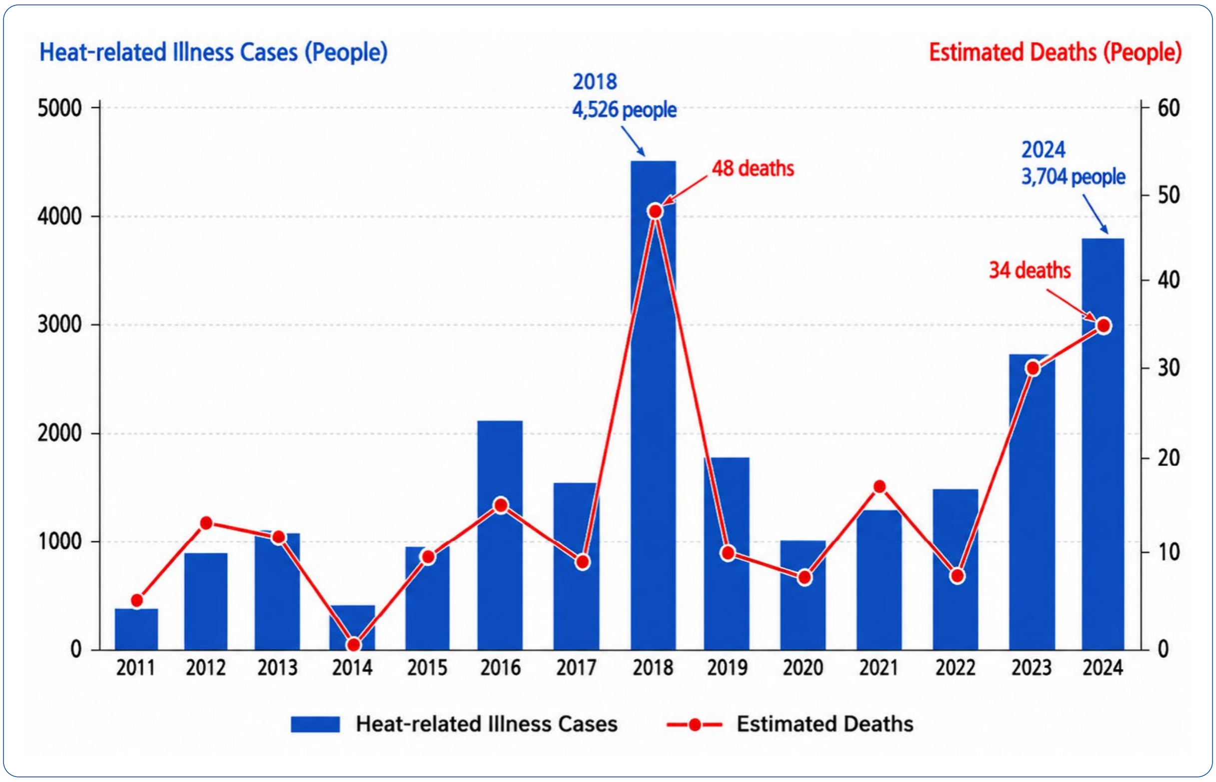
[Figure 1] **Long-term trend in annual mean temperature anomalies in South Korea (1973–2024)**



Source: SFOC analysis based on Korea Meteorological Administration, Annual Climate Analysis 2024.

The human toll is already visible in official statistics. The Korea Disease Control and Prevention Agency reported 3,704 heat-related illness cases and 34 deaths through its emergency-room surveillance system between May 20 and September 30, 2024. Compared with 2011, when monitoring began, cases increased 8.4-fold and deaths 5.7-fold. These figures clearly demonstrate that heatwaves are already causing tangible harm.

[Figure 2] **Trends in heat-related illness cases and estimated deaths in South Korea (2011–2024)**

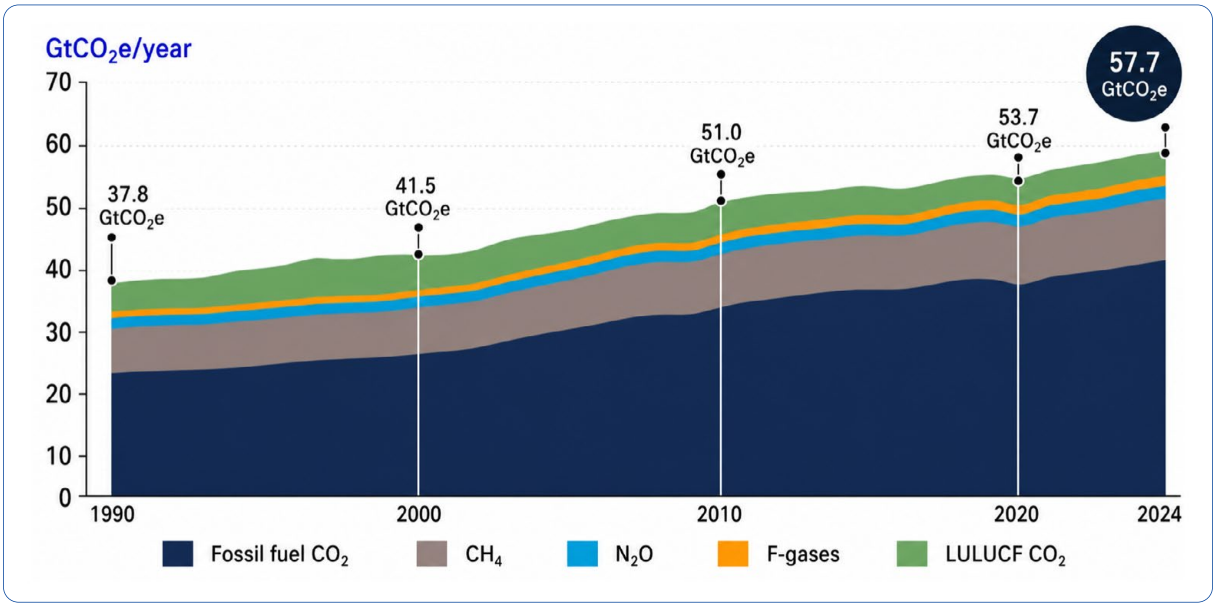


Source: Korea Disease Control and Prevention Agency, Results of the 2024 Heat-Related Illness Emergency-Room Surveillance System.

A fundamental driver of heatwave risk is the rising concentration of greenhouse gases in the atmosphere. Yet global emissions are not declining at the required pace. 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)



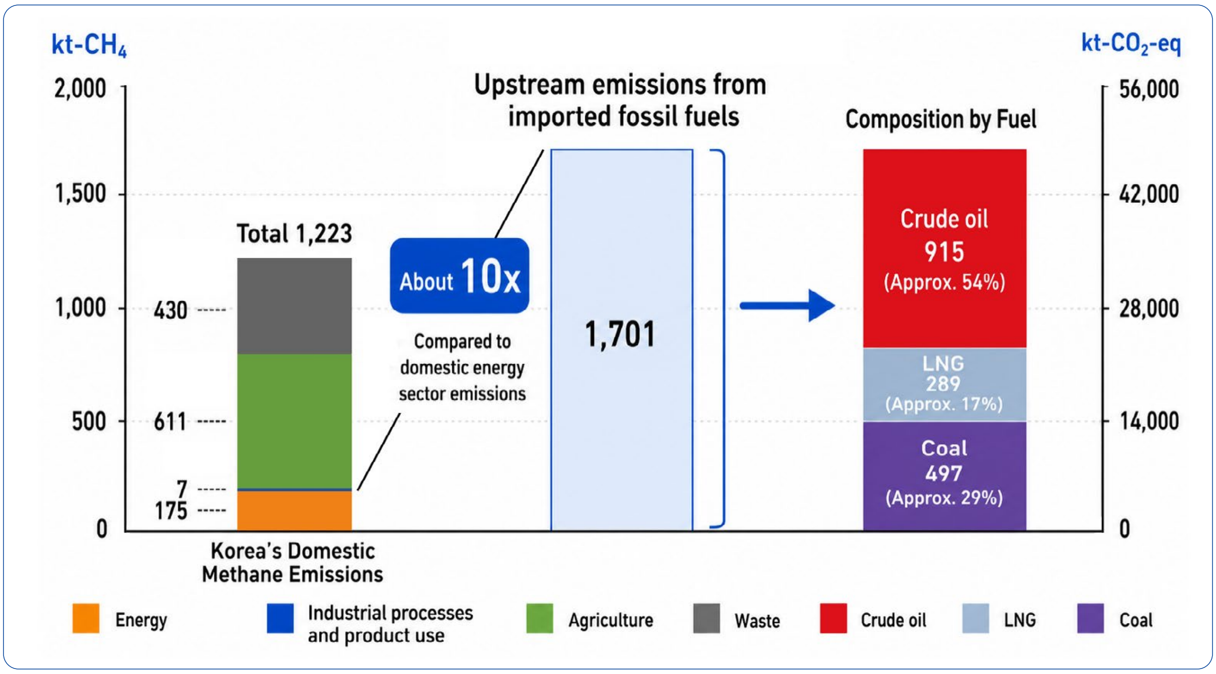
Source: UNEP, Emissions Gap Report 2025.

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

South Korea is a major energy importer. Most of the crude oil, gas, and coal it consumes is produced overseas. In 2024, the country's energy import dependence stood at 93.7%, while total energy imports reached USD 161.3 billion (approximately KRW 243 trillion). 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 South Korea. The country's approach to supply-chain emissions therefore cannot stop at emissions produced domestically; it must also account for emissions driven by South Korean 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] South Korea's domestic methane inventory and upstream methane emissions from imported fossil fuels



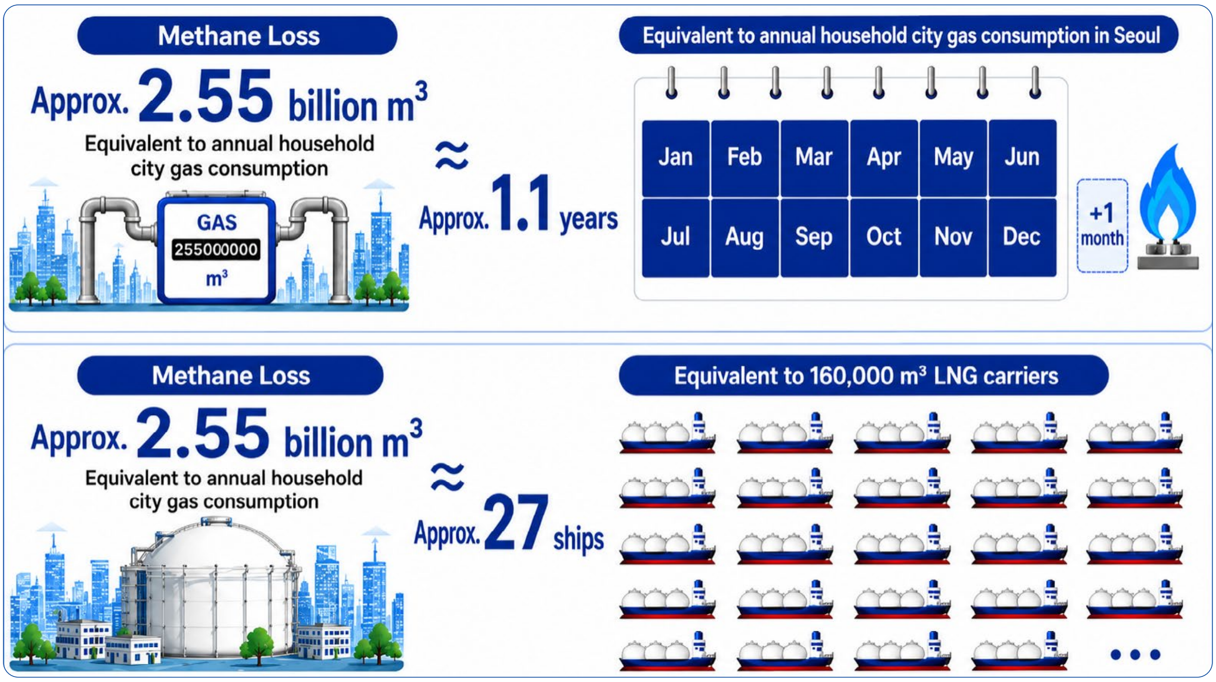
Source: SFOC analysis based on the 2025 National Greenhouse Gas Inventory Report of Korea and the IEA Global Methane Tracker.

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.

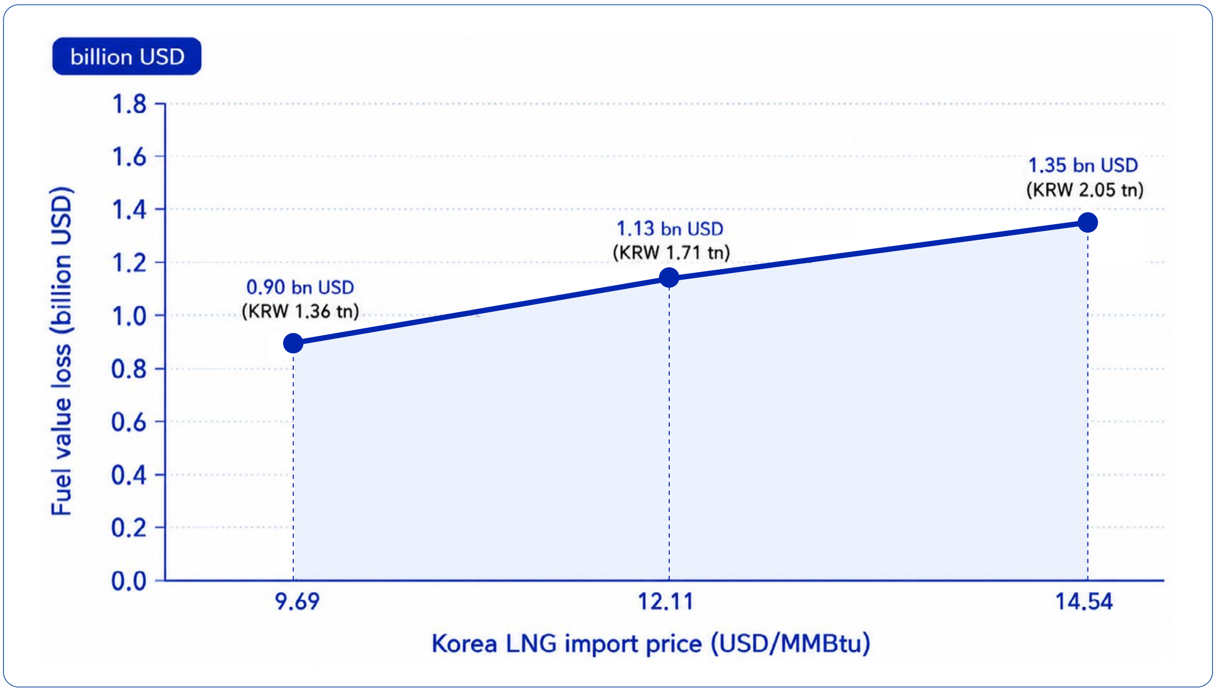
This report estimates lost fuel value by converting upstream methane emissions associated with imported fossil fuels into an equivalent gas volume and applying South Korea's average 2024 LNG import price. The 1,701 kt-CH_4 emitted at the production stage of South Korea's imported fossil fuel supply chains corresponds to an estimated USD 1.13 billion (KRW 1.71 trillion) in lost fuel value at the 2024 average import price of USD 12.1141/MMBtu. The methane volume—about 2.55 billion m^3—is equivalent to approximately 1.1 years of residential city-gas consumption in Seoul. It also corresponds to roughly 27 standard 160,000 m^3-class LNG carriers.

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



Source: SFOC analysis based on the IEA Global Methane Tracker, South Korea's average LNG import price, and Seoul Metropolitan Government energy statistics.

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



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

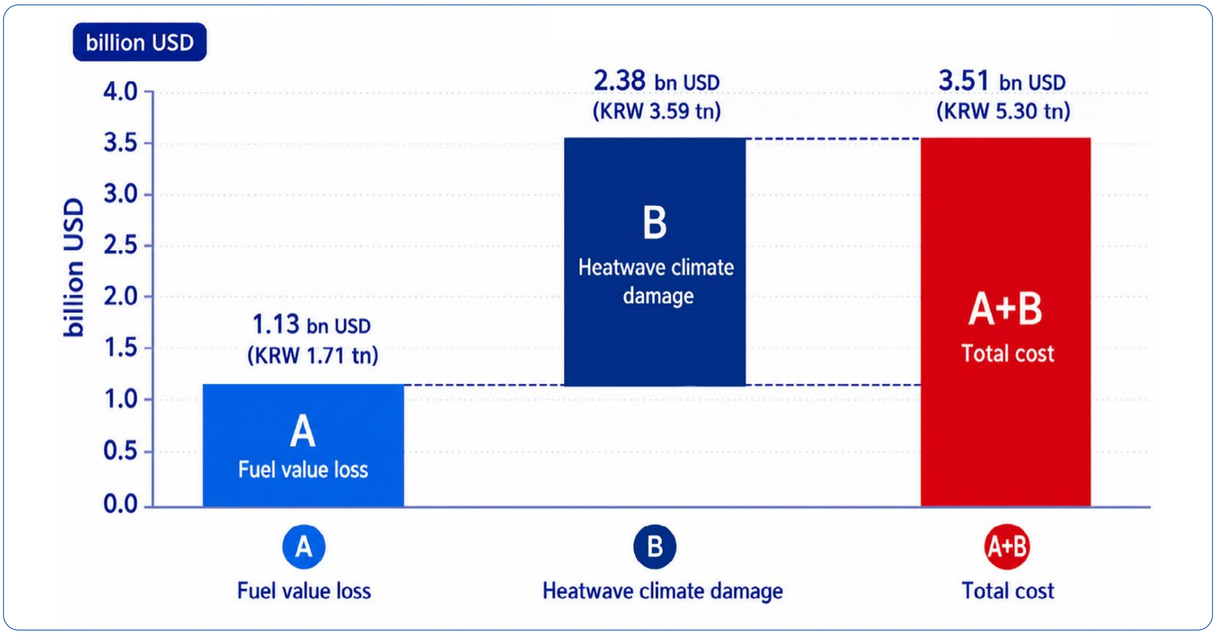
4. Estimating heatwave-related climate damage costs

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 South Korea 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 South Korea's domestic methane inventory and upstream methane emissions from imported supply chains yields estimated annual climate damage costs associated with heatwaves of approximately USD 2.38 billion (KRW 3.59 trillion).

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



Source: SFOC analysis.

5. Conclusion

In sum, methane emissions associated with South Korea'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 South Korean society as methane increases heatwave risk.

The policy priorities are clear. First, South Korean 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.

South Korea has already joined the Global Methane Pledge and established a domestic methane-reduction target. 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	1,700.74	kt-CH_4	Crude oil + LNG + coal
Methane density	0.667	kg/m³	At 20°C
Converted volume	2.550	bcm	Mass ÷ density
Energy equivalent	93.32	million MMBtu	1,000 m³ = 36.6 MMBtu
Base price	12.1141	USD/MMBtu	South Korea's average LNG import price, 2024
Lost fuel value	1.13 / 1.71	bn USD / tn KRW	1 USD = 1,508.93 KRW (market quote accessed July 10, 2026)

Calculation method: methane mass (kg) → methane volume (m³) = mass ÷ density → energy (MMBtu) → lost fuel value = energy × South Korea's average 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 / KRW)
Crude oil	915	1.37	0.608 bn USD / 0.92 tn KRW
LNG	289	0.43	0.192 bn USD / 0.29 tn KRW
Coal	497	0.74	0.330 bn USD / 0.50 tn KRW
Total	1,701	2.55	1.13 bn USD / 1.71 tn KRW

Lost fuel value is calculated using South Korea's average 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%)	9.69	0.90 bn	1.36 tn
Base	12.1141	1.13 bn	1.71 tn
High (+20%)	14.54	1.36 bn	2.05 tn
JKM 2024 average	11.90	1.11 bn	1.68 tn

B. Estimating heatwave-related climate damage costs

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

Item	Value	Unit
Imported supply-chain methane	1.701	Mt-CH_4
GWP100	28	-
Imported supply-chain CO_2e	47.62	MtCO_2e
Domestic methane inventory	34.24	MtCO_2e
Combined emissions	81.86	MtCO_2e
Heatwave damage coefficient (α_{1990})	29.07	USD/tCO_2e
Climate damage cost	2.38 / 3.59	bn USD / tn KRW

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
South Korea LNG import price	Base case	Consistent with South Korea's import price
JKM spot	Supplementary scenario	Can reflect market stress
IGU Asia Pacific	Supplementary scenario	Regional average; relatively broad

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