Reassessing the EU's LNG Import Expansion: Geopolitical Dependencies, Energy Security, and Climate Goals after the Russian Invasion of Ukraine

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Overview

This paper examines the necessity and implications of the European Union's rapid expansion of liquefied natural gas (LNG) import capacities following Russia's invasion of Ukraine. The conflict exposed vulnerabilities in Europe's energy security. As a response, the EU initiated a rapid expansion of LNG import capacities to diversify supply routes and reduce reliance on Russian gas. By 2025, LNG terminal expansions across Europe have increased import capacity significantly. This policy was coupled with the strategy, to phase out Russian fossil fuel imports through demand reduction, supply diversification, and an accelerated transition to renewable energy.

The study combines a techno-economic model of the gas transmission infrastructure with a policy analysis to assess whether this expansion was necessary and to analyze the impact on the security of supply, economic efficiency and environmental sustainability. The techno-economic analysis uses the European cross-border infrastructure and investigates import routes and technical implications. The results are input for the policy analysis in the context of the European Union's energy policy framework. The rapid expansion of LNG imports, while effective in addressing immediate supply risks, has far-reaching implications that extend beyond the security of supply and can lead to new dependencies on alternative LNG suppliers but makes LNG more attractive, which inadvertently promotes demand.

Such market dynamics run counter to the EU's climate policy objectives and undermine the long-term goal of reducing greenhouse gas (GHG) emissions. Therefore, the policy analysis considers the environmental consequences of these developments. The EU risks becoming dependent on fossil fuels longer than planned, risking a negative impact on investment in renewable technologies and transport infrastructure. The new LNG terminals and contracts may lower prices in the short-term but risk long-term issues like lock-ins or underutilization.

By addressing these interlinked concerns, this study aims to evaluate whether the EU's LNG expansion plans strike an appropriate balance between energy security, economic rationality and environmental responsibility, as well as contribute to a more resilient and sustainable energy future.

Methods

The methodological approach of this study integrates a quantitative analysis of the European gas network with a qualitative evaluation of the broader security, policy and environmental implications.

Techno-economic model

The approach uses a gas network and transportation model on the level of cross-border infrastructure. The goal is to identify the patterns of gas supply and cross-border transportation within Europe. The model is a deterministic linear optimization approach for and covers net transfer capacity between all European countries, storage and LNG import capacity, production and demand on the national level. The techno-economic assessment of the gas supply uses four scenarios that are analyzed using an annual basis and for the peak load hour: (1.) The gas transmission grid and LNG import capacities as of 2021, (2.) the gas transmission grid with LNG expansions as of 2024, (3.) planned future expansions of LNG capacities including demand (2035/2040), (4.) the 2021 grid with critical net transfer capacity improvements.

Policy Analysis

The theoretical framework guiding this analysis is the European energy policy triangle, which balances three critical dimensions: security of supply, economic efficiency and sustainability. The assessment examines the supply disruptions and discusses the additional supply security achieved by LNG imports. The study investigates how the increase in LNG import capacity has influenced market dynamics, including price effects and potential oversupply. This market

evaluation considers, the risk of stranded assets and if planning for renewable infrastructure, such as hydrogen terminals and grids, could be more beneficial. The environmental analysis focuses on comparing the lifecycle CO_2 emissions of LNG to those of pipeline gas, evaluating whether LNG infrastructure expansion aligns with the EU's climate targets. Additionally, a geopolitical analysis investigates how diversification of LNG supply sources shifts trade dependencies, focusing on the EU's increased reliance on exporters like the U.S. or Qatar. Finally, the policy implications of these findings are explored, including mechanisms to prevent market distortions, align LNG expansion with climate goals and ensure the planning of renewable infrastructure as part of a green transition.

Results

The results provide insights into the extent to which LNG infrastructure expansion has improved energy security and examine its long-term geopolitical and climate implications. By diversifying supply sources and reducing reliance on Russian gas, the EU achieved enhanced resilience against geopolitical disruptions. This achievement is accompanied by significant trade-offs, particularly in terms of economic efficiency and environmental sustainability. The modeling results show that the LNG import capacity that existed already before the Russian invasion was sufficiently large to replace most of the Russian gas imports via pipeline. However, there are some bottlenecks within the European gas transmission grid that prevented full utilization of potential. The need for further expansion of the LNG import capacities does not exist if the supply of Europe is assessed holistically. This is particularly important given the background of long-term declining gas demand.

From an economic perspective, the results show that the increase in supply led to price reductions to before crisis levels but stimulated artificial demand that contradicts the EU's climate policy objectives. Furthermore, the infrastructure's high capital costs and long amortization timelines could result in stranded assets, particularly if the EU accelerates its transition to renewables or hydrogen. These findings are expected to highlight the tension between short-term supply security and long-term economic prudence.

Environmentally, the results reveal a misalignment between LNG expansion and the EU's decarbonization goals. LNG's CO_2 lifecycle emissions are likely higher than those of gas imported via pipeline. This raises concerns about whether the EU can meet its climate targets while expanding its reliance on a carbon-intensive fuel source. The findings underscore the importance of integrating stricter policy mechanisms to mitigate these emissions and prevent the entrenchment of LNG as an energy source in the EU.

Conclusions

The research concludes with a discussion of alternative strategies, such as improving cross-border pipeline capacities and their ability to mitigate the EU's energy and geopolitical risks without jeopardizing climate targets. The rapid expansion of LNG infrastructure in response to Russia's invasion of Ukraine underscores the trade-offs inherent in balancing security, economic and environmental goals. The results indicate that it is preferable to directly invest in renewable infrastructure, even if initial utilization rates may be lower, rather than creating long-term dependence on fossil fuel assets. Expanding interconnectors is another crucial step, as it not only strengthens current energy security but also enables future conversion for hydrogen transport. This is relevant as hydrogen transport will probably flow from south to central and eastern Europe.

To address the challenges posed by the rapid expansion of LNG infrastructure while aligning with the European Union's climate and energy goals, several targeted policy measures are necessary. First, regulatory alignment is crucial to ensure that LNG infrastructure development does not conflict with the EU's climate goals. Second, the development of hydrogen-ready infrastructure should be prioritized. This approach will minimize the risk of stranded assets while facilitating the transition to a low-carbon economy and ensuring long-term utility for these investments. Third, it is recommended to diversify supply regions rather than further increase LNG import capacity. Diversification reduces risks associated with reliance on any single supplier or group of exporters and strengthens the EU's resilience in the face of global energy market disruptions.

In this context, European countries must strengthen collaboration and adopt a unified energy strategy, moving away from fragmented, nationally focused measures. Evaluating new LNG terminals solely from a national perspective risks undermining collective progress towards EU energy policy goals. A coordinated, EU-wide approach is essential to fostering energy security, sustainability and an efficient transition to a low-carbon economy. This alignment will also ensure that the EU maintains its leadership role in global climate initiatives while addressing immediate energy challenges.