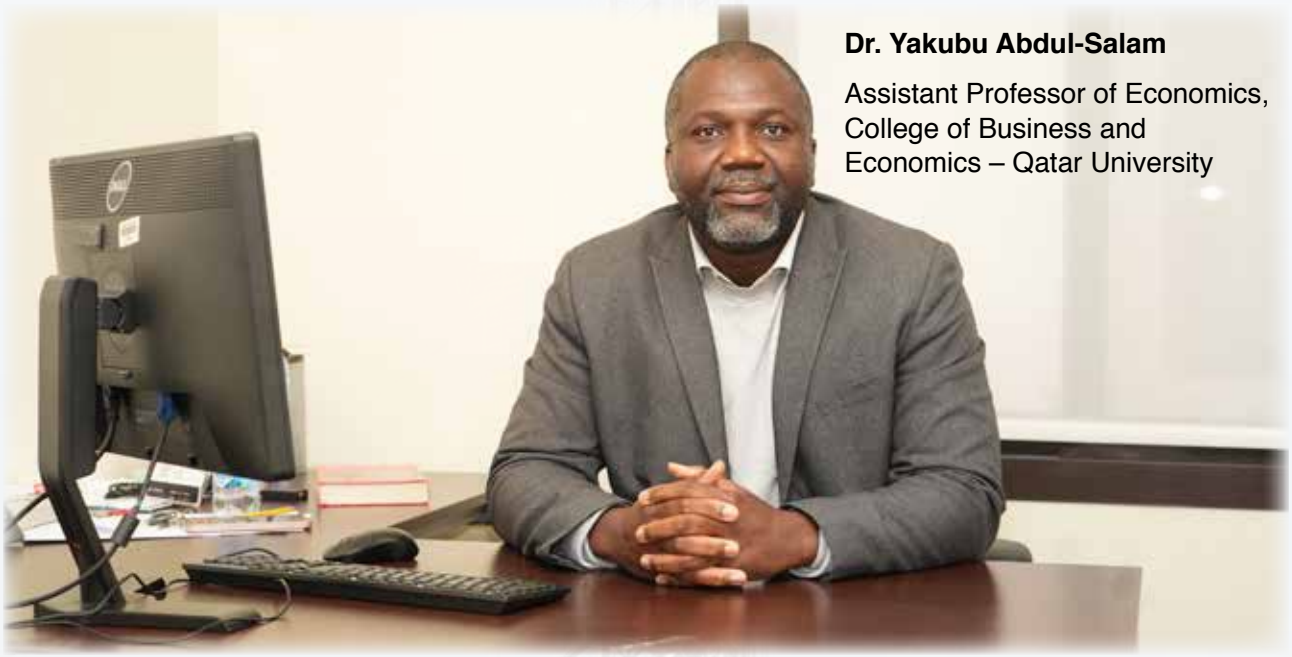
Qatar's LNG Exports:

Advancing Efficiency in Electricity Generation and Reducing Carbon Emissions in the Global Energy Transition



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As countries around the world seek to balance economic development, energy security, and climate change mitigation, the role of natural gas in the global energy transition has become increasingly important. While renewable energy sources such as solar and wind are expanding rapidly, many economies continue to rely heavily on fossil fuels to meet electricity demand. In this context, liquefied natural gas (LNG) has emerged as an important transitional fuel because it can generate electricity more efficiently and with lower carbon emissions than coal and oil.

Qatar is one of the world's leading LNG exporters and plays a central role in global energy markets. Since beginning LNG exports in 1997, Qatar has steadily expanded its trade relationships across Asia, Europe, and other regions (see Figure 1). Countries such as Japan, South Korea, India, China, Belgium, Italy, and the United Kingdom have relied on Qatari LNG to support electricity generation and diversify their energy systems. As global climate goals intensify, understanding the environmental and efficiency implications of these exports has become increasingly important.

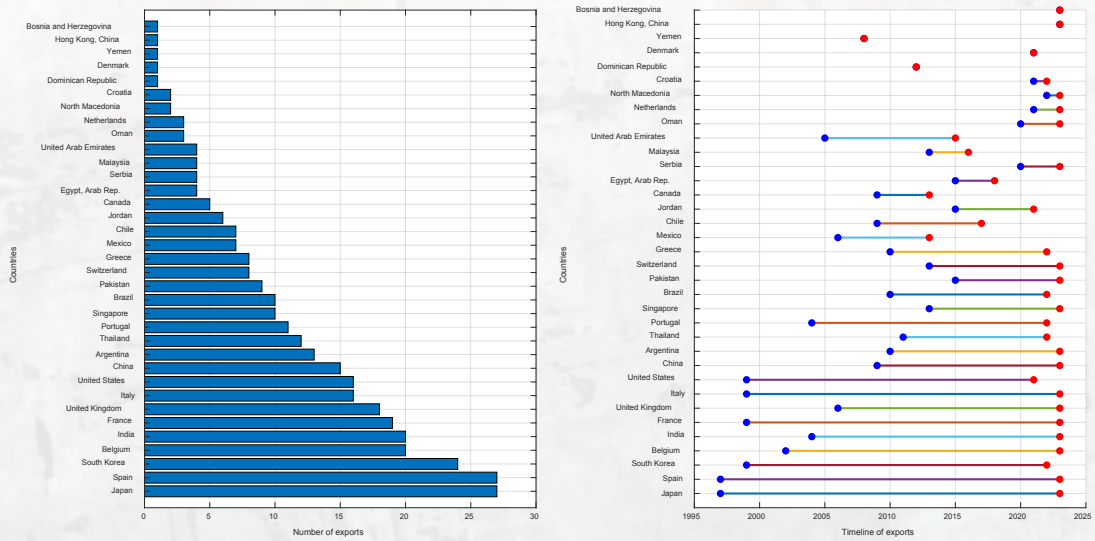


Figure 1: Frequency and timeline of LNG exports from Qatar to importing countries (Source: author plot using data from World Bank WITS Database, 2024).

∗ The left plot shows the frequency of LNG exports from Qatar to various countries, while the plot to the right depicts the timeline of these exports over the observed period (1997 – 2023)

A recent study at Qatar University examined the contribution of Qatari LNG exports to the global energy transition, focusing on two key dimensions: (1) improvements in electricity generation efficiency and (2) reductions in carbon dioxide (CO_2) emissions. The study combined econometric modelling with counterfactual scenario analysis to evaluate how Qatari LNG has affected electricity systems across importing countries between 1997 and 2022.

The first part of the study investigates whether increased use of Qatari LNG improves the efficiency of thermal electricity generation. Electricity generation efficiency refers to the amount of electricity produced relative to the amount of fuel combusted. More efficient systems require less fuel to generate the same quantity of electricity, reducing both waste and environmental damage.

Using panel data econometric techniques applied to 33 importing countries, the study finds strong evidence that Qatari LNG has significantly improved power generation efficiency. Natural gas-fired electricity generation is generally more efficient than coal- and oil-fired generation because natural gas plants, especially combined-cycle gas turbine systems, convert fuel into electricity more effectively.

The findings show that countries with higher shares of Qatari LNG in their electricity generation mix experienced significant improvements in electricity generation efficiency. However, the results also indicate diminishing marginal returns at very high levels of LNG penetration. In other words, the largest efficiency gains occur during the early stages of replacing coal and oil with Qatari LNG. As electricity systems become increasingly optimized, additional efficiency improvements become smaller over time.

The study also highlights important regional examples of fuel substitution. In Japan and South Korea, Qatari LNG played an important role in reducing dependence on oil in electricity generation. In countries such as Belgium, Italy, and the United Kingdom, Qatari LNG contributed to the gradual replacement of coal in power systems. These transitions improved electricity generation performance while supporting broader decarbonization objectives.

The second component of the study focused on carbon emissions reductions. To estimate the environmental contribution of Qatari LNG exports, the analysis develops a counterfactual scenario framework. This framework compares actual electricity generation systems, where Qatari LNG was used, and a hypothetical scenario in which coal and oil continued to dominate electricity generation.

The results reveal substantial emissions reductions attributable to Qatari LNG exports. Between 1997 and 2022, Qatari LNG exports avoided an estimated 3,525.66 million tonnes of CO_2 emissions through the substitution of coal and oil in electricity generation (see Figure 2). To place this in perspective, the cumulative emissions reductions are equivalent to approximately 10% of total global energy-related CO_2 emissions recorded in 2022.

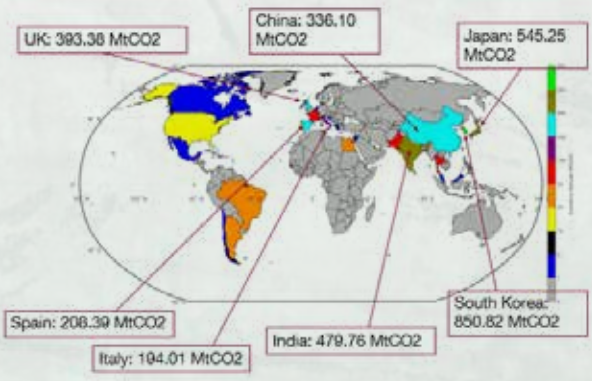


Figure 2: Cumulative end-use emissions reductions due to Qatari LNG exports, by country.

In recent years, annual avoided emissions associated with Qatari LNG stabilized at approximately 235 million tons of CO_2 per year. This exceeds the total annual energy-related emissions of several advanced economies, including Spain and the Netherlands. The study also estimates that these emissions reductions correspond to an annual global environmental benefit valued at approximately 41 billion US dollars.

The results demonstrate that Qatari LNG has made an important contribution to improving electricity generation efficiency and reducing emissions across importing countries. By facilitating the substitution of coal and oil with natural gas, Qatari LNG has supported cleaner and more efficient power generation systems while enhancing energy security in multiple countries and regions.

At the same time, the study points to the limitations of LNG within long-term decarbonization strategies. Although natural gas emits less carbon dioxide than coal and oil, it remains a fossil fuel. Excessive long-term reliance on LNG could create “carbon lock-in,” where countries continue investing in fossil fuel infrastructure instead of accelerating the transition to renewable energy systems. Furthermore, methane leakage across the natural gas supply chain remains an important environmental concern.

Consequently, the study concludes that while Qatari LNG can play a critical transitional role in the global energy transition, it should complement rather than replace long-term investments in renewable energy, energy storage technologies, and carbon abatement systems. In the short to medium term, Qatari LNG offers a practical pathway for reducing emissions and improving efficiency in countries that continue to depend on thermal electricity generation. Over the longer term, however, sustainable decarbonization will require a broader transformation toward low-carbon and renewable energy systems.

Overall, the findings reinforce Qatar’s strategic importance in the evolving global energy landscape. Beyond its economic significance, Qatari LNG exports have contributed meaningfully to cleaner electricity generation and climate change mitigation efforts across multiple countries. As the world navigates the complex transition toward more sustainable energy systems, Qatar’s LNG sector continues to play an influential role in supporting global energy security while contributing to emissions reduction.