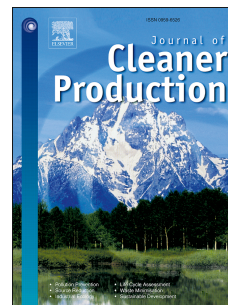


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Life cycle greenhouse gas emissions and freshwater consumption of liquefied Marcellus shale gas used for international power generation

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Abstract

The recent growth in U.S. natural gas reserves has led to interest in exporting liquefied natural gas (LNG) to countries in Asia, Europe and Latin America. Here, we estimate the life cycle greenhouse gas (GHG) emissions and life cycle freshwater consumption associated with exporting Marcellus shale gas as LNG for power generation in different import markets. The well-to-wire analysis relies on operations data for gas production, processing, transmission, and regasification, while also accounting for the latest measurements of fugitive CH₄ emissions from U.S. natural gas activities. To estimate GHG emissions from a typical U.S. liquefaction facility, we use a bottom-up process model that can evaluate the impact of gas composition, technology choices for gas treatment and on-site power generation on overall facility GHG emissions. For LNG exports to Mumbai, India for power generation in a combined cycle power plant with 50% efficiency, the base case life cycle GHG emissions, freshwater consumption, and CH₄ emissions as fraction of gross gas production are estimated to be 473 kg CO₂eq/MWh (80% confidence interval: 452 - 503 kg CO₂eq/MWh), 243 gal/MWh (80% CI: 200 - 300 gal/MWh) and 1.2% (80% CI: 0.81 - 1.79%), respectively. Among all destinations considered, typical life cycle GHG emissions range from 459 kg CO₂eq/MWh to 473 kg CO₂eq/MWh, with GHG emissions from liquefaction, shipping and regasification contributing 7 - 10% of life cycle GHG emissions.

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