255

TECHNO-ECONOMIC EVALUATION OF A CARBON-NEUTRAL TRANSOCEANIC LNG-CO_2 ENERGY SYSTEM INTEGRATING CARBON SEQUESTRATION

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Extended Abstract

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Abstract Summary

Liquefied natural gas (LNG) remains a critical component of global energy security; however, its lifecycle carbon emissions present a major challenge for decarbonization. This study presents an integrated techno-economic evaluation of a carbon-neutral, transoceanic LNG–CO_2 energy system linking the United States and Europe. In the proposed configuration, LNG is exported from the United States to European markets for power generation, while the resulting carbon dioxide (CO_2) is captured, liquefied, transported back across the Atlantic, and permanently stored in offshore geological formations in the United States.

The analysis adopts an incremental evaluation framework that focuses on the additional costs and benefits associated with integrating CO_2 transport and storage into an existing LNG export supply chain, rather than re-evaluating baseline LNG export revenues. A stoichiometric carbon accounting model is used to quantify CO_2 generation from LNG combustion and define corresponding transport and storage requirements. Maritime logistics and geological sequestration are evaluated using standardized vessel capacities, representative operating cycles, and field-scale injection constraints.

The techno-economic assessment incorporates additional capital and operating expenditures for dual-purpose maritime transport, CO_2 conditioning, terminal modifications, and offshore storage development. Revenue enhancements arise from improved vessel utilization through the elimination of ballast return voyages, CO_2 transport and storage service fees, and carbon-market incentives. Sensitivity analyses examine the effects of carbon price levels, storage development costs, vessel utilization rates, and regulatory conditions on breakeven carbon management costs.

Research findings demonstrate that bidirectional LNG–CO_2 logistics enhance capital efficiency and significantly reduce the net cost of achieving carbon-neutral LNG operations through integrated CO_2 transport and storage. The proposed framework provides a quantitative basis for assessing the incremental investments required to achieve carbon neutrality within established LNG export systems, while supporting long-term energy security.

Presenting Author Biography

Dr. Liying Xu specializes in the integration of financial economics and energy engineering. Her research focuses on valuation and pricing of energy assets, project finance, commodity and financial markets, and policy-oriented investment decision-making in energy infrastructure. She previously served as Assistant Professor of Finance at Oklahoma State University and Oklahoma Baptist University. She currently serves as Chief Energy and Financial Economist at Global Energy Sustainability. She holds a bachelor's degree in chemical engineering from Zhejiang University, China, and earned her master's and Ph.D. in energy finance and economics from The University of Texas at Austin, USA.