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Editorial: Green and sustainable LNG supply chain: A bridge to a low carbon energy society

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Editorial on the Research Topic
Green and sustainable LNG supply chain: A bridge to a low carbon energy society

Introduction

Due to its high energy density, low carbon dioxide emissions compared with coal, and ease of transportation and storage, liquefied natural gas (LNG) has been increasingly used in last decades especially, especially under climate policies (Zichittella and Perez-Ramirez, 2021). LNG is recognized as a transition energy carrier to assist the worldwide transition from a fossil fuel-based energy system to a zero carbon energy system.

The conventional LNG supply chain includes natural gas liquefaction, LNG transportation, and LNG regasification and storage. In recent years, substantial efforts have been conducted to reduce the carbon emissions of the LNG supply chain by adopting advanced optimization algorithms and emerging technologies (He et al., 2019). The aim of this Research Topic is to present recent progress in state-of-the-art research related to sustainability enhancement of the LNG supply chain towards a low carbon energy society. Within this Research Topic, four manuscripts were published covering key sustainability aspects across the LNG supply chain.

Energy-efficient natural gas liquefaction processes

To reduce the energy consumption of natural gas liquefaction processes is one of the main concerns in LNG supply chain. Ahmad et al. proposed an artificial neural network (ANN) using particle swarm optimization (PSO) algorithm as the learning method to predict the design variables of single mixed refrigerant natural gas liquefaction process under changing natural gas feed conditions. Moreover, a mini review of unconventional natural gas liquefaction processes to recover remote natural gas resources has been conducted and efficient separation of methane/nitrogen/hydrogen with low energy consumption, safe and compact liquefaction process for marine sloshing conditions, and fundamental researches related to gas-liquid equilibrium and supercritical fluid cooling heat transfer were also proposed by Xu et al.

Heat exchangers in LNG supply chain

Heat exchangers are the main components in natural gas liquefaction plants and LNG receiving terminals. The condensation heat transfer of natural gas and mixed refrigerants in the main cryogenic heat exchanger has also been studied from the numerical and experimental perspectives (Duan et al., 2017; Sun et al., 2019). New types of heat exchangers with high heat transfer efficiency also attracts attentions from the academic and industrial communities. Xie et al. conducted a state-of-the-art review of the current research status and technical challenges of printed circuit heat exchanger applied in floating liquefied natural gas (FLNG). They summarized and analyzed the heat transfer coefficients and pressure drop with distinctive flow channels in the printed circuit heat exchanger.

Natural gas district heating

Heating provided by natural gas-fired thermal plants could reduce the carbon emission by replacing the coal and oil-based thermal plants. Natural gas boilers are competitive with electric heaters, air source heat pumps, and hydrogen boilers for heating (Slorach and Stamford, 2021). The pipe insulation performance of natural gas-based district heating system for low-temperature applications was investigated by Usman and Kim. They designed a hybrid district heating system comprising natural gas-based fuel cell, heat pump and solar thermal. Polyethylene, ethylene propylene diene monomer rubber, and polyurethane were selected as the pipe insulation material for a 500 m pipe which supplied 60°C hot water. The results indicated that polyurethane with 32 mm as the optimum insulation thickness could achieve heat losses below 20 W/m.

Conclusion

This Research Topic covered key sustainability aspects across the LNG supply chain, including energy efficient natural gas liquefaction processes, high heat transfer coefficients heat exchangers, and district heating with natural gas fueled plant. The ANN approach is able to forecast the mixed refrigerant composition as the feed condition changes without conducting complex process simulation and optimization. The process integration can be a promising method to increase the energy efficiency of the unconventional natural gas liquefaction processes. Moreover, the performance of printed circuit heat exchangers should be tested under multiple sloshing conditions when they are applied on FLNG. There is a need to choose appropriate insulation material for natural gas fueled district heating system to reduce the heat loss. To further enhance the sustainability, greenhouse gas emissions and life cycle impact of the LNG supply chain should be studied in the future.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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