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LNG Technology Advances and Challenges

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Abstract

This paper outlines the development and implementation of technologies that have led to a significant growth in the worldwide LNG business and offers a look at technology directions that may hold promise to help continue future growth. Among the key technical enablers has been the evolution in the size of LNG trains over the past twenty-five years, resulting in significant unit cost reduction. Similar to liquefaction facilities, LNG ships have also been increasing in size to achieve similar reductions in unit cost of LNG transported. Lessons learned in the design, execution, and implementation of large LNG trains and ships, as well as the overall changes of LNG liquefaction trains over the past twenty-five years, have been key to the evolving design of the LNG value chain.

Nevertheless, the number of large discovered, undeveloped gas resources needed to realize such economies of scale is decreasing. Continuous technology evolution will have to be maintained to enable economic utilization of smaller, undeveloped, remote gas accumulations via concepts such as floating liquefaction. The need to access markets in stricter permitting environments will drive innovation in terminals, as seen in recent projects such as Adriatic LNG. In addition, an increasingly CO₂-constrained regulatory environment will likely necessitate improved efficiencies and lower greenhouse gas emissions across the LNG value chain.

Introduction

The volume of the international LNG trade has tripled over the past two decades, from 52 million tonnes per annum (MTA) in 1990¹ to 160 MTA in 2006. This growth is expected to continue over the next twenty years, resulting in a forecasted international LNG trade of 325 MTA by 2030.² As shown in **Fig. 1a**, the international LNG trade in 1990 was focused in the Asia-Pacific region, with LNG producers in Indonesia, Brunei, Malaysia, and Australia exporting LNG primarily to Japanese and Korean electric utilities. **Fig. 1b** reflects the transformative growth of the industry that occurred between 1990 and the present—major LNG trains were commissioned in the Middle Eastern nations of Qatar and Oman, as well as in the Atlantic Basin countries of Nigeria, Trinidad and Tobago, and Equatorial Guinea. Moreover, new LNG trains in Egypt expanded North Africa's historical presence in the LNG industry. A greater portion of the new LNG production was shipped to European and North American markets, where it was regasified at expanded and newly built import terminals.

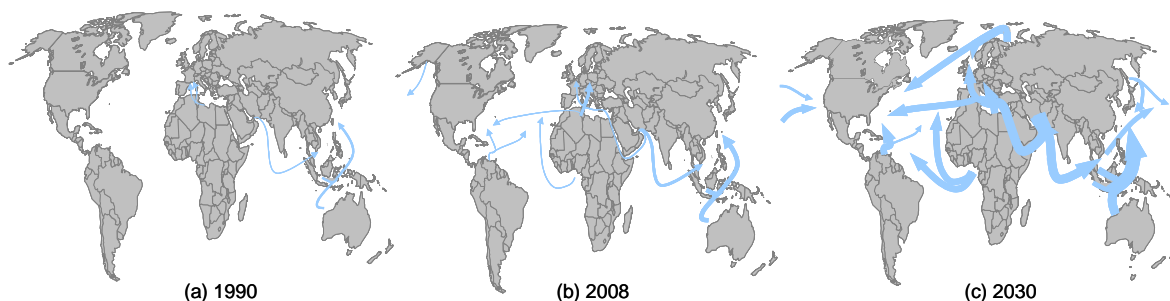


Fig. 1—Historical and forecasted growth of the world LNG trade.

Fig. 1c shows predicted trends in LNG growth. Production from the already prolific Asia-Pacific LNG exporters is expected to increase, and a portion of this LNG is expected to be routed to the West Coast of the North America. Important undeveloped gas resources remain in the Atlantic Basin countries and will likely be commercialized as LNG. In addition,