

Process Intensification Across the LNG Value Chain: Unlocking Efficiency from Liquefaction to Regasification

While transitioning towards a fully decarbonized future, LNG is expected to remain a cornerstone of the global energy system, underpinning energy security and operational flexibility while renewable generation, storage, and infrastructure continue to scale.

Therefore, the LNG industry is increasingly required to deliver higher efficiency, reduced emissions, and improved economic performance under evolving market and environmental constraints.

Process intensification (PI) provides a structured approach to address these challenges by minimizing equipment footprint, enhancing energy efficiency, and simplifying process configurations. This lecture investigates the application of process intensification principles across the LNG value chain, focusing on both liquefaction and regasification terminals.

- In liquefaction plants, PI is enabled through advanced refrigeration cycle design, integration of process functions, and deployment of highly efficient and compact equipment such as cryogenic heat exchangers and optimized compression systems. These solutions reduce specific energy consumption while improving overall plant compactness and constructability.
- In regasification terminals, process intensification is primarily achieved through efficient thermal integration and minimization of product losses. The optimization of vaporizer technologies, the utilization of waste heat from adjacent industrial or power generation facilities significantly reduce infrastructure requirements and enhance operational flexibility.
- Floating facilities (FLNGs and FSRUs) represent a natural implementation of process intensification concepts in the LNG Industry, where stringent space and weight constraints drive the integration and simplification of process systems. The combination of multiple process functions within a compact and modularized floating asset enables a faster deployment and increased flexibility for the monetization of remote or stranded gas resources.

The lecture highlights how a system-level approach to process integration allows trade-offs between energy efficiency, compactness, and operability to be effectively managed. Process intensification emerges as a key enabler for the next generation of LNG developments, supporting more flexible, cost-effective, and lower-carbon solutions across both export and import infrastructures.