

Liquefied Natural Gas (96/97S2)

Liquefied natural gas (LNG) technology has been adopted on a large scale for marine transport of natural gas, and on a smaller scale for other applications, notably gas storage for peak-shaving and for vehicle fuel. Marine transport of LNG is used mainly where pipeline transport of gas has not been considered feasible on technical or economic grounds, e.g. for sea routes where pipeline technology is inadequate, or where the distance is too great for economical viability. LNG plants built for this purpose are described as “base load” plants, to distinguish from peak-shaving applications.

Approximately six percent of world natural gas production is transported as LNG. International LNG trade commenced in 1964 with the first commercial shipment from Algeria to the UK. Today, trade is over 75 million tons per year, involving nearly 20 countries, with a fleet of about 100 of the world’s largest and most expensive cargo ships.

For a major new project, the total investment required can be in the region of \$5 billion or more. Although the liquefaction plant is the single largest cost element, large investments are also needed in ships and in the reception terminal. The main technical challenge is to minimize the costs of a supply chain which has to operate at minus 161°C. The core element is the liquefaction process itself, which is the major focus of this report. The main processes employed for liquefaction in base load LNG plans are listed below:

MAJOR LIQUEFACTION PROCESSES FOR BASE LOAD LNG PLANTS

Process Type	Process Name and Licensor	Description
Pure refrigerant cascade	Phillips cascade (Phillips Petroleum)	Propane, ethylene, methane cascade refrigeration cycle
Single mixed refrigerant (MR) cycle	PRICO Single-MR process (Pritchard Corporation); APCI Single-MR process (Air Products & Chemicals, Inc.)	Mixed refrigerant in a single refrigeration cycle
Propane pre-cooled mixed refrigerant (MR) cascade	APCI C ₃ -MR process (Air Products & Chemicals, Inc.)	Mixed refrigerant cycle in cascade with a pure propane refrigeration cycle
Double mixed refrigerant (MR) cascade	Tealarc double-MR process (Technip Snamprogetti)	Two mixed refrigerant cycles in cascade

The focus of LNG trade is East Asia; Japan imported 64 percent of the total of 75 million tons per year, with South Korea and Taiwan as the other main importers. The main export plants are in Indonesia, Malaysia, Brunei and Australia. Key constraints to growth will continue to be the massive capital investments needed, and the complexity of the

commercial and financial arrangements to establish the complete supply chain. In practice, much of the future growth of the business will result from the expansion of capacities at existing locations.