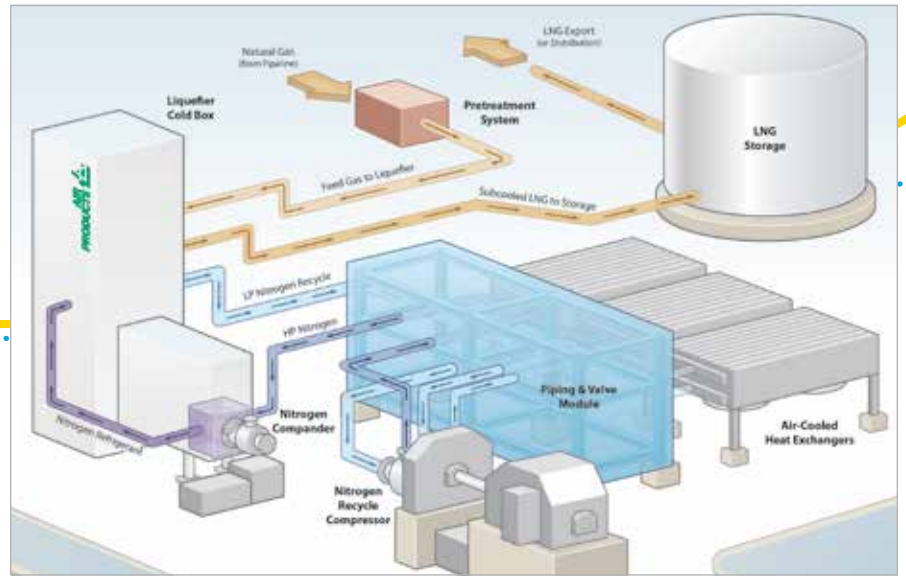
# Small-scale LNG liquefaction plant capabilities for capacity up to 800 TPD*

## Simple design, competitive cost and schedule




A peak shaving facility featuring the AP-N™ LNG Process, fully equipped with each core system integral to safe and reliable liquefaction.

Air Products' LNG cold boxes installed at a plant site in Hokkaido, Japan (courtesy of JAPEX).

### Small LNG plant applications

- Peakshaving and emergency reserve
- Mining and transportation fuel
- Remote gas monetization and virtual pipeline
- Bio LNG
- Shipboard and LNG terminal BOG reliquefication

## Unrivaled experience

Air Products' small-scale LNG offerings provide cost effective and reliable solutions for owners and project developers. Backed by over 75 years of experience engineering and designing cryogenic coldboxes using turbomachinery for refrigeration in air separation facilities, and over 50 years of experience in both air separation and LNG engineering and process design, Air Products' unrivaled technology is proven to perform.

Air Products also owns and operates more than 100 nitrogen liquefiers and over 300 cryogenic plants. Year in and year out, our system-wide plant availability exceeds 99 percent, while achieving the industry's lowest levels of operating and maintenance costs. This world class capability and proven experience carries over to the technology and equipment Air Products designs, engineers, and manufactures for natural gas liquefaction and nitrogen rejection.

## Air Products small-scale LNG offerings include:

- AP-200T™ Product - 200 TPD AP-N™ LNG Process
- AP-400T™ Product - 400 TPD AP-N LNG Process
- Customized capacity from AP-C1™ and AP-N LNG Processes
- AP-SMR™ LNG Process or multiple trains of AP-N LNG Process for higher capacity

*metric tonne per day

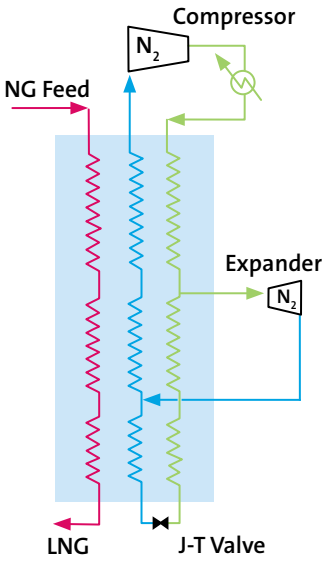
# Proven design

Air Products' efficient process designs have proven to be robust and reliable in natural gas liquefaction service. Small-scale liquefaction plants built decades ago, using Air Products' equipment, remain in service today. Utilizing our experience from designing and building of over 2,000 cryogenic facilities, Air Products can help with your small-scale LNG needs.

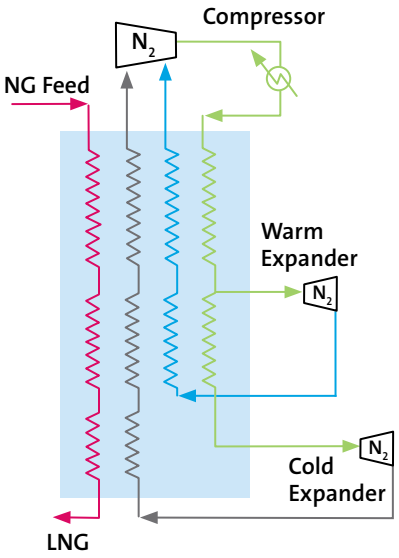
# Various process configurations available to suit your requirements

## AP-N Nitrogen recycle

This process is available in two options: single-expander or dual-expander.




Single-expander AP-N Process offers standard designs, low capital cost and proven technology.

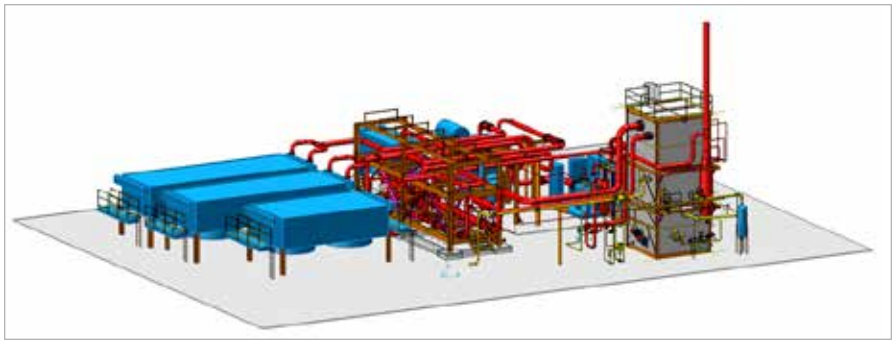



Dual-expander AP-N Process offers standard designs, multiple expanders allow for higher efficiency.

# Features and benefits of nitrogen expander cycles

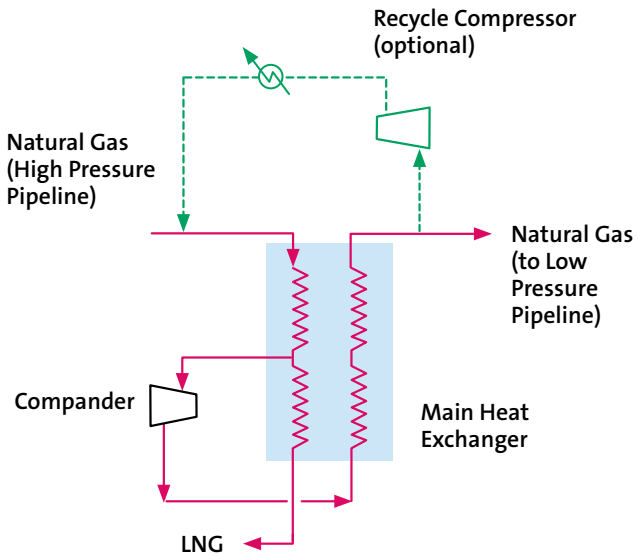
- Lower capital cost than competing mixed refrigerant technologies
- Simple operation and superior turndown efficiency
- Nonflammable and environmentally benign nitrogen refrigerant
- Low cost and ready availability of nitrogen
- Modularized design of the liquefier minimizes field construction cost
- High efficiency options

3D drawing for peak shaving, BOG reliquefication, and other small capacity applications.



## AP-C1™ LNG Process (methane expansion)

The AP-C1 process uses the feed gas as the refrigerant eliminating the need for external refrigerants and reducing the costs associated with refrigerant import and storage. The technology is proven and can convert natural gas feed directly to LNG by taking advantage of the pressure differential between two pipelines, thereby eliminating incremental power input as well as a refrigeration compressor. An optional methane recycle compressor would provide increased process flexibility and availability.




### Comparison of small-scale LNG liquefaction process options

| | Single-expander AP-N | Dual-expander AP-N | AP-C1 |
|---|---|---|---|
| Feed gas rate | 140 to 250 TPD | 200 to 650 TPD | 60 to 800+ TPD |
| Efficiency | Good | Better | Best |
| Capital cost | Lower | Low | Lowest |
| Refrigerant components | $N_2$ | $N_2$ | C1 |
| Subcooling capability | High | High | Low |

### For Reference: Table of Unit Conversions

| | | | | | | |
|---|---|---|---|---|---|---|
| 0 | 100 | 200 | 300 | 400 | 500 | TPD |
| 0 | 62 | 124 | 186 | 248 | 311 | kUS Gal/d |
| 0 | 0.04 | 0.07 | 0.11 | 0.15 | 0.18 | MTPA* |
| 0 | 5.2 | 10.4 | 15.6 | 20.9 | 26.1 | MMSCFD |
| 0 | 5.3 | 10.7 | 16.0 | 21.4 | 27.2 | kMMBTU/d |

*million tonne per annum

## Optional process technology and equipment features

- Nitrogen rejection (to meet LNG spec of max. 1% $N_2$)
- Hydrogen extraction (to handle hydrogen enriched natural gas)
  - Options for extracted hydrogen include reinjection into a pipeline, use as a fuel or other

## Air Products Rotoflow Turbomachinery for $N_2$ and C1 expanders/ companders

Building turbomachinery with high reliability, high efficiency, improved safety and lower operating costs is second nature at Air Products. Why? Because for more than seventy years we have been building turbomachinery equipment to exacting standards for our own use. As one of the only OEMs both manufacturing and operating turbomachinery, Air Products intimately know the equipment and the processes.

## Small-scale LNG plant experience

| Country | Customer | Start-Up | LNG Capacity (TPD) | Air Products Process |
|---|---|---|---|---|
| England | British Gas Council | 1981 | 227 | AP-SMR |
| Japan | Japex | 2004 | 144 | AP-N |
| | | 2007 | 206 | AP-N |
| United States | Alabama Gas Co. | 1965 | 103 | Cascade |
| | Massachusetts | 1973 | 165 | AP-SMR |
| | Hopkinton LNG | 1977 | 392 | Cascade |
| | Cove Point LNG | 1994 | 310 | AP-SMR |
| | Holtzville LNG | 2001 | 124 | AP-N |
| | Philadelphia Gas Works | 2002 | 330 | AP-C1 |
| | Fields Point LNG | 2022 | 412 | AP-N |

This experience enables us to deliver turbomachinery to you with exceptional performance, reliability, safety and value.

With over 3,000 units operating worldwide, we have unique access to operating data, giving us insight into every nuance of both equipment and processes. We continuously incorporate this operational feedback and knowledge into our machinery designs.

Air Products' cryogenic expander installed in a small-scale LNG plant.

## About Air Products

Air Products is a world-leading industrial gases company celebrating 80 years of operation. The company's core industrial gases business provides atmospheric and process gases and related equipment to manufacturing markets, including refining and petrochemical, metals, electronics, and food and beverage. Air Products is also the world's leading supplier of liquefied natural gas process technology and equipment.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