Low-Emission Ammonia Data (LEAD): Infrastructure

Executive Summary

January 2025
Ammonia Energy Association

Maritime Ammonia Trade is ready to Scale-up

AMMONIA ENERGY ASSOCIATION

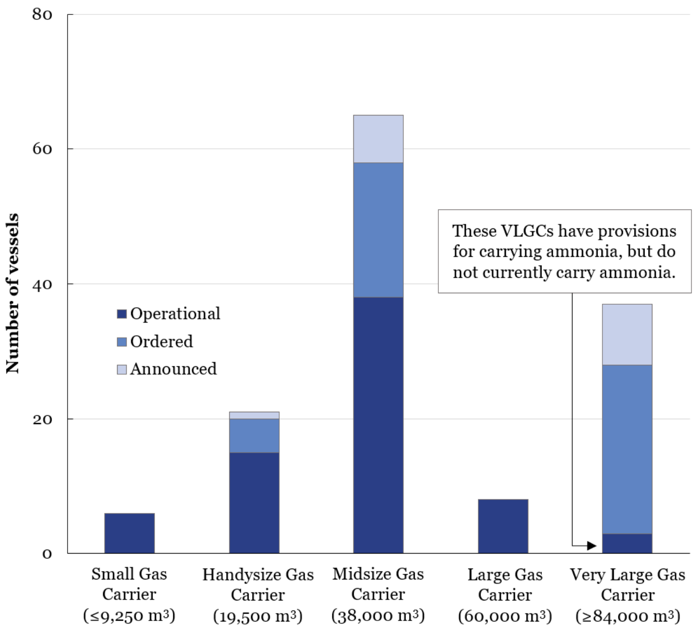
Around 17-20 million tons of ammonia (~10% of production) is transported internationally via seaborne vessels every year, with trade about constant over the past 20 years. Around 170 ocean going vessels are capable of carrying ammonia, although most of these vessels carry LPG. The existing ammonia fleet consists of around 72 vessels, with most vessels in the Midsize Gas Carrier class (MGC, around 38,000 m^3 or 25.9 kT).

Around 63 new vessels have been announced, of which 41 have been Ordered. This is in anticipation of the increased ammonia trade for energy applications, as well as for conventional uses in energy import locations. Most of the orderbook for ammonia carriers consists of Very Large Gas Carriers (VLGCs / VLACs), with an ammonia capacity of ≥84,000 m^3 (≥57.3 kT), allowing ammonia trade to scale up for energy applications.

- Draft interim guidelines for using ammonia as both cargo and fuel under the IGC Code are expected to be finalized at CCC 11 in September 2025, allowing ammonia carriers to use cargo ammonia as fuel in the engines.

Existing and future fleet of ammonia carriers

2025 Q1



Low-Emission Ammonia Data, Ammonia Energy Association

https://ammoniaenergy.org/lead/

Global Ammonia Terminal Capacity will expand

Ammonia storage terminals are globally distributed, with ammonia storage capacity in most industrial ports, totaling 11.5 million tons (MT) of existing capacity. Assuming 25 turnovers per year, and a similar distribution of importing and exporting terminals, around 144 MT can be transported annually. This exceeds the 17-20 MT of ocean-going transport each year, allowing for ammonia trade to expand.

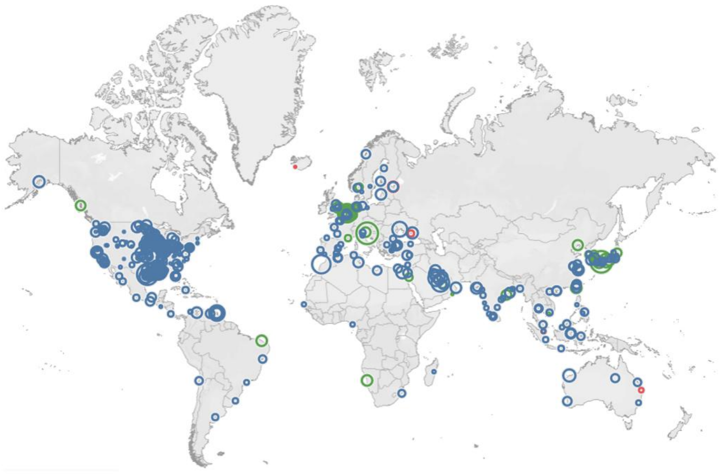
The United States has many inland ammonia terminals and the largest existing capacity (6.5 MT of existing capacity, including inland terminals), due to the direct use of ammonia as fertilizer in the US Midwest. This also implies significant inland ammonia transport and storage.

Around the rest of the world, ammonia storage terminals are mostly located in port areas, for ammonia import and for ammonia export. New export locations with multiple low-emission ammonia projects also announce centralized storage facilities, such as in Brazil and Namibia.

Ammonia Storage Infrastructure

Global capacity: 11.5 million tons of ammonia storage
2025 Q1

By Location (Operational, Under Development, Closed)



- Operational
- Under Development
- Closed

Low-Emission Ammonia Data, Ammonia Energy Association
https://ammoniaenergy.org/lead/

Global Ammonia Terminal Capacity will expand in East Asia

In East Asia, Japan and South Korea aim to import significant volumes of ammonia for energy applications, next to existing uses of ammonia in the chemical industry. Thus, ammonia storage facilities are Operational or Under Development in all industrial clusters.

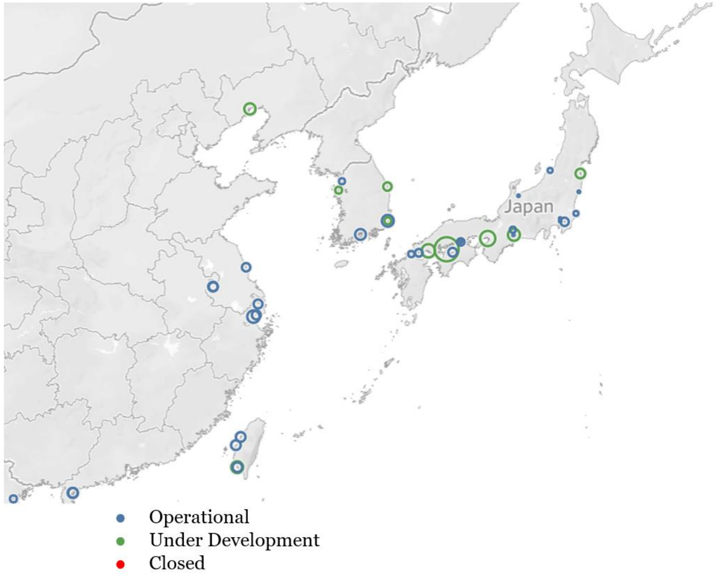
Japan aims to increase ammonia imports from around 0.2-0.3 million tons (MT) in the early 2020s, to 3 MT in 2030, and to 30 MT in 2050.

Assuming 25 turnovers per year, Japan's Operational ammonia storage capacity can process 4.4 MT. If the capacity Under Development is also included, about 16 MT of ammonia can be processed annually, indicating Japan is on track for its required ammonia import infrastructure.

Ammonia Storage Infrastructure in East Asia

2025 Q1

By Location (Operational, Under Development, Closed)



Low-Emission Ammonia Data, Ammonia Energy Association

https://ammoniaenergy.org/lead/

Global Ammonia Terminal Capacity will expand in West Europe

AMMONIA ENERGY ASSOCIATION

In West Europe, Belgium, Germany, the Netherlands, and the United Kingdom aim to import ammonia for energy applications. Also, the phase out of free allowances for CO_2 emissions in the European industry by 2034 will also result in the import of low-emission ammonia to Europe for existing markets.

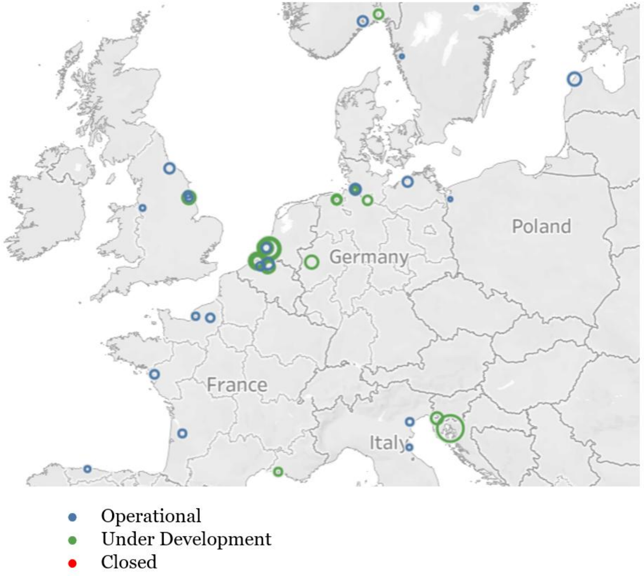
Rotterdam (The Netherlands) is the largest port in Europe with 13% of all energy utilized in Europe passing through the Port of Rotterdam. Rotterdam is also a major bunkering hub for vessels.

New import capacity for hydrogen and derivatives has been announced. Assuming 25 turnovers per year, 14.3 million tons (MT) of ammonia throughput capacity is Under Development in the Port of Rotterdam. To account for increased ammonia volumes, the PGS-12 design code for ammonia storage and handling has been updated recently.

Ammonia Storage Infrastructure in West Europe

2025 Q1

By Location (Operational, Under Development, Closed)



Low-Emission Ammonia Data, Ammonia Energy Association
https://ammoniaenergy.org/lead/

Ammonia Cracking is Developing with Pilots Under Construction

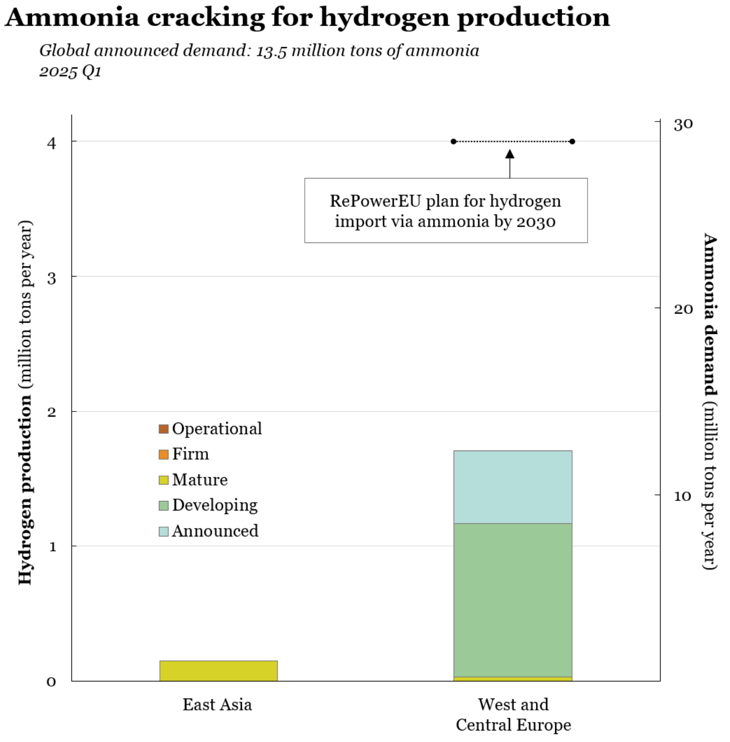
AMMONIA ENERGY ASSOCIATION

Ammonia crackers are considered for industrial hydrogen supply and for power generation in locations that import energy, such as East Asia, and West and Central Europe.

As of January 2025, 20 industrial-scale ammonia cracking projects are under development with 1.9 million tons (MT) of hydrogen capacity (or 13.5 MT of ammonia feedstock). While most projects are in early stages of development, several pilot-scale crackers are under construction.

- The 3 Firm and Mature projects in East Asia are focused on power generation. The 2 Firm and Mature projects in West and Central Europe are focused on industrial hydrogen supply.

In 2022, the RePowerEU plan indicated 4.0 MT of hydrogen would be imported via ammonia by 2030. The ammonia cracking projects announced so far could supply around one-third of this target. In addition, however, imports of ammonia for direct use (not cracking) may also be counted within the EU's target.



Low-Emission Ammonia Data, Ammonia Energy Association
https://ammoniaenergy.org/lead/

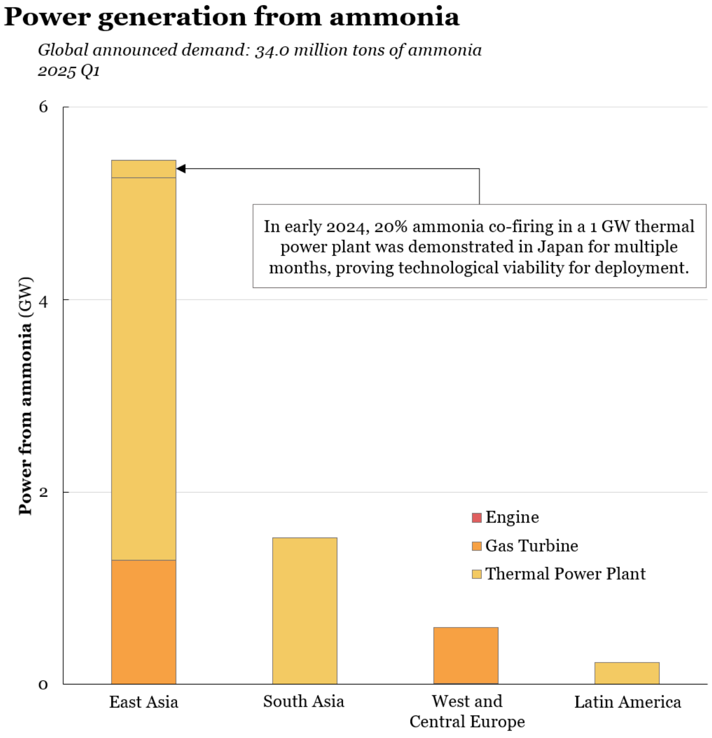
Ammonia for Power is Demonstrated as Policies and Projects develop

AMMONIA ENERGY ASSOCIATION

As of January 2025, 23 Ammonia for Power projects are under development, mostly based on ammonia-fueled gas turbines (7 projects) and ammonia co-firing in thermal power plants (15 projects). These projects have a combined power output of 7.8 GW from ammonia, and could represent up to 34.0 MT ammonia demand annually.

Most projects (19) are located in East Asia, with a significant focus on ammonia co-firing in thermal power plants (13 projects).

- In early 2024, 20% ammonia co-firing in a 1 GW thermal power plant was demonstrated in Japan. Japan is aiming to complete its Contract for Difference support in the first half of 2025.
- South Korea announced the conclusion of its first ammonia auction in December 2024.
- The first commercial demonstration of an ammonia-fueled gas turbine will be a 60 MW pilot project in Jurong Port (Singapore).



Low-Emission Ammonia Data, Ammonia Energy Association
https://ammoniaenergy.org/lead/

Assumptions

AMMONIA ENERGY ASSOCIATION

Ammonia Terminals:

- The number of turnovers for an ammonia terminal is assumed to be 25 per year.

Ammonia cracking:

- The hydrogen yield for ammonia crackers is assumed to be 78 wt.% H_2 (or 0.1385 kg-H_2/kg-NH_3)

Ammonia for power:

- The energy efficiency of an Engine is 30%, on a Lower Heating Value (LHV) basis
- The energy efficiency of a Gas Turbine is 40% for simple cycle operation, on a Lower Heating Value (LHV) basis
- The energy efficiency of a Thermal Power Plant is 35%, on a Lower Heating Value (LHV) basis

Terms of Use

AMMONIA ENERGY ASSOCIATION

For more information or questions related to this material, please contact Kevin Rouwenhorst at krouwenhorst@ammoniaenergy.org, Technology Manager, Ammonia Energy Association.

The original data upon which this material is based is available to the members of the Ammonia Energy Association. If you are interested in joining the AEA, please visit ammoniaenergy.org/members for more information. The original data is based on publicly available materials.