

AMMONIA AS A GLOBAL ENERGY CARRIER

SPECIAL EDITION

The Hydrogen Transition

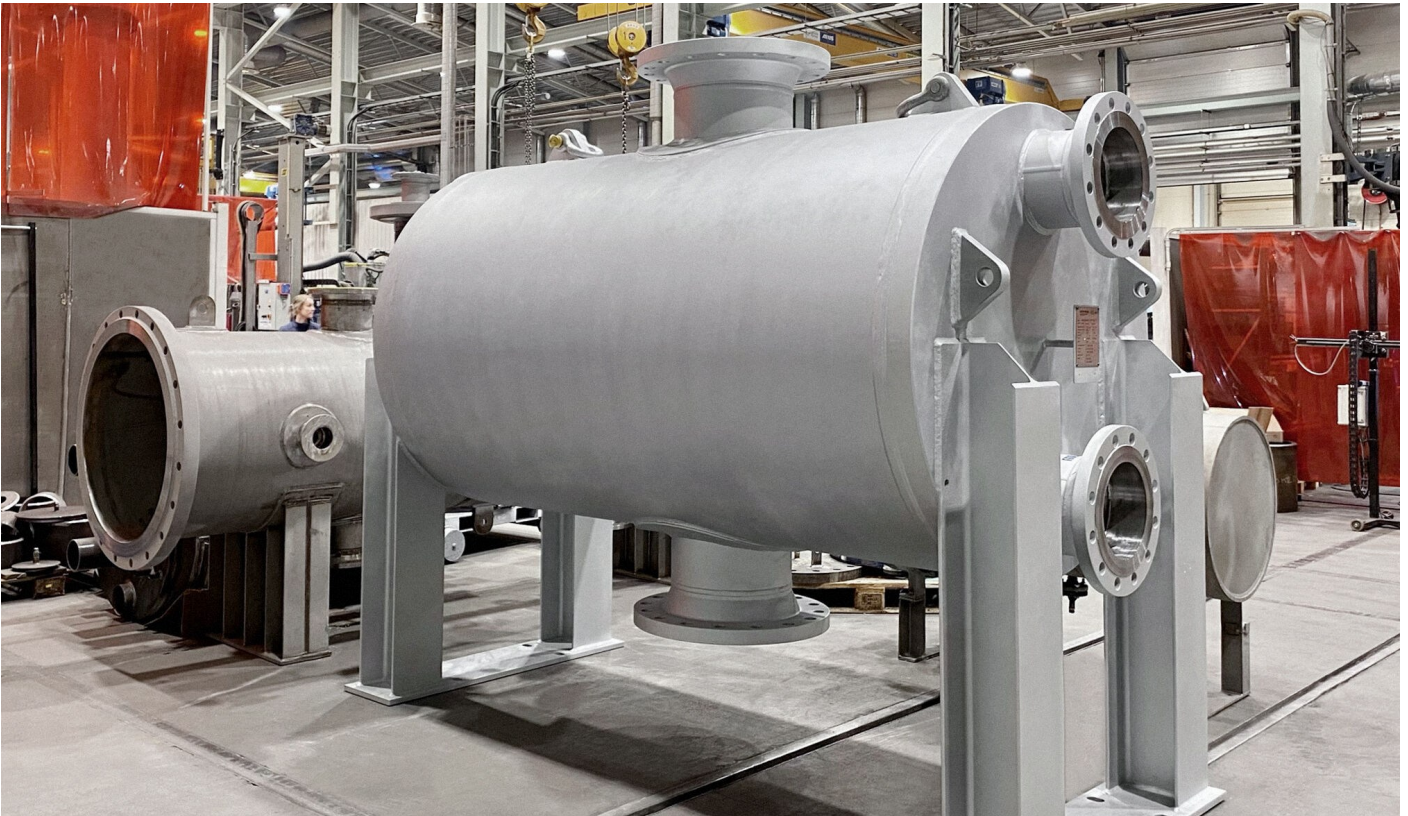
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Green Hydrogen in the Benelux: Slowed, but not stopped

By our correspondent: Marit Broks



ROTTERDAM – The green hydrogen sector in the Benelux is encountering noticeable headwinds. Persistently high electricity prices and a lack of committed industrial off-takers are slowing down project development across the region. Several initiatives remain in early planning stages, as investors and stakeholders adopt a more cautious stance.

Despite these challenges, industry experts emphasize that this is a temporary slowdown rather than a structural setback. Hydrogen remains widely regarded as a cornerstone of Europe's long-term decarbonization strategy.

TREND

Global shift in ammonia

A clear trend is emerging: hydrogen production is moving to regions where renewable energy is abundant and cost-effective. Countries with high solar irradiation, such as Namibia, parts of the Middle East, and South America, are positioning themselves as future exporters of green hydrogen.

Using solar power from photovoltaic (PV) installations, hydrogen is produced via electrolysis and immediately converted into ammonia for transport.

AMMONIA IMPORT

Ports prepare for import volumes

Major European ports such as Antwerp and Rotterdam are preparing to handle increasing volumes of imported ammonia. Upon arrival, the substance is stored in liquid form at -33°C . Before onward distribution via pipelines, rail, or ship, ammonia must be heated to approximately 0°C , a process that requires careful energy management.



We've asked managing director (Kapp) and industry expert Jeroen van Ruitenbeek about his vision.

"Ammonia (NH_3) is increasingly viewed as the most practical carrier for hydrogen on a global scale. Liquefied at -33°C under near-atmospheric pressure, ammonia can be transported using existing maritime infrastructure originally developed for LNG. Ammonia offers a higher volumetric energy density than compressed hydrogen. This makes it a transport-efficient and cost-effective solution for intercontinental energy trade."

When asking about safety concerns, Jeroen proceeds: "Ammonia is a colorless gas with a pungent odor and significant safety risks. It is toxic, corrosive, and flammable. Exposure can result in immediate harm to human health, while environmental risks must also be carefully managed. Strict safety protocols and robust heat transfer system designs are therefore essential across the ammonia value chain."

The heating challenge

Heating ammonia presents both technical and economic challenges. Due to its relatively high specific heat capacity, a considerable amount of energy is required to raise its temperature to suitable transport conditions.

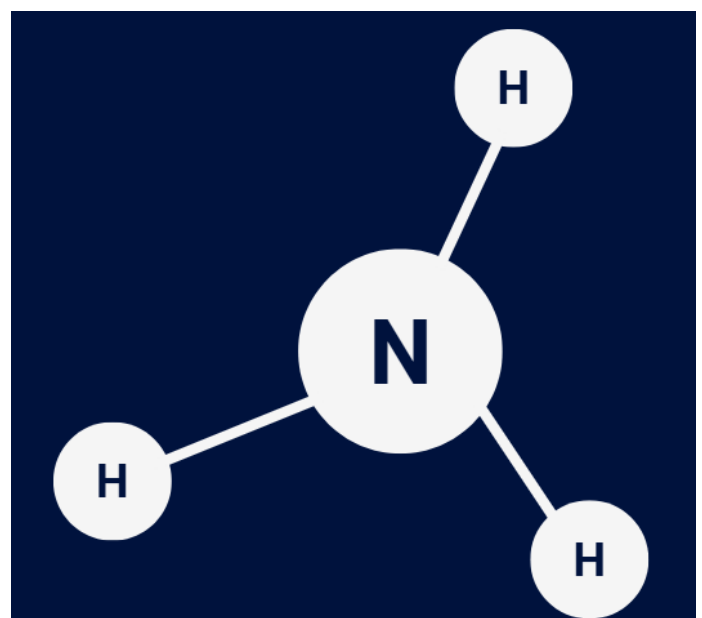
A range of solutions is currently being explored. One of the most promising approaches involves the use of seawater systems, which harness natural water sources to provide a highly efficient and sustainable heat supply with minimal need for external energy. Ambient air vaporizers offer another option, performing effectively under moderate climate conditions, though their efficiency declines in colder environments where freezing and condensation will occur.

Electric heating remains a reliable alternative, but its high energy demand raises questions about cost and sustainability at scale. Meanwhile, steam-based systems—widely used in conventional industrial processes—continue to play a role, in combination with intermediate fluids to maintain

safety and prevent operational issues such as freezing.

Across all these methods, advanced heat exchanger technologies are proving essential in improving both efficiency and safety, enabling the controlled and scalable handling of ammonia within the hydrogen value chain.

CHALLENGE



Heat exchange innovation

By Kapp Heat Transfer Engineers

Advanced heat transfer systems are enabling safer and more efficient ammonia processing:

Plate Heat Exchangers (PHE) allow effective heat recovery from natural sources such as seawater.

- **Fully welded Plate & Shell Heat Exchangers (PSHE)** are compact, reduce leakage risks and can handle high pressures
- **Electrical heaters** provide precise temperature control and reliable operation, ensuring consistent system performance.

Intermediate fluid systems enhance operational safety

These solutions are essential for scaling ammonia-based hydrogen infrastructure. Once delivered, ammonia can be converted back into hydrogen through a process known as cracking.

Two models are emerging:

- **Centralized Cracking** – Large facilities feeding hydrogen into regional networks
- **Decentralized Cracking** – Smaller, on-site units for industrial users

As NH₃ cracking is an endothermic process, it makes energy efficiency and heat recovery critical design considerations.

TECHNOLOGY SPOTLIGHT



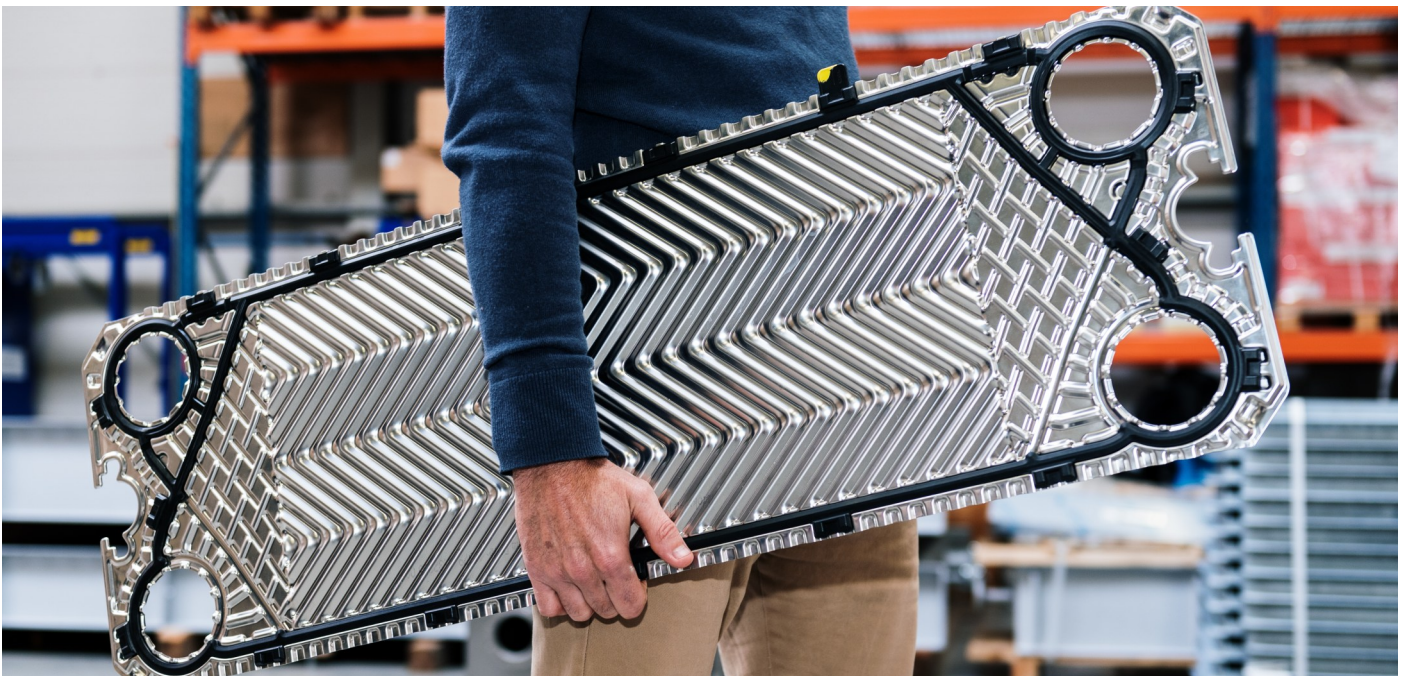
OUTLOOK

A Global Hydrogen Economy

While regional challenges persist, the broader trajectory is clear. The hydrogen economy is evolving into a global system, with production, transport, and consumption increasingly decoupled geographically.

Ammonia stands at the center of this transformation, bridging continents and enabling the large-scale movement of clean energy.

"The future of hydrogen is not confined by borders. It will travel where energy is needed most."



CONTACT

Want to know more about ammonia and hydrogen?

Or do you have a question about your process or production environment? Do you want to reduce costs, energy usage, and CO₂? Would you like to talk to people who know the industry and that are experienced in solving heat transfer problems? We would be happy to help.

ASK JEROEN



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