MISSION: AMMONIA

100% combustion in utility-scale gas turbines

WEBINAR PRE-READ

IHI | GE VERNOVA

This pre-read is designed to help you get the most out of our upcoming webinar in collaboration with IHI Corporation.

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Addressing the energy challenge: Why ammonia, and why now?

Ammonia (NH_3) has long been a cornerstone of the global industrial economy. With roughly **210 million tons produced in 2025**[1] it has long been essential to the global economy, especially in fertilizer production. Now, research is focusing on ammonia as a **lower-carbon emissions fuel for power generation**, a **hydrogen carrier**, and a **practical option for global energy transport and storage**.

Why it matters for power

While hydrogen is a promising carbon-free fuel, it presents significant hurdles in storage and transportation. Ammonia offers a strategic solution to these challenges. By "packaging" hydrogen into a liquid molecule that is easier to store and transport, ammonia builds upon more than a century of existing global infrastructure and operating and distribution know-how. Ammonia also offers several strategic advantages for the power sector:

LOGISTICS

Unlike liquid hydrogen, ammonia liquefies at moderate pressure and temperature, and its higher energy density offers a more established shipping profile globally.

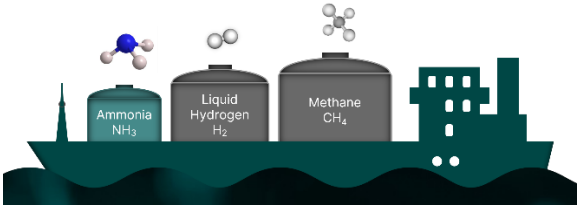
INFRASTRUCTURE

Millions of tons of ammonia are already traded and stored annually, providing a ready-made foundation for energy applications.

SCALABILITY

Ammonia meets the power industry's critical needs for high-volume delivery, long-term storage, and dispatchability.

A tale of three molecules: methane, hydrogen and ammonia



Compared with methane and hydrogen, ammonia has narrower flammability limits and lower flame speed, reducing some combustion risks (as seen in table 1). However, appropriate deployment of ammonia requires strong standards and handling protocols.

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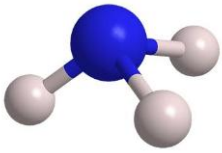
CHARACTERISTICS		Ammonia (NH_3)	Hydrogen (H_2)	Methane (CH_4)
Molecular weight	grams/mol	17	2	16
Boiling temperature	°C (°F)	-33.3 (-28)	-252.9 (-423.2)	-161.5 (-258.7)
Lower/Upper flammability limits	%	15/28	4/75	4.4/17
Flame speed	cm/sec	~6-7	~200-300	~30-40
Tank Material and capacity ratio		Carbon Steel Tank1.0	Stainless Steel Tank 1.5X	9% Nickel Steel Tank 1.7X
Current trade volume		~10% of total Production (~20MT)	Limited/Minimal	428 MT

Table 1. Comparison between ammonia, hydrogen and methane molecules
Information taken from IEA Ammonia Technology Roadmap Executive Summary; IEA Global Hydrogen Review 2024; IEA Global Hydrogen Review 2025; International Group of LNG Importers (GIINGL) 2026 Annual Report.



AMMONIA IS A WELL-ESTABLISHED CHEMICAL PRODUCT AND CAN BE A FUEL.

It offers higher volumetric energy density and easier liquefaction compared to hydrogen, which makes it suitable for direct use and combustion applications.

Technology is moving fast

Today, ammonia is mainly produced via the **Haber-Bosch** process using different hydrogen sources (e.g. natural gas and coal). At the same time, new lower-emission pathways are advancing, including:

- Gas reforming with Carbon Capture Sequestration (CCS)
- Water electrolysis using renewable electricity
- Emerging next-generation synthesis technologies:
    - Electrochemical synthesis (under development)
    - Plasma-assisted synthesis (under development)
    - Photocatalytic synthesis (research stage)

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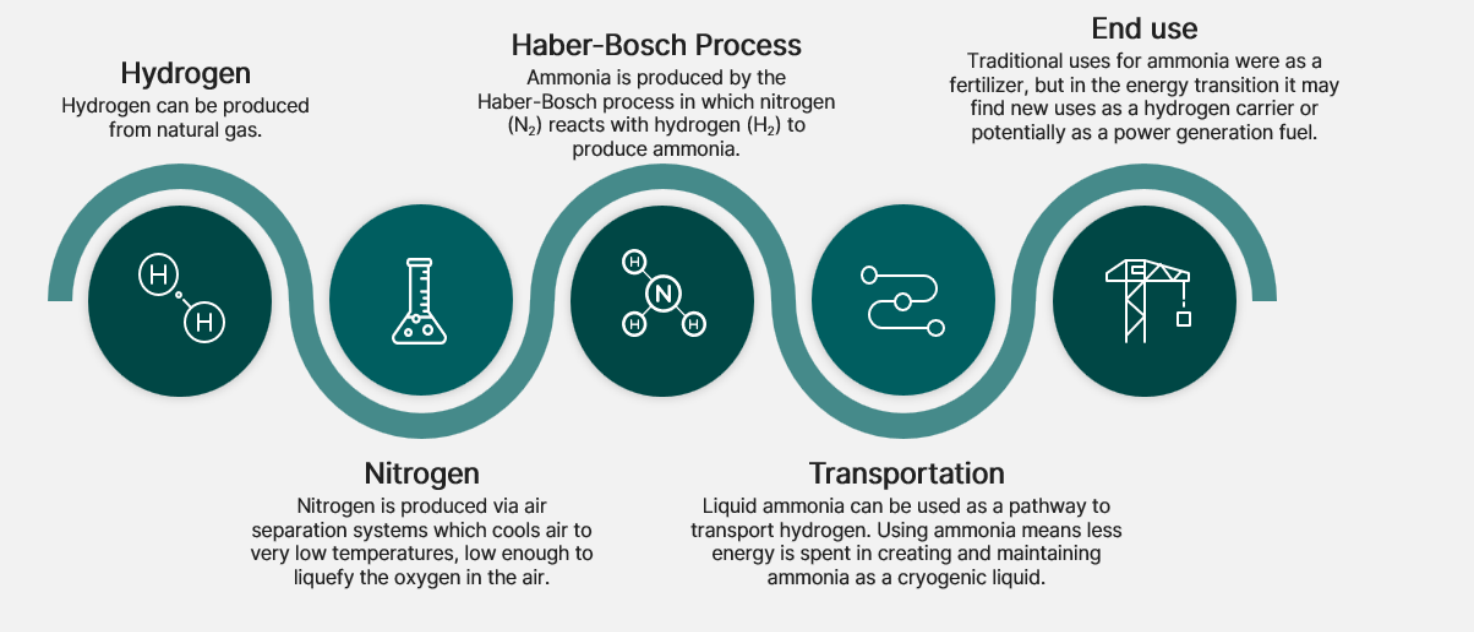
While these solutions mature, CCS enables low-carbon production today with technological maturity. Below you can see how ammonia is produced today:



As of August 2026, **405.8 million tons of low-emission and transitional ammonia capacity**[2] had been announced—showing strong momentum across the value chain.

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Illustration 1 presents that about 75% of ammonia is currently produced from natural gas and naphtha, with a share of 85% for fertilizers. As seen, ammonia is produced using various feedstocks, including renewable energy and water electrolysis, or fossil fuels such as coal, heavy fuel oil (HFO), natural gas, and naphtha.

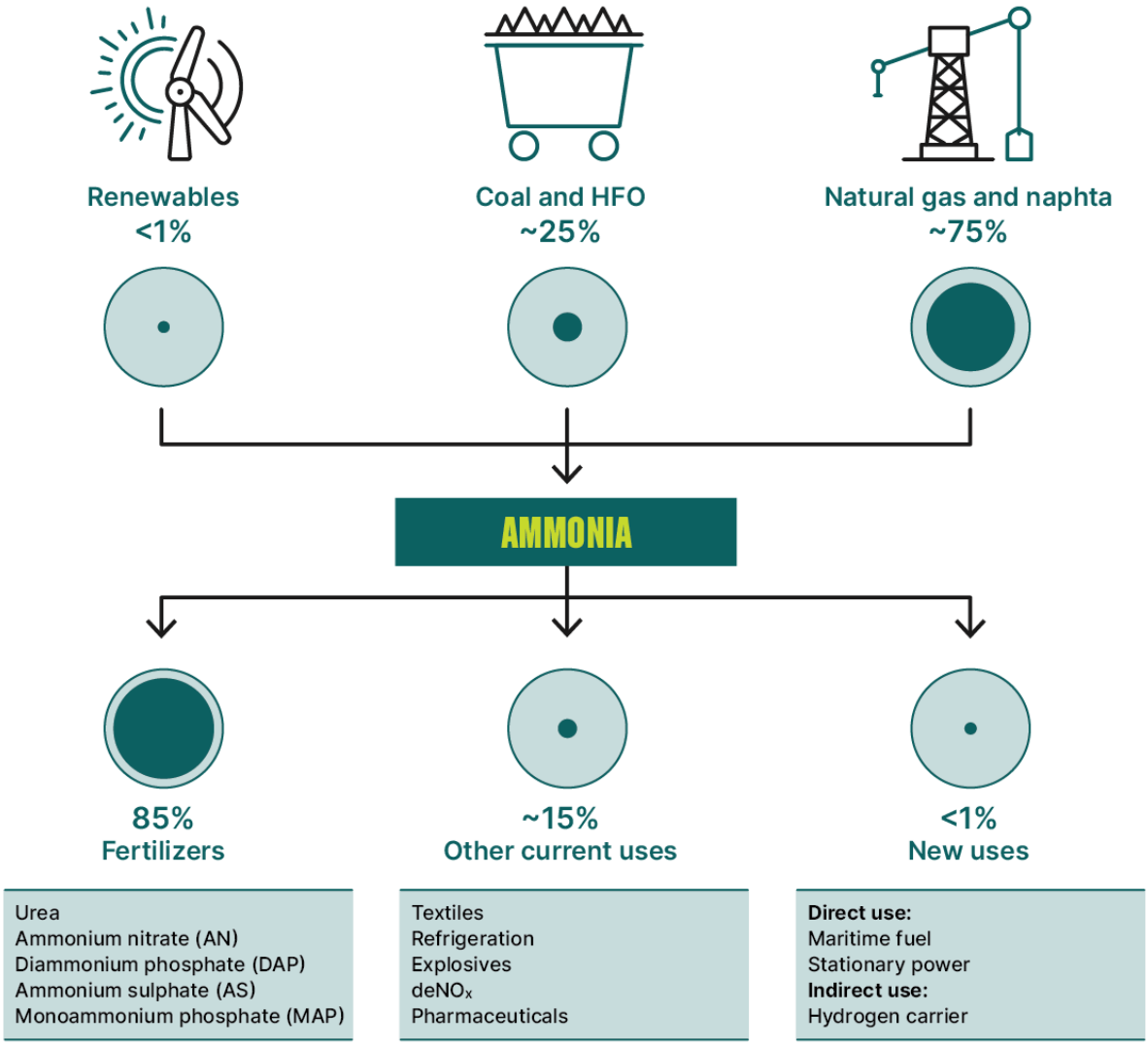

Illustration 1. Production of Ammonia, attributed to International Renewable Energy Agency in partnership with Ammonia Energy Association

Industry milestone: 100% ammonia combustion (joint development with IHI Corporation)

IHI and GE Vernova have successfully demonstrated 100% ammonia combustion using full-scale components under full-load F-Class gas turbine conditions. This is a major step toward enabling ammonia as a dispatchable, lower-carbon fuel for the grid. Our testing confirms that emission levels are aligned with the companies 'development roadmap.

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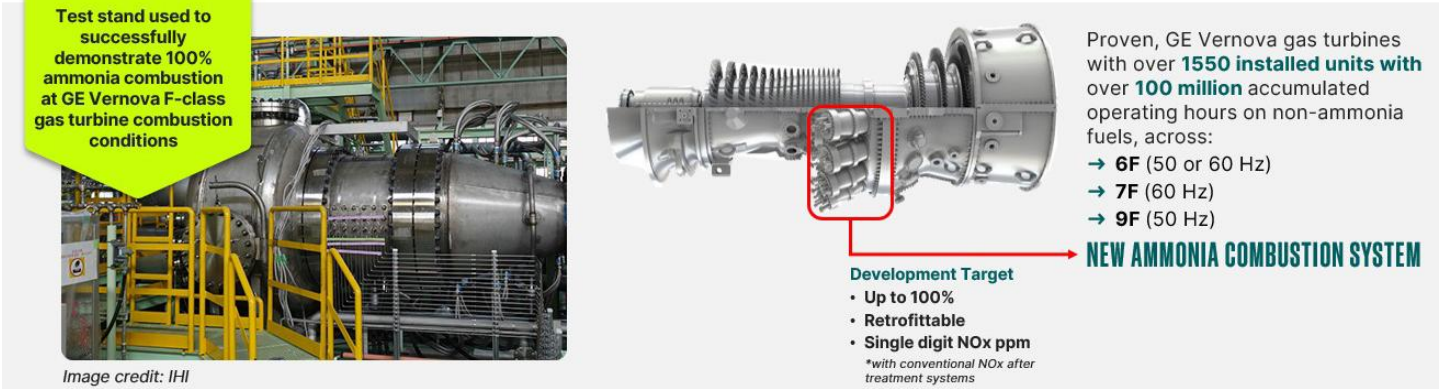
What this means for the grid:

- **Decarbonization**: providing reliable power with lower CO_2 emissions
- **Energy security**: enhancing grid stability through sustainable, dispatchable fuel

IGNITING THE NEXT GENERATION OF GAS TURBINES

100% AMMONIA COMBUSTION IN LARGE SCALE TEST



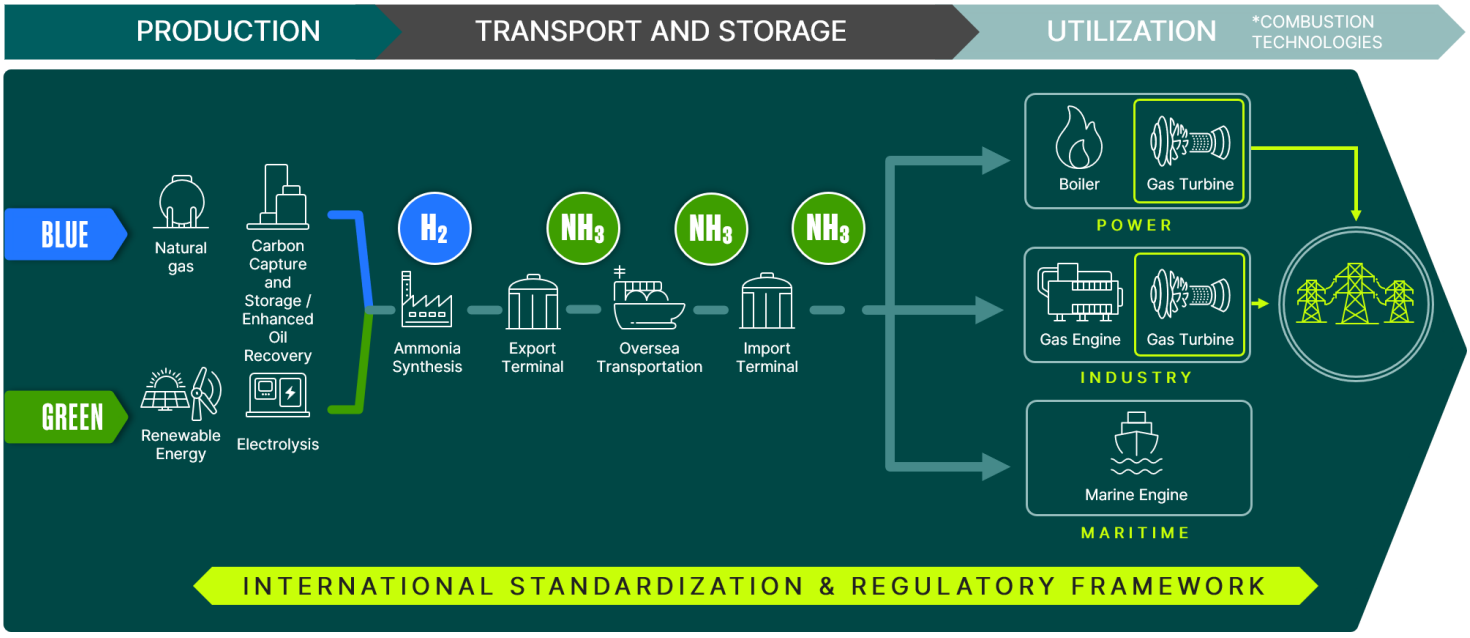
The path forward

Unlocking ammonia at scale requires a full value-chain approach—from production and transport to storage and end use. We believe in a holistic strategy that addresses:

- **Appropriate handling and social acceptance** - Addressing critical questions on NOx levels and handling.
- **Economic viability and standardization** - Developing international standards, technology, and regulatory frameworks.

DEMYSTIFYING THE AMMONIA VALUE CHAIN FOR POWER GENERATION

IHI



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Powering the future: East Asia leading the ammonia movement

The strongest demand signals today are coming from East Asia, where projects and policies are accelerating ammonia-to-power deployment.

- **Japan** has demonstrated ammonia co-firing and is supporting market growth through policy tools such as Contracts for Difference (CfDs).
- **Singapore** is advancing a 60 MW ammonia-fueled gas turbine pilot at Jurong Port.
- Reliance Industries Ltd (RIL) signed a long-term agreement to supply green ammonia to **South Korea's** Samsung C&T over 15 years.

Japan in particular is showing how policy, procurement, and imports can work together to build real demand and secure supply.

Japanese companies are starting to buy from new-build transitional and low-emission ammonia from projects overseas. They are doing this to gradually replace the traditional, higher emitting coal. This is more than a national story—it is a signal to the broader market about what demand creation can look like when policy intent is backed by procurement and deployment.

Going forward: Ammonia Energy Association (AEA) mission

The AEA and its members are leading efforts to decarbonize existing ammonia production and develop and expand lower-emission ammonia production pathways via:

AMMONIA ENERGY ASSOCIATION

- Gas reformation with carbon capture and sequestration (CCS);
- Water electrolysis with renewable electricity; and
- Other technology pathways

From vision to reality: the road to 2030

The road to 2030 will depend on turning ambition into execution—moving announced projects into operational capacity through collaboration, investment, and deployment. By the early 2030s[3], we expect to see the scale-up of these technologies potentially operating at a comparable scale, creating a balanced, resilient supply chain.

POLICY CERTAINTY

Like the schemes we're seeing in Japan and South Korea.

FIRM DEMAND SIGNALS

Buyers willing to commit to the offtake.

ENABLING INFRASTRUCTURE

The logistics to move clean ammonia from production hubs to demand centers.

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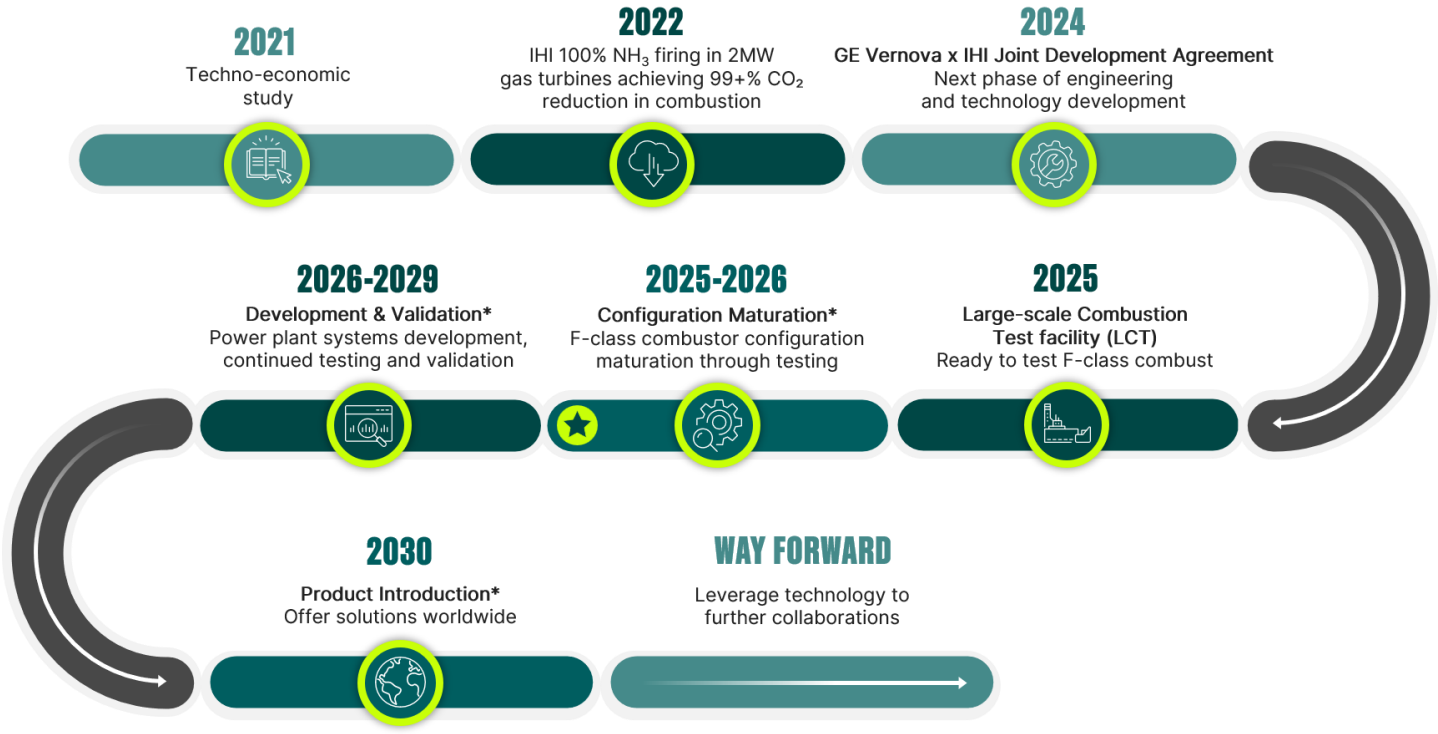
Learn the work that GE Vernova and IHI have been doing to make this technology a reality by 2030s.

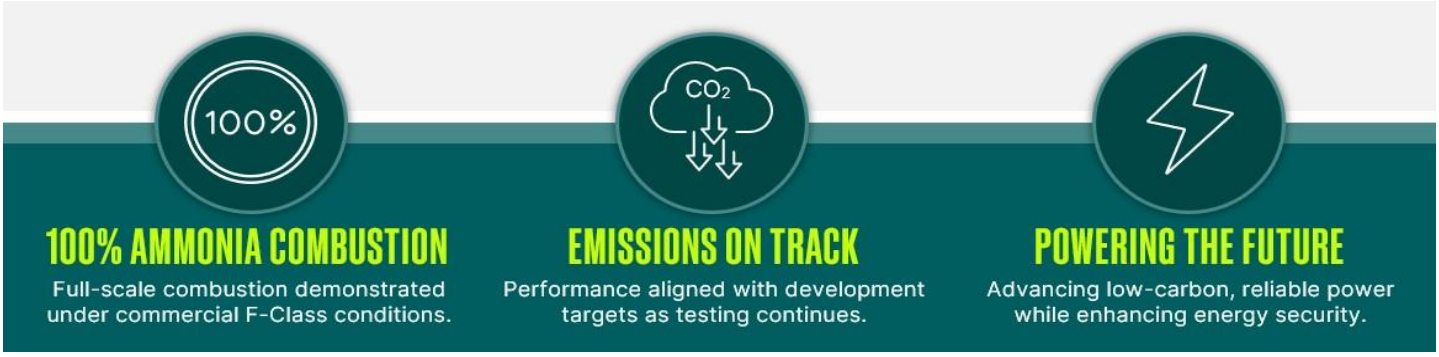
FROM VISION TO REALITY: ONE MILESTONE AT A TIME



*Expected dates based on current status.

Join the discussion

The energy transition is a marathon, not a sprint—but the pace of innovation is accelerating. During our upcoming panel discussion, we will explore the realities of ammonia as a fuel source, including our latest updates on safety and NOx control, with experts from the Ammonia Energy Association (AEA) and CF Industries.



[1] Source: S&P APAC Energy Market Outlook 2026

[2] **Transitional** refers to the retrofit of existing ammonia plants with decarbonization technologies, most often carbon capture and sequestration of process emissions. These plants generally serve existing end-uses (fertilizers, chemicals, explosives). Source: Ammonia Energy Association

[3] Expected dates based on current status.

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