AMMPOWER

Market-ready Solution for Decentralized Ammonia Production

November 2022, Phoenix

OTCQB: AMMPF
CSE: AMMP
FRA: 601A

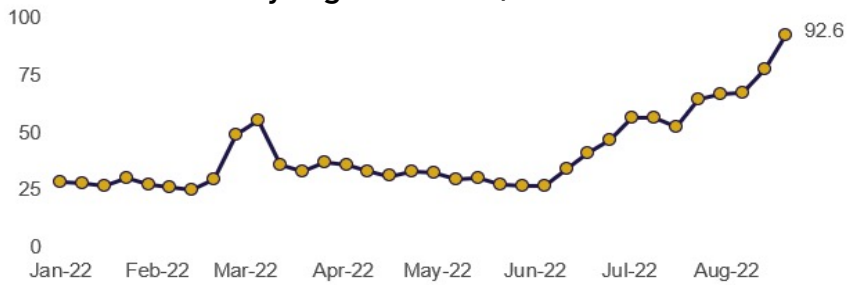
AmmPower: Decarbonizing the World Through Green Ammonia

Ammonia Today

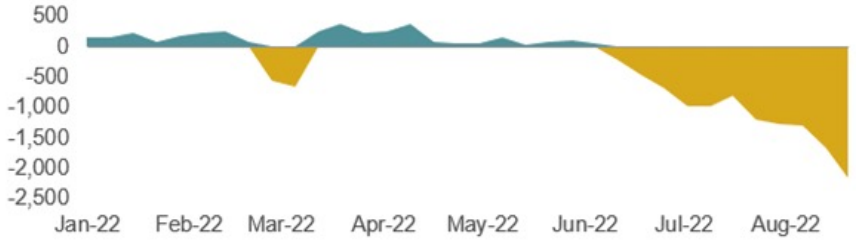
MARKET CHALLENGES

1 Natural gas drives the market price of ammonia

Weekly Avg Natural Gas, $ /MMBtu



Ammonia Profitability, $ /t



Source: CRU

- At peak, 67% of Europe's NH_3 production capacity has shut down from high natural gas costs making production unprofitable
- NH_3 demand remains high regardless of low supply and increased prices

Why is there a fertilizer shortage?

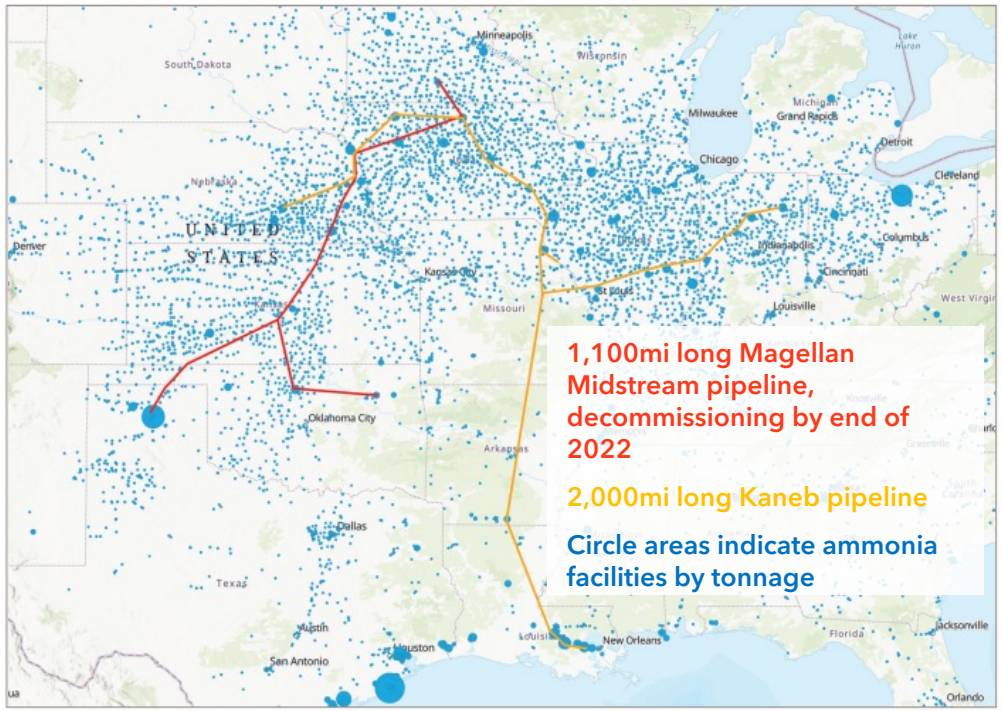
- Rising natural gas prices
- Ammonia via SMR becomes less profitable
- Ammonia plants shut down worldwide
- Ammonia shipment cancellations
- Cost of ammonia & ammonia transport increases

Ammonia Today

MARKET CHALLENGES

2 Ammonia production in the U.S. is CENTRALIZED

- About 60% of all U.S. ammonia production capacity was in Louisiana, Oklahoma, and Texas in 2020, according to the U.S. Geological Survey.
- U.S. domestic short-distance ammonia transport depends on a trucking system that now costs around $8/mile travelled.
- U.S domestic long-distance transport dependent on 2 major pipelines.



Source: The Royal Society 2020

"Union Pacific curtails fertilizer shipments, delaying deliveries and preventing new rail orders from being taken... impacting nitrogen fertilizer shipments during the spring application season."

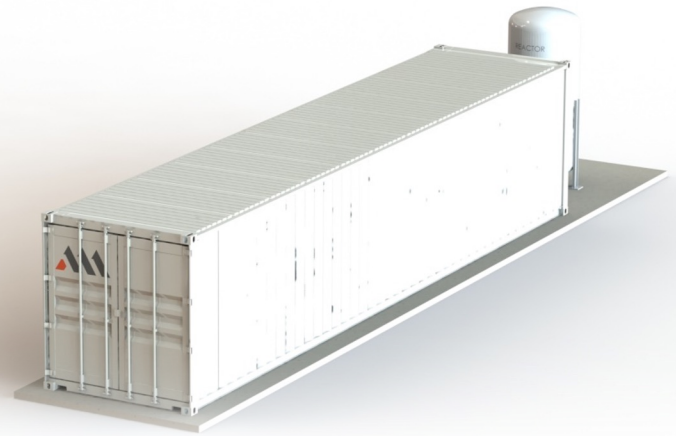
- CF Industries April 14, 2022

Solution

THE IAMM™ UNIT

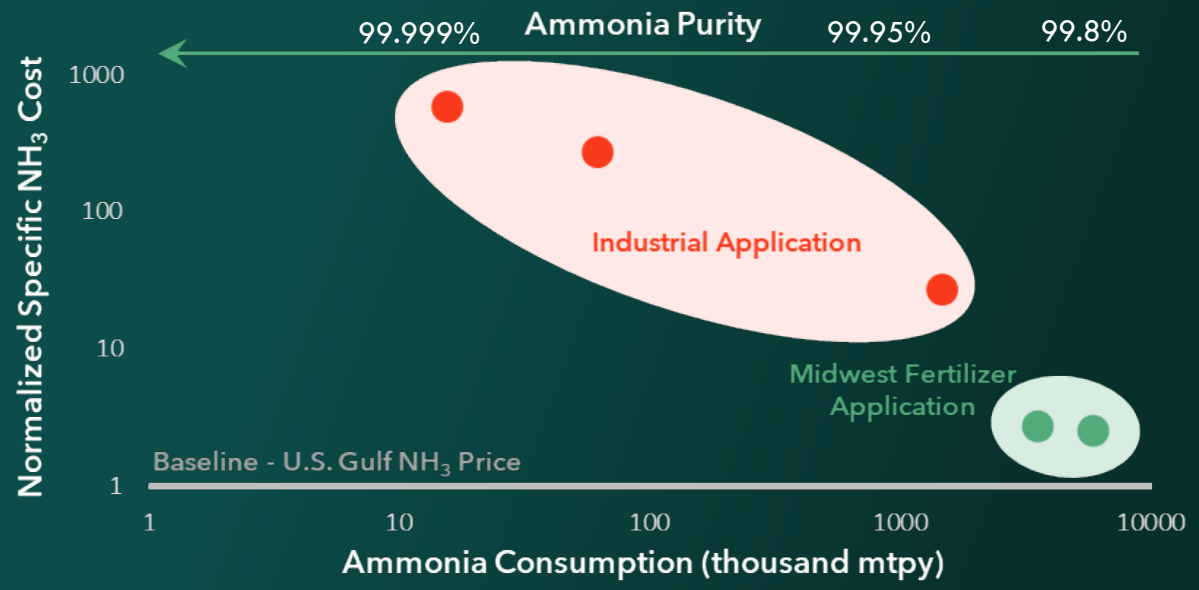
Create green ammonia and bring it closer to the end-user

1. Create green ammonia to create market stability
   - ✓ Green ammonia shifts the cost driver from natural gas to renewable electricity
   - ✓ Ammonia production becomes profitable again
2. Decentralize ammonia manufacturing by bringing production on-site
   - ✓ Shorten the ammonia supply chain
   - ✓ Reduce or eliminate ammonia transportation costs



The **Independent Ammonia Making Machine™** creates high-purity anhydrous ammonia from only water and air.

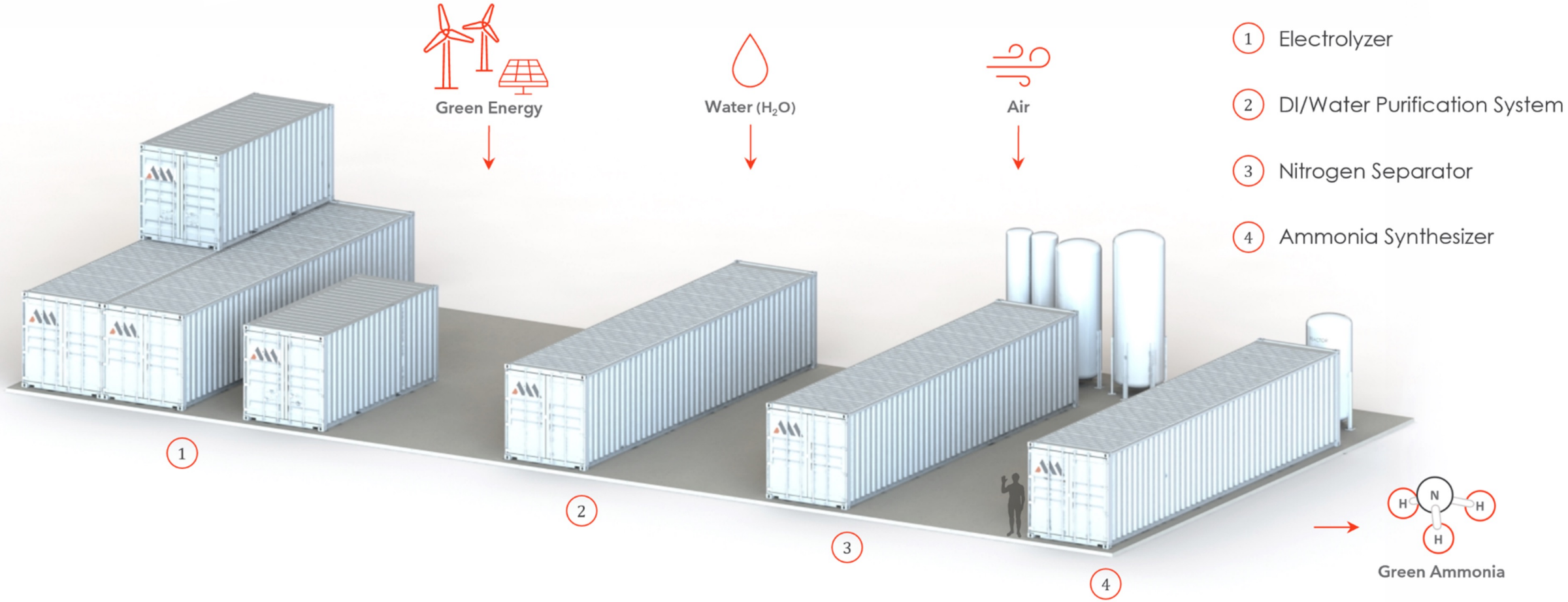
- ✓ Use green energy to make the ammonia "green"
- ✓ Reliably produce 4mt of carbon-free NH_3 each day
- ✓ Stack multiple units to scale up production
- ✓ Create green ammonia on-site and save on transportation & logistics costs
- ✓ Can be used for many agricultural and industrial applications



IAMM™ Unit

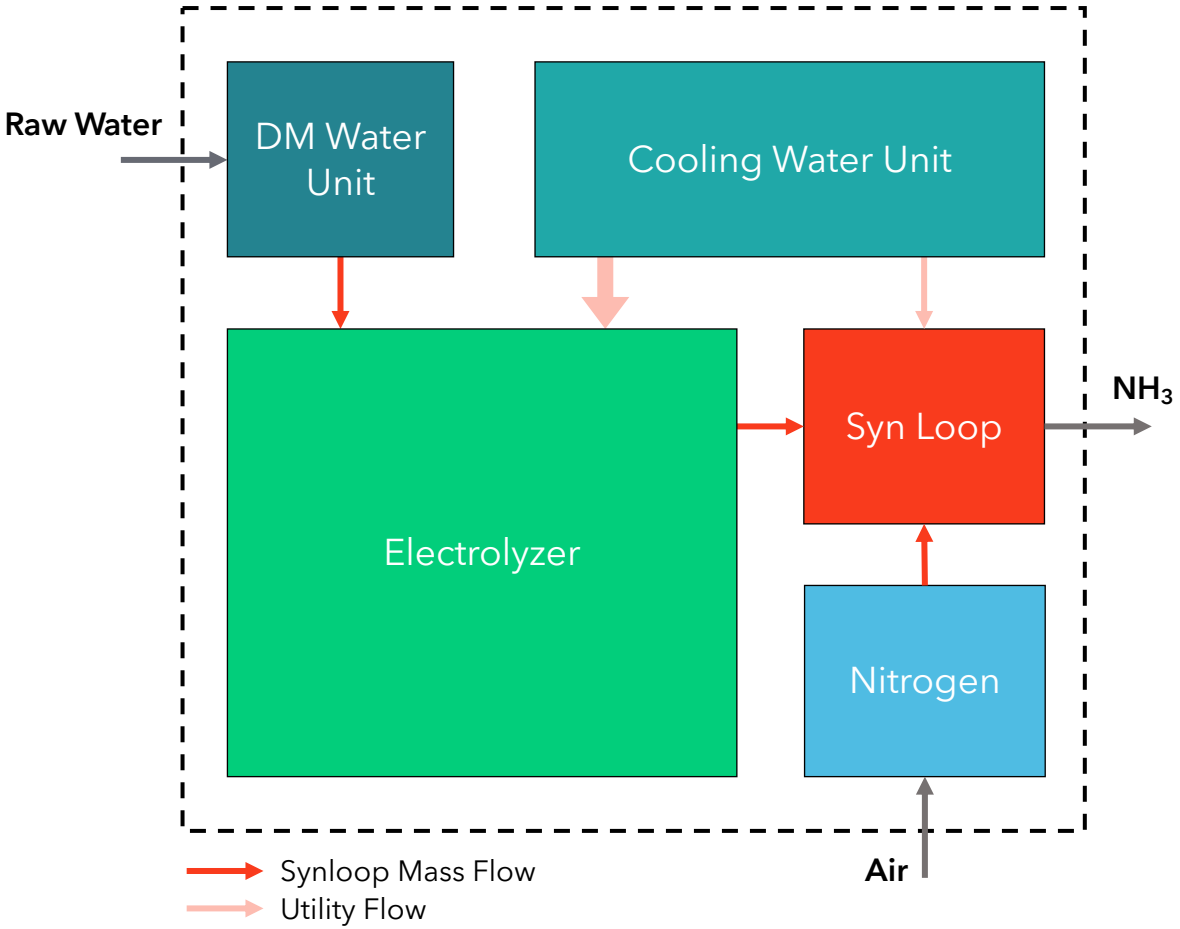
TECHNOLOGY OVERVIEW

How it Works

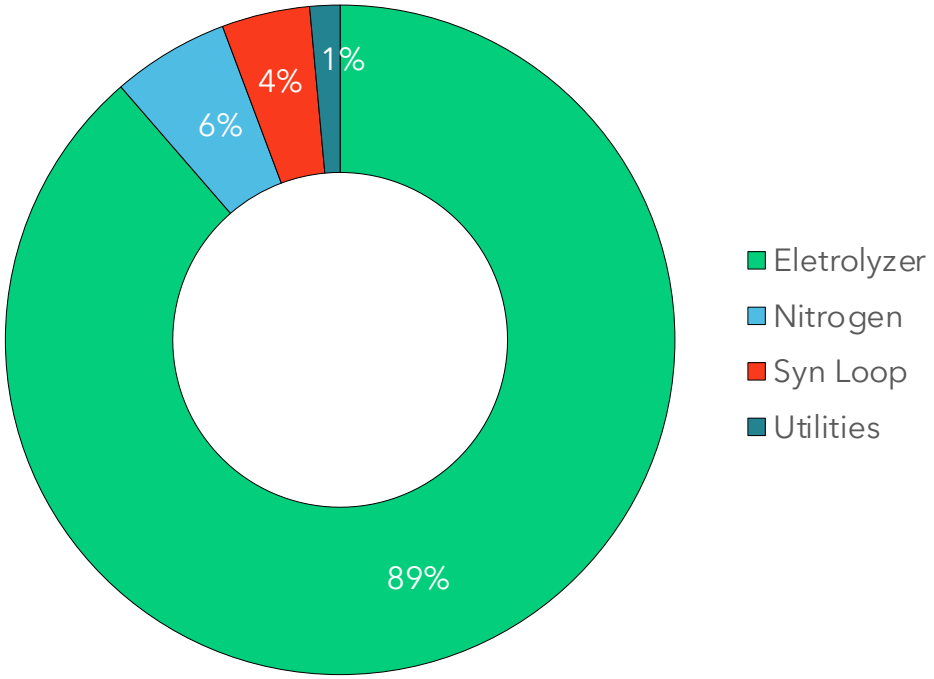


IAMM™ Unit

BLOCK FLOW DIAGRAM



10.3 MWh/tonne-NH_3



Overall Efficiency (HHV): 60.7%

Syn Loop Efficiency (HHV): 84.1%

IAMM™ Unit

TECHNOLOGY SELECTION: H2 + N2

Electrolyzer Selection

	Alkaline	PEM	SOE	AEM
Technology maturity	Proven	Proven for small scale	Demo to small scale	Demo to small scale
Efficiency (% LHV)	75%	76%	76 – 95%	63%*
Cold startup time	20 mins	30 secs	10 mins	20 mins
Operating temp (°C)	60-80	50-80	500-850	55
Output pressure (bar)	16 – 30*	30	3	30-35
Stack lifetime (years)	10	7-10	3-10	6-7
Platinum group metals or rare-earths used?	No	Yes. Iridium and Platinum.	Rare-earth oxides.	No
Estimated system cost in 2025 ($/kW)	350	550	750-1000	500

Source: Credit Suisse

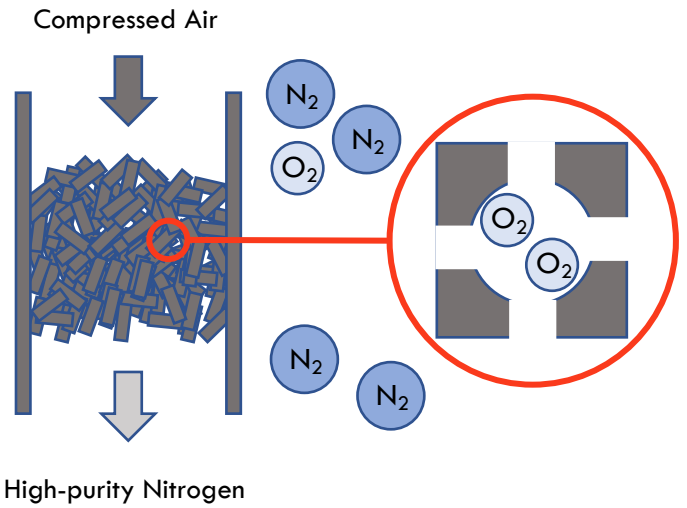
> Consistent with AmmPower's in-house, globally sourced procurement database

> Proven alkaline electrolyzers likely continue to dominate the market for their low CapEx and OpEx

Nitrogen Generator Selection

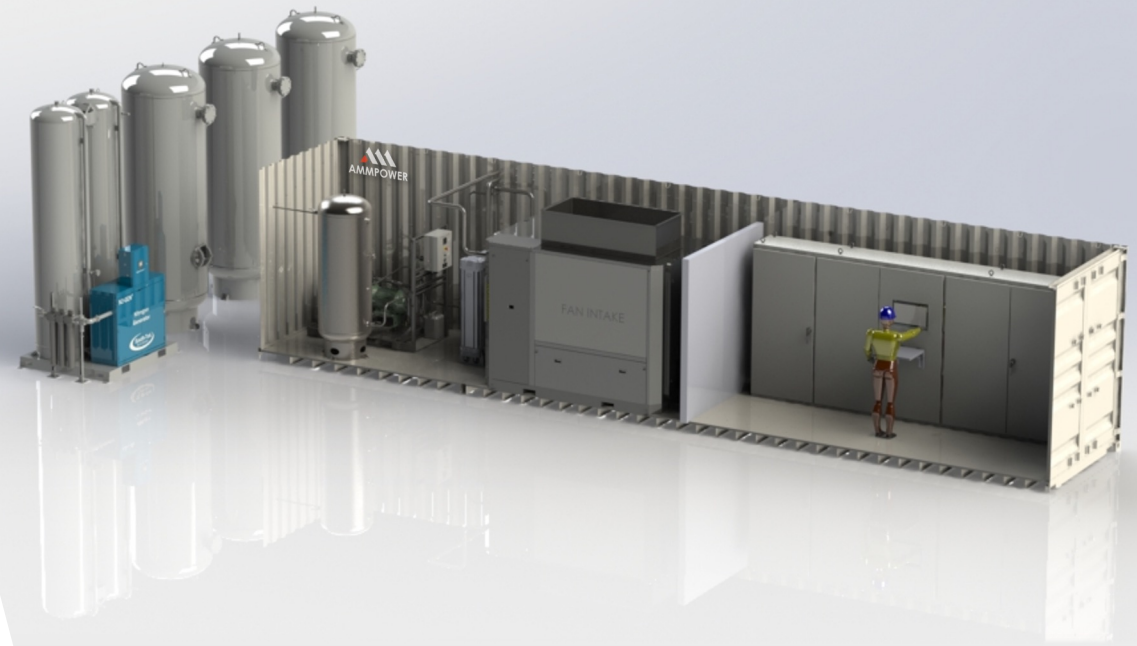
> Pressure Swing Adsorption (PSA) delivers high-purity nitrogen at a small scale

> Cryogenic separation is available for multi-unit configurations



IAMM™ Unit

TECHNOLOGY DESIGN



AmmPower's Approach

> In-house basic and detailed engineering

> Knowhow in product development and component sourcing

> Experienced engineering consulting team: 200+ years in ammonia industry

Ammonia Syn-Loop Design Optimization

Technical Solutions
Process Topology
Operating Conditions

→

Capital Cost
Variable OPEX
Fixed OPEX

→

Lowest Levelized Cost of Ammonia (LCOA)

1. **Waste heat recovery: avoiding steam generation**
2. **Ammonia converter design: cold-wall, dual-bed**

NEW modular small-scale technology

> Patent pending reactor design

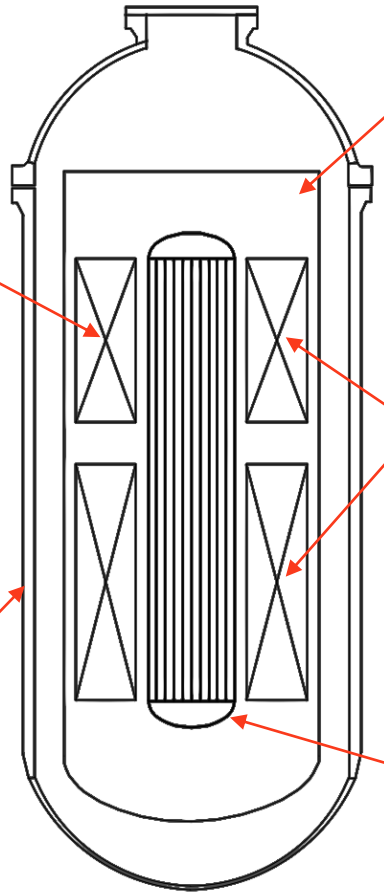
> Integrated automation control room

> Professional system integration methods

IAMM™ Unit

TECHNOLOGY DESIGN

Ammonia Converter



Serviceability while maintaining a compact form factor.

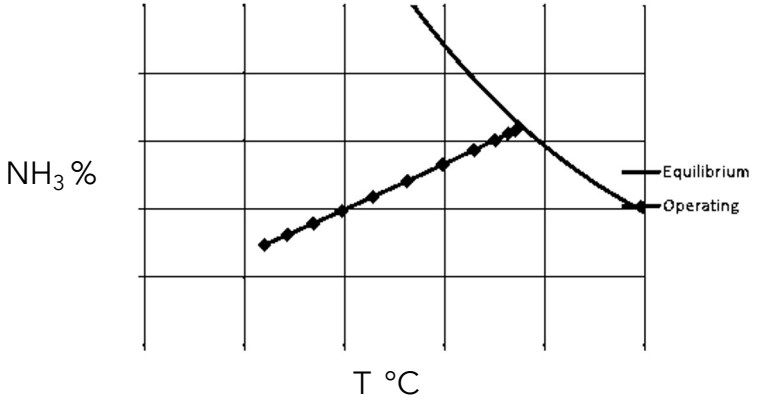
Thermal engineering for stable performance and improved flexibility.

Gas distribution design optimized for low pressure drop system.

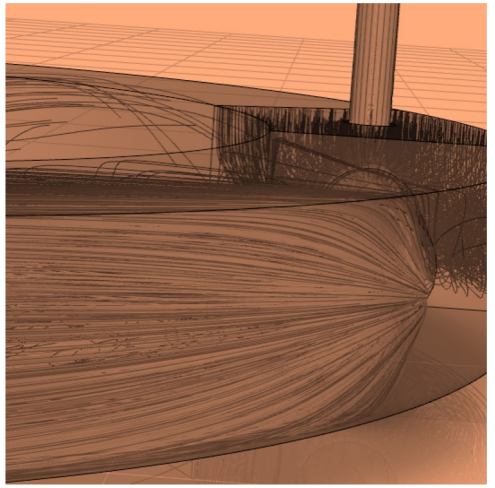
Minimize costs of fabrication using proper mechanical design. Rigorous FEA analysis performed for heavy cyclic operations.

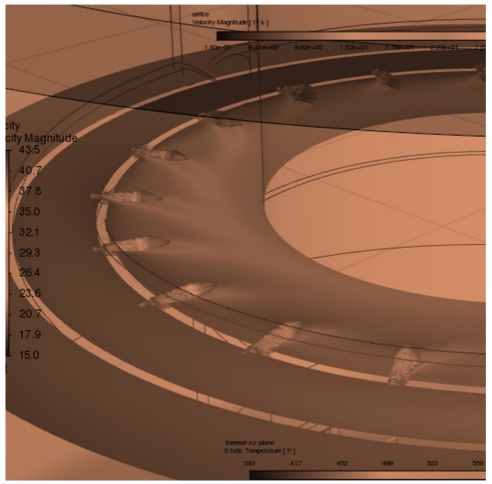
Metallurgical consideration for decades-long equipment life.

Catalytic Bed Performance



> Kinetic models of high fidelity allow the optimization of process conditions, catalyst volume, etc.





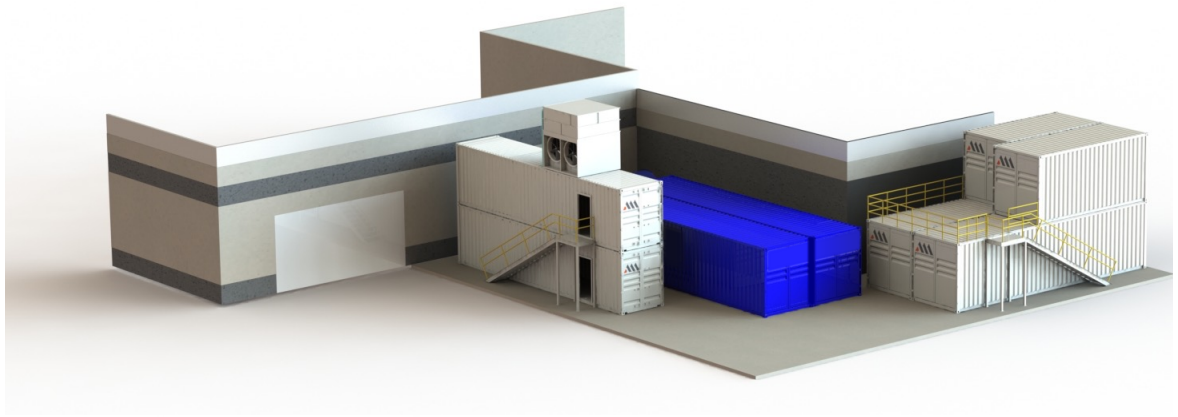
> CFD model to diagnose and prescribe design at an early stage.

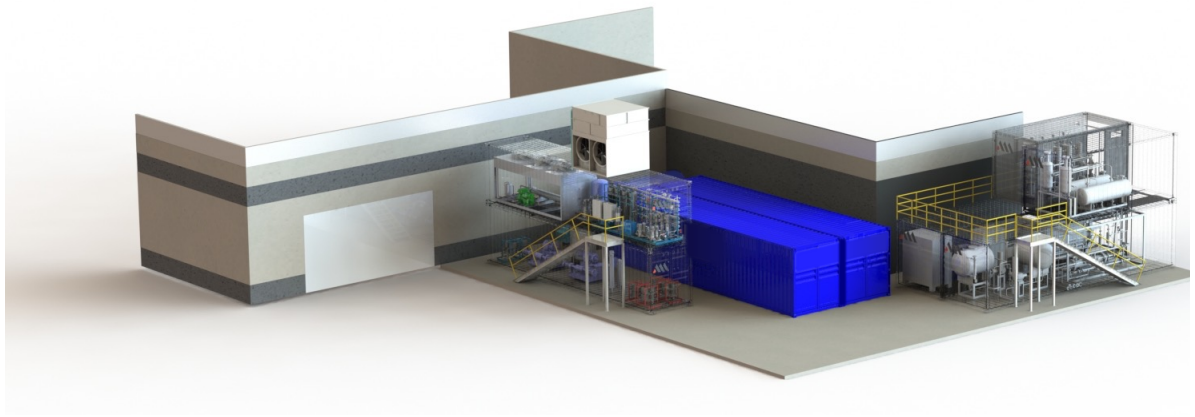
IAMM™ Unit

MODULAR & CUSTOMIZED SOLUTIONS

IAMM™ Compact

> For customers with available hydrogen

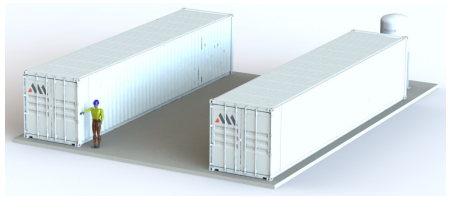




Stackable, multi-unit configurations available

IAMM™ Unit

SYSTEM CONFIGURATIONS

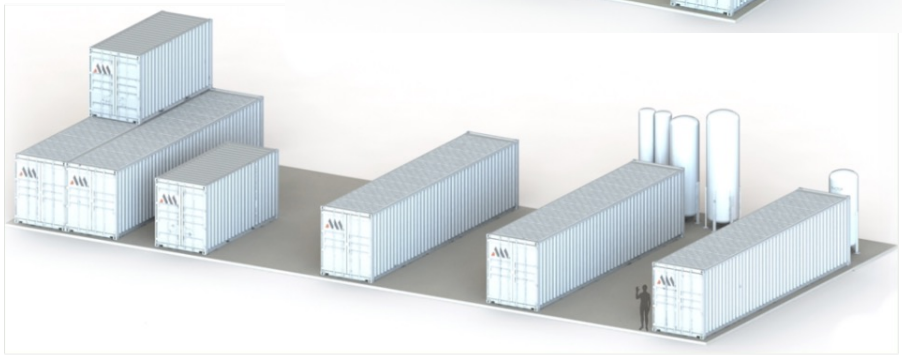


01 | IAMM™ Core

NH_3

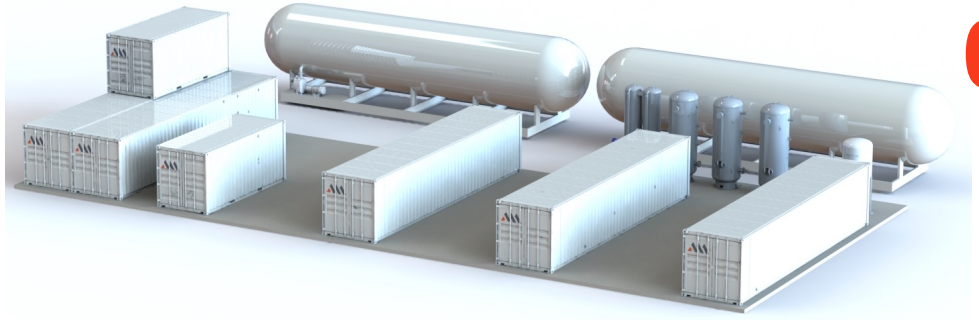
02 | IAMM™ Compact

N_2 NH_3



03 | IAMM™ Complete

H_2 N_2 NH_3



04 | IAMM™ Complete + Storage

H_2 N_2 NH_3 Storage

Visit IAMM.green

- View/download spec sheets.
- Get a custom budgetary quote.
- Learn more about the system and process design.
- Delivery in early 2023.

Learn more →

IAMM™ Unit

HIGHLIGHTS

Low CAPEX

- IAMM™ units have transparent and fixed price labels
- The specific capital cost is comparable to large-scale green ammonia projects.
- Downscaling achieved by in-house design of a patent-pending ammonia converter and innovative process design that avoids capital-intensive steam generation and low-temperature refrigeration units.

High Efficiency and Low OPEX

- High system efficiency.
- Electricity cost is about \$360/tonne NH_3 at an electricity price of \$35/MWh
- Renewable electricity usage in the US can benefit from production tax credits up to \$530/tonne NH_3.

Minimized Maintenance and Inherently Safe Design

- The IAMM™ units' process is inherently safe, easy to operate, and low in maintenance requirements.
- Clean process gasses only.
- Designed for medium operating temperature, avoiding any overheating and metallurgical issues.

Fast Product Turnaround and Simple Product Installation

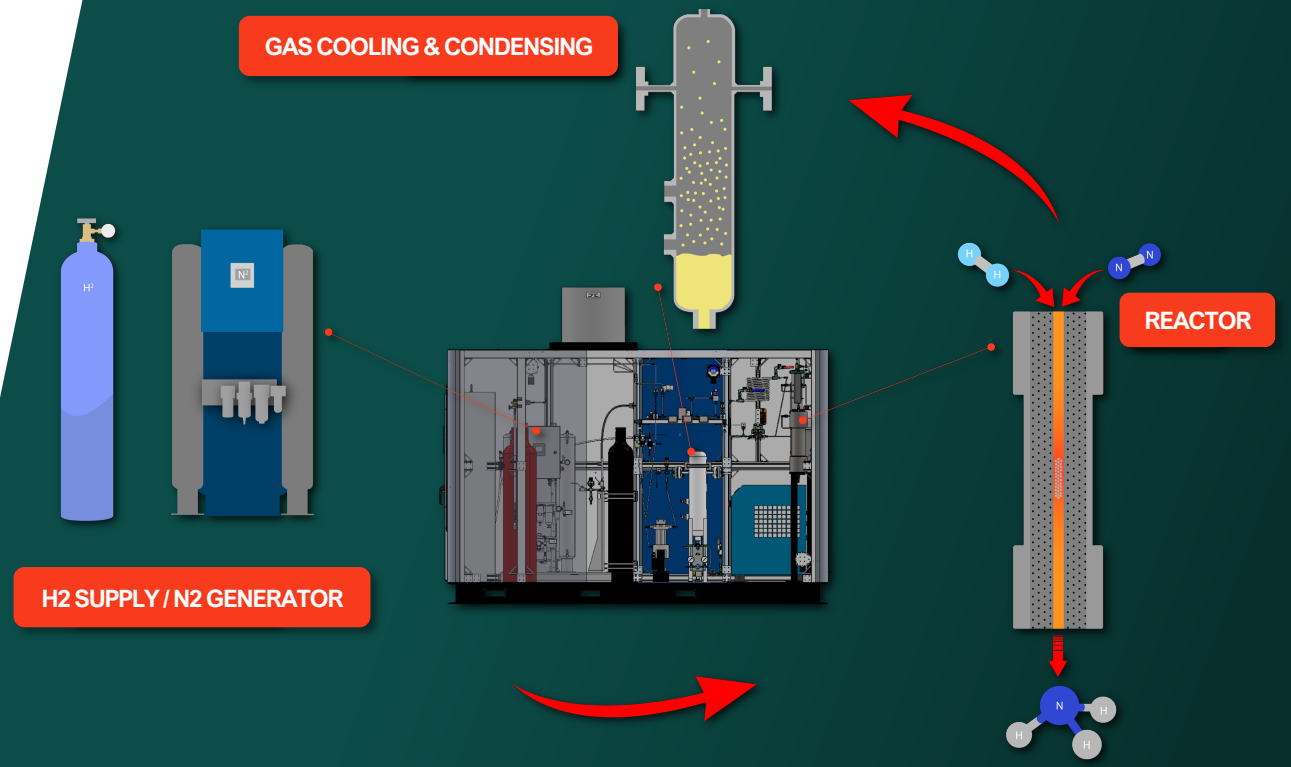
- Estimated delivery is within 40 – 52 weeks of order placement, 2 – 2.5 years shorter than the industry practice.
- Quick turnaround time attributed to the intrinsic modularity and vertical integration of Basic Engineering Design and EPC (detailed engineering, procurement, and construction)
- Fast and easy product deployment unlocks the potential for full benefits of the green policy with limited grace periods.

IAMM™ Unit

TECHNOLOGY DEMONSTRATION

50 kg/d IAMM™ Demonstration Unit

- Successfully built and operated pilot prototype in May 2022
- Validated AmmPower's proprietary reactor technology
- System prototype is mobile & available for future demonstrations
- Currently undergoing system process improvements through rigorous testing

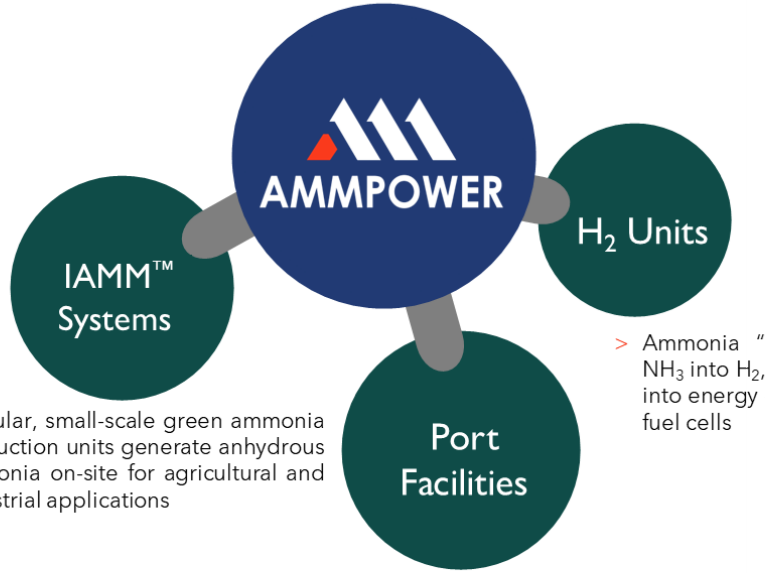


AmmPower

R&D AND MANUFACTURING FACILTY

> AmmPower is a clean energy company focused on the production of green ammonia. We are active in all facets of green ammonia technology, including the production of green fertilizers, carbon-free shipping fuel, and the 'cracking', or moving of green hydrogen as ammonia.

> Through the combination of research, science, and industrial manufacturing, AmmPower's team has filed for multiple patents in conjunction with the formation of intellectual property.



> Modular, small-scale green ammonia production units generate anhydrous ammonia on-site for agricultural and industrial applications

> Ammonia "cracking" units convert NH_3 into H_2, which can be converted into energy or used to fuel hydrogen fuel cells

> Large-scale, fully integrated, green ammonia production facilities will provide ammonia fuel and enable the transport of hydrogen

RESEARCH

OPTIMIZATION

MANUFACTURING

Get in Touch

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