Institute for Energy Economics and Financial Analysis

# Ammonia build-out: Recipe for risks

Todd Leahy

March 25, 2026

# Structure of the Report

Five sections presenting market risks for the US ammonia market:

- Impact of buildout on jobs
- Construction and operational cost increases
- The domestic market
- The global market
- Production and transport community risks as financial risks

# Key Findings

- Ammonia buildout will have a limited jobs impact
- Construction and operating costs, combined with market uncertainty pose financial risks
- Domestic agriculture is not driving the build out despite company statements
- Market and financial challenges exist in the global energy market
- Production and transport of ammonia pose community safety risks that are also financial risks

# Thesis Statement

Public money and tax benefits should not be invested in an ammonia buildout given all the risks present

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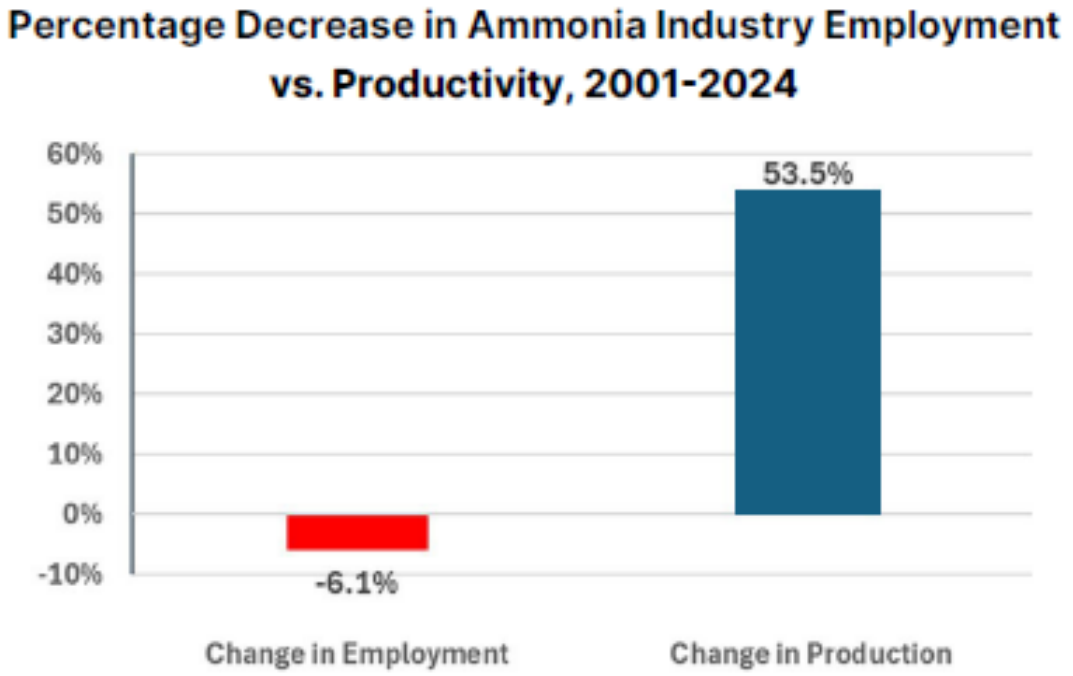
# Job creation – fact verse fiction

**Trey Cowan**

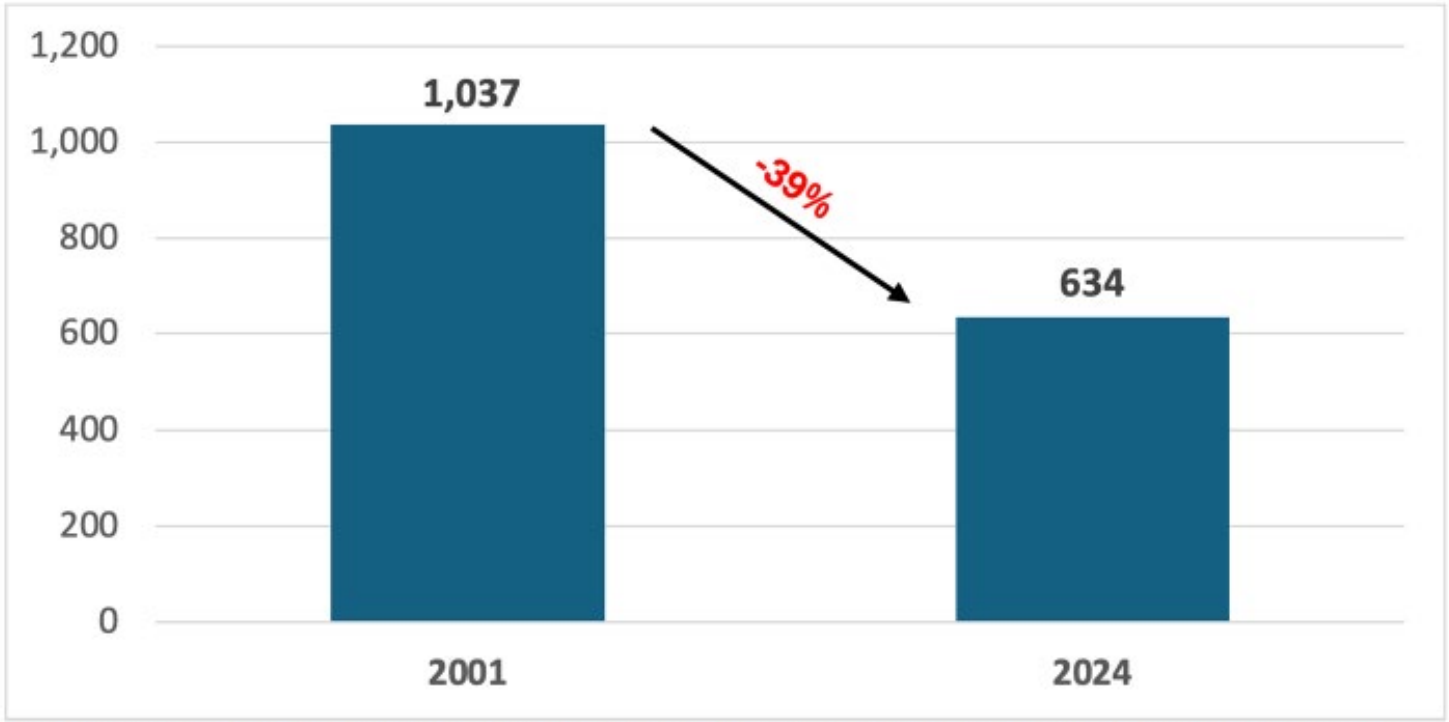
25 March 2026

# Job creation is traditional justification – but data show this no longer applies



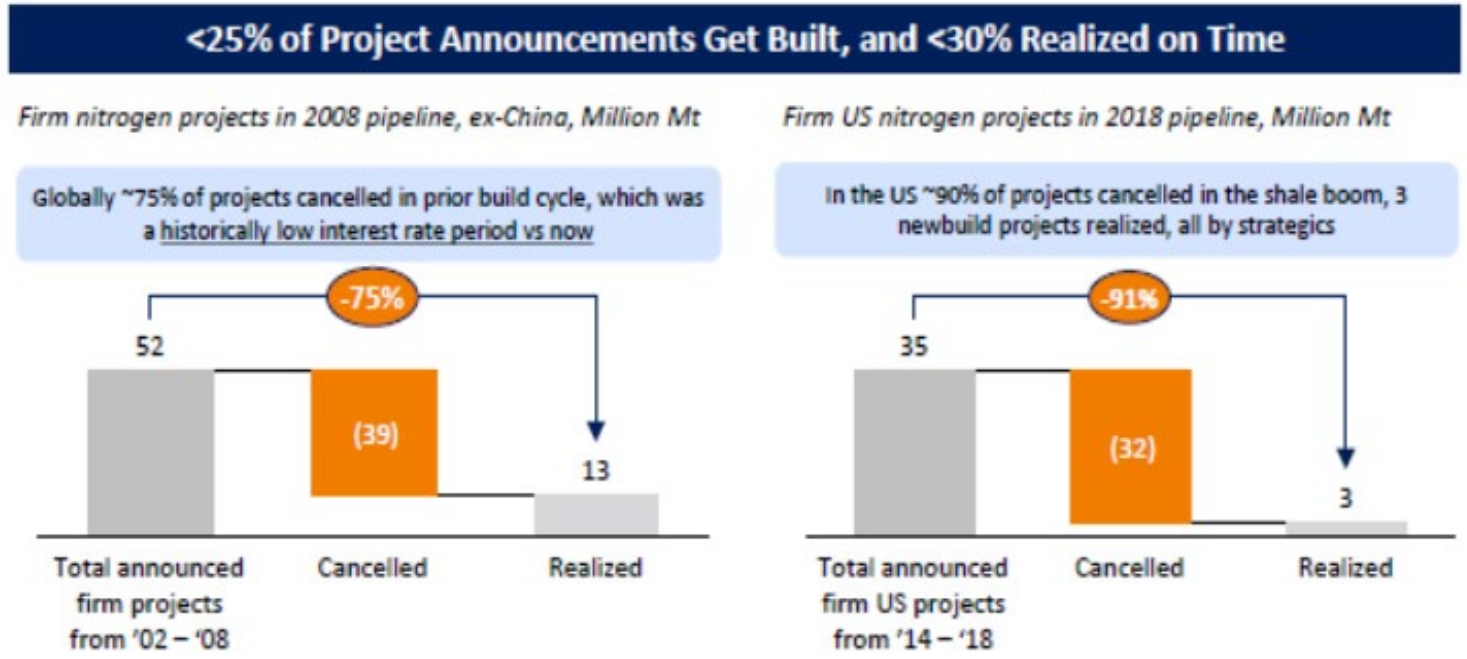

*Source: U.S. Bureau of Labor Statistics (NAICS code 325311 – Nitrogenous fertilizer manufacturing), U.S. Geological Survey—Minerals Yearbook (MYB)*

# Jobs provided by one million tons production – 2001 versus 2024




*Source: U.S. Bureau of Labor Statistics (NAICS code 325311 – Nitrogenous fertilizer manufacturing), U.S. Geological Survey—Minerals Yearbook (MYB)*

# Many ammonia projects announced have been scrapped




*Source: OCI Global Q2 2024 Results Presentation*[16]

# Risks are rising

| Henry Hub Spot Prices (Monthly Averages) | | | | | |
|---|---|---|---|---|---|
| | Average ($/mmBtu) | Standard Deviation | Coefficient of Variation | Skew | Kurtosis |
| **2011-2015** | $3.50 | $0.83 | 23.70% | 0.234 | 0.019 |
| **2016-2020** | $2.65 | $0.56 | 21.10% | 0.232 | 0.254 |
| **2021-2025** | $3.71 | $1.76 | 47.40% | 1.257 | 1.004 |

*Source: Federal Reserve Economic Data (FRED), Federal Reserve Bank of St. Louis*

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# Ammonia’s domestic product and demand

**Anika Juhn**

25 March 2026

# Key Takeaways

U.S. ammonia demand largely met by current domestic production

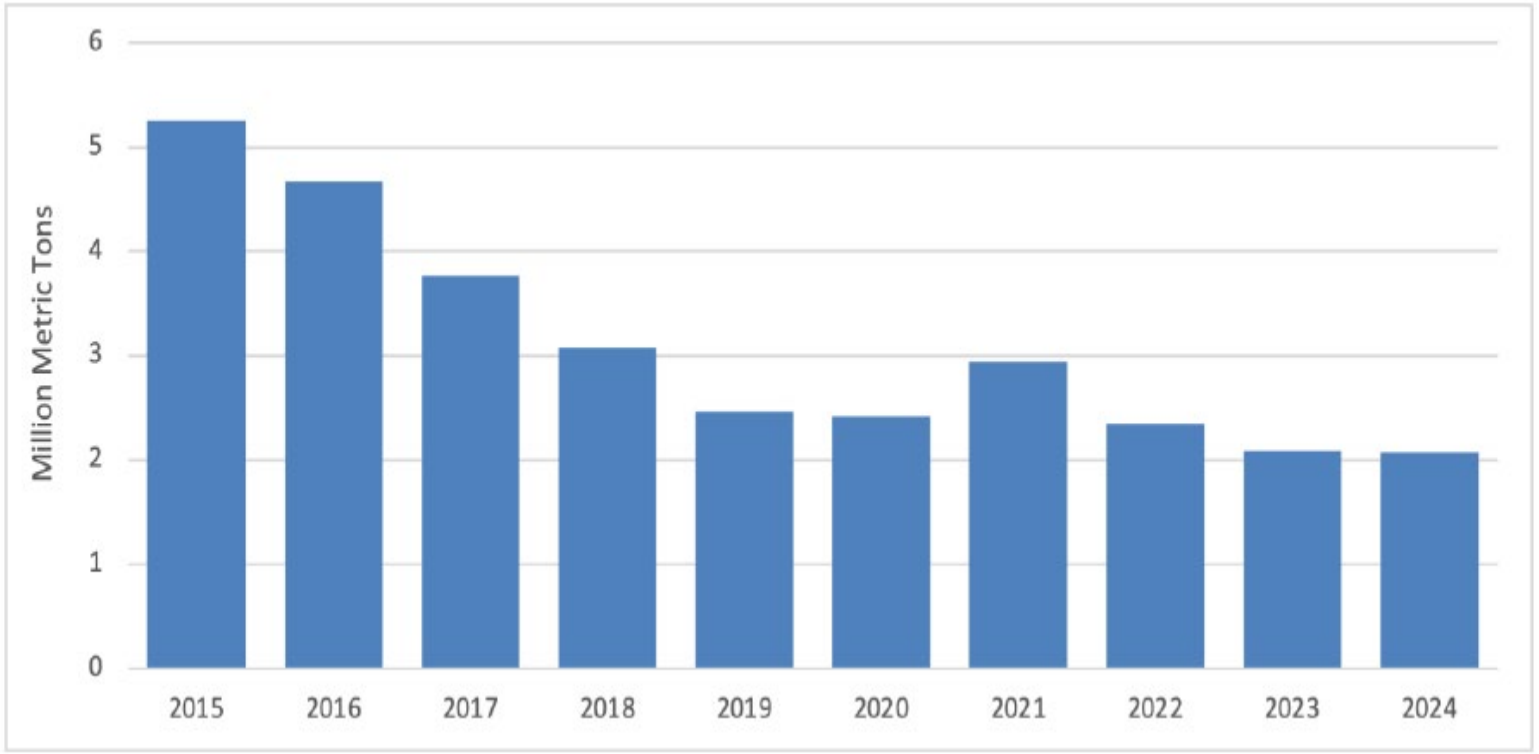
Potential international market for new, novel uses for ammonia such as fuel for power generation, shipping, or as a hydrogen carrier is speculative

Planned ammonia buildout targeting potential future demand in international markets for "low-carbon" ammonia is reliant on unproven carbon capture and large federal subsidies

# Domestic market is not looking for more ammonia

- Domestic demand is largely met by domestic supply
- Remaining import balance of 2 million metric tons per year; imports have been declining over last decade
- 88% of ammonia used for fertilizer; remaining 12% used for other purposes
- Historic consumption of nitrogen for fertilizer has been very steady

**Annual Ammonia Imports Have Declined Over the Last Decade**

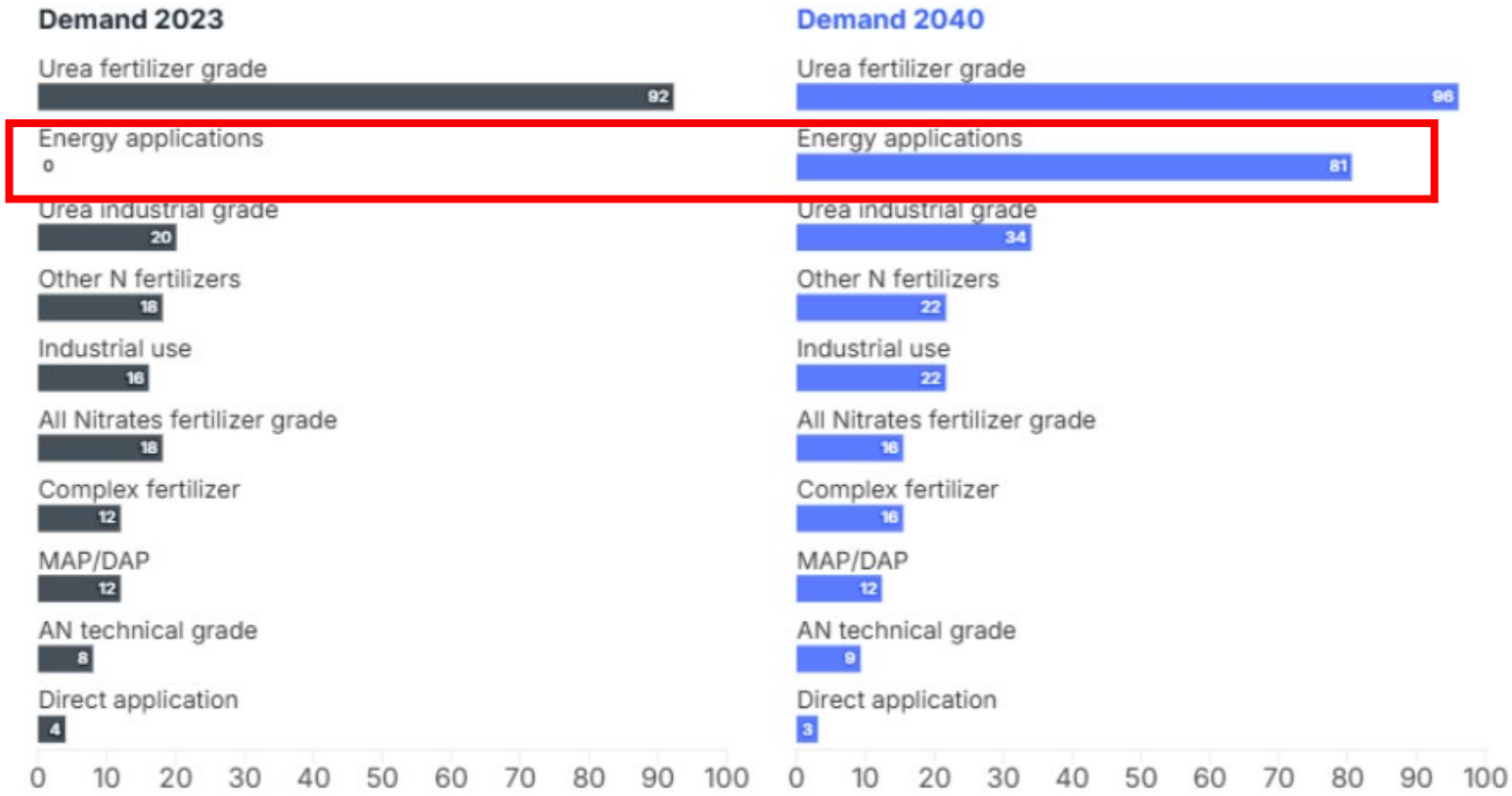



*Sources: ICIS, IEEFA*

# Proposed projects anticipate new uses for ammonia

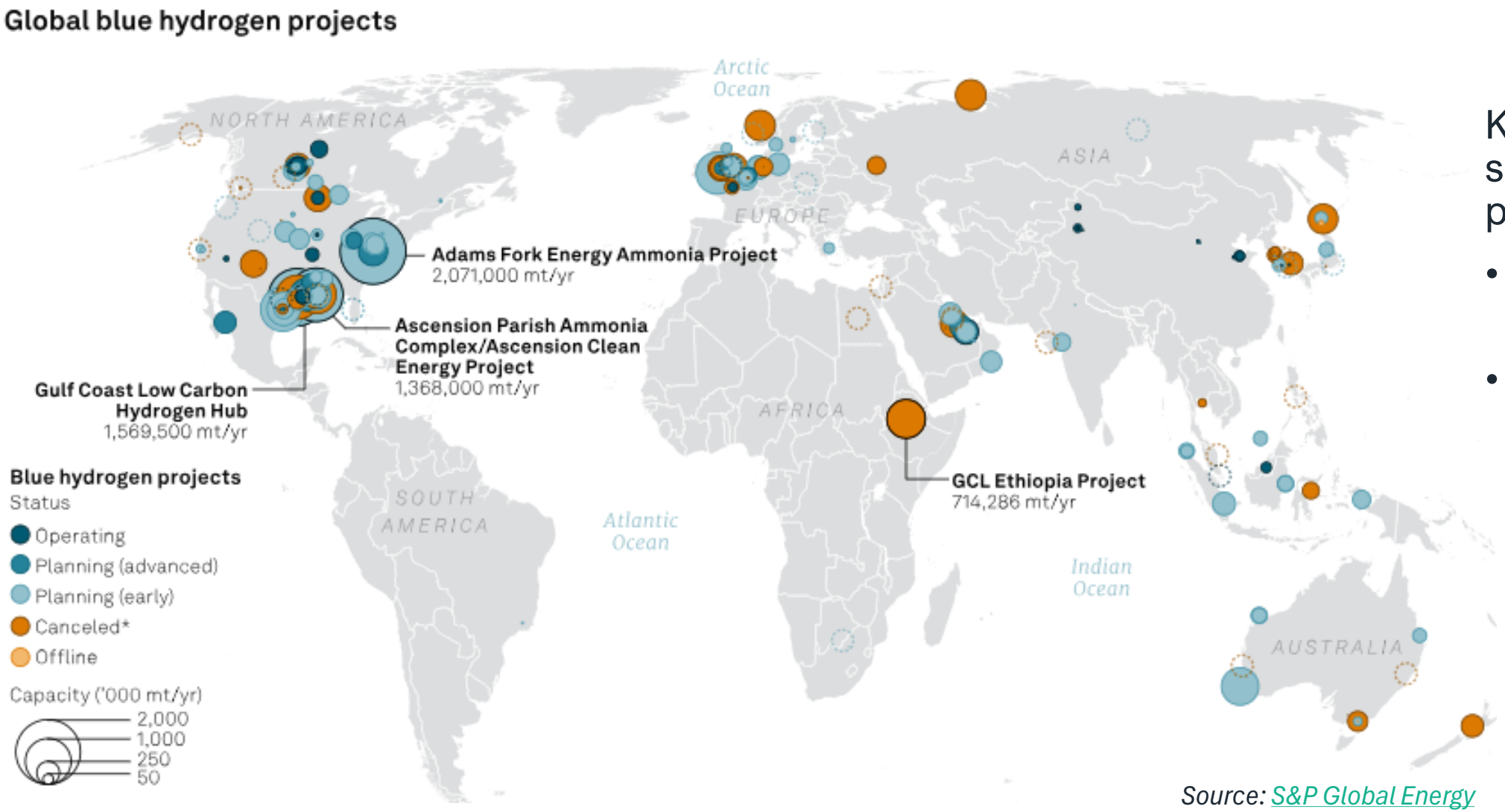
- Energy applications include use as a hydrogen carrier, combustion fuel for power and shipping sectors
- Energy applications for ammonia do not currently have a real market
- It is difficult for producers and off-takers to finalize contracts without price history and projections

**S&P Estimate of Global Demand for Ammonia in 2040 by Use**




*Source: S&P Global, IEEFA*

# U.S. leading development of CCS-dependent projects




Key drivers that support industry plans in the U.S.

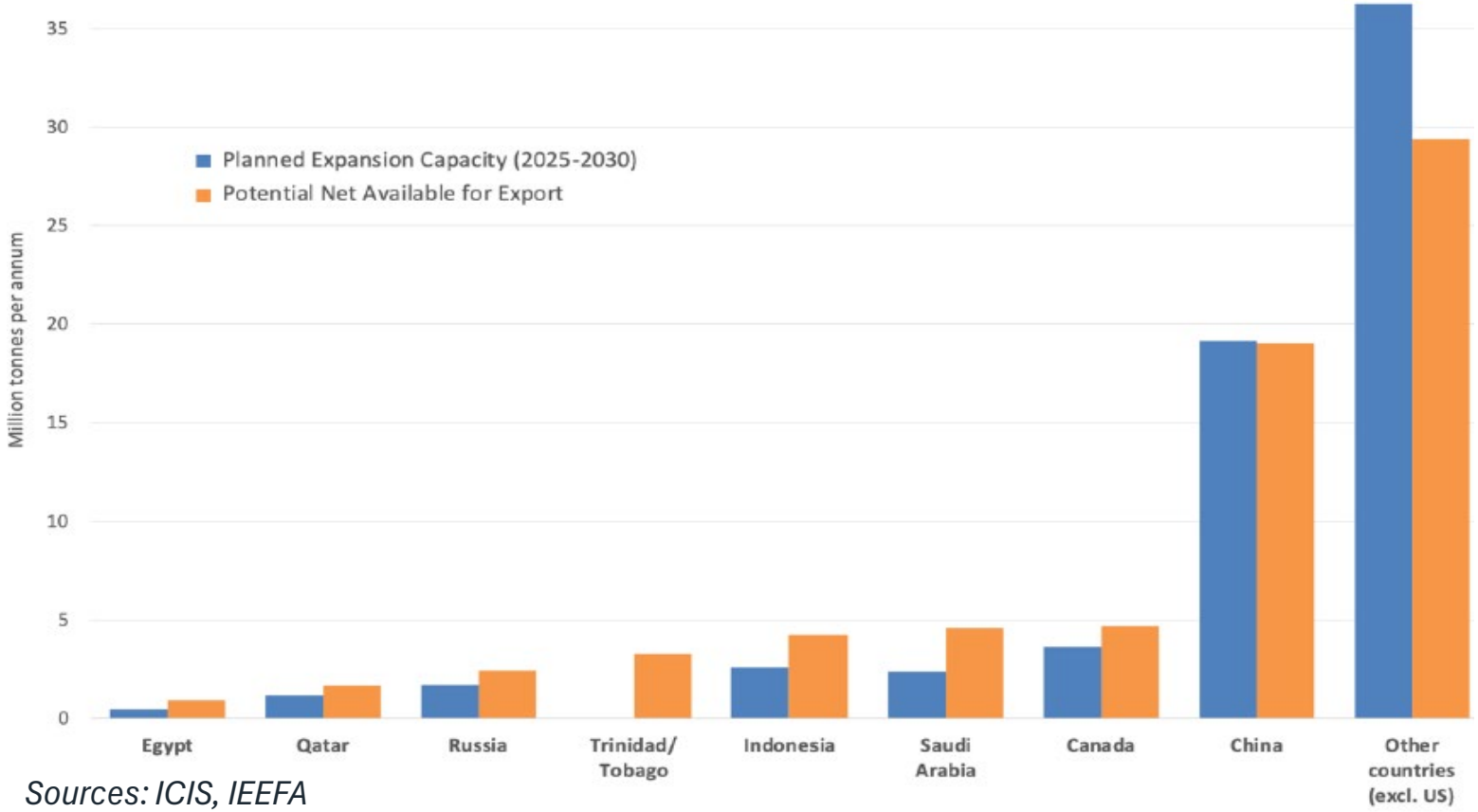
- Cheap natural gas supply
- Lucrative federal 45Q credit for $CO_2$ capture and use or storage

*Source: S&P Global Energy*

# Global competition for projected new supply

- Much of anticipated production will target international markets such as Europe and Asia
- Orange bars show potential ammonia supply available for export based on planned expansion capacity *(includes blue, grey, and green)*
- Total potential for export estimated at nearly 70 million metric tons per year
- U.S. projects will need firm offtake contracts to compete

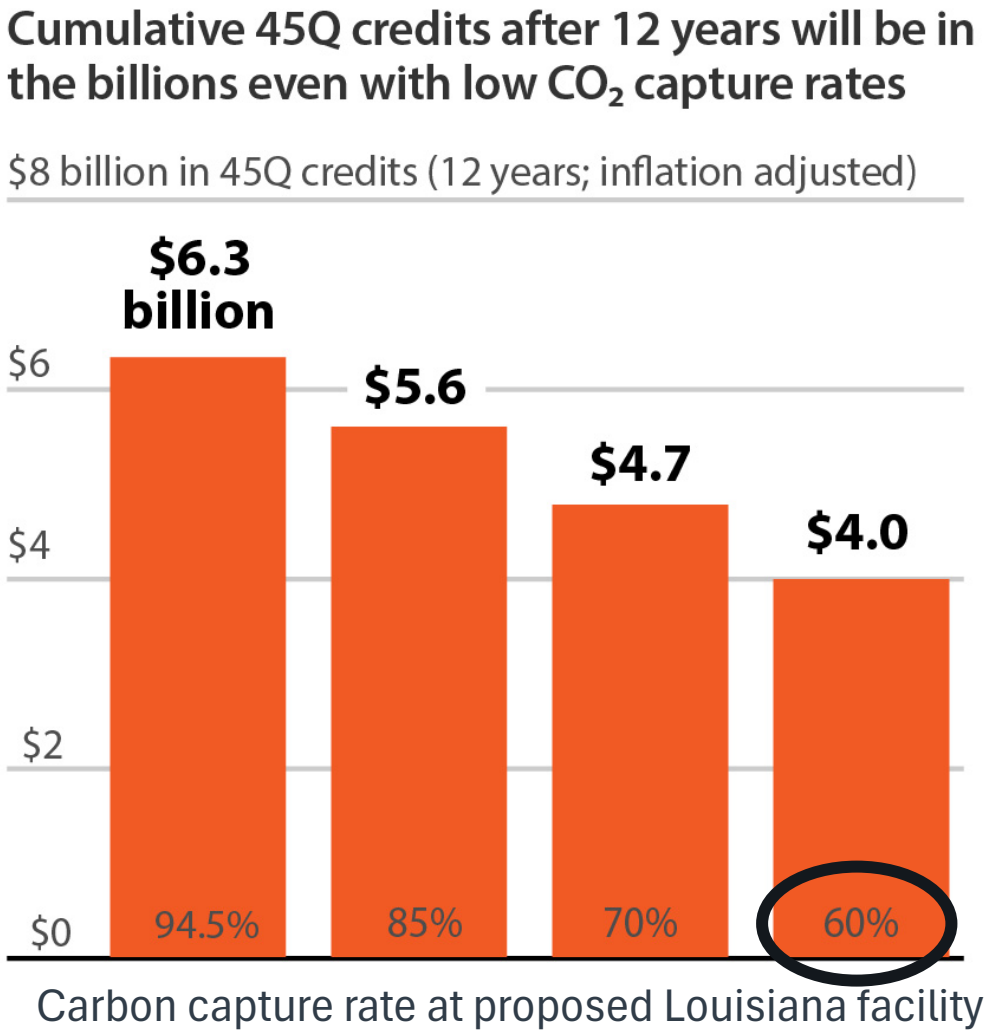
**Planned Ammonia Expansion and Potential Net Available for Export, 2025-2030**




*Sources: ICIS, IEEFA*

# How much taxpayer money is at stake?

- Air Products' ammonia / hydrogen production facility in Darrow, Louisiana
- Estimated $8 billion cost to construct facility
- Company promises to capture nearly 95% of $CO_2$ from the reformer that makes hydrogen
- Could amount to 5 million metric tons of $CO_2$ per year
- Over 12 years, this could total $6.3 billion in 45Q credits
- Even if capture rates are just 60%, the project could claim $4 billion from 45Q
- Just one proposed project out of hundreds




https://ieefa.org/articles/blue-hydrogens-carbon-capture-boondoggle

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# Coal’s ammonia alibi is losing steam in Asia

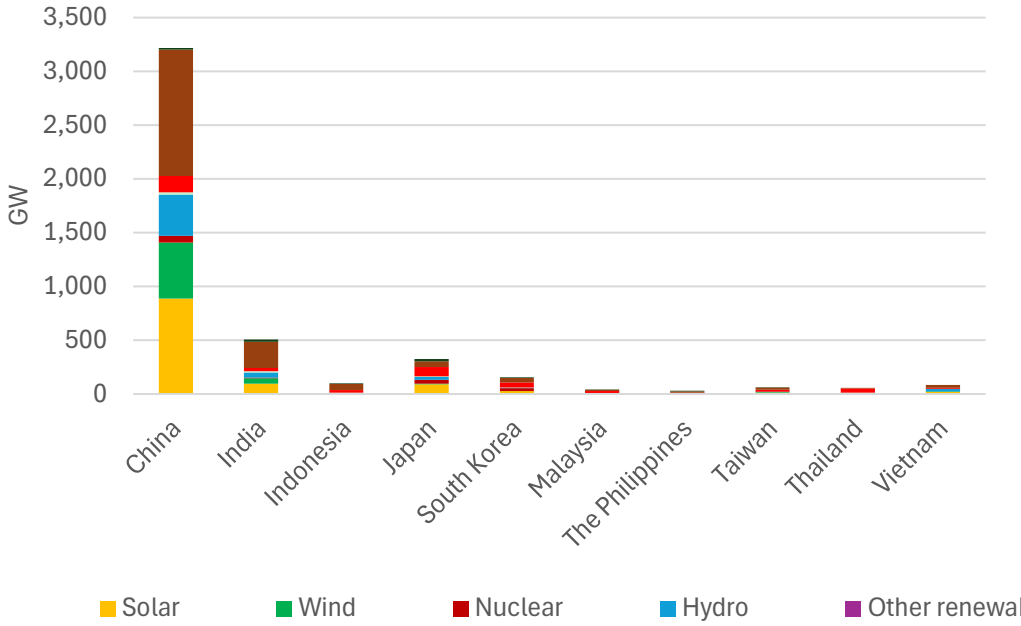
## Ammonia co-firing extends a lifeline to coal-fired power plants at the expense of energy security

**Christopher Doleman**

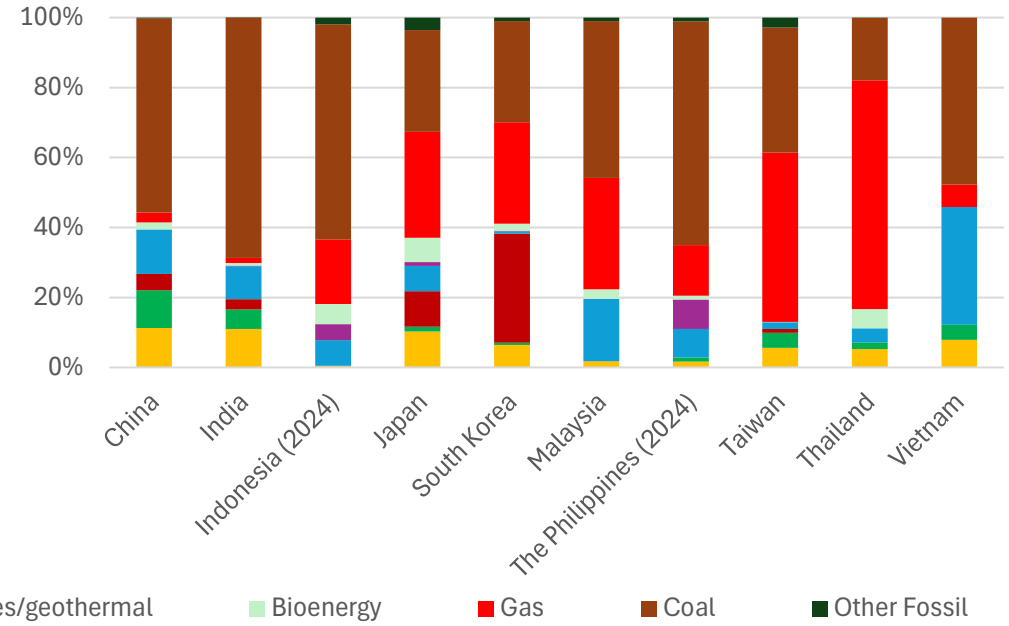
25 March 2026

# Asia is grappling with how to decarbonize a coal-heavy power sector

## Power capacity for select Asian countries, 2024



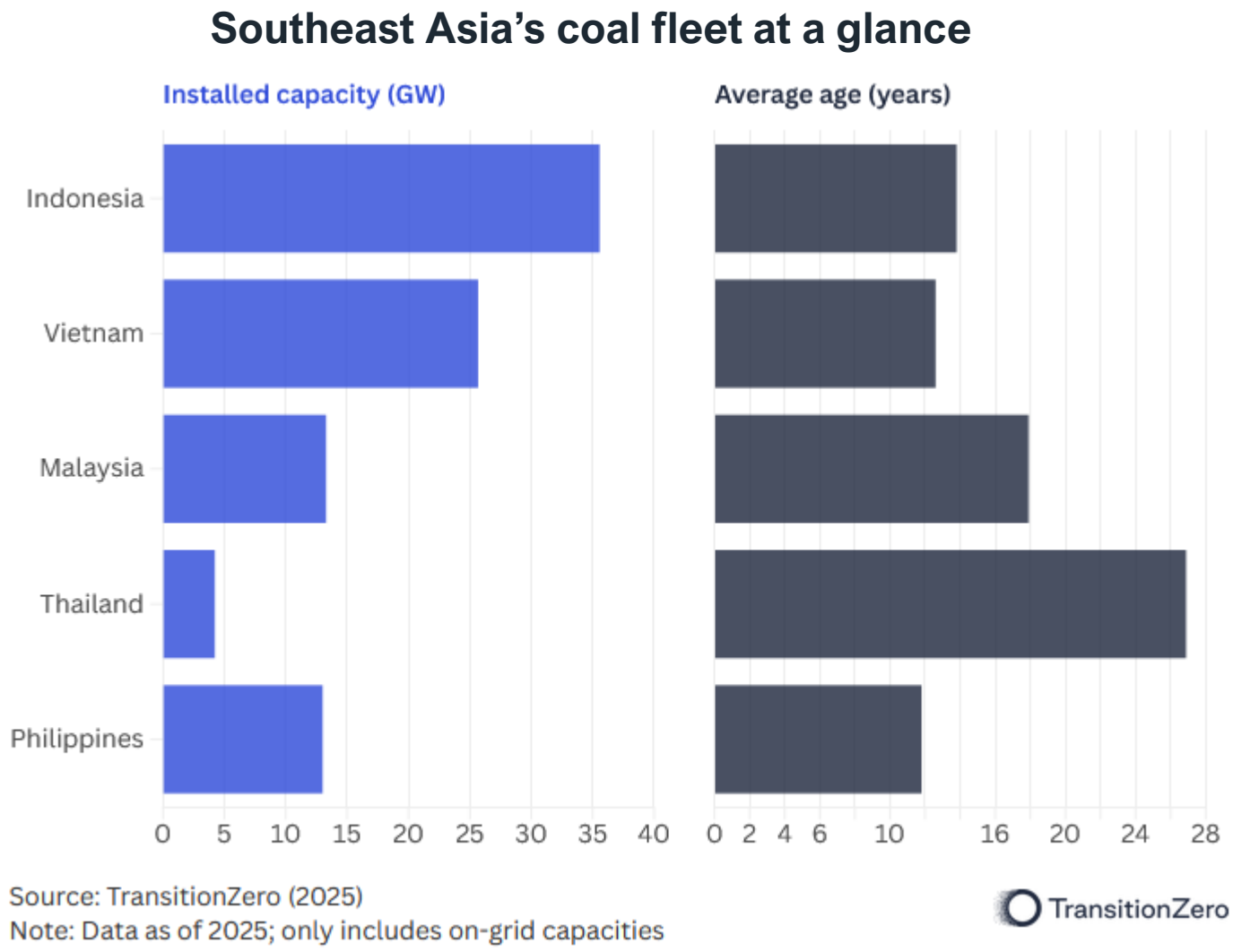

## Generation mix for select Asian countries, 2025




Solar | Wind | Nuclear | Hydro | Other renewables/geothermal | Bioenergy | Gas | Coal | Other Fossil

# Issues with retiring coal fleet

- **Valorization**: Many coal assets have decades of useful life remaining
- **Contracts**: Coal assets are underpinned by long-term PPAs that are prohibitively costly to break
- **Energy security and electrical reliability**: Reluctance to part with useful, baseload assets, particularly with rising electrification



# Valorization strategies

- Energy transition mechanism (ETM) to fund early retirement
- Equip units with CCS technology to abate emissions
- Retrofit coal units into flexible assets to back up renewables (China/India model)
- Co-fire alternative fuels with coal at increasing concentrations to meet decarbonization targets: biomass or ammonia (Japan, Korea model)
- We're focusing on **ammonia** today…

**JERA's Taketoyo thermal power station dust explosion in 2024**

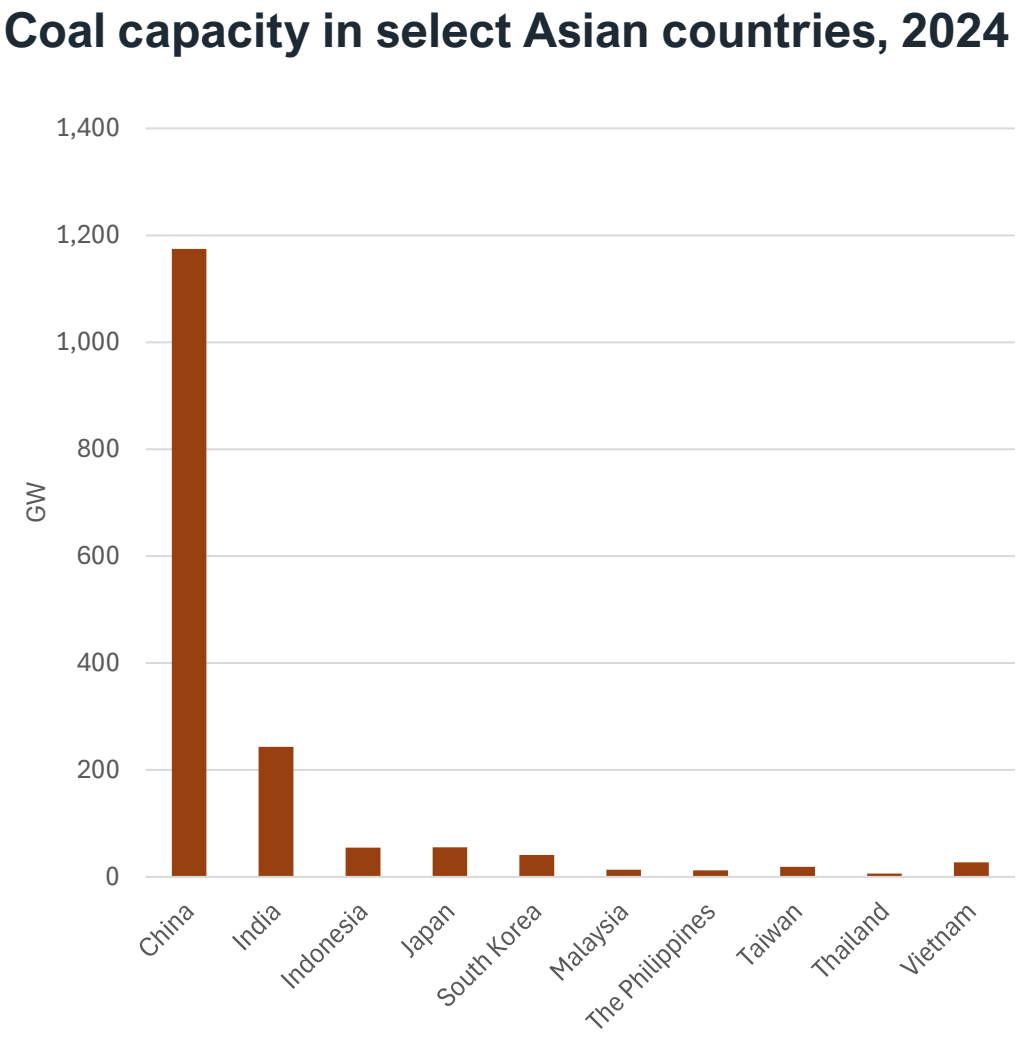

- Dust explosion during a 17% cofiring of wood pellets at a 1GW USC coal unit has cooled biomass cofiring enthusiasm
- Wood pellet cofiring may continue, but if JERA is pivoting towards ammonia, the rest of Asia may follow



Source: JERA

# Producers seeing a lot of coal-to-ammonia potential

- LNG analogy: Ammonia producers see coal-to-ammonia pathway as a potential bonanza
- Demonstration at 20% cofiring requires 0.5 Mtpa for a 1GW facility, which translates to 2.5 to 3 Mtpa for 100% ammonia combustion
- Industry thought process: This chart implies a 4 to 5 billion tonnes per year opportunity for this nascent industry





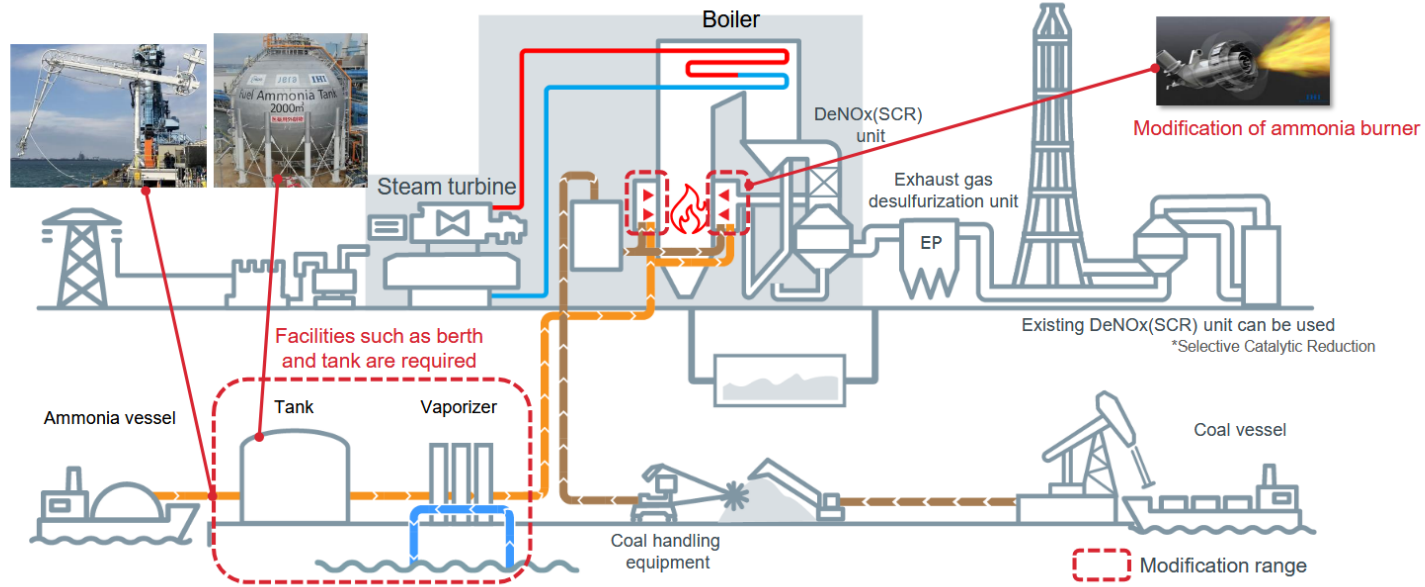

Source: EMBER, JERA, IEEFA

# Policy and commercial drivers

- Equipment manufacturing, energy companies, utilities, shipbuilders, and others are interested in the commercial opportunities of building an ammonia supply chain
- Asia Zero Emission Community (AZEC), other forums, MOUs serve to establish a demand market to underpin the commercial developments

## Outline of required modification for Ammonia Substitution

- Jera made modification works for Ammonia in Hekinan Unit 4.
- Small modification was required, but the most of existing facility and DeNOx (SCR*) unit for treatment of exhaust gas could be used.






- Policy-aligned finance institutions in Japan, Korea, elsewhere help unlock investments across the potential ammonia supply chain with subsidies, insurance guarantees, loans, and other support measures



Source: JERA

# No commercial ammonia co-firing projects in operation

## IEA's assessment of ammonia co-firing technology, Oct 2025

**Table 7.2 Targets, pilot and demonstration projects for ammonia co-firing in coal plants**

| Country | Year | Stage | Blending ratio | Notes |
|---|---|---|---|---|
| Indonesia | 2022 | Pilot | Undisclosed | 100-MW unit |
| China | 2022 | Pilot | 25% | 40-$MW_{th}$ unit |
| India | 2023 | Announcement | Up to 20% | 330-MW unit |
| Indonesia | 2023 | Pilot | Possibility of up to 60% | Actual ratio tested undisclosed |
| China | 2023 | Pilot | Up to 35% | 300 MW |
| Japan | 2024 | Pre-commercial | 20% | 1-GW plant |
| Indonesia | 2025 | Pilot | 3% | 300-MW unit |
| Japan | 2027 | Commercial | 20% | Target |
| Korea | 2027 | Demo | 20% | Target |
| Japan | 2028 | Pilot | 50% | Target |
| Korea | 2030 | Commercial | 20% | Target |

Notes: Projects at the memorandum of understanding stage or undergoing feasibility studies are excluded.

- Many MOUs not listed here across Southeast Asia
- Japan's commercial target year for the Hekinan 20% co-firing has since been kicked back to FY2029
- South Korea has since committed to phasing out coal by 2040, potentially obviating the need to pursue ammonia cofiring, and canceled subsidies

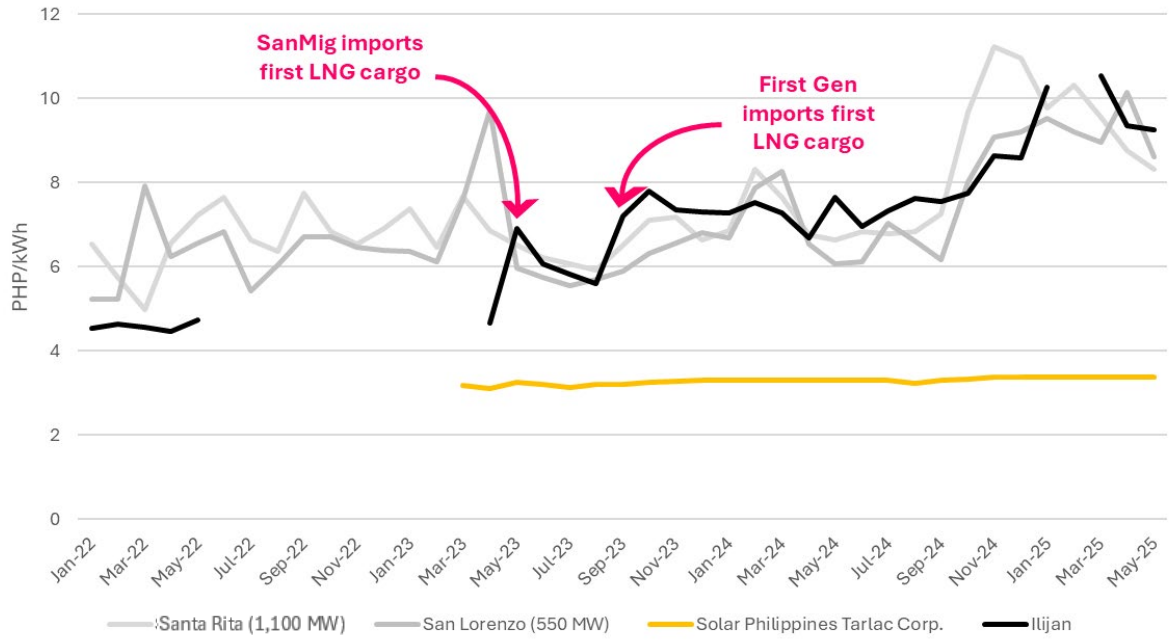


Source: IEA, media reports, company statements

# Without significant cost reductions, ammonia cofiring will reduce energy security

- Ammonia fuel cost will inflate the cost of power generation or require large subsidies to offset the higher costs
- Rystad estimates 10% green ammonia cofiring would increase LCOE of a coal plant by 50%
- JERA secured a 15-year contract for difference (CfD) subsidy to cover the cost between coal and ammonia; can other countries bankroll this difference? Can Japan at scale?
- LNG analogy 1: How will Southeast Asia integrate low-carbon ammonia, which is 6 to 17 times the cost of coal, if they are struggling to afford LNG, which is two to five times the cost?
- LNG analogy 2: Will ammonia be subject to similar volatility during supply disruptions? Is its availability a luxury to the highest bidder? Will coal be burnt anyway?

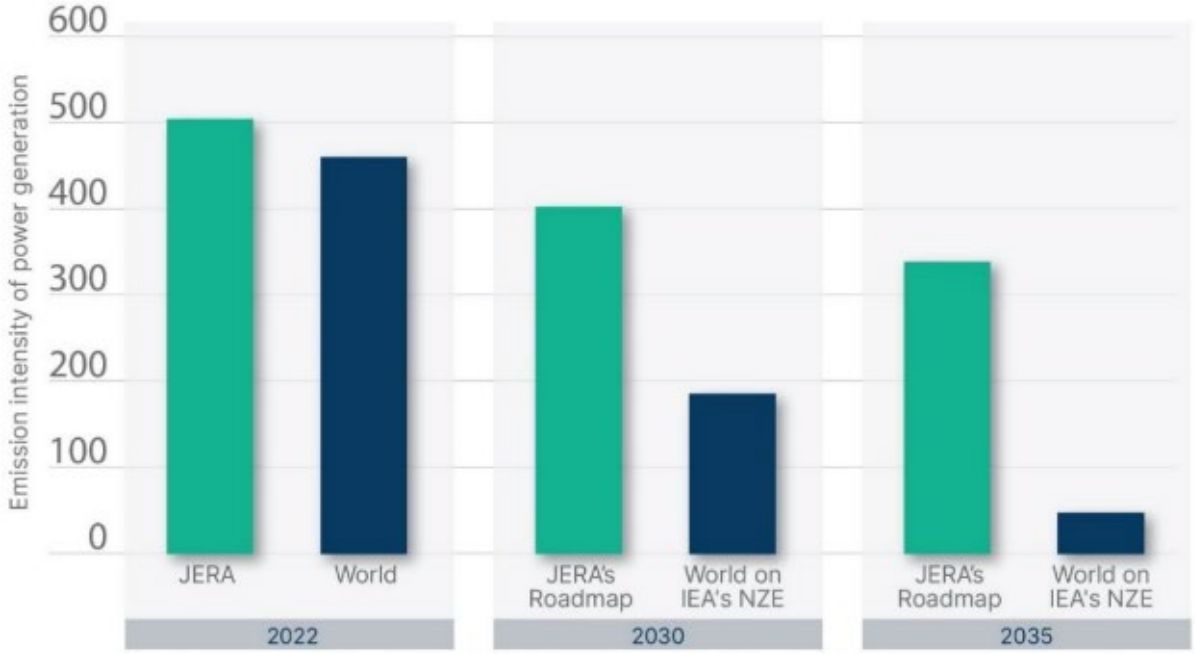
## LNG has been inflationary for gas-fired generation in the Philippines




Source: Rystad, Transition Zero, BNEF, Meralco, IEA, IEEFA calculations

# Not in line with decarbonization targets at low cofiring concentrations

**Emission intensity of power generation for JERA and the World on a net-zero pathway ($gCO_2$ per kWh)**




*Source: IEA's net zero emissions by 2050 scenario (NZE), JERA, IEEFA calculations.*

- NOx: Potential of higher NOx emissions during ammonia co-firing, but JERA's demos are yielding similar results to coal combustion
- It takes 50% ammonia cofiring to get GHG emissions in the ballpark of a large-scale gas plant, which is not even being tested yet
- Deploying solar, wind, and batteries are proven ways to reduce power sector emissions, immediately
- ETM or flexibility are better ways to deal with the valorization of useful coal assets

# Conclusions

- Asia's large, young coal fleet seen as an ammonia growth opportunity for producers and influential leaders across Asia's energy supply chains
- The commercial feasibility of ammonia cofiring is still uncertain, and the speed of adoption in leading countries is losing momentum
- Ammonia cofiring fails all three components of the "energy trilemma": It doesn't reduce emissions, it is inflationary for the cost of power, and is likely to have energy security issues that mirror LNG
- Ramping up renewables and pursuing ETMs or coal flexibility pathways provide a more cost-effective, immediate pathway for decarbonization

# Community Safety

# Toxic, Corrosive, and Explosive

- State regulators treat ammonia production in a class by itself
  - Although NH3 does not meet the DOT definition of a Flammable Gas (for labeling purposes), it should be treated as one
  - “may ignite and burn with explosive force,” and “poisonous gases are produced in fire”
    - “containers may explode in fire”
- Transportation carries risks
  - Pipelines, trains, boats, and automobiles
- Satellite observations reveal that industrial NH3 production plants are hotspots of ammonia emissions, which are greatly underestimated in inventories by a median factor of 50

# Conclusion

# What Should We Do With Public Money?

- Identify and invest in business that create **LOCAL** jobs
- Target reliable markets
- Generate economic benefits to their host communities

# Thank You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