India

Underweight *(no change)*

Chemicals - Overall

Ammonium nitrate is in a sweet spot

- The long-term trend in ammonium nitrate (TAN) & ammonia (NH_3) will persist for multiple years, but the main bottleneck is the lack of cost-competitive NH_3.
- With Russia embroiled in a war and LNG likely to decline, India has an ideal opportunity to become the world's alternative supply source for TAN and NH3.
- India's TAN capacity utilization is likely to rise to nearly 100% by CY25F. Global NH_3 supply will remain constrained as western nations shift towards green NH_3.

TAN supply relies on NH_3, whose production capacity is limited

TAN is manufactured using NH_3 and nitric acid (HNO3), and it's important to note that nitric acid is also produced from NH_3. Therefore, a cost-competitive and reliable source of NH3 is essential for TAN production. India's TAN capacity has been constrained due to lack of NH_3, primarily because of the unavailability of natural gas. However, demand is growing at an 8-10% CAGR, which means the required utilization of India's TAN capacity will exceed 100% by CY25F. Globally, new cost-competitive TAN capacities are not emerging, as Russia, which has access to cheap gas, is embroiled in a war with Ukraine, and western countries are transitioning to green ammonia, which has a production cost of at least US$700/t. Major global companies like Yara are shutting down their grey ammonia capacity in Europe, further constraining global supply. As ammonia prices rise, so will TAN prices. Thus, companies with a cost-efficient ammonia production process will benefit. Please note that unless NH_3 price exceeds US$600/t, green NH_3, even after accounting for CBAM (carbon border adjustment mechanism) & ETS (emission trading scheme), is not viable.

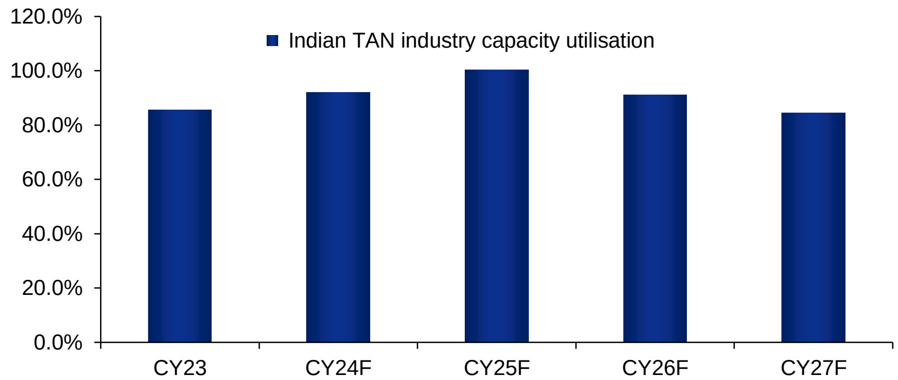
India's TAN capacity must increase to seize the global opportunity

India's TAN capacity is expected to expand by approximately 80% over the next three-to-four years. However, most of this capacity will still be utilized for domestic consumption, even with an estimated 300kt of imports likely in CY26F and CY27F. As Russia, the world's largest TAN exporter, is increasingly getting isolated from western markets—many of which are shutting down their ammonia production and becoming TAN importers—India has a significant opportunity to fill this supply gap. It's important to note that the Indian government had banned TAN exports during the period 1QFY23 to 3QFY24.

TAN spreads to rise significantly in FY26F before stabilizing in FY27F

India's TAN spreads collapsed in FY24 due to imports rising to 39% of demand in 2023. In 4QFY23, imports accounted for about 55% of quarterly demand. This influx of TAN flooded the market, leading to excessive inventory, which caused both prices and spreads to collapse. During this time, Indian exports were banned, leaving domestic manufacturers unable to alleviate the pressure from Russian dumping. Interestingly, the level of dumping seen in 4QFY23, which severely impacted India's TAN industry throughout 2023, needs to happen every quarter in FY26F to meet demand. However, as is often the case, this volume is unlikely to materialize at that time. TAN prices will rise due to 1) capacity constraints, and 2) rising NH3, as NH3 spreads over gas are expected to rise.

Figure 1: Indian TAN industry's required capacity utilization to rise in 2025F



SOURCE: INCRED RESEARCH, COMPANY REPORTS

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Ammonium nitrate is in a sweet spot

Indian ammonium nitrate is in a sweet spot as domestic demand is rising, capacity additions will take time, and imports, as a percentage of demand, are decreasing significantly. Additionally, the Indian government has allowed the export of ammonium nitrate, which provides a safety net for Indian companies in the event of domestic oversupply. It's worth noting that India used to be a significant exporter of ammonium nitrate, and so this policy change could help Indian companies tap export markets once again.

Ammonium nitrate - demand tailwind

Ammonium nitrate is primarily used as an industrial explosive and as a fertilizer ➤

Agriculture (Fertilizer):

- **Fertilizer:** Ammonium nitrate (TAN) is a major component in nitrogen-based fertilizers. It provides a rich source of nitrogen, which is essential for plant growth. The high nitrogen content (33-34% nitrogen by weight) makes it a popular choice among farmers for increasing crop yield, particularly for crops like corn, wheat, and cotton. It dissolves quickly in water, making nitrogen readily available to plants.

Mining and construction (explosives):

- **Explosives:** The other significant use of ammonium nitrate is in the production of explosives. TAN is used in a mixture with fuel oil (known as ANFO - ammonium nitrate fuel oil), which is a common explosive used in mining, quarrying, and civil construction. It is valued for its cost-effectiveness and safety in handling compared to other more volatile explosives.

Other uses:

- **Cold packs:** Ammonium nitrate can be found in instant cold packs used in first-aid kits. When water and ammonium nitrate mix, it undergoes an endothermic reaction, absorbing heat and cooling the pack.
- **Laboratory uses:** Ammonium nitrate can be used in laboratories for various chemical reactions, particularly in experiments involving nitrates or studying thermal decomposition.

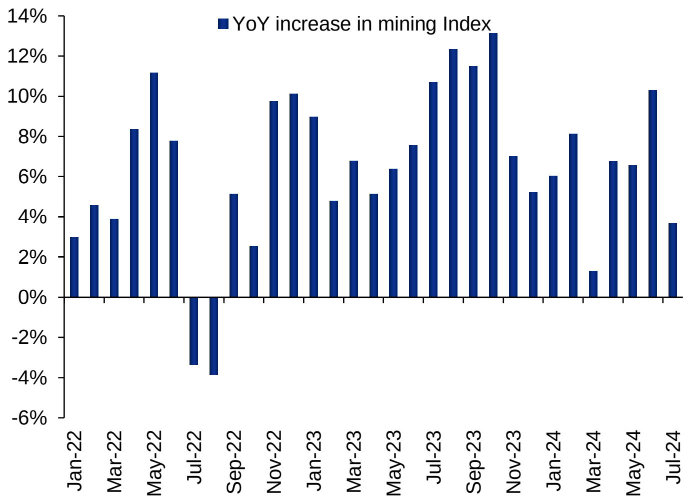
Due to its potential for misuse, especially in the manufacture of improvised explosive devices (IEDs), many countries regulate the sale and distribution of ammonium nitrate strictly.

India's ammonium nitrate manufacturing capacity has been approximately 1mt ➤

1. DFPCL: A leading manufacturer of technical ammonium nitrate (TAN) in India, which has plants at Taloja in Maharashtra and at Srikakulam in Andhra Pradesh. DFPCL's products cater to the requirements of mining, infrastructure, and pharmaceutical industries.
2. Vizag Chemical: A supplier and manufacturer of ammonium nitrate based in Vizag, Andhra Pradesh.
3. Gujarat Narmada Fertilizers and Chemicals (GNFC): A major manufacturer of ammonium nitrate in India.
4. Chambal Fertilisers: The company is building a 240kt capacity plant, which is expected to come on stream in FY27F.
5. Coal India: The company is planning capacity addition along with Bharat Heavy Electricals or BHEL. However, this depends on BHEL developing a coal gasification plant. Given the R&D involved, we believe it may take a decade for Coal India to bring the plant online.

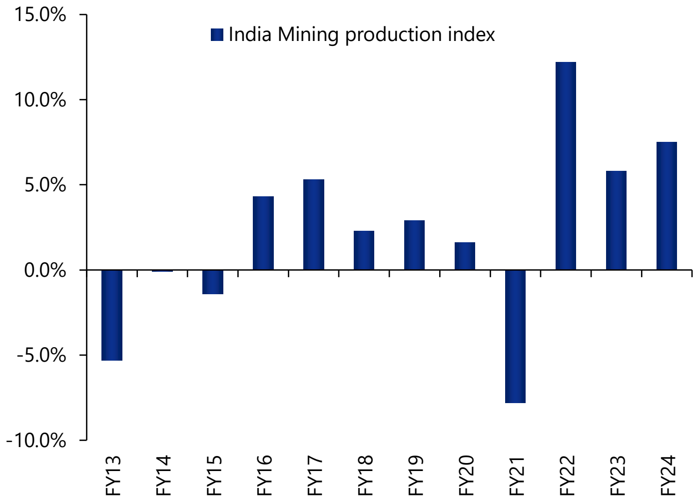
India's mining production has been growing @8% CAGR for the last two-to-three years

Figure 2: Monthly mining index series has been quite volatile…



SOURCE: INCRED RESEARCH, COMPANY REPORTS

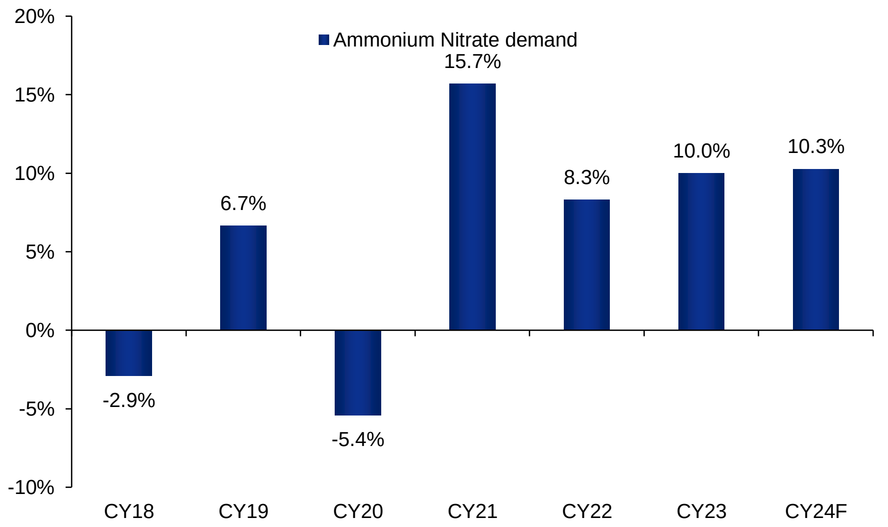
Figure 3: …while, on the other hand, yearly mining production has increased at a CAGR of 8% over the last three years



SOURCE: INCRED RESEARCH, COMPANY REPORTS

The rise in mining activity is driving the growth in ammonium nitrate consumption

Figure 4: Ammonium nitrate demand is growing @10% for the last four years



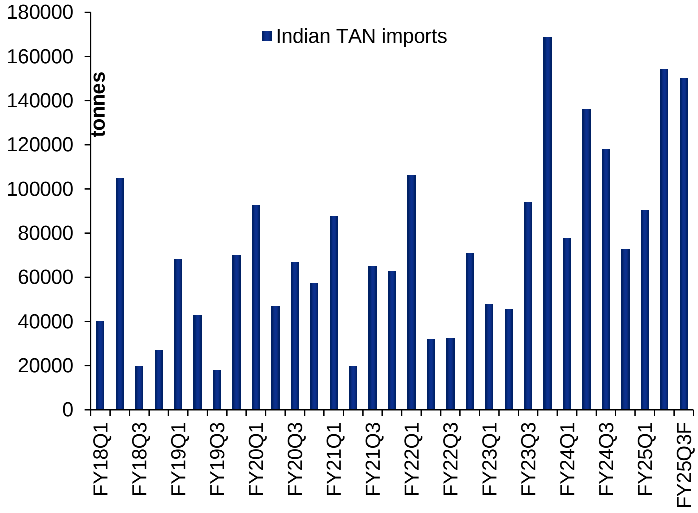
SOURCE: COMPANY REPORTS, INCRED RESEARCH

India's TAN production is insufficient to meet domestic demand

Over the years, India has been dependent on imports to meet domestic demand for TAN. Because of its critical and strategic use, the government of India keeps a great vigil on its domestic production and trade levels.

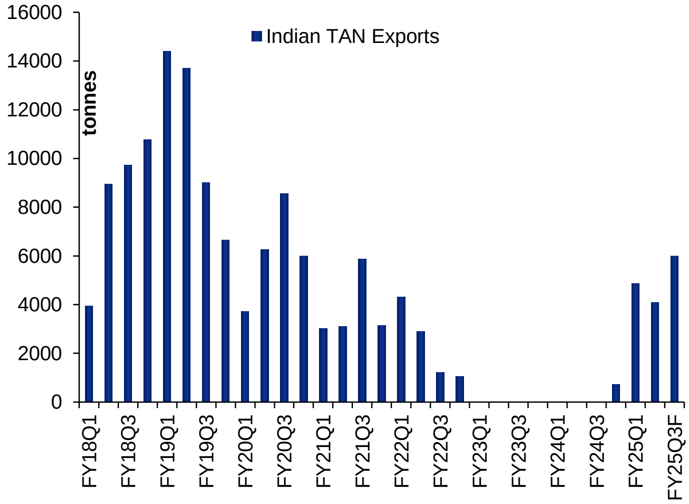
India has been an importer of TAN

Figure 5: Indian has been an importer of TAN for a long time



SOURCE: INCRED RESEARCH, COMPANY REPORTS

Figure 6: However, it also used to export, which helped balance the market in case of excess imports



SOURCE: INCRED RESEARCH, COMPANY REPORTS

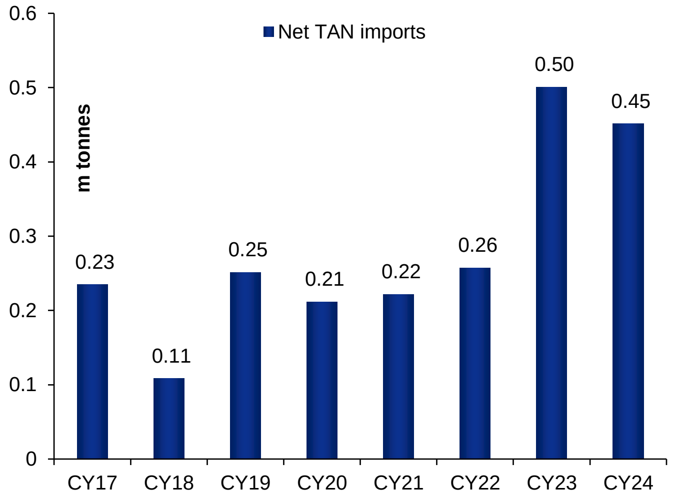
However, the Russia-Ukraine war raised concerns over reduced imports, leading the Indian government to ban TAN exports in 2022

The Russia-Ukraine war had significant implications on global supply chains, including fertilizers and chemical products, such as technical ammonium nitrate (TAN). Due to the disruption in imports, particularly of crucial raw materials from Russia, the Indian government imposed restrictions on the export of these products, including TAN, in 2022. The aim was to ensure adequate domestic supply, given the critical role that TAN plays in the mining and explosives sectors. This move was part of its broader efforts to maintain stability in the Indian market amid rising uncertainty in global trade.

While TAN imports didn't decrease in 2022, they flooded the Indian market in 2023

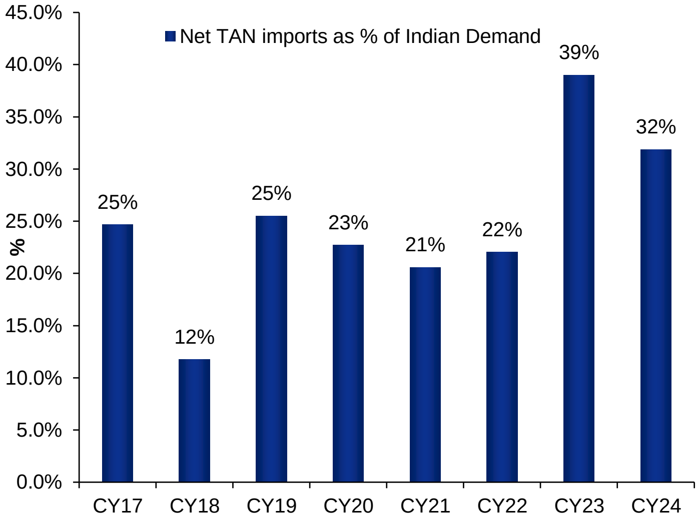
For the last several years, India's net TAN imports accounted for around 22-25% of overall demand. Any significant rise in imports beyond this level leads to inventory build-up, resulting in price collapse. Net ammonium nitrate imports in India rose to 39% of demand in 2023, resulting in a collapse of domestic prices.

Figure 7: Net TAN imports rose to 0.5mt and as exports opportunities were absent, the domestic market was flooded



SOURCE: INCRED RESEARCH, COMPANY REPORTS

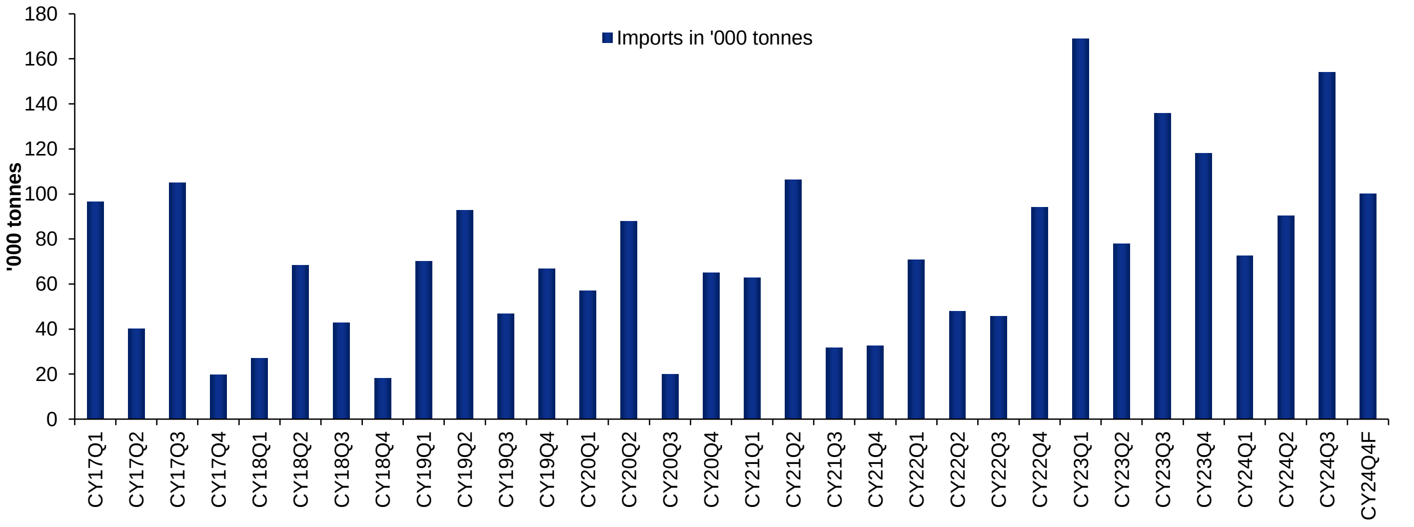
Figure 8: Net TAN imports, meeting 39% of local demand, are a recipe for price collapse



SOURCE: INCRED RESEARCH, COMPANY REPORTS

While imports were high in 2023, most of the imports were concentrated in 1QFY23, which led to very high domestic inventory

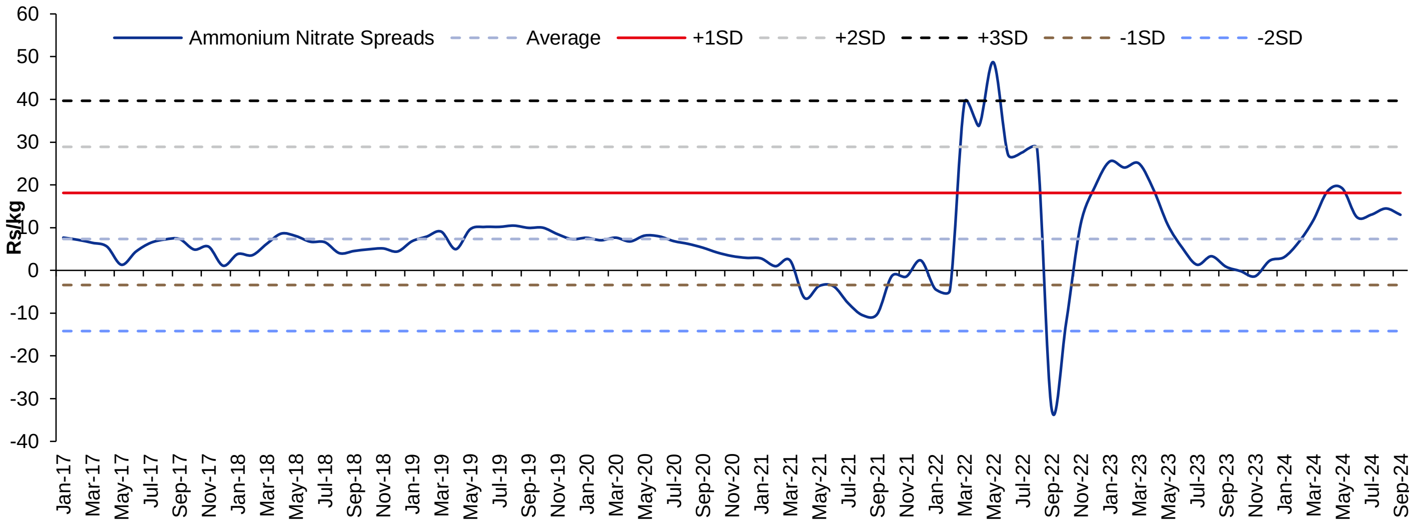
Figure 9: Extremely high imports in 1QCY23 (annualized imports accounted for nearly 60% of demand) led to massive inventory build-up, causing domestic TAN prices to collapse



SOURCE: INCRED RESEARCH, COMPANY REPORTS

As a result, Indian ammonium nitrate spreads collapsed in CY23

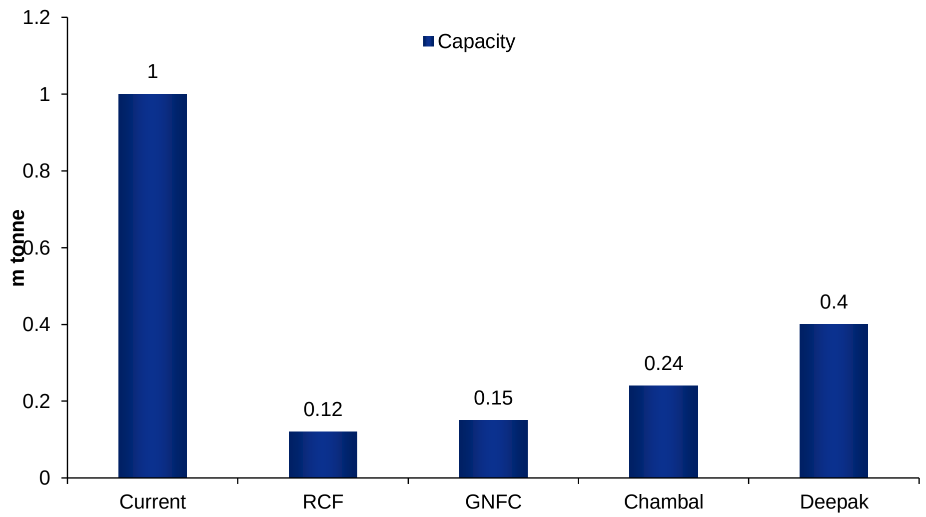
Figure 10: Ammonium nitrate spreads, calculated based on spot prices of ammonia and nitric acid, collapsed in CY23 and recovered only in CY24



SOURCE: INCRED RESEARCH, COMPANY REPORTS

Ammonium nitrate capacity addition is happening at a slow pace in India

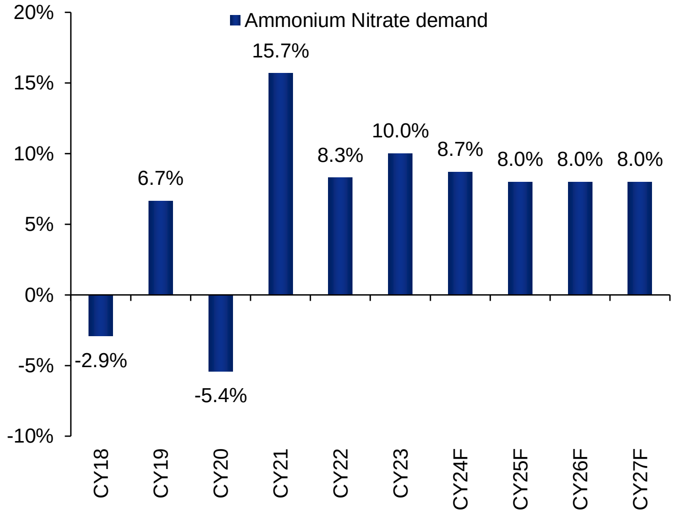
Figure 11: In the next four years, India is going to add ~0.9mt ammonium nitrate capacity



SOURCE: INCRED RESEARCH, COMPANY REPORTS

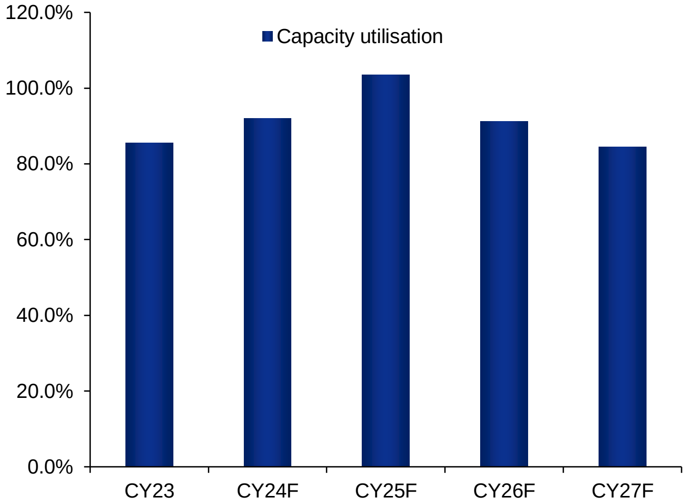
Required capacity utilization will be very high in CY25F, and unless Russian imports increase significantly, there will be shortage of ammonium nitrate in India

Figure 12: Ammonium nitrate demand is likely to increase by an 8% CAGR



SOURCE: INCRED RESEARCH, COMPANY REPORTS

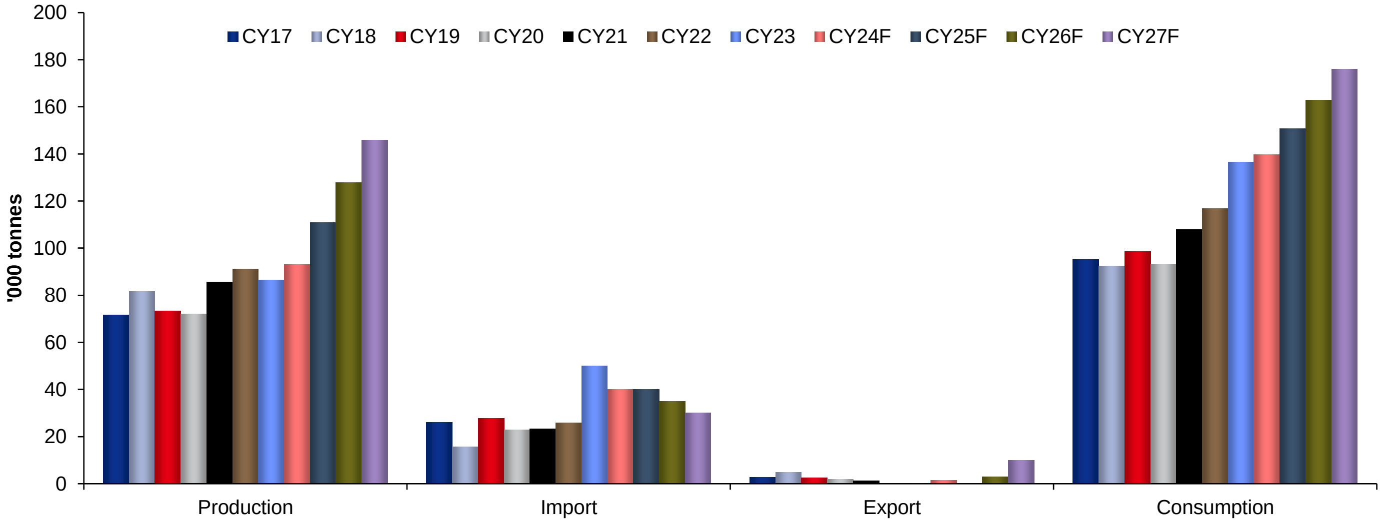
Figure 13: The required Indian TAN capacity utilization needs to rise to 105% before cooling off



SOURCE: INCRED RESEARCH, COMPANY REPORTS

We don't assume any ammonium nitrate exports in CY25F, but they may commence in CY26F.

Figure 14: Imports will begin trending downwards from CY24 and will most likely fall to 300kt by CY27F; India used to export ammonium nitrate in CY17/18, and this could potentially restart



SOURCE: INCRED RESEARCH, COMPANY REPORTS

Globally, ammonium nitrate is closely tied to ammonia production capacity

Ammonia is the main ingredient to produce ammonium nitrate

Ammonium nitrate (NH_4NO_3) is produced through a chemical reaction between ammonia (NH_3) and nitric acid (HNO_3). The process can be broken down into several key steps:

1. **Ammonia production**: Most ammonium nitrate plants first produce ammonia through the Haber-Bosch process, where nitrogen from the air reacts with hydrogen (usually derived from natural gas) under high pressure and temperature in the presence of a catalyst to produce ammonia.

   N2+3H2→2NH3

2. **Nitric acid production**: Nitric acid is produced by oxidizing ammonia in a process called the Ostwald process. In this process, ammonia is oxidized to form nitrogen oxides, which then react with water to produce nitric acid.

   4NH3+5O2→2HNO3+NO

3. **Neutralization reaction**: The core of ammonium nitrate production is the neutralization reaction between ammonia and nitric acid:

   NH3+HNO3 →NH4NO3

   This is an exothermic reaction, which means it releases heat. The resulting ammonium nitrate solution can be concentrated by evaporating water to produce either a liquid concentrate or a solid product.

4. **Concentration and prilling**: For solid ammonium nitrate production, the liquid solution is concentrated, then solidified through a process called prilling, where droplets of the molten ammonium nitrate are cooled in a prilling tower to form solid spherical granules. Alternatively, the solution can be concentrated to produce a molten form that is then sprayed into a cooling environment to form granules (granulation process).

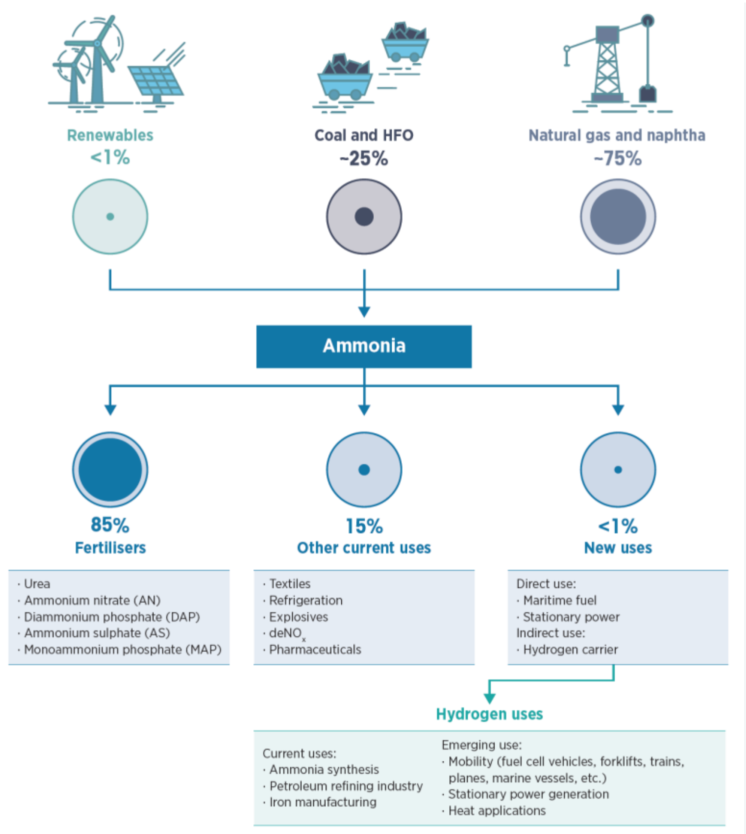
5. **Finishing**: The final product is dried, cooled, coated (to reduce moisture absorption and clumping), and packaged for various applications, such as fertilizers or industrial explosives (e.g., technical ammonium nitrate or TAN).

Global ammonia demand supply favours high prices

As the world is focusing on decarbonization, new natural gas-based ammonia capacities are few and far in between. At the same time, India and the Middle East can become green ammonia hubs, but that stage is far away. To compete with natural gas-based ammonia, green hydrogen prices need to fall below US$2/kg, which is difficult, as per the current technology. Technological innovation in solar power is needed to bring the overall ammonia production cost below US$2/kg.

85% of global ammonia production is used to make nitrogen-rich nutrients to be used in fertilizers/ explosives

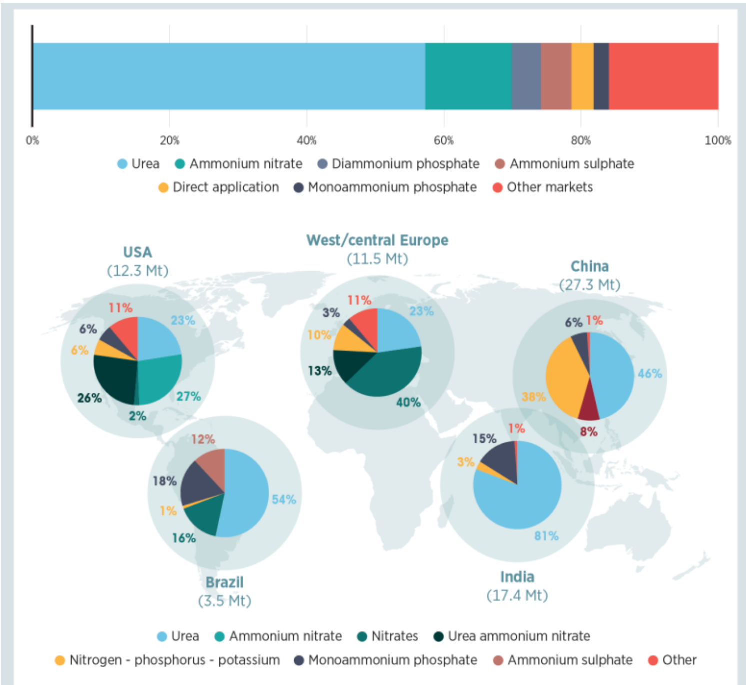
Figure 15: 85% of global ammonia production is used to make nitrogen-rich nutrients (urea, ammonium nitrate, etc.)



SOURCE: INCRED RESEARCH, IRENA

Out of the total fertilizer usage, ~58% is used to make urea and 12-13% in ammonium nitrate production

Figure 16: Urea still accounts for a major portion of ammonia usage

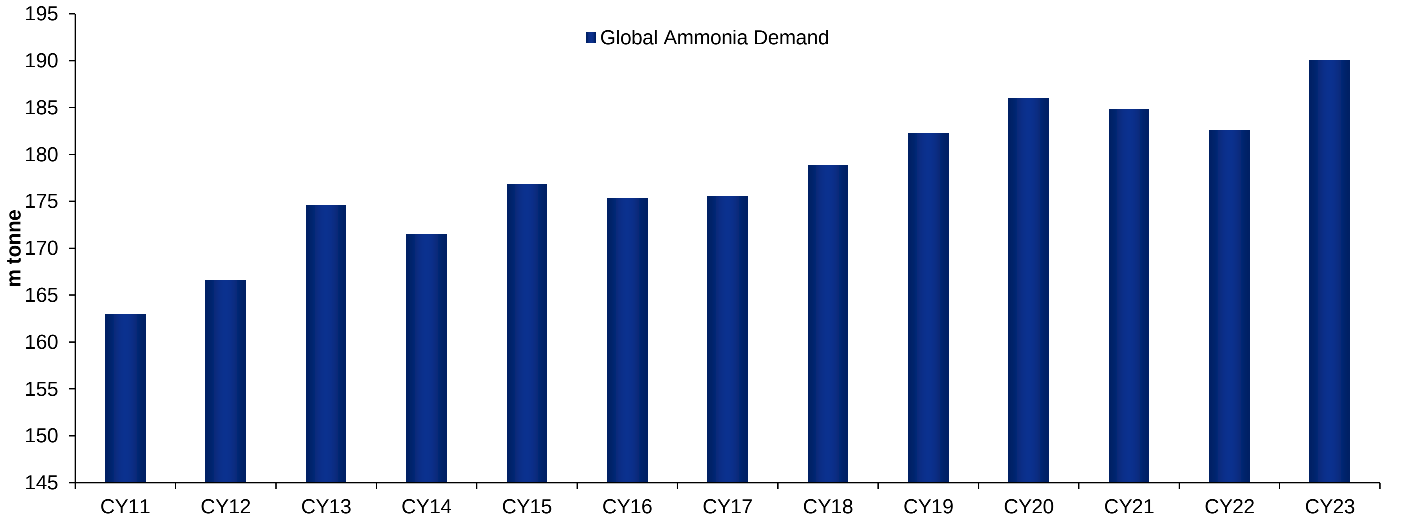


SOURCE: INCRED RESEARCH, IRENA

Global ammonia demand bounced back to 190mt in CY23

High gas prices led to a rapid rise in ammonia prices in CY22 and consequently, we saw the demand declining. The overall demand is likely to have bounced back to the CY21 level in Europe, which led to a rapid demand recovery to 190mt in CY23.

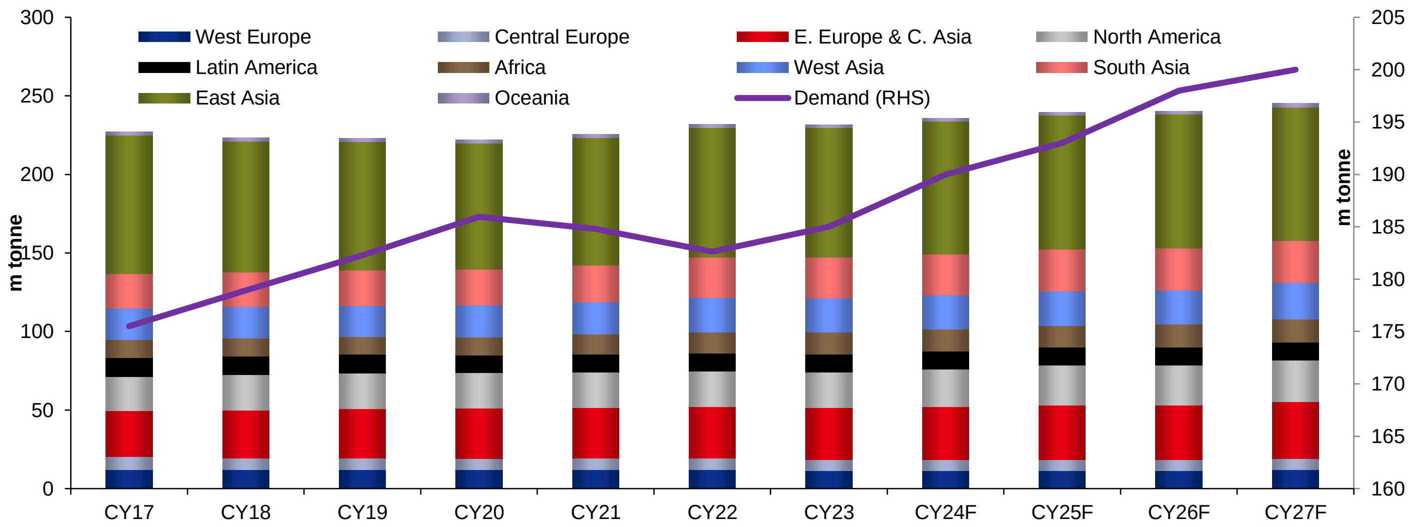
Figure 17: Global demand for ammonia bounced back to 190mt in 2023



SOURCE: INCRED RESEARCH, COMPANY REPORTS

Global ammonia capacity remains around 231mt

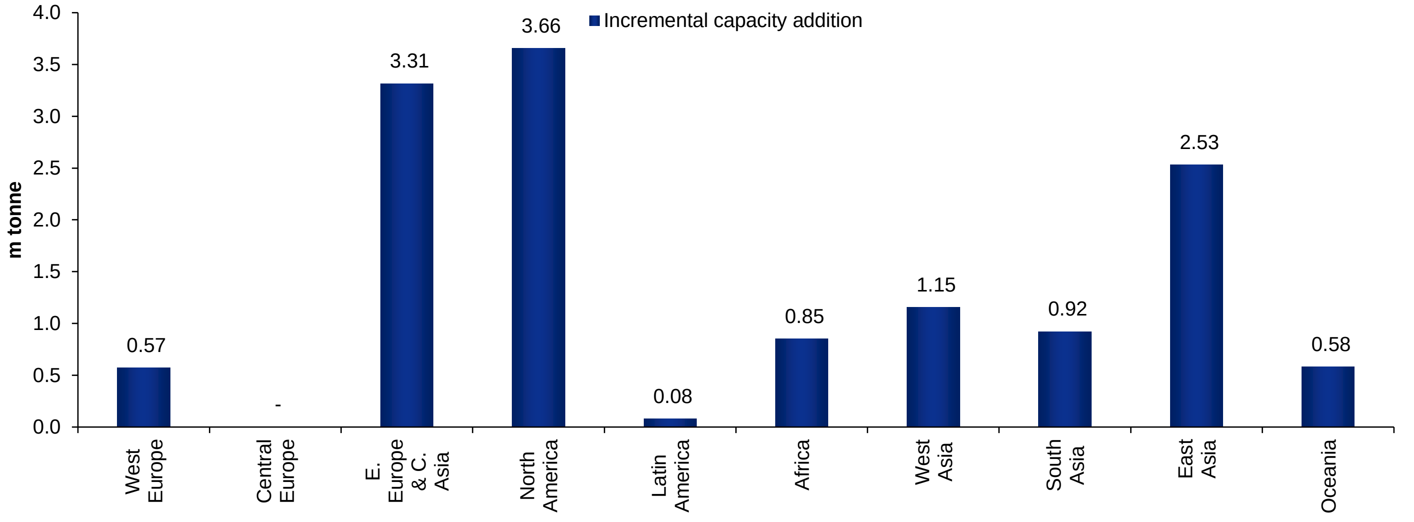
Figure 18: Global ammonia capacity is 231mt, which is likely to rise very slowly to 245mt by CY27F



SOURCE: INCRED RESEARCH, COMPANY REPORTS

Incremental capacity is getting added in high production cost zones

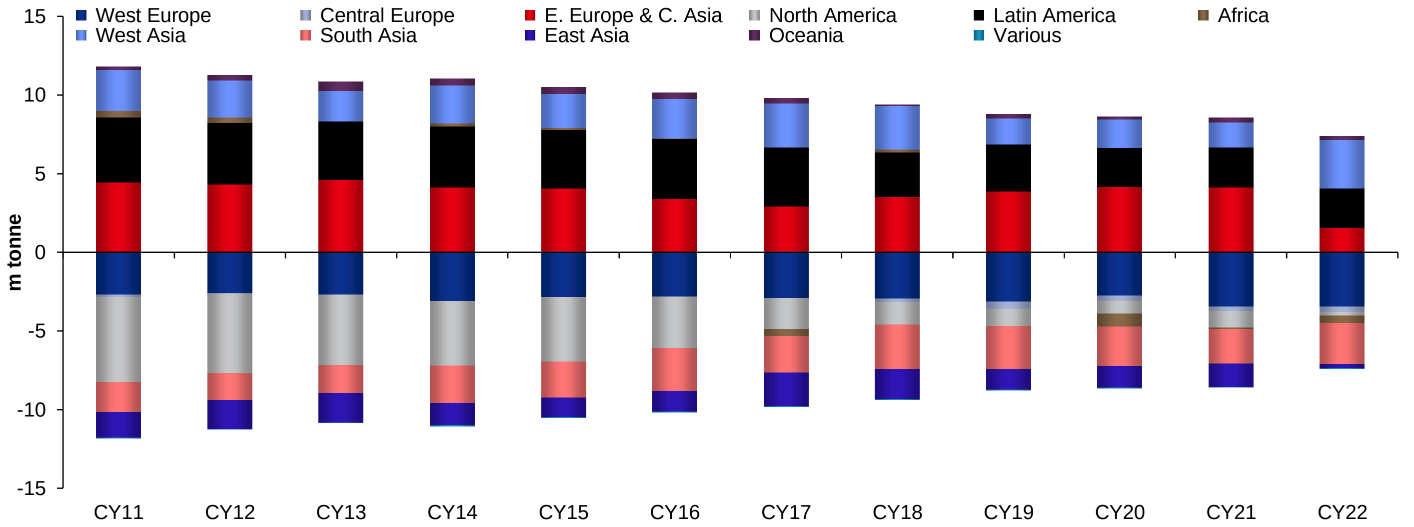
Figure 19: North America is going to emerge as a major centre for ammonia production in the coming years



SOURCE: INCRED RESEARCH, COMPANY REPORTS

Till CY22, West Europe was a big exporter of ammonia

Figure 20: West Europe has been a major exporter of ammonia till CY22 but going ahead, it may cease to be an exporter



SOURCE: COMPANY REPORTS, INCRED RESEARCH

European ammonia production is going to get impacted by carbon reduction policies

CO2 emission reduction targets for ammonia plants in Europe are influenced by several factors, including EU-wide regulations, national policies, and industry-specific guidelines. The European Union or EU has set ambitious climate targets, and these are translated into specific requirements for industrial sectors, including ammonia production. Here's a detailed overview:

EU-wide targets and regulations

European Green Deal:

Climate neutrality by 2050F: The EU aims to become climate neutral by 2050F, which means net-zero greenhouse gas emissions.

Intermediate target: A binding target to reduce greenhouse gas emissions to at least 55% by 2030F, compared to the 1990 level.

EU Emissions Trading System (EU ETS):

Cap-and-trade system: The EU ETS sets a cap on the total amount of greenhouse gases that can be emitted by covered entities, which is reduced over time.

Free allowances: Some industries, including ammonia producers, receive free allowances to mitigate the risk of carbon leakage (where production might shift to countries with less stringent emission constraints).

Annual reduction factor: The cap on emissions decreases annually, with the Linear Reduction Factor (LRF) currently set at 2.2% per year from 2021 to 2030.

Industry-specific Initiatives

Fertilizers Europe:

Sustainability roadmap: Fertilizers Europe, representing the fertilizer industry, has developed a roadmap to reduce carbon emissions.

Best available techniques (BAT): The industry is encouraged to adopt BAT to improve efficiency and reduce emissions.

Innovation and Technology

Green Hydrogen: Increasing the use of green hydrogen (produced via electrolysis using renewable energy) instead of natural gas.

Carbon capture and storage (CCS): Implementing CCS technologies to capture and store CO2 emissions from ammonia plants.

National Policies

Country-specific targets:

Countries within the EU have their own national targets and strategies aligned with the EU's overall climate goals. These may include additional measures or incentives for industrial emission reductions.

Carbon pricing mechanisms:

Some countries have implemented their own carbon taxes or additional pricing mechanisms on top of the EU ETS to further incentivize emission reductions.

Reduction Targets for Ammonia Plants

Short-term (by 2030F):

Reduction goal: Align with the EU’s 55% reduction target by 2030F. For ammonia plants, this could mean significant investments in energy efficiency, green hydrogen, and CCS technologies.

Specific reductions: Targets can vary, but a typical ammonia plant might aim for a 30-40% reduction in CO2 emissions by 2030F, depending on current emissions levels and technological feasibility.

Long-term (by 2050F):

Climate Neutrality: Achieving net-zero emissions by 2050F, which will likely require near-complete adoption of green hydrogen, full implementation of CCS, and potentially offsetting any remaining emissions through high-quality carbon offsets.

Ammonia plants in Europe face stringent CO2 emission reduction targets, driven by the EU’s overarching climate goals. By 2030F, significant reductions are expected, with a long-term goal of achieving climate neutrality by 2050F. Meeting these targets will require substantial investments in new technologies, efficiency improvement, and potentially the use of carbon offsets.

European ammonia companies will have to invest in carbon reduction technologies ➤

European ammonia companies are actively planning and implementing strategies to meet emission reduction targets set by the EU and national regulations. These strategies involve a combination of technological innovation, process optimization, and strategic investments.

Here are some of the key approaches:

1. **Green hydrogen**:
   - **Electrolysis**: Companies are investing in electrolysis technologies to produce green hydrogen using renewable energy sources. Green hydrogen can replace the natural gas typically used in the Haber-Bosch process, significantly reducing CO2 emissions.
   - **Partnerships and pilot projects**: Collaborations with renewable energy companies and investments in pilot projects to scale up green hydrogen production.
2. **Carbon capture and storage (CCS)**:
   - **CCS implementation**: Developing and integrating CCS technologies to capture CO2 emissions from ammonia production processes and store them underground or utilize them in other industrial applications.
   - **Research and development**: Investing in R&D to improve the efficiency and cost-effectiveness of CCS technologies.
3. **Energy efficiency**:
   - **Best available techniques (BAT):** Adopting BAT to enhance the energy efficiency of production processes. This includes optimizing reactors, improving heat integration, and reducing energy losses.
   - **Modernization of plants**: Upgrading existing facilities with state-of-the-art equipment and control systems to reduce energy consumption and emissions.
4. **Operational improvements**
   - **Process intensification:** Implementing advanced process control and intensification techniques to maximize yield and minimize waste.
   - **Waste heat recovery systems**: Utilizing waste heat recovery systems to capture and reuse heat generated during production, thereby reducing the overall energy demand.
5. **Onsite renewable energy**
   - **Solar and wind installations**: Installing solar panels and wind turbines at production sites to generate renewable electricity for use in ammonia production.
   - **Energy storage solutions**: Incorporating energy storage solutions to manage the intermittent nature of renewable energy sources.
6. **Power purchase agreements (PPAs)**: Entering into PPAs with renewable energy providers to secure a stable supply of green electricity for production processes.
7. **Funding and subsidies**:
   - **EU funding programs**: Leveraging funding opportunities from EU programs such as Horizon Europe and the Innovation Fund to support green projects and R&D activities.
   - **National incentives**: Taking advantage of national incentives and subsidies aimed at promoting low-carbon technologies and practices.
8. **Carbon offset projects**:
   - **Investment in offset projects**: Investing in high-quality carbon offset projects that sequester CO2 or reduce emissions elsewhere to compensate for any residual emissions from ammonia production.
   - **Certification standards**: Ensuring offsets are certified by reputable standards like the Verified Carbon Standard (VCS) or Gold Standard to guarantee their environmental integrity.

9. **Emissions tracking**:
   - **Advanced monitoring systems**: Implementing advanced monitoring systems to accurately track and report emissions, ensuring compliance with regulatory requirements.
   - **Transparency**: Maintaining transparency in emissions reporting and reduction efforts to stakeholders, including regulatory bodies and investors.

Companies like Yara International and BASF are already taking initiatives which will increase their cost of production ➤

1. **Yara International**
   - **Green hydrogen projects**: Yara International is actively developing green hydrogen projects, including a pilot plant in Norway, aimed at producing ammonia using renewable energy.
   - **CCS initiatives**: The company is exploring CCS options in collaboration with other industrial partners.
2. **BASF**
   - **Carbon management**: BASF is integrating renewable energy into its production processes and exploring the use of CCS to reduce emissions from ammonia production.

European ammonia companies are employing a multi-faceted approach to meet emission reduction targets, involving technological innovations, process optimization, renewable energy integration, strategic partnerships, and investments in carbon offset projects. These efforts are aligned with broader EU climate goals and are essential for achieving sustainable and low-carbon ammonia production.

Carbon capture and reduction emission technologies can add US$100-120/t to the cost of production➤

There are two methods of making ammonia from natural gas or coal gasification projects:

1. Steam Methane Reforming (SMR)
   - **Feedstock**: SMR is the most common method for producing hydrogen, which is a key component in ammonia production.
   - **Reaction**: It involves reacting methane (CH_4) with steam (H_2O) in the presence of a catalyst to produce hydrogen (H_2) and carbon monoxide (CO).
   - **Chemical equation**: $CH_4+H_2O \rightarrow CO+3H_2$.
   - **Catalyst**: Typically uses a nickel-based catalyst at high temperatures (around 700-1,000°C) and moderate pressure.
   - **SMR acts as a hydrogen source in NH_3 production**: The hydrogen produced from SMR is crucial for the Haber-Bosch process, which converts nitrogen (N_2) from the air into ammonia (NH_3).
   - **Carbon footprint**: SMR is carbon-intensive as it produces CO2 emissions directly from methane reforming. The carbon footprint can be mitigated by implementing carbon capture and storage (CCS) technologies.
2. Autothermal Reforming (ATR) - ATR combines partial oxidation (POX) with SMR in a single reactor, utilizing both oxygen (from air) and steam to reform methane.
   - **Reaction**: It generates hydrogen (H_2), carbon monoxide (CO), and carbon dioxide (CO_2).
   - **Chemical equation**: $CH_4+1/2O_2+H_2O \rightarrow CO+ 3H_2$.
   - **Heat source**: ATR is ‘autothermal’, which means it self-sustains its heat requirements through the exothermic reactions of methane oxidation and reforming.
   - **Efficiency**: ATR is more efficient than SMR because it integrates heat generation and reduces the need for external heat sources.

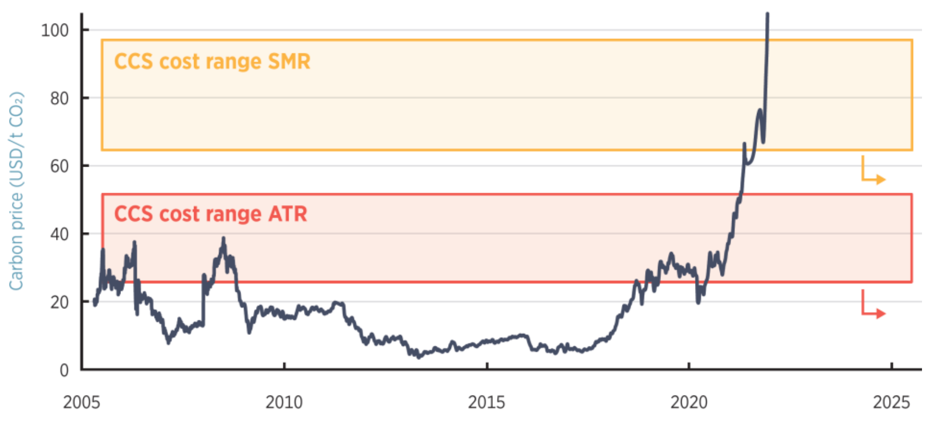
- **Flexibility**: Offers flexibility in hydrogen production and can be adjusted to meet varying process demands.
- **Reduced carbon footprint**: Compared to SMR, ATR can potentially reduce CO2 emissions per unit of hydrogen produced due to its internal heat generation and lower oxygen requirements.

SMR and ATR comparison and considerations

1. **Energy efficiency**:
   - ATR typically has higher energy efficiency compared to SMR due to its integrated heat generation.
   - Both processes require careful management of heat, pressure, and catalysts to optimize hydrogen and CO2 production.
2. **Carbon emissions**:
   - Both SMR and ATR produce CO2 emissions directly from methane reforming. To mitigate this, technologies like CCS can be integrated to capture and store CO2 emissions.
3. **Industrial applications:**
   - SMR is widely used in large-scale ammonia production due to its established technology and reliable performance.
   - ATR is gaining attention for its potential to reduce carbon emissions and improve energy efficiency, although it may require more complex process control.

SMR and ATR are pivotal technologies in ammonia production, particularly for generating the hydrogen necessary in the Haber-Bosch process. While SMR is more established and widely used, ATR offers advantages in efficiency and potentially lower carbon emissions.

Figure 21: The carbon reduction mechanisms will cost around US$100/t of NH3 produced



SOURCE: COMPANY REPORTS, INCRED RESEARCH

Most of the plants in Europe currently are based on SMR technology ➤

In Europe, approximately 70% of ammonia production relies on steam methane reforming (SMR) technology. This method is predominant due to the availability of natural gas as a feedstock. The remaining ammonia production mainly utilizes coal gasification and, to a lesser extent, other technologies like electrolysis of water.

Hence, it means that production cost will increase by at least US$100/t by 2030F ➤

Given the current status of technology of CCS (carbon capture and storage), the overall production cost of ammonia in Europe will rise by US$100/t. Please note that spot market prices of carbon credits will be well in excess of this and hence, most companies are well-advised to use CCS.

Figure 22: As of now, including CCs, European ammonia production cost is well above US$500/t

	Value	Unit
Gas cost in Europe	12	US$/mmBtu
Gas needed to make 1 tonne of NH3	31	mmBtu/t of NH_3
NH_3 RM cost	372	US$/t
Other costs	50	US$/t
Overall NH_3 production cost	422	US$/t
CCS cost	100	US$/t
NH_3 production cost including CCS	522	US$/t

SOURCE: INCRED RESEARCH, COMPANY REPORTS

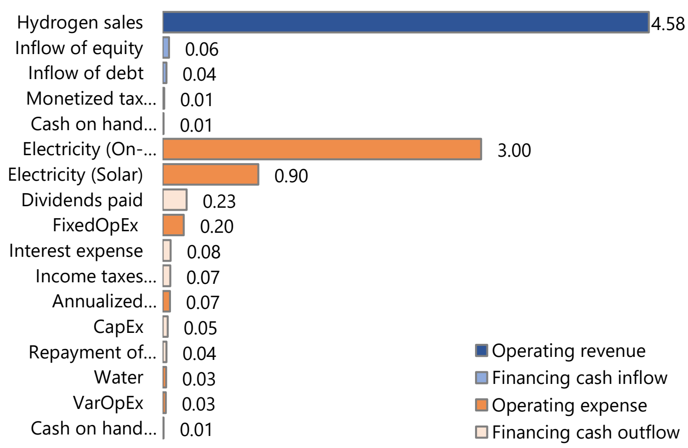
Figure 23: As more LNG liquefaction capacity comes online, production cost will come down to US$400/t

	Value	Unit
Gas cost in Europe	8	US$/mmBtu
Gas needed to make 1t of NH_3	31	mmBtu/t of NH_3
NH_3 RM cost	248	US$/t
Other costs	50	US$/t
Overall NH_3 production costs	298	US$/t
CCS cost	100	US$/t
NH_3 production cost including CCS	398	US$/t

SOURCE: INCRED RESEARCH, COMPANY REPORTS

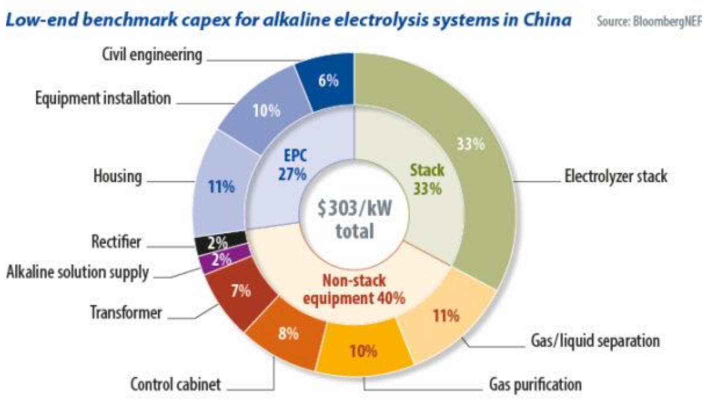
Green ammonia production cost heavily depends on cheap power cost ›

Figure 24: The cost of green hydrogen using cheap Chinese alkaline electrolyzer stack and wind power works out to US$6.6/kg



SOURCE: INCRED RESEARCH, COMPANY REPORTS

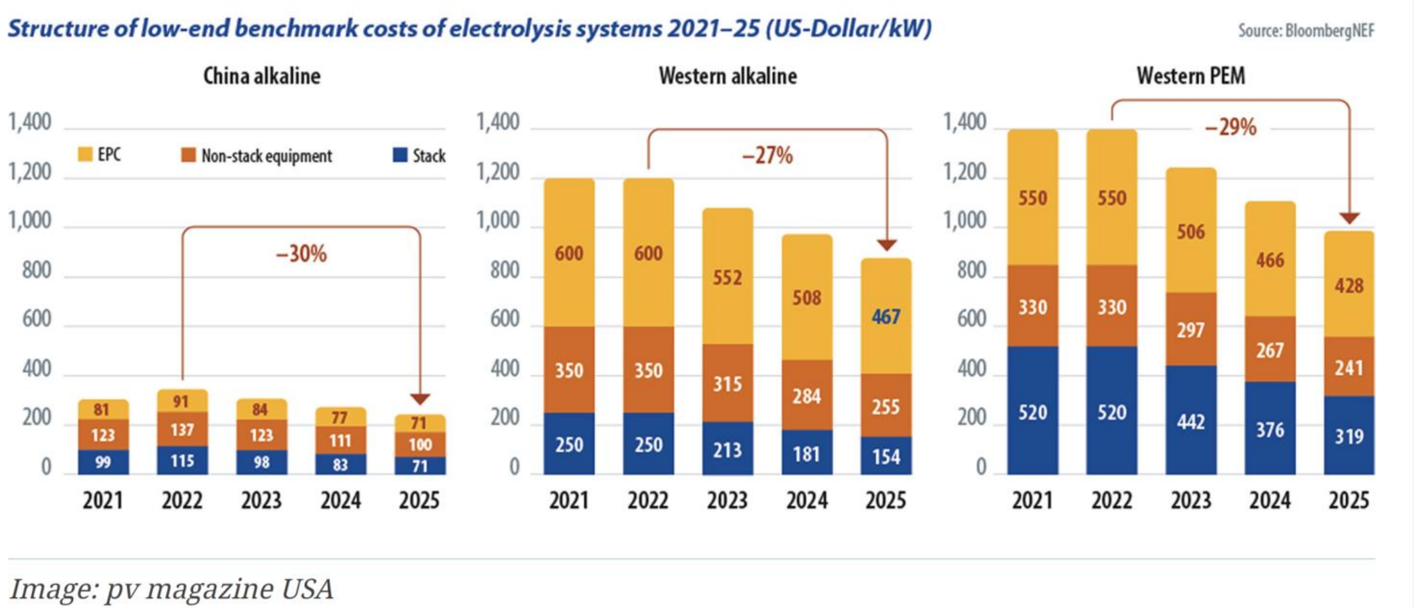
Figure 25: As of now, Chinese alkaline electrolyser can be bought at a price of US$303/kW



SOURCE: INCRED RESEARCH, HTTPS://WWW.PV-MAGAZINE-INDIA.COM/2024/03/22/ELECTROLYZER-PRICES-WHAT-TO-EXPECT/

However, stack cost is immaterial in the overall scheme of things. Its power cost that is most important. As evident in the graph above, almost 75% of the overall cost is driven by power. As solar power is difficult in Europe, wind power dependence is high. Getting wind power at less than 5 cents seems difficult in Europe.

Figure 26: If one uses European electrolyzers, then the cost of production will even go higher; however, as always, it's the power cost which is most important for H_2 production



SOURCE: HTTPS://WWW.PV-MAGAZINE-INDIA.COM/2024/03/22/ELECTROLYZER-PRICES-WHAT-TO-EXPECT/, INCRED RESEARCH

Green ammonia production cost in Europe will be well in excess of US$800/t

One tonne of ammonia needs ~180kg of hydrogen. In Europe, green H2 alone will cost ~US$800/t. At this cost, green ammonia production is unviable.

Hence, almost all European manufacturers will either shut shop or will go for CCS technologies

1. Green ammonia production is unviable as of now. The capex of wind power is coming down drastically and solar power is simply unviable in Europe.
2. Depending on spot purchase of carbon credits will be too dangerous for ammonia producers as post 2030F, spot prices of carbon credits may well shoot up to US$400/t i.e. (the difference between cost of green ammonia and gas-based ammonia)
3. The installation of CCS technologies will only increase the overall production cost by US$100-120/t.

European CBAM mechanism will come into force from 2025

1. The Carbon Border Adjustment Mechanism (CBAM) is a tool implemented by the EU to prevent carbon leakage and to encourage cleaner industrial production globally. It aims to level the playing field between EU producers, who face stringent carbon regulations, and non-EU producers, who may not be subject to similar carbon costs.
2. Initially, CBAM applies to imports of carbon-intensive goods such as cement, iron and steel, aluminium, fertilizers, electricity, and hydrogen. The coverage may expand in the future to include more sectors.
3. The mechanism is a part of the EU's broader climate strategy, complementing the EU Emissions Trading System (EU ETS).
4. From Oct 2023 to Dec 2025, there is a transitional period where importers must report the carbon emissions embedded in their goods. The first reports were due on 31 Jan 2024.
5. Starting 1 Jan 2026, importers will need to buy CBAM certificates to cover the carbon emissions of their imports. The price of these certificates will be linked to the average price of EU ETS allowances.
6. Importers must surrender a number of CBAM certificates corresponding to the emissions of their imported goods. These certificates are priced similarly to EU ETS allowances.
7. Importers can receive credits for any carbon taxes paid in the country of origin, reducing the number of certificates needed.
8. Companies need to understand and report the emissions profiles of their products. Failure to comply can result in additional costs and loss of market access in the EU.
9. Innovation to reduce emissions can lower costs associated with CBAM and potentially provide a competitive advantage.
10. Only authorized CBAM declarants can import covered goods into the EU. These entities must maintain detailed records of emissions data and comply with verification requirements.
11. CBAM is designed to incentivize non-EU countries to adopt greener production methods by making it more costly to export carbon-intensive goods to the EU. It also aims to prevent ‘carbon leakage’, where businesses relocate production to countries with lax emissions regulations, thus undermining global climate efforts.

Apart from CBAM, there are various other policy hurdles for ammonia production in Europe ➤

The EU is determined to reduce CO2 emissions in the coming decades and has embarked on an ambitious decarbonization path. New regulations have been implemented to force emission-intensive sectors, such as the ammonia industry, to decarbonize its production process. Every produced metric tonne of ammonia produces around 2.5 metric tonne (MT) of CO2, which is twice as much as the emission-intensive production of steel. There are three important changes in the EU regulations that force the industry to decarbonize - The Renewable Energy Directive (RED III), the phase-out of free EU emissions rights, and the Carbon Border Adjustment Mechanism (CBAM).

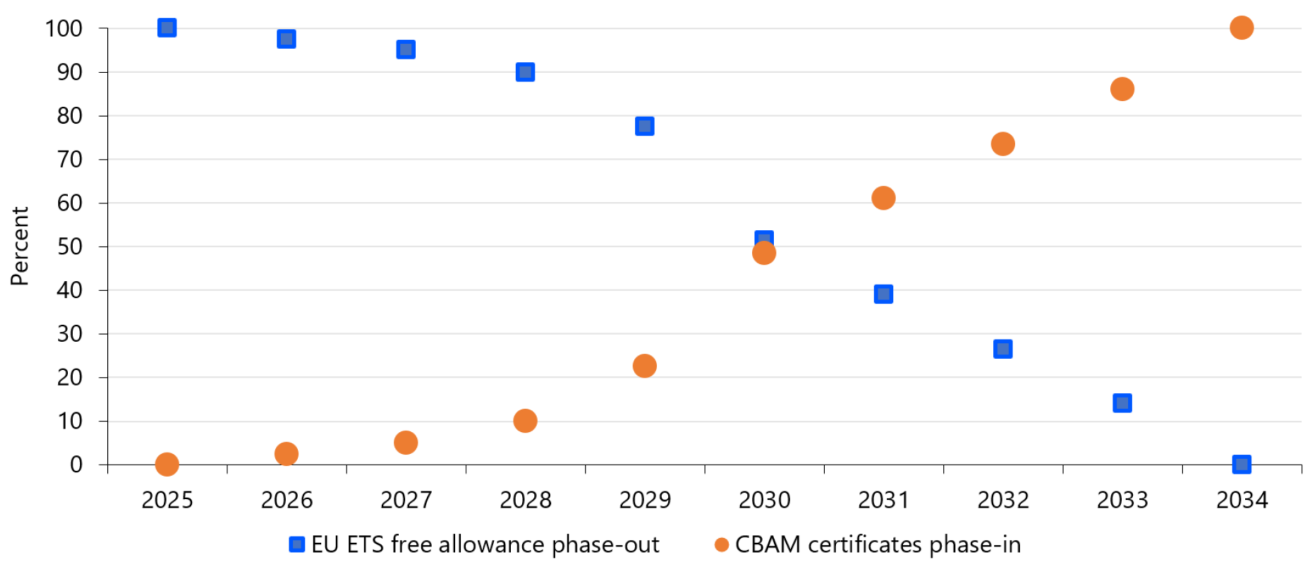
Renewable Energy Directive (RED III)

The revised Renewable Energy Directive (RED III) was agreed on in Sep 2023 and contains sector-specific binding sub-targets. RED III requires the hydrogen and fertilizer industries to replace 42% of grey hydrogen with Renewable Fuel of Non-Biological Origin (RFNBO), also referred to as renewable hydrogen or green hydrogen and all its derivatives, by 2030 and even 60% by 2035.

Phasing out free emission allowances

Another major change in the EU regulations that will drive up costs is the gradual phase-out of free carbon allowances (EUAs) under the European Union Emissions Trading System (EU ETS). Currently, the ammonia and fertilizer industry receives free emissions rights. This will change. From 2025, the free emissions rights will be gradually phased out. From 2034, the ammonia and fertilizer industry will have to pay for all its emissions. For the emission-intensive ammonia and fertilizer industry, this is another major cost increase, further eroding its cost competitiveness. However, a part of the effect of this cost increase should be neutralized by the Carbon Border Adjustment Mechanism (CBAM), a third relevant piece of EU legislation.

Figure 27: The way ETS free allowance is being phased out, it will become increasingly impossible to operate an ammonia plant in the EU

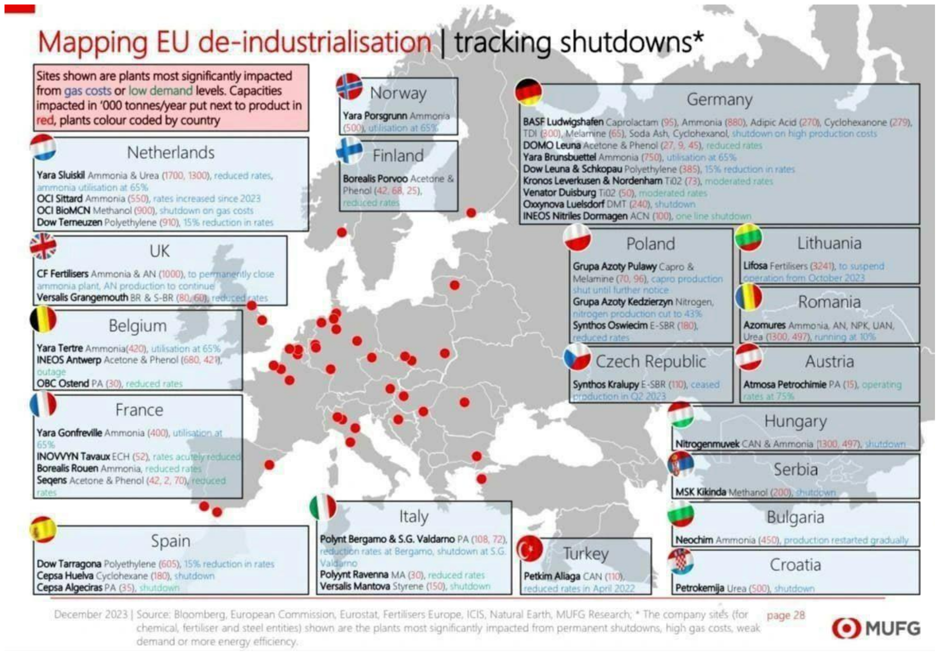


SOURCE: INCRED RESEARCH, COMPANY REPORTS

In an ETS/CBAM scenario, it doesn't make sense for producers to produce NH_3 in Europe as imported NH_3 will be cheaper ➤

Higher fixed cost of production, remote location of ammonia plants and unavailability of cheap Russian piped gases means the cost of ammonia production in Europe will be much higher.

Figure 28: There are multiple ammonia capacity shutdowns in Europe - one can count at least 8mt capacity shutdown in Europe



SOURCE: INCRED RESEARCH, COMPANY REPORTS

While there has been capacity shutdown, usage of fertilizers and technical ammonium nitrate is not going to come down in a jiffy and therefore, we are likely to see a rise in overall ammonia imports in the continent.

Figure 29: In a 50% ETS offset scenario, the cost of ammonia in Europe will work out to be US\$470/t

Manufacturing of ammonia in Europe		
Gas cost	10	US\$/mmBtu
Gas needed	31	mmBtu/t NH_3
Overall gas cost	310	US\$/t NH_3
Other costs	100	US\$/t NH_3
Overall cost of manufacturing	410	US\$/t NH_3
Carbon release per tonne NH_3	1.7	CO_2/t NH_3
Carbon prices	70	US\$/t CO_2
% Offset provided	50%	
Overall cost of manufacturing	469.5	US\$/t NH_3

SOURCE: COMPANY REPORTS, INCRED RESEARCH

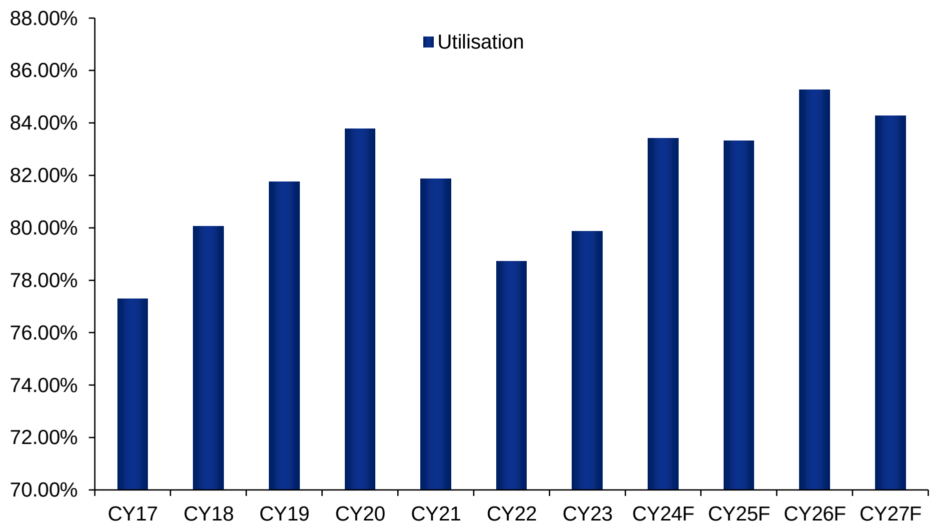
Figure 30: However, imports from India and the Middle East will cost ~US\$400/t

Imports of NH3 from India/MEA		
Gas cost	10	US\$/mmBtu
Gas needed	31	mmBtu/t NH_3
Overall gas cost	310	US\$/t NH_3
Other costs	25	US\$/t NH_3
Overall cost of manufacturing	335	US\$/t NH_3
Carbon release per tonne of NH_3	1.7	t CO_2/t NH_3
Carbon prices	70	US\$/t CO_2
% CBAM	50%	
Overall landed cost	394.5	US\$/t NH_3

SOURCE: COMPANY REPORTS, INCRED RESEARCH

Effective capacity utilization of ammonia to rise globally ➤

Figure 31: Global capacity utilization of ammonia to rise

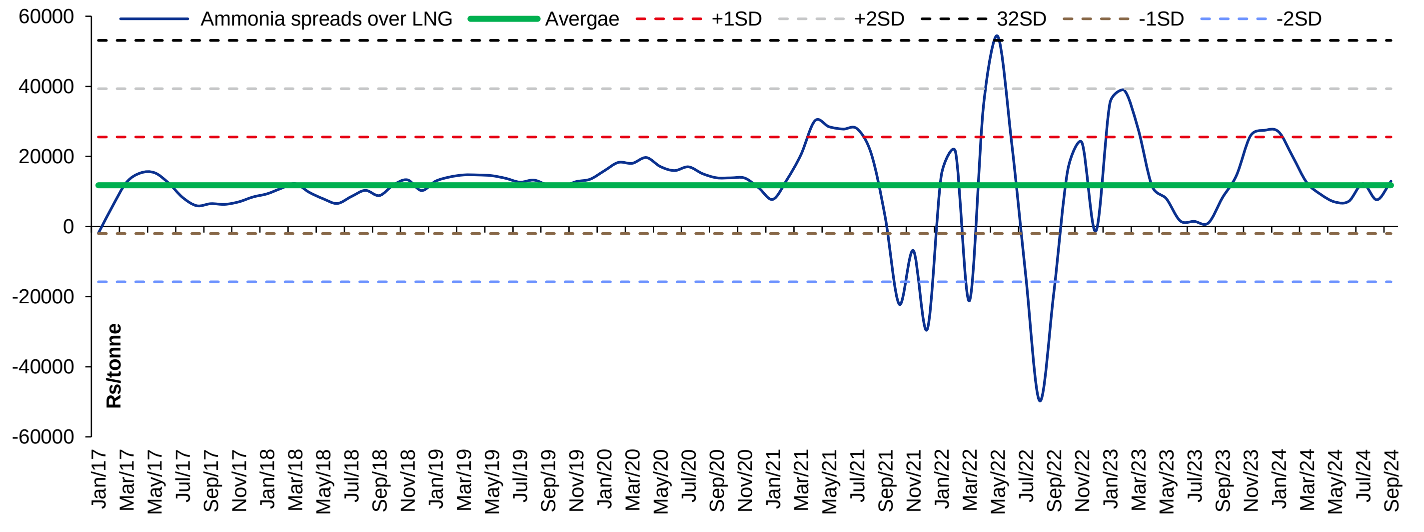


SOURCE: INCRED RESEARCH, COMPANY REPORTS

Ammonia spreads over LNG to rise in the coming years and we expect the rapid increase to start in 2HCY24F ›

The normal urea consumption season starts in India from Sep-Oct of every year and this is the time when the shortage of ammonia will be felt steeply in the global market. We expect the ammonia spreads to rise despite the fall in LNG prices.

Figure 32: Ammonia spreads over LNG are rising and will increase further in coming months



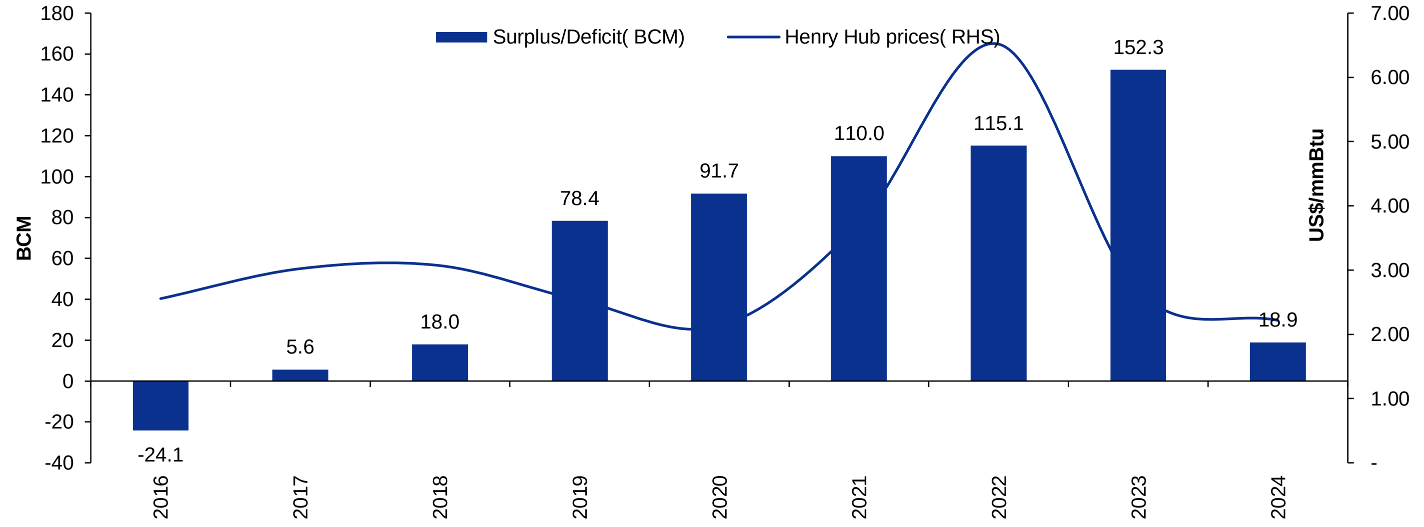
SOURCE: INCRED RESEARCH, COMPANY REPORTS

Likely rise in Henry Hub (HH) prices is another positive for ammonia

North America is also an important centre for ammonia imports in the world and it has significant capacity as well. Falling HH prices had helped US ammonia makers to be profitable but as more and more liquefaction gets commissioned, the demand for dry gas will increase, which will lead to higher prices for HH gas.

Henry Hub prices of natural gas are linked to excess gas supply in the US ›

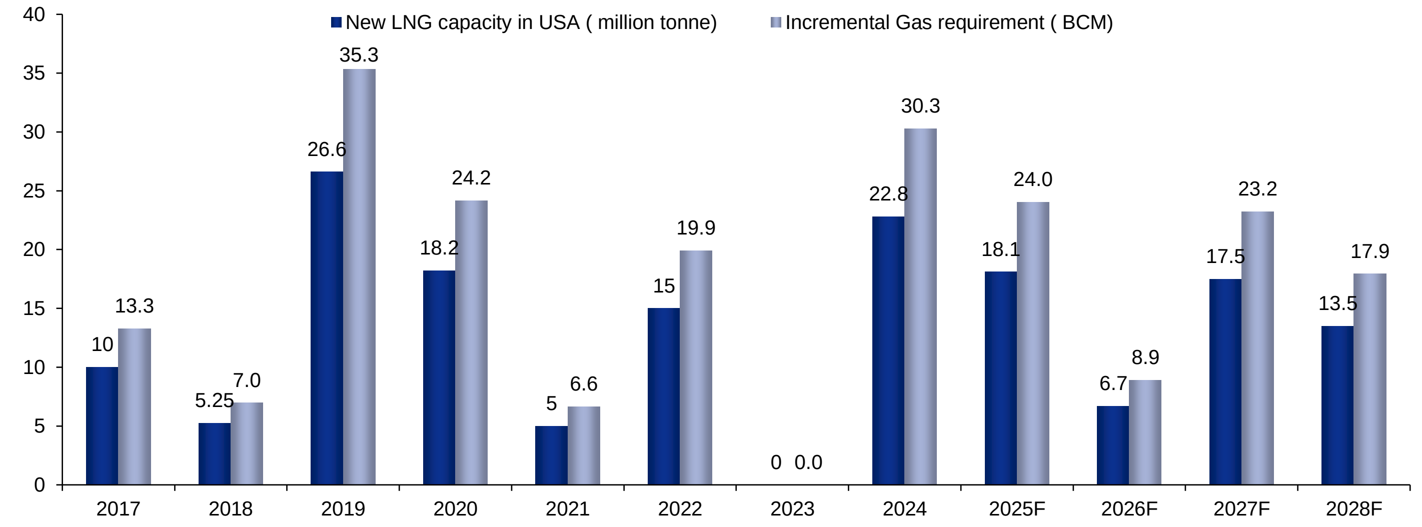
Figure 33: Barring 2002, when global gas prices went crazy because of the Russian invasion in Ukraine, HH prices have tracked the oversupply/ deficit in the US



SOURCE: INCRED RESEARCH, COMPANY REPORTS

Given the slew of gas liquefaction capacities, the US may face a scarcity of natural gas

Figure 34: In 2024F alone, at least 23mt of LNG capacity is getting commissioned, which can consume 31bcm of natural gas

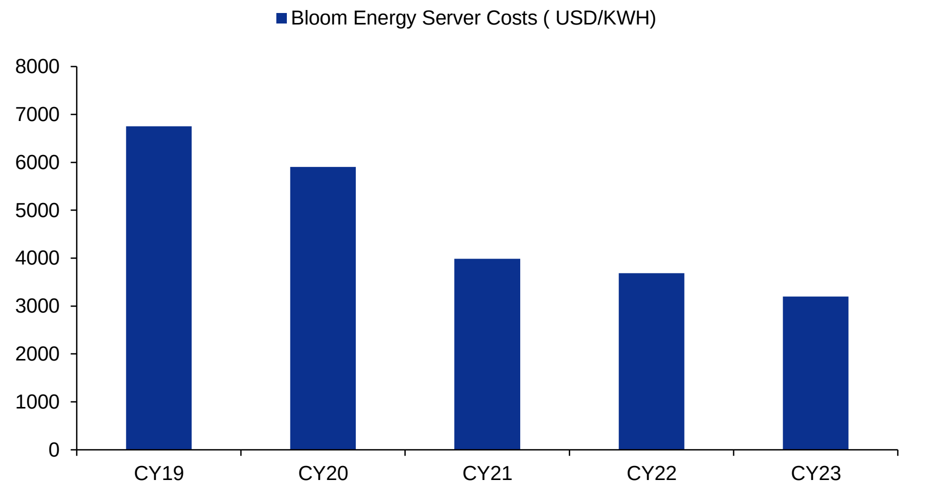


SOURCE: INCRED RESEARCH, COMPANY REPORTS

The US is also witnessing increased natural gas demand from fuel cells which are used in making micro grids for data centres

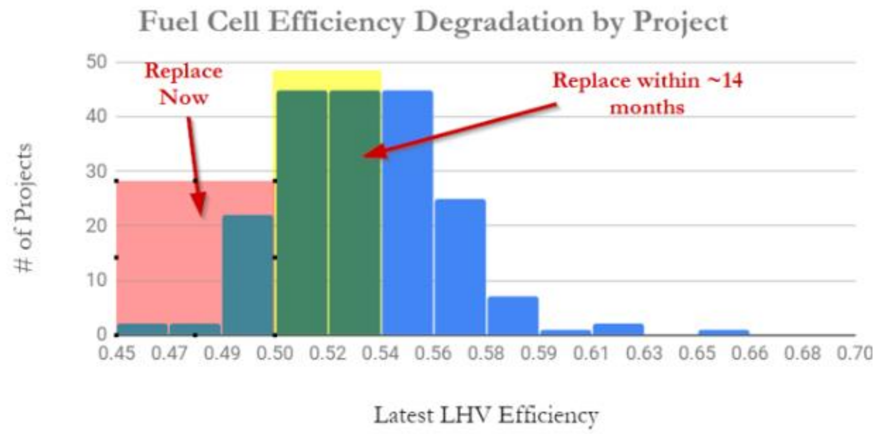
Bloom Energy's fuel cells' costing would primarily involve two sub-divisions - capital expenditure costs and operating costs. Let's focus on the capex costs first. Bloom Energy's fuel cells are currently priced at US$3,200/kW, and the company aims to incur double-digit percentage price reductions going ahead. However, for our analysis, we have assumed US$3,200/kW as a price point. Now, the critical question is the average life of the fuel cell. This has been a contentious point for Bloom Energy in the past but according to various media reports, solid oxide fuel cells last for around five-to-seven years, although Bloom Energy stated that the average lifetime of its cell is around 10 years. Hence, assuming a five-year lifetime means 365*24*5 units of power generated. Dividing US$3,200 (average price of the cell as mentioned above) by 365*24*5 will give us US$/kWh. Now moving ahead with the operating costs, Bloom Energy's fuel cells have a beginning life efficiency of 65%, which gradually decreases with every passing year, and once it goes below the 50% threshold, the company replaces the fuel cells. For our analysis, we have assumed Bloom Energy's fuel cells to have an average efficiency of 55%. Now, natural gas prices are volatile and are on the higher side in the US post Russia-Ukraine war, and we have assumed a price range of US$7-10/KCF. It must be noted that for our calculations, we have not considered any tax deductions and manufacturing incentives for Bloom Energy. However, Bloom Energy does receive a significant chunk of production tax incentives from the Inflation Reduction Act. This helps Bloom Energy to further subsidize costs for its consumers, making it far more competitive than grid power.

Figure 35: Bloom Energy has been reducing the average cost/kW of its fuel cells



SOURCE: INCRED RESEARCH, BLOOM ENERGY

Figure 36: Fuel cells' efficiency decreases linearly as the time from installation progresses; for our calculations, we have assumed an efficiency of 55%



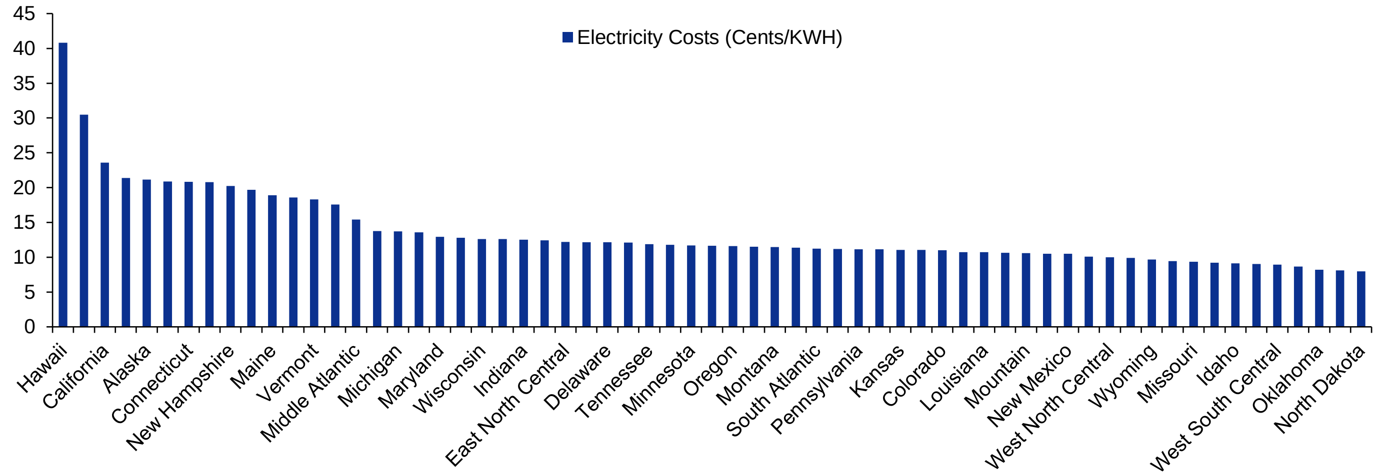
SOURCE: INCRED RESEARCH, BLOOM ENERGY

Figure 37: Different pricing scenarios in cents/kWh for energy generated from Bloom Energy's SOFC

		Average Life of Fuel Cell (Years)					
	Cents/KWH	5	6	7	8	9	10
Natural Gas Prices (Dollar/KCF)	7.06	11	10.7	9.8	9.2	8.7	8.3
	8.06	12.6	11.4	10.5	9.8	9.3	8.9
	9.06	13.2	12	11.1	10.5	10	9.6
	10.06	13.9	12.7	11.8	11.2	10.6	10.2
	11.06	14.6	13.38	12.5	11.8	11.3	10.9
	12.06	15.2	14	13.1	12.5	12	11.6

SOURCE: INCRED RESEARCH, BLOOM ENERGY

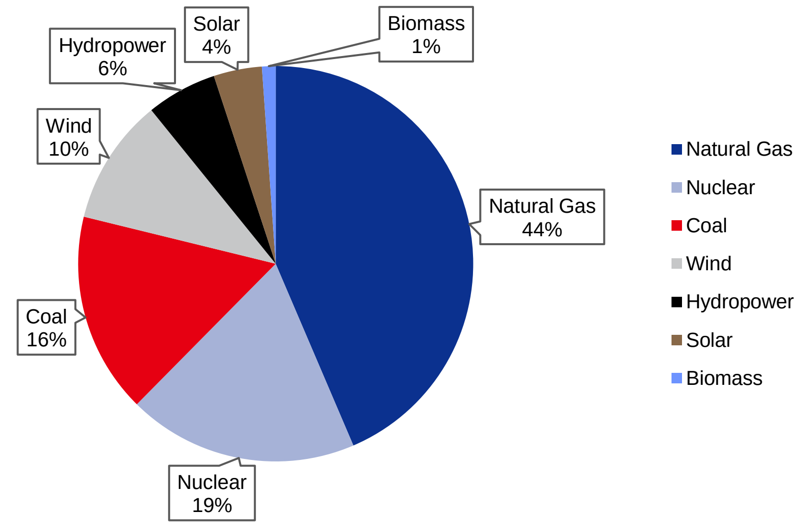
Figure 38: Bloom Energy's electricity costs are cheaper than grid power in most US states; the highlighted region is the energy cost from Bloom Energy's fuel cells



SOURCE: INCRED RESEARCH, EIA DATA

Data centres are also increasing grid power loads – please remember that gas power is the primary power source in the US ➤

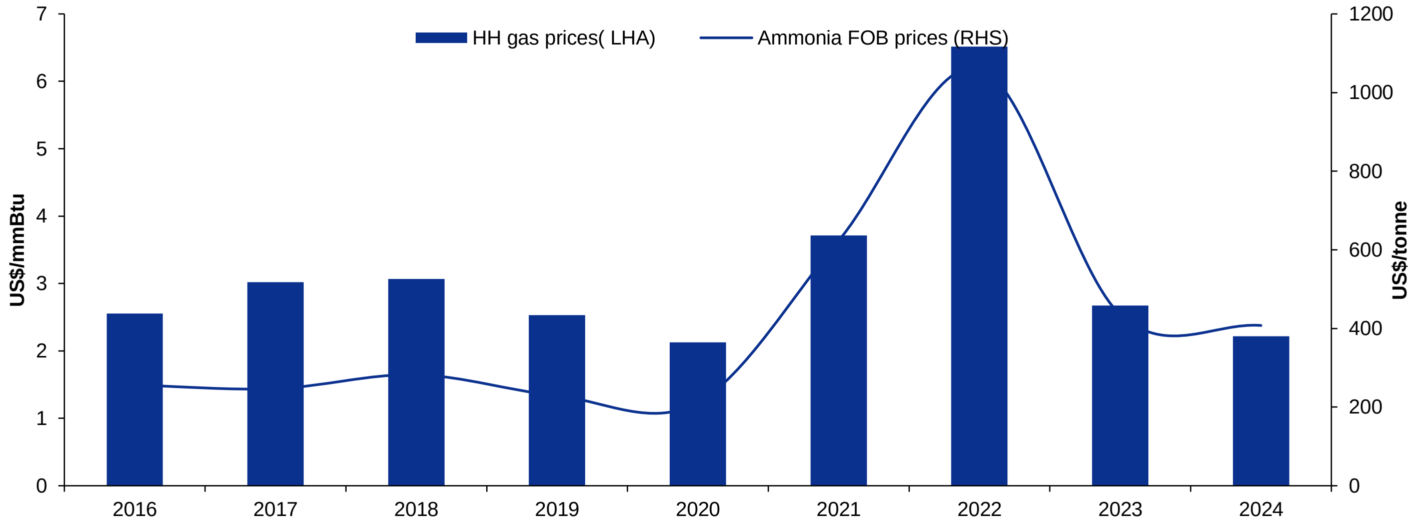
Figure 39: Gas-based power plants are the primary power source in the US



SOURCE: INCRED RESEARCH, EIA DATA

Rising Henry Hub prices will be positive for ammonia as its cost of production will increase in the US

Figure 40: US ammonia export prices are directly correlated with ammonia FOB prices in the US; higher the gas price, higher is the ammonia price

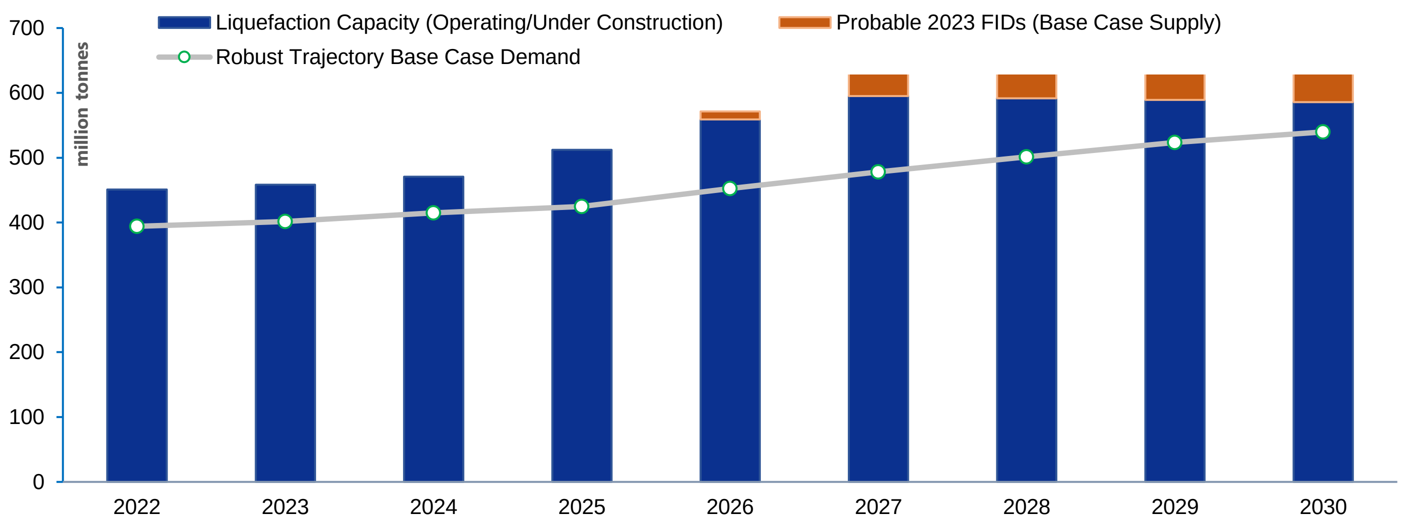


SOURCE: INCRED RESEARCH, COMPANY REPORTS

However, please note that LNG is in excess supply and so LNG prices are set to fall in the coming quarters

Rising Henry Hub prices doesn't mean a rise in LNG prices as LNG is in excess capacity and its prices are set to fall. Already, the long-term contracts are being signed at 9-10% slope to crude oil and we won't be surprised if the spot contract falls below the 7-8% slope.

Figure 41: Global LNG supply is more than demand, which means the LNG slope vis-a-vis crude oil will fall in the coming quarters



SOURCE: INCRED RESEARCH, ENERGY INTELLIGENCE

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Hold	The stock's total return is expected to be between 0% and positive 10% over the next 12 months.
Reduce	The stock's total return is expected to fall below 0% or more over the next 12 months.

The total expected return of a stock is defined as the sum of the: (i) percentage difference between the target price and the current price and (ii) the forward net dividend yields of the stock. Stock price targets have an investment horizon of 12 months.

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