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HYDROGEN FOR BREMEN'S INDUSTRIAL TRANSFORMATION

The Role for Ammonia in EU Industrial Transformation: Global Insights and a Deep Dive into Germany

Report

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Contents

Executive summary 4
Preface 6
1 Introduction 7
2 Trends in production and trade of ammonia 9
2.1 Overview of international trade patterns 9
2.2 EU positions in international ammonia trade 11
3 Global low-carbon ammonia projects 16
3.1 Global project pipeline 16
3.2 Offtake agreements 19
4 Transaction data analysis 26
5 Deep Dive: The Growing Role of Ammonia Imports for Germany 31
5.1 Transformation of the German ammonia market 31
5.2 Key industrial ammonia projects in Germany 32
5.3 Germany's role for ammonia in the EU 33
6 Discussion 34
6.1 The role for ammonia in EU industrial transformation 34
6.2 Implications for the EU energy transition and strategic hydrogen technology diffusion 35
References 37

Executive summary

Ammonia is emerging as a strategically important hydrogen derivative for the European energy transition. It is already a major global chemical commodity, mainly used in fertilizers, but it is now also being considered as a hydrogen carrier, maritime fuel and energy vector. This report examines how existing ammonia production and trade patterns, new low-carbon ammonia projects, offtake agreements and financing structures may shape the role of ammonia in the EU hydrogen transition and presents a deep-dive in ammonia project developments in Germany. The central findings are that renewable ammonia can support European decarbonisation and supply diversification, if policy, infrastructure, and finance turn a long but uncertain project pipeline into real low-carbon supply. The commitment of several German actors to signing green ammonia import contracts as well as investing in new infrastructure projects including ammonia crackers shows that Germany is becoming a key European test case for ammonia-based hydrogen import infrastructure.

The current ammonia market is highly path-dependent. Global exports have long been concentrated among a small group of producers, including Russia, Trinidad and Tobago, and Saudi Arabia. The EU has historically depended heavily on Russia, Algeria and Ukraine, but this structure changed sharply after Russia's invasion of Ukraine. Russian ammonia exports to Europe fell substantially after 2021, while Algeria, Trinidad and Tobago, Egypt, the United States and Türkiye became more important suppliers. This has diversified EU sourcing, but it has not removed import dependence. Instead, dependence has been redistributed across new Atlantic and Mediterranean supply corridors.

Within Europe, ammonia trade is organised through a hub-and-spoke structure. Belgium is the largest EU ammonia importer, while the Netherlands and Germany play important roles in intra-European redistribution and industrial use. These hubs are likely to remain central and may even become more important if low-carbon ammonia imports expand, because they already possess port infrastructure, storage capacity, chemical clusters and logistics networks. However, this also creates a strategic tension. Existing infrastructure can accelerate the transition, but it can also reinforce incumbent fossil-based systems if low-carbon standards are weak.

The global low-carbon ammonia project pipeline is large but immature. The IEA hydrogen project database identifies 484 ammonia-related projects, but most remain at concept or feasibility stage. Only a small minority have reached final investment decision, construction or operation. Electrolysis-based green ammonia dominates the announced pipeline, while blue ammonia projects are over-represented among advanced projects because they can often build on existing gas, ammonia and port infrastructure. The largest announced pipelines are found in countries such as Australia, the United States, Spain, India, Brazil, Canada, Egypt, China, Chile and Norway. Some of these are established ammonia or chemical-industry countries, while others are new entrants seeking to use renewable energy resources to enter future hydrogen-derivative trade.

The transaction data show a similar pattern. Headline investment values are large, but they are concentrated in a small number of mega-projects, many of which remain in financing or pre-financing stages. Project finance dominates, reflecting the infrastructure-like character of low-carbon ammonia assets. Public finance, guarantees, auctions and concessional support are likely to remain essential, especially for first-of-a-kind projects and new entrants.

Offtake agreements are becoming a key indicator of project credibility. Binding long-term agreements, government-backed auctions and take-or-pay contracts can make projects more bankable by reducing demand risk. Examples include NEOM's long-term offtake arrangement with Air Products, Yara's agreement with ACME in Oman, Fertiglobe's supply from Egypt to Europe, Uniper's agreement with AM Green in India, and Indian SECI auctions for domestic fertilizer demand. However, many agreements

remain non-binding, prices are often undisclosed, and contracted volumes should not be treated as guaranteed future supply.

Germany provides a concrete example of how these global trends are becoming embedded in national industrial strategy. German fossil-based ammonia production has become less competitive after the loss of cheap Russian gas, and domestic production fell sharply from 2.4 Mt in 2021 to 1.8 Mt in 2022. At the same time, Germany expects rising demand for renewable hydrogen in chemicals, steel, fuels and power-system balancing. Current plans therefore include ammonia import terminals and crackers at Rostock, Wilhelmshaven, Gelsenkirchen, Brunsbüttel, Hamburg and Lubmin. These projects show that Germany is preparing to use ammonia both as a substitute chemical feedstock and as a carrier for hydrogen imports.

For the EU, ammonia presents both an opportunity and a policy challenge. Demand-pull measures such as RFNBO targets, the European Hydrogen Bank and carbon-border measures can help create early markets for renewable ammonia. But support should be tied to strict carbon accounting, credible certification, and additional renewable electricity while minimising the reliance on blue ammonia which continues the dependence on fossil fuels. The EU should also treat ammonia partnerships as industrial-development relationships, not only import contracts. Done well, low-carbon ammonia can support fertilizer security, industrial decarbonisation and hydrogen trade diversification. Done poorly, it risks creating new dependencies and extending fossil-industrial lock-in.

Preface

This report has been produced by the Department of Technology and Society for the Wuppertal institute as part of a bilateral subcontracting agreement relating to the hyBit project. The report is based on various datasets which have been used to paint a picture of global developments. Generative AI (ChatGPT 5.5, used with a Lund University EDU license) has been used to aggregate and structure data, produce descriptive statistics, tables and Sankey diagrams, as well as for reviewing and editing the text.

1 Introduction

Ammonia is a central commodity in the global chemical economy and a strategically important component in the energy transition. The International Energy Agency estimates that around 70% of ammonia is used to make fertilizers, while the remaining 30% is used in industrial applications such as plastics, explosives, synthetic fibres and other chemical products. Yet ammonia is now being reconsidered as something more than a fertilizer intermediate. Because it can be produced from hydrogen and nitrogen, stored more easily than pure hydrogen, transported through established shipping and terminal infrastructure, and reconverted or used directly in some applications, ammonia is increasingly discussed as a hydrogen carrier, maritime fuel and energy vector. Ammonia production accounts for around 2% of global final energy consumption and about 1.3% of energy-sector CO_2 emissions, making it one of the most emissions-intensive large-volume chemical processes [1].

The sector's emissions profile is closely linked to its dependence on fossil hydrogen. Industrial ammonia is produced through the Haber–Bosch synthesis of nitrogen and hydrogen, with hydrogen obtained almost entirely from fossil feedstocks. This feedstock structure explains both the sector's high emissions intensity and its strong exposure to fossil-fuel price volatility. The dominant route is natural gas-based steam methane reforming, which accounts for 72 % of global ammonia production while about 26 % is coal-based ammonia, concentrated especially in China, with the remainder made up of around 1% oil-product-based production, and only a very small fraction from electrolysis [1]. The CO_2 footprint of ammonia production varies from about 1.6 t CO_2/ t NH_3 for natural gas based production to 3.6 t CO_2/ t NH_3 for coal based production, with oil based production in the middle of the range [2].

Ammonia's current end-use structure is dominated by fertilizers, but its non-fertilizer applications are industrially significant. Fertilizer demand includes direct application of ammonia and downstream nitrogen products such as urea, ammonium nitrate, ammonium phosphates and nitrogen solutions. Industrial uses include nitric acid and ammonium nitrate production, explosives, caprolactam and nylon value chains, acrylonitrile, melamine, refrigeration, emissions-control systems and other chemical intermediates [3]. However, net-zero scenarios point to a vastly different structure for ammonia markets as ammonia could become an important fuel for international shipping as well as a hydrogen carrier for both industrial use and energy conversion [4].

Green ammonia replaces fossil hydrogen with hydrogen produced by renewable-powered electrolysis. Blue ammonia retains fossil feedstocks, usually natural gas, but couples hydrogen production with carbon capture and storage or utilisation [2]. Both pathways aim to reduce the carbon intensity of ammonia, but they imply different resource geographies, infrastructure requirements and geopolitical dependencies. Green ammonia depends primarily on access to low-cost renewable electricity, water, electrolyser capacity, nitrogen separation, ammonia synthesis, storage and export logistics. It therefore favours regions with strong renewable resources and suitable port infrastructure. Blue ammonia depends instead on low-cost gas, reforming or gasification assets, carbon capture, CO_2 transport and durable storage, as well as credible accounting for methane leakage and capture rates. Techno-economic and life-cycle studies show that the relative attractiveness of green and blue ammonia varies substantially by region, electricity price, gas price, carbon capture assumptions, methane leakage and policy support [5].

The literature has thus identified ammonia as a key hydrogen derivative and the backbone of a potential hydrogen economy in which ammonia functions not only as a decarbonised chemical commodity but also as a fuel, storage medium and energy carrier [6]. Ammonia can be transported and used either directly, for example in combustion, fuel cells or maritime fuels, or indirectly after cracking back to hydrogen, but each pathway involves energy penalties, safety constraints and infrastructure requirements [7]. Ammonia could thus become a "spatial energy vector" [8] with a potential to connect regions with renewable resources to remote demand centres through intercontinental renewable-energy trade. Cost competitiveness for such arrangements will however depend on production scale, storage, port access and transport distance [9].

For the European Union, ammonia sits at the intersection of industrial decarbonisation, food-system security, trade policy and geopolitics. The EU aims to scale renewable hydrogen and hydrogen derivatives as part of its net-zero strategy and has identified a number of key action areas in its hydrogen strategy [10]. The European hydrogen strategy frames low-carbon hydrogen as a means of decarbonising hard-to-electrify industrial processes and supporting climate neutrality. Under REPowerEU, the EU set a target of 10 million tonnes of domestic renewable hydrogen production and 10 million tonnes of renewable hydrogen imports by 2030 [11]. Ammonia imports may therefore become relevant not only for fertilizer supply but also as a hydrogen carrier for industrial transformation. The key policy challenge is that ammonia imports can support several EU goals while potentially undermining others. Low-cost imports can reduce fertilizer and industrial input costs, but they may accelerate the decline of domestic production. Diversifying away from Russia can improve geopolitical resilience, but it may increase dependence on other external suppliers, including gas-rich exporters or renewable-rich regions outside Europe. Green ammonia imports can support decarbonisation, but they may compete with domestic renewable hydrogen production. Blue ammonia may provide lower-cost transition volumes, but its climate value depends critically on capture rates, methane leakage and storage permanence [12]. The EU must therefore navigate a market in which cost, resilience, energy independence, industrial strategy and geopolitical alignment point in different directions.

This report identified ammonia as a strategic hydrogen derivative undergoing transformation. It asks how current production and trade structures are changing, how green and blue ammonia investments may reshape future markets, and what these changes imply for Europe's industrial transition. The central proposition is that ammonia markets are likely to become more differentiated by carbon intensity, more closely linked to hydrogen policy, and more geopolitically contested. For the EU, the issue is not simply whether ammonia can be imported, but from where, at what cost, under what carbon-accounting rules, through which infrastructures, and with what consequences for industrial resilience and strategic autonomy.

2 Trends in production and trade of ammonia

This chapter analyses how international ammonia trade has evolved over the past two decades and how the EU's position has changed. The chapter draws on custom UN Comtrade datasets (HS code 281410: Anhydrous ammonia) prepared for this project as primary data source, supplemented with some data from IFASTAT in cases of multiple missing data points for some countries. The analysis identifies patterns of persistent global concentration, the weakening of Russia's export position after 2021, the increasing importance of Atlantic and Mediterranean supply corridors into Europe, and the hub-based structure of intra-EU redistribution. All of this has bearing on the strategic tension between import diversification and industrial autonomy.

Ammonia trade relies heavily on specialised logistics. Intercontinental trade is primarily maritime, using refrigerated or semi-refrigerated ammonia carriers and import/export terminals. Pipelines are important in some regional systems, especially around large production clusters, ports and industrial consumers, but they do not currently constitute a major mode for international ammonia trade. UN Comtrade data for 2024 indicates that over three quarters of international trade in ammonia is maritime with the remainder split between road, railway, and other (with lower reliability in this reporting).

2.1 Overview of international trade patterns

The global ammonia export market has long been concentrated in a small number of large exporters with the ten largest exporters capturing more than 80% of the exports, see Figure 1. According to the UN Comtrade exporter dataset, global ammonia exports increased slightly from about 15.3 Mt in 2005 to about 16.0 Mt in 2024, with peaks above 17 Mt in several years during the late 2010s and early 2020s. The leading exporters over this period include Russia, Trinidad and Tobago, Saudi Arabia, Canada, Indonesia, Algeria, Iran, Germany and the United States. In 2005, Trinidad and Tobago and Russia were the largest exporters, with approximately 3.41 and 3.31 Mt exported, equivalent to about 22% each of the global total. Ukraine was also a major exporter, with approximately 1.8 Mt, or 12%. By 2015, Russia and Trinidad and Tobago were almost equal in volume, each exporting roughly 3.6 Mt (22% of global exports). Saudi Arabia had become a major exporter by this point (1.6 Mt, 10%), while Indonesia, Canada, Iran and Algeria were also important. A significant break occurs after 2021 when Russian ammonia exports are reduced by about 80% to 2024, falling to eighth place. By 2024, Trinidad and Tobago had become the largest exporter, with about 2.77 Mt (17%), followed by Canada, Indonesia and Saudi Arabia. This shift should be interpreted within the broader disruption of energy, fertilizer and maritime trade after Russia's invasion of Ukraine. Figure 1 shows that global ammonia exports were already concentrated before the energy transition, but the relative importance of exporters changed sharply after 2021. This matters for low-carbon ammonia because the future market is unlikely to emerge in a neutral space. It will develop through existing infrastructure such as export platforms, ports, and geopolitical relationships.

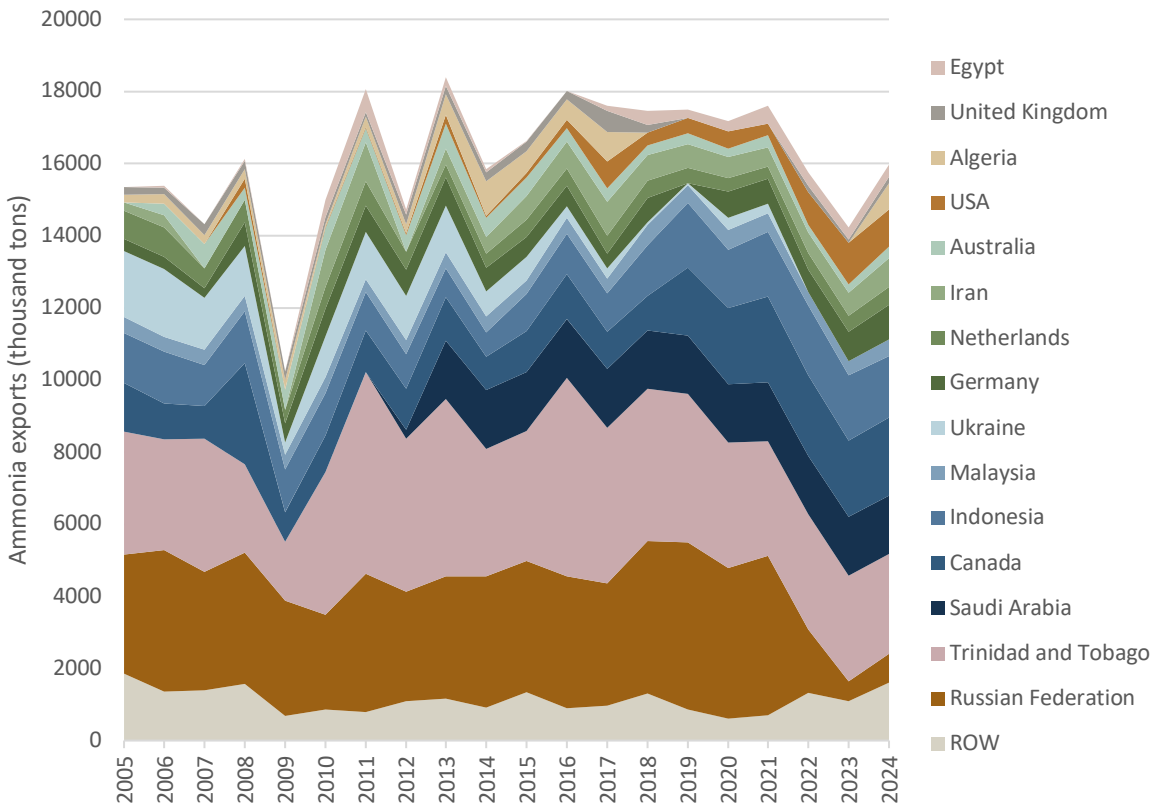


Figure 1. Major global exporters of ammonia. Based on data from UN Comtrade (HS code 281410 - Anhydrous ammonia; exports).

The importer dataset shows a different pattern, as seen in Figure 2. Whereas exports are dominated by a small set of resource-based producers, imports are spread across large agricultural and industrial demand centres. Major importers include the United States, India, Türkiye, Morocco, Belgium, and Germany as shown in Figure 2. The United States was the largest importer in the early years of the covered period, importing about 5.25 Mt in 2015. India has remained a large and persistent importer, reflecting the scale of its fertilizer demand. In 2024, Morocco appears as the largest importer in the dataset, with about 3.70 Mt, followed by India at about 2.39 Mt, the United States at about 2.07 Mt and Türkiye at about 1.59 Mt. These patterns underline ammonia's connection to agricultural and industrial geography. India and Morocco are major fertilizer-linked demand centres, South Korea and parts of Europe are industrial importers, the United States combines agricultural demand with domestic production and imports from neighbouring and Atlantic suppliers. The dynamics in the United States making the country both a major importer and exporter of ammonia in recent years have not been fully explored. The international trade data show that the ammonia market is global, food-system-linked and shaped by large export centres around the world. This has implications for future low-carbon ammonia: European buyers will compete with fertilizer and industrial demand in other regions.

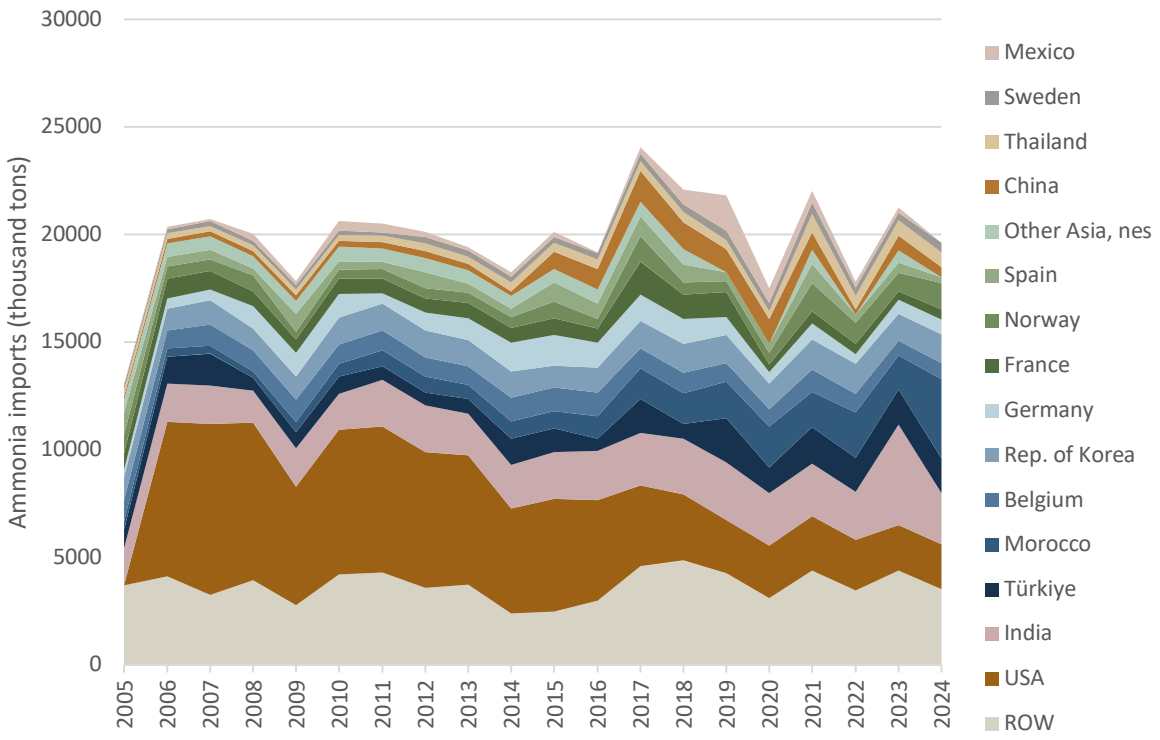


Figure 2. Major global importers of ammonia. Based on data from UN Comtrade (HS code 281410 - Anhydrous ammonia; imports).

The 2026 US–Iran war and the severe disruption of maritime traffic through the Strait of Hormuz underline the vulnerability of ammonia trade. Although global concern initially focused on oil and LNG market impacts, the crisis also exposed the Gulf's central role in ammonia and other key chemicals. As Adam Hanieh argues, the Gulf states are no longer only hydrocarbon exporters but diversified industrial and logistics hubs whose chemical, fertilizer and port infrastructures are deeply embedded in global industrial and agricultural systems [13]. Disruption at Hormuz therefore transmits not only through energy markets but also through ammonia, urea and wider agricultural supply chains. Rystad Energy estimates that around 15% of global ammonia trade and 21% of urea trade are tied to exporters potentially affected by a prolonged Hormuz closure, especially Saudi Arabia and Qatar, with import-dependent countries in Asia particularly exposed [14]. The shock reinforces a lesson already visible after the reduction of Russian ammonia exports from 2022: ammonia trade is not only concentrated by producer, but also vulnerable to specific corridors, ports and geopolitical interests. For the EU and other import-dependent regions, the likely policy response will be a stronger emphasis on supplier diversification, domestic or near-shore low-carbon ammonia production, and trade partnerships that reduce exposure to sensitive corridors. The crisis may consequently strengthen the case for green ammonia not only as a decarbonisation pathway, but also to improve security of supply.

2.2 EU positions in international ammonia trade

The European Union's aggregate ammonia imports by supplier from 2005 to 2024 are shown in Figure 3. The most important suppliers over time are Russia, Algeria, Trinidad and Tobago, Ukraine, Egypt, the United States, Türkiye, Libya and ROW. In 2005, the EU imported about 2.48 Mt of ammonia. Russia accounted for approximately 1.45 Mt, or 59% of EU imports. Algeria accounted for about 0.42 Mt (17%) and Ukraine accounted for about 0.22 Mt (9%). The top three suppliers therefore accounted for about 85% of EU ammonia imports. By 2015, the EU's ammonia imports had increased to about 2.61 Mt. Russia remained the largest supplier with about 1.05 Mt, equivalent to 40% of EU imports, while imports

from Algeria had increased to about 0.78 Mt (30%). The situation changed after 2021. In 2021, Russia and Algeria each supplied just over 1.0 Mt (35%), while Trinidad and Tobago supplied about 0.48 Mt (16%). By 2023, Algeria had become the largest supplier of about 0.57 Mt (28%) with Trinidad and Tobago following at 0.50 Mt (24%), while Russia had fallen to about 0.25 Mt (12%). The concentration metrics reinforce this interpretation. The EU's top-three supplier concentration ratio was about 85% in 2005, 85% in 2010, 81% in 2015 and 86% in 2021. It fell to about 70% in 2022 indicating that the EU ammonia import structure became less concentrated after the Russia–Ukraine shock. This does not mean that the EU has become independent or strategically secure. Rather, dependence has been redistributed. The EU has moved from a highly concentrated structure dominated by Russia and Algeria toward a more diversified Atlantic–Mediterranean supply system involving Trinidad and Tobago, the United States, Algeria, Egypt, and Türkiye.

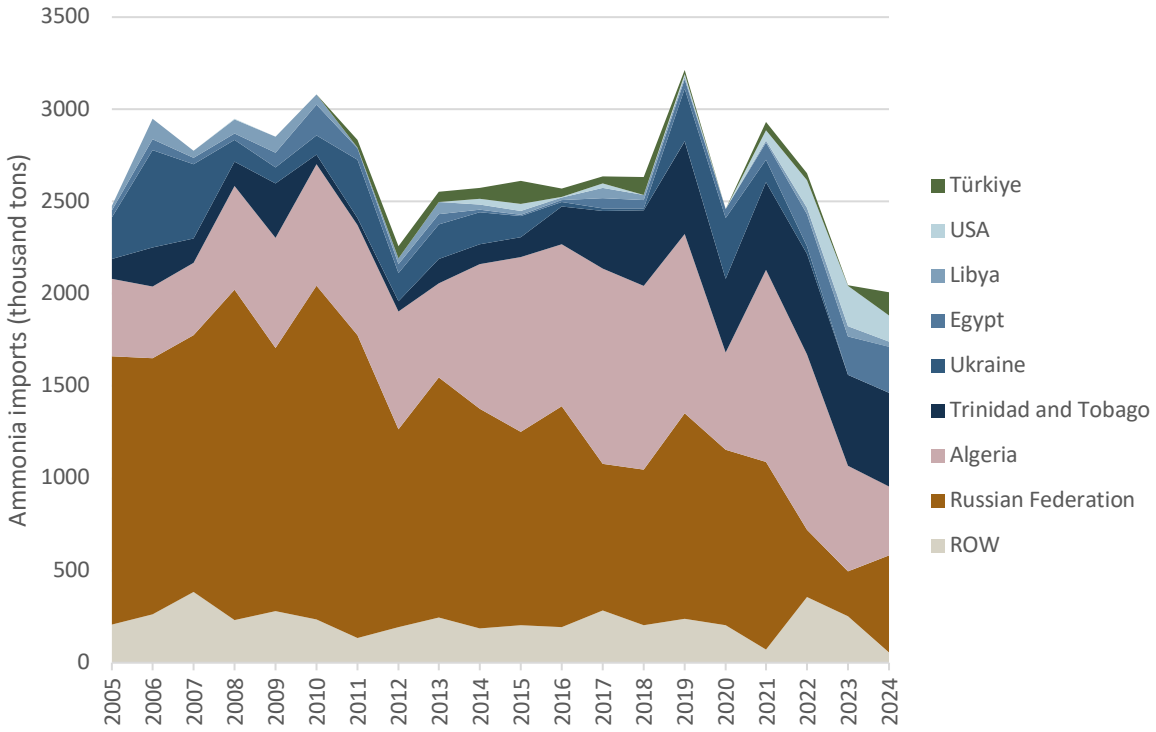


Figure 3. EU ammonia imports from key countries. Based on data from UN Comtrade (HS code 281410 Anhydrous ammonia; imports; reporter EU-27 member states).

The EU's current ammonia trade already contains a North African corridor through long-term trade relationship with Algeria and increasing importance of Egypt as a significant supplier after 2021. Trinidad and Tobago represents a different type of corridor. It is an Atlantic Basin exporter with established ammonia production and shipping links. Its rising role in EU imports together with imports from the USA especially after 2021 shows that Atlantic supply has become more important for Europe. The transition question is whether these corridors could be decarbonised, expanded and governed under credible low-carbon requirements. Green ammonia scenarios often focus on production costs in renewable-rich locations. However, the empirical trade data show that infrastructure and established trade relations matter.

Among individual EU member states, Belgium was the largest destination for extra-EU ammonia imports throughout 2005–24 as shown in Figure 4. Its reported volume rose from 0.69 Mt in 2005 to a peak of 1.04 Mt in 2019, before easing to 0.60 Mt in 2024. France and Spain also remained major destinations: French imports peaked at 0.58 Mt in 2006 and stood at 0.32 Mt in 2024, while Spain received roughly

0.32–0.44 Mt annually through 2021 before falling to 0.26 Mt in 2024. The other leading importers changed more markedly. This confirms the importance of North-Western Europe but also shows that import dependence is not confined to that region. The data identifies where imports were recorded, not necessarily final consumption as there is further intra-EU trade.

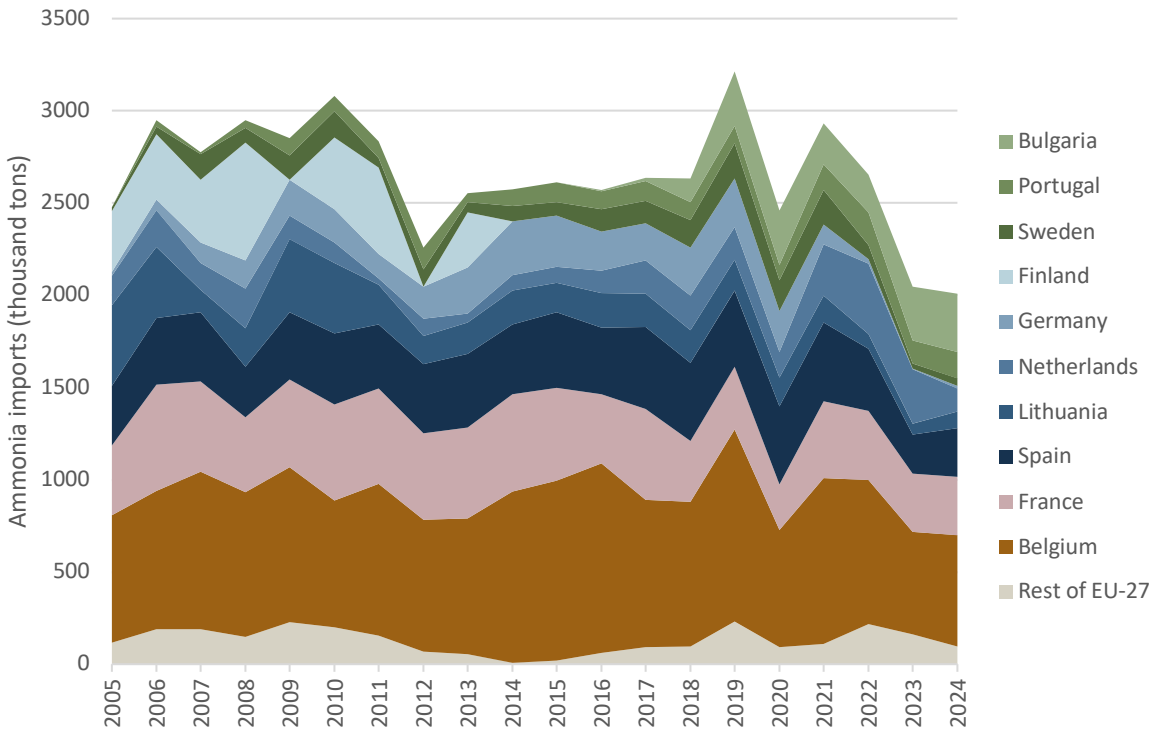


Figure 4. Key EU-27 ammonia import countries – extra-EU imports only. Based on data from UN Comtrade (HS code 281410 - Anhydrous ammonia; imports; reporter European Union).

The data shows that intra-EU ammonia trade is not evenly distributed but rather it is strongly hub-based, as shown in Figure 5. In North-Western Europe Belgium, the Netherlands and Germany are structurally important because they combine port access, storage, chemical industry with both large domestic production and demands as well as further intra-European logistics. Although German ammonia production is declining due to gas market instabilities following the Russian invasion of Ukraine in 2022 [15,16], the remaining infrastructure may still support future logistics and trade of imported ammonia. The Netherlands appears as a major intra-EU supplier while Germany appears both as a major importer and a major supplier to other member states. Belgium combines very large total imports with a central role in the North-Western European industrial and logistics system. This means that Europe's ammonia market should be understood as a hub-and-spoke system rather than as a set of independent national markets. The 2024 data illustrate this clearly. Belgium remains the dominant importer of ammonia into the EU, while Germany is an important participant in intra-EU flows. The Netherlands' extra-EU imports are now smaller, but its role in intra-EU redistribution remains strategically important. The structure of EU imports and internal trade shows that specific corridors are likely to remain critical for the transition towards low-carbon ammonia.

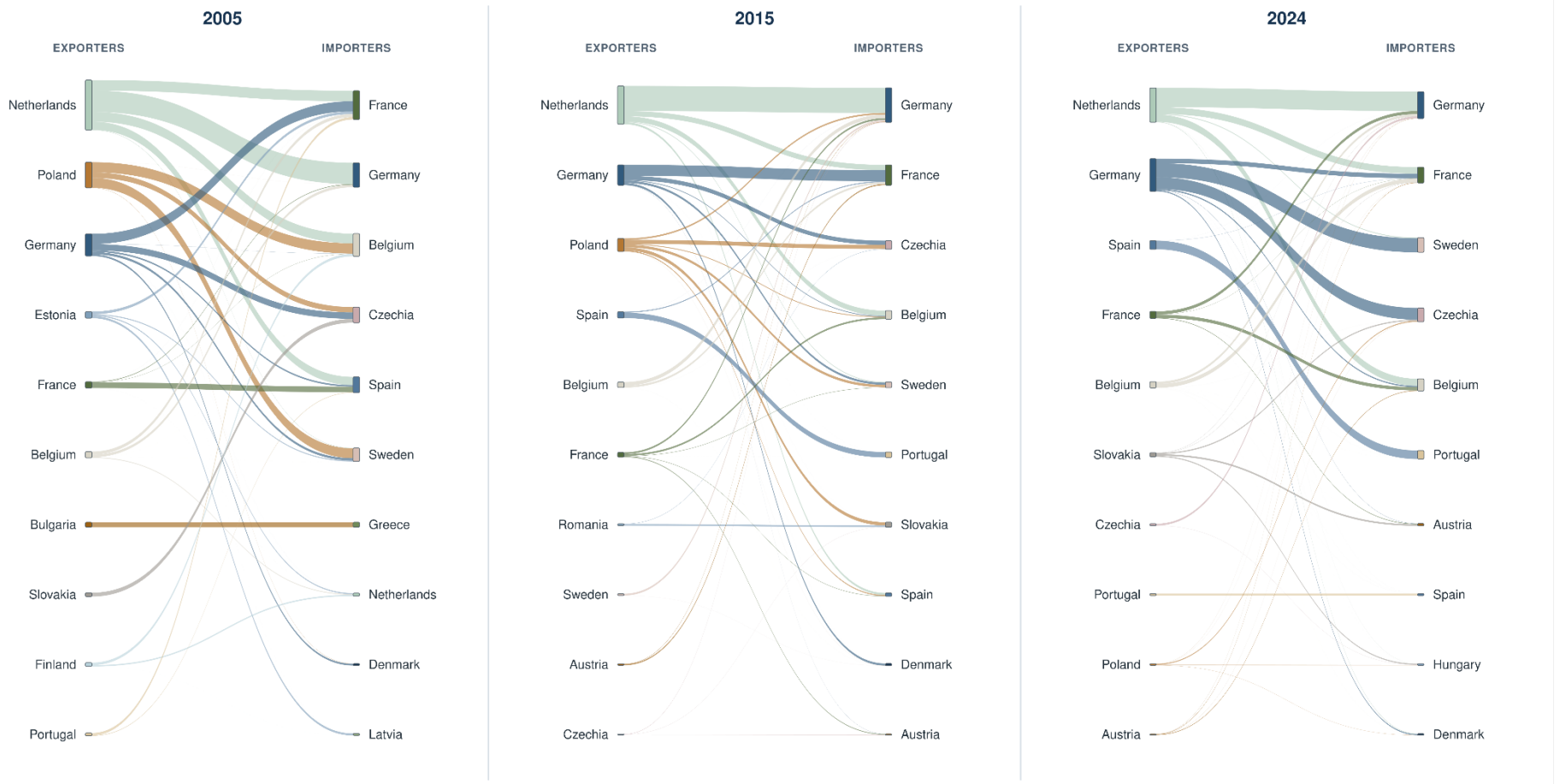


Figure 5. Largest intra-EU ammonia trade flows. Based on data from UN Comtrade (HS code 281410 - Anhydrous ammonia; imports; reporters EU-27 member states)

Three insights emerge from the data on EU trade in ammonia. First, the EU's external ammonia sourcing has diversified away from the earlier Russia–Algeria-dominated structure. Second, total import demand within the EU is concentrated in a small number of countries, with Belgium remaining the most important importer. Third, intra-EU redistribution means that the countries handling ammonia trade are not always identical to the countries where final industrial or fertilizer demand is located. This has direct implications for future low-carbon ammonia imports: import infrastructure, storage, cracking capacity, certification systems and industrial offtake will likely be concentrated in the same hub regions that already organise conventional ammonia trade. If ammonia becomes a major vector for importing renewable hydrogen or low-carbon hydrogen derivatives, the transition will not begin from a blank infrastructure map but most likely build on existing ammonia terminals, storage sites, port clusters and industrial corridors. The strategic significance of existing hubs in North-Western Europe may therefore increase rather than decline.

The trade patterns analysed in this chapter should be interpreted with several uncertainties in mind. First, the UN Comtrade data record reported cross-border movements under HS 281410, but they do not fully capture the contractual, ownership or final-use structures behind those flows. Some trade may reflect transit, re-export, intra-firm transfers or hub-based redistribution rather than final consumption in the reporting country. This is particularly relevant for the EU, where Belgium, the Netherlands and Germany act as import and redistribution nodes. Second, discrepancies between exporter-reported and importer-reported data, differences in reporting practices, missing values and transport-mode classifications introduce uncertainty into exact volume estimates. Finally, recent geopolitical shocks, including the collapse of Russian exports to Europe after 2021 and the disruption of Gulf trade routes in 2026, mean that the most recent trade pattern may reflect crisis adjustment rather than a stable new equilibrium. The analysis should therefore be read as evidence of structural dependence, concentration and corridor formation.

3 Global low-carbon ammonia projects

3.1 Global project pipeline

The IEA Production Projects database [17] is one of the most comprehensive global datasets on announced and operational hydrogen production projects. It contains information on project location, technology pathway, development status, planned production capacity, commissioning timelines and end-use applications, making it a valuable source for analysing the geography, maturity and technological composition of the emerging low-carbon ammonia project pipeline. The database identifies 484 ammonia-related projects, i.e. projects with ammonia as an end-use for the hydrogen produced, but excluding ammonia cracking projects. Notably, there is a striking imbalance between project announcements and implementation. 431 projects, or 89.0%, are at concept or feasibility-study stage. Table 1 shows that only 28 projects are recorded as FID/construction and 21 as operational. In other words, just 49 projects, or 10.1% of the ammonia-related projects, have reached an advanced status and will be available to the market in the next few years.

Table 1. Ammonia-related hydrogen production projects by status

Status	Projects	Share of total
Concept	189	39.0%
Feasibility study	242	50.0%
FID/Construction	28	5.8%
Operational	21	4.3%
DEMO	2	0.4%
Decommissioned	2	0.4%
Total	**484**	**100.0%**

This status profile is consistent with wider evidence on the hydrogen sector. As per the IEA data only a small share of announced low-emissions hydrogen production has reached final investment decision, while a large share remains at early development stages. IEA has identified delays and cancellations of many hydrogen projects as material risks for the development of the global hydrogen sector, citing unclear demand signals, financing hurdles, delays to incentives, regulatory uncertainty, licensing and permitting issues, and operational challenges [18]. Among the 300 ammonia-related projects with a date-online entry, 240 list dates in 2026–2030. However, because 89.0% of the full ammonia-related dataset remains at concept or feasibility-study stage, these dates should be treated as target dates rather than probable commissioning dates. The 2026–2030 concentration indicates the role of ammonia in national hydrogen strategies and corporate decarbonisation plans. It also reveals the risk of schedule bunching. Many projects are attempting to reach commercial operation in the same period, while competing for electrolyser supply chains, renewable power interconnections, concessional finance and bankable offtake. The IEA's recent hydrogen reviews identify these as precisely the types of barriers that cause delay and cancellation among hydrogen projects worldwide [18]. In fact, due to many delays and cancellations the capacity of projects announced to be completed by 2030 has decreased in the past year [19]. This has been dubbed the green hydrogen implementation gap: announced green hydrogen capacity has grown rapidly, but implementation has lagged, with only a small fraction of announced project capacity completed on schedule [20].

The full project pipeline is geographically broad as shown in Tables 2 and 3. Europe, Latin America, Asia Pacific, North America, Africa, Oceania and the Middle East all contain sizeable numbers of ammonia-related hydrogen projects. The largest project counts by country are Australia, the United States, Spain, India, Brazil, Canada, Egypt and China. This reflects the dual nature of the emerging ammonia market: some countries are positioning themselves as prospective exporters based on renewable resources and port access, while others are developing projects around existing ammonia, refining, chemicals, or industrial clusters.

Table 2. Regional distribution of ammonia-related hydrogen production projects

Region	All projects	Advanced projects
Europe **(of which Germany)**	100 (5)	4 (1)
Latin America	82	4
Asia Pacific	75	20
North America	71	11
Africa	64	3
Oceania	48	3
Middle East	38	3
Eurasia	6	1
Total	**484**	**49**

The subset of advanced projects is much more concentrated than the full pipeline of announced projects. Asia Pacific accounts for 20 of the 49 advanced projects, followed by North America with 11. China alone has 15 advanced projects, while the United States has 10. India has three. Brazil and Australia have two projects each in advanced stages, despite Australia having the largest total number of projects in the dataset. Another 17 countries (including Germany) have one advanced project each. The countries with the largest announced pipelines are thus not necessarily those with the most mature projects. Australia, Spain, Brazil, Canada, Egypt and Chile illustrate a pattern of large announced opportunity sets with limited movement into advanced stages. China and the United States, by contrast, show fewer total ammonia-related projects than some prospective export hubs but a larger number of advanced projects. This may reflect stronger domestic industrial demand, existing chemical-sector infrastructure, and policy incentives such as the US IRA which initiated a wave of investments in the United States, mainly benefiting blue ammonia [21].

Table 3. Leading countries by number of ammonia-related projects

Rank	Country	All projects	Advanced projects
1	Australia	45	2
2	United States	42	10
3	Spain	39	1
4	India	33	3
5	Brazil	31	2
6	Canada	29	1

7	Egypt	27	1
8	China	26	15
9	Chile	19	0
10	Norway	15	1

The emerging low-carbon ammonia pipeline partly builds on established ammonia-export capabilities, but also opens space for new entrants. Several countries that already appear among the major conventional ammonia exporters (as shown in Figure 1) also have sizeable low-carbon ammonia project pipelines. The United States, Canada, Australia, and Egypt combine existing ammonia capabilities with new low-carbon ammonia ambitions. This indicates that incumbent advantages still matter: established production know-how, port infrastructure, trading relationships and large domestic industrial demand (in the cases of China and India) can all help in advancing from ideas toward bankable projects. The United States is notable because it is both an important recent ammonia exporter and one of the countries with the largest number of advanced low-carbon ammonia projects, reflecting the pull of existing Gulf Coast ammonia infrastructure, natural-gas resources, and policy incentives through IRA. At the same time, the project pipeline also points to a widening of the ammonia map. Countries such as Spain, Brazil, Chile and Norway are much more prominent in the low-carbon project pipeline than in the historical export rankings. Their position appears less rooted in legacy ammonia export dominance and more in renewable-resource potential, industrial-policy strategies and anticipated demand for renewable hydrogen derivatives.

Electrolysis dominates the ammonia-related project pipeline. Of the 484 projects, 428 are electrolysis-based, representing 88.4% of the project count. Fossil-based hydrogen with CCUS accounts for 52 projects, or 10.7%. Among advanced projects electrolysis-based projects still dominate by count, but fossil-with-CCUS projects account for a higher share than in the full pipeline: 14 of 49 advanced projects, or 28.6% and representing an even larger share of the capacity of advanced projects (41.7%). Blue ammonia projects are clearly over-represented among advanced projects relative to their share of the total project pipeline, likely because blue ammonia projects are retrofits or brownfield investments to existing natural gas-based ammonia production with existing port infrastructure. Most green ammonia projects, by contrast, are greenfield projects that require large new renewable power systems and electrolyser deployment.

Table 4. Technology route by project count and disclosed hydrogen capacity

	All projects			**Advanced projects**		
Technology route	**Project count**	**Share**	**Disclosed capacity kt H_2/year**	**Project count**	**Share**	**Disclosed capacity, kt H_2/year**
Electrolysis-based / green	428	88.4%	93,602.8	34	69.4%	1,332.3
Fossil with CCUS / blue	52	10.7%	7,502.0	14	28.6%	955.1
Biomass	3	0.6%	135.3	1	2.0%	1.3
Other	1	0.2%	49.5	0	-	0
Total	**484**	**100.0%**	**101,289.6**	**49**	**100.0%**	**2,288.7**

The capacity data show a pronounced scale gap between the announced pipeline and the advanced projects that have reached FID/construction or operation, as shown in Table 5. The largest capacities are

overwhelmingly in the early-stage project categories. This means that aggregate pipeline capacity is a poor indicator of likely near-term supply. Across all ammonia-related projects with disclosed electrical capacity, the median size is 426.8 MW. For projects at FID/construction or operational status, the median disclosed electrical capacity is only 60 MW. The scale gap has several interpretations. First, smaller projects are more likely to reach operation because they can be integrated into existing industrial sites, local offtake arrangements or demonstration programmes. Second, very large export-oriented projects require simultaneous development of generation, conversion, port, storage, shipping, certification and customer-side infrastructure which increases the risk for delays or cancellations if any part falls through. Third, cost exposure is amplified: electrolyser capital costs, renewable power costs, financing costs, construction inflation and offtake uncertainty all matter more when projects move to multi-gigawatt scale.

Table 5. Capacity statistics for ammonia-related projects

Metric	All projects with data	FID/Construction + Operational	Concept + Feasibility
Electrical capacity, project count	413	33	378
Total disclosed electrical capacity, MW	545,409	8,027	537,020
Median electrical capacity, MW	426.8	60.0	500.0
Mean electrical capacity, MW	1,320.6	243.2	1,420.7
Maximum electrical capacity, MW	46,175.2	2,200.0	46,175.2
Hydrogen capacity, project count	449	40	407
Total disclosed hydrogen capacity, kt H_2/year	101,289.6	2,288.7	98,938.0
Median hydrogen capacity, kt H_2/year	86.6	15.5	87.5
Mean hydrogen capacity, kt H_2/year	225.6	57.2	243.1
Maximum hydrogen capacity, kt H_2/year	8,000.0	372.9	8,000.0

3.2 Offtake agreements

Tables 6 and 7 provide detailed information about projects with some form of identified offtake agreement with a future buyer of ammonia. They cover 22 agreement records linked to 21 named projects or facilities: 8 blue ammonia records and 14 green ammonia records. The offtake sample provides three insights. First, green ammonia agreements in the sample appear more advanced than blue ammonia agreements by formal agreement type. Second, most price information remains undisclosed, indicating that transparent price discovery is still limited. Third, the geography of production and the geography of demand differ markedly: blue ammonia agreements are concentrated in North America and oriented mainly toward Japan, South Korea and Europe, while green ammonia agreements show stronger links from the MENA, India, North Africa, Norway, Spain and Canada toward Europe, Japan and domestic Indian fertiliser markets.

Table 6. Identified offtake agreements for green ammonia projects.

Project / facility	Country	Region	Producer / plant owner	Buyers / offtakers	Export market	Volume under agreement	Start / term	Price	Energy source	Agreement classification	Source
NEOM Green Hydrogen Project	Saudi Arabia	Middle East	NEOM Green Hydrogen Co	Air Products	Global incl. Europe	Up to 1.2 Mt/yr	~2027 start; 30-year exclusive offtake	Not disclosed	Solar + wind	SPA / binding take-or-pay	[22]
ACME Duqm	Oman	Middle East	ACME / GHC SAOC	Yara Clean Ammonia	Europe	100,000 t/yr	Expected from 2027; long-term	Not disclosed	Solar + wind	SPA / binding take-or-pay	[23]
Egypt Green Hydrogen / Ain Sokhna	Egypt	Middle East / North Africa	Egypt Green Hydrogen consortium	Hintco / H2Global via Fertiglobe	Germany / Europe	Up to 397,000 t cumulative by 2033	Deliveries 2027–2033	€1,000/t delivered to Europe	Solar + wind	SPA / binding take-or-pay	[24]
AM Green Kakinada	India	South Asia	AM Green	RWE	Germany / Europe	Up to 250,000 t/yr	From 2027	Not disclosed	Not disclosed	MoU / framework cooperation	[25]
AM Green Kakinada + Tuticorin	India	South Asia	AM Green	Uniper	Germany / Europe	Up to 500,000 t/yr	First shipment expected 2028	Not disclosed	Not disclosed	SPA / binding take-or-pay	[26]
ACME Odisha	India	South Asia	ACME Group	IHI Corporation	Japan	400,000 t/yr	Expected around 2027–2028	Not disclosed	Solar + wind	HoA / term sheet	[27]
L&T Green Ammonia	India	South Asia	L&T Energy GreenTech	ITOCHU	Japan / Singapore	300,000 t/yr	Not clearly disclosed	Not disclosed	Not disclosed	MoU / framework cooperation	[28]
NTPC Renewable Energy / SECI SIGHT	India	South Asia	NTPC Renewable Energy	Krishana Phoschem via SECI	Domestic India	70,000 t/yr	10 years	₹51.80/kg (~$591/t)	Not disclosed	SPA / binding take-or-pay	[29]
ACME / SECI SIGHT	India	South Asia	ACME	Paradeep Phosphates via SECI	Domestic India	75,000 t/yr	10 years	₹55.75/kg (~$641/t)	Not disclosed	SPA / binding take-or-pay	[30]
Jakson Green / SECI SIGHT	India	South Asia	Jakson Green	Coromandel International	Domestic India	85,000 t/yr	Not disclosed	₹50.75/kg	Not disclosed	SPA / binding take-or-pay	[31]

Iberdrola green ammonia plant	Spain	Europe	Iberdrola	Trammo	Europe	Up to 100,000 t/yr	From 2026	Not disclosed	Not disclosed	MoU / framework cooperation	[32]
Skipavika Green Ammonia	Norway	Europe	SkiGA	EnBW	Germany / Europe	Not disclosed	Expected production 2026	Not disclosed	Hydropower + wind expected	MoU / framework cooperation	[33]
TEAL Ammonia	Canada	North America	TEAL Corporation	Trammo	Europe / global	800,000 t/yr	Not disclosed	Not disclosed	Hydropower	SPA / binding take-or-pay	[34]
Yanbu Green Hydrogen & Ammonia Project	Saudi Arabia	Middle East	ACWA Power	EnBW	Germany / Europe	Not disclosed	Target operation 2030	No information	Solar + wind	MoU / framework cooperation	[35]

Table 7. Identified offtake agreements for blue ammonia projects.

Project / facility	Country	Region	Producer / plant owner	Buyers / offtakers	Export market	Volume under agreement	Start / term	Price	Claimed carbon capture	Agreement classification	Source
Baytown low-carbon hydrogen/ammonia	USA	North America	ExxonMobil	Marubeni	Japan	~250,000 t/yr	Production expected ~2029	Not disclosed	~98% CO2 removed	SPA / binding take-or-pay	[36]
Baytown low-carbon hydrogen/ammonia	USA	North America	ExxonMobil	Trammo	Europe / global	300,000–500,000 t/yr	From ~2029	Not disclosed	~98% CO2 removed	HoA / term sheet	[37]
Blue Point Clean Ammonia	USA	North America	CF Industries, JERA, Mitsui	JERA	Japan	>500,000 t/yr contemplated	Target start 2028	Not disclosed	≥60% lower carbon intensity	MoU / framework cooperation	[38,39]
Louisiana low-emission ammonia	USA	North America	Air Products / Yara	Yara	Europe / global	Hydrogen equivalent to 2.8 Mt/yr ammonia	25-year agreement	Not disclosed	>95% CO2 capture	MoU / framework cooperation	[40]
Ingleside low-carbon ammonia	USA	North America	Yara Clean Ammonia / Enbridge	Yara	Europe / global	1.2–1.4 Mt/yr plant output	Not disclosed	Not disclosed	Not disclosed	MoU / framework cooperation	[41]
St. Charles Clean Fuels	USA	North America	Copenhagen Infrastructure Partners / Sustainable Fuels Group	LOTTE Chemical	South Korea	Volume not disclosed	Not disclosed	Not disclosed	85–95% lower carbon footprint	MoU / framework cooperation	[42,43]
TA'ZIZ low-carbon ammonia	UAE	Middle East	TA'ZIZ / ADNOC / Fertiglobe / Mitsui / GS Energy	Mitsui, GS Energy-linked value chains	Japan / South Korea	1 Mt/yr plant output	Not disclosed	Not disclosed	~50% lower carbon intensity	MoU / framework cooperation	[44,45]
Barents Blue	Norway	Europe	Horisont Energi	VNG	Germany / Europe	100,000–300,000 t/yr	Target start 2028	Not disclosed	99% CO2 capture	HoA / term sheet	[46]

The green ammonia sample contains more binding arrangements, including NEOM's exclusive offtake with Air Products, ACME Duqm's binding agreement with Yara Clean Ammonia, Fertiglobe's H2Global-backed supply to Europe, Indian SECI auction awards, AM Green's long-term offtake relationship with Uniper, and TEAL's exclusive offtake with Trammo. NEOM's project is particularly significant because it combines project finance, large-scale renewable power integration and a 30-year exclusive ammonia offtake agreement [22]. Yara's agreement with ACME covers 100,000 tonnes per year of renewable ammonia from Oman and has been described by Yara as a long-term agreement of unusual scale and tenure for renewable ammonia [23]. By contrast, the blue ammonia sample is more weighted toward MoUs, development agreements and heads of agreement. A strong blue ammonia offtake example is ExxonMobil's agreement with Marubeni for approximately 250,000 tonnes per year of low-carbon ammonia, linked to Japanese demand and a facility expected to remove around 98% of CO_2 from hydrogen production [36].

The offtake geography reinforces the distinction between production hubs and demand centres. The blue ammonia sample is dominated by the U.S. Gulf Coast, reflecting the availability of natural gas, existing ammonia and chemical infrastructure, port logistics and CCS-related project development. Intended markets are mainly Japan, South Korea and Europe. The green ammonia sample is more geographically diverse, but India is unusually prominent because of the SECI SIGHT auction mechanism. The intended-market pattern is highly significant. Japan and South Korea appear mainly as import markets for blue ammonia, reflecting interest in ammonia for power generation, industrial decarbonisation and trading-company value chains. Europe appears as a major market for green ammonia, particularly through Germany-linked procurement, Yara, Uniper, RWE, EnBW and Trammo. The Indian entries are however domestic offtake arrangements aimed at fertiliser producers, through several rounds of auctions conducted by the Solar Energy Corporation of India (SECI) showing how domestic demand creation can support early green ammonia deployment without relying on export markets [47].

The supplied offtake tables show that price transparency remains weak. All 8 blue ammonia records list prices as undisclosed. In the green ammonia table, 10 of 14 records also list prices as undisclosed. Only four green ammonia entries include price information: the H2Global/Fertiglobe Egypt award and three Indian SECI SIGHT auction awards. The absence of disclosed blue ammonia prices suggests that blue ammonia commercialisation is proceeding through bilateral negotiations and strategic partnerships rather than through publicly visible price formation. However, estimates by industry insiders shown in Figure 6 indicate that the estimated premium for blue ammonia is much lower than for green ammonia and that prices may actually be a bit lower than what the openly communicated information suggests. The H2Global/Fertiglobe award is the clearest international price signal in the sample. Fertiglobe was contracted to supply renewable ammonia to Europe at a delivered price of €1,000 per tonne, with deliveries expected between 2027 and 2033 and a maximum contract value of €397 million [24].

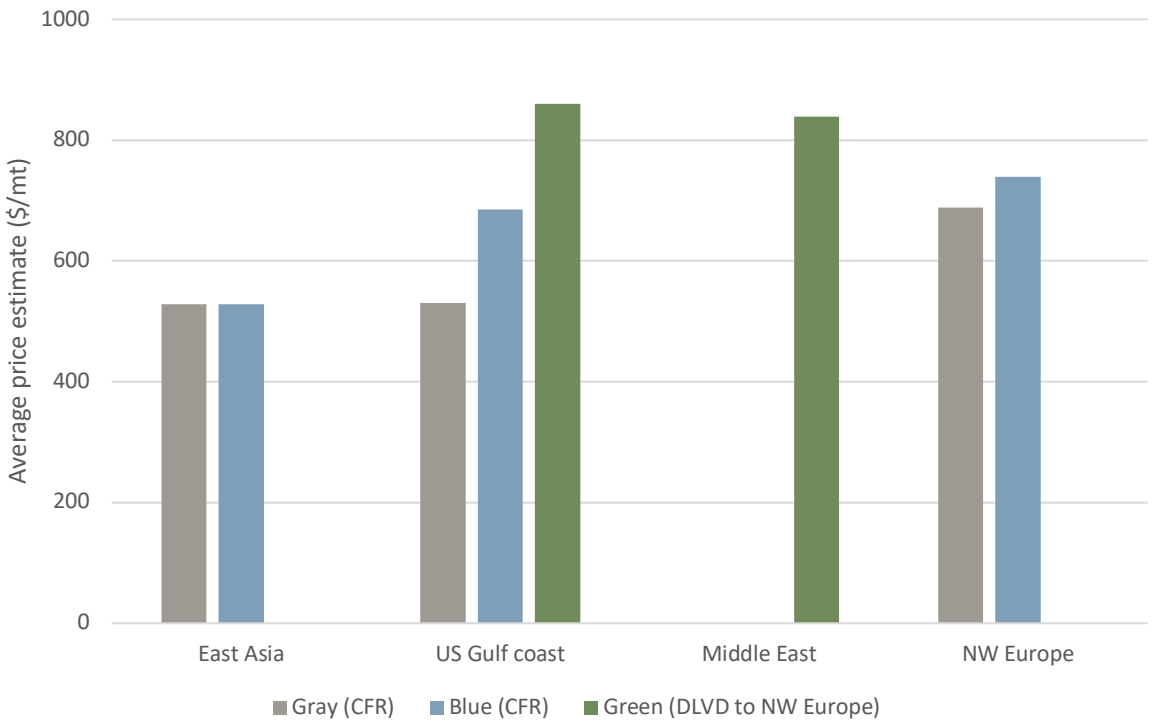


Figure 6. S&P Global estimated ammonia prices for different regions in Q4 2025 [48]. Note differences in delivery terms (CFR/DLVD) for comparisons.

Offtake agreements are important because they can transform a project into a bankable investment proposition. Long-term take-or-pay agreements, government-backed auctions and exclusive offtake arrangements can support debt financing by clarifying revenue, volume and counterparty risk. However, the offtake tables also show that many arrangements are not yet definitive. MoUs, heads of agreement, framework cooperation agreements and development letters may signal buyer interest, but they usually do not provide the same bankability as a binding long-term offtake contract. Even binding agreements may remain conditional on project FID, certification, infrastructure completion, policy support, permitting and financing. A project with an MoU should thus not be counted as equivalent to a facility guaranteed to come online. A project with a binding offtake is materially more advanced, but still not guaranteed to proceed unless the remaining development conditions are resolved. The offtake evidence also helps explain why some projects are more likely to proceed than others. Projects connected to credible buyers, policy-backed procurement mechanisms or existing industrial users appear better positioned. NEOM has an exclusive long-term offtaker; ACME Duqm has Yara; Fertiglobe has H2Global/Hintco-backed procurement into Europe; Indian projects have domestic fertiliser customers under SECI-administered auctions. These arrangements do not remove project risk, but they provide clearer demand-side anchors than projects relying only on future export-market expectations.

The offtake evidence provides useful insight into emerging market formation, but it is subject to substantial uncertainty. The sample is necessarily incomplete because many ammonia offtake negotiations are confidential, commercially sensitive or announced only through selective corporate communications. This creates a visibility bias toward large projects and agreements that sponsors want to publicise. The classification of agreements is also uncertain as public announcements often provide limited legal detail beyond headline messages. Price transparency is especially weak, with only a small number of green ammonia agreements disclosing explicit price information and no comparable open price discovery for blue ammonia agreements. In addition, contracted volumes should not be interpreted as guaranteed future supply. Even where offtake is binding, deliveries remain contingent on project FID, permitting,

renewable-power build-out, electrolyser procurement, port and storage infrastructure, shipping arrangements, certification and financing. The offtake tables therefore indicate where demand signals are strongest and where projects appear more bankable, but they should not be read as a precise forecast of volumes that will enter the market on the announced timelines.

4 Transaction data analysis

This chapter analyses green and blue ammonia-related asset and transaction records extracted from the Green Street EU infrastructure database, formerly IJGlobal. Green Street describes the infrastructure product as covering transactions, assets and market participants, with the asset database built from the IJGlobal dataset. The sample here covers project and corporate transactions linked to ammonia production assets, including project finance, additional facilities, portfolio financings and acquisitions. It is therefore a transaction sample rather than a census of all ammonia projects or all investment in the sector. The analysis includes only records with a "Latest Transaction Event Date" from 1 January 2020 onwards. Monetary values are reported as USD millions as recorded in the datasets. Entries with transaction value recorded as zero are treated as undisclosed or non-monetised records, not as evidence that no capital is involved.

Table 8. Green and blue ammonia project transaction sample

Metric	Value
Transaction entries	42
Underlying transaction records	147
Asset-linked entries	40
Underlying asset records	142
Entries with positive disclosed transaction value	23
Entries with zero or undisclosed transaction value	19
Total disclosed transaction value	USD 51.99bn
Mean positive disclosed transaction value	USD 2.26bn
Median positive disclosed transaction value	USD 310m

The largest disclosed projects are concentrated in a small number of countries, led by the Ras Al Kahir blue-ammonia project and several large green-ammonia projects in India.

Table 9. Largest disclosed transaction entries

Transaction	Country	Stage	Route	Value
Ras Al Kahir Blue Ammonia	Saudi Arabia	Pre-financing	Blue	USD 15.50bn
Thoothukudi Green H2 & ammonia	India	Financing	Green	USD 6.62bn
ABC Karnataka green H2 & ammonia	India	Financing	Green	USD 6.00bn
ACME Mangaluru H2/ammonia, Phase 2	India	Financing	Green	USD 5.98bn
AGA Uzbek fertiliser & fuels complex	Uzbekistan	Financing	Green	USD 5.50bn
Coega green ammonia	South Africa	Financing	Green	USD 4.20bn
West Terre Haute H2/ammonia DOE loan	United States	Financial close	Blue	USD 2.40bn
OCI clean ammonia plant acquisition	United States	Financial close	Blue	USD 2.35bn
Da'an wind/solar green H2-ammonia	Chin	Financial close	Green	USD 875m
ACME Mangaluru H2/ammonia, Phase 1	India	Financing	Green	USD 682m

The transaction timeline remains uneven. 2022 and 2023 contain the largest disclosed values, driven by a small number of very large financing and pre-financing records. 2024 has the highest number of entries,

but much less disclosed value. 2025 again contains a smaller number of high-value transactions, while the single 2026 entry in the current extract has no disclosed value. Because the sample is limited to the latest event date recorded in the database, later years should be treated as incomplete.

Table 10. Transactions by latest event year

Year	Entries	Disclosed value	Financial-close value
2021	2	USD 0.30bn	USD 0.00bn
2022	8	USD 23.79bn	USD 0.06bn
2023	5	USD 16.82bn	USD 0.87bn
2024	16	USD 2.44bn	USD 2.44bn
2025	10	USD 8.63bn	USD 3.10bn
2026	1	USD 0.00bn	USD 0.00bn

Most entries are still at financing or pre-financing stage. Financial close accounts for 12 of 42 entries and USD 6.46 billion, compared with USD 30.03 billion in financing-stage entries and USD 15.50 billion in pre-financing. The sample therefore captures a substantial development pipeline rather than only committed projects.

Table 11. Transactions by stage

Transaction stage	Entries	Disclosed value
Financing	19	USD 30.03bn
Pre-financing	11	USD 15.50bn
Financial close	12	USD 6.46bn

FACT BOX: Two different pathways

The Kakinada project in Andhra Pradesh, India, is one of the more advanced large-scale green ammonia projects in the dataset. AM Green is converting a former gas-based ammonia and urea complex into a renewable ammonia facility. The first phase is planned at around 1 million tonnes per year and reached final investment decision in 2024. Construction is now under way, with first deliveries expected in 2028. The project combines renewable electricity and storage with electrolysis and ammonia synthesis and is designed to meet EU requirements for renewable fuels of non-biological origin (RFNBOs). The Asian Development Bank describes Kakinada as one of the world's largest green ammonia developments and records USD 100 million of proposed financing. In January 2026 Uniper signed a long-term agreement to purchase up to 500,000 tonnes of renewable ammonia annually from AM Green's Indian portfolio, with the first shipments expected from Kakinada. The case thus provides a concrete link between investment in Indian renewable-ammonia production and anticipated European demand.

The proposed Corpus Christi project in Texas represents a different model and remains at an earlier development stage. German utility RWE, South Korea's LOTTE Chemical and Japan's Mitsubishi Corporation agreed to study an integrated facility integrating both green and blue ammonia production, sharing export infrastructure. The partners originally targeted first production by 2030 and envisaged a phased expansion potentially reaching 10 million tonnes per year. German involvement is direct through RWE, developing the project as part of emerging international ammonia supply chains serving Europe and Asia. The transaction data record the project at the financing stage rather than financial close, indicating that important milestones remain to be reached before a final decision.

These two projects illustrate contrasting pathways for developing international low-carbon ammonia supply chains. Kakinada demonstrates how renewable ammonia production in emerging economies can be supported by international financing and long-term European offtake agreements, while Corpus Christi highlights the role of multinational partnerships in developing large-scale projects. Both cases also demonstrate German involvement in shaping emerging ammonia markets, as an importer and potential investor in new production capacity.

Project geography is concentrated by value. Asia Pacific accounts for 27 of 42 entries and about 51.5% of disclosed value. MENA has only one entry, but it accounts for almost 30% of disclosed value because of the Ras Al Kahir blue-ammonia project. India is the largest country market by both count and disclosed value, while Saudi Arabia remains the second-largest market by value because of one very large blue-ammonia entry. The project locations are broader than the largest transaction values suggest, with smaller green-ammonia grants and development financings spread across Europe, Australia and Asia.

Table 12. Transactions by project region

Region	Entries	Disclosed value	Share of value
Asia Pacific	27	USD 26.78bn	51.5%
MENA	1	USD 15.50bn	29.8%
North America	7	USD 5.20bn	10.0%
Sub-Saharan Africa	3	USD 4.22bn	8.1%
Europe	4	USD 0.29bn	0.6%

The sample contains 32 green-ammonia transaction entries and eight blue-ammonia transaction entries. Corpus Christi is kept outside the simple split because it combines green and blue ammonia. Bundaberg is also kept outside the split because its planned hydrogen route is based on biomass gasification rather than the renewable-electricity-to-electrolysis route used here to define green ammonia. The green sample dominates by transaction count and, excluding the two special cases, represents about 60% of disclosed

value. Its value is concentrated in a handful of large Indian projects: Thoothukudi, ABC Karnataka and ACME Mangaluru Phase 2 together account for more than half of the disclosed green value in the sample. The blue sample has fewer entries but is highly concentrated in value because Ras Al Kahir alone accounts for USD 15.5 billion. The remaining blue projects are mainly in North America, with additional projects in Australia and Japan. This means that the overall headline value should not be read as a balanced measure of green and blue investment activity: one very large blue project has a strong effect on the total.

Table 13. Green and blue ammonia transactions

Route	Transaction entries	Positive-value entries	Disclosed value	Share of total disclosed value
Green ammonia	32	17	USD 30.99bn	59.6%
Blue ammonia	8	5	USD 20.70bn	39.8%
Corpus Christi - mixed green/blue	1	0	USD 0.00bn	0.0%
Bundaberg - biomass route	1	1	USD 0.30bn	0.6%

The dataset distinguishes how projects are financed from what type of transaction is taking place. Project finance is the dominant financing form. In project finance, repayment is primarily linked to the project's future cash flows, with risk allocated through a package of contracts such as engineering, procurement and construction agreements, offtake contracts, fuel or power supply agreements, concessions, guarantees and debt documents. It is typically used for large infrastructure and industrial assets where sponsors want to finance a discrete asset through a project company. Project finance is dominant, with 32 of 42 entries and USD 43.47 billion of disclosed value. Corporate finance is instead financed primarily on the balance sheet, creditworthiness and corporate strategy of an existing company. It is therefore more common in acquisitions, additional facilities, or investments by established industrial companies. Corporate finance accounts for five entries and USD 7.87 billion, mainly associated with acquisitions or additional facilities. Non-commercial finance includes grants, concessional funding, government-backed support or public-programme-related finance where the objective is not simply commercial return. Non-commercial finance accounts for five entries and USD 0.65 billion and includes grants or other public-programme support. Project finance therefore remains the main financial structure for new ammonia infrastructure, while other forms of finance matter for acquisitions, follow-on investment and early-stage support.

Table 14. Transactions by finance type

Finance type	Entries	Disclosed value
Project Finance	32	USD 43.47bn
Corporate Finance	5	USD 7.87bn
Non-Commercial Finance	5	USD 0.65bn

Primary financing is the most common transaction type, with 29 entries and USD 39.19 billion. This generally refers to financing raised for a new project or asset. Additional facilities account for four entries and USD 5.78 billion, these are follow-on financing events for an existing company or project. Portfolio financing, with five entries and USD 4.65 billion, refers to financing linked to a group of assets rather than one single facility. Asset acquisitions are ownership-transfer events rather than pure project-development financings.

Table 15. Transactions by transaction type

Transaction type	Entries	Disclosed value
Primary Financing	29	USD 39.19bn
Additional Facility	4	USD 5.78bn
Portfolio Financing	5	USD 4.65bn
Asset acquisition	4	USD 2.37bn

The actor data show a fragmented sponsor and offtake landscape but a recurring set of public and quasi-public actors. The lender and public-finance picture is especially interesting. The data identifies 10 transactions with at least one public actor classified as state lender, multilateral or awarding authority. These transactions account for only USD 0.25 billion in disclosed value, but that figure likely understates the role of the state because many public interventions appear through auction design, guarantees, concessional facilities, export-credit support, policy mandates or government-backed offtake rather than direct transaction value. This finding aligns with our previous analysis of public finance in petrochemicals [49] which shows that public finance has historically helped enable large petrochemical and fertiliser projects through export credit agencies, development finance institutions and state-backed lending, often leveraging private capital. The ammonia transaction data suggest a similar structural situation that may help leveraging the transition towards low-carbon ammonia. Public finance can support low-emissions ammonia by de-risking first-of-a-kind projects, enabling infrastructure, supporting demand creation and lowering the cost of capital. At the same time, if public finance supports blue ammonia, fossil-based fertiliser assets or ammonia export infrastructure without robust emissions standards and transition conditions, it may extend carbon lock-in in production. A key question to explore further is therefore whether public capital is crowding in genuinely low-emissions investment or reinforcing incumbent petrochemical lock-in.

The data shows a globally distributed ammonia investment landscape where headline investment values overstate the amount of truly committed capital. Capital is concentrated in a small number of large projects. Asia Pacific dominates by project count and value, especially India, while MENA's value is driven by a single Saudi mega-project. Project finance is the dominant financing form, reflecting the infrastructure-like character of new ammonia assets, but corporate finance and non-commercial finance remain important for acquisitions and early-stage public support. Asset data show that the market is primarily greenfield and pre-construction.

The transaction data should be interpreted cautiously. The dataset captures a valuable subset of ammonia-related financing and asset transactions, but it does not provide a complete picture of investment activity in the sector. Many entries have undisclosed or zero recorded transaction values, and these should not be interpreted as evidence that no capital is involved. Conversely, disclosed values for large projects may refer to total anticipated project cost, financing under discussion, pre-financing estimates or headline investment values rather than committed capital at financial close. This distinction is critical because the dataset shows that a large share of disclosed value remains in financing or pre-financing stages, while the financial-close subset is much smaller. The transaction analysis should therefore be treated as evidence of the scale, geography and financing structure of ammonia investment, but not as a complete measure of committed capital and project viability.

5 Deep Dive: The Growing Role of Ammonia Imports for Germany

5.1 Transformation of the German ammonia market

The current situation of the entire German chemical industry, including ammonia, as well as the steel and alumina industry can be characterized a structural crisis due to massive overcapacities of global production and non-competitive raw material and energy costs. The fossil business model for German basic industries is not working anymore. At the same time, the German and European society is expecting a transformation towards sustainable industrial production. Since Germany will be short on the required renewable energy for the transformation of all of its sectors, it will need to rely on energy imports. The key question will be which proportion of basic materials (e.g., from the chemical industry) will still be produced domestically in the future and which will be imported.

Regarding the use of ammonia in Germany, there are no detailed public data. Globally, 80% of the ammonia volumes is feeding the fertilizer industry [50]. The German ammonia market has entered a phase of transition: due to the interruption of cheap Russian gas supply, the entire ammonia value chain in Germany is facing huge economic challenges. The ammonia production based on imported LNG - combined with relatively high energy prices - is not competitive in comparison with ammonia imports. As a consequence, a consolidation of capacities has been seen in Germany. Following a slight decline in ammonia production from 2.7 Mt in 2013 to 2.4 Mt in 2021, production dropped sharply to 1.8 Mt in 2022, where it currently remains stagnant after a slight recovery in 2024 [16]. One example is a 45% reduction of ammonia production at BASF in Ludwigshafen by 2023.

Besides the fertilizer demand, smaller volumes of ammonia are used for other chemical value chains, e.g. nitric acid as an essential ingredient for polyurethanes production. These applications may rely on higher margins and hence allow higher ammonia pricing for a limited time. Nevertheless, over the medium and long term, import competition will drive the need for alternative sourcing of ammonia.

Ammonia serves as platform chemical, which provides the opportunity to substitute fossil ammonia by its green counterpart as a first step towards sustainable production, utilizing drop-in solutions that do not require immediate investment in new technologies at German sites. Initial examples of green ammonia deployment include BASF's Ludwigshafen fertilizer production [51] as well as Covestro's MOU with Fertiglobe for its polyurethane production in the US and China [52].

Direct electricity imports offer the highest efficiency among energy import options, but potential source regions are limited to neighbouring European countries. Therefore, additional long-distance imports will also be required in the future. The World Energy Council ranked green ammonia (and also green methanol) highest among different green energy import options due to their energy density and established, long-term global expertise in handling these (hazardous) materials [53].

In addition to chemical feedstock substitution, several recent projects aim to use green ammonia as a carrier for hydrogen in Germany. The most advanced market developments are led by the steel sector (e.g. ThyssenKrupp Steel Europe) and the fuel industry (e.g. BP). A further need for hydrogen is the transformation of fossil power generation. Hydrogen is expected to play an important role in the German Energiewende as back-up capacity during prolonged periods of low generation from volatile renewable energies, complementing short-term flexibility options such as batteries and demand management. Therefore, also the demand for ammonia (or methanol) as hydrogen carrier is expected to increase in the future.

5.2 Key industrial ammonia projects in Germany

The projected increase in future demand for ammonia imports, as outlined above, is also reflected in current industrial projects. Table 16 shows the publicly available plans for the construction of ammonia import terminals and cracker plants at German ports. The respective descriptions are taken from public sources (e.g. press releases or websites).

Table 16. Plans for construction of ammonia import terminals and cracker plants in Germany

Port	Operator	NH_3 (Mt/a)	H_2 (Mt/a)	NH_3 Import terminal	NH_3 cracker	Status
Rostock	Yara	0.6		X		In operation
	VNG, EnBW	0.14			X	Feasibility study; planned commissioning in the 2030s
Wilhelmshaven	BP	1		X		FEED study completed end of 2025; construction is scheduled to begin in 2027
	Uniper	2.6		X		Two-phase open season for capacity allocation has begun
	BP		0.13		X	Scheduled to begin operations in 2028
	Uniper		0.35		X	Pre-FEED
Gelsenkirchen (Inland port)	Uniper		0.0015		X	Currently under construction; scheduled to begin operations in late 2026
Brunsbüttel	Yara	3		X	(X)	In operation since October 24
Hamburg	MB Energy	0.6		X	(X)	Building permit issued on April 26; completion scheduled for 2028
Lubmin (Industrial port)	Deutsche ReGas, Höegh Evi		0.03	X	X	Scheduled to begin operations in early 2026 (no up-to-date information available)

Port of Rostock

The fertilizer manufacturer Yara already operates an import terminal for ammonia derived from fossil fuels at its Rostock site. In the future, the terminal could also be used to import green ammonia, and its capacity could be expanded [54]. As part of the AZAN project, EnBW is planning together with VNG to build and operate a large-scale cracker plant. The project partners' goal is to first conduct a feasibility study. Depending on the study's findings and potential expansion phases, 70,000 to 140,000 metric tons of hydrogen could be produced annually in the future [55,56].

Port of Wilhelmshaven

At the Wilhelmshaven site, both the oil company BP and Uniper plan to operate an import terminal and an associated cracker plant [54]. BP's import terminal, which is funded by the EU, aims to produce green hydrogen by converting ammonia sourced from production facilities around the world to supply industrial customers [57]. The converted hydrogen will then be fed into existing oil and gas pipelines, thereby connecting Wilhelmshaven with other industrial areas. Uniper's import terminal is already in the open season phase for the allocation of terminal capacity. The planned cracker plant will be the company's first commercial facility and will be an upscaled version of the plant in Gelsenkirchen (see below). The converted hydrogen will then either be fed into the core hydrogen network or transported by rail [58,59].

Port of Gelsenkirchen

The cracker demonstration plant developed by Uniper in collaboration with Thyssenkrupp Uhde at the Gelsenkirchen-Scholven power plant site will be one of the first of its kind worldwide and is part of a larger collaboration between the firms [60]. The plant will serve as the basis for the planned hydrogen import terminal in Wilhelmshaven (see above), where the technology will be applied on a large-scale industrial basis in a second phase. The goal of the collaboration is to convert imported ammonia into hydrogen on an industrial scale and make it available to a wide range of industries, such as energy, steel, and chemicals [61,62].

Port of Brunsbüttel

The fertilizer manufacturer Yara supplies "low-emission" ammonia directly to customers from its existing import terminal in Brunsbüttel [41]. Future plans also include cracking the ammonia into low-emission hydrogen and subsequently feeding it into the future hydrogen backbone network.

Port of Hamburg

The import terminal planned by energy supplier MB Energy on the grounds of the Blumensand tank farm in the Port of Hamburg is set to become Germany's first large-scale ammonia import hub [63]. A cracker plant (operated by Air Products) could be built in the immediate vicinity of the import terminal, where ammonia might be split into hydrogen and then fed into hydrogen pipelines [64]. There are also plans to load ammonia onto rail tank cars at the Port of Hamburg.

Port of Lubmin

In collaboration with Höegh Evi, Deutsche ReGas is planning to build the "Lubmin H2 Import Terminal". The terminal is set to be the world's first floating import terminal for the large-scale conversion of green ammonia into green hydrogen [65]. The ammonia, sourced internationally, will be converted into green hydrogen at the cracker plant and fed into the future core hydrogen network via the OPAL pipeline, which has been repurposed by GASCADE [66].

5.3 Germany's role for ammonia in the EU

The German ammonia import projects identified show that ammonia is moving into concrete industrial project and infrastructure planning. Germany's interest is driven by the declining competitiveness of domestic fossil-based ammonia production, the need for renewable energy imports, and expected future demand for hydrogen in chemicals, steel, fuels and dispatchable power. The projects listed show a broad shift from simple import terminals toward integrated ammonia-to-hydrogen systems, including crackers, port storage, rail logistics and links to the future hydrogen core network. Together, these projects suggest that Germany is not only preparing to import ammonia as a chemical feedstock, but also to use ammonia as a central logistics platform for renewable hydrogen imports. This confirms that Germany is becoming a key European test case for ammonia-based hydrogen import infrastructure.

6 Discussion

6.1 The role for ammonia in EU industrial transformation

The different data and evidence presented in this report point to the same central conclusion: ammonia is attracting a lot of interest as one of the main carriers of the hydrogen transition, but the market is still in a formative, high-risk phase. Ammonia is technically attractive because it is already produced, stored, shipped and traded at scale and it is institutionally attractive because it connects directly to existing EU objectives on renewable hydrogen, fertilizer supply security, maritime fuels, industrial decarbonisation and energy diversification. The emerging low-carbon ammonia market is being shaped by established trade corridors, industrial assets, port infrastructures, and the financial constraints of multi-billion-dollar project development.

Conventional ammonia trade has for decades connected fossil-resource regions, fertiliser producers and agricultural markets. A low-emissions ammonia system could reproduce some of these patterns while adding new ones. Exporters with cheap renewable energy may capture upstream production value through the renewables pull effect while European firms may capture upgrading and downstream industrial value. The EU may reduce direct fossil gas use in domestic ammonia production while increasing reliance on imports whose emissions profiles are harder to verify.

EU demand is currently being shaped by emerging regulation and governance initiatives, e.g. RFNBO targets, the European Hydrogen Bank, and the gradual extension of carbon pricing and CBAM to industrial commodities such as fertilizers. RED III requires RFNBOs to account for at least 42% of hydrogen used in industry by 2030 and 60% by 2035. This creates a regulatory demand pull for renewable hydrogen and derivatives such as ammonia, but also imposes strict qualification rules on electricity sourcing, additionality and emissions accounting systems which some producer countries may not meet.

Ammonia trade requires storage, terminals, safety systems, shipping relationships, downstream chemical users, and specialised knowledge. These assets create increasing returns: once a port cluster, pipeline system or fertilizer complex exists, it is cheaper to adapt it than to build a parallel system elsewhere. Thus Belgium, the Netherlands and Germany are likely to remain central to EU ammonia even if the carbon intensity of the molecule changes. They already provide the hub-and-spoke architecture through which low-carbon ammonia imports, cracking, blending into chemical value chains, and redistribution could be organised.

The IEA project data show that the global ammonia-related hydrogen pipeline is large but still dominated by projects at concept and feasibility stage. This matters for Europe because many import strategies implicitly assume that international supply will materialise at scale before 2030. The project dataset suggests caution: advanced projects are much fewer, smaller and geographically more concentrated than the full announced pipeline. The investment dataset leads to a similar conclusion. Headline transaction value since 2020 is substantial, but much of it is attached to financing or pre-financing records rather than financial close.

Offtake data provide a more concrete signal of market formation. They show that Europe is already emerging as a key intended destination for green ammonia, particularly through policy-backed procurement and large industrial buyers. Germany is a key target market among the identified offtake agreements with companies such as Uniper, RWE, and EnBW committing to buying green ammonia from projects abroad in the coming years. The offtake agreements also suggest that Europe's future ammonia imports may initially be more project-specific than market-based. This is consistent with IRENA and WTO's emphasis that renewable hydrogen derivative trade depends on partnerships with coherent regulation, certification and trade frameworks, not simply production potential [67]. For the EU, this

implies that import readiness is not only about terminals and shipping capacity but also about mutually recognised certification and credible emissions accounting.

Germany is actively developing the infrastructure necessary for ammonia imports through port projects, ammonia crackers and links to the future hydrogen core network. Multiple import terminal and ammonia cracker projects have been initiated, several of which are directly linked to hydrogen conversion rather than only ammonia handling. For example, BP and Uniper are developing import and cracking concepts at Wilhelmshaven, and Deutsche ReGas with Höegh Evi plan a floating terminal at Lubmin to convert internationally sourced green ammonia into hydrogen for injection into the future hydrogen network. This German evidence is significant because it shows how ammonia imports may become embedded in national industrial transformation strategies. Germany's fossil-based ammonia production has become less competitive after the interruption of cheap Russian gas supply, and domestic production dropped from 2.4 Mt in 2021 to 1.8 Mt in 2022, where it has remained broadly stagnant after a slight recovery in 2024. At the same time, Germany expects substantial future demand for renewable hydrogen in steel, fuels, chemicals and power-system balancing. Ammonia therefore appears in two roles: as a drop-in substitute for fossil ammonia in chemical and fertilizer value chains, and as a carrier for hydrogen imports that can be cracked near ports and connected to industrial demand centres.

An issue that remains central to the deployment of hydrogen technologies is the balance between domestic EU production and imports. Domestic green ammonia production may help integrate renewable electricity, support industrial clusters and reduce import dependence. However, European projects face constraints from electricity prices, slow permitting procedures, electrolyser costs and competition for renewable power. Imports from other regions may be quicker to ramp up and cheaper in the near term, but expose the EU to new dependencies and infrastructure lock-ins – something that the recent closures of the strait of Hormuz have shown can be a great vulnerability. The long-term future for the EU likely holds some production inside the EU, especially where ammonia plants, renewable electricity, and hydrogen infrastructure overlap. But the near-term trade opportunity probably lies in imports from regions that combine renewable resources, port infrastructure and government-backed industrial strategies, including MENA states such as Egypt, Oman, Saudi Arabia, the UAE, Morocco, as well as India – as evidenced already by the identified offtake agreements. Blue ammonia may offer earlier volumes because it can use existing gas, ammonia, port and industrial infrastructure. Yet its climate value depends on high CO_2 capture rates, low upstream methane emissions, and permanent storage with high integrity. Without these conditions, blue ammonia risks becoming a transitional label for continued fossil-based ammonia production. The offtake data show that blue ammonia agreements are often oriented toward Japan and South Korea with limited interest from European actors and markets. If the EU treats blue ammonia as a short-term bridge, it must define what "low-carbon" means with enough precision to avoid carbon leakage and fossil lock-in.

Europe is likely to become a major destination for renewable ammonia, but the import market will probably grow through a sequence of bilateral contracts, public auctions, demonstration cargoes and industrial partnerships before it resembles a deep commodity market. Prices will remain opaque and policy-dependent for some time. The few openly available data points on price indicate a significant green premium, but this is likely to decrease according to industry estimates.

6.2 Implications for the EU energy transition and strategic hydrogen technology diffusion

The analytical implication for the EU is that ammonia should be treated as a strategic hydrogen derivative, necessitating trade-offs between different priorities. First, EU demand pull must be strong enough to create a market but selective enough to avoid inefficient hydrogen use. RFNBO targets, the European Hydrogen Bank, CBAM and green public procurement can help create demand. Second, the EU should recognise renewables pull without assuming that production will automatically relocate to the cheapest renewable regions. Renewable-rich countries become credible partners only when renewable resources are

matched with finance, infrastructure, industrial capability and enforceable sustainability rules. The pipeline suggests that near term future trade will be organised through specific partnerships, not through a global green ammonia spot market. Third, the EU should leverage its industrial legacy. Existing ammonia hubs in Belgium, the Netherlands and Germany are strategic assets for import handling, storage, and redistribution. But the same hubs can lock in fossil pathways if low-carbon standards are weak. Policy should therefore support conversion of existing infrastructure while preventing blue-ammonia dependency from becoming entrenched.

Overall, ammonia is one of the most plausible hydrogen derivatives for international trade because it has existing infrastructure, established demand and a clear role in fertilizer and chemical value chains. But the transition from conventional ammonia to green ammonia will likely be slower, more policy-dependent and more path-dependent than many scenarios imply. EU and German demand can accelerate market formation, but only if it is matched by credible supply, bankable projects, robust certification and infrastructure that does not entrench fossil pathways. The decisive question is therefore whether the emerging ammonia economy becomes a vehicle for renewable industrial transformation or a new layer of carbon-intensive dependency.

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