Sector Analysis Ghana

Market Potential for Green Ammonia Applications

Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

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Currency units

GHS	Ghanaian cedi
EUR	Euro
USD	United States dollar

Conversion rate as of 28 August 2025
EUR 1 = GHS 13.1351
USD 1 = GHS 11.25

Source: Bank of Ghana, https://www.bog.gov.gh/treasury-and-the-markets/historical-interbank-fx-rates/

Technical units

°C	Degrees Celsius
GW	Gigawatt
GWh	Gigawatt hour
ha	Hectare
kg	Kilogram
km	Kilometre
km^2	Square kilometre
kW	Kilowatt
kWh	Kilowatt hour
m^2	Square metre
MPa	Megapascal
MW	Megawatt
MWh	Megawatt hour
Nm^3	Normal cubic metre
s	Second

Abbreviations/acronyms

AEMP	Africa Energy Market Place
AfCFTA	African Continental Free Trade Area
AfDB	African Development Bank
AMG	Agricultural Manufacturing Group
ANFO	Ammonium nitrate fuel oil
ASU	Air separation unit
CAGR	Compound annual growth rate
CCS	Carbon capture and storage
CO_2	Carbon dioxide
CSIR	Council for Scientific and Industrial Research
DAP	Diammonium phosphate
DFI	Development finance institution
DRI	Direct reduced iron
EIB	European Investment Bank
EPA	Environmental Protection Agency
EPC	Engineering, procurement and construction
ETIP	Energy Transition and Investment Plan
EU	European Union
FOB	Free on board
FOT	Free on truck
GCF	Green Climate Fund
GEF	Global Environment Facility
GHF	Green Hydrogen Fund
GIPC	Ghana Investment Promotion Centre
GRA-CD	Ghana Revenue Authority Customs Division
H_2	Hydrogen
H_2Upp	International Hydrogen Ramp-up Programme
HB	Haber-Bosch
ICMA	International Capital Market Association
IFC	International Finance Corporation
IMO	International Maritime Organization
IRR	Internal rate of return
LATAM	Latin America
LCOA	Levelised cost of ammonia
LCOH	Levelised cost of hydrogen
MAP	Monoammonium phosphate
MIGA	Multilateral Investment Guarantee Agency
MoF	Ministry of Finance
N_2	Nitrogen
NEA	North-East Asia
NH_3	Ammonia
NPK	Nitrogen, phosphorus and potassium
NPV	Net present value
O_2	Oxygen
PPA	Power purchase agreement
PSA	Pressure swing absorption
PtX	Power to X
PURC	Public Utilities Regulatory Commission
PV	Photovoltaic
RE	Renewable energy
SEFA	Sustainable Energy Fund for Africa
SMEs	Small and medium-sized enterprises
SORL	Sentuo Oil Refinery Limited
TOR	Tema Oil Refinery
VAT	Value added tax
WACC	Weighted average cost of capital
WEF	World Economic Forum

ENERGY SOLUTIONS – MADE IN GERMANY

The German Energy Solutions Initiative

The German Energy Solutions Initiative of the German Federal Ministry for Economic Affairs and Energy (BMWE) aims to globalise German technologies and expertise in climate-friendly energy solutions.

Years of promoting smart and sustainable energy solutions in Germany have led to a thriving industry known for world-class technologies. Thousands of specialised small and medium-sized enterprises (SMEs) focus on developing renewable energy systems, energy efficiency solutions, smart grids, and storage technologies. Cutting-edge energy solutions are also built on emerging technologies such as power-to-gas, fuel cells, and green hydrogen. The initiative's strategy is shaped around ongoing collaboration with the German business community.

The initiative creates benefits for Germany and the partner countries by:

- boosting global interest in sustainable energy solutions
- encouraging the use of renewables, energy efficiency technologies, smart grids, and storage technologies, while facilitating knowledge exchange and capacity building
- enhancing economic, technical and business cooperation between Germany and partner countries

THE PROJECT DEVELOPMENT PROGRAMME (PDP)

PDP is a key pillar of the German Energy Solutions Initiative and is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. It connects development cooperation with private-sector engagement and supports climate-friendly energy solutions in selected developing and emerging countries, enabling local businesses to adopt solutions in energy efficiency, electricity and heat supply, and hydrogen, while facilitating market access for German solution providers.

Developing and emerging economies offer promising business potential for climate-friendly energy solutions but also pose challenges for international business partners. The PDP team works closely with local industries to develop financially viable projects by providing technical expertise, financial guidance, and networking opportunities.

It identifies project leads, collects and analyses energy consumption data, and assesses projects from both a technical and economic perspective. This includes outlining the business case, calculating payback periods, and evaluating profitability. Companies can then choose to finance projects using their own funds or explore leasing and other financing options. PDP provides cost-free advice to local companies and connects them with German solution providers for project implementation.

Additionally, by offering training, organising reference project visits, and publishing studies on the potential of climate-friendly solutions and on navigating regulatory frameworks, the programme supports market development and fosters private-sector cooperation.

Executive summary

GREEN AMMONIA FOR GHANA'S COMMERCIAL AND INDUSTRIAL SECTOR

This sector analysis assesses the potential for green hydrogen and green ammonia production in Ghana, aiming to facilitate future project development and investment. It is part of a series that provides market insights and assists pre-development efforts to attract solution providers based in Germany and local stakeholders, with a view to them participating in Ghana's emerging green hydrogen economy.

Ghana offers promising opportunities across a number of sectors including agriculture, mining, manufacturing, and oil and gas, where green hydrogen and ammonia can serve as feedstocks and energy sources. The country's strategic location in West Africa, along with its abundant renewable energy resources, primarily solar and moderate wind and hydropower, mean that it is well positioned to develop green hydrogen and ammonia production facilities.

Key findings are as follows:

- **Market opportunities:** There is significant demand potential for green hydrogen and especially for green ammonia derivatives, such as green fertilisers and explosives for civil use. The agricultural sector alone is projected to achieve a compound annual growth rate (CAGR) of about 7% through 2030, with mining and manufacturing expected to expand by between 5% and 6% CAGR.
- **Economic feasibility:** Larger-scale green ammonia production projects leveraging a mix of solar photovoltaic (PV) and wind resources demonstrate competitive marginal costs, with a levelised cost of

Zusammenfassung

GRÜNES AMMONIAK FÜR DEN GHANAISCHEN C&I-SEKTOR

Die vorliegende Sektoranalyse bewertet das Potenzial für die Produktion grünen Wasserstoffs und grünen Ammoniaks in Ghana mit dem Ziel, die Entwicklung künftiger Projekte und Investitionen zu erleichtern. Sie ist Teil einer Reihe von Analysen, die Markteinblicke bieten und Maßnahmen der Projektvorentwicklung unterstützen, und mit denen Lösungsanbieter aus Deutschland sowie lokale Akteure dafür gewonnen werden sollen, sich an der entstehenden grünen Wasserstoffwirtschaft Ghanas zu beteiligen.

Ghana bietet vielversprechende Chancen in verschiedenen Branchen, darunter Landwirtschaft, Bergbau, verarbeitendes Gewerbe sowie den Öl- und Gassektor, in denen grüner Wasserstoff und Ammoniak als Rohstoffe und Energiequellen dienen können. Die strategische Lage des Landes in Westafrika sowie seine reichlich vorhandenen erneuerbaren Energieressourcen – vor allem Solarenergie sowie moderate Wind- und Wasserkraftpotenziale – machen Ghana zu einem geeigneten Standort für die Entwicklung von Produktionsanlagen für grünen Wasserstoff und grünen Ammoniak.

Die wichtigsten Erkenntnisse im Überblick:

- **Marktchancen:** Das Nachfragepotenzial nach grünem Wasserstoff und insbesondere nach grünen Ammoniakderivaten, etwa grünen Düngemitteln und Sprengstoffe für zivile Anwendungen, ist groß. Allein für den Agrarsektor wird bis 2030 eine durchschnittliche jährliche Wachstumsrate (CAGR) von rund 7 Prozent prognostiziert, während für den Bergbau und das verarbeitende Gewerbe ein Wachstum zwischen 5 Prozent und 6 Prozent CAGR erwartet wird.

ammonia (LCOA) of USD 3.35 per kg, which is, however, still higher than conventional grey ammonia prices. Policy measures such as a moderate carbon dioxide (CO_2) levy have a minimal effect on competitiveness, but curtailment of excess electricity significantly raises costs, underscoring the financial importance of integrated renewable energy systems.

- **Local conditions and challenges:** While Ghana offers favourable conditions, including renewable resources and land and water availability outside major cities, the country faces crucial obstacles, such as:
  - Critical policy gap with no dedicated national **green hydrogen policy** in place and a fragmented regulatory environment, with essential roadmaps, certification systems and safety standards still at early stages of development
  - Lack of a dedicated **skilled workforce**, academic training and technical programmes for green hydrogen and ammonia
  - **Infrastructure limitations**, including inadequate ammonia production, storage and transport and limited green hydrogen off-take agreements
  - High **capital costs and investment risks** which pose major financing challenges and create barriers to project viability and large-scale deployment
- **Integration potential:** Ghana's industrial clusters across sectors such as mining, agriculture, manufacturing and petrochemicals can become early adopters of green hydrogen and ammonia solutions, enhancing decarbonisation prospects and energy security while supporting economic growth.

- **Wirtschaftliche Machbarkeit:** Großskalige Projekte für die Produktion grünen Ammoniaks, die eine Kombination aus Photovoltaik (PV) und Windressourcen nutzen, weisen wettbewerbsfähige Grenzkosten auf. Die Stromgestehungskosten für Ammoniak (LCOA) liegen bei 3,35 US-Dollar pro Kilogramm und damit immer noch über den Gestehungskosten für konventionelles graues Ammoniak. Politische Maßnahmen wie eine moderate CO_2-Abgabe wirken sich nur geringfügig auf die Wettbewerbsfähigkeit aus, dagegen führen Abregelungen überschüssiger Elektrizität zu deutlichen Kostenerhöhungen. Hier zeigt sich die finanzielle Bedeutung integrierter Systeme.
- **Lokale Rahmenbedingungen und Herausforderungen:** Obwohl Ghana günstige Voraussetzungen bietet – darunter erneuerbare Ressourcen sowie verfügbare Land- und Wasserflächen außerhalb der großen Städte – bestehen wesentliche Hindernisse, etwa:
  - **Fehlende Regulierung:** Es gibt bislang keine nationale Strategie für grünen Wasserstoff, stattdessen aber ein fragmentiertes regulatorisches Umfeld. Wichtige Fahrpläne, Zertifizierungssysteme und Sicherheitsstandards befinden sich noch in frühen Entwicklungsstadien.
  - **Fehlende Fachkräfte:** Es mangelt an spezialisierten Arbeitskräften sowie an akademischen Ausbildungs- und Technikprogrammen für grünen Wasserstoff und grünen Ammoniak.
  - **Infrastrukturelle Einschränkungen:** Unzureichende Produktions-, Lager- und Transportkapazitäten für Ammoniak sowie nur wenige Abnahmevereinbarungen für grünen Wasserstoff.
  - **Hohe Investitionskosten und Risiken:** Beide stellen erhebliche Finanzierungsherausforderungen dar und schaffen Hürden für die Realisierbarkeit und großflächige Umsetzung von Projekten.

- **International collaboration and financing:** Some funding sources are available from German, European, multilateral and private instruments, including grants, concessional loans, guarantees and national incentives, such as tax holidays and free zone benefits. Leveraging such instruments will be essential in bridging financial gaps and fostering project viability.

BUSINESS OPPORTUNITIES FOR GERMAN SOLUTION PROVIDERS

Ghana presents German companies with a first-mover opportunity to shape its emerging green hydrogen and ammonia market. Such investments not only align with European Union (EU) sustainability objectives but also contribute to Ghana's broader industrialisation and decarbonisation agenda. Early entry will allow German developers to forge long-term partnerships, influence market policy and standards and position themselves at the forefront of Ghana's and West Africa's hydrogen economy. For Ghanaian stakeholders, collaboration with international investors offers a pathway to industrial diversification, fertiliser self-sufficiency, enhanced mining and chemical inputs for civil applications and low-carbon economic growth. Importantly, green hydrogen and ammonia development will also help Ghana achieve its Nationally Determined Contribution targets under the Paris Agreement, supporting the country's energy transition, climate resilience and food security goals.

CHALLENGES ON THE PATH TO A GREEN AMMONIA ECONOMY

Ghana faces critical policy, regulatory and economic challenges that constrain the development of its hydrogen and ammonia sectors. Key gaps include the absence of dedicated regulations, carbon pricing mechanisms and a cohesive governance framework to guide sector growth. On the economic front, high capital intensity, limited access to long-term

- **Integrationspotenzial:** Die industriellen Cluster Ghanas in Branchen wie Bergbau, Landwirtschaft, verarbeitendes Gewerbe und Petrochemie können zu frühen Anwendern von Lösungen für grünen Wasserstoff und grünen Ammoniak werden. Damit ließen sich sowohl die Aussicht auf die Dekarbonisierung als auch die Energiesicherheit verbessern und zugleich das Wirtschaftswachstum unterstützen.
- **Internationale Zusammenarbeit und Finanzierung:** Es stehen Finanzierungsquellen unter anderem in Deutschland und Europa sowie multilaterale und private Instrumente zur Verfügung, darunter Zuschüsse, zinsgünstige Kredite, Garantien und nationale Anreize wie Steuererleichterungen und Vorteile in Freihandelszonen. Die Nutzung dieser Instrumente wird entscheidend dafür sein, dass Finanzierungslücken geschlossen werden können und die Realisierbarkeit von Projekten gefördert werden kann.

GESCHÄFTSCHANCEN FÜR DEUTSCHE LÖSUNGSANBIETER

Ghana bietet deutschen Unternehmen die Möglichkeit, als First Mover den entstehenden Markt für grünen Wasserstoff und Ammoniak mitzugestalten. Solche Investitionen stehen nicht nur im Einklang mit den Nachhaltigkeitszielen der Europäischen Union (EU), sondern stehen auch im Einklang mit den übergeordneten Industrialisierungs- und Dekarbonisierungszielen der ghanaischen Regierung. Ein früher Markteintritt ermöglicht es deutschen Entwicklern, langfristige Partnerschaften aufzubauen, Einfluss auf Marktpolitik und Standards zu nehmen und sich an die Spitze der Wasserstoffwirtschaft in Ghana und Westafrika zu setzen.

Ghanaischen Akteuren eröffnet die Zusammenarbeit mit internationalen Investoren Wege hin zur industriellen Diversifizierung, zur Eigenoff-take agreements and demand uncertainties continue to undermine investor confidence. These barriers are compounded by resource and infrastructure constraints, such as competition for water needed in electrolysis, insufficient storage and transportation facilities and power grid limitations that hinder large-scale deployment. Additionally, Ghana's relatively modest domestic fertiliser market and strong competition from established global exporters underscore the need for strategic regional market integration and infrastructure development. Overcoming these interlinked technical, financial and institutional barriers will require coordinated policies, innovative financing mechanisms and targeted infrastructure investments. This will be essential in enabling Ghana to position itself as a competitive player in green ammonia production while advancing its broader clean energy transition and industrial decarbonisation objectives.

WHY GHANA MATTERS FOR GREEN AMMONIA

Ghana is poised to play a pivotal role in the future of green ammonia development, underpinned by its abundant renewable energy sources, particularly solar and hydropower, which will facilitate future cost-competitive production of green hydrogen, the critical input for green ammonia synthesis. Key strategic sectors, including agriculture, mining and steel manufacturing, are expected to drive substantial demand for green hydrogen and ammonia, enabling the country to reduce its reliance on imports, advance industrial decarbonisation and strengthen national food security. Furthermore, Ghana's advantageous geographic position on Atlantic shipping lanes creates significant opportunities for export to neighbouring countries.

versorgung mit Düngemitteln, zu verbesserten Inputs für den Bergbau und die chemische Industrie im zivilen Bereich sowie zu einem CO_2-armen Wirtschaftswachstum. Von zentraler Bedeutung ist zudem, dass die Entwicklung grünen Wasserstoffs und grünen Ammoniaks Ghana dabei unterstützt, seine im Rahmen des Pariser Abkommens festgelegten nationalen Klimabeiträge (NDCs) zu erreichen und somit die nationale Energiewende, Klimaanpassung und Ernährungssicherheit zu fördern.

HERAUSFORDERUNGEN AUF DEM WEG ZUR GRÜNEN AMMONIAKWIRTSCHAFT

Ghana steht vor großen politischen, regulatorischen und wirtschaftlichen Herausforderungen, die die Entwicklung seiner Wasserstoff- und Ammoniaksektoren einschränken. Zentrale Defizite sind das Fehlen von spezifischen Regulierungen, Mechanismen für die CO_2-Bepreisung und einem kohärenten Governance-Rahmen für den Ausbau des Sektors.

Auf wirtschaftlicher Ebene untergraben die hohe Kapitalintensität, der eingeschränkte Zugang zu langfristigen Abnahmevereinbarungen sowie Nachfragerisiken weiterhin das Vertrauen von Investoren. Diese Hürden werden durch Ressourcen- und Infrastrukturengpässe verschärft – etwa den Wettbewerb um Wasser für die Elektrolyse, unzureichende Lager- und Transportkapazitäten sowie Einschränkungen im Stromnetz, die den großflächigen Ausbau behindern. Darüber hinaus verdeutlichen sowohl der relativ kleine heimische Düngemittelmarkt als auch der starke Wettbewerb durch etablierte globale Exporteure die Notwendigkeit einer strategischen regionalen Marktintegration und eines gezielten Infrastrukturausbaus.

Die Überwindung dieser miteinander verflochtenen technischen, finanziellen und institutionellen Barrieren erfordert koordinierte politische

Maßnahmen, innovative Finanzierungsmechanismen und gezielte Investitionen in die Infrastruktur. Nur so kann Ghana sich als wettbewerbsfähiger Akteur in der Produktion grünen Ammoniaks positionieren und zugleich seine umfassenderen Ziele für die Energiewende und die industrielle Dekarbonisierung vorantreiben.

WARUM GHANA FÜR GRÜNEN AMMONIAK VON BEDEUTUNG IST

Ghana kann eine Schlüsselrolle in der zukünftigen Entwicklung grünen Ammoniaks einzunehmen. Grundlage dessen sind die reichlich vorhandenen Quellen für erneuerbare Energie, insbesondere Solar und Wasserkraft, die eine künftig wettbewerbsfähige Produktion grünen Wasserstoffs, dem Ausgangsstoff, der für die Synthese grünen Ammoniaks entscheidend ist, ermöglichen.

Wichtige strategische Sektoren wie Landwirtschaft, Bergbau und Stahlproduktion werden die Nachfrage nach grünem Wasserstoff und Ammoniak erheblich antreiben. Damit kann das Land seine Abhängigkeit von Importen verringern, die industrielle Dekarbonisierung vorantreiben und die nationale Ernährungssicherheit stärken. Darüber hinaus eröffnet Ghanas vorteilhafte geografische Lage nahe den atlantischen Schifffahrtsrouten bedeutende Exportmöglichkeiten in die Nachbarländer.

1

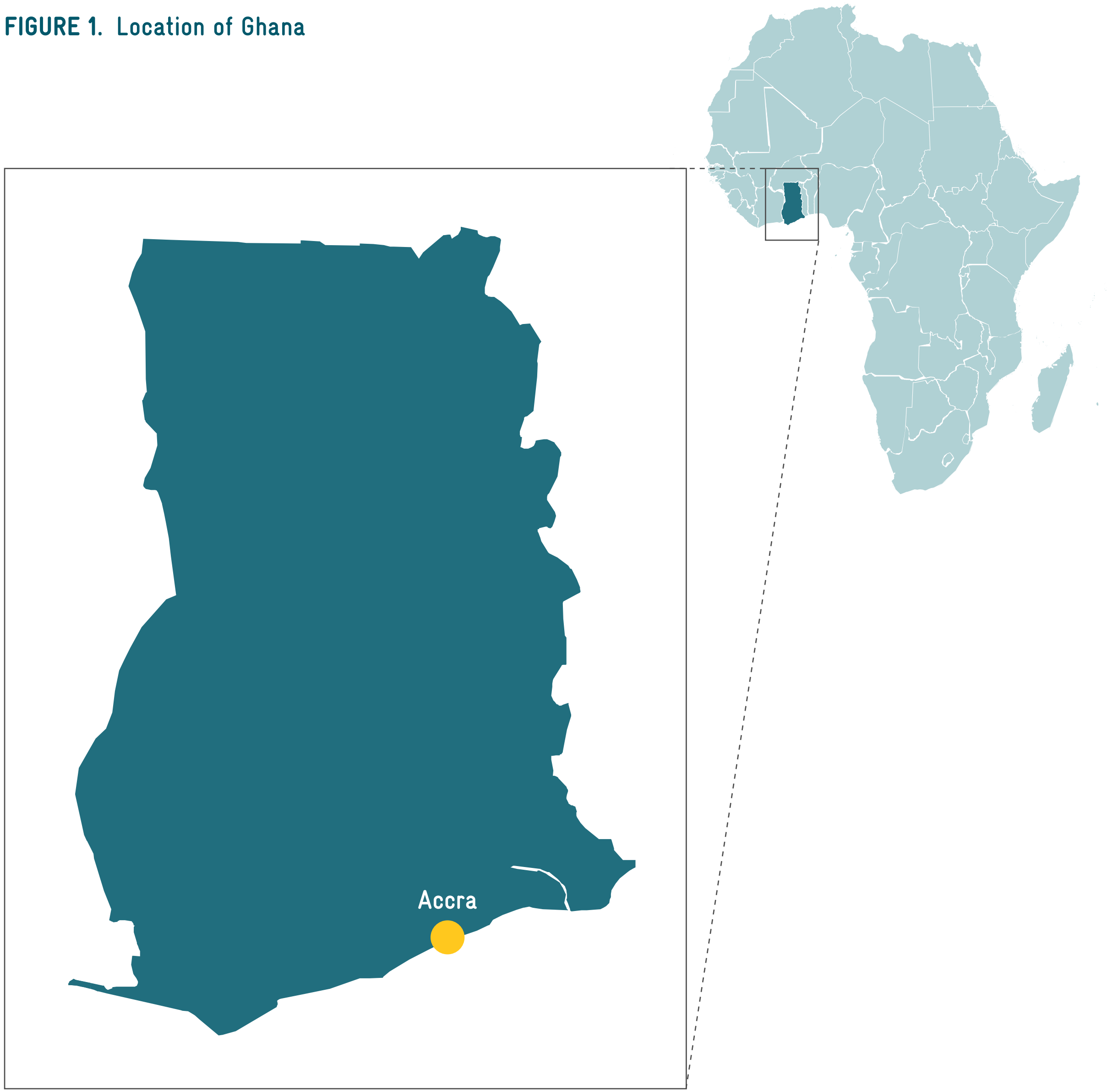
Ghana: Brief overview

1.1 General country information

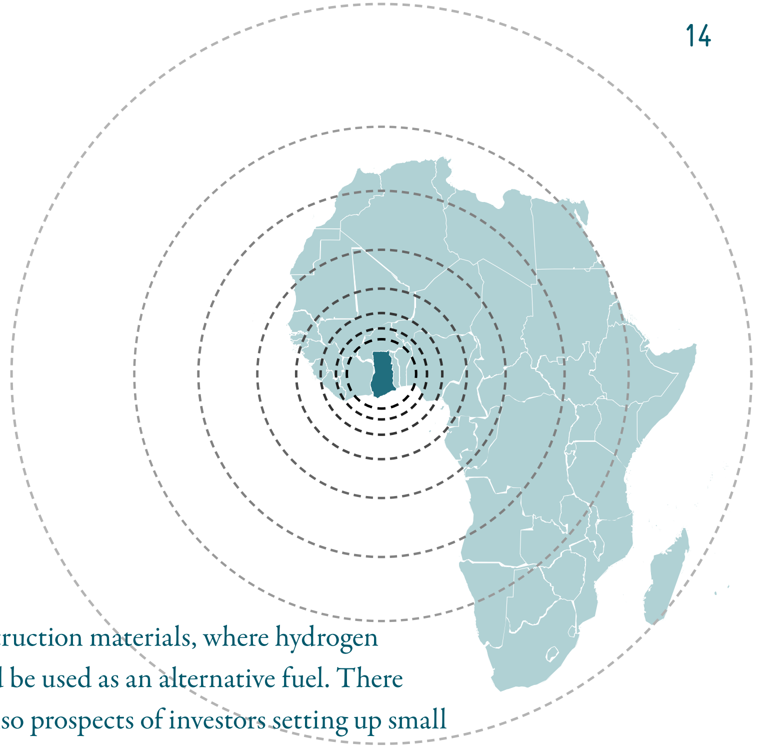
Ghana, officially the Republic of Ghana, is a West African country bordering Côte d'Ivoire, Burkina Faso and Togo, and the Gulf of Guinea to the south. It is known for being the first sub-Saharan African country to gain independence in 1957. Ghana has a diverse landscape, ranging from coastal savannas to tropical rainforests, and a population of around 35.1 million (Worldometer, 2025). The capital and largest city is Accra. Ghana is recognised for the strides it has made towards democracy and enjoys a high degree of media freedom.

Ghana's economy is driven by a diverse range of sectors, with agriculture, mining and services being the most prominent. Ghana is a major producer of gold, cocoa and oil, and these resources significantly contribute to export earnings and overall economic growth. The services sector, including information and communication, finance and tourism, also plays a vital role in the country's economy. The country's main imports include mineral fuels and oils, machinery, vehicles, fertilisers and foodstuffs. Specifically, refined petroleum, cars and rubber footwear are the most imported products. China, the Netherlands, India and the United States are among Ghana's top import partners. Its main exports include gold, crude petroleum, cocoa beans, manganese ore, cashew nuts and tuna.

FIGURE 1. Location of Ghana



Source: Sector Analysis Ghana (GIZ, 2023)



1.2 Economic development

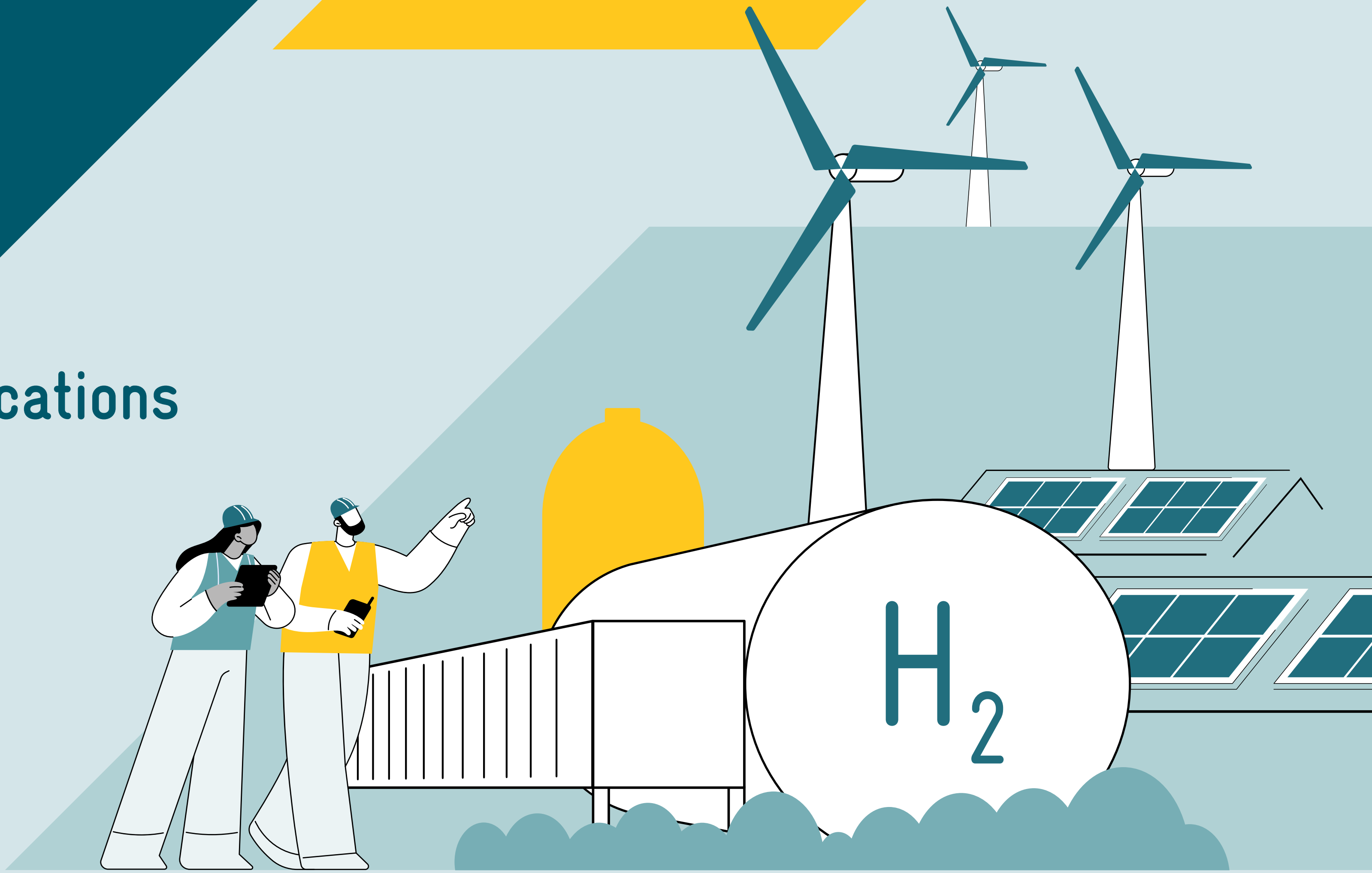
In 2024, Ghana's gross domestic product (GDP) growth exceeded expectations, reaching 5.7%, a significant improvement on the 3.1% recorded in 2023. This expansion was driven by the industrial sector, which grew by 7.1% year on year, thanks to strong growth in the extractive industry (mainly mining) and construction (World Bank, 2025a) .

The outlook for the sectors identified as being linked with the consumption of hydrogen and ammonia and its derivatives is outlined below:

- **Agriculture** is an important sector, with about 136,000 km^2 (approximately 57%) of the country's total land area (238,539 km^2), classified as 'agricultural'. About 50% of this agricultural land is under cultivation, and around 1% is under irrigation (GIPC, 2022). Ghana, like other parts of Africa, has failed to meet its food and nutrition security needs. Successive governments have, however, pursued various national agendas to remedy the situation. In Ghana, the food crops subsector is dominated by smallholder farmers whose cropping practices are characterised by inadequate use of productivity-enhancing technologies, low use of quality seeds and fertilisers and weak market linkages. The sector is projected to **grow at 7.01% CAGR**, reaching a market size of USD 21.30 billion by 2030. This trend is driven by factors such as strong population growth, sustained urbanisation and government investment in mechanisation, irrigation and infrastructure (MI, 2025) and indicates a potential increase in demand for fertilisers.
- The **mining and quarrying industry is poised for moderate-to-strong growth (5%–6% CAGR)** through 2030, anchored by gold expansion, diversification into lithium and policy stability (AMM, 2025). This projected growth can be attributed to the country's rich mineral resources, favourable mining regulations, political stability and investment opportunities in the gold sector. It is important to note that growth in the mining industry means high consumption of ammonium nitrate, the main ingredient in the production of explosives for civil use.
- The **manufacturing industry** in Ghana is expected to achieve **moderate-to-strong growth (~5%–6% CAGR)** from 2025 to 2030, anchored by automotive investments, agro-processing and infrastructure upgrades (Trading Economics, 2025b). The African Continental Free Trade Area (AfCFTA) is expected to boost Ghana's manufacturing output as well. There are several opportunities, including the production of chemicals, pharmaceuticals, green sponge iron and steel, and construction materials, where hydrogen could be used as an alternative fuel. There are also prospects of investors setting up small and medium-sized chemical plants to process ammonia into different products, including nitric acid, hydrazine, cyanide, ammonium hydroxide, phosphine, arsine, stibine, bismuthine and amino acids, among others.
- The **oil and gas sector** is a buyer of hydrogen and ammonia. The sector is poised for **moderate growth (5%–7% CAGR)** through 2030, anchored by offshore developments, gas monetisation and infrastructure investments (6Wresearch, 2025b). The discovery made at the Pecan Oil Field of estimated reserves of between 450 and 550 million barrels of oil equivalent (MoF, 2019), should improve the industry's growth outlook and eventually increase its ammonia and hydrogen requirements.

2

Hydrogen applications



2.1 Hydrogen production methods

Hydrogen can be produced through different processes according to the energy source and technology used, as summarised in Table 1. The hydrogen used to cover current demand comes almost exclusively from processing fossil fuels (natural gas and coal) in methane reforming and coal gasification (GIZ, 2025).

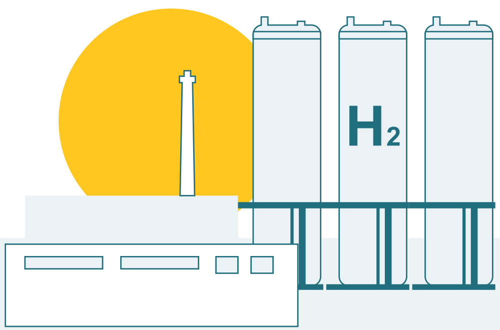
Hydrogen can also be produced as a by-product in refineries and petrochemical and chlor-alkali processes. The main products that generate hydrogen as a by-product are listed in Table 2 (adapted from (GIZ, 2025).

TABLE 1. Hydrogen production methods

Source: Sector Analysis Nigeria (GIZ, 2025)

Production process	Energy source	Technology options	Products	CO_2 emissions
Methane reforming	Natural gas	Steam methane reforming	H_2, CO, CO_2, N_2	High CO_2 emissions
		Autothermal reforming		Potential combination with CCS to reduce CO_2 emissions
Coal gasification	Coal	Gasification/reaction with O_2 and steam at high pressure and temperatures	H_2, CO, CO_2, N_2	
Methane pyrolysis	Natural gas	Thermal decomposition at high temperatures without O_2	H_2, CO, CO_2	
Biomass gasification	Biomass	Heating with limited oxygen	H_2, CO, CO_2	Low to no CO_2 emissions
Electrolysis	Electricity	Electrolysis (AEC, PEMEC, SOEC, AEMEC)	H_2, O_2	CO_2 emissions depend on electricity source
				Low to none for renewable energy sources

CCS	Carbon capture and storage
AEC	Alkaline electrolysis cell
PEMEC	Proton exchange membrane electrolysis cell
SOEC	Solid oxide electrolysis cell
AEMEC	Anion exchange membrane electrolysis cell



2.2 Hydrogen uses

Hydrogen is a key component of the global energy and industrial landscape, with similar applications worldwide. Current uses include:

1. **Refining:** Hydrocracking, hydrotreating and desulphurisation
2. **Ammonia:** Fertiliser production, chemical production (e.g. nitric acid, amines, explosives) and refrigeration
3. **Methanol:** Fuel (methyl tertiary butyl ether – MTBE), solvent, antifreeze and chemical feedstock (e.g. formaldehyde, acetic acid)
4. **Chemical industry:** Oxo alcohols, fatty alcohols, hydrogen peroxide, (H_2O_2), cyclohexane (C_6H_{12}), hydrochloric acid (HCl), caprolactam, phenol production, acetone production via hydrogenation of isopropyl alcohol, 1,4-butanediol (BDO), fine chemicals and pharmaceuticals used as reducing agents, etc.
5. **Iron and steel:** Used as a reducing agent in direct reduced iron (DRI) production and as a reducing atmosphere in annealing processes in steel roll mills
6. **Glass:** Used as a reducing agent in glass melting to improve quality, in specialty glasses to control optical properties and as an alternative fuel or in furnaces to replace natural gas, for example
7. **Electronics:** Chemical vapour deposition, mainly for semiconductor manufacturing and light emitting diode (LED) production, and as a reducing agent
8. **Food industry:** Hydrogenation of oils (fats) and fatty acids
9. **Metal processing:** Employed in a pure state or in a mixture as a shielding gas for welding processes

Emerging uses of hydrogen include aerospace, where it is used as a propellant, and energy storage for balancing renewable energy supply and demand. In Ghana and other West African countries where the power grid has become expensive to install and maintain and has contributed to the increased cost of power, on-site power systems are expected to flourish in the coming years. In such a situation, if hydrogen systems are cheaper than battery systems, they could become a common feature going forward, which would benefit the hydrogen market immensely.

It is expected that green hydrogen will play a key role in the energy transition. This will include the replacement of current hydrogen demand, for example, by green hydrogen produced via electrolysis (as shown in Figure 2) but also new areas of use such as mobility (road, air and maritime transport), electricity generation, production of synthetic fuels (e-fuels)

TABLE 2. Hydrogen as a by-product

Final product	Typical use of hydrogen by-product	Specific hydrogen generation
Ethylene	On site as feedstock for other processes	190 Nm^3 H_2/tonne ethylene
		(11 kg H_2/tonne ethylene)
Styrene		220 Nm^3 H_2/tonne styrene
		(20 kg H_2/tonne styrene)
Chlorine (via chlor-alkali process)	Fuel for heat boilers and/or combined heat and power units	270–300 Nm^3 H_2/tonne chlorine
		(24–27 kg H_2/tonne chlorine)
	On site as feedstock for other processes (e.g. the production of hydrochloric acid)	
Acetylene	On site as feedstock for other processes	3,400–3,740 Nm^3 H_2/tonne acetylene
		(305–336 kg H_2/tonne acetylene)
Cyanide		2,470 Nm^3 H_2/tonne cyanide
		(222 kg H_2/tonne cyanide)

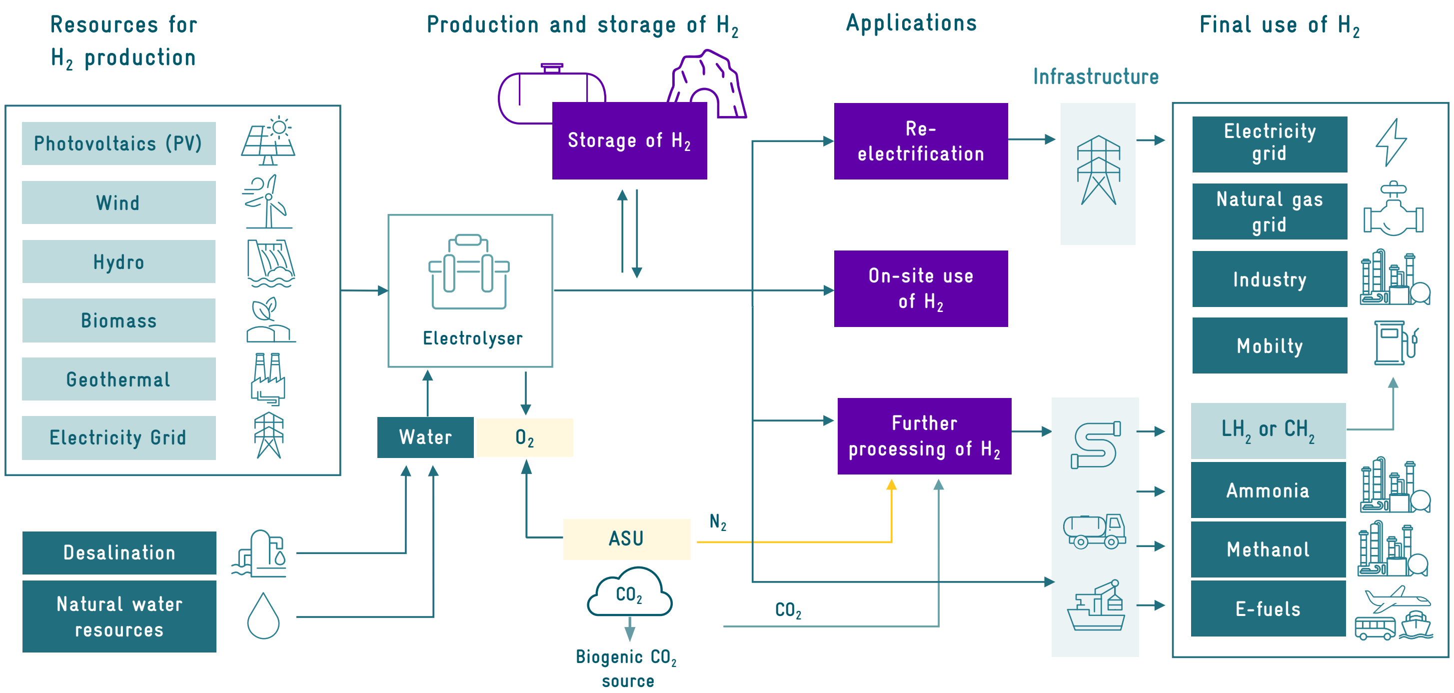
Source: Sector Analysis Nigeria (GIZ, 2025) and high-temperature heat generation, among others (GIZ, 2025). The switch from conventional production processes to electrolysis for hydrogen generation will require additional feedstocks for derivatives production, including a nitrogen source for ammonia production and a sustainable CO_2 source for methanol and synthetic fuel production.

These applications provide an initial indication of how green hydrogen might be used in the future. Which applications gain traction will largely depend on possible alternative technologies with which hydrogen will have to compete, on national and international decarbonisation targets and commitments and on available energy sources in individual countries.

Furthermore, the production of hydrogen by electrolysis generates 8 kg of oxygen per kg of hydrogen as a by-product. Some typical applications for high-purity liquefied oxygen include water treatment, medical care and industry (metallurgy, pulp and paper, chemicals, etc.). Nonetheless, taking into consideration that current technologies for oxygen production, such as air separation units (ASUs) and pressure swing absorption (PSA), are mature, easily scalable and applicable to on-site oxygen generation, the economically feasible use of oxygen generated by electrolysis is quite restricted and very location-dependent (GIZ, 2025).

FIGURE 2. Potential applications of green hydrogen

Source: Sector Analysis Nigeria (GIZ, 2025)



Storage: In tanks or geological.

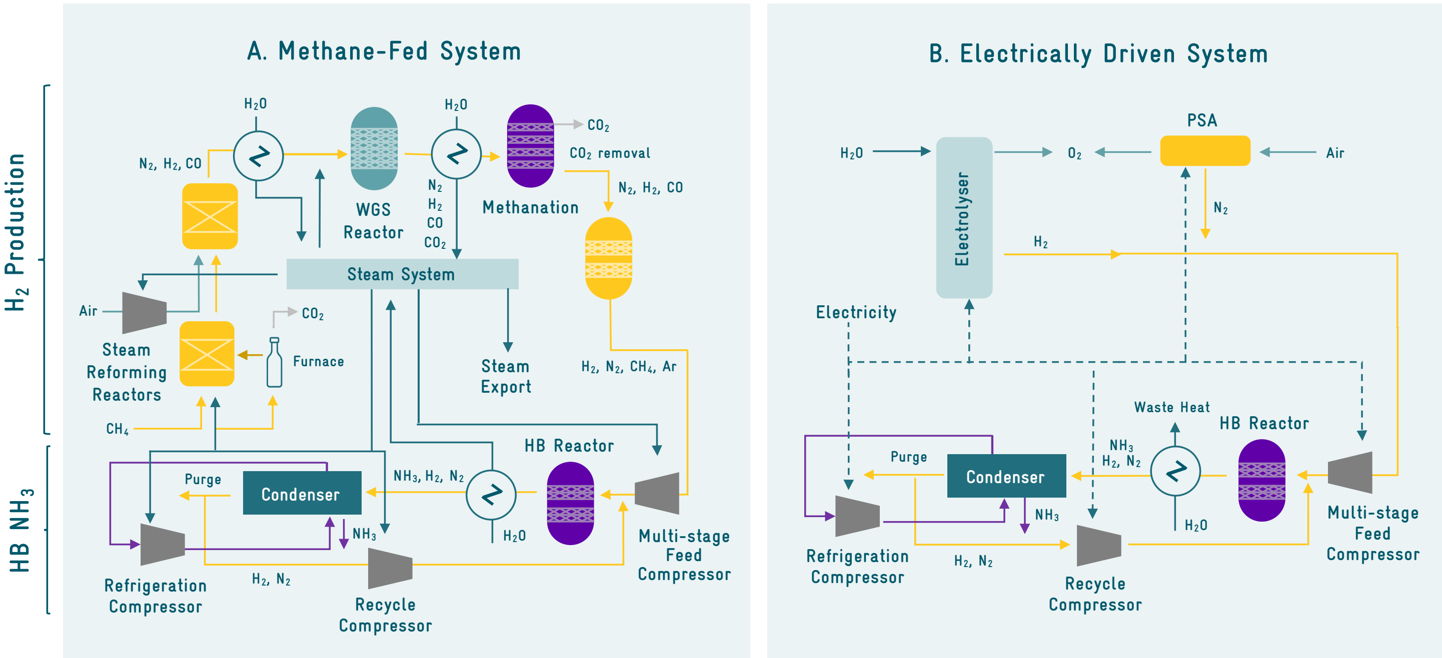
H_2	Hydrogen
LH_2	Liquefied hydrogen
CH_2	Compressed hydrogen
ASU	Air separation unit

2.3 Ammonia – the most common hydrogen downstream product

Ammonia production is the second largest current use of hydrogen, accounting for 33% of total hydrogen demand (Yakubson, 2022). Ammonia is a key precursor in the industry and is mainly used for nitrogen-based fertilisers (around 70%–80%) and other industrial applications, such as plastics and explosives production (Driscoll, Salmon, & Bañares-Alcántara, 2023). Ammonia is synthesised via the Haber–Bosch (HB) process, in which hydrogen (H_2) reacts with nitrogen (N_2) to form ammonia (NH_3) under high pressures and at high temperatures (Ribeiro & Santos, 2025). Figure 3 shows a schematic of the conventional HB process as well as a green hydrogen-based process. Conventional ammonia production is based on steam methane reforming, which involves using steam and nitrogen from the air. For the green ammonia option, an external source of nitrogen is required (i.e. from air through an ASU), and the compressors that are steam-driven in the conventional process are mainly electrically driven. Little to no steam is used in this green ammonia production process.

FIGURE 3. Schematic of a conventional (A) and green (B) HB process

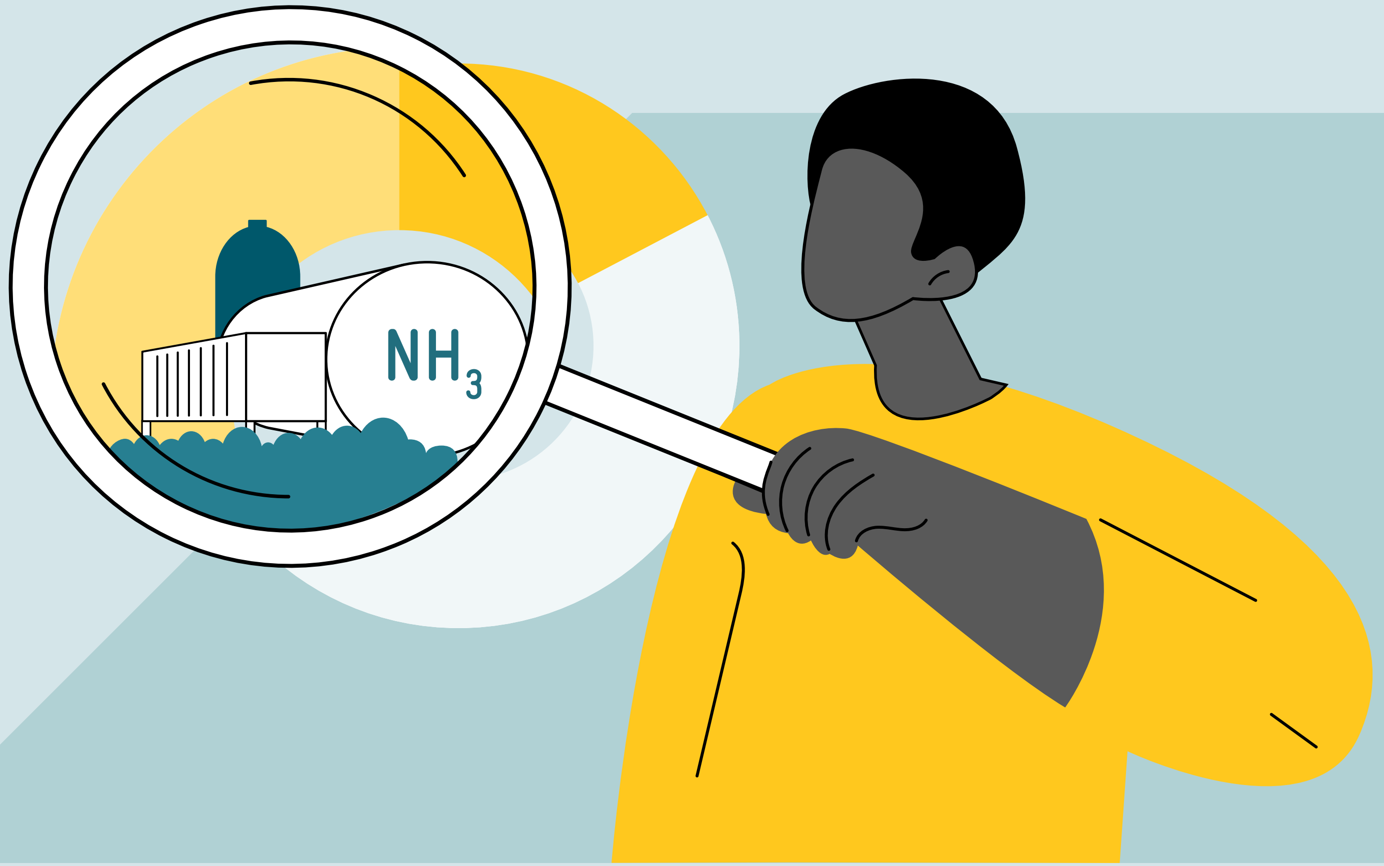
Source: Sector Analysis Nigeria (GIZ, 2025)



Ammonia is a key ingredient in nitrogen fertilisers and, as such, critical for crop growth. It is important to note that the production processes for some fertilisers require a carbon source, which needs to be sustainable in order to obtain green fertilisers. For example, the synthesis of urea is carried out by feeding gaseous ammonia (NH_3) and carbon dioxide (CO_2) into a reactor at high pressure (14 MPa or 140 bar) and temperature (170–190 °C). There are projects currently being studied by Rikair, a major oxygen producer in Ghana, to capture CO_2 from power plants. There could be linkages with these projects going forward.

3

The Ghanaian ammonia market



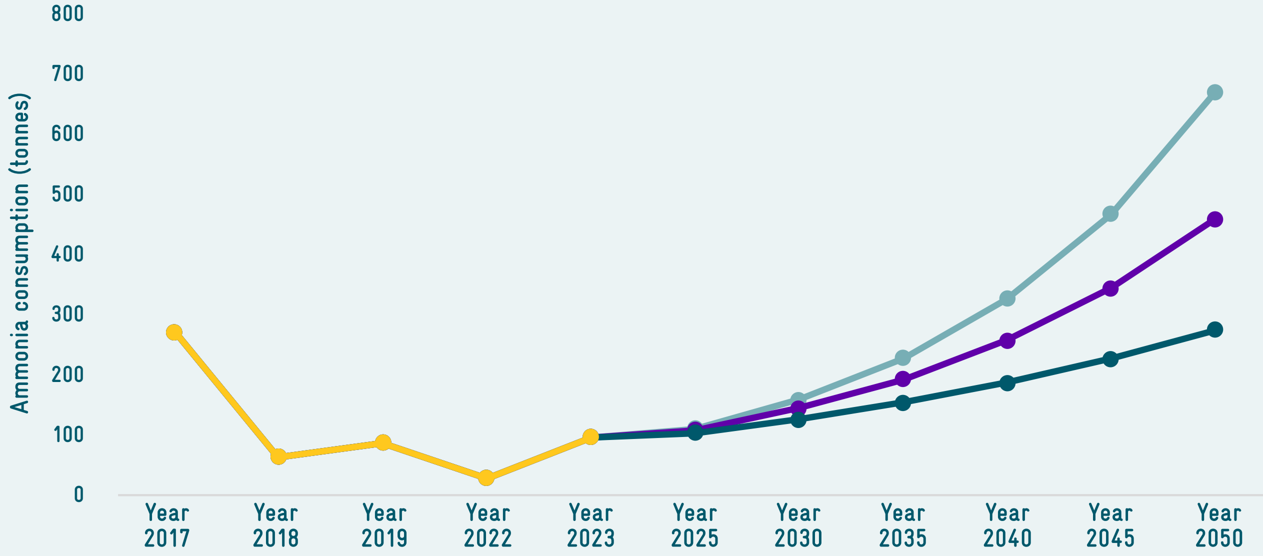
Hydrogen in Ghana is currently consumed primarily in the form of ammonia-based fertilisers and explosives, and small amounts are used for some other industrial applications. At present, Ghana relies entirely on imports to meet its demand for hydrogen and hydrogen-derived products, due to the absence of domestic production facilities.

3.1 Ammonia

Figure 4 shows the growth of ammonia consumption, considering different growth scenarios, based on historic import data from the database of the Ghana Revenue Authority Customs Division (GRA-CD) and from the Sector Analysis – Ghana (GIZ, 2023).

FIGURE 4. Ammonia consumption (tonnes)

Source: Authors' own compilation, Blue Alliance (2025)



MAIN ASSUMPTIONS

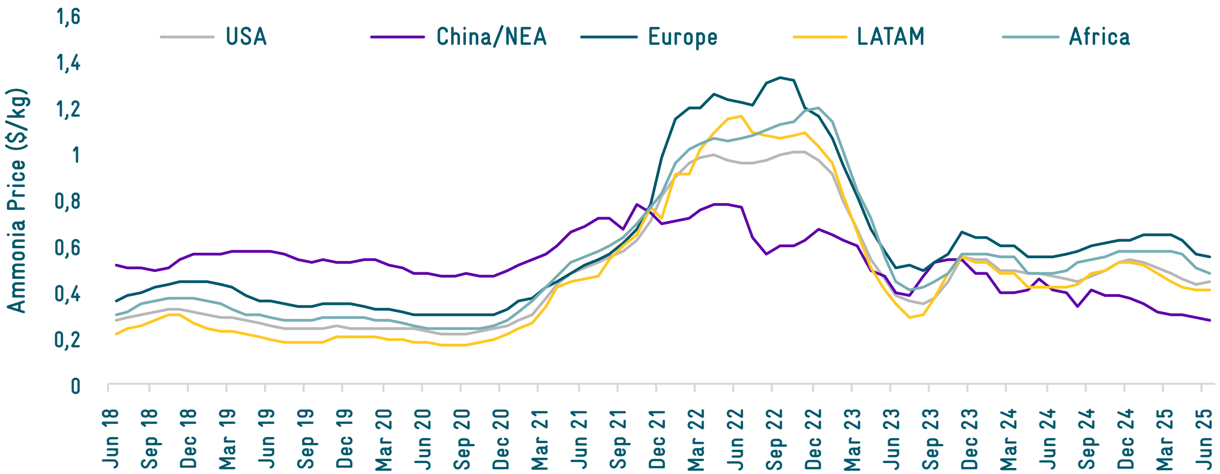
Very optimistic scenario: If absorption refrigeration and other uses of ammonia as a major refrigerant grow and structural reforms succeed, with the resulting reduction in price per kg, then an additional 1.5% is estimated over the optimistic manufacturing sector growth scenario.

Optimistic scenario: 5%–6% growth scenario for the manufacturing sector. This scenario is expected to be achievable with energy sector reforms, enhanced access to credit by small and medium-sized enterprises (SMEs) and improved technology adoption in manufacturing in general and in agro-processing and textiles in particular.

Baseline scenario: 3%–4% average growth is estimated if current challenges persist.

FIGURE 5. Ammonia FOB Price/Kg across regions

Source: Ammonia price index (Business Analytiq, 2025a)



3.2 Fertilisers

At present, there is no primary production of inorganic fertilisers in Ghana. They are imported as compound fertilisers and in bulk. The bulk fertilisers are blended into various formulations and distributed through a network of distributors and retail agro-dealers.

Six of the major importing companies, namely Yara Ghana, Chemico Limited, Solevo (formerly Louis Dreyfus Company Ghana), OmniFert, GloFert and Agricultural Manufacturing Group (AMG), have invested in blending plants that allow them to create different fertiliser formulations. All blending plants are located in the southern part of the country, close to the point of entry. Yara, Chemico and AMG are located in the port city of Tema, Solevo is in Kpong (about 53.5 km from Tema) and OmniFert is located in Dawhenya (about 3.8 km from Tema), while GloFert is further away in Teacher Mantey (about 72.7 km from Tema).

A small percentage of organic fertilisers are produced locally by the Accra Compost and Recycling Plant (ACARP), Safisana, Jekora Ventures, Farmers Hope Company Ltd., etc. Carmeuse Lime Products Gh Ltd, a lime producing company located in Takoradi, started producing agricultural lime in 2020.

3.2.1 Current consumption patterns

Ammonia-based fertilisers (including urea) accounted for 29% of all fertilisers consumed in the period 2020–2024. Consumption fluctuated significantly, dropping sharply to 46,362 tonnes in 2021 and peaking in 2022 at 147,934 tonnes. Consumption fell to 101,504 tonnes in 2024, which can be attributed to the COVID pandemic and commodity price shocks after the start of the Russia–Ukraine war.

TABLE 3. Historical trends for common fertiliser consumption in Ghana (tonnes)

Product	2020	2021	2022	2023	2024	%
Ammonia-based fertiliser (incl. urea)	191,862	46,362	147,934	104,396	101,504	29%
NPK	299,422	152,012	272,106	133,249	264,898	55%
Other fertilisers	127,342	40,332	81,041	54,703	12,669	16%
	618,625	238,705	501,081	292,349	379,071	100%

Source: Authors' own compilation, Blue Alliance (2025)

The most widely used ammonia-based fertilisers in Ghana are urea and ammonium sulphate. The reasons for this are outlined in the following figure.

FIGURE 6. Reasons for the predominance of urea and ammonium sulphate in Ghana

Source: Authors' own compilation, Blue Alliance (2025)

HIGH DEMAND FOR NITROGEN IN KEY CROPS

Nitrogen is a critical nutrient for staple and cash crops in Ghana, such as maize, rice and vegetables. Ammonia-based fertilisers, such as ammonium sulphate and urea, provide readily available nitrogen, which is essential for plant growth and yield enhancement (GMI Research, 2024).

SUITABILITY FOR SOIL CONDITIONS

Many soils in Ghana suffer from nutrient depletion, particularly nitrogen, due to intensive farming and erosion. Ammonia-based fertilisers help replenish nitrogen efficiently, especially in regions with high crop turnover (Ornella & Fan, 2024). The acidic nature of some Ghanaian soils also makes ammonia fertilisers preferable, as they can be more stable than nitrate-based alternatives under certain pH conditions.

GOVERNMENT SUBSIDIES AND IMPORT TRENDS

Historically, Ghana's fertiliser market has been dominated by imports, with NPK blends and ammonia-based fertilisers being the most common. Government programmes, such as Planting for Food and Jobs, have subsidised these fertilisers to promote agricultural productivity (GMI Research, 2024).

CROP-SPECIFIC PREFERENCES

Cash crops such as oil palm and cotton rely heavily on nitrogen for growth. For instance, ammonium sulphate is widely used in cotton farming, while urea is applied in maize and rice cultivation. Even in cocoa farming, where fertiliser use was traditionally low, new formulations such as Asase Wura (which includes ammonia-based nutrients) are being introduced to boost yields.

COST AND AVAILABILITY

Ammonia-based fertilisers, such as urea, are relatively cost-effective compared to specialised blends, making them accessible to smallholder farmers who dominate Ghana's agricultural sector (GMI Research, 2024). The depreciation of the Ghanaian cedi and high import costs also push farmers towards affordable nitrogen sources, with urea and ammonium sulphate being more readily available than complex formulations.

LACK OF DOMESTIC PRODUCTION OPTIONS

Ghana does not produce fertilisers domestically and relies entirely on imports. Ammonia-based fertilisers are easier to procure in bulk from international markets than more specialised products. Efforts to establish local production are still in progress, so that imports remain the primary source of supply (Ornella & Fan, 2024).

3.2.2 Fertiliser market development

Figures for recommended ammonia-based fertiliser application by area harvested and type of crop reveal that barely a tenth of the potential market is currently being served, as can be seen in Table 4.

Figure 7 shows growth projections for fertiliser imports, considering different scenarios and based on the GRA-CD database.

Fluctuations in the domestic fertiliser market are attributed to geopolitical factors (e.g. China's export restrictions on phosphate and nitrogen fertilisers), logistical issues (e.g. port congestion in Iran and West Africa), which further strain supply consistency and pricing (Green Gubre, 2025d) and the absence of local fertiliser production, which has left Ghana vulnerable to international commodity price shocks.

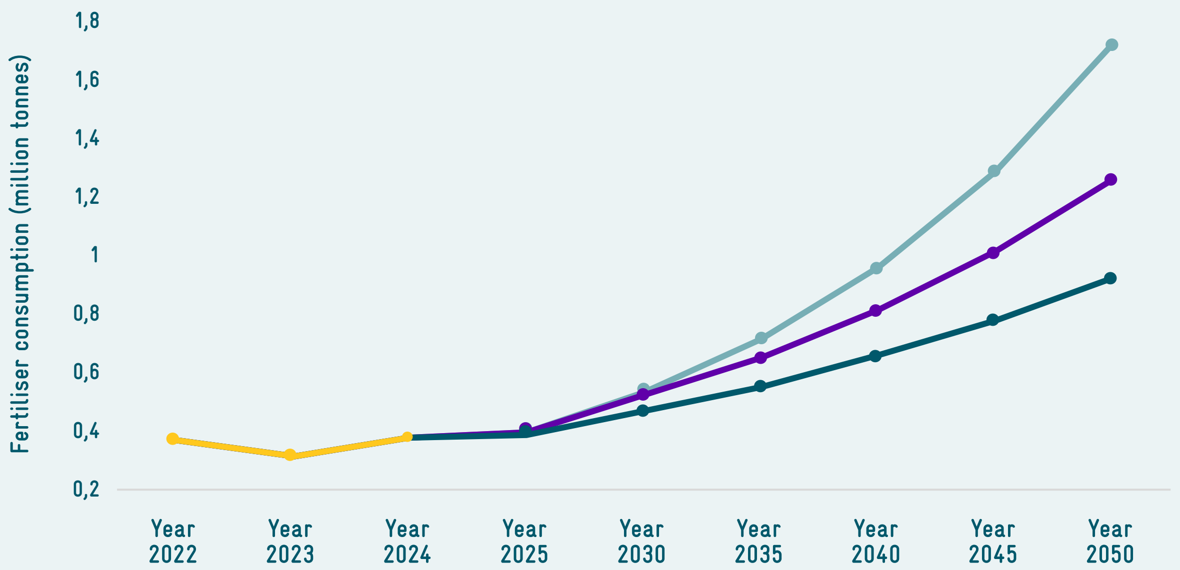
TABLE 4. Estimated potential fertiliser market size in Ghana

Crop	Average area harvested annually	Ammonia-based fertiliser (kg/ha)	Market size (tonnes)
Cassava	1,047,748	187.5	196,453
Maize	1,241,000	500.0	620,500
Cocoa	1,455,707	136.0	197,976
Rice	332,000	500.0	166,000
Other (average)	1,337,235	181.9	303,592
Total			**1,484,521**

Source: Authors' own compilation, Blue Alliance (2025)

FIGURE 7. Fertiliser consumption (million tonnes)

Source: Authors' own compilation, Blue Alliance (2025)



MAIN ASSUMPTIONS

Very optimistic scenario: If the adoption of climate smart technologies, value chain development to reduce post-harvest losses and efforts to improve market access are successful, then an additional 1% consumption is estimated under the very optimistic scenario.

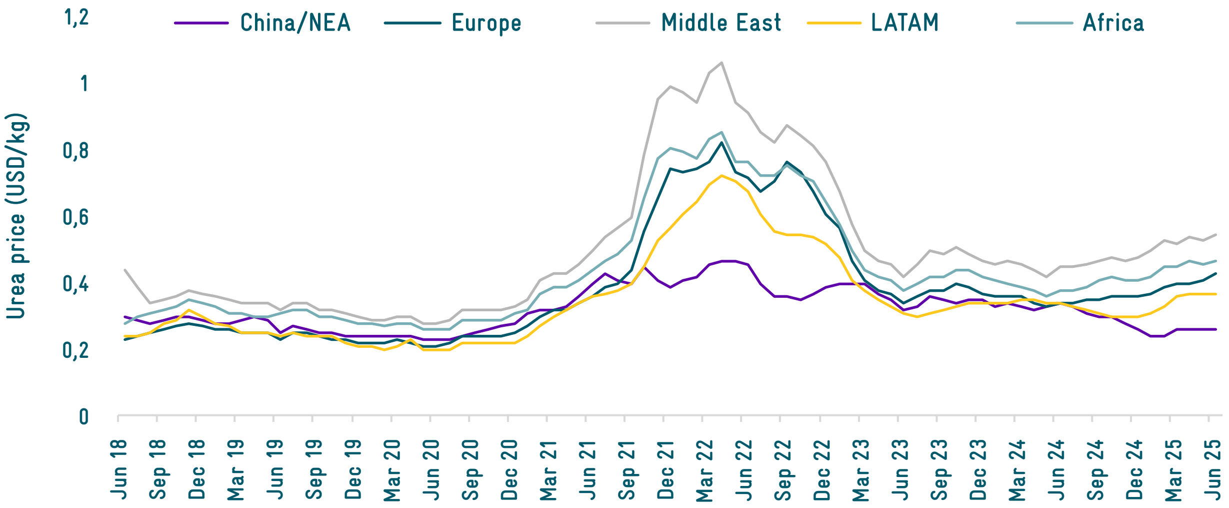
Optimistic scenario: 5.5% growth is projected if the roll-out of irrigation schemes, technology adoption to boost yields and agro-processing scaling to capture more value from exports are successful.

Baseline scenario: 3.5% growth is projected if current challenges persist with rising urban population.

3.2.3 Fertiliser prices

FIGURE 8. Urea FOB price trends

Source: Urea ammonium nitrate (UAN) price index (Business Analytiq, 2025f)



3.2.4 Fertiliser cost structure

The fertiliser cost structure is made up of international and domestic costs.

Import cost is determined by the international FOB price, and domestic costs are influenced mainly by infrastructure, policies and macroeconomic conditions. It is important to note that FOB prices are generally determined by global energy prices. The FOB price trend for urea is shown in Figure 8. A breakdown of the cost of importing urea into Ghana is provided in Table 5.

TABLE 5. Cost of importing urea at Tema Port

Source: Authors' own compilation, Blue Alliance (2025)

Importer costs and charges	USD/tonne	Added costs (USD/tonne)	Share of cost (%)
FOB	435.00	435.00	70.88%
Cost, insurance and freight (CIF)	475.01	40.01	6.52%
Total taxes, tariffs and levies	507.71	32.70	5.33%
Port charges	568.43	60.72	9.89%
Total forwarding fees	569.98	1.56	0.25%
Free on truck (FOT) cost at Tema Port	577.92	7.94	1.29%
Bagging	613.73	35.81	5.83%
Total FOT bagged at Tema Port	613.73	613.73	

3.2.5 Fertiliser price variations in Ghana

Ghana's fertiliser market exhibits notable regional price disparities, influenced by factors such as subsidy distribution, transportation costs, local blending capacity and demand patterns. These variations and their drivers are explained below.

1. **Differences between northern and southern Ghana:** Contrary to what might be expected, fertiliser prices are lower in northern Ghana than in the south, despite the north's harsher climate and higher transportation costs from import hubs in the south. The higher prices in southern Ghana are attributed to commercial market dynamics, including greater demand for diversified blends (e.g. crop-specific NPK) and less reliance on subsidies. The lower prices in northern Ghana may stem from a higher concentration of subsidies (80% of fertilisers are subsidised) and government programmes, such as Planting for Food and Jobs, which prioritise staple crop zones (Migwe-Kagume, Avatim, & Fincham, 2021).

2. **Key drivers of regional differences:** The key drivers of regional differences include:

    - **Subsidy allocation:** Subsidised fertilisers (e.g. urea, NPK) are distributed at fixed prices nationwide, but leakage (resale or smuggling) and timing gaps cause regional price fluctuations (Migwe-Kagume, Avatim, & Fincham, 2021)
    - **Transportation and logistics:** Southern ports (e.g. Tema) handle most imports, but poor rural infrastructure in the north increases costs for commercial suppliers, which are usually offset by subsidies
    - **Climate and demand:** The north's single rainy season concentrates demand, while the south's dual seasons spread purchases, affecting price volatility

3. **International and local market influences:** International and local market influences on price differences include:

    - **Global prices:** The rising cost of urea (6.6% year-on-year increase in the first quarter of 2025) and phosphate (driven by China's export restrictions) disproportionately affects commercial markets in the south, where unsubsidised prices align with global trends (Leconte-Demarsy & Rice, 2025)
    - **Organic alternatives:** Southern horticulture sectors use pricier organic fertilisers (e.g. microbial blends), while the north relies on cheaper subsidised synthetics (Renub Research, 2025)

4. **Data transparency challenges:** Ghana's Fertilizer Dashboard, developed by the Visualizing Insights on Fertilizer for African Agriculture (VIFAA) programme, highlights these disparities but notes inconsistent data on cross-regional smuggling and actual farmer purchase prices (Avatim, Migwe-Kagume, & Fincham, 2021).

3.2.6 Recent developments

Recent developments in the local fertiliser market include:

- Investments in local production, including the USD 5 billion plant in Atuabo (in partnership with Qatar's Al Jedad Holding) (Kubwa, 2025) and the USD 3.5 million blending plant in Shai Hills, aim to reduce import reliance and stabilise prices (Baisie, 2025). These projects are expected to produce urea and ammonia domestically.

- There appears to be growing demand for organic and bio-fertilisers (e.g. compost, microbial products) due to environmental concerns and government promotion of sustainable farming, which adds another layer to market dynamics. However, higher production costs and limited raw materials constrain this segment (Renub Research, 2025).

3.3 Civil explosives (ammonium nitrate)

Ammonium nitrate is used as a high-nitrogen fertiliser. It is found in calcium ammonium nitrate and other compound fertilisers, such as monoammonium phosphate (MAP) and diammonium phosphate (DAP). It is also used in the pharmaceutical industry for the production of nitrous oxide (N_2O), anaesthetics and analgesics for surgical and dental procedures and instant cold packs. However, as far as is known, there are no companies producing N_2O or cold packs locally at present. The main use case for ammonium nitrate in Ghana is as a key component in the production of explosives for civil use, for example, ammonium nitrate fuel oil (ANFO) or emulsion explosives, which is the main focus of this section.

3.3.1 Market development

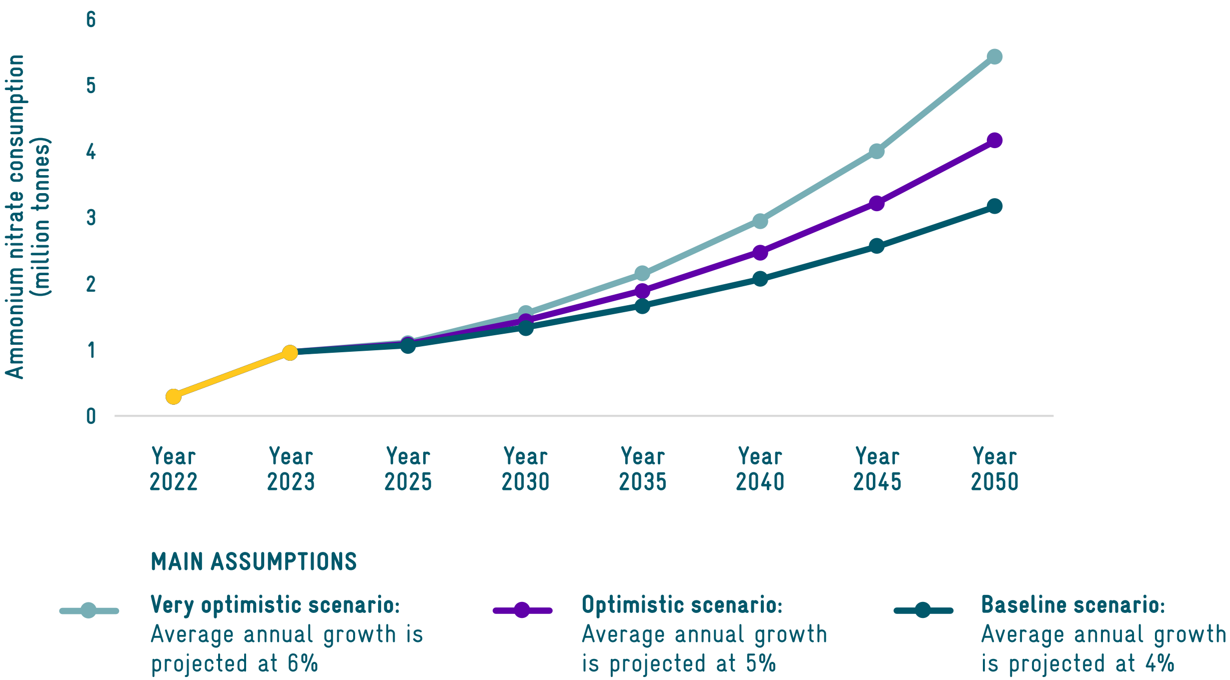
Ghana's mining sector is expected to achieve **4%–6% annual growth** through 2045, contingent on reforms, invesvtment in downstream industries and sustainable practices (PADC, 2025).

This growth is expected to be driven by:

- Gold output, which is projected to rise by **6.25% in 2025** to **5.1 million ounces**, thanks to new large-scale mines, such as Newmont's Ahafo South Mine and Shandong's Namdini Mine, offsetting declining output at aging operations (e.g. Perseus' Edikan and Gold Fields' Damang Mines) (AMM, 2025).
- **Artisanal small-scale gold mining**, whose output could grow by **30%–40% annually** if regulatory reforms are successful in reducing smuggling and improving formalisation (African Business, 2025).
- **Pipeline of gold exploration projects**, such as Cardinal Namdini (358,000 ounces a year) and Ahafo North (325,000 ounces a year), which are expected to sustain output.

It is important to note that demand for explosives in mining is projected to increase by 5.6% CAGR globally (TBRC, 2025). Considering different scenarios computed with data from the GRA-CD database, demand for ammonium nitrate is expected to rise from 1.17 million tonnes in 2024 to about 1.64 million tonnes in 2030 and further to around 4.36 million tonnes in 2050, as shown in Figure 9.

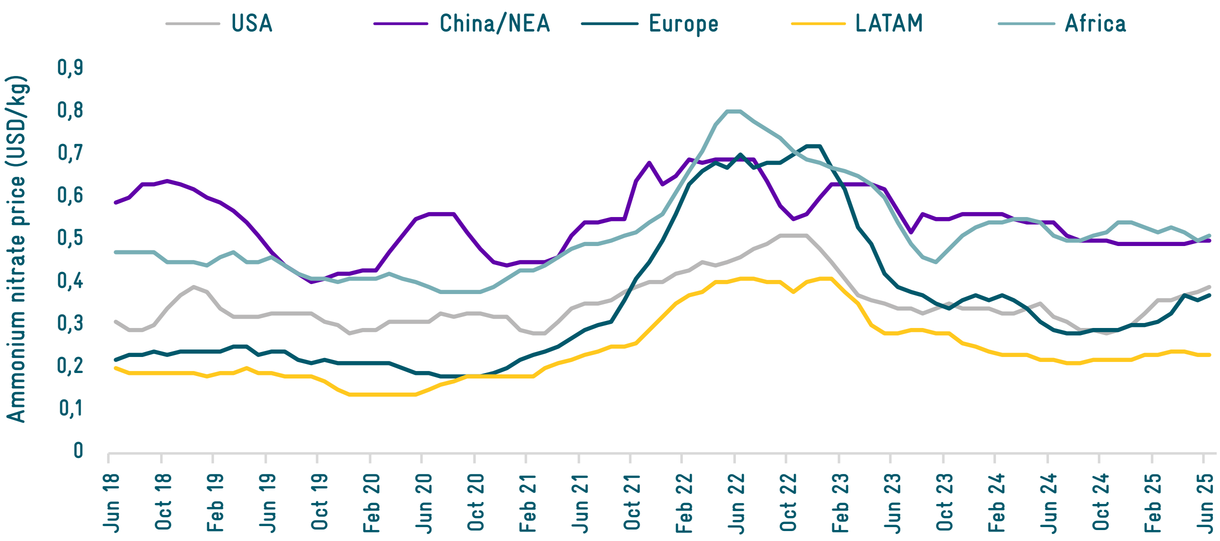
FIGURE 9. Ammonium nitrate consumption (million tonnes) Source: Authors' own compilation, Blue Alliance (2025)



3.3.2 Ammonium nitrate prices

FIGURE 10. Ammonium nitrate FOB price trends

Source: Ammonium nitrate price index (Business Analytiq, 2025b)



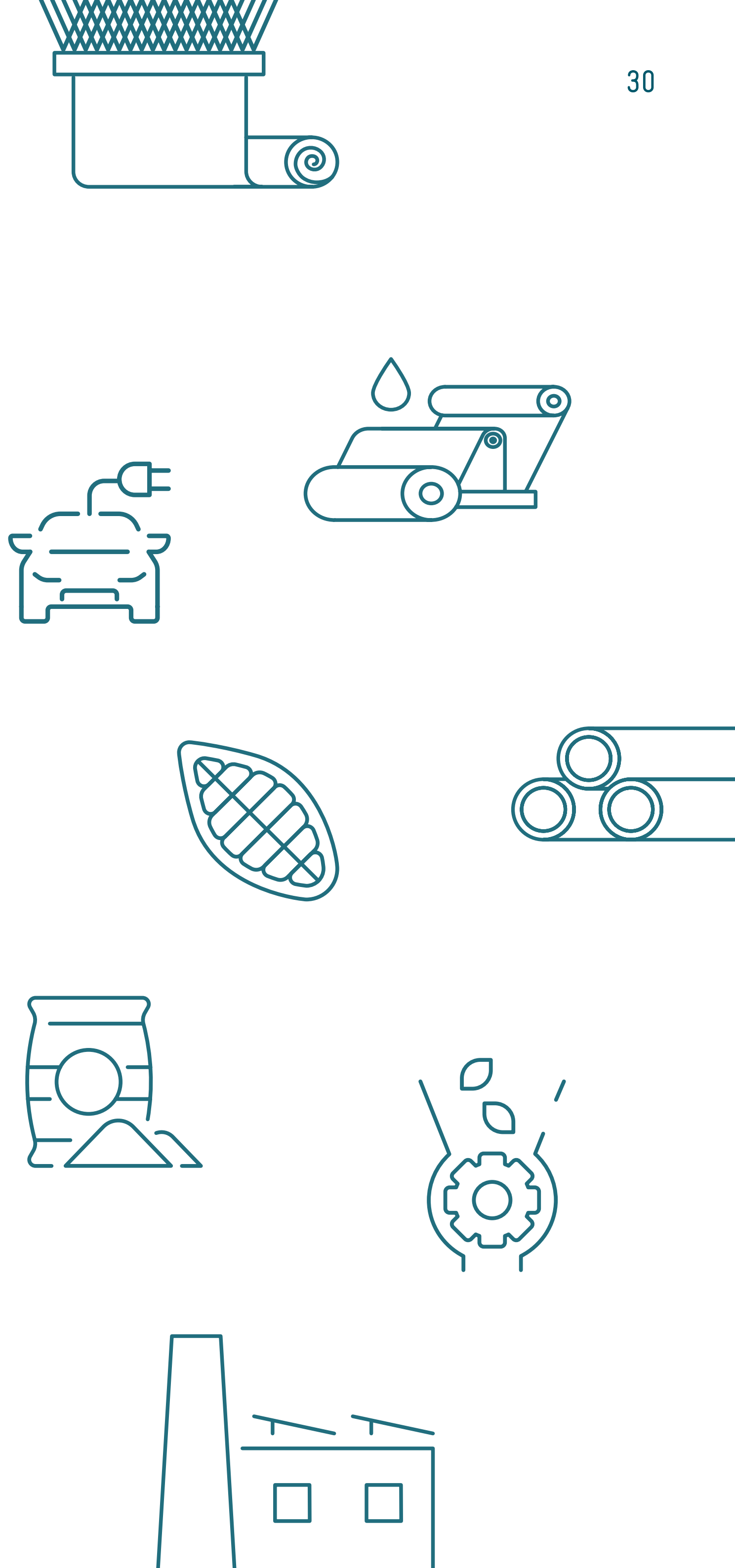
4

Industrial clusters

Ghana has been actively developing industrial clusters and enclaves as part of its economic transformation strategy, leveraging public–private partnerships, foreign investment and policy initiatives to boost industrialisation, job creation and export competitiveness.

The location of the main industrial clusters is shown in Figure 11. Apart from industrial clusters, there are sector clusters as well. These include:

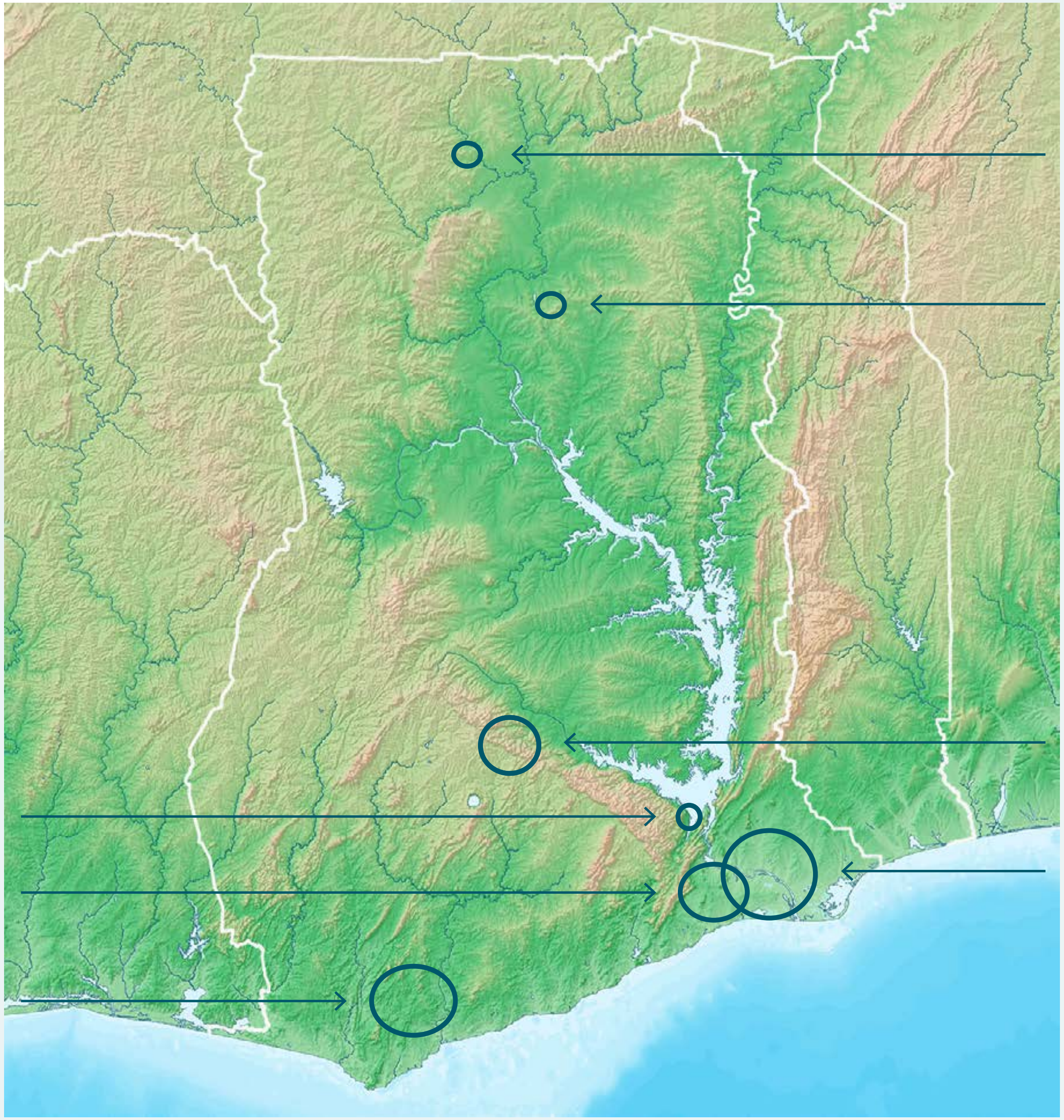
- **Suame Magazine (Kumasi):** Africa's largest artisanal engineering cluster, with over **200,000 fabricators** specialising in metalwork, auto repairs and machinery. It serves regional markets in West Africa.
- **Automotive cluster:** This includes **Kantanka Automobiles** (local assembly) and **Mahindra & Mahindra Ghana**, which produces sports utility vehicles (SUVs) and electric vehicles for the African market.
- **Aluminium and steel:** The **Volta Aluminium Company (VALCO), Tema Steel** and others form a metals cluster.
- **Shea butter clusters (northern Ghana):** They are supported by the **West Africa Competitiveness (WACOMP) Ghana Programme** (EU and United Nations Industrial Development Organization – UNIDO). Women-led cooperatives receive support for improved processing techniques, market access and compliance with international standards.
- **Dodowa mango cluster:** Farmers and processors collaborate on solar drying facilities and good agricultural practices, boosting quality for export markets.
- **Cocoa processing:** Major players, such as the **Cocoa Processing Company, Niche Cocoa** and others operating in Tema and Takoradi, produce cocoa butter, cocoa powder and chocolate for global markets.
- **Akosombo Textiles Limited** (**ATL**) and **Ghana Textile Manufacturing Company** (**GTMC**): They focus on traditional African prints.
- **Local artisan hubs:** Small-scale weavers and dyers in the Ashanti and Volta Regions produce handmade textiles for niche markets.
- **Cement production:** This sector is dominated by **Ghacem, Dzata Cement** and others, with clusters in Tema and Takoradi.
- **Quarrying:** Shai Hills and parts of the Eastern Region have a host of stone and sand quarries supplying road and housing projects.



All the identified industrial clusters in Ghana are critical to advancing the country's green hydrogen and ammonia agenda. While current direct use remains limited, demand is expected to grow as prices decline and technologies mature. Over time, most factories and industrial hubs in Ghana could integrate green hydrogen as an energy source and green ammonia for applications such as cooling, thereby strengthening industrial competitiveness and supporting Ghana's low-carbon transition.

FIGURE 11. Location of industrial enclaves

Source: Authors' own compilation, Blue Alliance (2025)



5

Conditions for local production of ammonia and its derivatives

5.1 Availability of and access to raw materials for fertiliser production

This subsection covers the most commonly used nitrogenous fertilisers (e.g. urea, NPK, ammonium phosphate, ammonium nitrate, urea ammonium nitrate, ammonium sulphate, calcium ammonium nitrate, ammonia, nitrogen and phosphorus, and nitrogen and potassium), explosives and other chemicals (e.g. sulphuric acid, nitrate, phosphate and potassium) and their cost in relation to world market prices.

TABLE 6. Types of ammonia derivatives

Source: Authors' own compilation, Blue Alliance (2025)

Type of Fertiliser	Product Formulation	H_2	Nitrogen (N)	CO_2	Phosphate (P)	Sulphate	Potassium	Local Price, USD/tonne	FOB Price, USD/tonne
Ammonia	$N_2 + 3H_2 \rightarrow 2NH_3$	X	X	–	–	–	–	9,025	360–535 (IMARC, 2025d)
NPK	Blending N, P, K compounds in specific ratios to achieve the desired NPK composition. For example, a 15-15-15 NPK fertilizer	–	X	–	X		X	945	550–727 (IMARC, 2025d)
Urea	$2NH_3 + CO_2 \rightarrow (NH_2)2CO + H_2O$	X	X	X	–		–	762	420–435 (Green Gubre, 2025d)
Ammonium Phosphate	MAP: $H_3PO_4 + NH_3 \rightarrow NH_4H_2PO_4$ Or DAP: $H_3PO_4 + 2NH_3 \rightarrow (NH_4)_2HPO_4$	X	X	–	X		–		MAP: 414–420 DAP: 633–636 (Green Gubre, 2025c)
Ammonium Nitrate (AN)	$NH_3 + HNO_3 \rightarrow NH_4NO_3$	X	X	–	–		–	720	270–530: (Business Analytiq 2025b)
Ammonium Sulphate (AS)	$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$	X	X	–	–	X	–	762	192–258: (Chemanalyst, 2025)
Urea Ammonium Nitrate (UAN)	Urea: 30-40% + Ammonium Nitrate: 40-50% + Water to Balance	X	X	X	–		–		310–390: (Business Analytiq, 2025f)
Calcium Ammonium Nitrate	$2NH_4NO_3 + CaCO_3 \rightarrow Ca(NO_3)_2 + (NH_4)_2CO_3$: Mixing ammonium nitrate with calcium carbonate or limestone in a specific ratio	X	X	X	–		–		310–390: (Chemanalyst, 2025)

TABLE 7. Availability of Raw Materials for Ammonia Derivatives

Source: Authors' own compilation, Blue Alliance (2025)

Availability	Sources	Local/Regional source available (y/n)	Local price, USD/tonne	Import price, USD/tonne
Sulphate	H_2SO_4 (Import)	N	–	70–75 (Green Gubre, 2025a)
	Gypsum($CaSO_4 \cdot 2H_2O$)* (Import)	N	–	63 (Statista, 2025a)
	K_2SO_4 (Import)	N	–	450–595 (IMARC, 2025d)
	$MgSO_4$ (Import)	N	–	260 – 370 (Business Analytiq, 2025c)
Phosphate	MAP (Import)	N	–	414–420 (Green Gubre, 2025c)
	Rock Phosphate**	Y	–	150–200 (Business Analytiq, 2025e)
	Phosphoric Acid (Import)	N	–	847–1,115 (IMARC, 2025e)
Nitrogen	The atmosphere (Import)	Y	–	–
Potassium	KCL*** (Import)	N	–	330–402 (Chemanalyst, 2025)
	K_2SO_4 (Import)	N	–	450–595 (IMARC, 2025f)
	KNO_3 (Import)	–	–	625–882 (Chemanalyst, 2025)
CO_2	Breweries and Kasapreko****	Y	810	220–766 (IMARC, 2025c)
H_2	Erium (Import)	N	H_2: N50: 7,097	4040–6260 (IMARC, 2025f)
			H_2: N60: 9,700	4040–6260 (IMARC, 2025f)
O_2	Erium, Rikair & Others	Y	1,000	335–382 (Chemanalyst, 2025)
Nitrate	Nitric Acid (HNO_3)	N	–	210–350 (Business Analytiq, 2025d)

*Ghana may have gypsum deposits, but there is limited information as to the existence of significant natural deposits. However, researchers have explored alternative sources, such as producing gypsum from clamshells and waste sulphuric acid from end-of-life lead acid batteries. A study by the University of Mines and Technology successfully produced gypsum using this method, with clamshells obtained from the Volta Region (Gohoho & Dankwah, 2019). Additionally, there is evidence of plans to establish a gypsum powder and plaster board factory in Accra, which would produce gypsum products for Ghana and surrounding countries. This suggests potential demand for gypsum in the construction sector. Gypsum deposits are found in West Africa, particularly in Nigeria, where significant deposits exist across various states.

**Phosphate deposits in Ghana are limited, but there are signs of phosphate mineralisation in some areas. Some potential sources include the Aflao area in the Volta Region, where Kropz's subsidiary, First Gear Exploration, is currently undertaking exploration work to confirm if neighbouring Togo's Hahotoe-Kpogame-Kpeme (HKK) deposit extends into this area. Initial mobile metal ion (MMI) geochemistry studies have shown the presence of phosphates. In West Africa, the countries with significant phosphate deposits include:

- Senegal: With over 1 billion tonnes of phosphate reserves, it is the second largest fertiliser producer in West Africa. The country's phosphate mining industry is led by companies such as Industries Chimiques du Sénégal (ICS), Société Sénégalaise des Phosphates de Thiès (SSPT) and Baobab Mining and Chemicals Corporation (BMCC). Senegal aims to boost local fertiliser production using natural gas and phosphate resources.
- Togo: It is known to have phosphate deposits, but less information is available on the scale of its reserves.
- Burkina Faso: It has rock phosphate deposits that remain largely untapped for local agricultural use.
- Mali: Like Burkina Faso, Mali has rock phosphate deposits with the potential for agricultural application.
- Niger: It also possesses rock phosphate deposits.

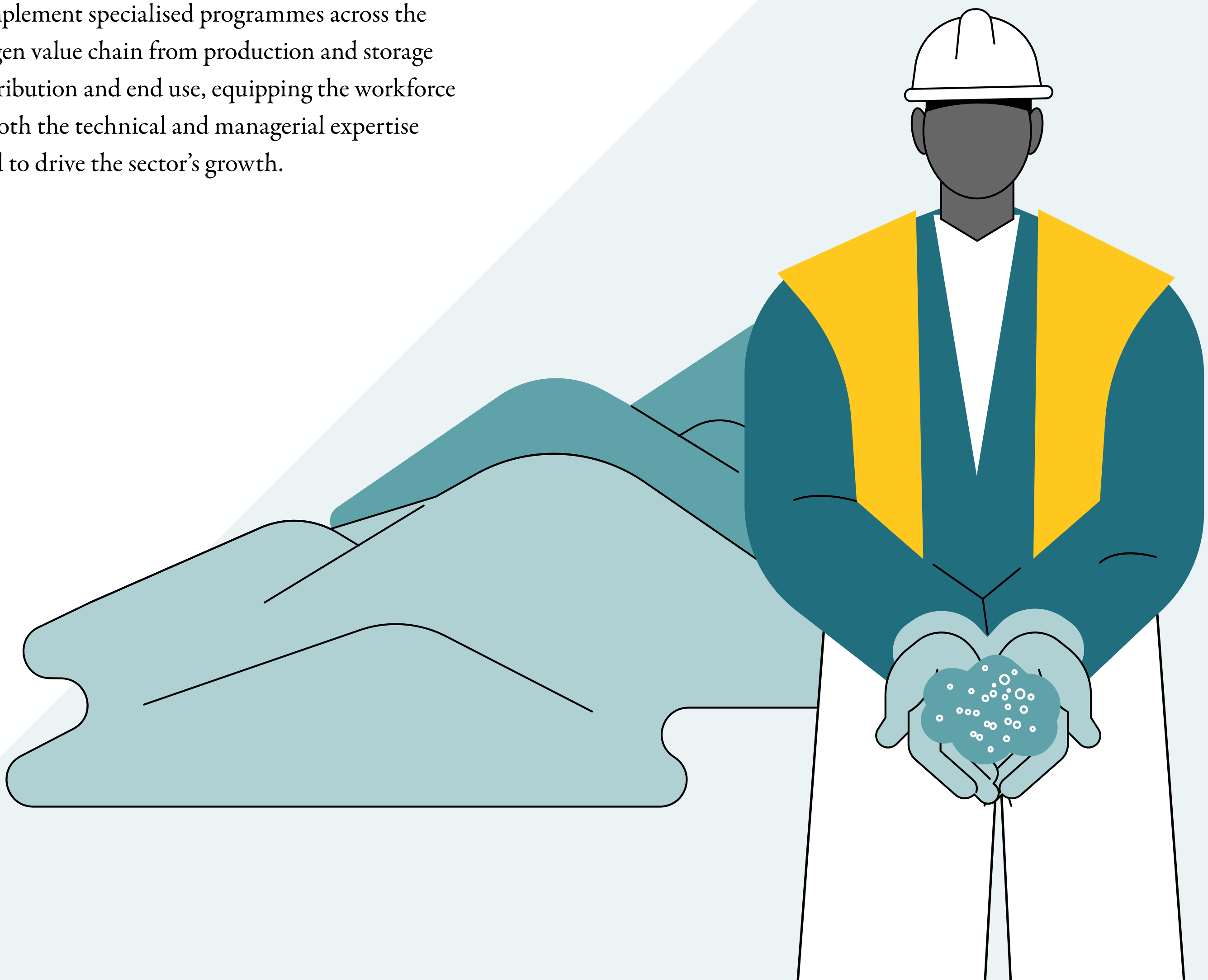
***Analysis carried out on samples obtained from ponds in ElectroChem's salt field at about 17 degrees Baumé were inconclusive. Further testing will have to be carried out at 15 to 19 degrees Baumé to determine the potential crystallisation of potassium chloride in commercial quantities. The same approach could be applied to the bitterns from salt fields in order to determine the potential for harvesting sulphates as well.

****Breweries appear to be using most of the CO_2 obtained from their processes and procure additional amounts from Kasapreko's CO_2 plants at USD 810 per tonne (July 2025). Kasapreko operates three CO_2 plants in West Africa, producing approximately 25 tonnes of CO_2 per day, with a purity of 99.99% or higher.

5.2 Availability of skilled labour

Currently, Ghana lacks a skilled workforce specifically trained for the green hydrogen and ammonia value chain. There are no dedicated training programmes or academic curricula focused on the technical, operational and safety requirements of this emerging sector. As the country explores opportunities in green hydrogen production and utilisation, this skills gap presents a major bottleneck to industry development and investment readiness. To ensure a successful market take-off and long-term sustainability, it is crucial to establish specialised training programmes and incorporate green hydrogen and ammonia modules into university and vocational curricula. Building local technical capacity will not only support project implementation but also enhance Ghana's competitiveness in the global energy transition and green economy space.

A green hydrogen economy requires a diverse range of academic backgrounds and skills, from technical fields such as engineering and chemistry to non-technical areas such as policy and project management. Specific areas of expertise include renewable energy systems, hydrogen production technologies, materials science and safety protocols. Furthermore, skills in areas such as project management, communication, and policy and regulatory knowledge are also crucial for the successful development and implementation of a green hydrogen economy. Closing this skills gap through targeted education and training is vital to positioning Ghana as a competitive player in the global green hydrogen and ammonia economy. To achieve this, it is recommended that government, industry and academia collaborate to design, integrate and implement specialised programmes across the hydrogen value chain from production and storage to distribution and end use, equipping the workforce with both the technical and managerial expertise needed to drive the sector's growth.



5.3 Policy and regulatory framework for green hydrogen

A comprehensive and dedicated hydrogen policy and regulatory framework does not yet exist in Ghana. The current development of green hydrogen projects is instead shaped by a patchwork of existing policies, strategies and regulations that only indirectly address hydrogen. While these provisions provide initial guidance, they remain fragmented and insufficient to steer the sector's growth. Ghana is nonetheless advancing its green hydrogen ambitions as part of its broader energy transition strategy, with several policy initiatives and regulatory elements beginning to take shape. This section examines these piecemeal measures, highlighting their relevance to green hydrogen development while emphasising the pressing need for a coherent and specific national framework.

The current landscape includes the following.

1. **Strategic policy foundations:**
   - Renewable Energy Act (No. 832, 2011): Although it does not deal with hydrogen specifically, it provides the foundational legal framework for renewable energy development that enables green hydrogen production
   - Energy Transition Framework (2023): It sets the target of completing the transition from fossil fuels to green energy by 2070, with specific milestones including 70% of road vehicles running on electricity or hydrogen by 2045
   - Renewable Energy Master Plan: It is currently under review to incorporate green hydrogen provisions, following the Ministry of Energy's call for partnerships in this area
2. **Institutional framework:** The key institutions involved in green hydrogen governance are:
   - Ministry of Energy: It leads policy formulation and international partnerships for green hydrogen development
   - Energy Commission: It is responsible for licensing and technical standards
   - Environmental Protection Agency (EPA): It oversees environmental compliance, including through Ghana's Carbon Market Office, which manages climate finance opportunities relevant to hydrogen projects
   - Public Utilities Regulatory Commission (PURC): It will likely be involved in tariff setting for hydrogen-related utilities
3. **Future policy directions:** Emerging policy priorities for the country include:
   - Integration with transport policy: There are plans to transition road and rail transport to hydrogen and electricity by 2070 (GCTU, 2024)
   - Infrastructure development: There is a need for policies governing hydrogen storage, transportation (including pipelines) and refuelling stations (GCTU, 2024)
   - Certification standards: Alignment with international green hydrogen standards is needed to ensure environmental integrity (GH_2, 2025b)

In Ghana, regulatory clarity and targeted incentives are likely to emerge in the coming years as pilot projects generate operational experience. Nevertheless, several foundational elements for establishing a hydrogen economy are still missing, including a comprehensive policy framework or strategy, a national roadmap and dedicated support schemes to guide investment and market development.

The main existing regulatory bodies and enablers for the manufacturing sector, under which green hydrogen and ammonia products fall, are listed in Table 8. For established companies seeking to transition from grey ammonia to green ammonia production, the following strategic considerations are particularly important, as they indicate the institutions that project developers must engage with in their quest to develop projects in Ghana.

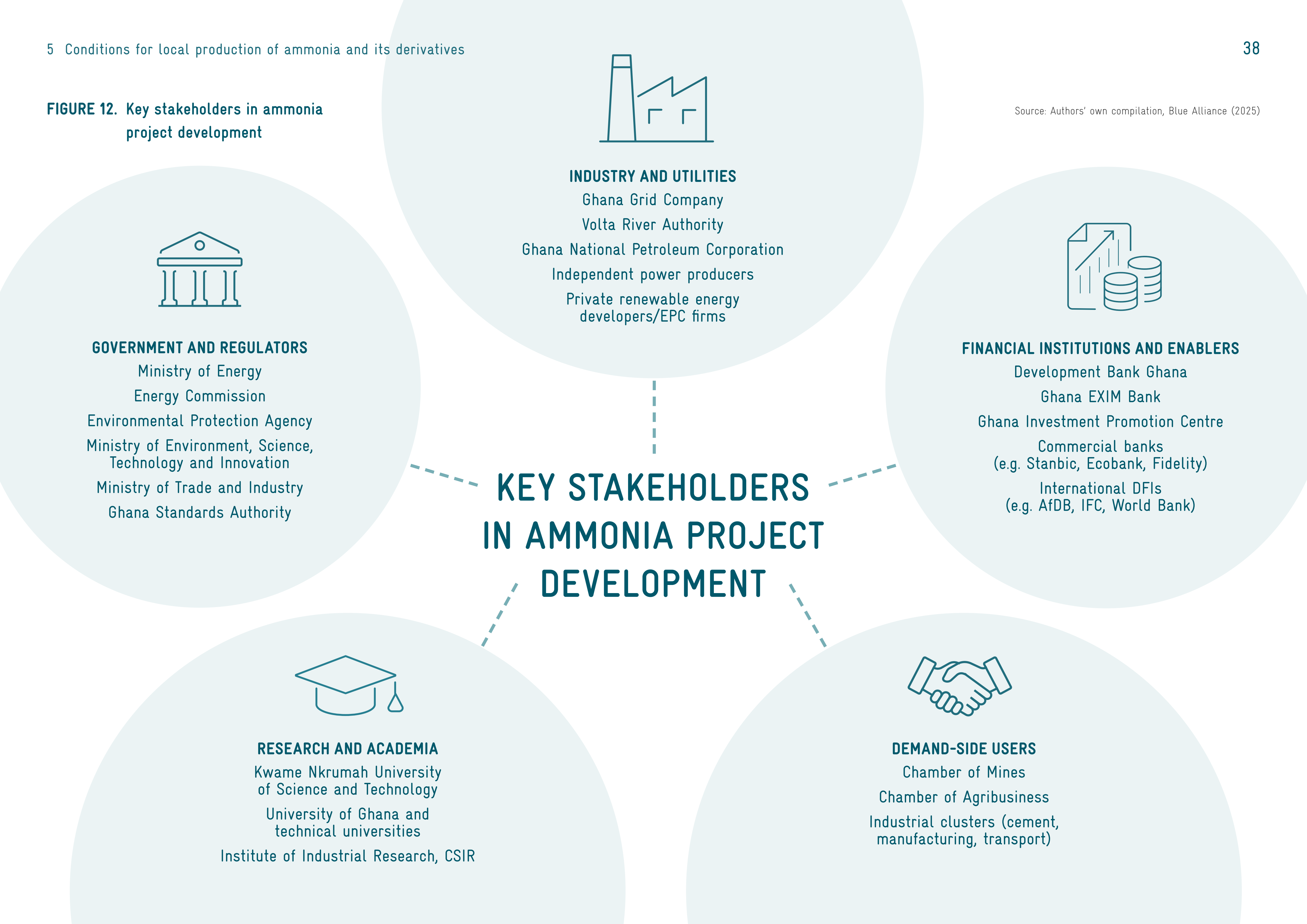
TABLE 8. Main regulatory bodies and enablers for the manufacturing sector

Source: Authors' own compilation, Blue Alliance (2025)

Category	Institution	Mandate
Government and regulators	Ministry of Energy (MoEn)	Leads national energy policy, including renewable energy and hydrogen integration
	Energy Commission	Regulates and licenses energy activities; key for permitting hydrogen projects
	Environmental Protection Agency (EPA)	Oversees environmental impact assessments and compliance
	Ministry of Environment, Science, Technology and Innovation (MESTI)	Supports R&D and innovation in clean energy
	Ministry of Trade & Industry (MoTI)	Industrial policy, trade facilitation, and market development for hydrogen and ammonia products.
	Ghana Standards Authority (GSA)	Ensures quality, safety, and fair trade in goods and services through standardization, metrology, testing, and certification
Industry and utilities	Ghana Grid Company (GRIDCo)	Transmission access and grid integration
	Volta River Authority (VRA)	State-owned utility, potential partner in renewables/hydrogen
	Ghana National Petroleum Corporation (GNPC)	Transition role, hydrogen blending, gas-to-hydrogen synergies
	Independent power producers	Off-takers and co-developers for hydrogen in power generation
	Private renewable energy developers/ EPC firms	Project execution, operation and maintenance and technology deployment
Research and academia	Kwame Nkrumah University of Science and Technology (KNUST)	Energy systems research and engineering capacity
	Technical universities	Technical skills development
	Institute of Industrial Research, Council for Scientific and Industrial Research (CSIR)	Applied industrial and energy research
Demand-side users	Chamber of Mines	Ammonium nitrate/hydrogen use in mining explosives
	Chamber of Agribusiness	Ammonia/fertiliser applications for agriculture
	Industrial clusters (cement, manufacturing, transport)	Potential off-takers for hydrogen and derivatives
Financial institutions and enablers	Development Bank Ghana (DBG)	Long-term financing for green industries
	Ghana EXIM Bank	Export support for hydrogen/ammonia value chains
	Ghana Investment Promotion Centre (GIPC)	Investment facilitation and incentives
	Commercial Banks (Stanbic, Ecobank, Fidelity)	Potential financing partners for project development
	International DFIs (AfDB, IFC, World Bank)	Concessional financing, guarantees and risk mitigation

FIGURE 12. Key stakeholders in ammonia project development

Source: Authors' own compilation, Blue Alliance (2025)



For greenfield investors aiming to establish a new and sustainable green hydrogen or ammonia market, the first port of call should be the **Ghana Investment Promotion Centre** (GIPC). When making an investment, the following strategic considerations are especially critical:

- Business security and protection is provided by GIPC in the form of guarantees, including the following:
  - **Multilateral Investment Guarantee Agency (MIGA) membership and bilateral promotion and protection agreements** protect private investment
  - **The 1994 GIPC Act guarantees 100% transfer of profits, dividends**, fees, etc.
  - **Automatic expatriate quotas are granted, depending on paid-up capital**
- Standard corporate income tax stands at 25%. However, the Ghana Revenue Authority offers preferential rates for manufacturing companies. **Businesses located outside regional capitals benefit from a 12.5% tax rate**, while those in regional capitals (except Accra and Tema) **qualify for a 18.75% rate**.
- **Manufacturing companies in free zones enjoy a 100% waiver on all direct and indirect customs duties and levies for imported goods used in production and subsequent exports**. They are also **exempt from corporate income tax for the first 10 years**, after which a **maximum tax rate of 8% applies**.
- An investment of USD 50 million or more in a project qualifies the investor as a strategic partner, which means that they can **negotiate their own exemptions with the Government of Ghana**.
- With regard to imported plant and machinery, projects proponents would need to apply to GIPC for a waiver of duties, value added tax (VAT) and levies.
- With regard to imported raw materials, project proponents would need to apply to the GRA-CD office in James Town, Accra, for a **concessionary rate of 5% in place of duties, VAT and levies**.
- **Compact solar systems are exempt from import tax.**
- Companies (foreign and local) that produce in Ghana and export 70% of their produce are exempted from paying corporate taxes for the first 10 years of their operation under the Ghana Free Zone Authority (GFZA) after having obtained a special licence to operate as a free zone entity.

Like the country's other manufacturers, green hydrogen and ammonia projects **can tap into the growing regional markets, reaping the benefits offered by the AfCFTA**. Although, the focus here is more on local production and the use of green ammonia derivatives instead of imported grey ones, investors with higher production capacities could target the markets in neighbouring countries as well.

5.4 Technical and country-specific risks

For green hydrogen and ammonia processing plants, as for any other manufacturing facility, there are a number of intrinsic risk factors which must be mitigated properly in order to achieve the project's objectives and targets. The identified risks specific to Ghana and measures that can be taken to manage them are shown in Table 9.

TABLE 9. Risks and risk management measures

Source: Authors' own compilation, Blue Alliance (2025)

Risk	Description	Possible mitigation measures
Land acquisition risks	Common issues include unclear titles, multiple sales and bureaucratic delays that can lead to costly project setbacks	• Conduct thorough land due diligence • Engage with local chiefs and community leaders early • Secure proper documentation and legal agreements • Include stakeholder consultation and compensation plans where needed
Community and social risks	Community opposition or social unrest can delay or disrupt project development	• Engage with communities early and transparently • Create local employment and shared value initiatives • Include grievance redress mechanisms in project governance
Regulatory risks	• No clear policies or standards for green hydrogen/ammonia • Complex permitting due to new technology • Broader stakeholder involvement needed beyond Energy Commission	• Engage early with regulatory bodies (Energy Commission, EPA, etc.) • Develop sector-specific guidelines • Align with existing legal frameworks • Advocate for clear licensing pathways • Incorporate international best practices • Foster continuous dialogue with regulators • Support regulator training
Foreign exchange risks	Ghanaian manufacturers face dollar fluctuations and cedi depreciation, which impacts competitiveness	• Hold assets and transact in multiple currencies • Adjust prices with changing import costs • Use multiple international suppliers • Process payments promptly • Use automated currency orders for targets • Monitor foreign exchange trends • Explore local currency financing options
Financial and investment risks	Difficulty in securing long-term financing due to project novelty or perceived risk	• De-risk the project with feasibility studies, off-take agreements and government backing • Engage with development finance institutions (DFIs), climate funds and green investors early
Market risks	• Currency depreciation (foreign exchange risk) affects input costs • Global commodity price volatility impacts profitability • Lack of long-term off-take agreements creates market uncertainty • Policy gaps and limited incentives slow adoption • Illegal small-scale gold mining (galamsey) limits land access and poses environmental risks	• Engage with the Ghana Cocoa Board (COCOBOD) and government agencies on fertiliser off-take opportunities • Secure off-take agreements with ANFO and emulsion producers in the mining sector • Diversify ammonia products, markets and regions • Develop contingency plans for market and supply disruptions • Regularly monitor financials and market data • Collaborate with regional trade bodies for better access and alignment • Invest in storage and logistics infrastructure • Advocate for supportive policies and incentives • Collaborate with industry associations for unified advocacy
Human resource risks	The project may lack skilled personnel for design, construction and operation	• Use contract experts during early-stage phases • Partner with institutions for hydrogen-specific training • Prioritise local hiring and capacity building • Provide strong health, safety and hazardous materials (HAZMAT) training • Collaborate with stakeholders to grow talent pipelines • Implement mentorship and succession planning • Conduct regular skills audits • Offer competitive compensation and retention packages • Establish clear career development pathways

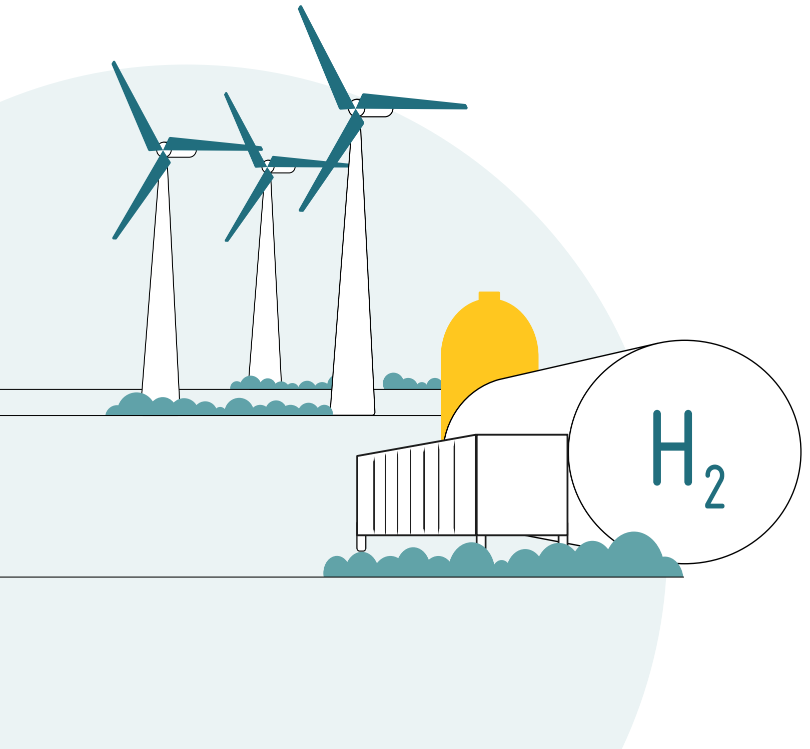
6

Identifying and analysing potential use cases

6.1 Overview

Ghana's industrial landscape presents significant opportunities for the integration of green hydrogen and green ammonia across various sectors. In the near term, promising applications include fertiliser production, mining explosives and oil refining, where hydrogen or ammonia can be readily integrated into existing industrial processes. In the medium term, potential use cases are expected to expand into small-scale industrial processes, back-up and off-grid power generation and specialised transport segments as enabling infrastructure and policy frameworks mature. Over the long term, as technology costs decline and the hydrogen ecosystem evolves, Ghana could see broader integration in heavy-duty transportation, glass manufacturing and large-scale iron and steel production, aligning with global decarbonisation trends. These applications span both small- and large-scale project opportunities, reflecting international patterns observed in the early stages of hydrogen market development.

6.2 Potential small-scale use cases (electrolyser capacity: from 1 MW to 10 MW)



Small-scale green hydrogen projects serve industries with moderate hydrogen demand or decentralised production needs. Such setups prioritise on-site or near-site generation to minimise logistical costs and seamlessly integrate with existing processes. Electrolysers will therefore typically be powered by local wind or solar PV plants and can be supported by battery energy storage or hydrogen storage to manage fluctuations in electricity supply and hydrogen demand. In most cases, the hydrogen and its derivatives are consumed directly on site, ensuring efficiency and reliability.

Typical small-scale applications include electronics, specialty glass production, welding processes and the food industry, either for hydrogenation or as a protective gas in food packaging. In Ghana, potential applications are currently limited, but it is anticipated that there will be varying degrees of small-scale usage of green hydrogen and ammonia in sectors such as those indicated in the following subsections.

Food industry

Hydrogen plays a modest but vital role in Ghana's food and beverage sector. Breweries and related producers use small quantities of hydrogen annually for processing. It is also critical in the hydrogenation of vegetable oils and fatty acids, a process that improves the shelf life, texture and stability of products such as margarine and shortening. Although current consumption levels are low, Ghana's palm and groundnut oil processing industries hold potential for green hydrogen integration. This is especially relevant given that hydrogen is imported in bottles at high prices (about USD 8 per kg). Local production using green hydrogen could reduce import costs, support domestic food processing and contribute to Ghana's broader industrial and energy sustainability goals.

Drug and chemical production

Hydrogen is used as a key feedstock in Ghana's pharmaceutical and chemical industries, albeit in modest quantities. In the pharmaceutical sector, it supports the synthesis of active pharmaceutical ingredients, which requires high-purity hydrogen. In the chemical industry, hydrogen enables processes such as hydrocracking, hydrogenation and the production of specialty chemicals. Although current consumption is limited to a few tonnes annually, reliance on imported bottled hydrogen – sold at up to USD 8 per kg – presents an opportunity for cost-effective, locally produced green hydrogen. This aligns with Ghana's industrial transformation agenda, which promotes pharmaceutical localisation and industrial decarbonisation. Target sectors include plastics, pesticides, dyes, waste treatment, textiles, rubber, and pulp and paper, along with ammonia-based chemicals such as ammonium bicarbonate, bisulphite and chloride.

Glass industry

Ghana does not currently have hydrogen-powered glass manufacturing. However, initiatives such as the Dawa Industrial Zone offer a strategic opportunity for clean tech investments. With strong policy support for sustainable industrialisation and local value addition, green hydrogen can power future glass production, reduce emissions from imported packaging and deliver long-term economic and environmental benefits.

Cutting and welding

Green hydrogen can be used to produce high-temperature oxy-hydrogen flames for metal cutting and welding, an application particularly relevant to Ghana's mining, oil and gas, and manufacturing sectors, which are experiencing steady growth and increased demand for industrial fabrication and maintenance services.

Refrigeration and cooling

Ammonia is currently used as a refrigerant in breweries and cold stores in Ghana. Demand for industrial and commercial refrigeration is expected to grow due to urbanisation, population growth and an increased need for cold chains, cooling and data storage. Rising temperatures may boost the adoption of absorption refrigeration, supporting sectors such as hospitality and manufacturing and enabling cooling-as-a-service business models.

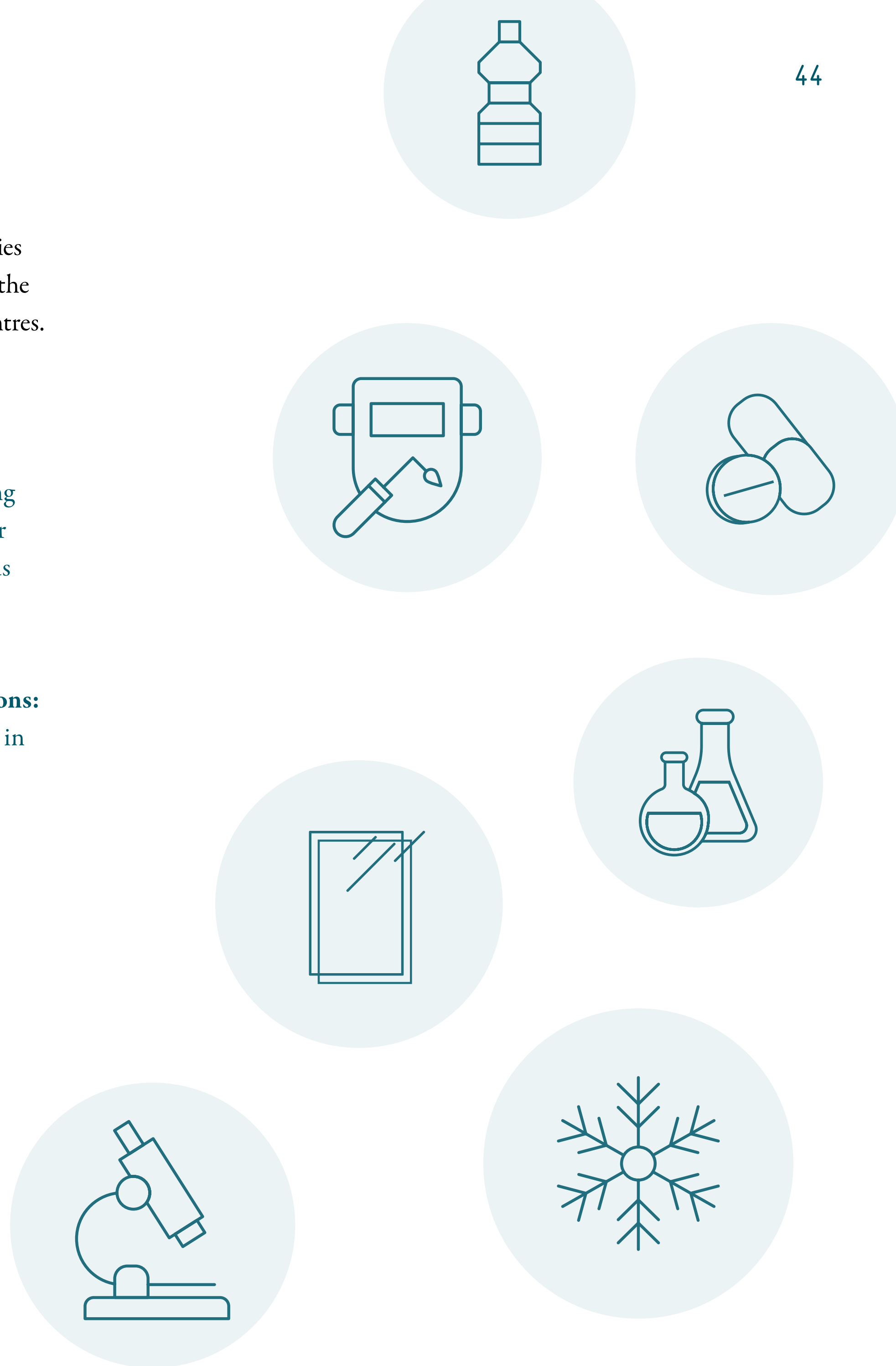
Research

Hydrogen and ammonia are used in small quantities for laboratory and research purposes in Ghana by the country's educational institutions and research centres.

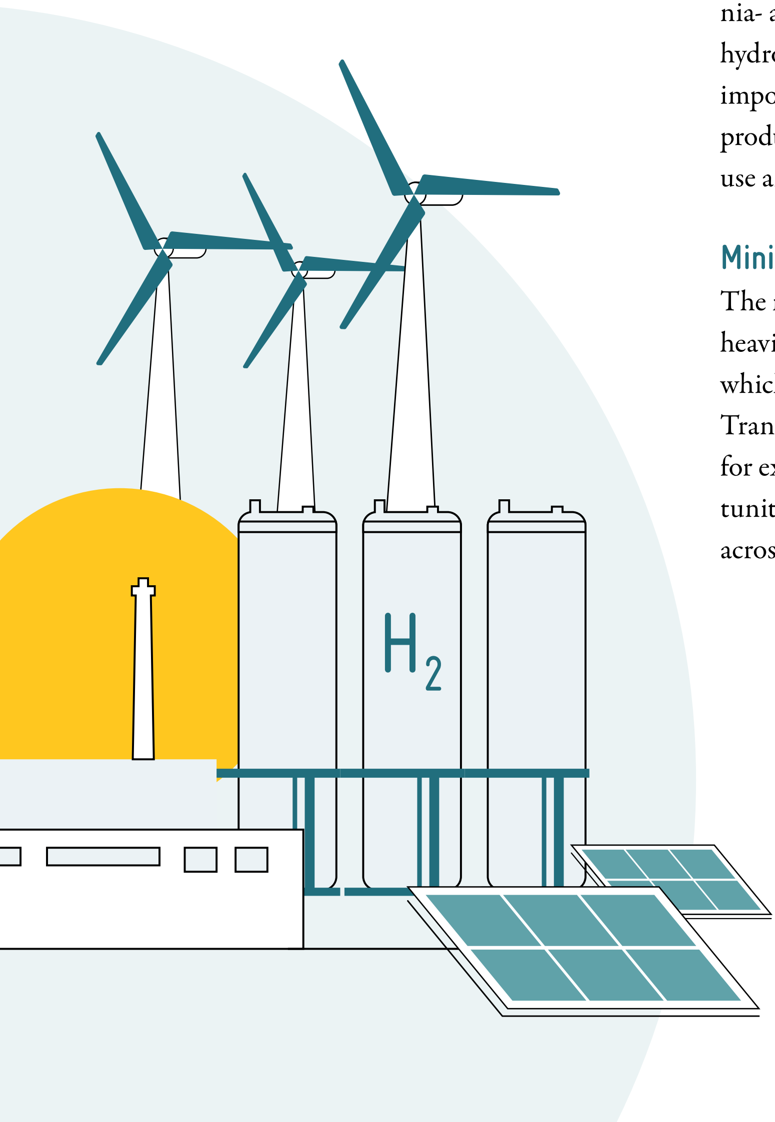
Potential future uses

Potential future uses include:

- **Small-scale off-grid power generation:** Using hydrogen in fuel cells to generate electricity for commercial, industrial and residential use, thus reducing reliance on fossil fuels and offering a cleaner energy source
- **Small-scale heating for industrial applications:** Using hydrogen to power boilers and furnaces in industrial applications



6.3 Potential large-scale use cases (electrolyser capacity: 10 MW and above)



Ammonia and fertiliser production

Ghana does not currently have domestic fertiliser manufacturing capacity and relies heavily on imports to meet agricultural demand. This presents a strategic opportunity to establish local production facilities powered by green hydrogen, particularly for ammonia- and urea-based fertilisers. Developing a green hydrogen-based fertiliser industry would reduce import dependency, lower emissions and enable the production of green-labelled fertilisers for both local use and export to regional markets.

Mining and quarry explosives

The mining and quarrying sector in Ghana relies heavily on ammonium nitrate-based explosives, which require ammonia produced using hydrogen. Transitioning to green hydrogen-derived ammonia for explosive manufacturing presents a major opportunity to reduce emissions and increase sustainability across Ghana's expanding mining sector.

Oil refining and petrochemicals

Ghana's petroleum refining sector is anchored by two primary facilities:

- **Tema Oil Refinery (TOR):** Ghana's largest refinery historically processed around 45,000 barrels per day but halted operations in 2022 due to financial and technical challenges.
- **Sentuo Oil Refinery Limited (SORL):** This newer private refinery has an initial capacity of 40,000 barrels per day. Despite partial commissioning in 2023, it remains inactive pending regulatory approvals and infrastructure upgrades.
- Both refineries are critical to reducing Ghana's reliance on imported petroleum products, yet neither is currently producing.
- The planned expansion of facilities such as TOR and the revival of the SORL project could significantly increase hydrogen demand for hydrotreating and hydrocracking. Retrofitting or developing refineries to be green hydrogen-compatible would support national goals for cleaner energy and industrial decarbonisation.

Iron, steel and cement

Although Ghana does not yet have DRI technology in operation, future investment in hydrogen-based DRI for steelmaking could result in considerable green hydrogen demand. Green hydrogen may also serve as a low-carbon heat source in cement manufacturing and in the metallurgical and mining sectors, which are expanding under Ghana's industrialisation agenda. While large-scale hydrogen use is currently limited, Ghana's industrialisation drive, renewable energy potential and strong policy interest in climate-friendly industrial transformation position the country as a promising hub for green hydrogen adoption in the medium to long term. According to techno-economic evaluations carried out by the authors for AIA Industries' Foundry Project in 2023, Ghana consumes about 485,000 tonnes of scrap steel a year. This figure provides an indication of the scale of steel production in Ghana. In addition to this, in 2024, Ghana imported USD 600.24 million worth of iron and steel from China, which corresponds to about 1,339,286 tonnes (Trading Economics, 2025a). With regard to cement, Ghana's production reached 4 million tonnes in the first half of 2024, reflecting a 17% year-on-year increase compared to the same period in 2023. The country's total production capacity is estimated to be just below 11 million tonnes per year, with significant overcapacity of around 3.5 million tonnes (OneStone, 2024). In 2023, Ghana imported 646,924 tonnes of cement, according to the GRA-CD database.

Export

There is potential to export green hydrogen, ammonia and its derivatives to other countries, including neighbouring West African countries, especially those that are slow to react and attract similar investors, taking advantage of benefits under the AfCFTA and the opportunities that arise as companies seek means to decarbonise or transition to low-carbon options. Ghana's strategic location and slightly more developed infrastructure make it an attractive hub for green ammonia production and export to other countries. The AfCFTA is a free trade agreement encompassing most of Africa which aims to eliminate trade barriers and boost intra-African trade. This initiative, a flagship of the African Union's Agenda 2063, seeks to increase trade, promote industrialisation and create jobs. Ghana's main competitor in West Africa is Nigeria, which has more favourable solar and wind resources. Ghana could still have a slight advantage when it comes to expanding to the west of the Gulf of Guinea, taking into account distance and transportation costs.

Transportation

Hydrogen can be used in fuel cell vehicles to reduce greenhouse gas emissions, especially in heavy-duty trucking.

7

Potential green ammonia business cases for Ghana

7.1 Hydrogen: Techno-economic calculations for use cases

To provide a preliminary indication of the techno-economic feasibility of projects of varying sizes, three different scenarios have been assessed for direct hydrogen use at a location in Western Region, home to the country's big mining sites and, at the same time, an important region for agricultural production and industry, for which there are a number of potential applications.

Here, a transition to green hydrogen could be considered in the short to medium term. For the selected cases, the analysis examined the optimal renewable energy mix, including PV and wind, necessary to meet annual hydrogen demand using different electrolyser sizes (1 MW and 8 MW). The main results of these three cases are summarised in Table 10. They consider exemplary renewable profiles in Prestea-Huni Valley District in Ghana's Western Region. It should be noted that the results could vary significantly in other parts of the country, for example, if wind or solar conditions are different or utility-scale projects with significantly larger component sizing are planned.

TABLE 10. Techno-economic calculations for direct hydrogen use cases

Source: Analyses performed by GIZ (2025)

Case	Unit	Small-scale H_2 (wind and PV)	Small-scale H_2 (PV only)	Large-scale H_2 (wind and PV)
Demand (H_2)	tonnes/year	45	45	450
Installed RE (capacity)	MW	PV: 2; Wind: 0.5	PV: 4	PV: 22; Wind: 2
Electrolyser size	MW	0.9	1	8
WACC	%	15.1	15.1	16.3
Total investment	million USD	4.55	6.19	36.92
Oxygen sales	million kg	0.33	0.36	3.07
Excess RE sales/consumed	GWh	1	3.11	9.19
LCOH grey	USD/kg	5.37	5.37	5.37
LCOH proposed case/green	USD/kg	16.41	17.96	14.04
Project IRR	%	7.9	9.1	9.8
NPV	million USD	−1.07	−1.19	−10.57
Financing gap	USD/kg	11.04	12.59	8.67

Based on the results presented in Table 10, the following can be concluded:

- **Resource utilisation and cost analysis:** Relatively favourable wind resources are available at the chosen location in Western Region compared to other parts of the country. Although these resources alone are insufficient to power an electrolyser, a combination of PV and wind presents a significantly better business case, with a LCOH of around USD 1.50 per kg than the PV only solution (small case scenario).
- **Financial viability:** Grey hydrogen is currently imported in bottles at a price of around USD 8 per kg. As such imports are uneconomical even for quantities of 45 tonnes, taken as a reference for the small case scenario, hypothetical local grey hydrogen production at a price of USD 3.20 per kg is assumed for the base case, which is slightly higher than international prices of around USD 3 per kg. Taking into account annual price escalations of 2% above inflation, this results in a LCOH of USD 5.37 per kg over the project lifetime. For the proposed cases, the modelling revealed a LCOH for green hydrogen of between USD 14.04 per kg (large-scale) and USD 17.96 per kg (small-scale PV only) which corresponds to a factor of 2.6 and 3.3 respectively compared to the base case. Closing the significant finance gap of USD 8.67 to 11.04 per kg would entail leveraging a funding source or a mix of them, as described further in **Section 8.3**, to make the project economically feasible.
- **Investment returns:** The project's IRR varies between 7.9% under the small-scale PV + wind scenario and 9.8% under the large-scale scenario.

7.2 Hydrogen: Sensitivity analysis

The results of the sensitivity analysis, which was carried out considering a carbon tax and without excess electricity usage scenarios, are summarised below. The analysis shows that a CO_2 levy of USD 10 per tonne – which is considered a realistic starting price for a CO_2 pricing scheme currently under discussion in Ghana – would only marginally lower the LCOH for the proposed case by about USD 0.12 per kg.

Making green hydrogen competitive by taxing the standard grey product would require CO_2 levies at a scale that would be politically unfeasible to implement.

Curtailment of excess electricity would significantly increase the cost of green hydrogen per kg by USD 4.7 to 9.3 per kg, depending on the case. The increase is highest for PV only solutions since combined PV + wind solutions allow for smaller renewable energy system designs (especially PV) that produce less excess electricity. As there are few industries in Ghana requiring hydrogen (or ammonia) in their production processes that could absorb large quantities of excess electricity on site for existing loads, such a curtailment scenario is not unrealistic, especially for large-scale systems. In a scenario without the sale of excess renewables, the implementation of battery storage might be an option. In such a scenario (which has not been modelled here), the size of the electrolyser could be reduced since the system could still produce the same amount of hydrogen with electricity from battery storage when renewable electricity is not available (increased system capacity factor).

TABLE 11. Techno-economic calculations for direct hydrogen use cases (with carbon tax of USD 10 per tonne)

LCOH grey	USD/kg	5.37	5.37	5.37
LCOH proposed case/green	USD/kg	16.29	17.84	13.92
Project IRR	%	8.0	9.2	10.0
NPV	million USD	-1.05	-1.17	-10.33

Source: Analyses performed by GIZ (2025)

TABLE 12. Techno-economic calculations for direct hydrogen use cases (without excess electricity usage)

LCOH grey	USD/kg	5.37	5.37	5.37
LCOH proposed case/green	USD/kg	21.22	27.14	18.60
Project IRR	%	2.7	1.3	3.6
NPV	million USD	-1.83	-2.73	-19.61

Source: Analyses performed by GIZ (2025)

7.3 Ammonia: Techno-economic calculations for use cases

Given that current hydrogen use in Ghana is highly dependent on ammonia and ammonia-based fertiliser and explosives production, a complementary techno-economic analysis has been conducted for three ammonia use cases that align with the hydrogen use cases presented in **Section 6**. The results are summarised in Table 13.

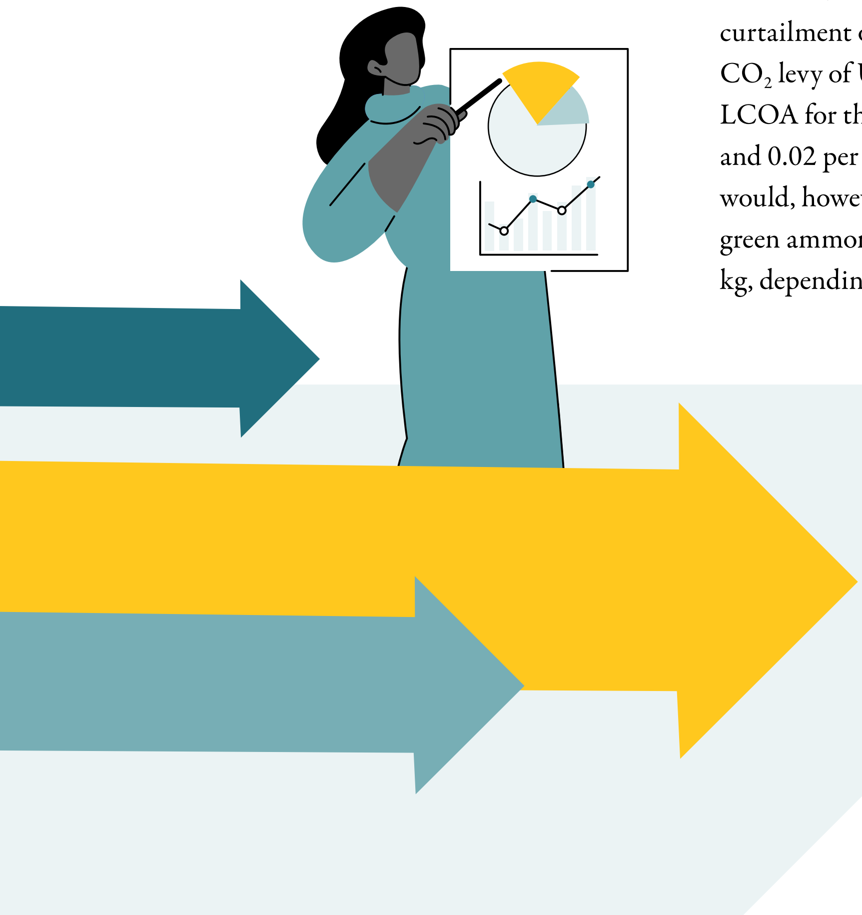
TABLE 13. Techno-economic calculations for ammonia use cases

Source: Analyses performed by GIZ (2025)

Case	Unit	Small-scale NH_3 (wind and PV)	Small-scale NH_3 (PV only)	Large-scale NH_3 (wind and PV)
Demand (NH_3)	tonnes/year	270	270	2,700
Installed RE (capacity)	MW	PV: 2; Wind: 0.5	PV: 4	PV: 22; Wind: 2
Electrolyser size	MW	1.0	1.0	8.3
WACC	%	15.1	15.1	15.1
Total investment	million USD	5.32	6.97	41.55
Oxygen sales	million kg	0.33	0.36	3.07
Excess RE sales/consumed	GWh	1.00	3.1	9.19
LCOA grey	USD/kg	1.68	1.68	1.68
LCOA proposed case/green	USD/kg	3.94	3.96	3.35
Project IRR	%	8.4	9.7	9.8
NPV	million USD	-1.17	-1.21	-6.8
Financing gap	USD/kg	2.26	2.28	1.67

7.4 Conclusions

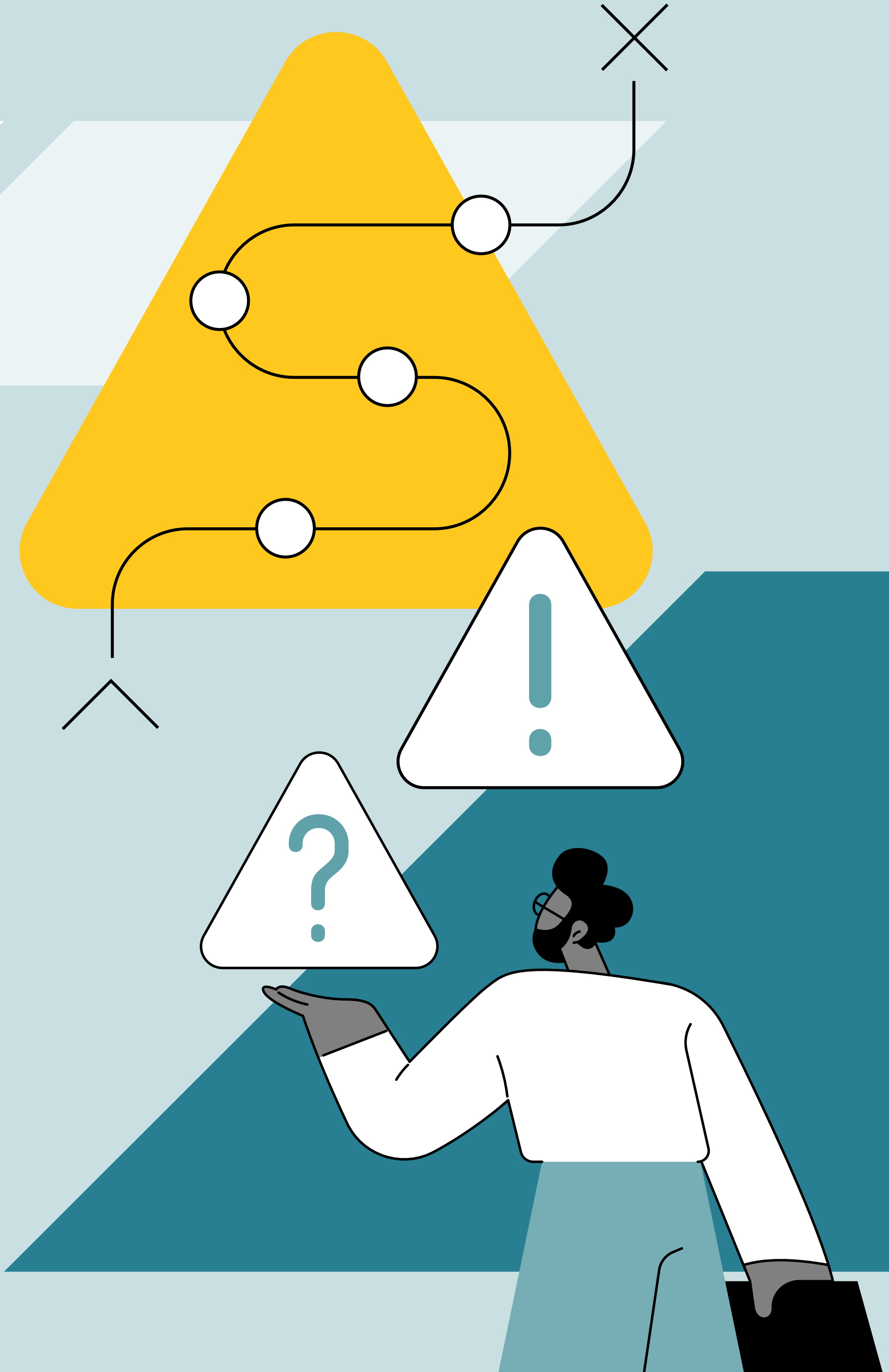
Overall and under current assumptions, the results support the general rationale that larger projects are more cost-efficient than small-scale projects, with an estimated LCOA as low as USD 3.35 per kg (large-scale PV + wind) compared with USD 3.96 per kg (small-scale PV). However, this is still more than twice as much as for the conventional grey product and does not result in a positive NPV. As for the hydrogen use cases, corresponding sensitivities were calculated for a CO_2 tax of USD 10 per tonne and curtailment of excess electricity. They show that a CO_2 levy of USD 10 would only marginally lower the LCOA for the proposed case by between USD 0.01 and 0.02 per kg. The curtailment of excess electricity would, however, significantly increase the cost of green ammonia by between USD 0.86 and 1.54 per kg, depending on the case.



It is important to note that the aforementioned options provide an estimate of potential green hydrogen and ammonia costs and that cost evaluations should be conducted on a project-by-project basis, as factors such as the local renewable profile and the industry's off-take profile (the analysis in **Section 7.1** assumes a constant profile) can significantly influence the levelised cost, particularly due to their impact on the sizing of the electrolyser and storage system required. This effect is smaller for ammonia than for hydrogen, as ammonia has significantly lower storage costs. Additionally, securing an off-taker for the oxygen produced can be challenging, as revenue from the sale of this by-product generally does not justify investment in extensive transport infrastructure. In certain scenarios, it may be feasible to derive additional benefits from using the electrolyser's waste heat for applications such as industrial pre-heating processes and to conclude a power purchase agreement (PPA) with other renewables, for example, to make use of the constant renewable profile of existing hydropower assets.

8

Charting a way forward for green ammonia deployment in Ghana



8.1 Country-specific challenges for green ammonia implementation

Ghana's pursuit of green ammonia deployment as part of its energy transition and agricultural modernisation faces several unique challenges. While the country has demonstrated commitment through its Energy Transition and Investment Plan (ETIP) and has updated its net zero target, bringing the date forward from 2070 to 2060 (Kasaghana, 2025), the path to establishing a viable green ammonia industry presents distinct hurdles that must be addressed.

Water resource constraints

High water requirements: Electrolysis demands significant water input of about 9 tonnes per tonne of hydrogen (Astute Analytica, 2025), competing with water needed for agriculture, manufacturing and potable water supply. Investors must therefore consider the source of water in their project siting analysis.

It is important to note that this challenge generally arises in relation to very large-scale projects.

Policy and regulatory gaps

ABSENCE OF H_2/NH_3 REGULATIONS

While the 2011 Renewable Energy Act and the ETIP provide general direction, Ghana lacks the detailed roadmaps, certification systems and product and safety standards that have accelerated adoption in Europe, through initiatives such as H_2Global and the European Hydrogen Bank (Proton Ventures, 2025), and in some Asian countries, for example, Thailand and India.

NO CARBON PRICING

Unlike Norway's USD 176/tonne CO_2 tax or the EU's Carbon Border Adjustment Mechanism (charge of 50% of the Emissions Trading System price for ammonia imports from 2026) (Proton Ventures, 2025), Ghana has no comparable mechanisms to bridge the green–grey price gap.

FRAGMENTED COORDINATION

Multiple agencies (Energy Commission, EPA, PURC) oversee aspects of energy and the environment (SEforALL, 2025), but Ghana lacks the kind of dedicated hydrogen/ammonia governance structure seen in more advanced markets.

Economic and financial barriers

CAPITAL INTENSITY

With 50% of production costs tied to capital expenditure, Ghana's high cost of capital and perceived investment risks deter financiers, especially given global liquidity tightening since 2022 (Proton Ventures, 2025). It is again advisable to seek funding for green hydrogen and ammonia projects from outside sources with low interest rates and more favourable terms (e.g. Green Climate Fund – GCF), through the Ministry of Finance (MoF), the National Designated Authority, or Ecobank Ghana Limited, the Direct Access Entity. For more details, see **Section 6.3**.

LACK OF LONG-TERM OFF-TAKE AGREEMENTS

The ammonia market traditionally operates on a floating price basis, making it difficult to secure the price guarantees needed to de-risk projects (Proton Ventures, 2025). Ghana's domestic fertiliser market may not provide sufficient demand certainty, but targeting the neighbouring West African countries as a block could enhance prospects immensely.

Infrastructure and technological limitations

INADEQUATE STORAGE AND TRANSPORTATION

Global projections indicate a need for 35 million tonnes of additional ammonia storage by 2030 (Astute Analytica, 2025). Ghana currently has negligible ammonia-specific storage capacity, and massive investments would be required in cryogenic storage tanks and specialised handling facilities. This situation offers a formidable business opportunity to investors and requires them to undertake extensive project siting analysis that takes into account the major consumers of the products.

POWER GRID CONSTRAINTS

While Ghana is aiming for 150 GW solar PV capacity by 2060 (SEforALL, 2025), current renewable energy infrastructure cannot support the energy requirements of green ammonia production at scale, specifically 10–11 MWh per tonne of ammonia (Proton Ventures, 2025). For this reason, it is prudent to install on-site renewable energy production for green hydrogen and ammonia projects.

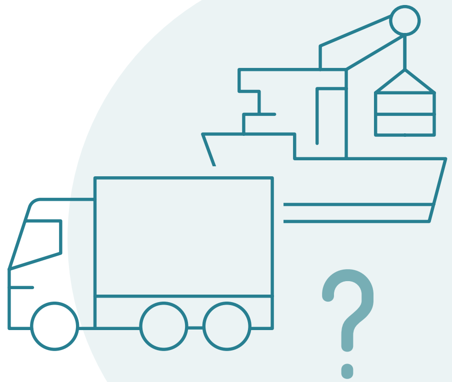
Market challenges

LIMITED DOMESTIC DEMAND

While agriculture consumes 50% of global ammonia (Farmonaut, 2024), Ghana's fertiliser market is relatively small, lacking the scale of the markets in India (18 million tonnes/year) or China (35 million tonnes/year) (Astute Analytica, 2025) to anchor major production. Therefore, targeting West Africa as a block could make it easier to address this challenge. It is worth mentioning that nine countries in West Africa, namely the Niger, Togo, Benin, Senegal, Burkina Faso, Côte d'Ivoire, Ghana, Mali and Nigeria, imported about 2.8 million tonnes of fertiliser in 2020. Ghana, in that year, imported about 510,000 tonnes (IFDC, 2022) and 554,239 tonnes in 2024 (Ecofin Agency, 2025).

EXPORT COMPETITION

Ghana would be competing with established exporters, such as Australia (targeting 5 million tonnes/year by 2030) and Saudi Arabia's NEOM project (1.2 million tonnes/year), requiring exceptional cost competitiveness (Astute Analytica, 2025). It is, however, important to indicate that the emission levy of the International Maritime Organization (IMO) and the general cost of transportation could benefit investors in Ghana. In addition to this, the Volta Economic Corridor, a major multimodal transport system that integrates the Volta Lake with a railway network to connect Ghana's ports to landlocked neighbours Burkina Faso, Mali and Niger (Abraham, 2024), could enhance distribution prospects in West Africa.



8.2 Opportunities identified for hydrogen implementation

This section examines the current opportunities, support frameworks and implementation pathways for green hydrogen technologies in the Ghanaian context.

Renewable energy deployment

SOLAR POTENTIAL

With irradiation levels of 4.5–5.6 kWh/m²/day (highest in northern regions), Ghana could generate solar electricity at <1.9 EUR/kWh by 2050 according to H_2ATLAS-AFRICA projections (Acquah, 2024). Currently, installed solar capacity is modest (231 MW as of 2023) but growing (ISA GHIC, 2023).

HYDROPOWER DOMINANCE

Existing hydro infrastructure (1.58 GW from Akosombo and Kpong dams and 400 MW from Bui Dam) provides 36% of national capacity and could enable hybrid renewable–hydrogen systems (ISA GHIC, 2023).

WIND POTENTIAL

Ghana's wind potential is strongest along coastal and ridge-top corridors (5.5–7.0 m/s at 50 m), with resource mapping confirming bankable sites. While current installed capacity is negligible, pilot projects show strong feasibility, and national plans target 275–325 MW by 2030, including the Volta River Authority's 150 MW pipeline on the eastern coast. Offshore resources also present a promising future complement (Adaramola, Agelin-Chaab, & Paul, 2014); (Dzebre, Ampofo, & Adaramola, 2021); (Odoi-Yorke, Frimpong Adu, Ampimah, & Atepor, 2023).

Strategic industrial applications: Agricultural transformation

GREEN FERTILISER PRODUCTION

Local green ammonia could be used to produced nitrogen fertilisers, reducing import dependency and price volatility and helping to achieve food security goals.

Strategic industrial applications: Industrial decarbonisation

MINING AND BAUXITE

Ghana's gold mining and bauxite–aluminium industry could use green hydrogen for high-temperature processes and fuel switching.

MANUFACTURING AND COLD STORAGE

Hydrogen and ammonia and its derivatives could be used as feedstock, and ammonia as a refrigerant.

OIL AND GAS PROCESSING

The gas processing companies and the petroleum refineries (i.e. TOR and SORL) present opportunities for green hydrogen integration to reduce carbon-intensive processes.

Strategic industrial applications: Maritime fuel

MARITIME FUEL

Emerging demand for green ammonia as a shipping fuel (e.g. Nordic Green Ammonia Powered Ships (NoGAPS) project) could position Ghana as a regional hub if infrastructure is developed. IMO has agreed to a levy on shipping emissions, where ships failing to meet a decarbonisation target will face a USD 100 charge for every tonne of CO_2 above the established threshold, and those falling short of a lower target could have to pay up to USD 380 per tonne. This new pricing mechanism starts in 2028 and aims to encourage the use of zero and near-zero emission fuels by generating revenue for green fuel development and supporting vulnerable nations in their transition to cleaner practices (Edie, 2025).

Strategic industrial applications: Energy export potential

REGIONAL HYDROGEN CORRIDOR

Ghana is exploring participation in the proposed West African Hydrogen Pipeline led by Morocco (ISA GHIC, 2023).

AMMONIA SHIPPING

Proximity to Atlantic shipping lanes creates potential to export to Europe, although cost competitiveness against Namibia (targeting 300,000 tonnes/year) remains challenging (Acquah, 2024).

Strategic industrial applications: Transport sector

TRANSPORT SECTOR

With regard to hydrogen mobility, there appear to be no active projects as yet, but Ghana's Energy Transition Framework targets hydrogen, particularly for shipping (e.g. Volta Lake Transport) and aviation.

8.3 National and international financing instruments and incentive schemes for green hydrogen investments in Ghana

Ghana's emerging green hydrogen sector benefits from a growing ecosystem of national and international financing instruments and incentive schemes designed to accelerate investment and deployment.

German instruments for investment in the international market

H_2GLOBAL (H_2GLOBAL STIFTUNG, 2025)
A reverse auction-based mechanism to support green hydrogen market development, offering 10-year purchase agreements. No project size or investment limitations; non-EU hydrogen producers can participate if they meet EU sustainability standards.

PTX DEVELOPMENT FUND (KFW, 2025)
Set up by the German Government and KfW Group. Provides non-reimbursable grants for large-scale projects in emerging economies, with no specific investment thresholds. Eligible countries include Brazil, Colombia, Egypt, India, Kenya, Morocco and South Africa (KfW, 2025). At present, Ghana is not listed among the eligible countries, but eligibility criteria and target countries may evolve in future funding rounds. The deadline for the second call for expression of interest was 5 March 2025. Investors should watch out for the announcement of the third call for expression of interest on the Fund's website.

INTERNATIONAL HYDROGEN RAMP-UP PROGRAMME (H_2UPP) (FEDERAL MINISTRY FOR ECONOMIC AFFAIRS AND CLIMATE ACTION, 2025)
Supports early-stage public–private partnerships for pilot projects, with a minimum public contribution of EUR 100,000 and a total project cost of at least EUR 200,000. Companies must contribute at least 50%. The deadline for submissions was in March 2025 (International PtX Hub, 2023), although the overall programme is expected to continue until 2026 (Federal Ministry for Economic Affairs and Climate Action, 2025). There was a call for the submission of project outlines for the funding of climate-friendly alternative drive systems in passenger transport, closing on 31 August 2025 (Federal Ministry for Economic Affairs and Energy, 2025). It is worth watching this space for relevant calls for project submissions.

UFK UNTIED LOAN GUARANTEES (UFK-GARANTIEN.DE, 2025)
Provides loan guarantees to reduce political and economic risks in targeted countries. Green hydrogen projects may be eligible if they align with Germany's energy strategy.

European instruments for investment in the international market

GREEN HYDROGEN FUND (GHF)

The European Investment Bank (EIB) established this fund to support large-scale green hydrogen infrastructure projects with substantial investments, requiring a 30%–40% contribution from applicants. Ghana may be eligible based on specific criteria (EIB, 2025). There is also the Neighbourhood, Development and International Cooperation Instrument – Global Europe programme (NDICI-GE), which is a major financing tool that contributes to eradicating poverty and promoting sustainable development, peace and stability around the world.

CLEAN HYDROGEN PARTNERSHIP (CLEAN HYDROGEN PARTNERSHIP, 2025)

It primarily supports the development and commercialisation of clean hydrogen technologies. No fixed limitations on project size or investment, but large, impactful projects are prioritised. Third countries may participate through specific agreements.

Multilateral instruments

AFRICAN DEVELOPMENT BANK (AFDB) (AFDB, 2025)

The Africa Climate Change Fund (ACCF) is a multi-donor trust fund that enhances access to climate finance through capacity building, direct project implementation and the strengthening of enabling environments.

The Africa Fertilizer Financing Mechanism is a special fund administered by the AfDB Group. It provides innovative financing solutions to improve production, procurement and distribution of organic and inorganic fertilisers and soil health interventions in Africa.

The Africa Energy Market Place (AEMP) is a collaborative investment platform created by the AfDB as part of the New Deal on Energy for Africa, the transformative partnership to light up and power Africa by 2025. The AEMP has been specifically designed to aid private investment in the energy sector by using a tripartite model that brings governments, the private sector and development partners together.

The Sustainable Energy Fund for Africa (SEFA) provides grants and concessional finance for renewable energy projects, including green hydrogen, in Africa. Ghana could benefit from SEFA to develop hydrogen infrastructure.

MIGA (MIGA, 2025)

MIGA offers political risk insurance and credit guarantees for hydrogen investments in developing countries, with a focus on projects with significant developmental impact. There is no strict minimum investment amount, but larger projects, especially those aligned with national development priorities, are likely to be prioritised.

GLOBAL ENVIRONMENT FACILITY (GEF)

Provides grants and concessional loans for renewable energy projects, including green hydrogen, to achieve decarbonisation and environmental goals (GEF, 2025).

WORLD BANK LOANS

The World Bank promotes the implementation of renewable energy, including hydrogen, through different programmes and initiatives. The bank indicated in 2021 that developing countries accounted for just USD 1.6 billion of the estimated USD 33 billion in outstanding green loans and that the market was growing rapidly and would outpace green bond market growth in the near term (World Bank, 2021).

Private Finance

HYDROGEN ONE CAPITAL

A private venture fund specializing in direct or indirect investments in hydrogen infrastructure and technology (HydrogenOne, 2025).

BREAKTHROUGH ENERGY VENTURES

Through different programs, Breakthrough Energy supports cutting-edge research and development by investing in companies with clean products to accelerate the clear energy transition (Breakthrough Energy, 2022).

GREEN BONDS

These bonds are fixed-income financial instruments designed to fund sustainable projects like renewable energies or clean transportation. There are different standards that can be applied. Two of the common ones are the Green Bond Principles issued by the International Capital Market Association (ICMA, 2025) and the Climate Bond Standards (Climate Bonds, 2025). These mechanisms provide diverse funding options tailored to different stages of hydrogen project development, ensuring both public and private contributions to the sector's growth.

National Financing Instruments

RENEWABLE ENERGY INVESTMENT FUND

Ghana's Ministry of Energy and Green Transition is establishing a Renewable Energy Investment and Green Transition Fund to support renewable energy deployment, including green hydrogen technologies. This fund will leverage fossil fuel revenues to finance Residential solar installations, Solar-powered irrigation facilities, Energy systems for hospitals and schools and SME renewable energy projects (P. Jowett, 2025), etc.

TAX INCENTIVES

Under existing frameworks like the Ghana Investment Promotion Centre (GIPC) Act and Free Zone Act, green hydrogen investors can access 10-year tax holidays for qualifying projects, Custom duty exemptions on renewable energy equipment and Import duty waivers for clean transport technologies (including hydrogen vehicles) (ActionAid, 2025).

GREEN CLIMATE FUND (GCF)

There is the potential for investors to access GCF funds through the Ministry of Finance, as the National Designated Authority (NDA) and Ecobank Ghana Limited, as the Direct Access Entity (DAE) (Green Climate Fund, 2020).

9

Conclusions

The study reveals a set of critical insights on shaping the future of green hydrogen and ammonia development in Ghana. These findings cover market demand, economic and technical feasibility, policy and institutional readiness, enabling local conditions and financing opportunities. Together, they provide a comprehensive understanding of both the potential for scaling this emerging sector and the challenges involved. Based on these findings, the following conclusions are drawn.

MARKET PROSPECTS AND DEMAND GROWTH
Green ammonia and its derivatives, particularly green fertilisers and green explosives for civil use, present promising opportunities. These prospects are further enhanced by the projected expansion of key demand-driving sectors, with agriculture expected to grow at 7% CAGR, mining and manufacturing each at 5%–6% CAGR, and oil and gas at 5%–7% CAGR through 2030.

ECONOMIC AND TECHNICAL INSIGHTS
Larger-scale projects are more cost-efficient, with a LCOA of USD 3.35 per kg compared to USD 3.96 per kg for small-scale PV, although both are higher than the levelised cost for grey ammonia. While a CO_2 levy has a minimal impact on reducing costs, curtailment of excess electricity could significantly increase them. Economic viability, however, can be enhanced by reducing capital expenditure and securing cheaper PPAs with renewable energy companies.

POLICY AND INSTITUTIONAL GAPS
Ghana still lacks detailed roadmaps, certification systems and product and safety standards needed to accelerate adoption, despite the general direction provided by the 2011 Renewable Energy Act and the ETIP. In addition, no dedicated training programmes or academic curricula currently exist to build the technical, operational and safety expertise required for this emerging sector.

ENABLING CONDITIONS FOR LOCAL PRODUCTION
Ghana offers moderate market conditions for green ammonia production, thanks to strong demand, favourable renewable energy resources and a stable policy environment. Additional advantages include regulatory incentives and land availability outside major regional capitals.

FINANCING OPPORTUNITIES AND SCALABILITY
Green hydrogen and ammonia projects in Ghana can potentially access a range of financing sources from German, European and multilateral programmes as well as private capital and national incentives. Instruments include grants, concessional loans, guarantees, venture funds, green bonds and tax breaks. Together, these mechanisms can help reduce risks, attract investment and support scalability from pilot initiatives to large-scale commercial deployment.

10

Recommendations

The following recommendations highlight actionable pathways to advance green hydrogen and ammonia development in Ghana, matching local market needs and German technology and fostering investment opportunities and sustainable, scalable growth.

TARGET FERTILISERS AND MINING AS ANCHOR MARKETS

Anchor green ammonia deployment in Ghana's high-demand fertiliser and mining sectors, ensuring secure off-take agreements and stable revenue streams. These sectors provide immediate domestic market pull, and gradual scaling can open up opportunities for regional exports and integration into global green value chains.

PRIORITISE LARGE-SCALE, HYBRID RENEWABLE PROJECTS

Promote utility-scale projects that integrate solar, wind and hydropower through competitive PPAs. Hybrid designs will minimise curtailment, optimise capacity utilisation and lower the LCOA, thereby creating bankable project pipelines that appeal to German investors seeking scale and reliability.

LEVERAGE BLENDED FINANCE AND RISK MITIGATION INSTRUMENTS

Utilise German and European financing tools (H2Global, EIB's GHF), in combination with concessional finance from the AfDB-managed SEFA and private equity, to structure blended finance models. These mechanisms will de-risk early-stage investments, enable scalability from pilot to commercial plants and attract broader private sector participation.

INVEST IN LOCAL CAPACITY BUILDING

Support the establishment of specialised training programmes, research partnerships and academic curricula focused on hydrogen technology, operations and safety. Collaboration with Ghanaian universities and technical institutes will help build a skilled workforce, enhance local ownership and ensure the long-term sustainability of power-to-X (PtX) projects.

DEVELOP A JOINT GREEN HYDROGEN ROADMAP

Establish a collaborative and comprehensive roadmap that aligns emerging green hydrogen and ammonia policies with international sustainability and certification standards. Such alignment will ensure compatibility with local use and future export markets while providing policy certainty and investment confidence for developers and local stakeholders.

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