UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

GLOBAL PROGRAMME
GREEN HYDROGEN IN INDUSTRY

H4D Partnership

AN **H4D** DELIVERABLE FOR
WORKSTREAM FIVE -
HYDROGEN USE IN INDUSTRY

GREEN AMMONIA FOR LOW-CARBON FERTILIZER PRODUCTION

Case Studies in North Africa

Why green ammonia matters?

Ammonia underpins all mineral nitrogen fertilizers, accounting for nearly 70 percent of global ammonia use, which makes how it is produced critically important for food systems; producing ammonia through green pathways—by using renewable electricity to generate hydrogen and synthesize ammonia—enables a locally sourced fertilizer supply while significantly reducing the climate impact associated with conventional ammonia production

1

2.1 CO_2-eq per kg NH_3

Conventional natural-gas ammonia has a global average emissions intensity of 2.1 kg CO_2-eq per kg NH_3 in 2022 .

3

Green ammonia can support food security, energy sovereignty, and industrialization while reducing exposure to fossil fuel price volatility

NH_3

430 Mt CO_2e

2

Ammonia production and use generate major emissions across the supply chain, with about 430 Mt CO_2e in Scope 1 and 610 Mt CO_2e in Scope 3 in 2020

Africa's fertilizer challenge

22 kg/ha vs 146 kg/ha

A sevenfold gap in fertilizer use

Africa applies only 22 kg of fertilizer per hectare, compared to a global average of 146 kg/ha. This gap directly limits crop yields and suppresses rural incomes.

+

90%

Heavy dependence on imports

More than 90% of Africa's fertilizer supply is imported, leaving food systems highly exposed to global price volatility

+

Global shocks, local impact

Global instability and supply chain disruptions exposed this vulnerability, triggering sharp price spikes across African agricultural markets.

Strategic Imperatives

Africa's fertilizer gap is not a supply problem — it is a structural dependence problem that green ammonia can resolve domestically.

Green ammonia is simultaneously a food security intervention and an industrial decarbonization strategy — the two goals are inseparable.

North Africa's renewable energy assets make it the most logical launchpad for this transition on the continent.

The window of opportunity is open now: global decarbonization momentum, EU regulatory pressure, and declining renewable costs converge in this decade.

Global Fertilizer Market Overview

Production Volume

Global fertilizer production reached 200 million tonnes in 2022, with nitrogenous fertilizers (ammonia-based) making up 50% of that total.

Geographic Shifts

While China remains the top nitrogen producer, its market share has dropped from 32% to 22% over the last 12 years.

Extreme Concentration

Specific regions dominate critical resources—Morocco holds 70% of global phosphate reserves, while Canada produces nearly 32% of the world's potash.

Domestic Dominance

Despite a global production of 185.6 million tonnes, only 9% of ammonia is traded internationally. Most is consumed in the country where it is produced.

North African Influence

Egypt is a powerhouse in urea production (nearly 50% of Africa's output), whereas Morocco is the continent's largest ammonia importer to sustain its phosphate industry.

Strategic Leverage

Because the international ammonia market is "thin," countries that can produce it domestically gain significant geopolitical and economic advantages.

Green Ammonia Opportunity

Morocco's high demand for imported ammonia (1.28 Mt/year) presents a massive, ready-made market for transitioning to domestic green ammonia production.

No "One-Size-Fits-All"

Green energy strategies in North Africa must be tailored to each country's specific role—whether they are currently an exporter (like Egypt) or an importer (like Morocco).

Country Snapshot– North Africa's Green Advantage

Egypt

Morocco

Tunisia

	Egypt	Morocco	Tunisia
Current Ammonia Position	**Africa's leading ammonia producer**. Net producer (4.47 Mt NH_3/yr, 2023); declining natural gas output pushed Egypt back toward net-importer status in 2024.	**Largest ammonia importer in Africa**, sourcing mostly from Trinidad & Tobago (45.3%) and Saudi Arabia (27.5%) to feed its phosphate-based fertilizer industry.	**Net NH_3 importer (~99,000 t/yr, 2023)**; domestic production insufficient for fertilizer industry demand.
Estimated H_2 Needed to Replace Current Ammonia	**~805,140 tonnes** of green hydrogen/year (based on 4,473,000 t NH_3 production in 2023).	**~230,580 tonnes** of green hydrogen/year (based on 1,281,000 t NH_3 imports).	**~17,820 tonnes** of green hydrogen/year (based on 99,000 t NH_3 imports).
Solar Potential (GHI)	**5.52–6.71 kWh/m²/day**— among the world's highest irradiation levels.	**4.76–6.13 kWh/m²/day** — exceptional, especially in desert regions.	**4.57–5.80 kWh/m²/day** — over 3,000 sunshine hours/year; up to 3,400 hrs/yr in the south.
Solar Potential (DNI)	**5.25–7.85 kWh/m²/day;** excellent for CSP technology.	**4.52–7.20 kWh/m²/day;** particularly strong for CSP in desert regions.	**>2,000 kWh/m²/yr across central/south;** up to 2,300 kWh/m²/yr in the extreme southeast.
Wind Energy Potential	**8–10 m/s** along Red Sea coast**; 6–8 m/s** in southwest; wind power density **507.6 W/m².**	**7–10 m/s at 100 m;** onshore density **541.1 W/m²;** overall potential **~25 GW;** best sites in L'Oriental and Guelmim-Oued Noun.	Speeds **>7 m/s** at 80 m in prime locations (Bizerte, Nabeul, Kasserine, Tataouine); ~32,200 km² suitable land; gross potential >8,000 MW.
Renewable Energy Target	**42% renewable electricity by 2040 (~85 GW)**; Low-Carbon H_2 Strategy targets 1.5 Mt H_2/yr by 2030 .	**52% renewable capacity by 2030 (~20 GW);** H_2 roadmap targets 131.5 GW renewables by 2050; Morocco Offer launched March 2024.	**35% RE by 2030; 50% by 2035; 100% by 2050;** National Green H_2 Strategy (2024) targets 100 GW renewables and 8.3 Mt H_2/yr.
Water Resources	Total supply ~59.25 BCM/yr; ~20 BCM annual deficit; desalination scale-up targeted from 1.4 M to 8.8 M m³/day.	Ranked 22nd globally in water stress; requires 50–70 Mm³/yr desalinated water for H_2; H_2 production could consume 4–6% of total water by 2050.	Water stress coefficient 96%; rainfall highly uneven (150–1,500 mm); desalination designated as exclusive water source for H_2 production.
Local Fertilizer / Industrial Capacity	NH_3 nameplate capacity >6.2 Mt/yr; key producers: EFC (1.55 Mt), MOPCO (1.28 Mt), EBIC (0.73 Mt), Abu Qir group (>1.68 Mt); most advanced ammonia infrastructure in Africa.	OCP Group holds ~70% of world phosphate reserves; fertilizer capacity expanded from 4 Mt to 12 Mt (2012–2021); USD 12B green investment programme (2023–2027) targeting 100% RE by 2027.	GCT (state-owned): phosphate rock capacity 8.5 Mt/yr; installed capacity DAP (1.3 Mt), TSP (0.9 Mt), MGA (1.3 Mt), AN (0.33 Mt); industry significantly underutilized.
Green Ammonia Projects	**Damietta** (0.15 Mt NH_3/yr), **Egypt Green Ph.1&2**, **ACME Egypt** (2.1 Mt/yr), **Scatec Ain Sokhna Ph.1&2** (~4 Mt/yr total); solar/wind electrolysis-based.	**AMUN phases** (~7 Mt NH_3/yr total), **OCP Tarfaya Ph.1&2** (3 Mt/yr), **Jorf H_2 Project** (0.1 Mt/yr, operational by 2027); predominantly new build solar/wind capacity.	Nascent stage: **H2 Global Energy flagship** (1 Mt NH_3/yr, target 2031), **Demonstrator Tunisia pilot in Gabès** (630 t NH_3/yr, 2025–2030); long-term export target 350,000 t NH_3/yr by 2050.
Transport Infrastructure	**2nd largest port capacity in Africa (~800,000 TEUs)**; LNG terminals (Damietta SEGAS 5 Mtpa, Sumed BW FSRU 5.7 Mtpa); ports of Abu Qir, Edco & Damietta have existing ammonia/LNG handling; pipelines available for repurposing.	**Largest port capacity in Africa (~900,000 TEUs)**; 12 commercial seaports on Mediterranean & Atlantic; key export hubs: Dakhla, Tan-Tan, Laayoune, Agadir; Morocco Offer includes dedicated H_2 port infrastructure and pipeline development.	**Smallest port capacity (~100,000 TEUs)**; extensive natural gas pipeline network (part of North Africa's 23,733 km network); engineering studies underway to repurpose pipelines for H_2; Gabès port being developed for green ammonia handling.
Overall Maturity Level	**Advanced** — Largest existing ammonia infrastructure in Africa; multiple green ammonia projects progressing from feasibility to construction; comprehensive Low-Carbon H_2 Strategy (2024) with Golden License; 2nd-ranked in Africa for announced green H_2 capacity for ammonia (29% of Africa's total).	**Advanced-to-Leading** — Most ambitious project pipeline (AMUN, OCP Tarfaya); Jorf H_2 Project operational by 2027; Morocco Offer (2024) as a fully structured framework; largest port capacity; OCP's USD 12B green investment signals strong commercial commitment .	**Emerging** — Largest ambitions relative to current size (100 GW, 8.3 Mt H_2/yr by 2050); however projects remain at demonstration/announcement stage; policy framework still nascent; smallest port capacity; Gabès pilot (2025–2030) as first concrete step.

Acronyms:

AN (Ammonium Nitrate), ANRE (National Authority for the Regulation of the Electricity Sector), ATR (Autothermal Reforming), BCM (Billion Cubic Metres), CAPEX (Capital Expenditure), CCS (Carbon Capture and Storage), CCUS (Carbon Capture, Utilization and Storage), CO_2-eq (Carbon Dioxide Equivalent), CSP (Concentrating Solar Power), DAP (Diammonium Phosphate), DCP (Dicalcium Phosphate), DNI (Direct Normal Irradiation), EBIC (Egypt Basic Industries Corporation), EECA (Eastern Europe and Central Asia), EFC (Egyptian Fertilizer Company), ESMAP (Energy Sector Management Assistance Program), FAO (Food and Agriculture Organization), FID (Financial Investment Decision), FSRU (Floating Storage and Regasification Unit), GCT (Groupe Chimique Tunisien), GHG (Greenhouse Gas), GHI (Global Horizontal Irradiation), GW (Gigawatt), H_2 (Hydrogen), H_2SPA (Hydrogen Sale and Purchase Agreement), H_2/yr (Hydrogen per Year), IEA (International Energy Agency), IRENA (International Renewable Energy Agency), kt H_2/yr (Kilotonnes of Hydrogen per Year), kWh/kWp (Kilowatt-hours per Kilowatt Peak), kWh/m²/day (Kilowatt-hours per Square Metre per Day), LAC (Latin America and the Caribbean), LCOH (Levelized Cost of Hydrogen), LNG (Liquefied Natural Gas), m/s (Metres per Second), m³/day (Cubic Metres per Day), MAP (Monoammonium Phosphate), MASEN (Moroccan Agency for Sustainable Energy), MGA (Merchant-Grade Phosphoric Acid), MIME (Ministry of Industry, Mines and Energy — Tunisia), Mm³ (Million Cubic Metres), MOPCO (Misr Fertilizers Production Company), Mt (Million Tonnes), Mt-NH_3/yr (Million Tonnes of Ammonia per Year), MW (Megawatt), NH_3 (Ammonia), OCP (Office Chérifien des Phosphates), ONEE (National Office of Electricity and Drinking Water), OPEX (Operational Costs), P_2O_5 (Phosphorus Pentoxide), PEM (Proton Exchange Membrane), PPA (Power Purchase Agreement), PPP (Public-Private Partnership), PV (Photovoltaic), PVOUT (Photovoltaic Power Output), RE (Renewable Energy), SDS (Sustainable Development Scenario), SMR (Steam Methane Reforming), t (Metric Tonne), TEU (Twenty-foot Equivalent Units), TSP (Triple Superphosphate), UNIDO (United Nations Industrial Development Organization), W/m² (Watts per Square Metre), WACC (Weighted Average Cost of Capital)

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Green Hydrogen Policy Landscape

	Egypt	Morocco	Tunisia
National H_2/ RE Strategy	**Low-Carbon Hydrogen Strategy** (2024); Central Scenario: 1.5 Mt H_2/yr by 2030, 5.8 Mt by 2040; Green Scenario: 3.2 Mt H_2/yr by 2030, 9.2 Mt by 2040.	**National Hydrogen Roadmap** (2021); "Morocco Offer" officially launched 11 March 2024 as the comprehensive strategic framework for a competitive green hydrogen industry.	**National Strategy for the Development of Green Hydrogen and Its Derivatives** (July 2024); targets 8.3 Mt H_2/yr (6.3 Mt for export, 2 Mt domestic use).
Renewable Energy Target	**42%** of generated electricity from renewable sources **by 2040.**	**52%** of total electricity from renewables **by 2030** (20% solar, 20% wind, 12% hydro).	**35%** RE by 2030; 50% by 2035; 100% **by 2050.**
Key Enabling Legislation	**Decree No. 203/2014** (Competitive bidding, feed-in tariffs); **Electricity Law No. 87/2015** (Private-to-end-user sales); **Green Hydrogen Incentives Law No. 2** of 2024.	**Law 13-09** (private sector participation); **Law 54-14** (priority grid access); **Law 58-15** (net metering); **Law 48-15** (established ANRE); **Law 40-19** (certificates of origin for RE).	**Law No. 2015-12** (Independent power production, liberalization); **Decree No. 2016-1123** (Competitive auctions for solar PV and wind); **Law No. 2016-71** (Tunisian Investment Fund).
Institutional Governance	**National Council for Green Hydrogen and Its Derivatives** (2023), chaired by the Prime Minister.	**Green Hydrogen Steering Committee**; **MASEN** serves as the main investor coordination entity.	**National Hydrogen Working Group** under MIME.
RE Procurement Mechanism	Competitive **auctions** and **long-term PPAs** managed by NREA; **private-to-private (P2P)** regulations recently approved.	Competitive **auctions** managed by MASEN; **grid access guaranteed** via ONEE/ANRE.	Competitive **auctions** under Decree 2016-1123; **bilateral access agreements** to national grid.
Financial Incentives for RE / H_2	Income tax rebate of 33%–55% on H_2 activities; VAT exemption on equipment imports; zero VAT on green H_2 and derivatives exports; exemptions from real estate tax, stamp duties and customs; 30% tax deduction for RE projects for 7 years; reduced customs duties on equipment (from 5% to 2%).	Investment grants up to 10% of new capital goods (up to MAD 20M); export-oriented solar industries receive free-zone status; 15-year VAT, customs and patent relief; 5-year corporate tax holiday then fixed 8.75% rate for 20 years.	Energy Transition Fund (up to TND 100M in loans and subsidies); Law No. 2016-71 Subsidies, equity investment and preferential tax treatment; planned VAT exemptions, GOs, and blended finance via EIB, EFSD+, H2Global and EBRD.
Infrastructure & Land Access	**7,600 km^2 allocated for for RE projects** (5,700 km^2 wind; 1,900 km^2 solar); dedicated customs ports; 30% reduction on seaport fees; 25% discount on industrial land usufruct; 20% discount on port storage fees.	**300,000 ha initially earmarked** (from 1M ha total); up to 30,000 ha per project; shared ports, desalination, grids and dedicated H_2 pipelines; 2,000-ha land bank for clean energy industries.	Planned investments in H_2 backbone pipeline, ports and desalination; Gabès pilot co-located with GCT (2025–2030).
Permitting Simplification	"**Golden License**" implemented: one-stop mechanism consolidating all permits; companies may import without importer registration and export without export licensing.	**Dedicated regulatory framework** planned covering production, storage, transport and traceability; streamlining permitting part of Morocco Offer commitments.	**Exploring regulatory approval process** modeled on Egypt's Golden License; framework still at early stage.
Green Ammonia-Specific Demand Targets	**Export-oriented: 1.4 Mt H_2/yr for export by 2030** (central scenario); required electrolyzer capacity: 13 GW by 2030, scaling to 48 GW by 2040.	**Domestic green ammonia demand: 0.5 Mt (2030)**, 2.5 Mt (2040), 3.8 Mt (2050); up to 10.7 GW of Haber-Bosch capacity needed by 2050.	Gabès pilot: 630 t NH_3/yr; long-term export target: 350,000 t NH_3/yr by 2050 (**starting with 20,000 t by 2030**).
Workforce Development & Human Capital	Up to 30% of workforce may be foreign nationals during first 10 years to facilitate knowledge transfer; no specific national training body named in this section.	GreenH2A and Cluster Maroc Hydrogène lead training and capacity-building programmes; academia–industry collaboration emphasized.	Green H_2 modules planned for vocational schools; practical training linked to GCT Gabès pilot; strategy projects 116,000+ jobs created by 2050.

Key Takeaways

Egypt leads on investor incentives

Morocco leads on scale and infrastructure commitment

Tunisia is the most ambitious long-term renewable target case

Acronyms:

AN (Ammonium Nitrate), ANRE (National Authority for the Regulation of the Electricity Sector), CBAM (Carbon Border Adjustment Mechanism), DAP (Diammonium Phosphate), EBRD (European Bank for Reconstruction and Development), EETC (Egyptian Electricity Transmission Company), EIB (European Investment Bank), EFSD+ (European Fund for Sustainable Development Plus), GCT (Groupe Chimique Tunisien), GOs (Guarantees of Origin), GW (Gigawatt), H_2 (Hydrogen), H_2/yr (Hydrogen per Year), IEA (International Energy Agency), kt (Kiloton), LCOH (Levelized Cost of Hydrogen), MASEN (Moroccan Agency for Sustainable Energy), MIME (Ministry of Industry, Mines and Energy — Tunisia), Mt (Million Tonnes), Mt H_2/yr (Million Tonnes of Hydrogen per Year), MW (Megawatt), NH_3 (Ammonia), NREA (New and Renewable Energy Authority — Egypt), OCP (Office Chérifien des Phosphates), ONEE (National Office of Electricity and Drinking Water), P2P (Private-to-Private), PPA (Power Purchase Agreement), PPP (Public-Private Partnership), PV (Photovoltaic), R&D (Research and Development), RE (Renewable Energy), t (Metric Tonne), TND (Tunisian Dinar), UNIDO (United Nations Industrial Development Organization), EU (European Union), VAT (Value-Added Tax), WACC (Weighted Average Cost of Capital)

Policy Recommendations

1. Demand creation

- Establish targeted incentives for farmers and agricultural cooperatives to adopt green ammonia-based fertilizers.
- Launch public awareness campaigns highlighting the benefits for productivity, sustainability and economic resilience.

2. Policy and regulatory framework

- Harmonize regulatory frameworks and standards across regions to facilitate cross-border trade of green ammonia.
- Streamline permitting and licensing procedures through "single-window" or "golden license" initiatives, reducing bureaucracy and accelerating project deployment.

3. Renewable energy development

- Accelerate the expansion of renewable energy infrastructure, particularly hybrid solar and wind systems, to optimize electrolyser utilization and reduce costs.
- Allocate dedicated zones or hubs for renewable hydrogen and ammonia production, leveraging existing infrastructure where possible.

4. Other infrastructure development

- Upgrade and repurpose existing natural gas infrastructure, including pipelines and storage facilities, to transport and store hydrogen or ammonia.
- Invest in expanding port capabilities specifically designed to efficiently manage green ammonia exports.

5. Financing / cost of capital

- Establish green financing mechanisms, including low-interest loans, green bonds, and public-private partnerships (:s) to mitigate upfront investment barriers.
- Provide sovereign guarantees or financial risk-sharing mechanisms to attract international investment and reduce the cost of capital.

6. Skills development

- Develop specialized vocational training programmes and educational curricula focused on renewable energy, hydrogen technologies and green ammonia.
- Create partnerships between academic institutions and industry stakeholders to ensure alignment between skills training and industry needs.