



PRODUCTION OF 'GREEN' FERTILISERS BASED ON RENEWABLE AMMONIA

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AMMONIA (NH₃) PRODUCTION

Ammonia is one of the most important products of the chemical industry. It is used in the production of:

- **nitrogen fertilisers (urea, ammonium nitrate)**
- **explosives**
- **nitric acid**
- **plastics and fibres**
- **refrigerants**

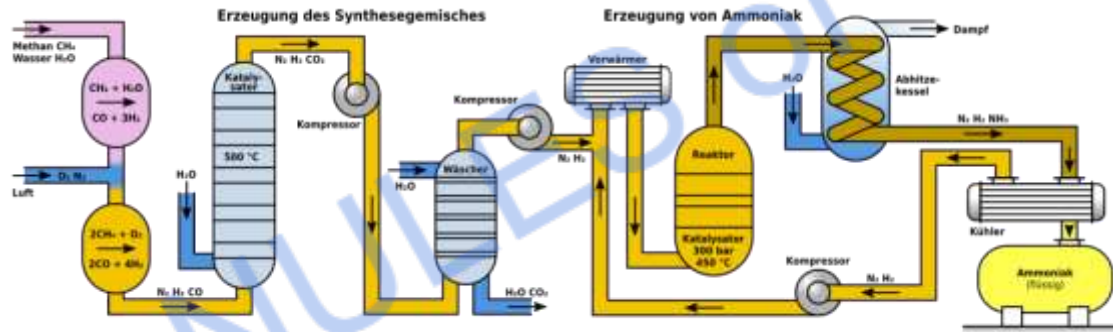
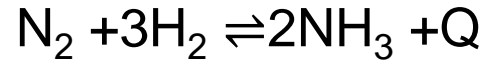


Global production exceeds 180 million tonnes per year, and almost all ammonia is produced using the Haber–Bosch process.

THE MAIN REACTION IN AMMONIA SYNTHESIS

air

natural gas

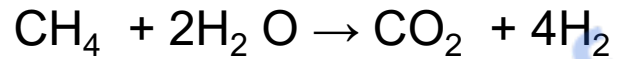


temperature 400–500 °C
 pressure 150–300 bar
 Catalyst Fe₃O₄ (iron)
 Conversion per pass 15–25 %

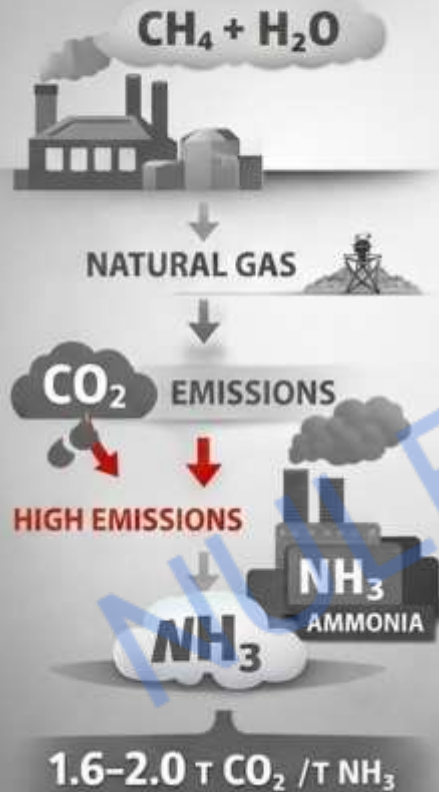


OVERALL REACTION FOR THE PRODUCTION OF HYDROGEN FROM METHANE

(reforming + conversion)



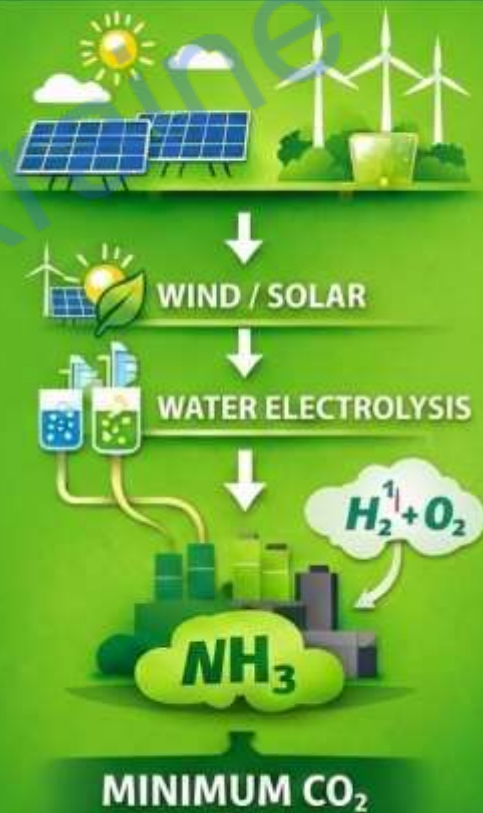
GREY AMMONIA



BLUE AMMONIA



GREEN AMMONIA



COMPARISON OF TYPES OF AMMONIA

Parameter	Grey	Blue	Green
Source H ₂	natural gas	natural gas	electrolysis
CO ₂	high	medium	almost 0
energy consumption	low	average	very high
cost	\$	\$\$	\$\$\$

For 1 t of NH₃, approximately:
9–12 MWh of electricity

The history of green ammonia production

1921

- Italian chemist Luigi Casale launches the first commercial process for synthesising ammonia using hydrogen obtained by electrolysis of water. This became the first viable alternative to the traditional Haber-Bosch process using fossil fuels.

1928

- A 165 MW industrial facility is launched in Rjukan, Norway. It used 150 electrolyser modules to produce green hydrogen using energy from local hydroelectric power stations.

1949

- A similar Norwegian project is launched in Glomfjord, also based on hydroelectric power and alkali electrolyzers.

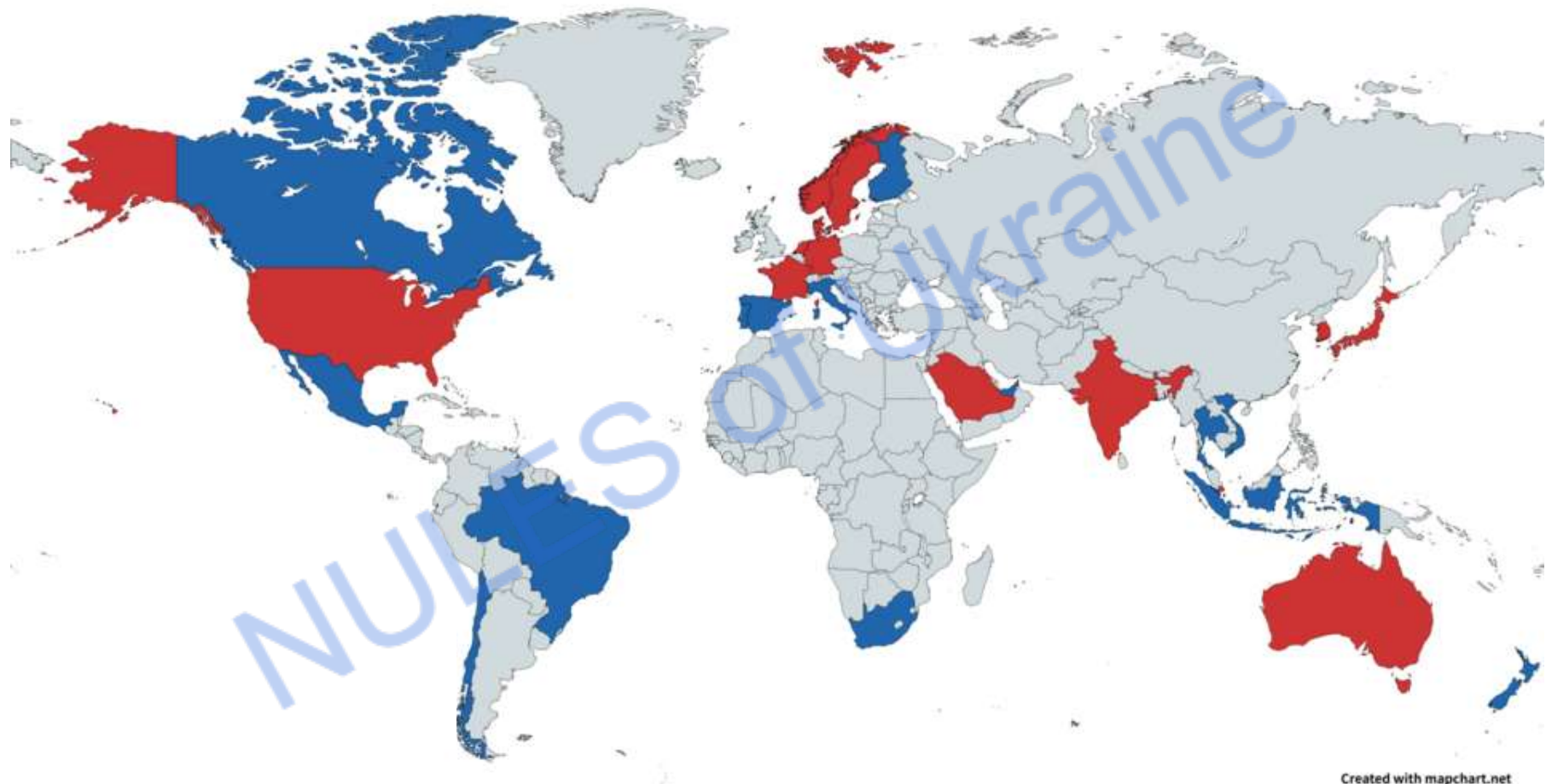
1959

- Projects are emerging in Egypt based on hydroelectric power from the Aswan Dam (with a capacity of 203 MW) and a smaller plant equipped by the BBC.

In the 1960s, production of this product began to decline due to its lack of economic competitiveness compared to cheap ammonia produced from natural gas.

Renaissance: A New Era for Green Ammonia (2018 – present)

- **2018:** The concept of 'blue' ammonia (with CO₂ capture) emerges as a transitional stage. That same year, active research and the first demonstration projects using renewable energy to power electrolysis begin.
- **2022:** Global production of green ammonia accounted for just 0.01% of the total, but over 60 companies announced plans to build new plants
- **2023:** Nature dedicates an entire special issue to 'green ammonia synthesis'
- **2023–2024:** The *Viking Energy* vessel in Norway begins using green ammonia from Yara in its fuel cells. *China National Energy Group* successfully tests the co-firing of ammonia with coal at a large-scale power station (600 MW)
- **2030:** The green ammonia market is forecast to reach \$54.8 billion (up from ~\$63 million in 2022). Mass adoption in international shipping is expected to begin
- **By 2050:** An ambitious target has been set to completely replace 'brown' ammonia with 'green' ammonia (net-zero agile ammonia)



KEY PROJECTS AT THE YARA PLANT



Project name / Site	Location	Capacity / Scale	Status / Year of completion	Key technology
Herøya	Norway	24 MW electrolyser	Operational	Hydrogen production from water via electrolysis using renewable energy (replacing natural gas).
Cubatão	Brazil	N/A	Operational	Use of renewable biomethane from sugarcane waste instead of fossil gas.
Sluiskil	Netherlands	Capture of ~800,000 tonnes of CO ₂ per year	Launch in 2026 (capture project)	Europe's largest industrial CO ₂ capture project at an operational plant for underground storage.
Yuri Renewable Hydrogen to Ammonia Project	Pilbara, Western Australia	10 MW electrolyser (640 tonnes of H ₂ /year)	Construction to be completed in 2026	Integration of solar-powered electrolysis to replace part of the hydrogen from SMR at an existing Yara plant.
Louisiana Clean Energy Complex	Louisiana, USA	2.8 million tonnes of ammonia per year (planned)	FID expected in mid-2026, completion by 2030	Partnership with Air Products: Yara will acquire facilities for the production of ammonia from low-carbon hydrogen (with 95% CO ₂ capture).
NEOM Green Hydrogen Project	Saudi Arabia	Up to 1.2 million tonnes of ammonia per year	Over 90% complete, commissioning in 2027	Partnership with Air Products: Yara will commercialise 'green' ammonia through its global network.

SKOVGAARD ENERGY (RAMME, DENMARK)

- The plant has an annual capacity of 5,000 tonnes of 'green' ammonia and delivers emissions reductions of approximately 9,600 tonnes of CO₂ per year.
- The project received DKK 81 million (approximately €11 million) in funding from the Danish Energy Technology Development and Demonstration Programme (EUDP).
- Power is supplied by 50 MW of new solar panels and 12 MW of Vestas wind turbines.



SOUTHERN TRANSPORT HUB (ODESSA REGION)

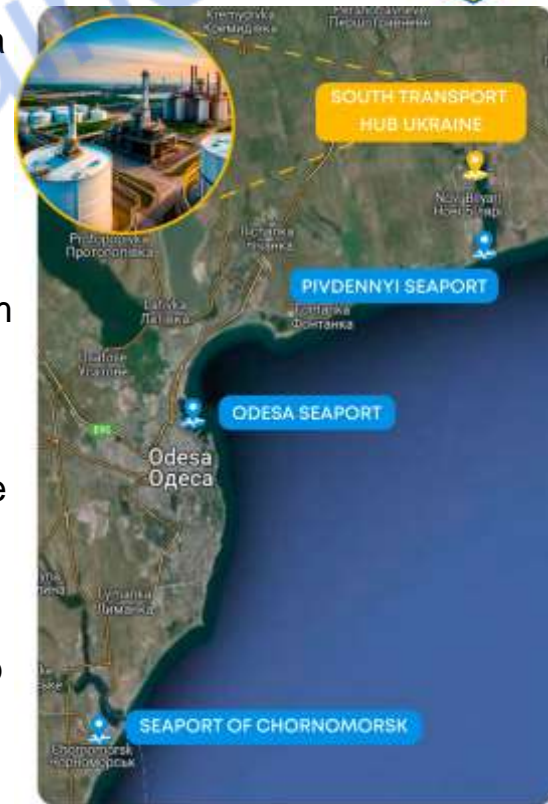


This is a major project aimed at establishing a large-scale centre for the production of **green hydrogen and green ammonia** in Ukraine, utilising **solar and wind energy**.

It involves:

- the installation of large **electrolysers (~1,485 MW)** for hydrogen production from renewable sources;
- the synthesis of green ammonia (up to \approx **1.2 million tonnes per year**);
- the use of the Pivdennyi port infrastructure for **product exports**;
- potential supply to Europe.

This is one of the most ambitious projects in the country, aiming to become **an export hub for green energy products**.



H2U Hydrogen Valley

Planned:

- a solar power station of **~120 MW**
- wind farm **~80 MW**
- an electrolyser of **~100 MW**

This will enable the production of:

- around **21,000 tonnes of green hydrogen per year**
- around **120,000 tonnes of green ammonia per year**
(partial conversion of gas into methanol, etc. is possible)

This project could serve as a pilot site for fertilisers and for further scaling up.



STRATEGIC PLANS AND POTENTIAL BY 2030

- to build up to **10 GW of electrolysis capacity** by 2030;
- part of this will be specifically for **the production of green ammonia**, including for the domestic fertiliser market;
- this will significantly contribute to **the decarbonisation of the economy** and reduce dependence on energy imports.



POTENTIAL BENEFITS FOR ORGANIC HORTICULTURE

- The agricultural sector's carbon footprint is reduced.
- Suitable for certified 'green' products, which are easier to sell on European markets.
- The use of such fertilisers in orchards enables the production of organically certified produce.



POTENTIAL BENEFITS FOR ORGANIC HORTICULTURE

- Production of urea and ammonium nitrate
- A stable domestic market — less dependence on imports.
- Construction of green ammonia plants and conversion of ammonia into fertilisers → thousands of jobs.
- Development of electrolyzers, ammonia synthesis technologies and fertiliser logistics.
- Support for related sectors: metallurgy, engineering, and service companies.



PROGRESS

Promoting Green Deal Readiness in
the Eastern Partnership Countries



THANK YOU FOR YOUR ATTENTION!

NULS of Ukraine

