

GREEN AMMONIA

The fast track to a more sustainable future



STAMI GREEN AMMONIA

WHAT ARE THE CHALLENGES

A new perspective on the fertilizer industry

The future is sustainable

As we move towards a decarbonized world, the industry is facing a huge challenge: how to achieve cost-effective zero-emission production. Carbon-free production technology is no longer science fiction, in any industry. We need to scale it up now. Since 2015, hundreds of countries across the planet have pledged to achieve **net-zero emissions by 2050** with the Paris Agreement. To meet this challenge we need realistic, cost-effective solutions **to create**

a **more sustainable food value chain** and ways of realizing green, effective, affordable energy storage.

Are you up to the challenge? We are!

Green is the answer

As world market leader in fertilizer plant design, licensing and construction, we believe **Green Ammonia** can play a key role in helping meet the carbon challenge.

Here's why.

Are you
up to the
challenge?
We are!





GREEN AMMONIA

Towards a sustainable food value chain

Green Ammonia can help you hit your zero-emission targets.

Ammonia without fossil fuels? Yes, we can!

Fact: 80% of global ammonia production is used as a raw material in the production of nitrogen fertilizer. Some 180 million metric tons of ammonia was produced in 2019 to meet that demand. Ammonia plays a vital role in food production, but its production

generates 1% of total global greenhouse gas emissions. That's mostly because traditional (brown/grey) ammonia production uses fossil fuels as feedstock.

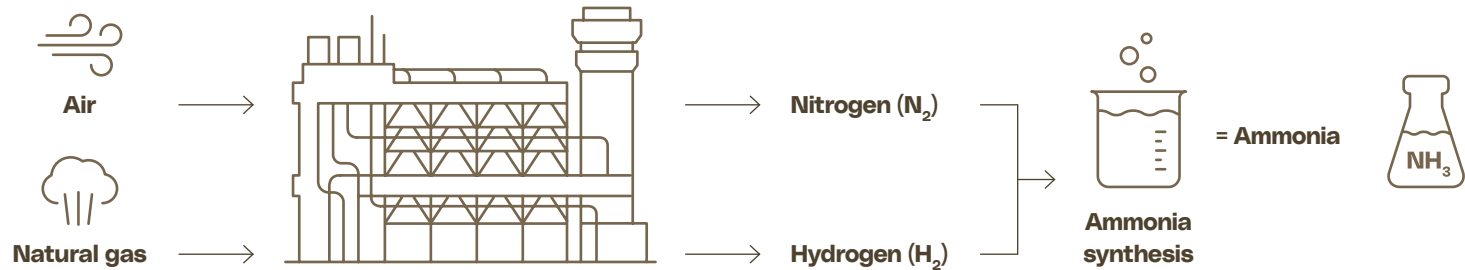
So what if we produce ammonia without fossil fuels? What if we could produce green ammonia **by using only sun, air and water**? Let's see what difference that would make.

TRADITIONAL ('GREY') AMMONIA PRODUCTION

Ammonia is made from hydrogen and nitrogen. A traditional ammonia plant converts fossil fuel (such as natural gas) into gaseous hydrogen. Hydrogen is

produced from hydrocarbons in a method known as steam reforming. Nitrogen is derived from process air. Ammonia is then synthesized from the hydrogen and nitrogen

in a catalytic reaction at high pressure and high temperature in the Haber-Bosch method.

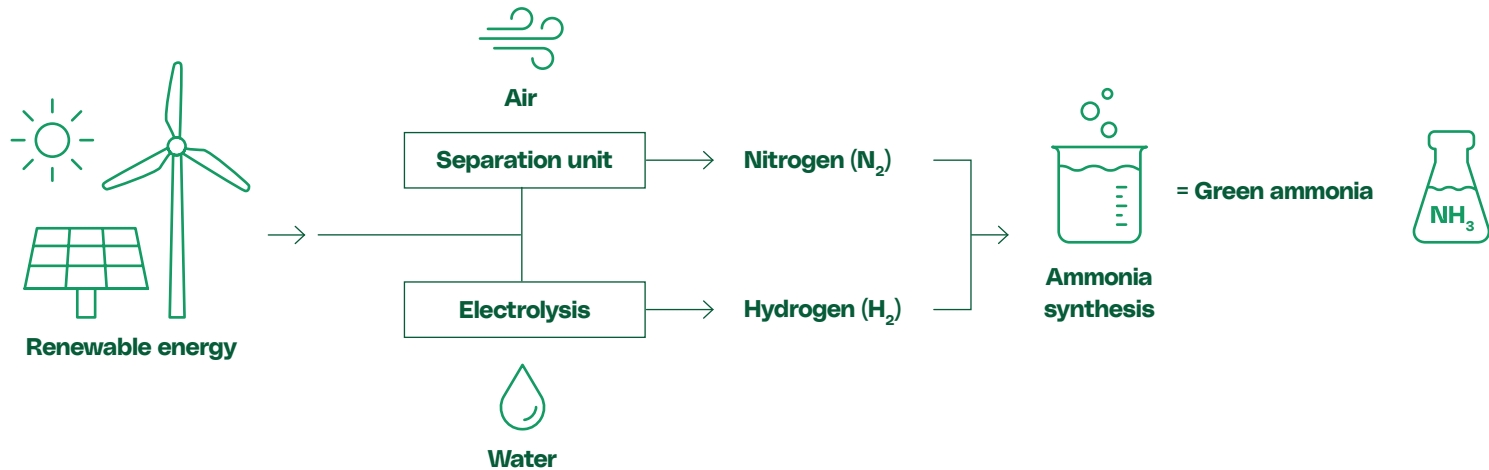


GREEN AMMONIA PRODUCTION

Ammonia can now also be produced in a much more environmentally friendly way without recourse to fossil fuels. Here, hydrogen is synthesized by **water**

electrolysis, while nitrogen is extracted from the **air**. The temperature and pressure needed for the hydrogen-nitrogen reaction during the ammonia synthesis loop are

powered by sustainable energy, such as wind or solar. The output is carbon-free ammonia, also known as green ammonia.



GUARANTEED WEATHERPROOF PROCESS

Green ammonia is all well and good, but what if the weather doesn't play ball? It's important, because production facilities like chemical fertilizer plants need a stable, continuous power supply 24/7, 365 days

a year. As a result, fossil fuel is a popular energy source, as its supply is so reliable. But **sustainable power supply solutions are available** even when the wind stops blowing and the sun stops shining.

Chemical fertilizer plants need a stable, continuous supply of electricity.

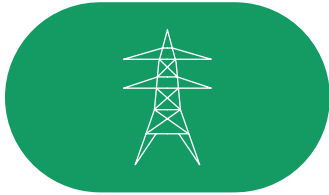


Did you know?

As it's a liquid ammonia is easy to store and transport to plants where it can be used as feedstock. So green ammonia is a very good way to transmit energy.

And the infrastructure is already in place. There's a worldwide network of ports, storage facilities and well-established shipping routes.

Overview



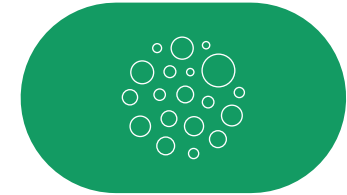
Green electricity grid

The plant can be connected to a green energy grid as a backstop if the renewable energy supply fails.



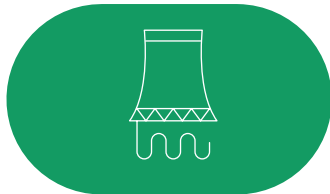
Hydropower

A plant located near a source of fast-running water can convert this kinetic energy into electrical energy. Which can be used to power the plant.



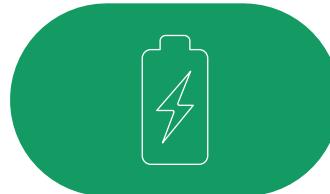
Combusting green ammonia

Ammonia can be burned to produce electricity: the only by-products are nitrogen and water. So green ammonia can be used to make electricity to produce... green ammonia.



Geothermal energy

Earth's thermal energy can be harnessed to generate electricity.



Batteries

Surplus energy can be stored in batteries for use at a later time.

RENEWABLE FEEDSTOCK FOR FERTILIZER PLANTS

Green ammonia: the missing link

As we said, ammonia is the main building block for nitrogen fertilizers. Nitrogen is a primary nutrient for plants and it plays a vital role in food production to **feed the world's fast-growing population**. By 2050 our planet will be home to almost 10 billion hungry mouths. How do we feed them in a sustainable way?

Smart, **sustainable fertilizers** like green ammonia play an important role in keeping crop yield and food production at a high level without increasing our environmental

impact. That means green ammonia can be used as a **valuable, renewable feedstock for nitrogen fertilizer plants**.

Where does Stamicarbon fit in?

Stamicarbon has developed a new standard for the green ammonia market. Our **Stami green ammonia technology** package includes the license and the engineering requirements to build **small-scale green ammonia plants** of standardized capacities. We can also help you with financing, project development and feasibility studies.

We offer a
one-stop-shop
for small-scale
green ammonia
plants.





OUR TECHNOLOGY MAKES THE DIFFERENCE



Your benefits

Stami green ammonia technology is a comprehensive solution for future-proof, carbon-free ammonia production.

- Most competitive technology in terms of CAPEX (when compared to other technologies)
- Strongest reference base with 4 plants in operation (more than any other licensor in the <500 mtpd capacity range)
- Full modularization (customized solutions according to requirements)
- Improved reliability (only one compressor is required for all services)
- Proven design in operation (based on reciprocating compressor, while other technologies are not)
- Availability of digital solutions, such as a dedicated operator training simulator and process monitoring tool.

LET'S GET TECHNICAL

Technically speaking, it's in **the pressure of the synthesis gas** where we make a difference. Our reference plant is gas-based with a different make-up synthesis gas. Why is that good for you?



Want to be part of the green solution?

For more information about our green ammonia technology, visit

www.stamicarbon.com/green-ammonia

Or email us at

communication@stamicarbon.com

No inerts

The green ammonia setup is more favorable, due the **high purity of the synthesis gas feedstock**. There are no inerts and so more hydrogen and nitrogen. There is a higher conversion per pass and purging is unnecessary, so the need for ammonia recovery is minor or even nonexistent.

Single-step condensation

The ammonia is condensed by cooling water; a **large refrigerating compressor is not needed**. This **drives a substantial CAPEX saving**, compared to other technologies, essential to offset the lack of economies of scale. Single-step condensation uses ammonia as a cooling medium, which increases the reliability of the plant. With an added advantage that the compression is included in the multi-service compressor without the need for a dedicated unit.



WE ARE STAMICARBON

Stamicarbon is the Nitrogen innovation and license company of the MAIRE Group. We are a trailblazing specialist in the fertilizer industry, with the vision needed to help feed the world and improve everyone's quality of life. As a global leader in fertilizer technologies, we have licensed more than 260 urea plants and completed more than 110 revamping and optimization projects.

Our leading position is based on more than 75 years' licensing experience and maintained by continuous innovation in terms of technologies, products and materials. Headquartered in Sittard, the Netherlands, Stamicarbon has a sales office in the USA and representative offices in Russia and China. For more information, see www.stamicarbon.com.

WHAT CAN WE DO FOR YOU?

Any questions about Green Ammonia? Like to know how our expertise, knowledge and experience creating, optimizing and upgrading fertilizer plants can help you make the switch to sustainable, futureproof production? We are here for you. Contact our experts at www.stamicarbon.com.



Stamicarbon

Mercator 3 - 6135 KW Sittard - Netherlands | P.O. Box 53 - 6160 AB Geleen - Netherlands
Tel. +31 46 4237000 - communication@stamicarbon.com - www.stamicarbon.com