



Green Ammonia

The answer to a more sustainable future

The innovation & license company
of Maire Tecnimont.



A person wearing a blue lab coat is seen from the side, using a laptop. The laptop screen displays a 3D wireframe model of a complex industrial facility, likely a fertilizer plant, with various pipes, tanks, and structures. The background is a blurred server room with rows of server racks and glowing lights. The overall color scheme is dominated by blue and teal tones.

What's the challenge?

The fertilizer industry in a new perspective

The future is sustainable

As the world is moving towards a decarbonized society, the industry is facing a huge challenge: how to organize a zero-emission production in a cost-effective way?

Carbon-free production technology, in any industry, can no longer be seen as something of the future. It is something we need now.

Since 2015, hundreds of countries worldwide have already set targets to reach **net-zero emission by 2050** with the Paris agreement. To solve this challenge we need realistic,

cost-effective solutions that can **make the food value chain more sustainable**, plus methods for making energy storage green, effective and affordable.

Are you up to the challenge? We are!

The solution is green

As world market leader in designing, licensing and developing fertilizer plants, we believe **Green Ammonia** can play a crucial role in helping overcome the carbon challenge. Here is why.

Are you up to the challenge?
We are!



Green Ammonia

A sustainable food value chain

Ammonia without fossil fuels? Sure, we can!

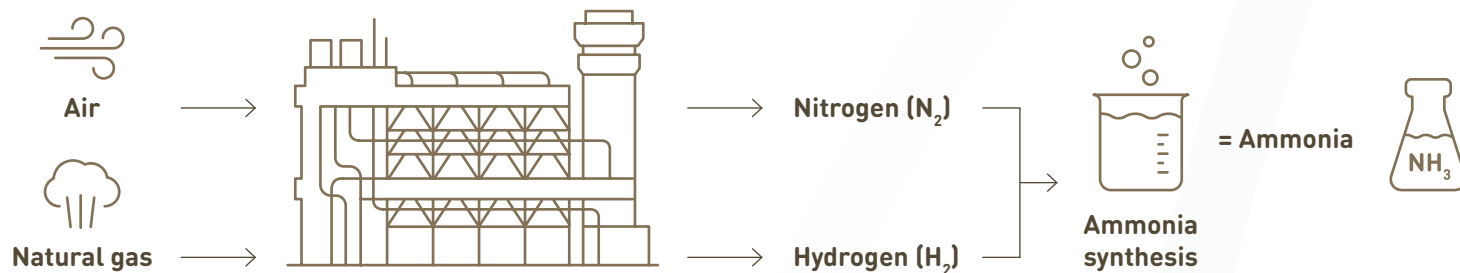
Fact: 80% of global ammonia is used as a raw material for nitrogen fertilizer production. Roughly 180 million metric tons of ammonia was produced in 2019 to meet that demand. Ammonia plays a vital role in food production, yet its production causes **1% of the total global greenhouse gas emissions**. This is mostly because traditional (brown/grey) ammonia production uses fossil fuels as feedstock.

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

Green Ammonia
can help you achieve
zero emission targets.

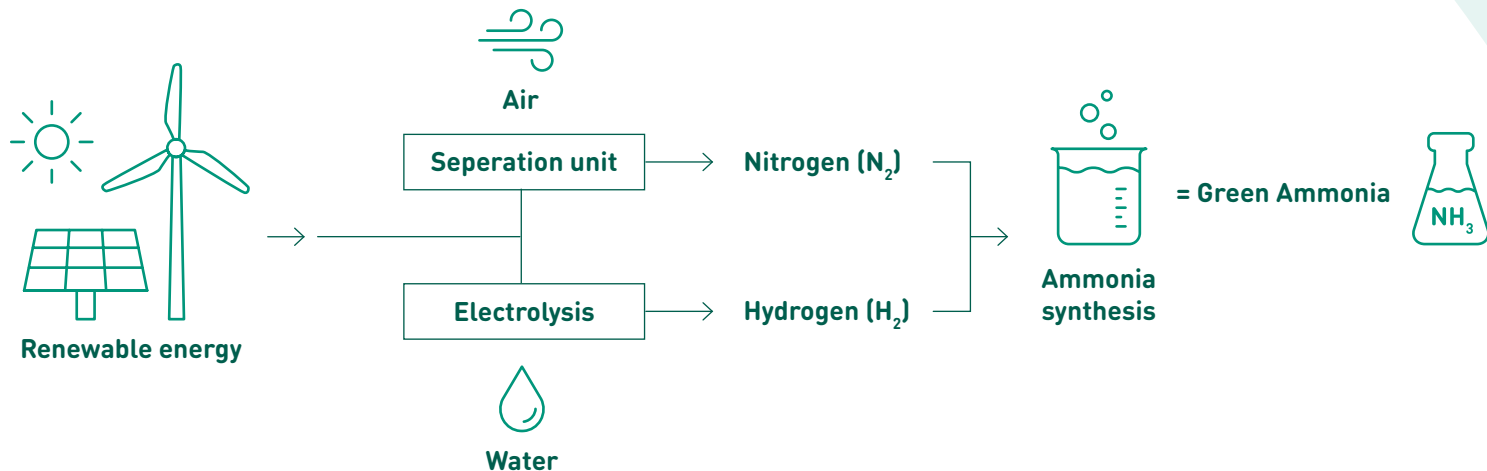
Traditional ('grey') Ammonia production

To make ammonia, you need hydrogen and nitrogen. A traditional ammonia plant **converts fossil fuel (e.g. natural gas) into gaseous hydrogen**. Through a method known as 'steam reforming' hydrogen is produced from hydrocarbons. The nitrogen on the other hand is derived from process air. The hydrogen is then catalytically reacted with the nitrogen at high pressure and temperature to produce ammonia. This synthesis process is known as the Haber Bosch method.



Green Ammonia production

Nowadays, besides conventional ammonia production, ammonia can be produced far more ecologically by eliminating the use of fossil fuels. In this eco-friendly process, hydrogen is made by using **water electrolysis** and nitrogen is obtained from the **air**. The temperature and pressure that is needed for the hydrogen-nitrogen reaction during the ammonia synthesis loop is **powered by sustainable energy**, such as wind or solar energy. The output is carbon-free ammonia, also known as Green Ammonia.



It's a guaranteed 'weatherproof' process

Green Ammonia is great, but what happens when the weather conditions aren't right and renewable energy cannot be generated? An important issue, because certain production facilities such as chemical fertilizer plants need a stable, consistent and continuous flow of electricity 24/7 all year around. Using fossil-fuel as energy is popular in this

case as, unlike renewable energy, it is guaranteed and can be controlled.

However, even when the wind doesn't blow and the sun doesn't shine, there are **easy and sustainable solutions to overcome intermittency in power supply.**

Chemical fertilizer plants
need a stable, consistent and
continuous flow of electricity

Always power available



Green electricity grid connection

The plant can be connected to a green energy grid that can provide it with immediate green energy should enough renewable energy not be available.



Hydropower

A plant located near a source of fast running water can apply the kinetic energy created by the fast movement of the water and convert it into electrical energy. This can be used to run the plant.



Batteries

When there's a surplus of renewable energy it can be stored in batteries that can be used at a later stage when needed.



Geothermal energy

The thermal energy stored inside the Earth can be harnessed to generate electricity.



Using Green Ammonia itself

Ammonia can be burned to produce electricity with its only by-products being nitrogen and water. This means that Green Ammonia can be used to make electricity to produce... Green Ammonia.

Did you know?

As ammonia is a liquid it can more easily be stored and transported, for example to certain chemical plants where ammonia can be used as feedstock. This makes Green Ammonia a great energy carrier. Besides, for ammonia, a good infrastructure is already in place. There's a worldwide network of ports, storage facilities and well-established shipping routes.

A vibrant landscape of a green field at sunset, with a path leading towards the horizon under a colorful sky. The sun is low on the horizon, casting a warm glow over the scene. The sky is filled with soft, colorful clouds in shades of orange, pink, and blue. The field is lush and green, with a path leading towards the horizon. The overall mood is peaceful and hopeful.

A renewable feedstock for fertilizer plants

Green Ammonia: the missing link

As we mentioned already, ammonia is the main building block for nitrogen fertilizers. Nitrogen is a primary nutrient for plants and plays a vital role in food production and **feeding the fast-growing population**. By 2050 there will be nearly 10 billion people on this planet to be fed. How to do address that challenge sustainably?

Smart, **sustainable fertilizers** like Green Ammonia play an important role in keeping crop yield and food production high, without increasing our environmental impact. In other words: Green Ammonia can be used as a **valuable, renewable feedstock for fertilizer plants** to produce the necessary nitrogen fertilizers.

Where does Stamicarbon fit in?

Stamicarbon has developed a new standard for the Green Ammonia market. Our **Stami Green Ammonia technology** package contains both the technology license and engineering requirements to build **small-scale Green Ammonia plants** in standardized capacities. On top of this we can assist you with financing, project development and feasibility studies.

We offer a one-stop-shop
for small-scale Green
Ammonia plants.

A woman with red hair, wearing a white lab coat and clear safety goggles, is looking intently at a microscope. In the background, a man wearing safety goggles and a lab coat is also working with a microscope. The scene is set in a laboratory with a blue and white color palette.

**Our technology
makes the difference**



These are your benefits

The Stami Green Ammonia technology offers you a **total solution** for a carbon-free and future-proof 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 (customised 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

In a technical sense, it's **the pressure of the synthesis gas** where we make a difference. Our reference plant is gas based with a different make-up synthesis gas. Your benefits?

No inerts

The application of the Green Ammonia set-up is more favorable, due the **high purity of the synthesis gas feedstock**. No inerts are present at the benefit of hydrogen and nitrogen presence. This means that the conversion per pass will be higher, while we can avoid purging with consequential a small, or even redundant need for ammonia recovery.

Single step condensation

The produced ammonia is condensed by cooling water, **without the need for a large refrigerating compressor**. This is a **substantial CAPEX saving**, compared to other technologies, which is essential to compensate lack of economy of scale. This single step of condensation, uses ammonia as cooling medium, which increases the reliability of the plant. With as added advantage that the compression is included in the multi-service compressor without the need for a dedicated unit.



Do you want to be part of the green solution?

For more information on our Green Ammonia technology visit our website www.stamicarbon.com/green-ammonia or send us an e-mail at communication@stamicarbon.com.

We are Stamicarbon

Stamicarbon is the innovation and license company of the Maire Tecnimont 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. A global leader in fertilizer technologies, we have licensed more than 260 urea plants and completed more than 110 revamping and optimization projects.

This leading position is based on 75 years of experience in licensing and is maintained by its continuous innovations in technologies, products and materials. Stamicarbon's headquarters is in Sittard, The Netherlands with a sales office in the USA and representative offices in Russia and China. For more information: www.stamicarbon.com.

What can we do for you?

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.

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