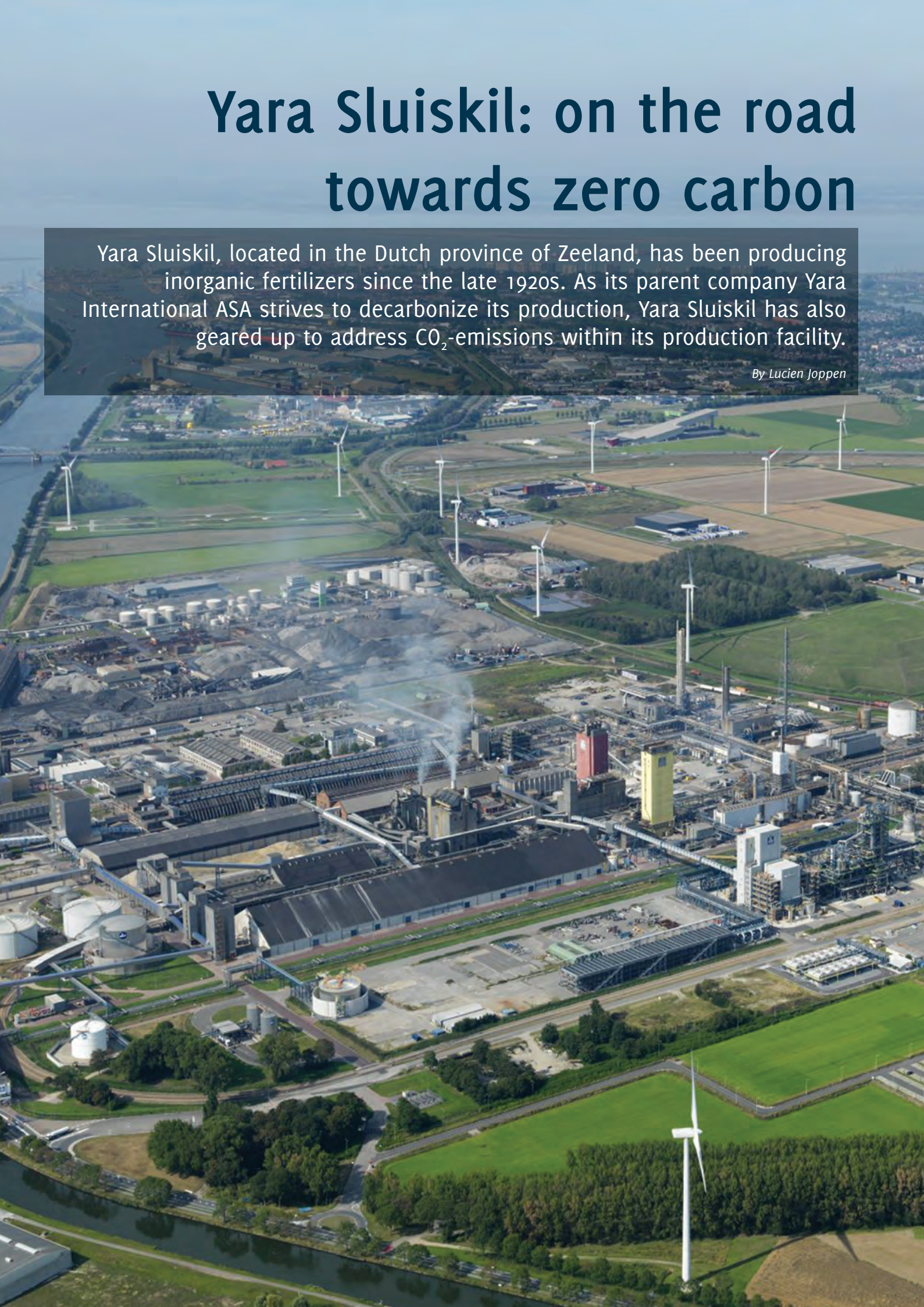
Yara Sluiskil: on the road towards zero carbon

Yara Sluiskil, located in the Dutch province of Zeeland, has been producing inorganic fertilizers since the late 1920s. As its parent company Yara International ASA strives to decarbonize its production, Yara Sluiskil has also geared up to address CO_2-emissions within its production facility.

By Lucien Joppen



But first, a short trip back in time. In 1929, the Compagnie Néerlandaise de l'Azote (CNA) started beside the existing coke plant in Sluiskil (ACZC). The choice for this location was prompted by the presence of a coking plant. Coke gas could be used as a raw material for the production of fertilizers.
After World War II, the introduction of natural gas (to replace coke oven gas, ed.) from 1966 onwards was an important factor in the factory's continued growth. In 1998, when the interconnector that transports high caloric Norwegian and UK natural gas was built, Yara made a connection. Later on, the production location was connected to a high caloric gas supply from the Dutch province of Groningen. Today, Yara Sluiskil use about 75 per cent high caloric gas and will switch to full intake later this year.
In the 1960s, the company changed ownership, continuing under the name Nederlandse Stikstof Maatschappij (NSM). This lasted until 1979, when the company changed over to Norsk Hydro. After a number of years, the name was changed to Hydro Agri in 1989. This remained until 2004, when Norsk Hydro spun off its fertilizer activities into Yara International ASA (see box text Yara International) and the plant in Sluiskil was named Yara Sluiskil.

Rich past

Roughly a century after its inception, little on the production site of Yara Sluiskil reminds visitors of its rich past. During World War II, a significant part was bombed due its strategic importance. In the 1950s, the production restarted and increased rapidly. Today the plant with a capacity of 5 million tons of end products is the largest fertilizer production location in north-western Europe and responsible for feeding feed 40 million people worldwide. Yara Sluiskil has invested about 1 billion euro in the production and loading facilities and infrastructure in the last decade, for example in a state-of-the-art urea factory (Urea 8).
Yara Sluiskil is the largest production facility in the Yara International group, accounting for 15 percent of the group's production volume. The Dutch facility produces an array of bulk chemicals, ranging from ammonia, ammonium nitrate, CO_2, urea and nitric acid. The 5 million tons of end products consist of roughly 3.5 million tons of fertilizers and 1.5 million tons of industrial chemicals.
Yara Sluiskil's main business is the production of various premium nitrogen-containing fertilizers and specialties, based upon varying mixtures, both in solids and liquids. Apart from fertilizers, Yara Sluiskil also has a broad product portfolio, ranging from feed additives and industrial chemicals to food-grade CO_2. One of its largest specialties is the exhaust gas additive for diesel engines AdBlue which takes up a volume of 1 million tons.

Energy efficiency

Yara Sluiskil uses natural gas (2 billion m^3 per annum) as hydrogen containing feedstock (80 percent). As mentioned earlier, Yara Sluiskil has invested heavily in asset upgrades to increase production and energy efficiency. The plant reduced its net greenhouse gas emissions from 5.2 million ton in 1990 to 1.9 million ton in 2020. The captured CO_2 in end products as urea and direct delivery to greenhouses and food industry is counted to the production site.
"We have continuously invested and are investing in more energy efficient processes to reduce overall CO_2 emissions from our site", says Gijsbrecht Gunter, manager external relations at Yara Sluiskil. "For example, our new Urea-7 factory only uses 65 percent of the energy consumption per ton urea solution compared with the previous urea factories. In 2005 we realized a laughing gas (N_2O) reduction by applying an in-house developed catalyst in our nitric acid factories already and reduced 1.8 million tons CO_2 equivalent. Over the years, the Haber-Bosch-process (producing hydrogen and ammonia from natural gas and nitrogen from the air) has been optimized to produce a ton of ammonia with an energy input of about one third of the initial energy consumption when the process was invented. Compared with other forms of H_2-generation, for example based on coal, this methane-based process has a far more favorable CO_2 footprint. All in all, Yara Sluiskil has reduced its gross CO_2 footprint from 5,9 million tons in 1990 to 3.3 million tons in 2020 and the net emission reduced from 5.2 to 1.9 million tons, due to the valorisation of CO_2 in end products as urea and direct delivery to the food industry, breweries, green houses and many more."

Yara International: Facts & Figures

Yara International ASA is a Norwegian nutrient company and one of the largest fertilizer producers on the planet. The company's largest business area is the production of nitrogen fertilizers. However, it also produces technical nitrates, ammonia, AdBlue and other nitrogen-based chemicals. The company was established in 1905 as Norsk Hydro, the world's first producer of mineral nitrogen fertilizers (based on the Birkeland-Eyde-process). The company demerged as Yara International ASA in 2004 and is listed on the Oslo Stock Exchange (the Norwegian government owns more than a third of Yara directly and also a part via the state pension fund and is therefore its largest shareholder). The company has around 17,000 employees, production sites on six continents, operations in more than 60 countries and sales to about 150 countries.

Key facts & figures (2020)
Revenues: USD 11.6 billion
Total deliveries: 38.1 million tons
a. Fertilizer deliveries: 29.0 million tons
b. Industrial product deliveries: 7.1 million tons
c. Ammonia trade: 2.0 million tons
President and CEO, Svein Tore Holsether, since Sept. 2015
Headquartered in Oslo, Norway
About 17,000 employees
Operations in over 60 countries

Reduce GHG-emissions

Regardless of the above optimisation steps, Yara Sluiskil still is one of the major CO_2-emitters in the Netherlands, along with Shell Pernis, Dow Chemical, Chemelot and various gas and coal-fired power plants. As such, the company is facing pressure continuously

Bird's eye view of the production facility.

Zooming in on the ammonia plant.

Fertilizer plant in Porsgrunn.

Electrolysis in Glomfjord-site of Yara. The company employed this technology until it was outcompeted by SMR.

from different stakeholders. To address these concerns, the company has imposed very ambitious climate targets for 2030 and beyond. Not only for its production sites, but also across its supply chain and to the agricultural sector. In practice, this means low carbon sustainable feedstocks and energy for production and transport of end-products, but also for example slow release fertilizers specified on crop type and cultivation circumstances, precision farming tools and digitalization.

"As it stands now in Sluiskil, we are on track to reduce our net CO_2-emission footprint by 85 percent in 2030, compared with 1990. Right now, we are already at the 65 per cent mark."

According to Gunter, Yara Sluiskil has devised a Climate Roadmap 2030 to further reduce 1.2 to 1.4 million tons of GHG-emissions in 2030. "The first pathway is to adapt existing assets to reduce/mitigate GHG emissions, such as the last nitrous oxide (laughing gas) emission on the nitric acid plants which is about 300 times more 'potent' than CO_2. Further reductions are feasible, for example by earlier replacements of the burner in our nitric acid plants. But also internal usage of residual heat and green energy."

Green hydrogen

The second pathway is carbon capture and storage (CCS). As mentioned earlier, Yara Sluiskil used part of its CO_2 (approximately 1.4 million tons) for a wide product range. The remainder, roughly 800,000 tons, is already captured as pure CO_2 and could be liquified and stored in empty gas fields. We have experience with capturing, liquefying and large shipping transport of CO_2 since the early '90s in Sluiskil and see CCS as a temporary and reliable technology to make big steps in a rapid way. CCS will be phased out when green hydrogen is available.

Wind powered electrolysis to produce green hydrogen.

"The third path consists of two lanes, both leading towards green hydrogen", Gunter states. "One lane is to produce green hydrogen on site. For this purpose, we have joined forces. Ørsted has the ambition to develop a 100 MW wind powered electrolyser plant to produce renewable hydrogen. With the renewable hydrogen we could generate around 75,000 tons of green ammonia per year, which is roughly 4 percent of our hydrogen production capacity in Sluiskil, but enough to fertilize 500,000 hectares of farmland. These numbers underline the scale of the production site in Sluiskil. The project has the potential to abate more than 100,000 tons of CO_2 per year. If the required public co-funding is secured and the right regulatory framework is in place, the project could be operational in 2025. For Yara, green hydrogen production via electrolysis is not new, since 1991 Yara has operated a 155MW electrolyser plant in Glomfjord (see image)."

The second lane is a real game changer that would involve Yara outsourcing (part of) its hydrogen production and connecting to a regional H_2-pipeline infrastructure. There are several projects planned in the Netherlands to produce large scale green hydrogen. However, given Yara's H_2-need of about 340,000 ton annually, this would be quite an ambitious volume.

"Today, the plants in Sluiskil are world class in terms of energy efficiency and carbon food print, reliability and safety. If we are able to realize our Climate Roadmap to 2030, our production location, which has been in operation for almost a century, could continue as a frontrunner for the next 100 years and keep feeding the world in a sustainable way."

Yara Herøya: going zero-carbon

In the last weeks of December, Yara received good news. The company has been granted NOK 18 million euro (1.8 million euro) from Enova to produce green ammonia. With this, Yara officially takes the first step towards full decarbonisation of its ammonia plant at Herøya in Porsgrunn (Norway). Yara has entered a joint-venture with Aker Clean Hydrogen and Statkraft. HEGRA, short for Herøya Green Ammonia, goes further than a technology-partnership as it also marks the beginning of developing a Norwegian value chain for green ammonia and hydrogen, says Auke Lont, Chair of HEGRA's Board.

Yara's fertilizer factory at Herøya is one of Norway's largest sources of CO_2 emissions outside the oil and gas industry, releasing 800,000 tons of CO_2 annually.

"Norway has the unique opportunity to take a leading position in the green transition, but the window of opportunity is limited. That is why this decision is so important and will be able to help accelerate a new, Norwegian industrial adventure. Green ammonia is a versatile, climate friendly input factor and hydrogen energy carrier. Emission free ammonia is the key to reducing emissions from world food production and long-distance shipping", says Svein Tore Holsether, CEO of Yara.

Yara's corporate board has made the decision to invest in the 24 MW demonstration plant, where the technology will be demonstrated and quality assured. This plant will be one of the largest projects producing green ammonia in the world, producing 20,500 tons per year, which converts into between 60,000 and 80,000 tons of green fossil-free mineral fertilizer. The project aims to supply the first green ammonia products to the market as early as mid-2023, both as fossil-free fertilizer, as well as fuel for ships.