SwitcH2 B.V.
SeaWater into Clean Hydrogen

# Progress report year 2

# OFFSET

## Offshore Floating Storage of Energy and Transfer

Main applicant: SwitcH2 BV
Partners: TU Delft, BW Offshore Management BV, MARIN, Strohm BV
Program: MOOI
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SeaWater into Clean Hydrogen

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|---|---|
| Project title: | OFFSET (Offshore Floating Storage of Energy and Transfer) |
| MOOI Mission: | A, Electricity |
| Specific theme: | "Innovations as integral component of wind energy areas on sea" |
| Date of this report: | 28 April 2025 |
| Contact person: | SwitcH2 BV: project-leader mr. Bob Rietveldt, |
| email: | bob.rietveldt@switch2offshore.com |
| General information: | www.switch2offshore.com |


Short Summary: The project is now running for two years and already yielded a number of positive milestones in het field of:

- Decrease in size of the concept: resulting in lowering CAPEX;
- Wave energy conversion is possible but limited within the vessel; we also explore external systems.
- Safety studies have resulted in a new top-side layout design (location of living quarters has changed).
- Studies on direct seawater electrolyses continued and focussed on catalyst materials, quality and stability and use of selective membranes.

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# 1 Project Summary

### Background

In order to meet the climate goals of 2030 and 2050, the deployment of (offshore) wind farms will need to increase. It is projected that the Netherlands will produce 43 GWh of energy through offshore wind deployment by 2050. However, generating this amount of energy through renewable energy sources such as wind comes with several obstacles, due to the variability caused by weather dependence and the limited capacity of the grid. It is inevitable that periods of surpluses and scarcity will alternate if these obstacles are not addressed, causing further grid congestions and losing valuable energy. At the same time, the Netherlands is facing the challenge of physical scarcity, especially in relation to offshore wind farms to be deployed at the North Sea.
Several solutions are being developed today to overcome these challenges and obstacles, among which the conversion to energy carriers such as hydrogen and ammonia. These can store the valuable energy in order to stabilize and increase the overall efficiency of the grid. Additionally, producing energy carriers at the source of the renewable energy brings on further savings and advantages compared to land-based production of such energy carriers. Yet, these renewable fuels as energy carriers are still not competitive due to high prices and require significant infrastructure to be implemented efficiently.

### Purpose of the project

The purpose of the project is to develop an overall integrated system in which the infrastructure for hydrogen and/or ammonia are included, which will revolutionise the way in which the offshore wind sector and relevant (energy-intensive) industries currently operate. This system is called OFFSET: Offshore Floating Storage of Energy and Transfer. We will develop a floating hydrogen and/or ammonia production and storage facility that is connected to an adjacent wind farm and that will operate continuously. The produced hydrogen can be transported to shore through existing oil and gas pipelines, whereas the produced ammonia can be transported to end-users by shuttle tankers. This easily scalable solution will decrease the cost of green fuels and thereby increase their accessibility. The aim is to provide a flexible solution that answers to the needs of the global energy transition and corresponding scenarios regarding energy carriers. During the project, the production of hydrogen directly from seawater is being researched in order to provide a long-term strategy for increasing efficiency and affordability.
Finally, the project aims to secure energy supply, increase the competitiveness of hydrogen and ammonia as green fuels, and facilitate the road to zero emissions, while taking away the pressure on (seabed use at) the North Sea.

### Results

At the end of the project, the consortium will have developed a viable technical and economic solution which can be realised, and which van be made visual by means of a small-scale model (1:50) of the OFFSET facility for testing in the offshore basin of MARIN. Additionally, a thermoplastic composite pipe for transferring hydrogen and offloading and bunkering of ammonia will be developed, as well as engineering design plans of the OFFSET facility, safety roadmaps, and a lab validation of direct seawater electrolysis. The results will allow the first OFFSET facility to be operational by 2030. For the longer term, by 2035, it is expected that the first OFFSET facility with direct seawater electrolysis will be implemented.

The consortium will actively involve stakeholders from different sectors, such as energy companies, wind farm operators, wind farm developers, ammonia production projects, and energy-intensive industry sectors. These stakeholders all have a commercial interest in more accessible hydrogen and ammonia at lower prices, as well as energy grid optimizations and the other benefits that the overarching OFFSET system represents.

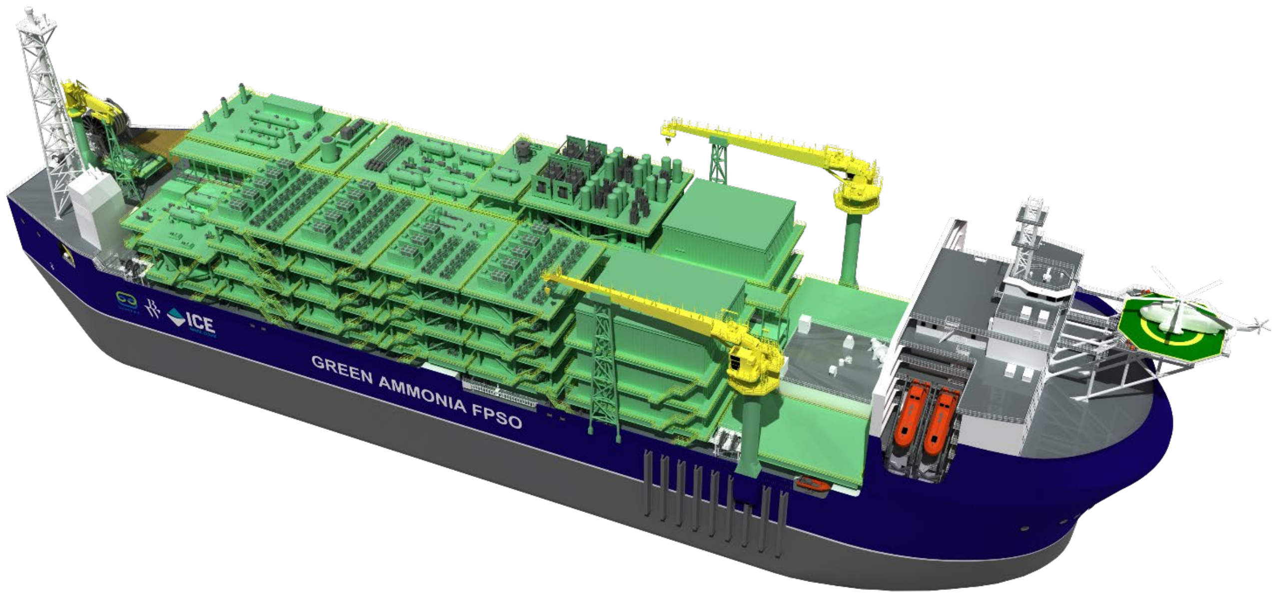


Figure 1: SwitcH2, graphic representation of the OFFSET solution.

## 2 Project activities

The entire project is a result based. The project is developed to realize the different results during the project. Per result different activities are planned.
Currently we just finished year 2 of the project (March 2024 to March 2025). An update per result on last year activities is presented hereafter.

**Result 1: Proof-of-concept of direct seawater alkaline electrolysis**
**Start (actual): 01-03-2023**
**End (planned): 28-02-2027**
**Involved partners: MARIN and TU-Delft**

**Current status: ongoing as planned;** During the second year of the OFFSET project (March 2024 – February 2025), significant progress was made in developing and validating the proof-of-concept for direct seawater alkaline electrolysis. This result, led by TU Delft in collaboration with SwitcH2, focuses on enabling hydrogen production directly from seawater, eliminating the need for an energy-intensive desalination step. The main research activities centered around catalyst development, process stability, electrolysis efficiency, and system integration.

**Description:**
This result refers to a proof-of-concept (lab validation) of a novel method to convert direct seawater into hydrogen. This result and process technology can consequently be integrated in an electrolyser. Research under this result continued throughout the last year and yielded a number of subresults.

**Key findings** of this result are:

- Membrane stability: The PTFE-based selective membrane demonstrated greater long-term stability compared to forward osmosis membranes, which suffered from degradation due to pH fluctuations and sodium ion transport.
- Catalyst efficiency: Optimized Ni-based electrodes showed improved durability in seawater conditions, though further refinements are needed for commercial viability.
- Process validation: The bipolar membrane-controlled system successfully regulated pH levels, reducing unwanted side reactions and increasing hydrogen production efficiency.
- Hydrodynamic considerations: Preliminary results indicated that moderate vessel tilting does not significantly impact electrolysis performance, but further testing is planned for 2025.

Activities under result 1 will continue as planned. In 2025 we expect to finalize membrane and electrode durability testing, scaling up of the laboratory setup and try to mimic marine conditions/offshore deployment and publications on research results are expected within 2025.

**Result 2: Research results of marinization of floating production of green fuels**
**Start (actual): 01-03-2023**
**End (planned): 01-03-2025**
**Involved partners: MARIN and BWO**

**Current status: ongoing as planned.** Significant advancements were made in researching and optimizing the marinization of floating hydrogen and ammonia production. This work was led by MARIN and BW Offshore (BWO), focusing on hydrodynamic behavior, vessel stability, and the adaptation of onshore production technologies for offshore deployment.

**Description:**
The key objective of this result is to ensure feasible solutions and efficiency of hydrogen and ammonia production under dynamic marine conditions.
A number of subactivities are executed during the second year of the project.

**Hydrodynamic study of the floating facility**
MARIN conducted advanced numerical simulations and model tests to evaluate the hydrodynamic behavior of the FPSO under varying sea conditions. Using diffraction calculations and time-domain simulations, they analyzed vessel motions and their impact on integrated production systems. The power output of the Oscillating Water Column (OWC) Wave Energy Converters (WECs) was refined with updated hydrodynamic data, while the effects of wave impact, vessel tilting, and liquid sloshing inside storage tanks, particularly for ammonia, were assessed. Status: The study identified deviations in oscillating water column responses due to scale limitations in model testing, and further refinements are ongoing

**Model testing and design optimization**
MARIN conducted model tests in the Shallow Water Wave Basin to evaluate an updated hull design with two integrated Oscillating Water Column (OWC) Wave Energy Converters (WECs). A comparative study analyzed different OWC designs (L-shaped vs. moonpool-type) and their placements (bow vs. stern) to determine the most efficient configuration. Results showed that the moonpool-type OWC at the bow provided superior stability and energy capture, making it the preferred design for further development.

**Structural and safety considerations for offshore production (BWO)**
BW Offshore conducted a detailed study on marinized designs for hydrogen and ammonia production, evaluating the impact of offshore conditions on equipment and material choices. In collaboration with equipment suppliers, they optimized space-efficient adaptations for key processing units such as separators, reactors, and nitrogen supply systems. Additionally, fire and explosion risk assessments led to relocating living quarters and modifying the topside layout to enhance safety and operational efficiency.

**Floating vs. fixed platform evaluation**
The study confirmed that an FPSO solution remains the most flexible and scalable option, particularly when considering integration with offshore wind farms.

**Integration of wave energy into the production system**
The impact of vessel motion on OWC energy efficiency was assessed, leading to refinements in turbine placement and chamber design.

**Material and equipment selection for offshore adaptation**
A study was performed comparing onshore vs offshore material requirements. Corrosion-resistant materials and modular equipment designs were identified as key factors for offshore durability and ease of maintenance.

**Key findings**
At the end of Year 2, the hydrodynamic analysis confirmed that the FPSO's motion behavior under varying wave conditions supports the integration of production units without major operational disruptions. The moonpool-type OWC at the bow proved to be the most efficient design for energy capture. Safety enhancements were implemented through topside layout revisions, addressing fire, explosion, and HAZID/HAZOP risks. Additionally, BW Offshore finalized marinized equipment designs, optimizing space efficiency and ensuring compatibility with offshore motion constraints.

**Result 3: Validation of thermoplastic composite pipes for OFFSET**
**Start (actual):** **01-12-2023**
**End (planned):** **31-12-2026**
**Involved partners: Strohm BV**

**Current status: ongoing.** The third result of the OFFSET project, led by Strohm, focused on the validation of thermoplastic composite pipes (TCPs) for hydrogen and ammonia transportation in offshore conditions. The execution of this result is slower than expected due to validation issues and focus on other high priority projects within Strohm. Associated costs for the exectuion of R3 are currently also lower than expected due to delays and other priorities within Strohm. For now we expect to be able to generate the expected results within current project planning (e.g. before the end of 2026).

**Description:**
**Material testing and engineering of TCP for hydrogen and ammonia**
Within the second year material testing was conducted to evaluate hydrogen and ammonia permeability, mechanical properties, and environmental resistance of Thermoplastic Composite Pipes (TCP). Various composite materials were compared to identify the optimal configuration for offshore

hydrogen risers and ammonia offloading systems. Additionally, pipe testing under simulated offshore conditions was initiated to assess rapid gas decompression resistance and mechanical durability.

**Dynamic riser system design**

Finite Element Analysis (FEA) was used to gain insight to optimize the structural design of the TCP riser system, ensuring it can withstand dynamic loads from floating production facilities. Orcaflex simulations were used to evaluate the hydrodynamic behaviour of the flexible risers under wave and current loading. Additionally, the system's feasibility for connecting FPSO-based hydrogen production to existing offshore pipelines was assessed.

**Integration of Fiber Optic Cable (FOC) for data transmission**

A first proof-of-concept prototype was developed to embed fibre optic cables within TCPs for real-time monitoring of hydrogen and ammonia flow parameters. Laboratory tests assessed data transmission efficiency, mechanical durability, and long-term stability of the integrated fibre optics.

**Key findings result 3**

Material validation confirmed that Thermoplastic Composite Pipes (TCP) are suitable for hydrogen transport, though refinements are still needed for ammonia applications. Dynamic simulations demonstrated the feasibility of deploying TCP risers to stabilize the cable for FPSO applications, with further optimization planned. Additionally, the proof of concept integration of embedded fibre optics showed strong potential for remote monitoring and predictive maintenance.

**Result 4: Basic design OFFSET with integrated equipment**
**Start (actual):** 01-12-2023
**End (planned):** 28-02-2027
**Involved partners: SwitcH2, TU-Delft and BWO**

| | |
|---|---|
| Design and selection of battery system | TU Delft |
| Process design | SwitcH2 |
| Structural design engineering plans/reports | BWO |
| HAZID/HAZOP safety reports | SwitcH2 |

**Current status: ongoing as planned**

Result 4 focused on developing the basic engineering design of the OFFSET FPSO system, ensuring integration of all key components, including hydrogen electrolysis, ammonia production, energy storage, and structural stability. This work was led by SwitcH2, TU Delft, and BW Offshore.

**Description:**

This result refers to the engineering plans for the OFFSET facility, in which all equipment is integrated, also based on the outcomes of result 3. Tangible outcomes of this result are detailed engineering plans that will allow for the direct implementation of the OFFSET facility.

**Subresult (1) Continuous Energy Supply, responsible during project: TU-Delft:** Investigated battery backup options to ensure operational stability during low-wind and low-wave periods.

**Subresult (2) Process design, responsible partie during the project are SwitcH2 and BWO**
BWO and SwitcH2 defined the topside layout, including electrolyzer placement, ammonia synthesis modules, and storage tanks. Within this sub-result we collaborated with Ohmium (PEM electrolyzers) and ThyssenKrupp Uhde (ammonia synthesis) for integration requirements.

**Subresult (3) Structural design, responsible partie during the project is BWO and Subresult (4) HAZOP and HAZID safety analyses, responsible partie during the project is SwitcH2.**
A structural stress analysis was conducted  to ensure FPSO hull stability under operational loads. Revised topside safety measures, including fire and explosion hazard mitigation strategies by SwitcH2 (HAZOP & HAZID).

**Key findings result 4**
The basic FPSO layout is finalized with defined process flows and component placements. The marinized electrolyzer design is validated, ensuring offshore operational feasibility and conducte safety studies led to layout refinements, thus improving risk mitigation strategies.

**Result 5: Small-scale operational prototype OFFSET**
**Start (actual): 01-03-2023**
**End (planned): 28-02-2027**
**Involved partners: MARIN, SwitcH2**

**Current status: started**
The result is focused on developing and testing a 1:50 scale prototype of the OFFSET FPSO, evaluating its motion behavior, energy efficiency, and system integration under realistic offshore conditions. MARIN and SwitcH2 lead this effort.

**Description:**
A number of activiteis are executed under this result:
**OWC chamber testing (MARIN);**
Single OWC chamber tests are conducted to assess power generation efficiency. Based on these test we evaluated wave energy capture efficiency under different sea state conditions.

**Validation of Small-Scale FPSO Prototype** (MARIN, SwitcH2)

Built and tested a 1:50 scale FPSO model; tests measured vessel motions, accelerations, and wave interactions under operational and extreme sea conditions.

**Key findings**
OWC can generate a stable power stream, although limited. Scale model tests confirmed structural stability and hydrodynamic performance under various environmental conditions.

**Result 6: Enabling supporting actions (other project activities)**
**Start (actual): 01-03-2023**
**End (planned): 28-02-2027**
**Involved partners: SwitcH2**

**Current status: ongoing as planned**

**Description:**
Under this result technical project management continued. Furthermore activities are conducted regarding stakeholder engagement and dissemination of project findings: project presentations where given at events (World Hydrogen summit) and a few articles were published. Regarding the market and business case development a market analysis was done on hydrogen and Ammonia offtake strategies and SwitcH2 engaged with ACE Terminal (Rotterdam) and Eneco to conduct potential pilot projects after this MOOI project.
Parallel SwitcH2 secured MoU's with strategic suppliers on building the Offset vessel.

# 3 Challenges and project perspectives

Currently there are no specific challenges that hamper or delay the project. We did encounter some delays on activities and subsequent project costs within project partner Strohm but we expect to be able to increase activities within the coming year and resolve these delays.

During the second yar of the project market potential did not change. The need for additional solutions within the offshore wind industry that don't use cable arrays and do not further stress the already limited energy distribution network (power cables) still has a good market potential. Furthermore there are incentives being deployed to stimulate the production of green hydrogen (subsidy on prices in order to compete with current grey/blue solutions).

With strong technological progress and industry partnerships, the OFFSET project is well-positioned to play a leading role in offshore green hydrogen and ammonia production, provided that the remaining technical and regulatory challenges are effectively addressed in the remaining project duration.

## 4 Contribution to the MOOI-mission:

This did not change during year 2 of the project. We still comply with the MOOI-mission description as earlier presented. This project will contribute to the overall mission statements of the MOOI-mission A, Electricity. It answers to all identified challenges in relation to the upscaling of wind and solar energy on either sea or land:

| Mission A challenge | OFFSET solution |
|---|---|
| **Energy production needs to become more affordable** | OFFSET offers the solution for a greater yield from offshore wind farms and therefore also the affordability of wind energy by providing flexbility to the overall wind energy system. It also produces green hydrogen. This flexibility is necessary to cope with the challenge of fluctuating energy production. OFFSET will use a neighbouring wind farm's energy supply to power the constant production of renewable energy carrier hydrogen, combined with the on demand production of ammonia. This will significantly reduce the peaks and lows within the wind energy supply and thereby increase the accessibility and affordability, as more supply can be ensured against a relatively low investment cost at systems level. |
| **There is a scarcity of both land and sea** | OFFSET will produce its hydrogen and ammonia offshore on an FPSO. Electrolysers can be stacked onboard and with the most efficient engineered design of the OFFSET, and already a 300 MW capacity will be possible on only one unit. This represents a huge capacity while consuming little space in comparison to other energy production solutions. Due to its integration with a wind farm and the size of only one or several OFFSETs are needed, no excessive maritime spatial planning is required. |
| **Integration in the Dutch energy system is complicated** | The OFFSET concept will make integration of produced wind energy in the Dutch system more accessible through the implementation of the renewable energy carriers hydrogen and ammonia. These can be transported to shore for electrification or direct implementation in industries. |
| **Sustaining the environment and ecology of the North Sea** | Primary threats to the North Sea ecology include pollution and resource exploitation such as gas and oil. The OFFSET facility will not extract any resources except for seawater for the electrolysis process and produce no greenhouse gas emissions that contribute to ocean acidification. The OFFSET project will take into account the risk of extracting seawater and consequently the risk of extracting fishes or other species. Further, the OFFSET facility will use existing pipelines where possible for the transportation of hydrogen, which will avoid constructing new infrastructure in the already occupied North Sea region, and thereby refrains from adding more pressures on the ecology and environment. |

Table 1: The contribution of the OFFSET solutions to MOOI Mission A, Electricity.

The project fits within the MOOI mission A; Electricity.

The accompanying goal of this mission A is to stimulate the innovation themes that can lead to a first implementation within 10 years (before 2032) and can contribute to affordable, trustworthy, clean and safe energy supply. The OFFSET project answers to this goal by bringing hydrogen production to a high and cost-efficient level, consequently providing solutions to flexibility in the energy grid that increases the trustworthiness of the overall energy system level. With the current project planning, it is expected that the first OFFSET facility will be operational in 2030. This answers to the MOOI mission of implementing these innovations before 2032.

Secondly, this project will contribute specifically to the first innovation theme that belongs to this mission, "Innovations as integral component of wind energy areas on sea". The overall OFFSET system is especially related to this innovation theme through focus on trustworthiness, flexibility, security of supply, and safety of the energy system. This is because it combines the wind energy production with the conversion and storage of hydrogen and ammonia. The OFFSET concept involves a system approach, as it brings not only innovative solutions to the production of hydrogen through direct seawater alkaline electrolysis, but combines this with the conversion to ammonia, the bunkering or offloading through thermoplastic composite pipelines, their transportation to shore through existing oil and gas pipelines, and the exploitation that follows. Innovations are taking place at all levels of the renewable energy system, while making optimal use of the available space. One OFFSET can already have a 200 MW capacity and thereby takes up relatively little space when integrated in a wind farm. The OFFSET solution will have a capacity of 300 MW.
Additionally, the OFFSET project takes into account the protection of the North Sea and its ecology. The North Sea is an extremely occupied area full of economic activities, such as maritime transport, fisheries, wind farms, and resource extraction facilities. Due to the foreseen increase of wind farms in the future to achieve the climate goals, the North Sea will only become more occupied and the pressures on its ecology will only increase. The OFFSET project approaches these pressures holistically, by being a zero emission facility that requires relatively little space and does not require the construction of new infrastructure.

# 5 Spin off of the project within and outside the offshore energy sector

As the project did not yield any tangible spin off during year 2, other than expected sub results.

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# 6 Dissemination of results, and project publications

On the dissemination of the results SwitcH2 participated actively in articles and interviews on project OFFSET which have been published on social media and in cooperation with RVO.
Publications since the start of the project include:

- Post from RVO on the RVO site and LinkedIn "Met drijvende productieplatforms willen we groene waterstof op zee produceren" (rvo.nl)
- Publication: Groene waterstof maken met hulp van offshore windenergie en zeewater | Windenergie Nieuws (windenergie-nieuws.nl)

Press release via RVO on Windpower.nl

- Via Wendy Laursen in the Motorship June 2023 – Switch 2 Offshore
- Via ThyssenKrupp PR on LinkedIn https://www.linkedin.com/posts/thyssenkrupp_kooperation-f%C3%BCr-schwimmende-gr%C3%BCne-ammoniakanlage-activity-7092789232447959040-Gr1q?utm_source=share&utm_medium=member_desktop
- Via TU-Delft on their web-site: https://www.tudelft.nl/en/2023/h2-platform/mooi-grant-for-a-floating-green-hydrogen-and-ammonia-project
- Via SwicH2 website that shows a number of related publications: https://switch2offshore.com/2024/05/07/may-2024-europoort-kringen-2024/
- World Hydrogen Summit stand in Rotterdam 13 till 15-05-2024
- H2makers presentation at TU delft 27-05-2024
- Presentation of OFFSET at the RVO innovatiedag 05-06-2024
- TU-delft poster at ECCNS Symposium 22-05-2024
- TU-delft Poster ALD/ALE in 4 till 7-09-2024

The 2024 "Europoort Kringen"-publication is attached to this report as an annex.

SwitcH2 zet in op 'groene' FPSO

# DRIJVENDE ELECTROLYSE OP VOLLE ZEE

Het duurt niet lang meer voordat SwitcH2 begint met de eerste productie, opslag en het transport van groene waterstof en groene ammoniak op zee. Het wil hiervoor een drijvende unit gebruiken, die volgens Saskia Kunst van het bedrijf kan concurreren met electrolysers op land.

Saskia Kunst

Saskia Kunst, directeur en medeoprichter van SwitcH2, is als dochter van een Rotterdamse havenondernemer niet onbekend met het ondernemerschap. “Mijn vader had een internationaal expeditiebedrijf in de Waalhaven. Daardoor ben ik opgegroeid met de internationale handel en het transport. Als kind ging ik al mee naar kantoor. Zo kon ik de sfeer van het ondernemen proeven.” Ze werkte in de containeroverslag voor bedrijven als Hutchison Port Holdings en PSA International en ook leidde ze de grootste containerhaven in Genua. Bij SBM Offshore maakte ze voor het eerst kennis met de olie- en gassector en hernieuwbare energie. “Met de oprichting van SeaWater into Clean Hydrogen (SwitchH2) in 2021 kwamen deze twee werelden samen”, aldus Kunst. “Ik heb in het verleden eigen ondernemingen gehad. Op basis van de geleerde lessen uit de olie-en gaswereld stond ik ervoor open iets te starten dat zowel innovatief is als waarbij bewezen technieken worden gebruikt.”

## SYSTEEMINTEGRATIE

De samenwerking met haar compagnon Bob Rietveldt omschrijft Kunst als volgt: “Wij zijn samen aan deze ontwikkeling begonnen. Ik zeg altijd: Bob tekent en ik reken. Ik neem de commerciële en financiële kant van de onderneming op mij. Bob is verantwoordelijk voor alle technische zaken.” Samen kwamen zij op het idee van een ‘groene’ FPSO (floating production storage & offloading unit). Kunst: “De FPSO geldt al drie decennia als gouden standaard voor het ontwikkelen van olie- en gasvelden. Dit zijn schepen die gewonnen ruwe olie en gas in het ruim tot halfproducten verwerken. Van daar wordt het naar raffinaderijen getransporteerd. Wij willen eenzelfde soort schip, dat eveneens aan de zeebodem is verankerd, voeden met groene stroom die is gewonnen uit wind-, zonne- en golfenergie. Aan boord bevindt zich een electrolyser met een capaciteit van 300 megawatt, die groene waterstof of groene ammoniak produceert. De groene waterstof kan via bestaande gaspijpleidingen naar de kust worden getransporteerd. Als die infrastructuur er niet is, maken wij er ammoniak van, die via een drijvende slang wordt overgepompt naar de shuttle carrier voor het vervoer naar een terminal, wat al vele jaren wordt gedaan. De Nederlandse overheid wil op zee twee windparken realiseren die los van het elektriciteitsnet opereren. Eén ervan komt ten noorden van de Waddeneilanden. Dat is koren op onze molen. Door ons op zee geproduceerde waterstofmoleculen kunnen via een gaspijpleiding naar land worden getransporteerd of als ammoniak per schip worden geöffload. Het is mooi om te zien hoe de overheid hiermee voorsorteert op een systeemintegratie.”

**“EEN GROTERE CAPACITEIT HEEFT EEN GUNSTIGE UITWERKING OP DE KOSTPRIJS VAN GROENE WATERSTOF EN GROENE AMMONIAK”**


Kunst (midden op de foto) samen met andere werkgroepleden bij leidingenproducent Strohm.

## VERGEZICHT

Het idee dat op ammoniak varende schepen deze groene brandstof op zee zouden kunnen tanken of bunkeren bij een FPSO van SwitcH2, is interessant, maar een vergezicht, vindt Saskia Kunst. “Op de middellange termijn zie ik dit niet gebeuren. Die twee bewegende units naast elkaar vormen een grote uitdaging. Het is beter om de waterstof en ammoniak naar een terminal op land te transporteren.”

### Het is een interessant concept. Wie zijn jullie potentiële afnemers?

“Die zijn in verschillende categorieën te verdelen. Ten eerste richten wij ons op de scheepvaart. Er zijn verschillende rederijen die schepen in bestelling hebben waarvan de motoren op ammoniak kunnen draaien. Daarnaast kijken wij naar bunkerbedrijven. Wij voorzien dat die ammoniak in hun assortiment willen opnemen. Ten derde is de zware industrie een mogelijke afnemer van groene waterstof. Denk aan bedrijven in de petrochemie, raffinage-, chemie- en staalsector.”

### Hoe ver zijn jullie hiermee?

“Doordat wij van bewezen technieken gebruikmaken, zitten wij redelijk dicht tegen de marktintroductie aan. We hopen in de loop van volgend jaar ons eerste project te kunnen starten. Tot die tijd moeten wij nog een aantal aspecten uitwerken. Wij zijn nu bezig stappen te zetten in de basic engineering. Dat moet leiden tot een compleet technisch plaatje. We werken hard aan de commerciële contracten voor de inkoop van stroom en voor de off-take. We maken grote stappen voorwaarts.”

> **“IK HEB DIT SOORT PROJECTEN EERDER GEDAAN, MAAR NOG NIET IN DEZE ‘GROENE’ VORM”**

### Aan welke aspecten moeten jullie nog schaven?

“Voornamelijk is er aan de vraagzijde nog werk te doen. De markt is wat afwachtend, wat onder meer valt te verklaren doordat Europese subsidieregelingen traag op gang komen. Net als offshore wind is dit een sector die een eerste impuls van de overheid nodig heeft om tot ontwikkeling te komen. Daarnaast is het kader aan wet- en regelgeving nog niet op orde voor de schaalgrootte waar wij ons op richten.”

### Over schaalgrootte gesproken: 300 megawatt is fors, meer bijvoorbeeld dan de electrolysers die in de haven van Rotterdam verrijzen.

“Wij realiseren anderhalf keer zoveel capaciteit als bijvoorbeeld Shell, dat een groenewaterstoffabriek op de Maasvlakte bouwt. Dit valt te verklaren doordat wij ‘lessons learned’ uit de offshore wereld kunnen benutten. Op een schip zijn wij in staat om heel efficiënt te bouwen. Aanvankelijk gingen wij uit van een capaciteit van 200 megawatt, maar gaandeweg bleek dat wij dit kunnen uitbreiden naar een ontwerp van 300 megawatt. De afmeting van het schip is bepalend voor de capaciteit. Ook moet je rekening houden met het toekomstige onderhoud en hoe het efficiënt valt te opereren. Een grotere capaciteit heeft een gunstige uitwerking op de kostprijs van groene waterstof en groene ammoniak. Daarom is 300 megawatt interessant.”

### Is de kostprijs van geproduceerde groene waterstof op zee concurrerend met productie op land?

“Jazeker. Vaak wordt gedacht dat productie op zee duurder is. Dat is echter niet het geval. Dat komt doordat je het schip kunt bouwen waar dat het goedkoopst is. Op land kun je dat niet doen. Daarnaast kunnen wij bij de bouw van de FPSO profiteren van de kennis die hiervoor in het verleden is opgedaan. Ook is een schip flexibel; het kan op termijn eventueel elders worden ingezet. Verder is snelheid een voordeel. Omdat wij maar een kleine impact op de zeebodem hebben - alleen met het afmeersysteem - zijn wij minder tijd kwijt aan het aanvragen en verkrijgen van milieuvergunningen.”

### Is dit ook waarom jij het concept kansrijk acht?

“Inderdaad, en er is nog een bijkomend voordeel op het gebied van veiligheid. Zoals ik net vertelde, wordt ammoniak al jarenlang succesvol en veilig in shuttle carriers verscheept. Ik geloof dat je de ammoniakketen uit oogpunt van veiligheid beter op zee kunt realiseren dan in bebouwde gebieden en zelfs in industriële havens.”

### Wat is tot nu toe het lastigst gebleken?

“Eigenlijk loopt het voorspoedig. Wij hebben succesvol de proof of concept afgerond, DNV heeft ons Approval in Principle verleend en ook verloopt de samenwerking uitstekend met de aandeelhouders BW Offshore en Dutch Oceans Capital. We hebben een mooie subsidie ontvangen van RVO en werken samen met partijen als TU Delft, Marin en Strohm.”

### Speelt Rotterdam een rol in jullie plannen?

“Wij zijn onder de indruk van de visie en voortrekkersrol waarmee de Rotterdamse haven de energietransitie heeft ingezet. Wij werken er nauw mee samen, want ammoniak gaat in Rotterdam aanlanden, waar het zal worden opgeslagen. Dat het Havenbedrijf Rotterdam nu al incentives geeft aan schepen die op groene brandstoffen varen, is precies wat wij nodig hebben om ons concept te doen omarmen.”

### Je gebruikt jouw kennis, kunde en netwerk uit het verleden nu in SwitcH2. Wat heb je als directeur van SwitcH2 geleerd?

“Wij doen dit voor eigen rekening en risico, iets wat ik ken en waarvoor ik niet wegloop. De schaal en het belang - de investering in de FPSO bedraagt meer dan 1 miljard euro - zijn echter nieuw. Ik heb dit soort projecten eerder gedaan, maar nog niet in deze ‘groene’ vorm. Wij ontwikkelen niet alleen een nieuwe technologie, maar ook de markt zelf. Daarbij ben je afhankelijk van anderen. Die moet je zien te lezen en soms moet je het tempo accepteren.”

### Je bent tevreden?

“Dit is fascinerend om te doen. Elke dag geeft weer opnieuw energie. We hebben allemaal aan olie en gas verdiend en hiermee kunnen wij weer wat terugdoen voor de maatschappij.”