



# Program International online seminar on multifunctional artificial islands

7 AND 8 APRIL 2021

OFFSHORE  
SERVICE  
FACILITIES

**Offshore wind energy will play a major role in a future CO<sub>2</sub>-free energy supply system. With the growing capacity of offshore wind energy, the integration of energy from the North Sea into the entire energy system becomes a challenge. Artificial islands may contribute to the solution. Artificial islands in wind energy areas in the North Sea may serve as hubs for the transport infrastructure of offshore wind energy by means of electrons or molecules (hydrogen). Islands will then host electrical and power-to-gas installations and function as a base for operation and maintenance activities and other marine activities, such as providing marine safety, food pre-processing (seaweed) and high energy-demanding activities such as datacentres. A Dutch consortium intends to develop a concept pilot island and share and gather ideas and information through this seminar.**

### MULTI-PURPOSE ISLANDS

In the Innovation Agenda (IKIA), which is linked to the Climate Agreement and by the Ministry of Economic Affairs and Climate, 'energy' islands in the North Sea are considered after 2030. When new wind farm areas are selected, the preparation of the energy infrastructure should follow suit. TenneT, as a central player, considers hubs for the future offshore electricity infrastructure and has initiated many studies together with the North Sea Wind Power Hub consortium. Multi-purpose islands can bring interesting social and economic benefits and opportunities for the export of (Dutch) knowledge and expertise. This is also concluded in studies of Offshore Service Facilities (OSF), engineering and consultancy firm Royal HaskoningDHV, Van Oord, Boskalis, Stichting New Energy Coalition, CE Delft, and knowledge institute Marin, Deltares and TNO.

### INTERNATIONAL ONLINE CONFERENCE ON MULTIFUNCTIONAL ARTIFICIAL ISLANDS

On April 7 and 8, 2021, an international two-day online conference on multifunctional islands in the North Sea for participants with contributions from Denmark, Germany, the Netherlands, Belgium and the UK is planned. We expect at least 150 online participants for two interactive, collaborative days of networking, information-sharing, and fun in a professional setting.

The goal is to paint a clear picture of the challenges ahead, the possible role of artificial islands, the possible benefits and opportunities for other applications, as well as the challenges in planning, timing, ecology, ownership and interference of the various potential users and future possibilities for floating or hybrid islands. The result could be a clear plan of the development steps and R&D that are necessary for the development of a concept of a first/demonstration/pilot project and to benefit from the opportunities and possibly accelerate development.

**The organisers wish to create an overview of those islands' ideas, possibilities, and impossibilities and exchange knowledge and insights with parties involved. The results of the conference will be published and shared with the participants.**

# Dag 1 April 7, Morning

10:00	Ernst van Zuijlen, OSF	Conference welcome
<b>10:10</b>	<b>Session 1</b>	<b>Keynote Session - setting the scene</b>
	Chris Westra, We@Sea	The necessity and benefits of artificial energy islands, hubs for the energy transition and multi-use
10:40	Break	
<b>10:45</b>	<b>Session 2</b>	<b>Electricity</b>
	Martijn Duvoort, DNVGL	Challenges for offshore energy production, conversion and transport, interconnection, Islands can be cheaper than jackets
11:45	Lunch Break	
<b>12:15</b>	<b>Session 3</b>	<b>The role of Hydrogen</b>
	Rene Peters, TNO	Hydrogen as an essential part of the energy transition, offshore production, storage, processing, compression, challenges and benefits, re-use of infrastructure
13:15	Break	
<b>13:20</b>	<b>Session 4</b>	<b>Concepts and design</b>
	Ronald Stive, RHDHV	Technically the construction of an island is not a problem; innovations are possible, breakwater and floating, hybrid, temporary solution, limits because of water depth
14:20	Break	
<b>14:25</b>	<b>Closing session</b>	<b>Closing day 1</b>
14:35	Ernst van Zuijlen, OSF	Summary of day 1; announcement of day 2

# Dag 2 April 8, Afternoon

12:30	Ernst van Zuijlen, OSF	Short summary of day 1, opening day 2
<b>12:40</b>	<b>Session 5</b>	<b>Ecological aspects</b>
	Han Lindenboom, NIOZ	Threats and opportunities for nature, building with/ for nature
13:40	Break	
<b>13:45</b>	<b>Session 6</b>	<b>Legal and policy aspects</b>
	Weero Koster, Aeolian	Northsea, EEZ, ownership of property, permitting, tendering, PPS, policy, international aspects UNCLOS, safety
14:45	Coffee Break	
<b>15:15</b>	<b>Session 7</b>	<b>Co-use and sharing;</b>
	Erik Zigterman, RHDHV	Who can benefit from an island, how to optimally use the space, logistics, synergies
16:15	Break	
<b>16:20</b>	<b>Session 8</b>	<b>Conclusions &amp; Next steps</b>
	Bob Meijer, TKI Wind op Zee	Demonstration, Pilot, Public-Private Partnership, an opportunity for energy transition, Dutch civil engineering sector. Start preparing a pilot: startup engineering, preparation and further R&D, good business case, multiple-use
<b>17:20</b>	<b>Closing session</b>	<b>Closing of the seminar</b>
17:35	Ernst van Zuijlen/ Chris Westra	Goodbye and credits

# Session 1

Session 1	Keynote Session	'Setting the scene.'
<b>Chairs</b>	Ernst van Zuijlen / Chris Westra	OSF / We@Sea
	Manon van Beek	TenneT
	Hans Timmers	NWEA
	Titia Kalker	Ministry of Public Works
	Huib den Rooijen	The Crown Estate
	Ulrik Stridbaek	Ørsted

## CONTENT OF THE SESSION

**The necessity and benefits of artificial energy islands, hubs for the energy transition and multi-use of space, expressed by key stakeholders. Setting the scene for the seminar.**

# Session 2

<b>Session 2</b>	<b>Electricity</b>	
<b>Chair</b>	Martijn Duvoort	DNV
	Thomas Donders	Tennet
	Andreas Wagner (invited)	Stiftung Offshore Windenergie
	Joost Vermeulen	Ministry of Economic Affairs and Climate
	Maksym Semenyuk	DNVGL

## CONTENT OF THE SESSION

### **Challenges for offshore energy production, conversion and transport; interconnection; Islands can be cheaper than jackets**

Bringing the electricity production of large offshore windfarms ashore is a challenge as offshore cabling, onshore connection, and onshore transport becomes more complex. It at least takes several years of planning, preparation, and construction. Also, the variability of renewable sources poses questions toward a stable system in the future.

It is generally accepted that the electricity network needs a flexible and interconnected offshore infrastructure. Hubs can serve multiple purposes: shore connection but also interconnection and potentially storage. Hubs can be constructed on existing islands, on jacket constructions or on artificial islands, or in the future, on floating constructions. At a larger distance from shore, HVDC solutions are preferable because transport losses can be limited.

If no islands are present and metocean conditions are favourable (water depth, waves), an artificial island may be a cheaper solution than jackets, even in water depths of over 30 meter.

Questions to be answered in the near future are partly practical: Where will new large wind farms be constructed? What is the actual cost-benefit? Can parts of electrical infrastructure be combined with other functionalities?

Also, it can be discussed if international cooperation is essential, what the preferred size of electrical capacity should be if HVDV solutions would allow the lower quality of AC connection etc.

# Session 3

<b>Session 3</b>	<b>The role of Hydrogen</b>	
<b>Chair</b>	Rene Peters	TNO
	Catrinus Jepma	Rijks Universiteit Groningen
	Ad van Wijk	TU Delft
	Luuk Feenstra	GasUnie
	Pieter de Jong	RWE

## CONTENT OF THE SESSION

### **Hydrogen as an essential part of the energy transition, offshore production, storage, processing, compression, challenges and benefits, re-use of infrastructure**

As system integration challenges for a pure electrical solution for transport, storage and flexibility in the energy system increase, other energy carriers may provide solutions.

One of the potential solutions can be provided by conversion to hydrogen. If conversion to hydrogen took place close to the wind farms, this would reduce the energy transport losses. This would allow the re-use of the offshore gas infrastructure with a very high transport capacity and might be suitable for hydrogen transport under certain conditions or adaptations.

Hydrogen can be transported to shore and fed into a transport backbone to provide an alternative for fossil feedstock for industry or back-up capacity for electricity production.

Re-use of transport pipes would also facilitate interconnection with, e.g. the UK, again adding flexibility to the system

Storage of hydrogen in offshore salt caverns may even increase the value of this solution. Also, further processing to other feedstock like ammonia is possible.

However, electrolysis capacity currently is not big enough to really add to the system integration demands (in the order of GW's). Also, electricity demand will increase by electrification of industry and therefore may reduce the swift increase in hydrogen demand.

Offshore production of hydrogen poses additional questions, like the supply of freshwater. The use of heat (or even oxygen) produced during the electrolysis process would require other processes to be integrated on the island.

During the seminar, the IJvergass project results will be discussed, as many of the questions were dealt with in this R&D project.

# Session 4

<b>Session 4</b>	<b>Concepts and design</b>	
<b>Chair</b>	Ronald Stive	RHDHV
	Wim Klomp	RHDHV
	Roderik Hoekstra	Deltares
	Wouter Ockeloen	Van Oord
	Erik Jan de Ridder	Marin

## CONTENT OF THE SESSION

**Technically the construction of an island is not a problem. Innovation is possible. Breakwater and floating/ hybrid/ temporary solutions. Limits because of water-depth.**

Large scale Offshore Windfarms in the North Sea at a large distance from the coast will require temporary (during construction) and permanent (during operation and maintenance) marine-logistic activities. These activities' magnitude and scale will need to plan for environmentally friendly, safe and efficient offshore support facilities. The presently applied offshore logistics in the North Sea are, in the near future, best to be supported/ replaced by more robust and practical solutions. Why not by building dedicated 'artificial islands'?

In the last decades, dredging companies have been involved in many land reclamation projects worldwide. Roughly spoken, these artificial islands did not exceed a water depth of about 15 meters and a design wave condition of about 7 meters. Most of the islands have been reclaimed using dredged sand, whereas the marine edge was often reinforced with rock and or concrete block slopes.

The North Sea imposes challenges regarding the design and construction of an artificial island, which undoubtedly can be mastered by engineers and contractors. But at what cost, how fast and last but not least, how environmentally friendly? How can we efficiently accommodate in the design water depths up to say 40 m and wave heights up to say 12 m? Can marine edges be built without the abundant use of hard (concrete) materials and also contribute to the ecosystem where they are located. Can the impact of the island's footprint be reduced by combining traditional reclamation techniques with floating "building ground" and at the same time still facilitate all required island functions? Do contractors have suitable plant and material for safe and relatively fast construction?

Researchers, engineers and contractors have the knowledge and international experience to realise large scale offshore energy islands. However, to tackle the North Sea's specific challenges, it is most efficient to start with a relatively small to intermediate scale Artificial Island Pilot. The Pilot will give valuable feedback on which functions can be most practically accommodated on the island, what are the environmental pro's and con's, how can the logistics and marine transport with respect to large scale wind farm construction and operation best supported, what are the actual all-inclusive island construction costs and how feasible is the application of floating structures?

# Session 5

Session 5	Ecological aspects	
Chair	Han Lindeboom	WUR
	Heleen Vollers	SDN en N&M
	Mardik Leopold	WUR
	Ib Krag Petersen	Danish Bird expert
	Emilie Reuchlin	WWF
	Marjolein van Wijngaarden	Boskalis
	Peter de Jong	Natuur en Milieu

## CONTENT OF THE SESSION

### Threats and opportunities for nature; building with/ for nature

Four major elements determine the functioning of marine ecosystems: habitat type, energy entering the system, intrinsic properties of living nature and man-made drivers of change. The building of artificial islands will create new habitat types in the open sea. This offers threats and opportunities for a different future. Physical properties like currents, waves, stratification, depth and sediment transport will change, and new hard or soft substrata will create habitats for other organisms.

Novel structures in the offshore marine environment will inevitably create both opportunities and challenges to the local or wider environment. An artificial island will attract high numbers of birds and create resting, breeding and foraging opportunities. Likewise, marine mammals such as seals might use offshore islands as new resting and feeding sites. At the same time, habitat loss will also occur for the animals currently using these sites. The island will be encased by surrounding wind farms. So, the opposing forces of attraction to the new structures must be carefully weighed against detrimental displacements, new competition and -in the case of birds- collision risks.

The new features that offshore energy islands will bring to the marine environment offer interesting design and management possibilities. Questions that need to be addressed are: do we want to stimulate or oppose the settlement of breeding birds? Are all species of birds equally welcome or to be opposed? Do we allocate specific parts of the island for birds and or mammals? How do we design the islands itself, and the islands' structures so that breeding will be promoted or discouraged?

The Dredging Industry has a great interest in creating Islands at Sea. Of course, this is part of our core business, but even more so, we see this as an opportunity to deliver sustainable and innovative solutions to society. Nature-Based Solutions are, in our opinion, a strong proposition for an Island at Sea to become an opportunity for ecology and economy, instead of the thread they may otherwise become. We strongly believe that we have a role to play in the whole process to make sure such islands will become technically feasible, cost-effective and ecologically attractive solutions.

The North Sea Foundation and Natuur & Milieu stand for a clean and healthy North Sea in which both nature and offshore wind energy can thrive. Artificial energy islands could provide a solution to reduce the cost of offshore wind energy. At the same time, artificial islands bring risks and opportunities for the North Sea ecosystem. We believe that these ecological risks and opportunities should be carefully and scientifically safeguarded before moving forward.

Wind energy will help reach climate targets, but WWF cautions not to let marine biodiversity foot the climate bill. A healthy North Sea ecosystem provides space for sustainable energy and food harvesting, which is why we need a network of Marine Protected Areas and place wind energy outside MPAs. WWF questions whether permanent energy islands in the North Sea are a good solution or that temporary structures such as repurposed platforms provide a better option with fewer ecological (cumulative) impacts. Furthermore, impacts on the ecology need assessment against the restoration potential.

# Session 6

Session 6	Legal and policy aspects	
Chair	Weero Koster	Aeolian
	Ilse van der Velden	Ministerie van I&W
	Ceciel Nieuwenhout	RU Groningen
	Marjolein Dieperink	AKD
	Wouter Herzberger	NRF

## CONTENT OF THE SESSION

### **North sea, EEZ, ownership of property, permitting, tendering, PPS, policy, international aspects UNCLOS, safety**

The development of a multi-purpose Island with maximum utility for a diverse group of users outside the Dutch 12-Mile zone can be a hotbed for legal innovation. The experience gained in the offshore industry, and the realisation of offshore wind power generation facilities can be leveraged to address a number of issues. Still, these efforts are all directed at single-purpose installations used a single operator. Creating an Island that can be used for various purposes raises numerous international and public-private law questions regarding the Exclusive Economic Zone. Property law, financing and taking security, planning and zoning, use and management, labour-condition, police- and safety functions, and influence on the aquatic environment, to name but a few. These issues must be addressed within the framework of international, EU and national Dutch law, regulation and policy. This session addresses the issues with a panel of international legal experts experienced in the offshore industry.

# Session 7

<b>Session 7</b>	<b>Co-use and sharing</b>	
<b>Chair</b>	Erik Zigterman	RHDHV
	Geert Timmers	Deutsche Windtechnik
	Zinzi Reimert	Stichting Noordzeeboerderij
	Jeroen van der Tang	NL Digital

## CONTENT OF THE SESSION

### **Who can benefit from an island; how to optimally use the space, logistics, synergies?**

The pilot island will, next to primary (energy-related) functions, offer space to other applications. It is essential that the island contributes to innovations, a sustainable society and facilitates knowledge on the effects of such infrastructure on ecology, above and below sea level.

The island is, in fact, a new industrial space to use sustainably and optimally. From the first two perspectives, it is therefore vital to select functions that strengthen each other and reduce the use of energy. E.g. datacentres use high amounts of electricity and produce much heat. They can be placed close to the production area of energy (on an island), but then their residual heat should be made available for heating the premises or, e.g. for pre-processing seaweed (drying). Can the island be constructed in such a way that freshwater can be collected and stored? An island will with a hotel function will enhance the personnel's safety: fewer shipping movements, emergency assistance and resting place. An important function will be the O&M support for the surrounding wind farms. The island may help to reduce the number of ship movements drastically. Those and other ships can use the island as a charging base for electric (or hydrogen-fuelled) transport. The seminar will give insight in the sustainable innovations required.

The island's construction may contribute to strengthening the ecology of the North Sea (session 6). Research, located on the island, should be facilitated in such topics but also regarding the influence on sand transport, the monitoring of sea-level rise, potential hybrid or completely floating islands, optimisation of maintenance of the island, further opportunities for multifunctional use, etc. This will help to develop further artificial islands in a sound and ecologically friendly way.

Klaas Jan Wardenaar of Smartland landscape architects works on a multiple use of space at sea. With this main goal, Smartland works together with the North Sea farm on seaweed cultivation within wind farms and is also working on a nature-inclusive island design. The introduction video shows these designs.

# Session 8

Session 8	Conclusions & Next steps	
Chair	Bob Meijer	TKI Wind op Zee
	Erik Oostwegel	RHDHV
	Various other contributors	

## CONTENT OF THE SESSION

On the base of two days of discussing various aspects of artificial island (the need, the design, the consequences and opportunities) we hope to conclude that ample opportunities exist and that The North Sea offers a great possibility to start as soon as possible with a the development. After all conceptual studies it seems time to kick off with actual site selection, actual design based on specific site conditions and metocean data. Then real costs and legal and ecological boundaries can be used in deciding what activities can be involved and witch companies to take a part. Also, the next round of innovative solution with floating or hybrid elements and building with or for nature can be investigated. How can offshore conditions for personnel be improved? Will offshore hydrogen play a role in the near future? Will safety at sea be improved? Is international cooperation a precondition?