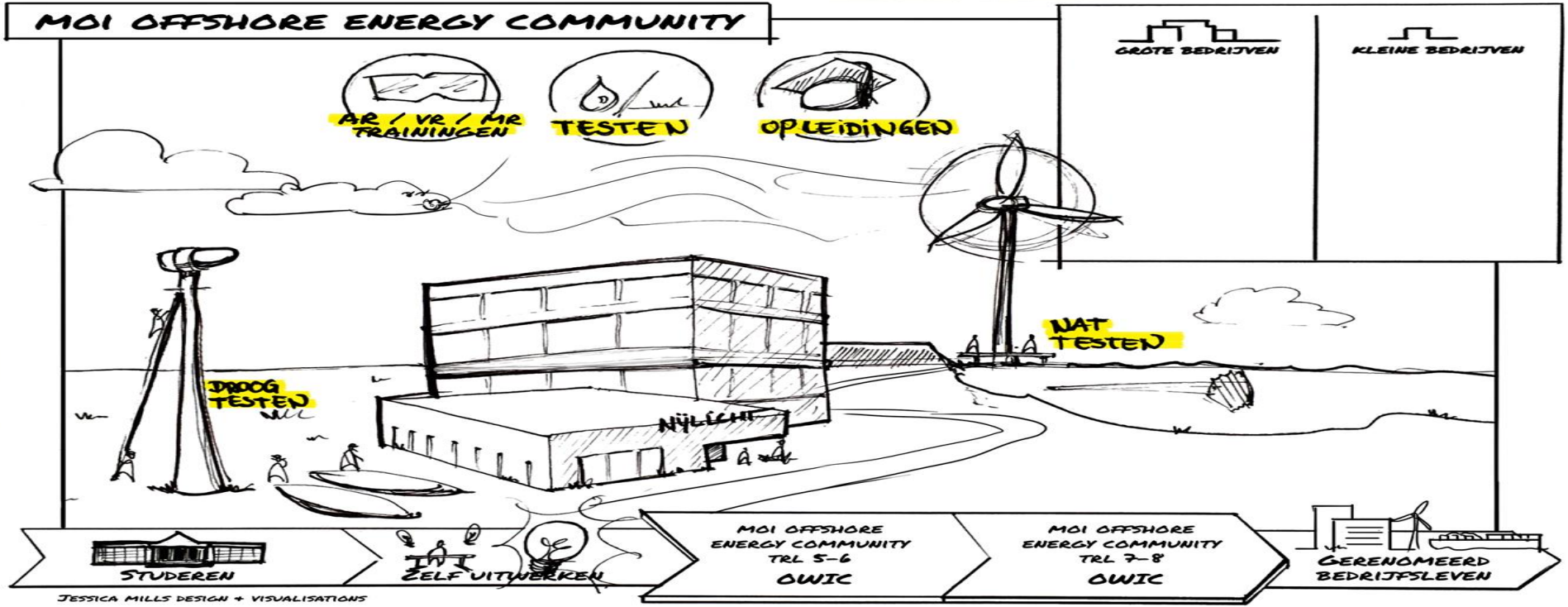
October 7th Groningen
Wind Meets Gas 2022

Workshop Wind-Meets-Hydrogen Clusters in de Noordzeeregio &Innovaties in Offshore Wind Operations and Maintenance

- *Introduction – Dirk Jan Hummel, Project director OWIC and Tonnie Schuijl, DHSS Eemshaven*
- *Drones, Robots and ROV's – John Troch, DroneQRobotics*
- *The future of offshore wind maintenance– Hans van Beek, Tarucca*
- *Green Hydrogeen initiatives – Jens Fuhrman, RWE and Green Hydrogeen clusters – Wim AB, NOM*
- *Sustainable re-use of Rotor blades – Ingrid Klinge, NEC*

OWIC – Eemshaven as the innovatiehub in offshore wind!



Offshore Wind Innovation Centre

OWIC

The project

Focus on five themes:

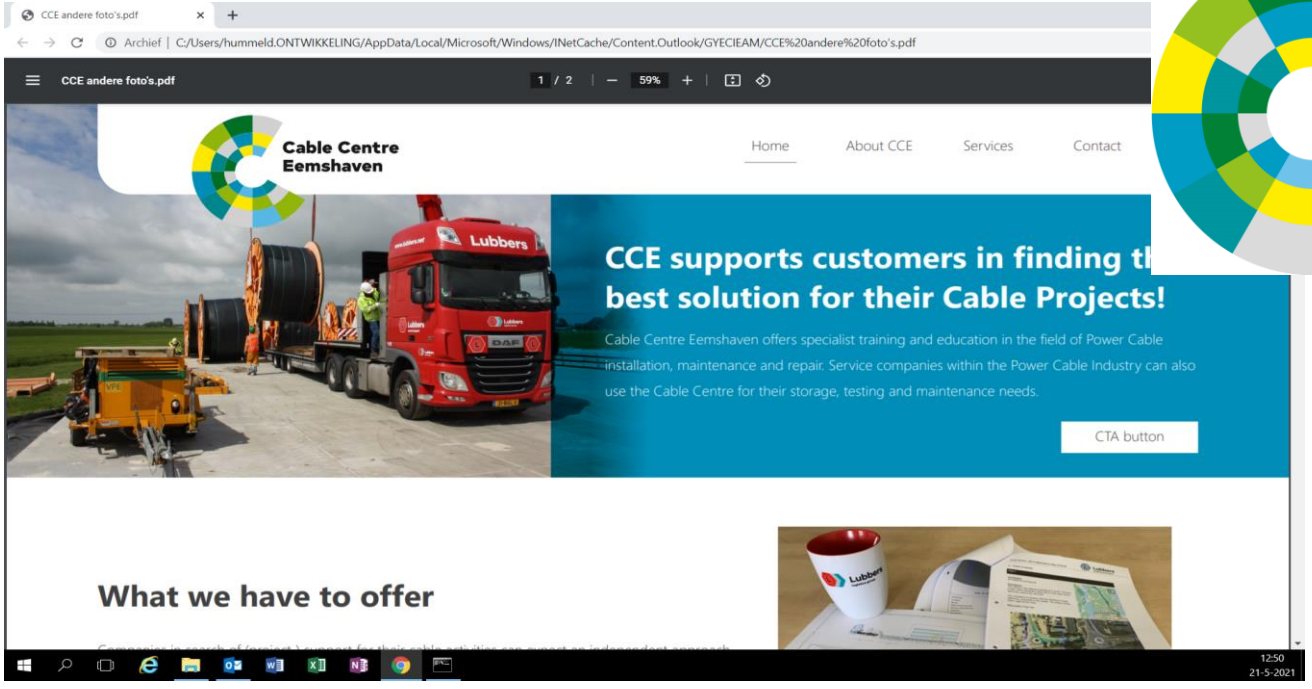
- ***Cable***
- ***Bolting***
- ***Predictive maintenance***
- ***Rotor blade***
- ***Energy Storage***

EUROPESE UNIE
Europees Fonds voor regionale ontwikkeling

Offshore Wind Innovation Centre

OWIC

Cable



Cable Centre Eemshaven

EUROPESE UNIE
Europees Fonds voor regionale ontwikkeling

Offshore
Wind
Innovation
Centre

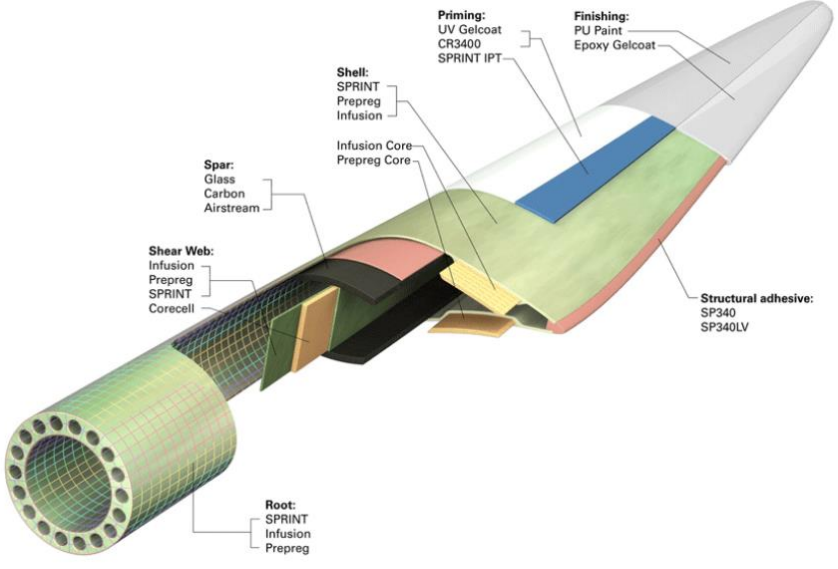
OWIC

Predictive Maintenance

Offshore Wind Innovation Center

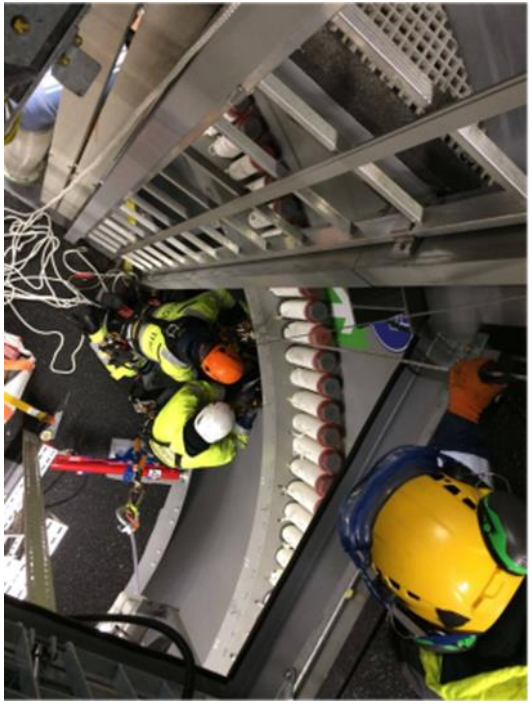
OWIC

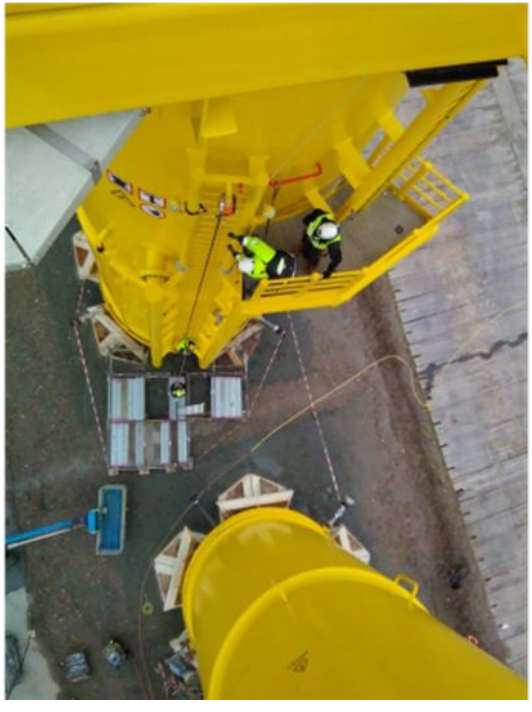
Recycling Rotorblades

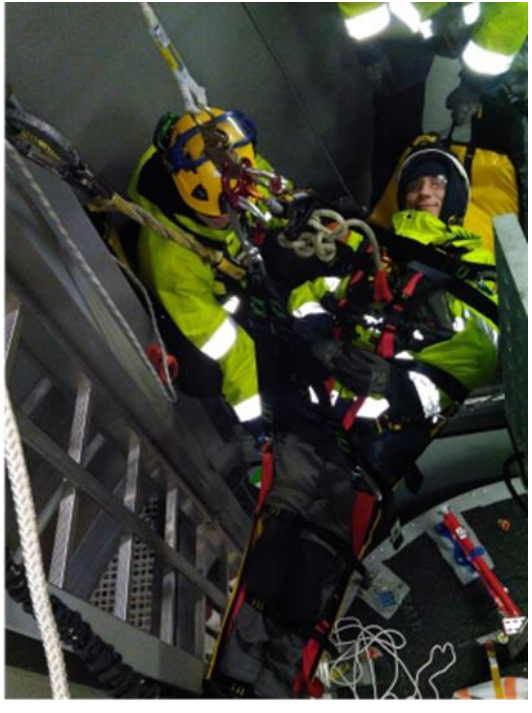


EUROPESE UNIE
Europees Fonds voor regionale ontwikkeling

Bolting





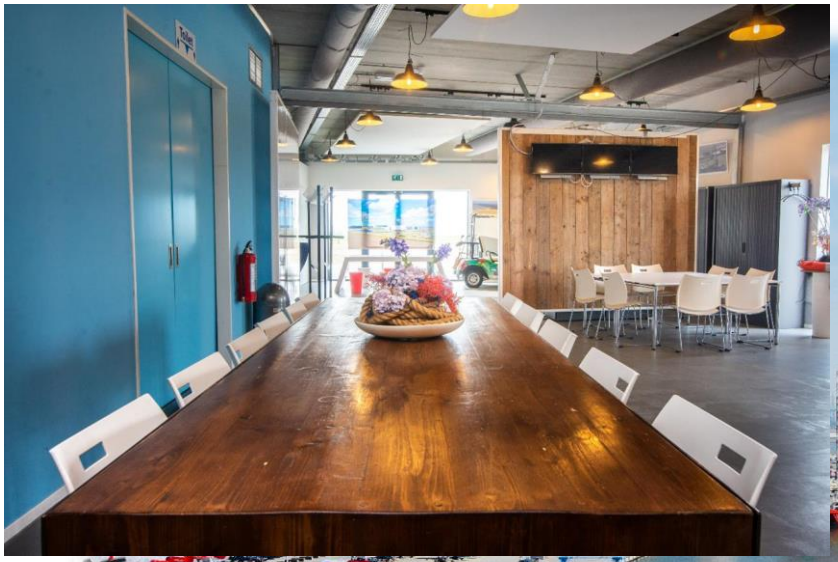


Offshore Wind Innovation Center

OWIC

Training and Education

MOI Offshore Energy Community Eemshaven



economic board groningen

NORTHERN NETHERLANDS OFFSHORE WIND
NNOW

GRONINGEN INNOVATION PORT

Program

- *Drones, Robots and ROV's – John Troch, DroneQRobotics*
- *Sensor the blades – Hans van Beek, Tarucca*
- *Green Hydrogeen initiatives – Jens Fuhrman, RWE and Green Hydrogeen clusters - Wim AB, NOM*
- *Sustainable re-use of Rotor blades – Ingrid Klinge*

- *Drones, Robots and ROV's – John Troch, DroneQRobotics*

The Future of Offshore Wind Maintenance

We know how it should look like,
but how do we get there?

Wind meets Gas 2022 – Hans van Beek

- The enormous growth in offshore wind power capacity
- The even-more enormous need for offshore maintenance
- The lack of labor
- The great multitude of ongoing R&D activities to create solutions
- The time is running out and need for retro-fit solutions
- The need for more real-life trials and experiments

Tarucca

Sensor-based condition & structural health monitoring of wind turbine blades (start-up)

Co-founder

EAISI EINDHOVEN AI SYSTEMS INSTITUTE

TU/e

Program Manager

Dutch set 70GW by 2050 offshore wind target

Netherlands' new goal will also require 50GW of capacity by 2040

16 September 2022 Offshore Wind

[Image: Blix Consultancy]

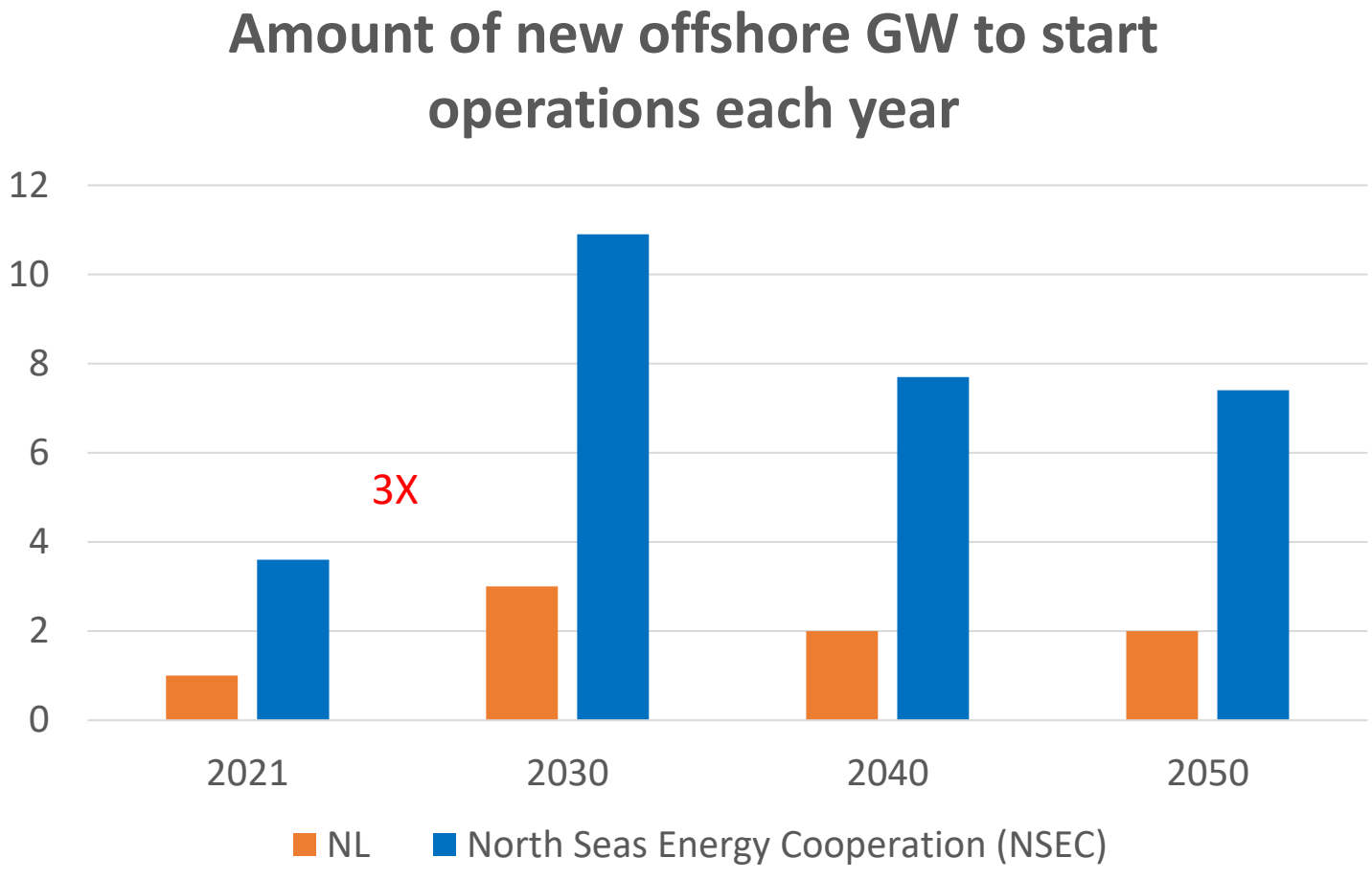
Back to overview

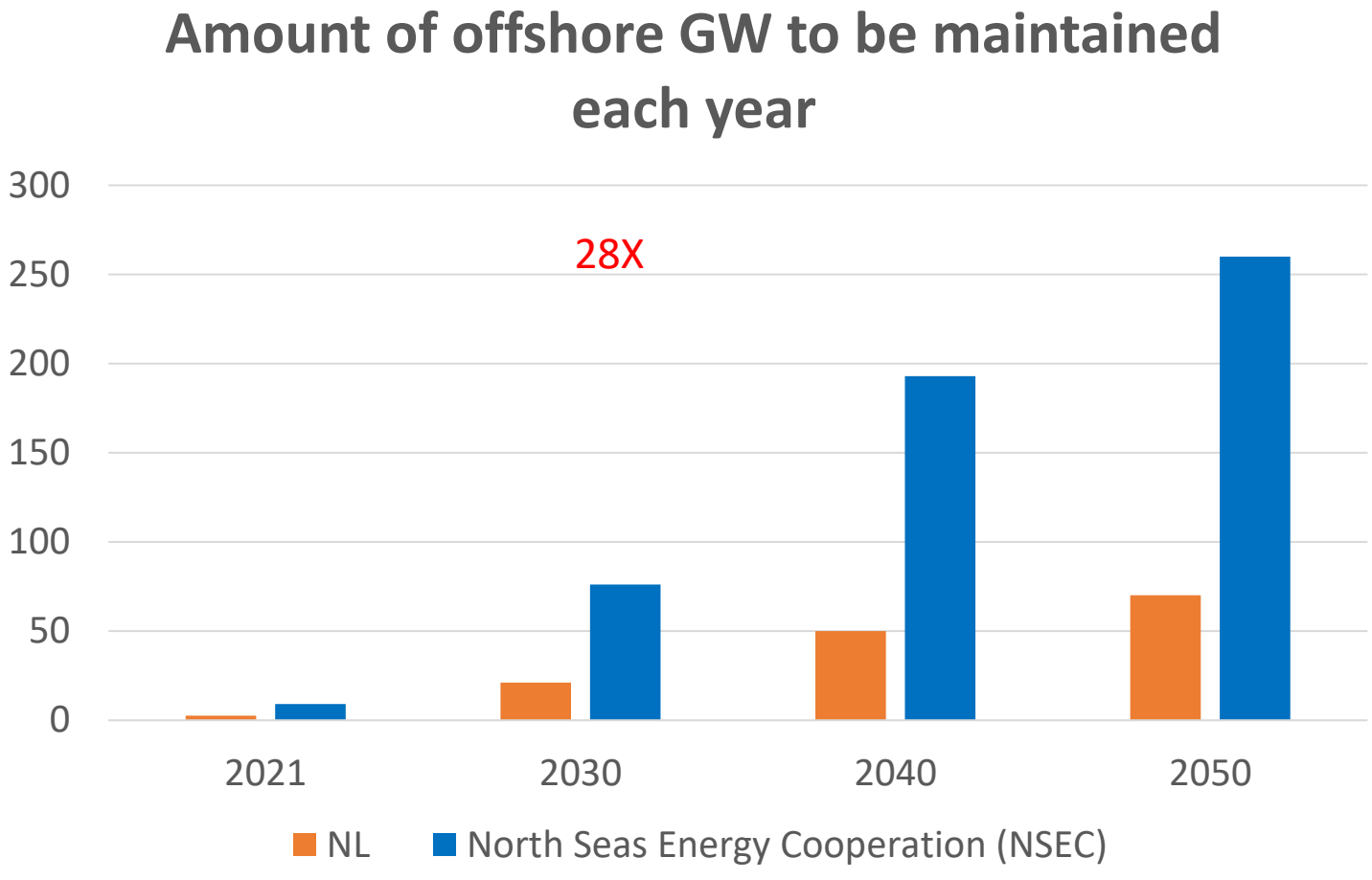
Nine North Seas Countries Set 260 GW by 2050 Offshore Wind Target

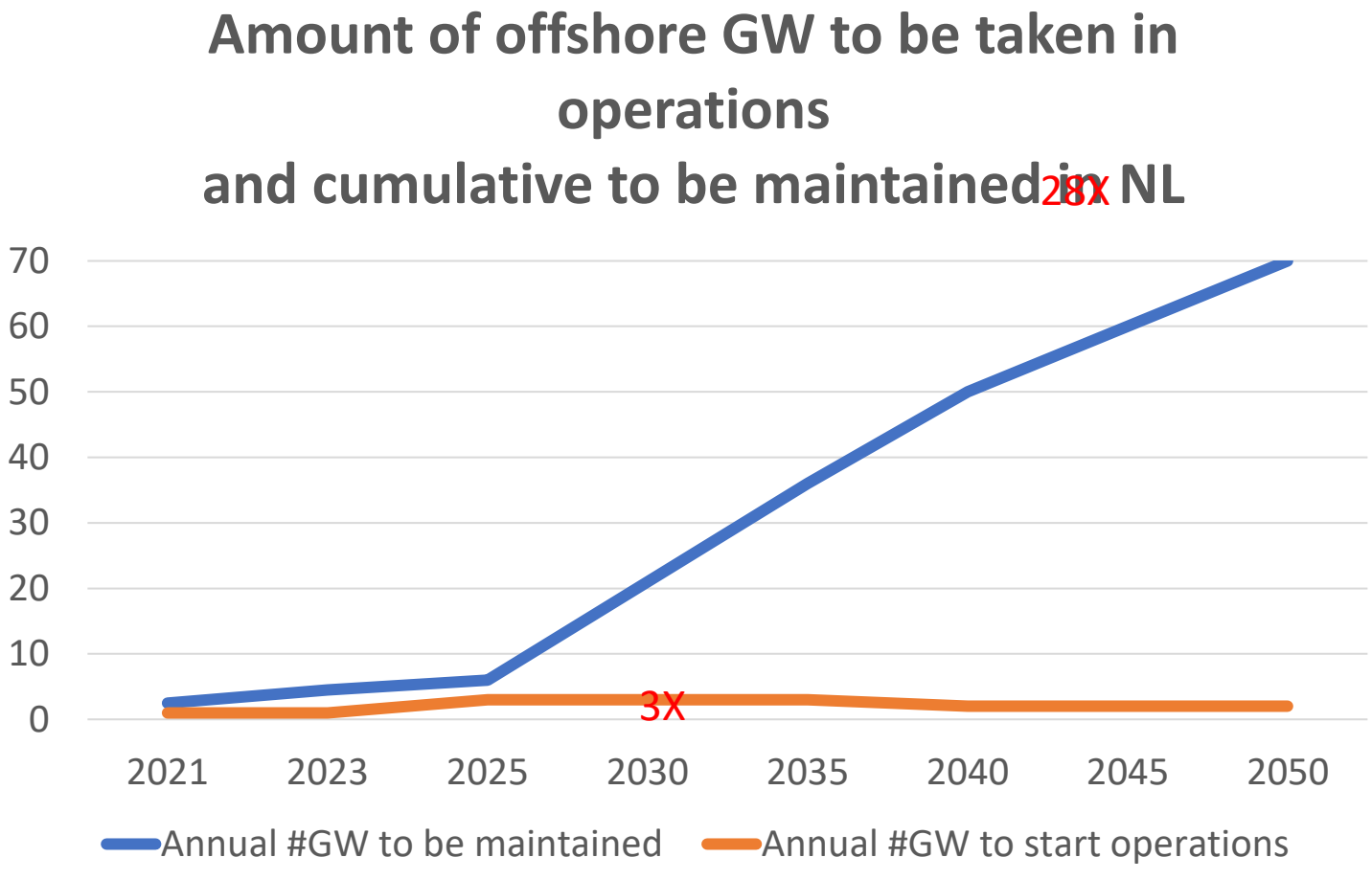
September 12, 2022, by Adnan Durakovic

Energy Ministers from the nine members of the North Seas Energy Cooperation (NSEC) have agreed to reach at least 260 GW of offshore wind capacity by 2050.

Related news


Amount of new offshore GW to start operations each year
12
10
8
6
4
2
0
3X
2021
2030
2040
2050
NL
North Seas Energy Cooperation (NSEC)


Amount of offshore GW to be maintained each year
300
250
200
150
100
50
0
28X
2021
2030
2040
2050
NL
North Seas Energy Cooperation (NSEC)


Amount of offshore GW to be taken in operations
and cumulative to be maintained in NL
28X
3X
70
60
50
40
30
20
10
0
2021
2023
2025
2030
2035
2040
2045
2050
Annual #GW to be maintained
Annual #GW to start operations

Business

Record-high labor shortage in the Netherlands: more vacancies than people looking for a job

Clément Vérité May 18, 2022 2 minutes read

With a 3.5% unemployment rate, the Netherlands experience a record-high labor shortage with more open positions than people without a job.

SHORTAGE OCCUPATIONS IN THE NETHERLANDS – LIST

№	Occupation
1	Doctors, medical staff
2	Engineers (especially in mechanical engineering and chemical industry)
3	Logists
4	Programmers (different directions)
5	Agricultural workers
6	Builders (different directions)
7	Creative professions (designers, artists)
8	Teachers
9	Financiers
10	Energetics

Occupational groups – most unfilled vacancies

Annex 1: images for text 2 – national

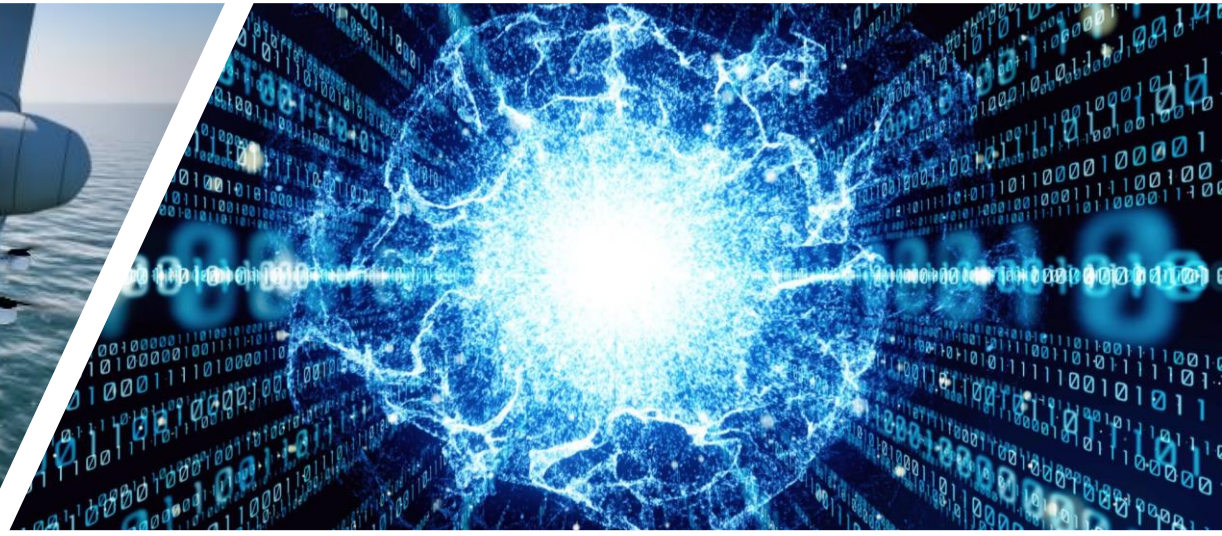
The top 10 occupations with the most unfilled vacancies in the fourth quarter of 2021 were:

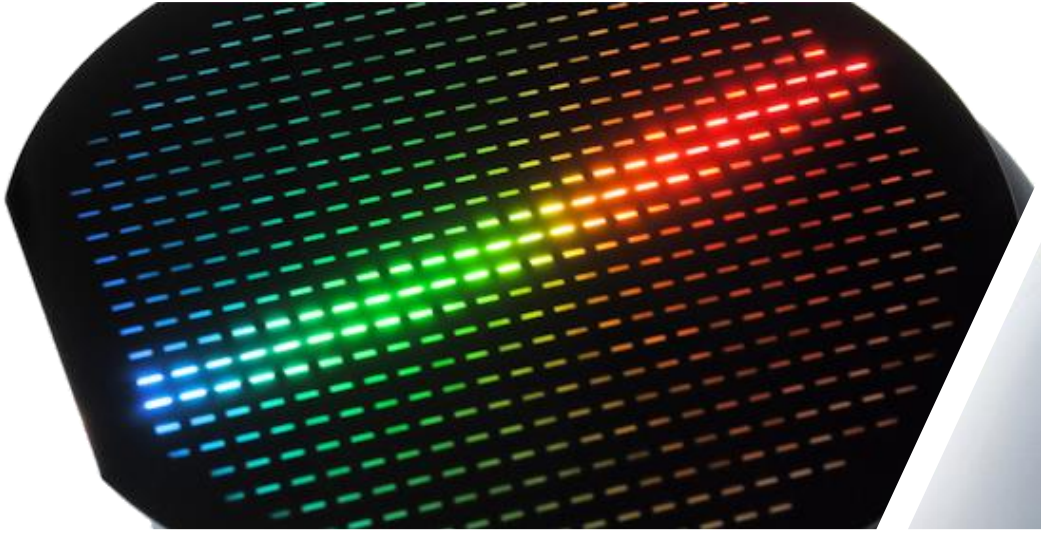
1. Technicians for industrial machinery and equipment
2. General/domestic truck drivers
3. Shelf-stackers / checkout assistants
4. Production workers
5. Warehouse and shipping workers
6. Hospitality workers
7. Customer service workers
8. Production planners
9. Commercial office staff
10. Plumbers, gas, water and plumbing fitters

Show of hands….

Will we have enough qualified manpower in 2040-2050 in the Netherlands to maintain our 50-70 GW offshore wind power if we do not drastically change the way we conduct maintenance of the offshore wind parks?

- ☐ Yes, most likely
- ☐ No, probably not





Show of hands….

By 2040, will over 80% of all the offshore wind turbine blades be inspected and monitored for damage through….

- ☐ Humans with help of some tools
- ☐ Autonomous robots, drones and sensor systems

WORLD CLASS MAINTENANCE

Maintenance Robotics in Offshore Wind

AIRTuB




Eneco · STORK A Fluor Company · LM WIND POWER a GE Renewable Energy business

avans hogeschool · inholland hogeschool · Dutch Terahertz Space Quality Inspection

SAXION University of Applied Sciences · DEMCON advanced mechatronics · FUSION ENGINEERING

Hanzehogeschool Groningen University of Applied Sciences · Development Center for Maintenance of Composites · nlr

TNO innovation for life · Scalda

HZ University of Applied Sciences · glayers · TU Delft

TKI WIND OP ZEE · FIXAR · Field lab ZEPHYROS · NWEA · MARS 4 EARTH · Energy Port Zeeland

smart industry

Living lab de KAAP Vlissingen
=> Offshore Renewable Energy O&M Campus

- Shared large-scale innovation test & demo facility
- Located at: Kenniswerf, Vlissingen

Field lab ZEPHYROS
WORLD CLASS MAINTENANCE

Offshore Wind Innovation Center

OWIC

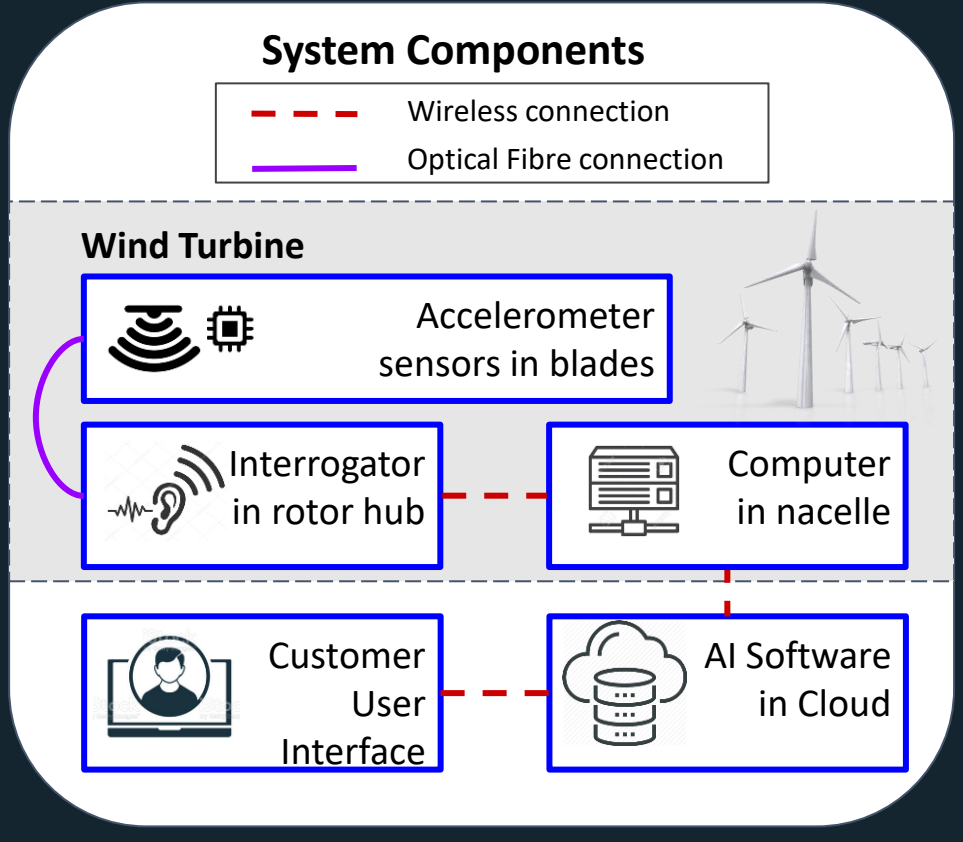
Predictive Maintenance

Tarucca is developing a remote condition monitoring system for blades

- ✓ To prioritize deployment of highly-skilled human resources
- ✓ To lower the costs of maintenance and wind energy
- ✓ To keep wind energy scalable
- ✓ To increase the lifespan of the blades

Tarucca's IoT solution architecture to monitor wind turbine blades

- Several photonic chip-based sensors in the blades
- One Interrogator in the hub (central cone of the rotor)
- Local computer in the nacelle (big box on top of tower)
- Cloud facility for AI based analysis
- Customer user interface



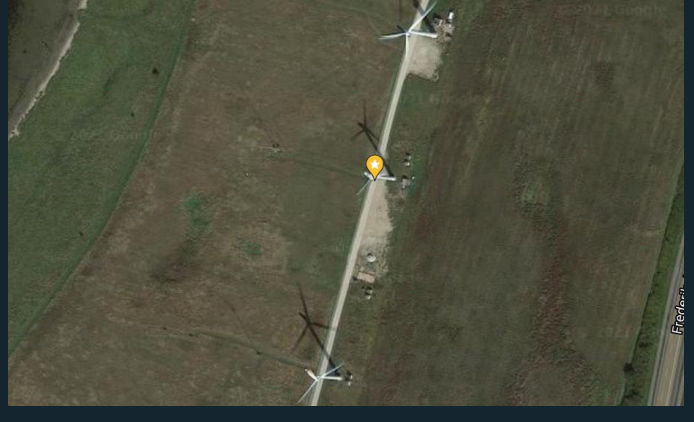
Tarucca's AI project delivered Proof of remote damage detection

AI software tells apart in de sensor data:

- An undamaged state of the blade from
- Various damaged states (trailing edge cracks of 15, 30 and 45 cm)

When:

- Only data from 2 sensors at retro-fit positions in the blade
- Only data from wind turbine in normal operation.
- Only data from one blade over time is used.

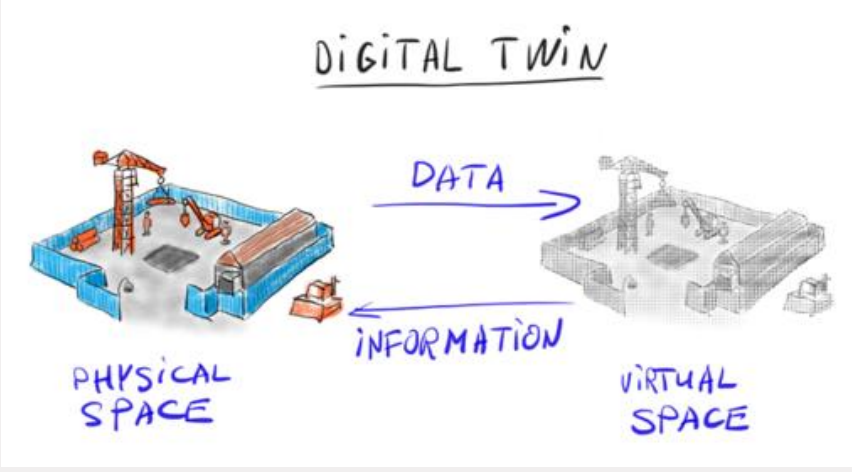


Some examples of TU/e research areas using AI

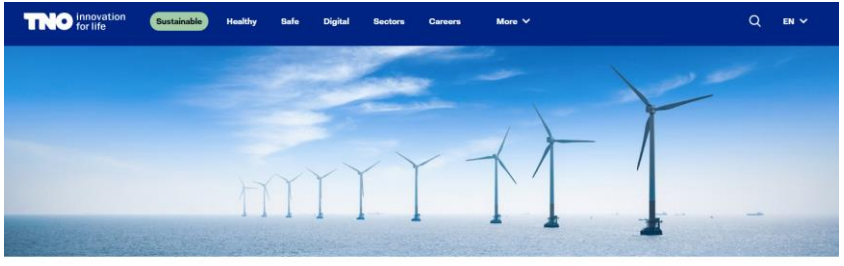
- Making machines **and systems capable of learning their own dynamics** and continuously adapt their behavior, just like humans do.
- Optimizing the manufacturing and **maintenance processes** through reliable machine learning in industrial systems.
- Having cars, robots and systems learn to **anticipate future events** from sensory data from the past.
- Researching maintenance and reliability for innovations leading to a **higher system availability against a lower TCO**.
- Reducing maintenance costs through modelling of processes and **decision making under uncertainty**.

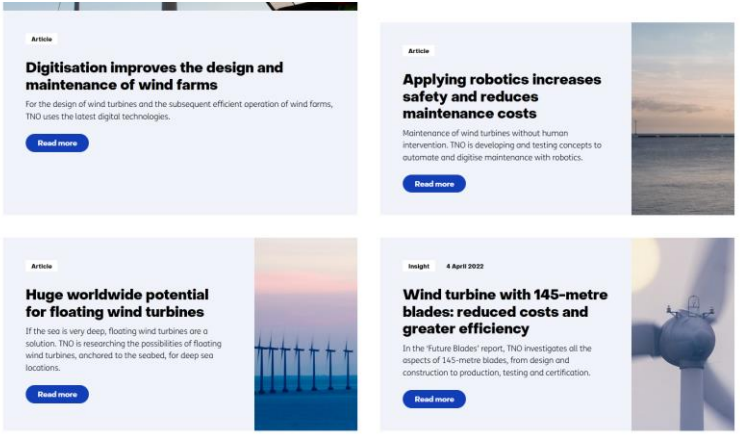
Some examples out of 58 TU/e research outputs with digital twins

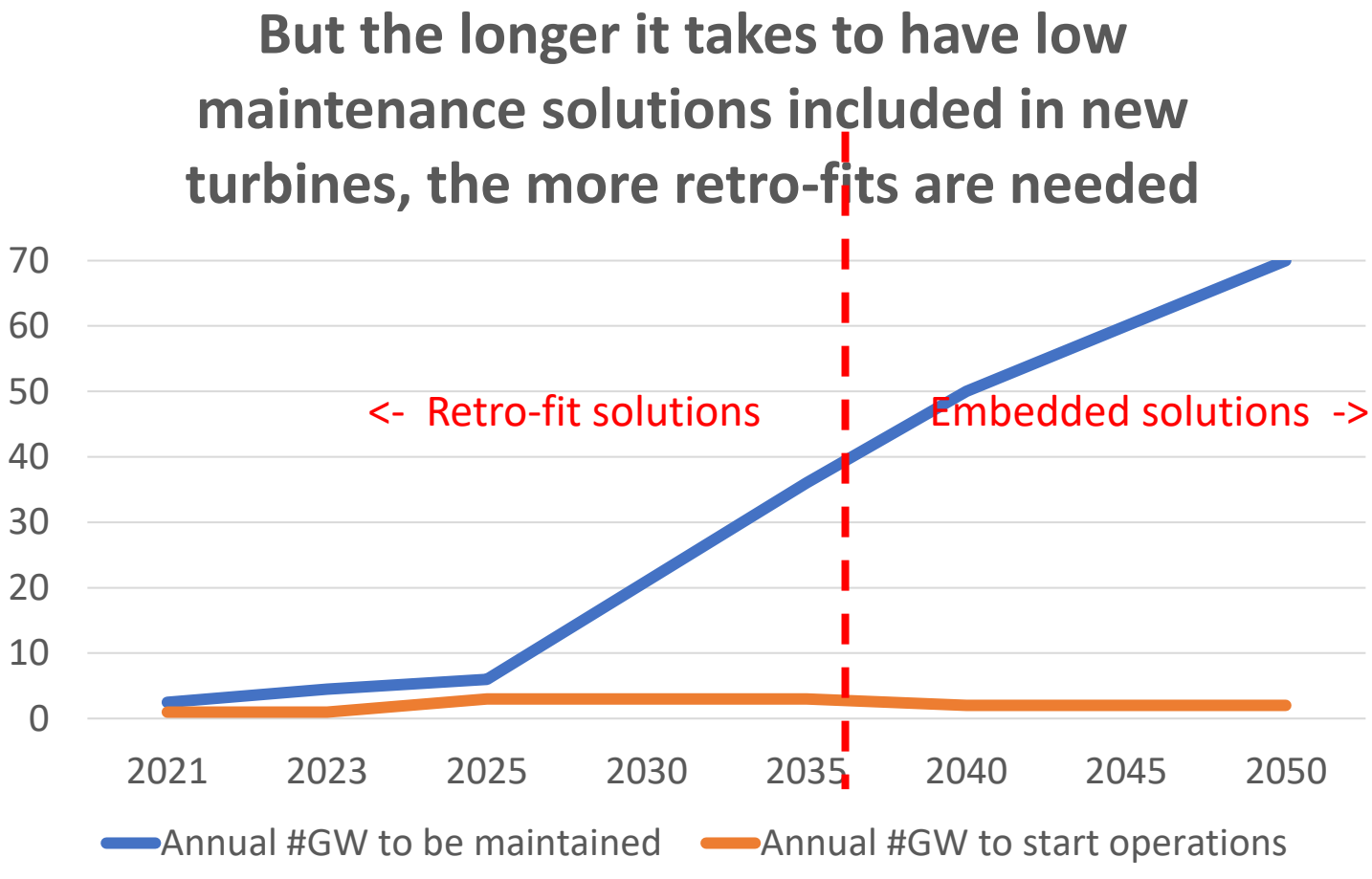
- Digital twins in mechatronics: from model-based control to **predictive maintenance**.
- Building digital twins for **robot navigation**.
- Real-time **performance monitoring** using semantic digital twins.
- Machine learning for digital twins to **predict responsiveness** of cyber-physical energy systems.
- Digital twins in control: **from fault detection to predictive maintenance** in precision mechatronics.



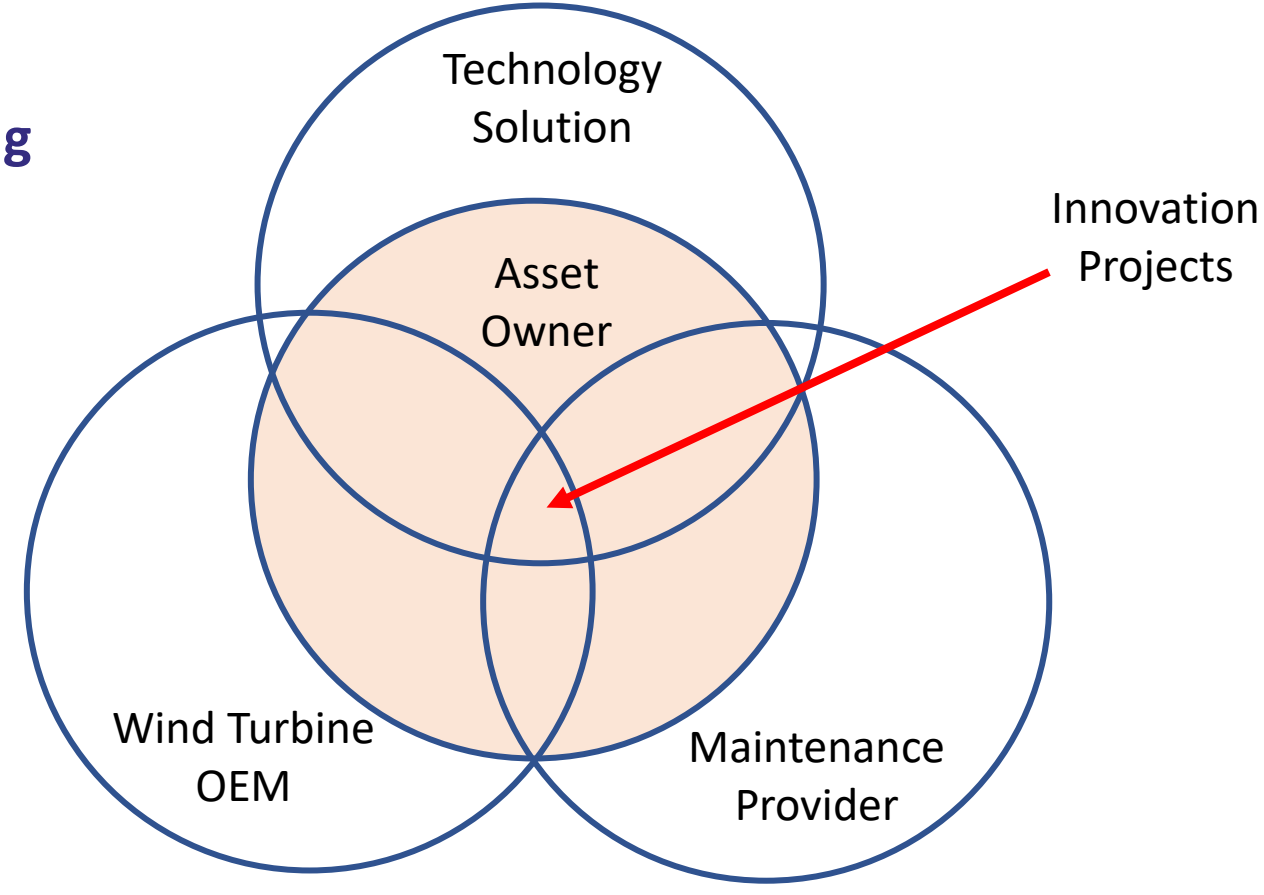
A lot of research going on at TNO



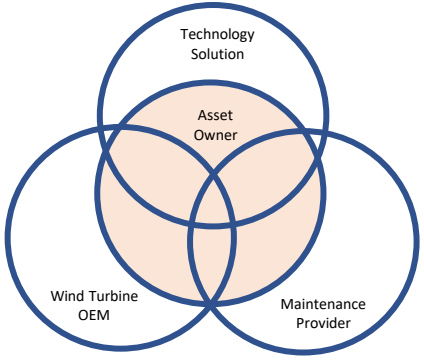



But the longer it takes to have low maintenance solutions included in new turbines, the more retro-fits are needed
70
60
50
40
30
20
10
0
<- Retro-fit solutions
Embedded solutions ->
2021
2023
2025
2030
2035
2040
2045
2050
Annual #GW to be maintained
Annual #GW to start operations

Innovation:
R&D + Doing



Show of hands….



Who is the problem owner to ensure that by 2040 offshore wind turbine maintenance is done autonomous or in any case very efficiently with the available manpower….

- ☐ Technology providers
- ☐ Maintenance providers
- ☐ Wind turbine OEMs
- ☐ Asset owners
- ☐ All the above

- Where are all the life trials and practical experiments with real wind turbines?

- Behind closed door?

- To secure the future of offshore maintenance, shouldn’t we have more open innovation projects?

- The future of offshore wind maintenance;
let’s get more innovation projects going to secure our green electricity in 2040 and 2050 and
make the expectations reality.

- Thank you!
- Welcoming questions!

Interreg
North Sea Region
Inn2POWER
European Regional Development Fund

EUROPEAN UNION

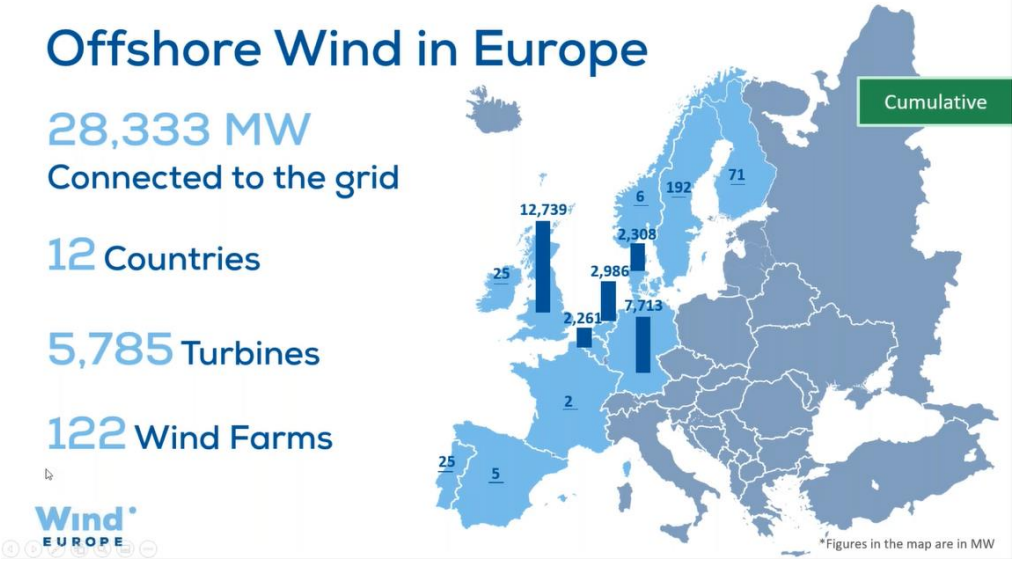
We bring you Inn2POWER

Wind meets Gas
07 October 2022

About

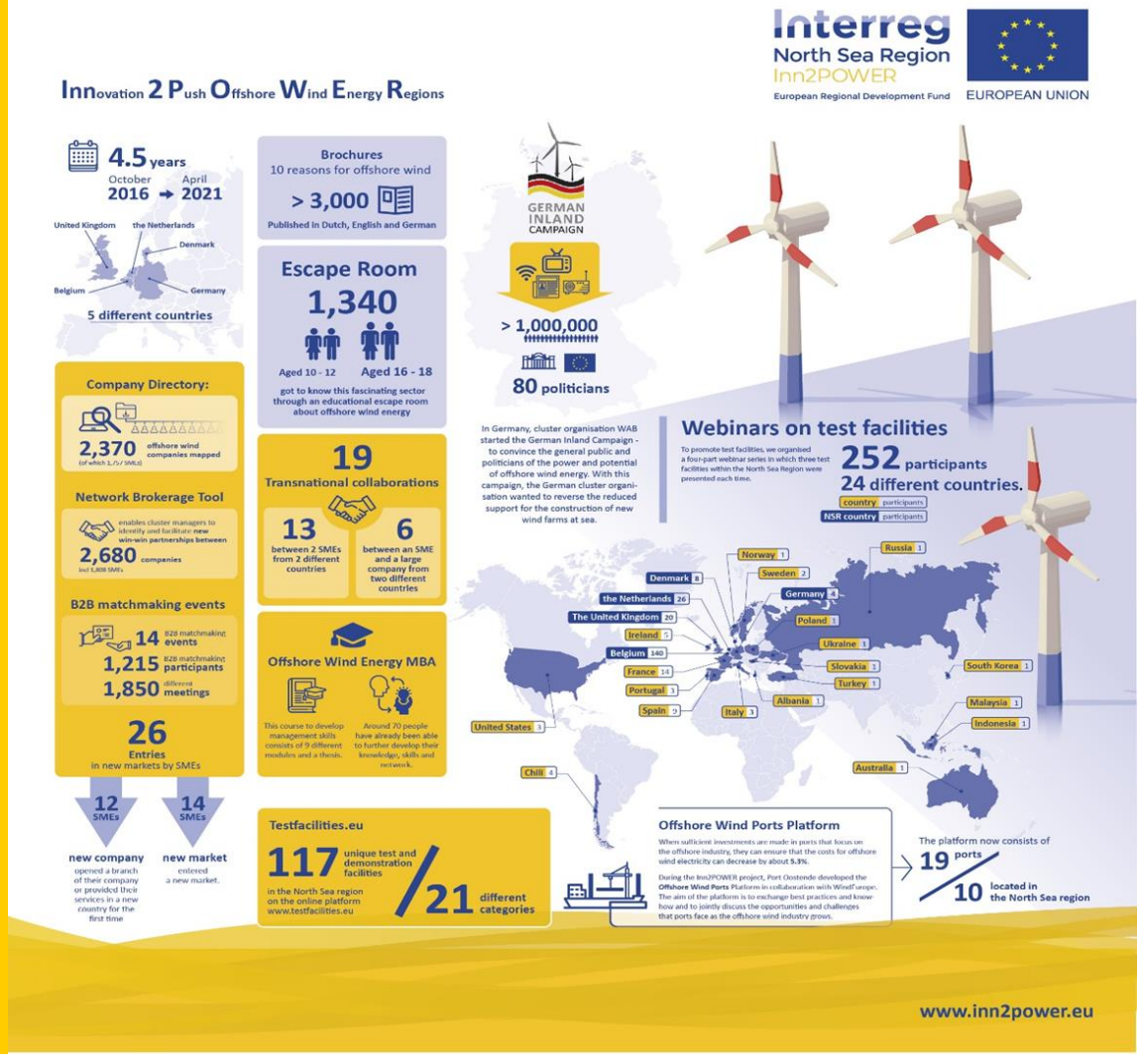
Partners

Tools



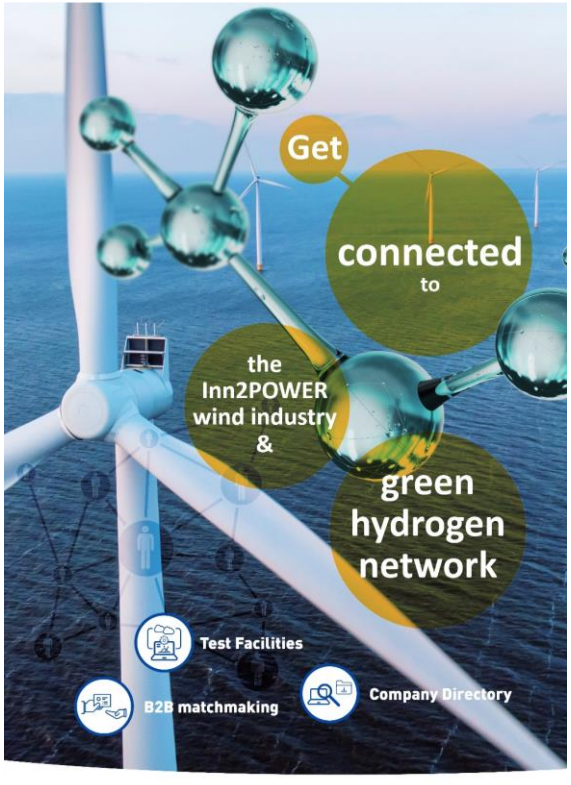
Wind now meets 16% of Europe's electricity demand and much more in many countries: Denmark 48%; Ireland 38%; Germany 27%; Portugal 24%; Spain 22%

Interreg
North Sea Region
Inn2POWER
European Regional Development Fund
EUROPEAN UNION

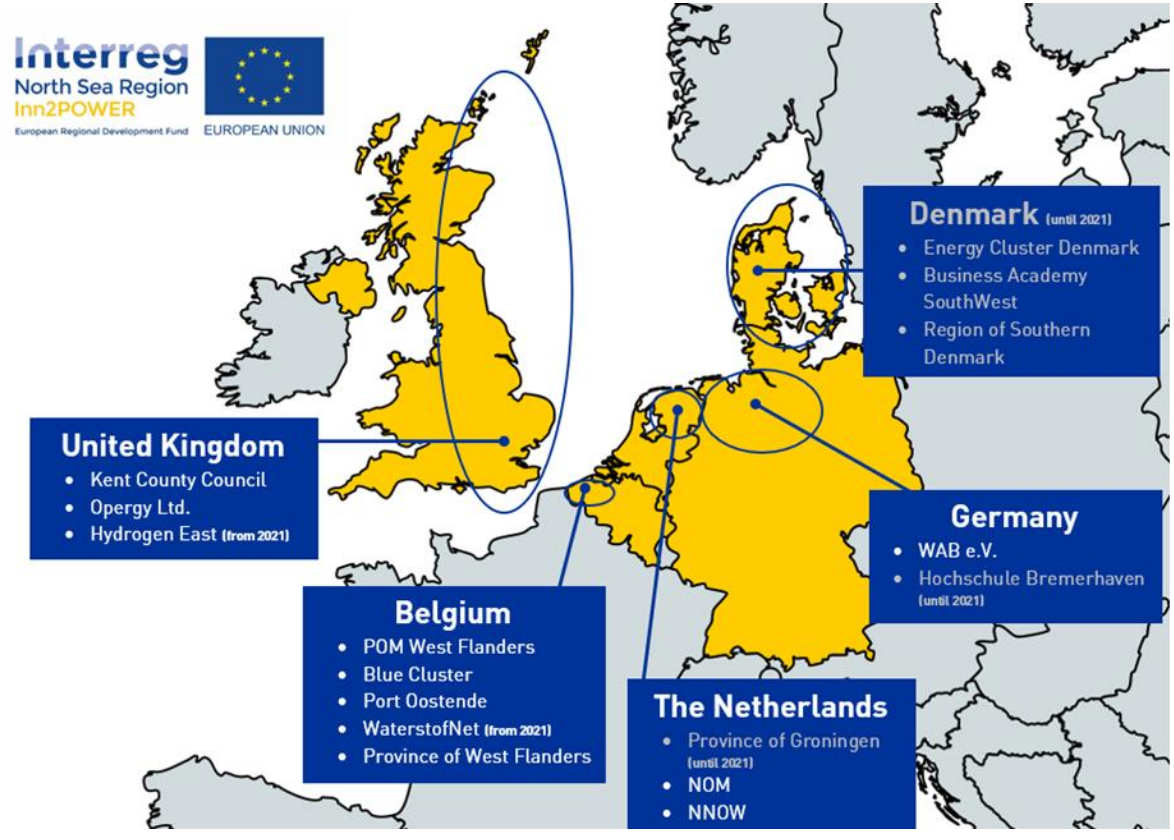

Innovation 2 Push Offshore Wind Energy Regions
Interreg North Sea Region Inn2POWER European Regional Development Fund
EUROPEAN UNION
4.5 years
October 2016 → April 2021
United Kingdom
the Netherlands
Denmark
Belgium
Germany
5 different countries
Brochures
10 reasons for offshore wind
> 3,000
Published in Dutch, English and German
Escape Room
1,340
Aged 10 - 12
Aged 16 - 18
got to know this fascinating sector through an educational escape room about offshore wind energy
GERMAN INLAND CAMPAIGN
> 1,000,000
80 politicians
In Germany, cluster organisation WAB started the German Inland Campaign - to convince the general public and politicians of the power and potential of offshore wind energy. With this campaign, the German cluster organisation wanted to reverse the reduced support for the construction of new wind farms at sea.
Webinars on test facilities
To promote test facilities, we organised a four-part webinar series in which three test facilities within the North Sea Region were presented each time.
252 participants
24 different countries.
country participants
NSR country participants
Company Directory:
2,370 offshore wind companies mapped
(of which 1,75/ SMEs)
Network Brokerage Tool
enables cluster managers to identify and facilitate new win-win partnerships between
2,680 companies
incl 1,808 SMEs
B2B matchmaking events
14 B2B matchmaking events
1,215 B2B matchmaking participants
1,850 different meetings
26
Entries
in new markets by SMEs
12 SMEs
new company
opened a branch of their company or provided their services in a new country for the first time
14 SMEs
new market
entered a new market.
19
Transnational collaborations
13
between 2 SMEs from 2 different countries
6
between an SME and a large company from two different countries
Offshore Wind Energy MBA
This course to develop management skills consists of 9 different modules and a thesis.
Around 70 people have already been able to further develop their knowledge, skills and network.
Norway 1
Russia 1
Sweden 2
Denmark 8
Germany 4
the Netherlands 26
Poland 1
The United Kingdom 20
Ireland 5
Ukraine 1
Belgium 140
Slovakia 1
South Korea 1
France 14
Turkey 1
Portugal 1
Albania 1
Malaysia 1
Spain 9
Italy 3
Indonesia 1
United States 3
Australia 1
Chili 4
Testfacilities.eu
117 unique test and demonstration facilities
in the North Sea region on the online platform www.testfacilities.eu
/21 different categories
Offshore Wind Ports Platform
When sufficient investments are made in ports that focus on the offshore industry, they can ensure that the costs for offshore wind electricity can decrease by about 5.3%.
During the Inn2POWER project, Port Oostende developed the Offshore Wind Ports Platform in collaboration with WindEurope. The aim of the platform is to exchange best practices and know how and to jointly discuss the opportunities and challenges that ports face as the offshore wind industry grows.
The platform now consists of
19 ports
/10 located in the North Sea region
www.inn2power.eu

- About
- Partners
- Tools

Interreg North Sea Region Inn2POWER
European Regional Development Fund
EUROPEAN UNION



Interreg North Sea Region Inn2POWER
European Regional Development Fund
EUROPEAN UNION


Interreg
North Sea Region
Inn2POWER
European Regional Development Fund
EUROPEAN UNION
Denmark (until 2021)
Energy Cluster Denmark
Business Academy SouthWest
Region of Southern Denmark
United Kingdom
Kent County Council
Opergy Ltd.
Hydrogen East (from 2021)
Germany
WAB e.V.
Hochschule Bremerhaven (until 2021)
Belgium
POM West Flanders
Blue Cluster
Port Oostende
WaterstofNet (from 2021)
Province of West Flanders
The Netherlands
Province of Groningen (until 2021)
NOM
NNOW


Your address book for
European Offshore Wind & Green Hydrogen Supply Chain
Company Directory 2.0
Scan & Discover our new tool right away!
Search by Capability
Reset Filter
Search by Supply Chain Sector
Search by Supply Chain Role
Search by Supply Chain Categories

- About
- Partners
- **Tools**

COMPANY

DIRECTORY

Interreg North Sea Region Inn2POWER European Regional Development Fund — EUROPEAN UNION

Welcome to Interreg Europe mapping system

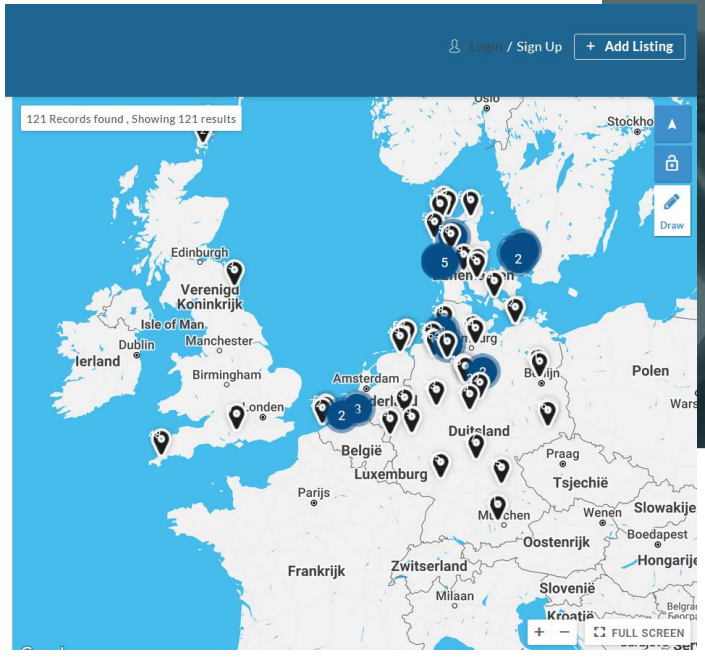
https://mapping.inn2power.eu/

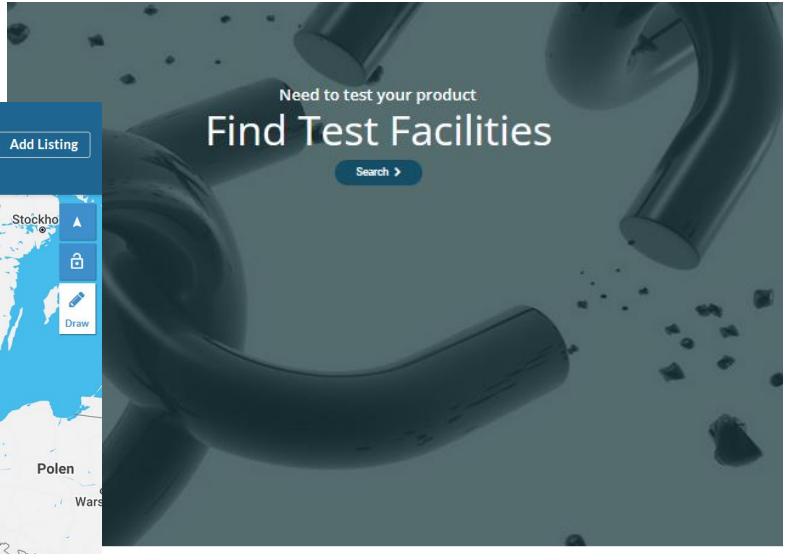
Interreg North Sea Region Inn2POWER European Regional Development Fund — EUROPEAN UNION

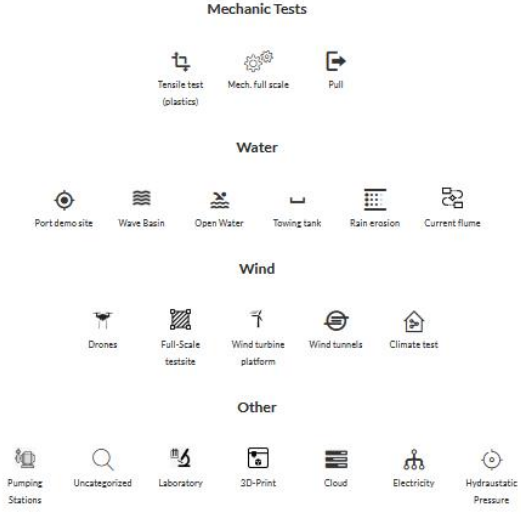
- About
- Partners
- **Tools**

TEST

FACILITIES







www.testfacilities.eu

Interreg
North Sea Region
Inn2POWER
European Regional Development Fund
EUROPEAN UNION

- About
- Partners
- **Tools**

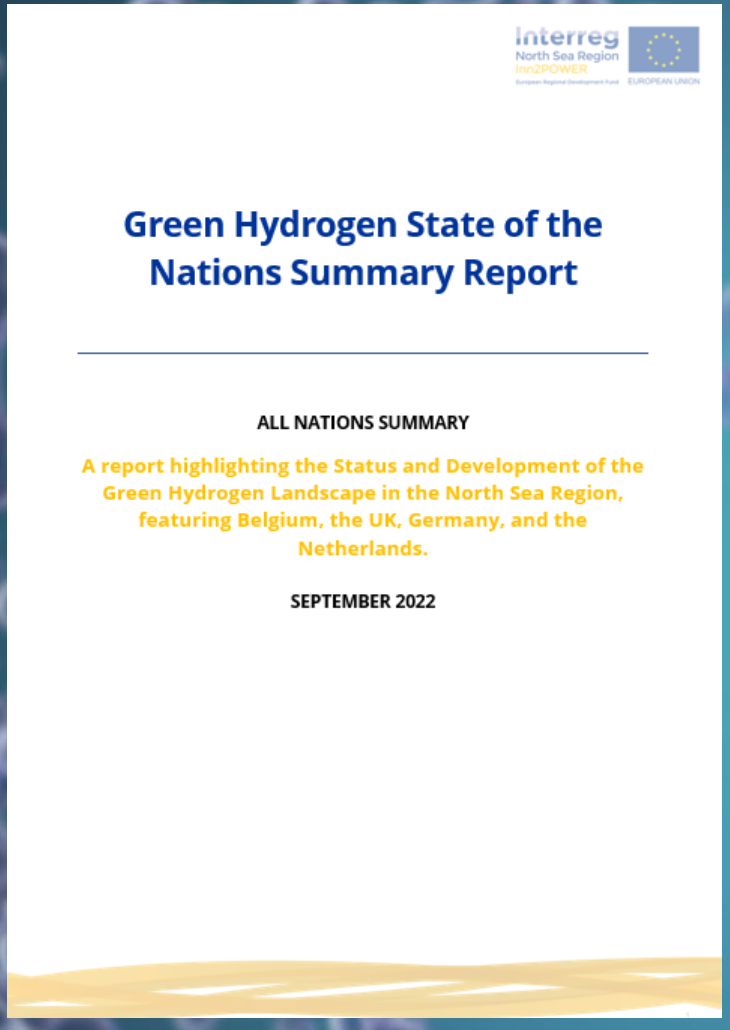
B2B meetings

Interreg
North Sea Region
Inn2POWER
European Regional Development Fund

EUROPEAN UNION

- About
- Partners
- **Tools**
  - **State of the Art**
  - **Reports on H2**

Interreg North Sea Region Inn2POWER European Regional Development Fund EUROPEAN UNION



- About
- Partners
- **Tools**
  - **State of the Art**
  - **Reports on H2**

Interreg
North Sea Region
Inn2POWER
European Regional Development Fund

EUROPEAN UNION

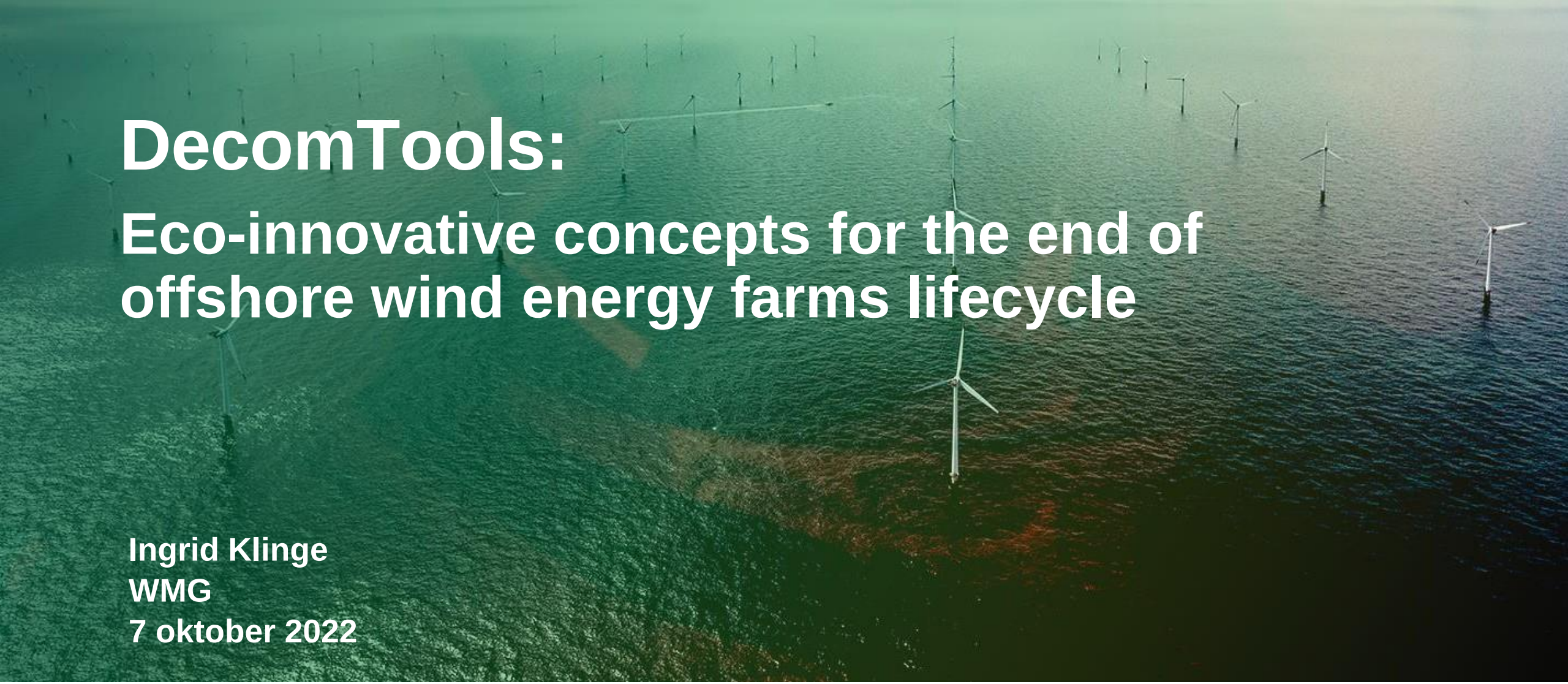
Thank you!

Wim A.B.
NV NOM
ab@nom.nl

Interreg North Sea Region Inn2POWER European Regional Development Fund EUROPEAN UNION

www.inn2power.eu

- *Ingrid Klinge – Decom tools*



DecomTools:

Eco-innovative concepts for the end of offshore wind energy farms lifecycle

Ingrid Klinge
WMG
7 oktober 2022

Interreg
North Sea Region
Decom Tools
European Regional Development Fund

EUROPEAN UNION

14 Project Partners

New Energy Coalition

Port of Grenaa
Support your business

UNIVERSITY OF ABERDEEN

Hamburg Institute of International Economics

Port Oostende energy port

POM West-Vlaanderen

De Lauwershorst Groep

University of Applied Sciences
HOCHSCHULE EMDEN·LEER

everything has value.
Virol

SAMSØ KOMMUNE
- vi gør det sammen

energy CLUSTER DENMARK

Western Norway University of Applied Sciences

MARLOG

marinescotland

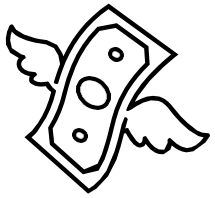
The Scottish Government

Interreg
North Sea Region
Decom Tools
European Regional Development Fund

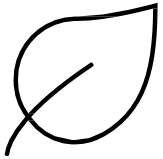
EUROPEAN UNION

Introduction – Aims of the project

An overall sustainable approach to the offshore wind farms‘ end of lifecycle is missing. This project shall close this gap by devising and developing eco-innovative concepts that:



Reduce the decommissioning's cost by 20%



Reduce the decommissioning's environmental footprint by 25%

Increase the know-how and expertise of involved stakeholders

The project consists of four major perspectives

Economic	Technical	Logistical	Reycling
Target Market analysis and impact on regional economic development	**Target** Process optimization for dismantling single offshore wind energy structures	**Target** New concepts addressing logistical requirements for decommissioning complete offshore wind parks	**Target** Recycling concept for dismantling / repowering OWE
Implementation examples • Infrastructure & labour market requirements • Stakeholder analysis	**Implementation examples** • Decision Support System (DSS) • Innovative Vessel Design	**Implementation examples** • Discrete event simulation model • Process description for offshore decommissiong	**Implementation examples** • Concepts for Recycling • Concepts for Repowering Offshore Wind Farm

Interreg North Sea Region Decom Tools
European Regional Development Fund
EUROPEAN UNION

A deeper dive into the outcomes of the economic perspective

Market situation

Increasing amount of OWTs to be decommissioning: around 1000 by 2030

The market is becoming attractive as new business opportunity to more and more stakeholders

Experience and best practice is needed for all stakeholders

Essential requirements

Ports

- Ports are the central HUBs
- Infrastructural adjustments have a long investment horizon and need to be taken now!!!

Vessels

- Availability of suitable vessels for decommissioning needs to be ensured.
- New and more efficient vessels are needed

Recycling

- For some materials recycling processes are well known and work with sufficient capacities (e.g. steel)
- But for other materials like compsites of blades, new procedures are needed

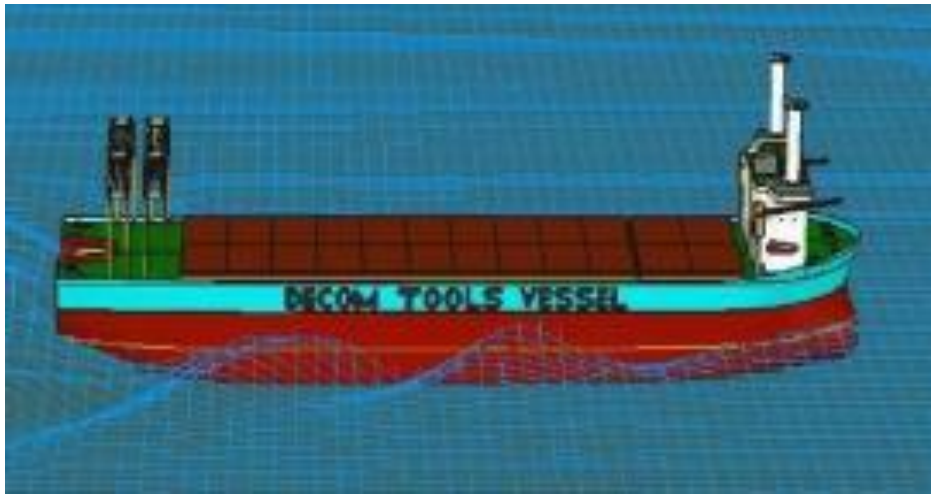
Qualification

- Experience from oil and gas decommissioning are transferable
- A streamlined provision of courses at different levels needs to developed

A deeper dive into the outcomes of the technical perspective

- Decision Support System (DSS)
  - Tool to conduct a multi-criteria evaluation of dismantling processes taking into account turbines, foundations, components, site, repowering O&M costs, environmental issues
  - Tool to integrate decommissioning already in offshore parks planning phase

- DecomTool-Vessel
  - Design of a highly specialized vessel for OWT-decommissioning incl. new tools to build an efficient and reliable procedure



Interreg
North Sea Region
Decom Tools
European Regional Development Fund

EUROPEAN UNION

A deeper dive into the outcomes of the logistical perspective

8 Discrete Event Simulation Model

Simulation-Models covering various logistical concepts for offshore decommissioning

- include the two logistics systems of pendulum and feeder systems which are subdivided into three subcategories
- The dismantling strategies include the part-by-part configuration, the bunny-ear configuration, and the star configuration.
- Another model contains exclusively the designed DecomTool Vessel.

3 VR-Models

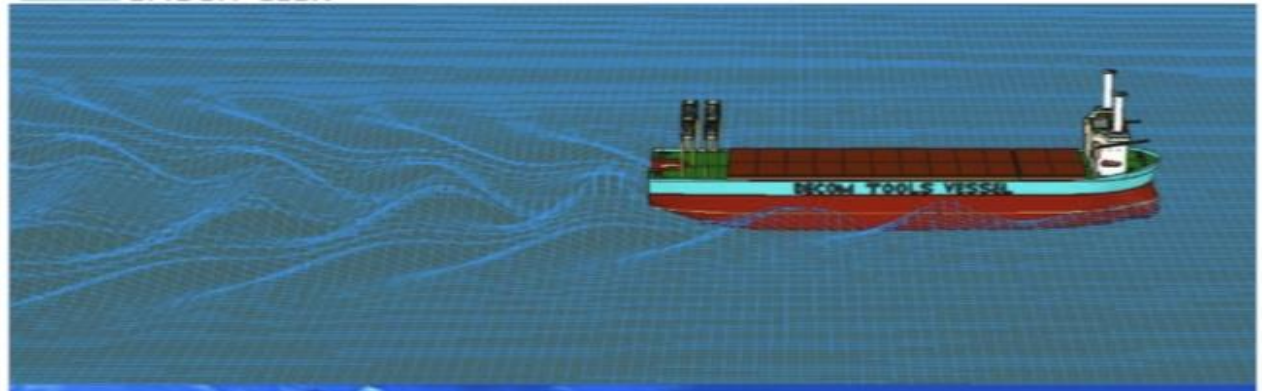
Models demonstrate decommissioning process virtually

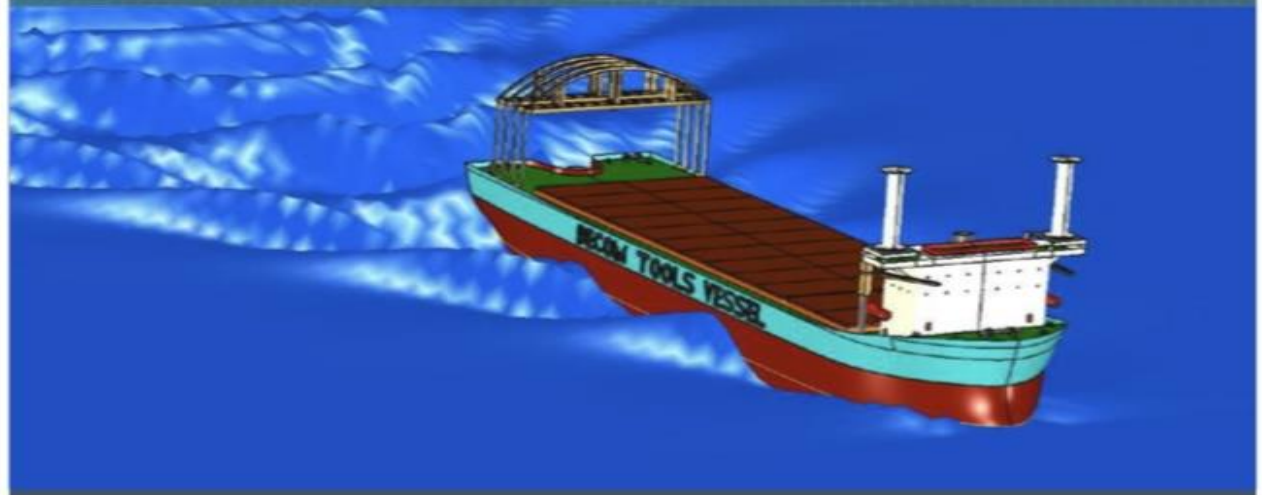
- Transfer from CTV to OWT
- Manoeuvring in an OWF
- Prepared model with additional information on the reconstruction of specific OWT components in the nacelle

Interreg
North Sea Region
Decom Tools
European Regional Development Fund
EUROPEAN UNION

University of Applied Sciences
HOCHSCHULE EMDEN·LEER

interreg North Sea Region Decom Tools
European Regional Development Fund
EUROPEAN UNION





Decom Tools Vessel Design

Presenting an Ecco-Sustainable Approach to Decommission Offshore Wind Parks by Designing a New Ship, New Tools and Efficient and Reliable Procedure

Authors: Hamed Askari and Ahmad Halimah

Supervisors: Professor Dr. Marcus Bentin and Dr. Stephan Kotzur

A deeper dive into the outcomes of the recycling perspective

special attention on steel, cables, magnets and wind turbine blades (most of them have high monetary potential or critical environmental impact)

The concept of Circular Economy (CE) in disposing of the materials/ components into consideration

3 developed concepts for reycling of blades

1. Shredding of wind turbine for reuse in different products and processes (e.g. cement production)

2. Reuse of blade parts (e.g. playgrounds)

3. separate the composite material under high temperatures -> pyrolysis.

More about this in the upcoming presentations ☺

A deeper dive into the outcomes of the recycling perspective

special attention on steel, cables, magnets and wind turbine blades (most of them have high monetary potential or critical environmental impact)

The concept of Circular Economy (CE) in disposing of the materials/ components into consideration

3 developed concepts for reycling of blades

1. Shredding of wind turbine for reuse in different products and processes (e.g. cement production)

2. Reuse of blade parts (e.g. playgrounds)

3. separate the composite material under high temperatures -> pyrolysis.

More about this in the upcoming presentations ☺

Gap analysis 1

PARTICIPATING COUNTRIES:
• DENMARK , • GERMANY, • THE NETHERLANDS • BELGIUM • NORWAY
• THE UNITED KINGDOM BASED

ON ISSUES CONCERNING:
• REQUIREMENT • PLANNING • ECONOMICS • SPACE • RECYCLING AND REUSE • SUSTAINABILITY • ENVIRONMENT

Interreg North Sea Region Decom Tools
European Regional Development Fund
EUROPEAN UNION

Gap analysis 2

SITUATION:

- TENDERING IS VERY REGIONAL
- CONTRACTORS ARE VERY INTERNATIONAL
- LIFETIME DIFFERS
- DIFFERENT ACCENTS OF APPROACHES PER COUNTRY

- **CONCLUSIONS:**
- LAWS AND REGULATIONS IN LINE WITH INTERNATIONAL LAWS
- ADAPTION OF LEGISLATION BETWEEN NATIONS IS POSSIBLE

Interreg North Sea Region Decom Tools
European Regional Development Fund
EUROPEAN UNION

Gap analysis 3

IMPORTANT ISSUES:

• WINDPARKS EVOLUTION HAS EVOLVED FROM EXPERIMENT TO A NORMAL INDUSTRY.

• ENVIRONMENTAL NEUTRAL REMOVAL IS ESSENTIAL
• OVERALL SCENARIOS OF DECOMMISSIONING MUST BE DEVELOPED DUE TO VARIETY OF WINDMILL TYPES
• CARBON FOOTPRINT REDUCTION BY PROCESSING SYNTHETIC MATERIAL IS TRUMP
• REGULATORY FRAMEWORK IS IMPORTANT TO MATCH LIABILITIES
• GOVERNING GUIDELINES NEEDED TO MANAGE THE PROCESS TO COME TO A COORDINATED APPROACH
• **ONE RULE APPROACH SHOULD BE ESTABLISHED**

Interreg North Sea Region Decom Tools
European Regional Development Fund
EUROPEAN UNION

Gap analysis 4

What has to be done?

DEVELOPMENT OF AN INTEGRATED INFRASTRUCTURE OR ONE-STOP-SHOP

• DEVELOPMENT OF DECOMMISSIONING AND WASTE MANAGEMENT AT REGIONAL, NATIONAL AND INTERNATIONAL LEVEL

• STIMULATING KNOWLEDGE DEVELOPMENT

Interreg North Sea Region Decom Tools
European Regional Development Fund
EUROPEAN UNION

If you want to get more detailed insights into

the outputs, come to our regional workhop

on 1th of november in Emshaven

and check out our website!

More information about DecomTools

www.northsearegion.eu/decomtools

Ingrid Klinge
New Energy Coalition

Interreg North Sea Region Decom Tools

European Regional Development Fund

EUROPEAN UNION

RWE

Eemshaven Energy Hub for NW Europe

RWE plans to convert Eemshaven into an Energy Hub for NW Europe

1. **The most robust, flexible and efficient energy system** is the one that integrates economic sectors, forming an **energy hub** that delivers **green electrons and green molecules** on large scale

2. With its current infrastructure, **Eemshaven is in the pole position** to become an energy hub. **RWE** is part of multiple initiatives **driving innovative offshore wind, green H_2 and green CO_2 developments forward**

3. **Bringing together the entire value chain**, the wider Eemshaven region can become the **frontrunner for the circular green economy** and can even **deliver negative emissions with bio energy and CCUS**

Energy hubs are the most robust, flexible and efficient energy systems and Eemshaven is in the pole position

Current and future production in Eemshaven

What is needed to develop this

Space: land is scarce, think about dedicated hydrogen hubs

Infrastructure: if we go to the North-Sea go there once! Pre-invest in infrastructure corridor

Masterplan: an integrated concept needs planning, like the H2 backbone this will solve chicken & egg problems

Collaboration: governments (Germany-Netherlands) Business and knowledge institutions

Bringing together green electrons and green molecules will support decarbonization and build the green value chain for tomorrow