FFU Seminar -2020

Greener offshore oil and renewable energy developments.

Cleaner, cheaper and faster

We help our clients to produce energy from offshore wind farms and marginal oil fields.

By: Jørn Haugvaldstad 01-2020

The development team

O&G based knowledge utilized through green energy

Engineering team

EICT Solutions for Remote Operation and Monitoring
Kairos a/s

Structural design verification
Gudme Stad a/s

Seabed soil interface mechanics
Norwegian Geotechnical Institute

Dedicated NUI crane development
Melcal Marine

Technology , Project owner and Manager
Jørn Haugvaldstad

Platform advisor
Asbjørn Tansø

Structural and Marine design advisor
Prof. Ove T. Gudmestad
Siv. Ing. Petter Vabø

Financial advisor
Tor Eskeland -

3rd party verifications
Independent analysis, testing and verifications of Structural design and Marine operations executed by SINTEF Ocean, University of Stavanger, University College of Cork – Ireland and University Patras in Greece

Collaboration partners

EPC partner
Worley Parsons – Rosenberg
Platform construction and Load out

Ocean Installer
Marine installation

WISE group
Offshore positioning and levelling

Contractor supply chain
Offshore wind Turbines

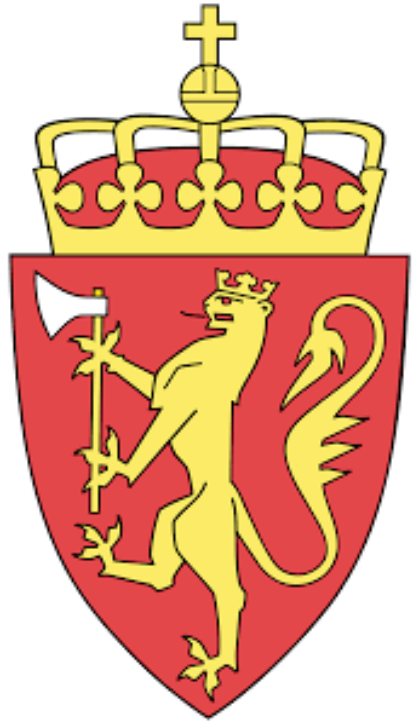
Wartsila
Installation vessel interface

Government and politics

Ministry of Petroleum and Energy - Guidelines

Norway shall:

- Paris agreement – Contractual olbligations to reduce emmissions.
- Greener Industry - Prioritize renewable energy production and «Green» industry projects.
  Finance institutions will favorize financing solutions for «Green» projects.
- Continued Oil and Gas production , but « make the industry Greener».
- Offshore wind developments are preferred over onshore wind –
  Visual pollution from onshore wind favors offshore wind developments where 3 offshore licences being sanctioned.

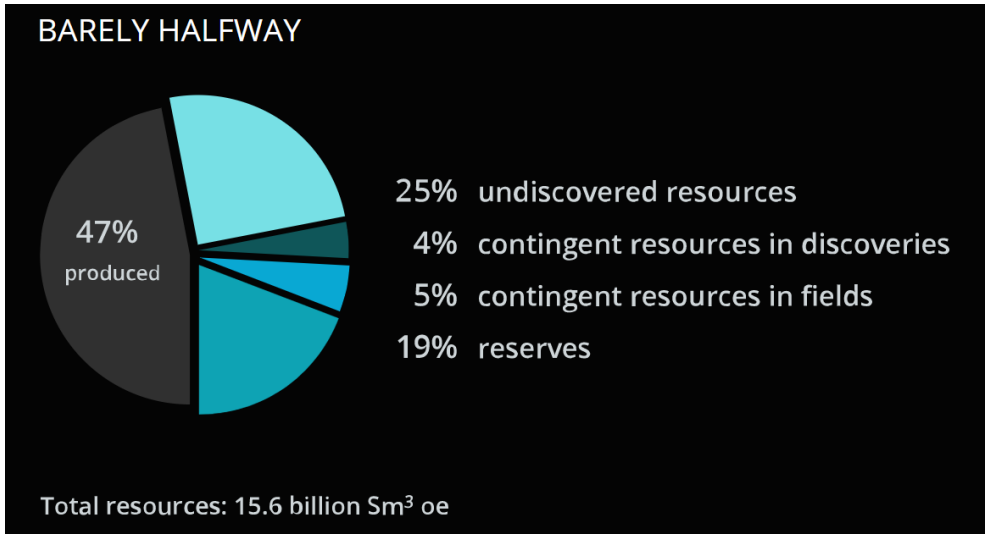


Norwegian Petroleum Directorate (NPD)

NCS – Focus areas

- *New Technology is needed.*
  NPD sees new technology to be the key to more create value on the Norwegian shelf.
- *Marginal fields* near existing infrastructure is one priority area.
- To make *marginal fields profitable*, the strategy is to apply new cost-effective technology.
- *Technology qualification processes* needs to be speeded up.

NPD has now opened for a parallel development of PUD's and Technology qualification.



NORWEGIAN PETROLEUM DIRECTORATE

The Green offshore marked

Identified marked needs

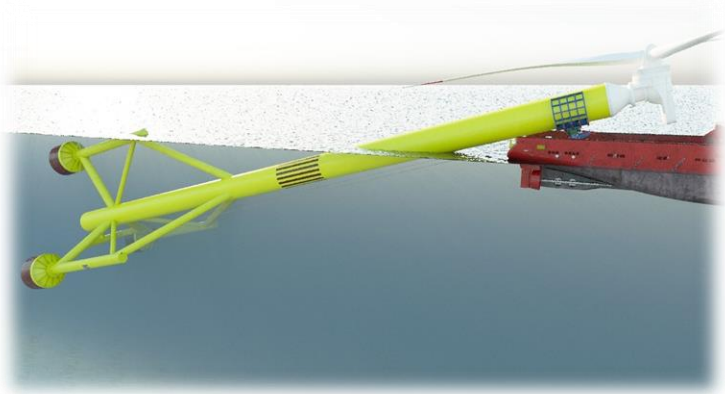
- Green, low cost marginal field development solutions
- Green petroleum field developments
- Make existing fields greener (modifications)
- Offshore windfarm development

In near future: Wind / Petroleum / Hydrogen hybrids.

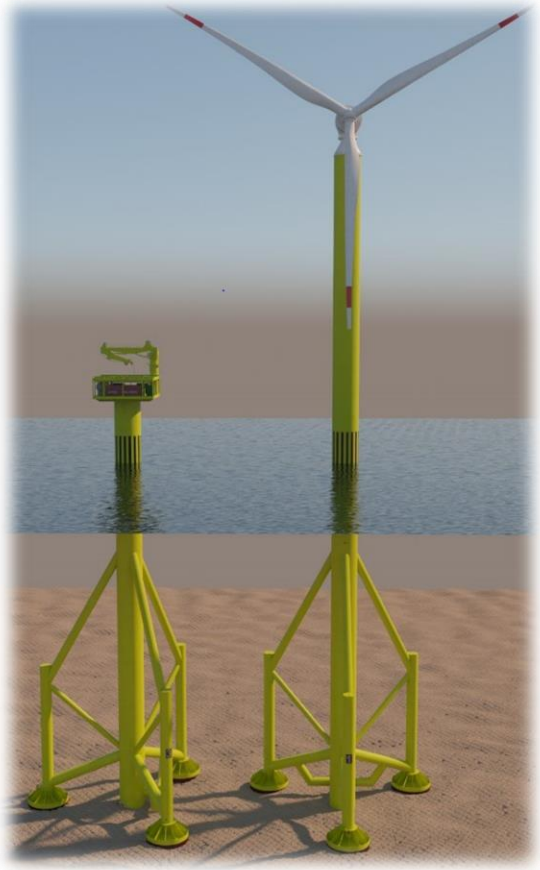
Our solutions

MC-7 Offshore solutions with integrated MINT installation solution

MINT Transport and Installation – MC-7 Wind



Wind turbine – Installation



MC-7 Petro and MC-7 Wind structures

Patents reference: # 340946 and 340965 - Norway

MINT Transport and Installation – MC-7 Petro

Platform – Transport test video

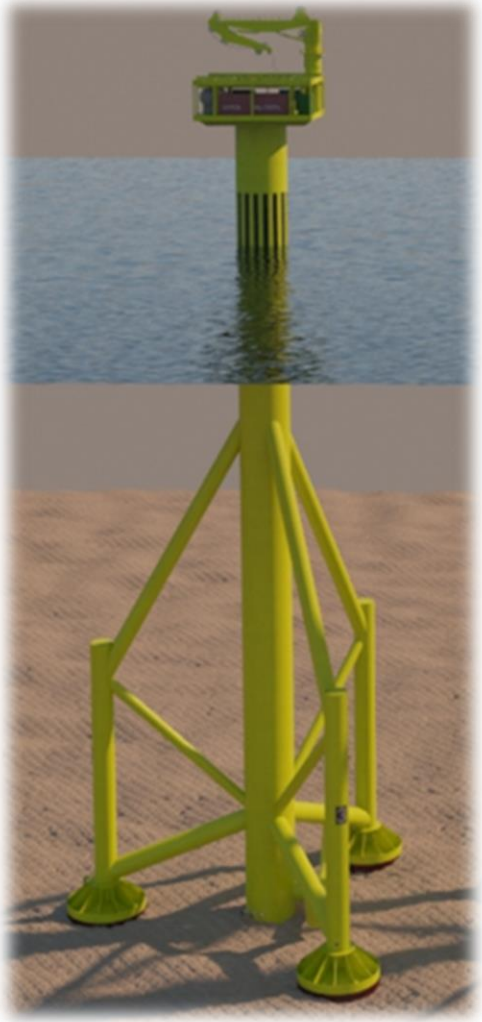
The novelty of the technology is that complete offshore units can be assembled and tested onshore, transported offshore and installed in one piece without using heavy lift cranes.

MC-7 Petro

Area of use

- The MC-7 Petro is a low cost, «subsea on sticks» type NUI platform solution designed to make marginal fields profitable.
  All visits will be by a W2W gangway deployed from a SSV.
- The design covers water depths down to 150 meter and can accommodate up-to 12 well slots. The solution is more cost-effective in developments with more than 3 wells, especially when frequent well interventions are required.
- The MC-7 Platform has the following offshore O&G area of use:

  - Unmanned wellhead platform (tie-in or full process)
  - Riser platforms
  - Transformer stations and distributions for onshore power supply to oilfields
  - Wind turbine driven power supply to platforms (Fuel cell option)
  - Pipeline booster stations
  - Wind turbine driven water injection
  - Hydrogen production



Drilling alternatives

Mobile unit alternatives

Drilling in the field's late life is more cost effective with vessel than drilling with conventional JU-rig.

Drilling method selectable from JU-rig,
Modular Mobile Drillrigs supported by Vessels ,
anchored Semi-submersible DRG's or Tender Rig .

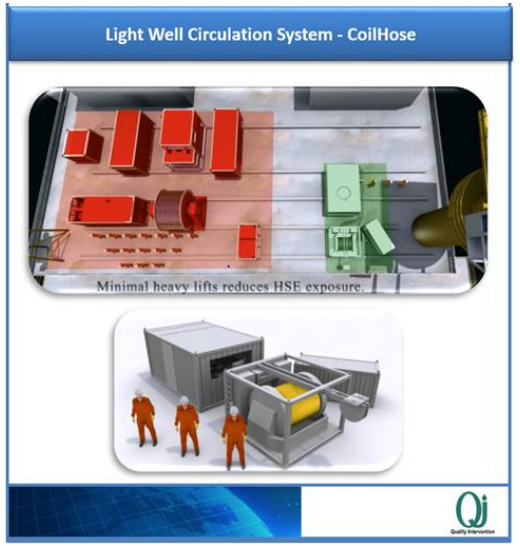
Flexible selection of Drilling Methodes gives schedule advantages and contract negotiation edge

The Modular Drill Rig Equipment is powered and supported through Hoses & Umbilicals from the Support Vessel/Semi-sub.

Flexible lay-out for alternative Drilling methodes focusing on simultanoulsly drilling, production and well intervention requirements

Well intervention

Well stimulation – Wireline – Coiled tubing



- Well Interventions are executed with modular units transported offshore by the Support Vessel and loaded/erected by the Platform Crane.

- The operation is supported from a DP Service Vessel.

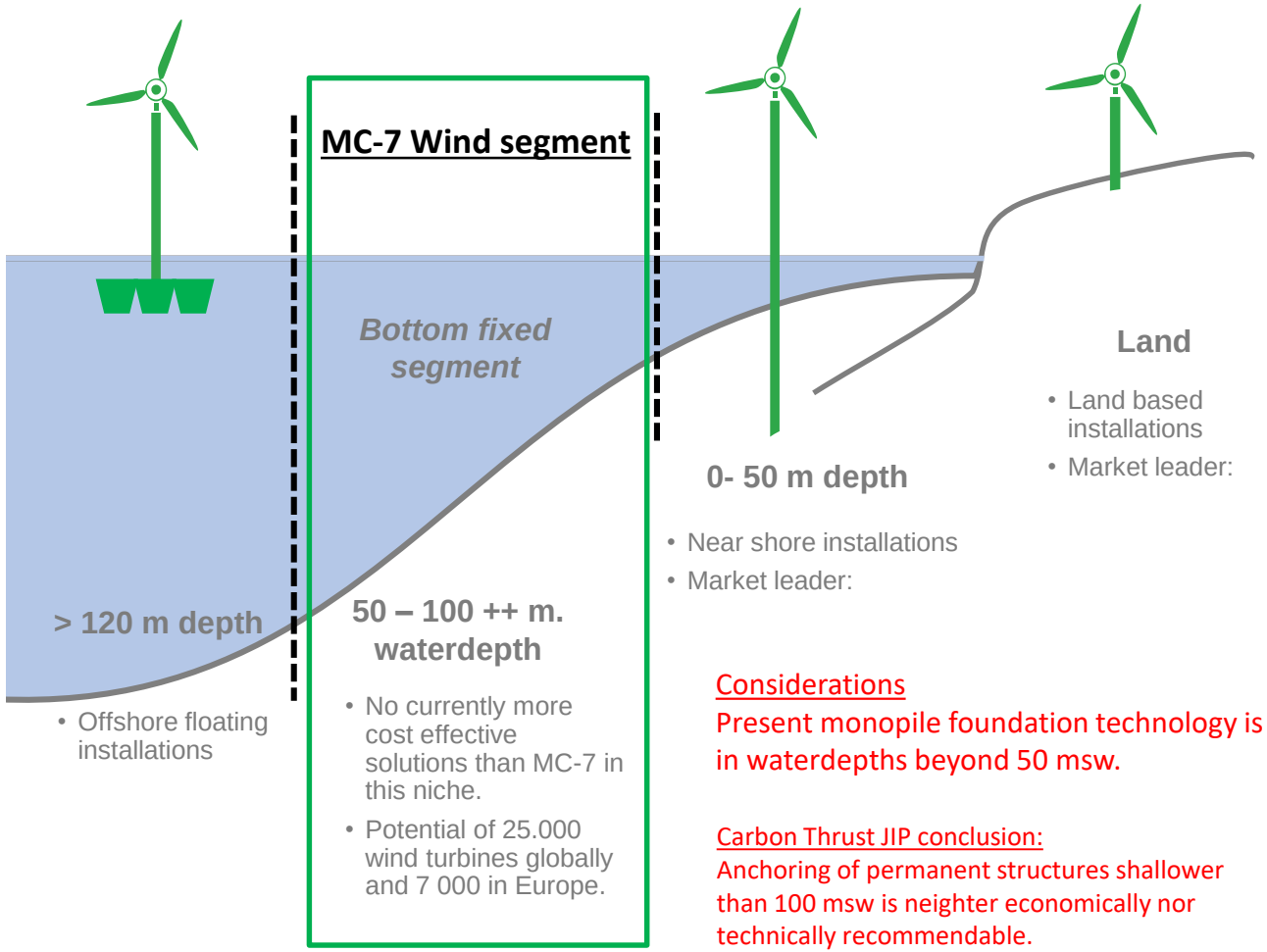
Offshore wind technology considerations

Seabed - fixed turbine structures is more favorable in cost and risk scenario compared to floating /anchored turbines.

MC-7 Wind solution advantages:

- CAPEX - Construction cost, onshore completion and offshore transport & installation as one complete unit.
- OPEX – Main component replacement hoisting to/from vessel.
- ABEX – Reversed installation and towing with <u>one</u> vessel.
- RISKS – In a disaster assessment from loss of anchors an uncontrolled floating scenario risks to loosen anchors and/or damage other near by units.
  It also represent a general risk for other traffic at sea.

  In an equal disaster assessment for a bottom fixed unit this will fall to the seafloor without risking damage to other units.

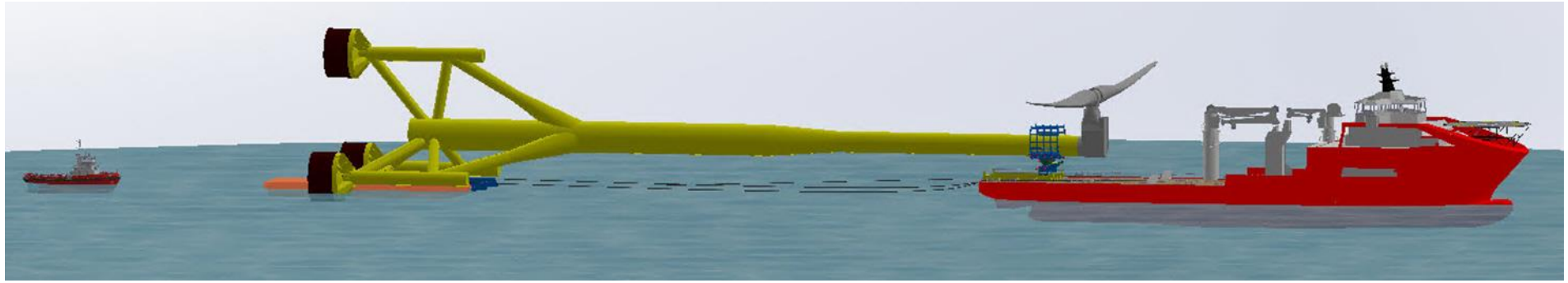


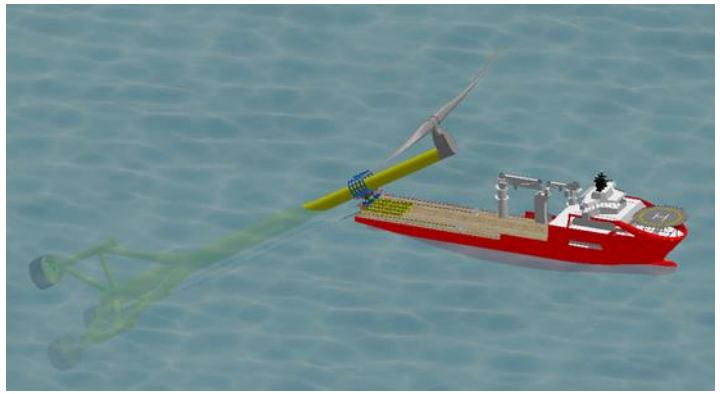
<u>Considerations</u>
Present monopile foundation technology is unsuited in waterdepths beyond 50 msw.

<u>Carbon Thrust JIP conclusion:</u>
Anchoring of permanent structures shallower than 100 msw is neighter economically nor technically recommendable.

Our installations method

Example: Turbine size 10 MW – 120 meter above sea level

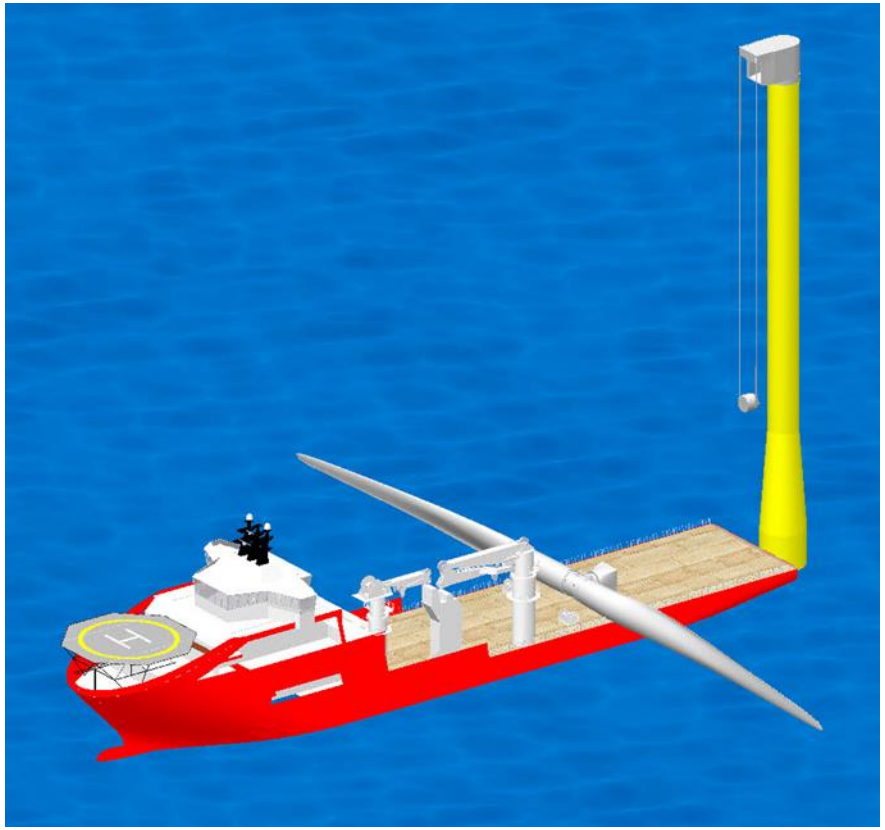


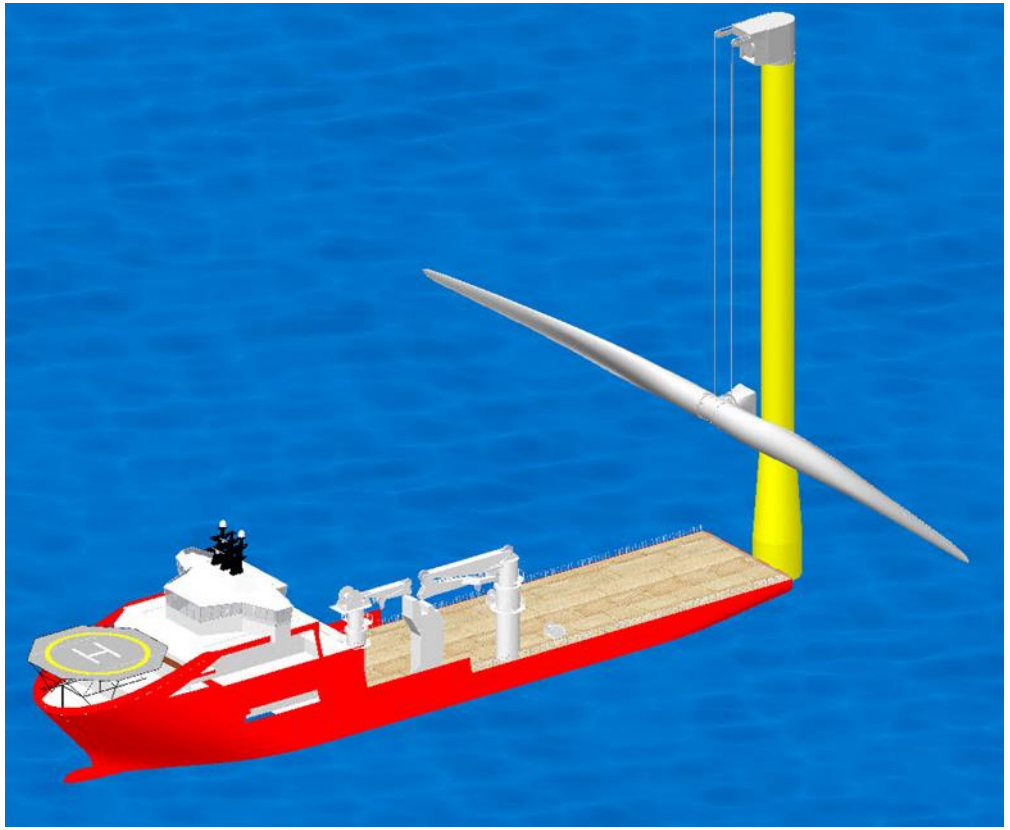


Seabed fixed structures for waterdepths 50 to 100 ++ meters installed as complete units.

Operating and IMR solutions

Turbine sizes 10 – 15 MW – 130 meter above sea level

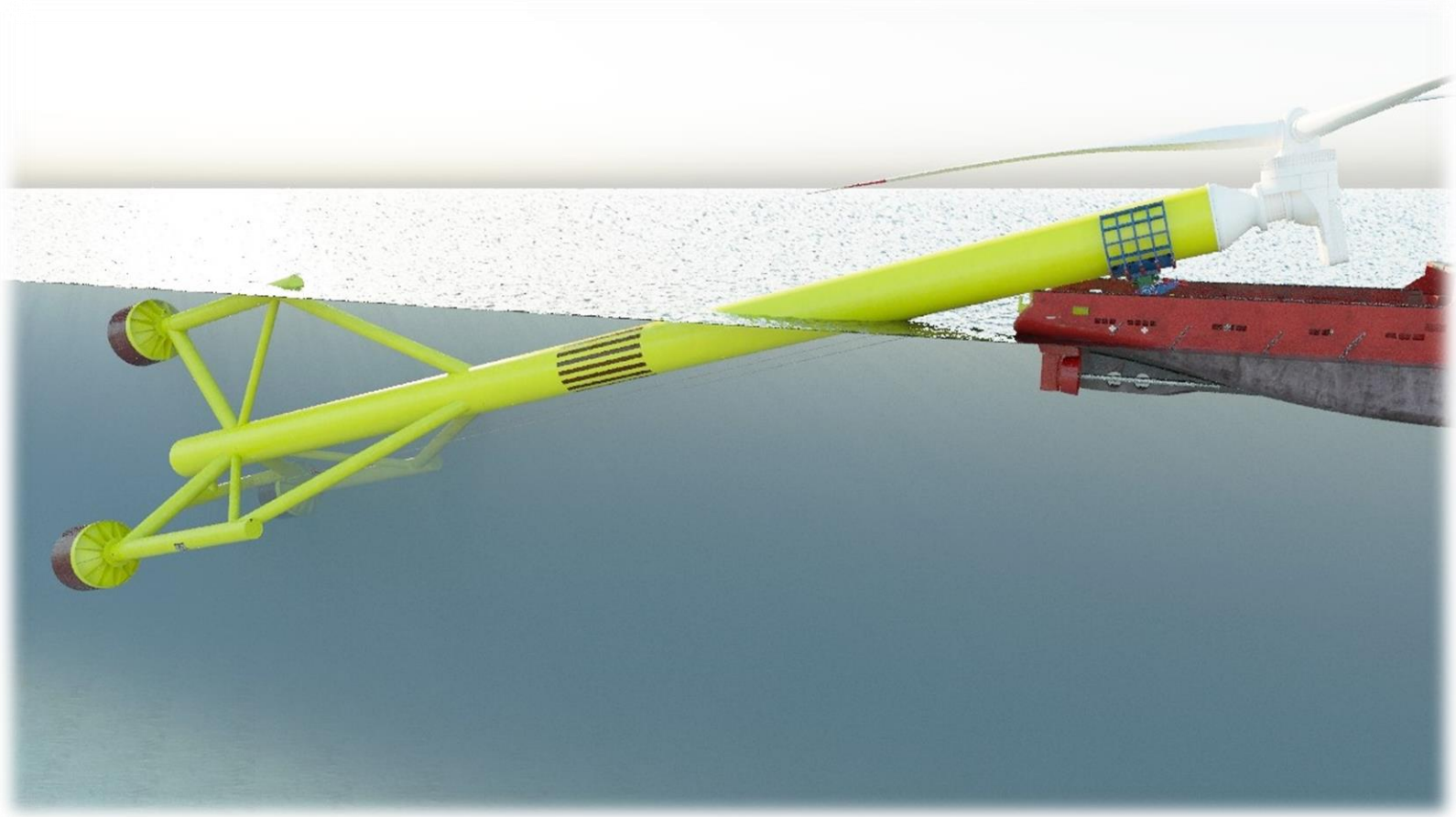




1. Integrated lifting rigging solution for re-installation replacement of turbine parts.
2. Two groups of Service and repair tasks. Tasks requiring more than 24hrs downtime shall be executed onshore by interchangeable component replacement.

Sessation or Re-use

MC-7 Reverse installation removal

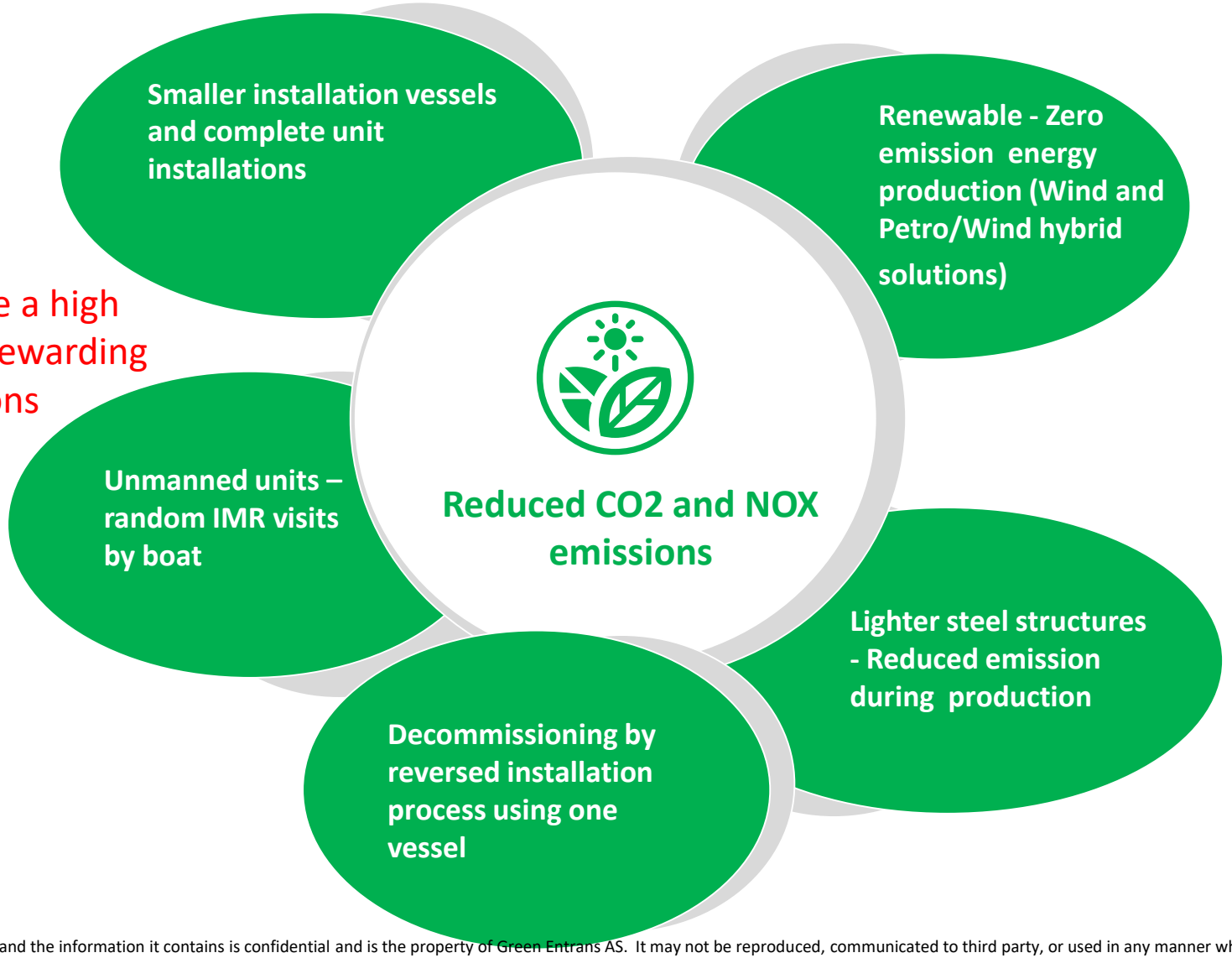


MC-7 Wind – Removal after service

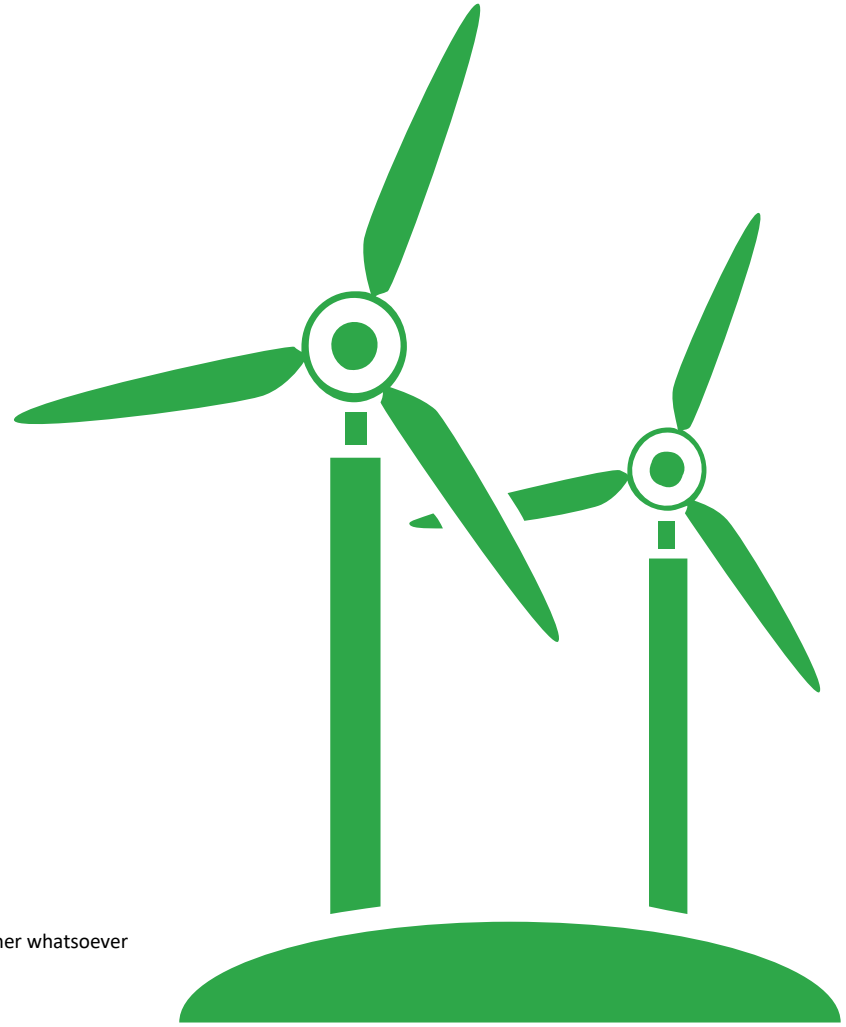
The Green solution

Reduced emissions compared to present methods

Our MC-7 solutions will have a high score in financial packages rewarding carbon emmissions reductions



Time for questions



Industrial development trends

Offshore energy transformation

Petroleum

The petroleum industry is struggeling with:

- low oilprices
- increasing emmission fees/taxes
- political negative reputation

Development cost targets are:

- profitable solutions for 40 USD/Bbl or better.

Technology trends is:

- Digitalization
- Autonomus operation of Normally unmanned (NUI / UWP's) and subsea installations
- Remote operation of offshore installations from centralized onshore control room(s)

Offshore wind energy

The offshore wind industry is still at a pioneering stage continuously striving to become competitive to the onshore energy cost.

Technology trends are:

- Bigger turbines
- Bigger rotor diameters
- Higher towers (above water level)
- Further away from shore in deeper waters

Operational criteria

Recommended and Survival

Recommended maximum criteria - Transport:

- H_S 3 meter
- Wave periods 8-9 seconds

The transport survives H_S 4 in 30° heading.

Recommended maximum criteria – Installation:

- H_S 2,5 meter
- Wave periods 8-9 seconds

The installation survives H_S 3 in 30 ° heading

Note:

The recommended criteria is based on specific vessel and barge sizes /designs. The criteria's may change when using other floating units.

Installation vessel stability:

The operational feasibility has been confirmed by Ocean Installer verifying the test loads against the CSV Normand Vision. Stability capacity is confirmed.
Further structural analysis in the stern deck beam structure will be required per project.