

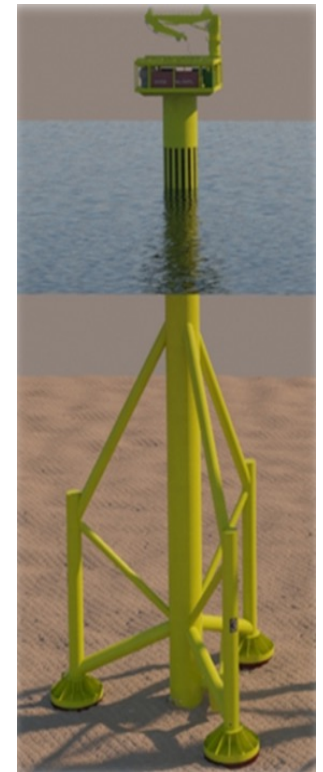


Romanian Energy Day

June 27

Safe, Green, Light, Fast

We help our clients to produce energy from offshore wind farms and oil fields safe, green, light and fast throughout a longer service time.



Our vision

Sustainable future



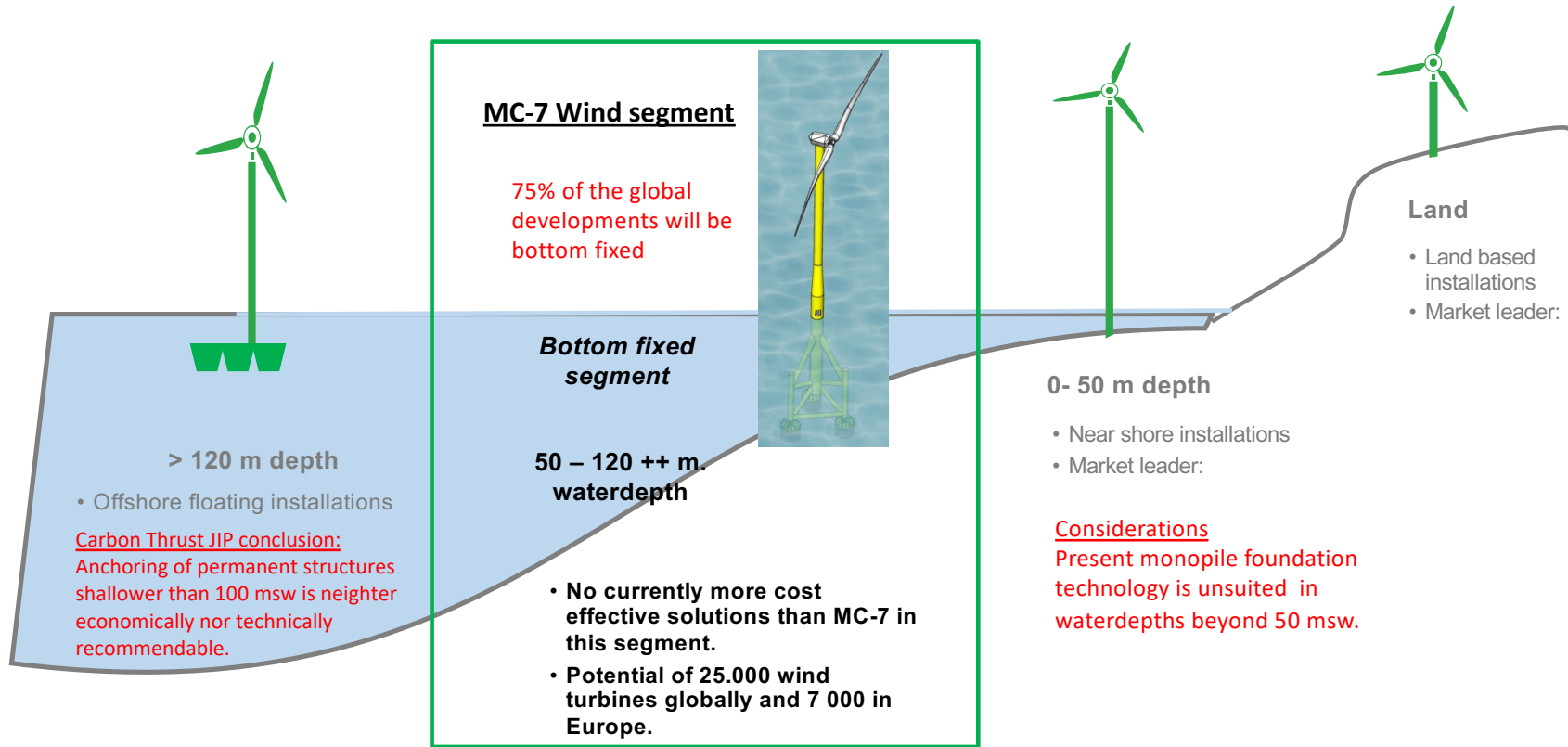
All our product and windfarm solutions are tailored to meet our values:

- Always safe
- High value from efficient low cost designs
- Offshore experience and competence from construction to cessation.
- Low carbon emission throughout the service lifetime.
- Minimizing impact to marine and birdlife.

All our business strategies, activities and products are funded on our values.

Offshore wind - Landskape

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



Romania offshore wind resources

Extract from EPG study



Text from EPG study

Romania's offshore wind sector, finding an estimated total potential natural capacity of **94 GW**, out of which only **22 GW** could be installed as fixed turbines.

Comment to the EPG study

- Bottom fixed wind turbines are not limited to 50 meters waterdepth as suggested by the study (and EU). Our bottom fixed turbines can be used down to 120 meter.
- Our bottom fixed turbines are more cost effective than floating/anchored solutions
- Romanian wind resources are better further from shore. Bottom fixed turbines occupies less of the seafloor area. Installing Turbines in the best wind resource area first gives the best economy.

Conclusion

Our wind turbine technology will expand the Romanian fixed turbine potential to approx. 65 GW, up from 22 GW and at a lower cost.

EPG
ENERGY POLICY GROUP



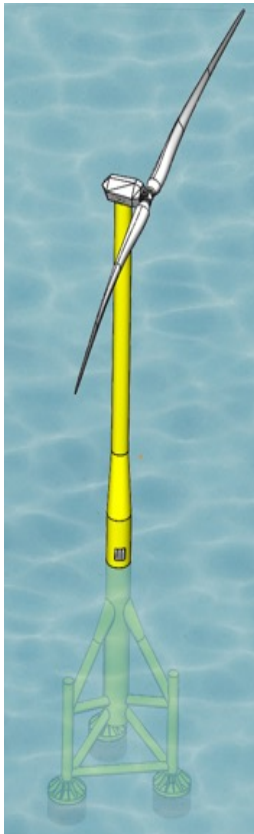
STUDY BY:

Energy Policy Group (EPG)
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www.engpro, office@engpro

IN COOPERATION WITH:

Dunărea de Jos University of Galați (Florin Onea, Lilliana Rusu and Eugen Rusu).

Windfarms designed for cost-effective offshore operations



The Offshore Wind Power Industry pain

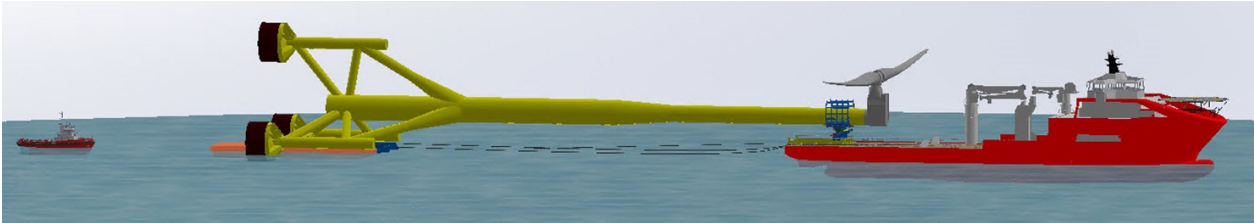
- Today's offshore windfarms production cost is far too high 30 to 40 %
- Can not compete with Hydro Power and onshore wind
- Environmental issue with anchored structures
- Costly fabrication sites
- Costly special designed installation and service vessels needed
- Limited delivery chains
- Less steel weight
- Occupation of seafloor

The MC-7 12 MW Wind turbine solve the industry pain

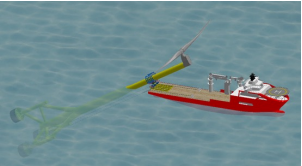
MC-7 12

Marine operational overview MC 7 Wind Turbine

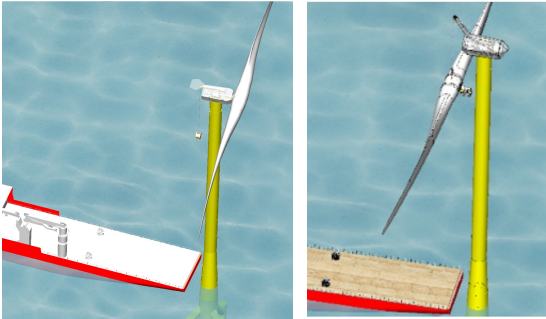
Robust solutions tailored for efficient maritime operations.



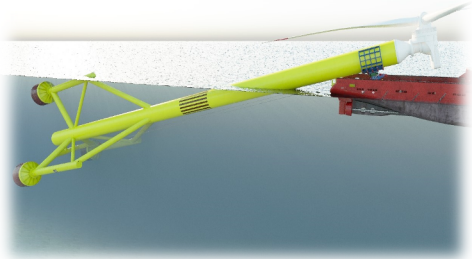
Transport: Yard to location.



Installation



IMR - Modular replacement



Removal

Minimizing impact to marine and birdlife.



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Burgos / Pasuquin offshore windfarm

Project delivery overview – Step 1

Offshore windfarm



Offshore Onshore

Windfarm and Landfall - Control station



Export Sea cable

Telecom

Export Land cable

Landfall connection point

- Isolation breakers – Seacables
- Isolation breaker - Landcable
- DC/DC step-up converters to Grid Voltage.
- Power export metering

NGPC grid
Bangui substation
DC/AC Inverter

300 MW = 25 Turbiner a' 12 MW

4 Delivery steps

Present step 4 x Turbines = 48 MW

Future step(s): 3x7 x Turbines = 252 MW

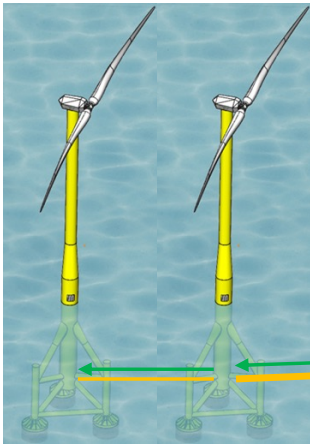
Total: 300 MW

Ekofisk Vind

Principal lay-out from turbines to grid



2 x MC-7 Offshore wind turbines



Turbines

Platform

Wind Turbines control module located in Platform control room



Power supply

Capacity: 24 MW

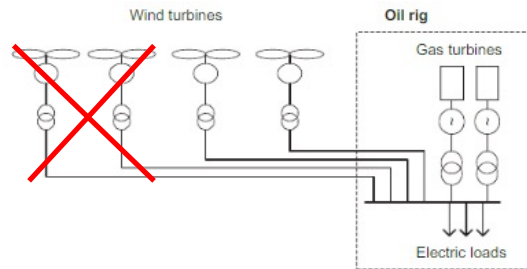
Power: AC

Hertz: 50 Hz

Voltage: 66 kV

Umbilical

Subsea powercable
1 x 24 MW



- Isolation breakers – Seacables
- Trafo to Grid Voltage.

Platform Grid

Fig. 1. Simplified illustration of oil-rig electrical system with connection of offshore wind turbines.
Source: SINTEF Energy research

Romania Offshore Energy production areas

Fast and optimal pace by step by step development



Figure 1. Romanian exclusive economic zone (EEZ) and water depth

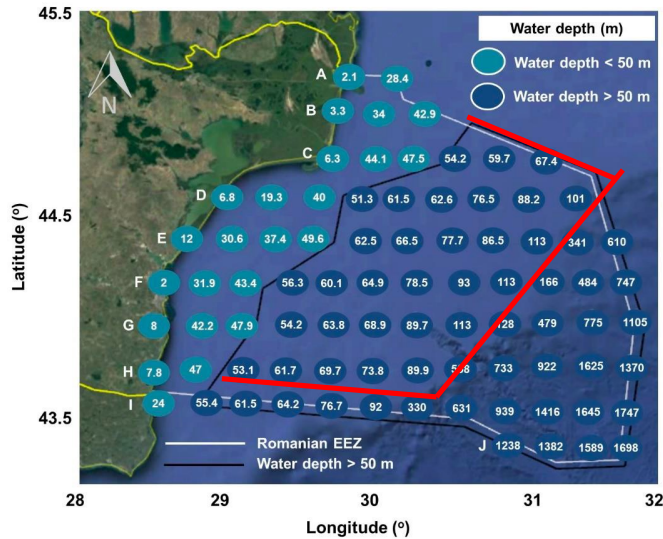


Figure 2. Average wind speed measured at 100 m height (U100)

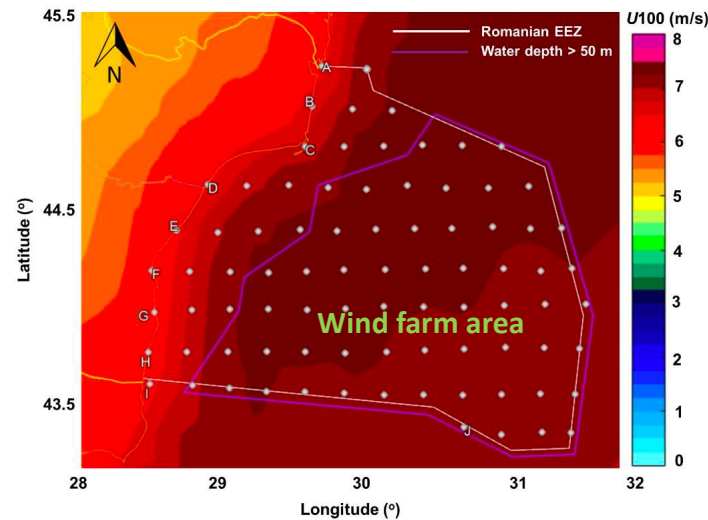
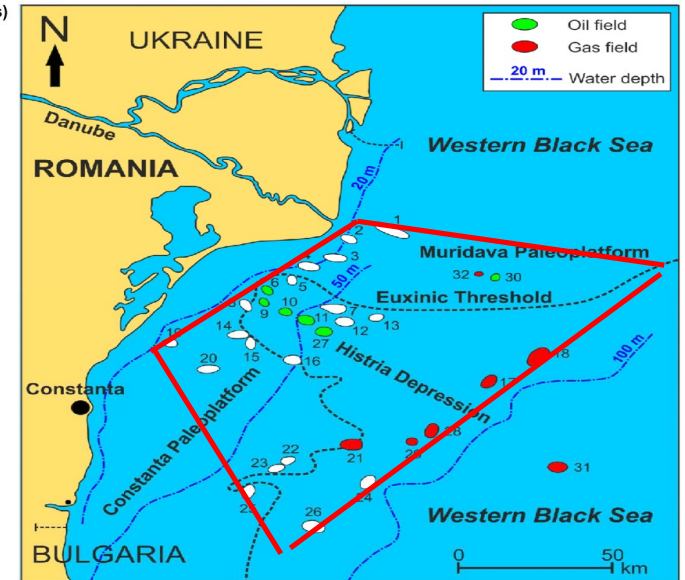


Figure 3. Romanian offshore petroleum reservoir locations



Waterdepth suited for MC-7 Petro

Step by step development

Initial step 10 x 12 Turbines = 120 MW

Future step(s): 40 x Turbines = 480 MW

Total: = 600 MW



Collaboration With Romanian Industry

- The offshore Wind Energy opportunities and green oil production in Romania and thereby EU is huge.
- The Romanian and Norwegian governments and industry and institutions are positive to collaborate within the energy sector
- Norway has an internationally recognised offshore energy industry and technologies from its offshore Wind and Petroleum energy exploitation experience benefitting Romania .

We wish to:

1. Listening to Romanian needs and share our experience from the Norwegian Continental shelf to optimise your Legislation process for the development of your Maritime Special multi-use plan.
2. Collaborate with Romanian companies in investing and developing offshore energy production licenses.
3. Deliver our products partly or fully constructed in collaboration with Romanian Yards and Marine operators.

Romania Energy day 27 June



We thank Romania's Ambassador for Norway HH. Cristian Badescu and his team for acting on the EU Commission strategy by inviting us to collaborate with the Romanian Industry.

We also thank Mr. Corneliu Bodea and Mr. Mihai Macarie from Romanian Energy Center (CRE) for their effort to take this further and the invitation to the Romanian Energy day.