OFFwind Highlights No. 7 – DECEMBER 2024

THE COST OF OFFSHORE WIND POWER

This Highlight tries to summarize the costs of offshore wind power and the main factors affecting these costs.

In the reference projects included, the cost of fixed bottom offshore wind park electricity is estimated to be 91 €/MWh and floating wind power to 140 €/MWh. Compared to electricity from large scale land-based wind parks and solar photovoltaic parks, offshore wind electricity is more expensive.

However, offshore wind is a relatively new developing industrial sector, and the costs are likely to change as the industry evolves.

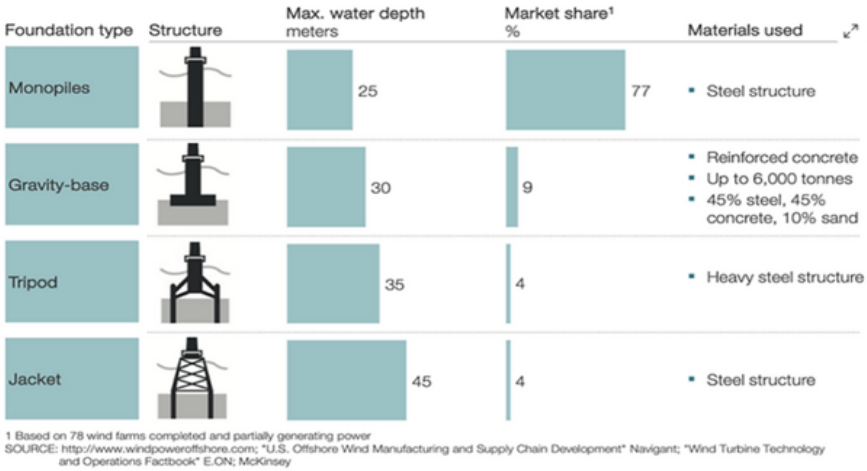
The cost of offshore wind power varies depending on the specific conditions of the offshore location. Some of the important variables include:

- Water depth and type of turbine foundation.
- Distance to land and the electricity grid.
- Turbine and park size.

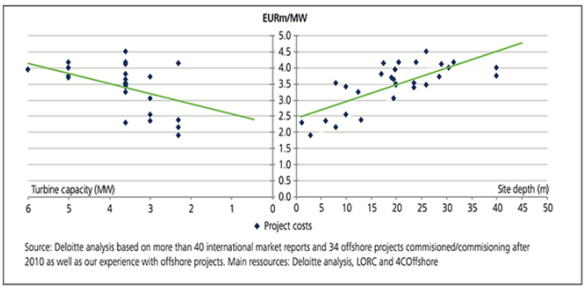
Publicly available cost information rarely provides details on all these variables, and whether the grid connection costs are included in the stated costs. This makes it difficult to compare the costs of different offshore projects.
Also, offshore wind power is a new and developing industrial sector, and the costs are likely to change as the industry evolves.
Therefore, the cost information provided in this Highlight should be consider as indicative and cannot, as such, be directly applied to any specific project.

Water depth affects the foundation type

As shown in Pictures 1 and 2 below, the water dept affects the turbine foundation type and the investment costs of offshore wind power.



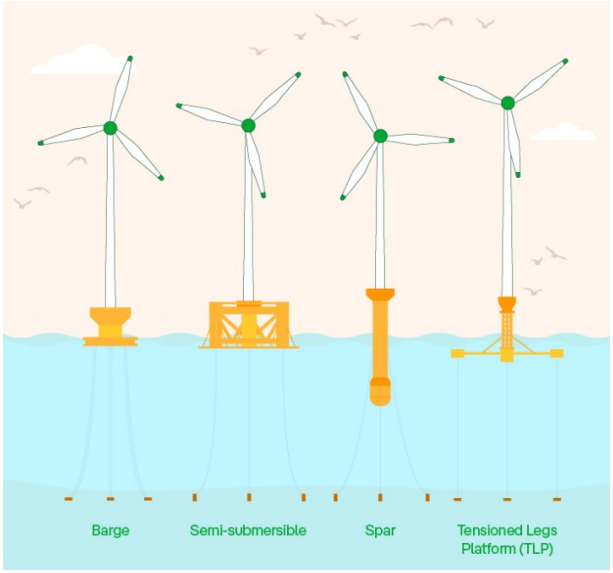
Picture 1. Offshore foundation types based on 78 wind farms completed in 2016. Source: MacKinsey, 2016.



Picture 2. Indication of how water depth and turbine size affect offshore wind investment costs. Source: Deloitte, 2014

Floating wind turbines

Floating offshore wind turbines can be installed in deeper waters further and from shore, but floating turbines have higher costs than fixed bottom turbines – mainly because of higher costs of the substructure and foundation.



Picture 3. Different types of platforms for floating wind turbines. Source: Iberdrola

Cost summaries

The US National Renewable Energy Laboratory, NREL, provides in their *report "2022 Cost of Wind Energy Review" (December 2023*), a cost summary table for fixed bottom and floating 600 MW wind parks with the parameters in Table 1.

Parameter	Fixed bottom park	Floating wind park
Distance from shore	50 km	36 km
Water dept	34 m	739 m
Park capacity	600 MW	600 MW
Turbines	50 x 12 MW	50 x 12 MW
Substructure	Monopile	Anchored floating platforms

Table 1. Parameters for the reference parks.

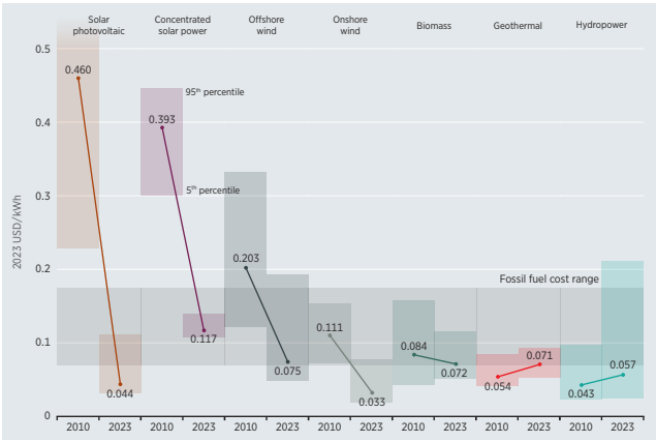
Parameter	Fixed-Bottom 12.0-MW Offshore Wind Turbine	Floating 12.0-MW Offshore Wind Turbine	Units
Capital expenditures	4,640	6,169	$/kW
Fixed charge rate (real)	6.48	6.48	%
Operational expenditures	108	87	$/kW/yr
Net annual energy production	4,295	3,346	MWh/MW/yr
Total LCOE	**95**	**145**	**$/MWh**

Table 2. Costs of the reference parks.
(Note 1 Euro = 1,04 USD in December 2024)

As shown in Table 2, both the capital costs and the operational costs are higher for the floating wind park. The **levelized cost of energy, LCOE**, is calculated to **95 USD/MWh** for the fixed bottom park and **145 USD/MWh** for the floations park.

Cost of renewable electricity

The development of the costs for renewable electricity from year 2010 to 2023 is shown in Picture 4 below. The cost off offshore wind power is currently higher than the costs of onshore wind and solar photovoltaic power.



Picture 4. Global LCOE from newly commissioned, utility-scale renewable power technologies, 2010 and 2023. Source: IRENA "Renewable power Generation Costs in 2023"

The global weighted average LCOE value derived from the individual power plants commissioned in year 2023, as stated by IRENA, are:

Offshore wind	7,5	US¢/kWh
Biomass	7,2	“
Geothermal	7,1	“
Hydropower	5,7	“
Onshore wind	3,3	“

Recent developments in the Baltic Sea.

On 4 November, 2024, the Swedish government announced that it rejects 13 submitted applications to build offshore wind farms in the Baltic Sea, south of the Sea of Åland.

The rejection of these parks may, with time, increase the interest in investments further north in the Gulf of Bothnia.

Picture 5. The 13 offshore wind parks rejected by the Swedish government on November 4, 2024

Picture 6. Some of the offshore wind areas being considered in the Gulf of Bothnia.

Planned Offshore wind in Finnish waters

In June 2024, nearly over 69 900 MW of offshore wind power capacity was being planned in Finland.

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