

# Offshore Wind Farms

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## Situation

As Bill McKibben said "There is an urgent need to stop subsidizing the fossil fuel industry, dramatically reduce wasted energy, and significantly shift our power supplies from oil, coal, and natural gas to wind, solar, geothermal, and other renewable energy sources" [1].

Reliance on non-renewable resources will cause major economic and environmental damage.

Components of levelized cost of energy

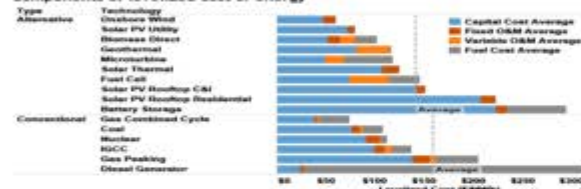


Figure 1: Levelized cost of energy for different energy powers [2]

Comparing with onshore wind power, offshore winds tend to flow at higher speeds than onshore winds, and thus it allows turbines to produce more electricity. Offshore wind farms are the most efficient method of producing wind energy.

## Problems

- Offshore wind farms have higher cost of construction than land based farms due to maintenance and labor needed.
- Onshore windfarms use High Voltage Alternating Current transmission systems, but using it for Offshore windfarms would cost far more due to the increased energy transfer distance.
- High wind intensities and height of waves may cause the blades to bend and break which will cause an automatic shutdown of the turbines and this has a high cost associated with it.
- Offshore wind farms can negatively affect the surrounding environment.
- Offshore wind farms occupy large layout compared to land based farms that will cause the destruction of marine life communities

## Solutions

- In order to decrease the impact on the environment, careful planning needs to be done when choosing a site for the offshore windfarms
- The decreasing costs of the technology means that the cost of constructing offshore windfarms will decrease.
- The offshore windfarms need to be constructed in areas of low marine population to decrease the damage caused to fish grounds.

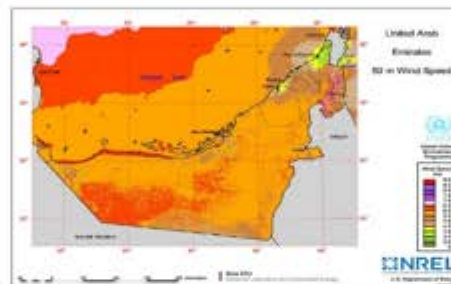


Figure 2: Wind resources of the United Arab Emirates [3]

- Using High Voltage Direct Current transmission systems instead of HVAC systems will lead to a much lower cost of energy transfer from the windfarm to the shore.



Figure 3: Bending of turbine due to high wind intensities [4]

- At dangerous wind speeds, the blades will be stowed and aligned in the direction of the wind. When wind speeds return to normal, the blades will extend back to the regular shape.

## Evaluation

### Economic concerns:

The costs of installing an offshore wind turbine were around \$5 million /MW of capacity in 2010, while installing turbine on land has installation costs between \$2-2.5 million/MW of capacity.

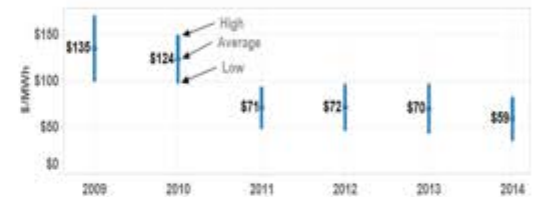


Figure 4: Levelized cost of wind power energy [5]

### Environmental impacts:

- 1- The risk of seabirds being struck by wind turbine blades
- 2- The heavy equipment used in installation process will destroy the fish habitat for large areas

### Efficiency :

Offshore wind speeds tend to be faster than on land. Small increases in wind speed yield large increases in energy production. In fact, the generation from the UK's offshore wind farms rose by 10% in the first quarter of 2016.

## References

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- [2] C. Wang and K. Wang, "Dynamic Stability Analysis of a DFIG-Based Offshore Wind Farm Connected to a Power Grid Through an HVDC Link," IEEE Transactions on Power Systems, vol. 26, no. 3, pp. 1501-1510, 2011.
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- [4] S. Lumbareis and A. Ramos, "Optimal Design of the Electrical layout of an Offshore Wind Farm Applying Decentralized Strategies," IEEE Transactions on Power Systems, vol. 28, no. 2, 2013.
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