

# BURBO BANK OFFSHORE WIND FARM



## Who we are

DONG Energy is one of the leading energy groups in the Nordic region. Our headquarter is in Denmark. Our business is based on procuring, producing, distributing, trading and selling energy and related products in Northern Europe. We employ approximately 4,500 people and generate DKK 36 billion in revenue.

DONG Energy owns wind turbines in northern Europe and has more than 30 years of experience in the wind power industry. DONG Energy is among the world elite when it comes to constructing and operating offshore wind farms. In 2006 renewable energy accounted for approximately 15% of DONG Energy's total capacity.

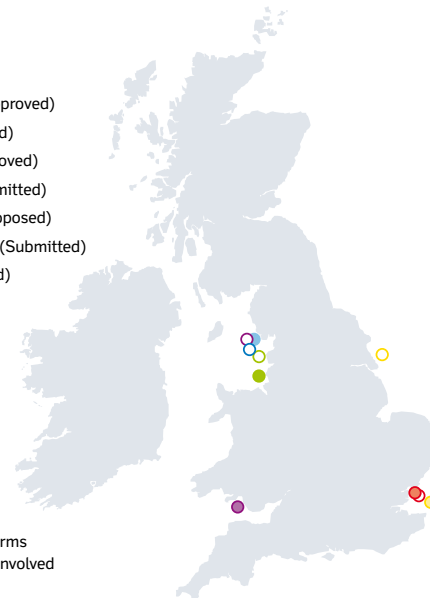
The biggest offshore wind farms world wide are on stream in Denmark with a strong DONG Energy involvement in impact assessment activities, construction, operation and major investment.



DONG Energy is also one of the leading offshore wind developers in the UK. DONG Energy has full/part ownership of Barrow, London Array, Walney, West of Duddon Sands, Cirrus Array, Scarweather Sands, Westermost Rough and Gunfleet Sands Offshore Wind Farms. Construction at Burbo Bank Offshore Wind Farm, a fully owned Dong Energy Project, commenced early in April 2006 and first power was generated on 21 July 2007.

- Burbo - (Operational)
- Barrow - (Operational)
- Scarweather Sands - (Approved)
- London Array - (Approved)
- Gunfleet Sands 1 - (Approved)
- Gunfleet Sands 2 - (Submitted)
- Westermost Rough - (Proposed)
- West of Duddon Sands - (Submitted)
- Cirrus Array - (Submitted)
- Walney - (Submitted)

Location of offshore wind farms in which DONG Energy are involved



## Why offshore wind?

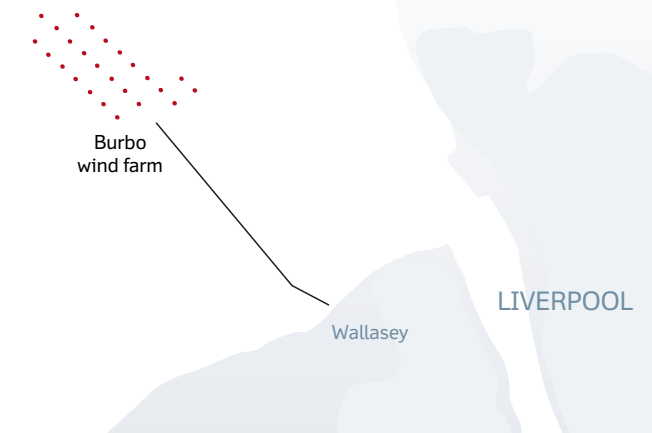
Wind turbines harness the immense power of the wind to produce clean and green electricity, with no waste products or environmentally damaging emissions, from a resource that will never run out. The UK is Europe's windiest country and is estimated to have at least one third of the entire European Union wind resource. This makes offshore wind power a vital technology to assist in the UK Government's aim of reducing CO<sub>2</sub> emissions. Placing wind turbines offshore only increases the environmental gains as the turbines can produce an energy output which is up to 25% higher than for comparable turbines onshore.

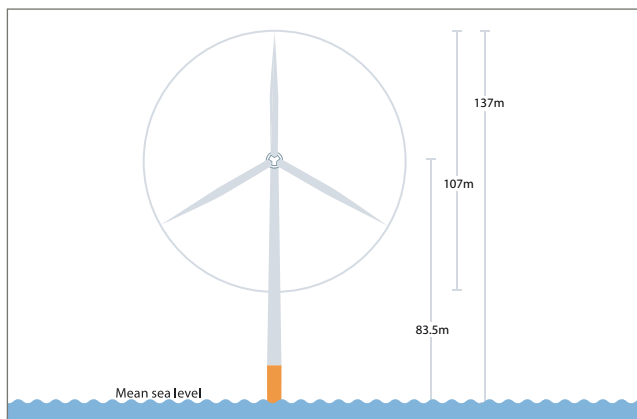
To help combat climate change, the Government has set a target of 15% of electricity supply from renewable energy by 2015. In March 2007 the 27 nations of the European Union agreed to a legally binding target of 20% of all energy to be supplied from renewable sources by 2020. Increasing the amount of energy generated from renewable sources also increases the diversity and hence the security of supply. It is anticipated that wind power will play a dominant role in terms of contributing to the European target.

## Location

The Burbo Bank Offshore Wind Farm comprises 25 efficient wind turbines and is situated on the Burbo Flats in Liverpool Bay at the entrance to the River Mersey, approximately 6.4km (4.0 miles) from the Sefton coastline and 7.2km (4.5 miles) from North Wirral. The location was chosen for a number of reasons:

- Good average wind speed
- Shallow water depth
- No perceived environmental issues
- Good seabed conditions for foundations.
- Close to an onshore electricity connection
- Within Port Authority jurisdiction (for safety reasons)
- Local familiarity with wind power - Seaforth Docks Wind Farm





## Project details

The wind farm is capable of generating up to 90MW (megawatts) of clean, environmentally sustainable electricity.

The wind turbines are 137m high from mean sea level to blade tip.

Each turbine is anchored to the seabed by a foundation consisting of a steel monopile (a single tubular structure) 5m in diameter and 52m in length. The foundation is driven up to 25m into the seabed.

Electric cables buried under the seabed connect the wind turbines to the land. Onshore, these cables travel a further 3.5km underground, following existing roads, to a substation at Wallasey. This substation steps up the electricity from internal wind farm voltage (33kV) to 132kV so that it can be fed into the national electricity grid.

Each wind turbine is designed to run for approximately 6000 hours each year over 20 years. By comparison, the design life time of a car engine is 20 times less, i.e. only one year if the car is set to run 4,000 to 6,000 hours.

The design of the wind turbines allows for minimum service, but each wind turbine will need a few annual service inspections. In connection with maintenance inspections, service technicians will access the wind turbines by boat. For this purpose an operation and maintenance facility has been

Wind turbine type (Siemens)	3.6MW
Total output of the wind farm	90MW
Expected annual output	315,000,000kWh
Rotor diameter	107m
Hub height	83.5m
Weight, nacelle	125 tonne
Weight, rotor	95 tonne
Weight, tower	180 tonne
Weight, foundation	400 tonne
Total weight per wind turbine	800 tonne
Length of monopile	52m
Cut-in wind speed	4m/s
Full power output from	14m/s
Cut-out wind speed	25m/s
Mean wind speed hub height	>9m/s
Depth of water	2-8m at lowest tide
Distance from shore	7km
Distance between wind turbines	530-720m
Wind farm area	10km <sup>2</sup>

located in Liverpool harbour. The operation and maintenance facility will be used as a base for the routine monitoring, management and maintenance of the wind farm.

The 25 turbines are identical and each wind turbine comprises of a three-bladed rotor of 107m diameter (52m blades and hub) positioned in the front of the nacelle, all mounted on an 83m tower. The rotor is connected directly to the gear box in order to transfer the rotational energy to the generator, which transforms the wind energy into clean electricity.

The production from the wind turbines depends upon the actual wind speed. As wind speed increases the turbines' output will increase according to the power curve.

The wind turbines start to generate power at a wind speed of only 4m/s, and level out at 3.6MW at a wind speed of 14m/s.

If the wind speed exceeds 14m/s, the turbine will automatically and gradually pitch the blades out of the wind so as to prevent overload. If the wind velocity exceeds 25m/s, the turbines will disengage for safety reasons.

At a wind speed of 9m/s, which is the expected average wind speed on the site, a total volume of 80,928m<sup>3</sup> of air is passing through the rotor every second. This equates to almost 100 tonnes per second!

## The Environment

The wind farm will contribute to tackling the issue of climate change. It is estimated that over the 20-year operating life of the wind farm, the savings amount to 6.4 million tonnes of carbon dioxide, together with significant amounts of other greenhouse gases.

Reduction of greenhouse gas emissions also contributes to the British Government's commitment to global emissions reduction and climate change control. Also the Government's commitment towards energy diversity and security from a clean, sustainable source is benefited.

The turbines at Burbo are expected to produce an annual output of 315,000,000 kilowatt-hours, which corresponds to the consumption of more than 80,000 British households.

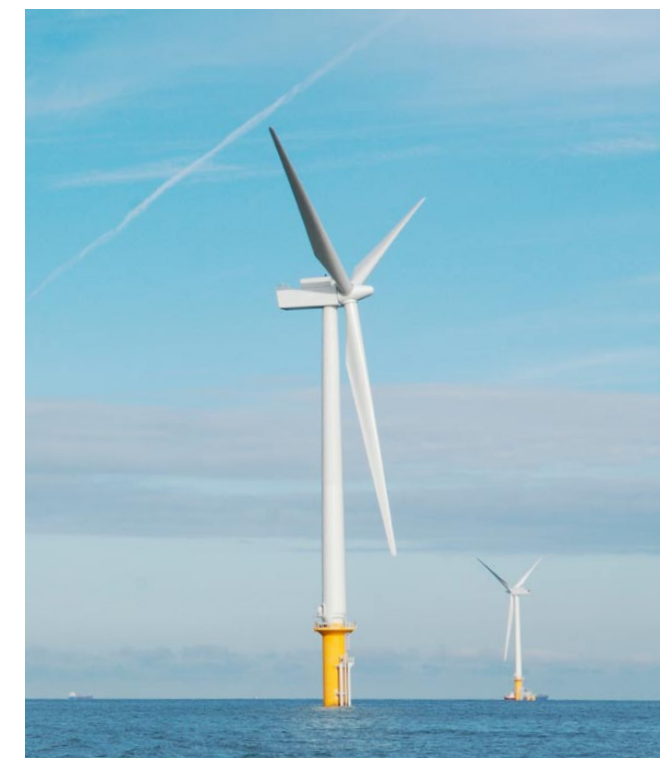
Impacts on the environment have been assessed in accordance with the regulations for undertaking an Environmental Impact Assessment as laid down by European law.

All assessments undertaken on the Burbo project have shown that there will be no significant impacts on coastal processes, bird and marine life or archaeology. Where impacts have been identified, appropriate mitigation measures have been implemented.

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