Evaluation of wind farm efficiency and wind turbine wakes at the Nysted offshore wind farm

Here, we quantify relationships between wind farm efficiency and wind speed, direction, turbulence and atmospheric stability using power output from the large offshore wind farm at Nysted in Denmark. Wake losses are, as expected, most strongly related to wind speed variations through the turbine thrust coefficient; with direction, atmospheric stability and turbulence as important second order effects. While the wind farm efficiency is highly dependent on the distribution of wind speeds and wind direction, it is shown that the impact of turbine spacing on wake losses and turbine efficiency can be quantified, albeit with relatively large uncertainty due to stochastic effects in the data. There is evidence of the ‘deep array effect’ in that wake losses in the centre of the wind farm are under-estimated by the wind farm model WAsP, although overall efficiency of the wind farm is well predicted due to compensating edge effects. Copyright © 2010 John Wiley & Sons, Ltd.