Average power losses due to wind turbine wakes are of the order of 10 to 20% of total power output in large offshore wind farms. Accurately quantifying power losses due to wakes is, therefore, an important part of overall wind farm economics. The focus of this research is to compare different types of models from computational fluid dynamics (CFD) to wind form models in terms of how accurately they represent wake losses when compared with measurements from offshore wind farms. The ultimate objective is to improve modelling of flow for large wind farms in order to optimize wind farm layouts to reduce power losses due to wakes and loads. The research presented is part of the EC-funded UpWind project, which aims to radically improve wind turbine and wind farm models in order to continue to improve the costs of wind energy. Reducing wake losses, or even reduce uncertainties in predicting power losses from wakes, contributes to the overall goal of reduced costs. Here, we assess the state of the art in wake and flow modelling for offshore wind farms, the focus so far has been cases at the Horns Rev wind farm, which indicate that wind form models require modification to reduce under-prediction of wake losses while CFD models typically over-predict wake losses. Further investigation is underway to determine the causes of these discrepancies. Copyright (C) 2009 John Wiley & Sons, Ltd.