

FarmFlow



EWIS

Being one of the leading institutes on wind energy research, ECN established the EWIS (ECN Wind Industrial Support) group in 2009 to better bring the R&D results to the market. During the last three decades, ECN has developed expertise on aerodynamics, structural analyses, turbine control, offshore operation and maintenance, and grid connection. With the growing wind industry, ECN received more requests for assistance and EWIS has become the vehicle to support the wind energy industry in their product developments.

EWIS's focus is on the high end of the market which means that we will make use of tools and knowledge that have been developed in-house and include the latest R&D results!

The EWIS team is a mixture of young professionals and experienced researchers which ensures a fast response and high quality.

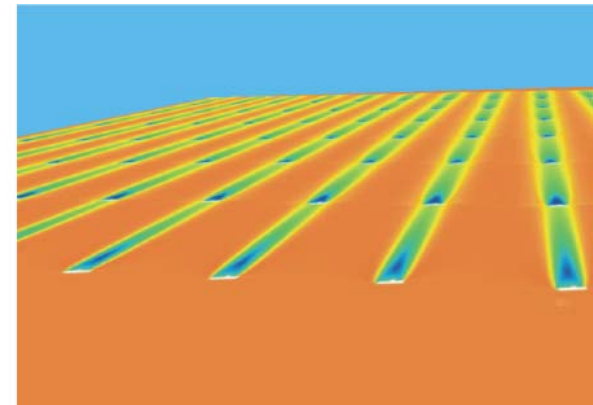
More information

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Product description

The Software

The FarmFlow program is an advanced and validated tool to calculate the wind turbine wake effects of offshore wind farms. The unique feature of FarmFlow is that both the reduction of the wind speed behind wind turbines as well as the added turbulence due to the wakes are calculated. This makes FarmFlow the preferred tool to perform wind farm energy yield calculations and, in conjunction with an aero-elastic code, perform design calculations on wind turbines which are placed in wind farms.



The Model

Especially offshore, wind power is produced by wind farms, in which large numbers of wind turbines are grouped together. Under these circumstances there is a mutual influence of wind turbines on each other due to aerodynamic wake effects: the flow at a downstream wind turbine is affected by the wind turbine(s) which are placed upwind. For the optimisation of the wind farm lay-out, these wake effects must be taken into account, because:

- The energy yield decreases due to the lower mean wind speed in the wake;
- The mechanical loads on turbines increase due to the changed wind field and the increased turbulence intensity in the wake.

FarmFlow calculates both the aerodynamic wake losses and the added turbulence levels.

Specifications

Description of Software:	<ul style="list-style-type: none"> • FarmFlow executable • User manual • 1 hardware key with licence for 1 year
Designated sites:	single user
Licence fee:	€ 20000 for the first licence € 10000 for the second licence € 5000 for each following licence
Licence term:	1 (one) year
Services:	<ul style="list-style-type: none"> • 16 man-hours software support by telephone or e-mail, not on-site • if available, updates of the software
Additional maintenance tee:	One third of the licence fee per year for extension of licence term by one year
Maintenance services:	<ul style="list-style-type: none"> • 16 man-hours software support by telephone or mail, not on-site • if available, updates of the software
Additional options:	One-day training in the use of FarmFlow by ECN experts. Reviews of wind farm calculations

In order to calculate the wind field in a wind farm, the essence is the prediction of the incoming wind field in front of a turbine, including the wake effects of other turbines. World-wide, a wide range of models have been developed to solve this problem, varying from very simple empirical solvers to very complex and time consuming CFD flow solvers. ECN has developed the program FarmFlow which is a compromise between these two extremes. FarmFlow uses a parabolised Navier-Stokes solver with a $k-\epsilon$ turbulence model, in combination with a free vortex wake model to calculate the pressure gradients in the near wake. This approach delivers state of the art accuracy with reasonable calculation time. It calculates both the mean wind field as well as the fluctuations in the wind.

The FarmFlow tool includes a user-friendly interface that allows easy calculations. The wind resource can be analysed. When the wind climate is known, the tool will calculate the Annual Energy Production taking into account the wake losses in the offshore wind farm.

In order to use the FarmFlow model for optimisation of 100+ MW wind farms, a special version is included in the FarmFlow tool that is very fast with nearly similar accuracy as the full model.

The FarmFlow tool includes a database with properties of commercially available wind turbines that is easily extended or modified by the user or alternatively by ECN.

The Experience

The FarmFlow program is a validated tool to calculate the wake effects of large offshore wind farms. Results from FarmFlow have been compared to available measurements of many offshore wind farms and in addition scored the best in a blind test. The FarmFlow tool allows the user to accurately calculate the wake losses and turbulence levels in the offshore wind farm and thus optimize the lay-out. This optimization involves both the power output and the mechanical loading levels, the latter in conjunction with aero-elastic codes. The program combines a relatively short calculation time with an excellent accuracy. Multiple wake effects and wind farms which consist of different turbine types can be modelled in a straightforward way. Since the code is optimised for offshore wind farms, complex terrain is not included.