wind & economy
Strategic Optimisation

Wind and Economy Strategic Optimisation Software

An EERA-DTOC Spin-off DTOC

The Challenge of Designing an Offshore Wind Farm

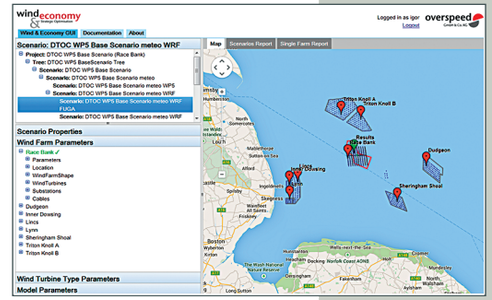
One of the most challenging tasks for wind farm developers is the optimisation of offshore wind power plants.
Large offshore wind farms and wind farm clusters, such as those in the German Bight or on the Dogger bank, change the wind climate itself and make this optimisation task even more demanding.

During the process of wind farm optimisation, hundreds of variations are considered and need to be managed, documented and benchmarked.

Title page, page 1 and page 10, www.siemens.com/presse

Wind & Economy: Optimised Offshore Wind Farms

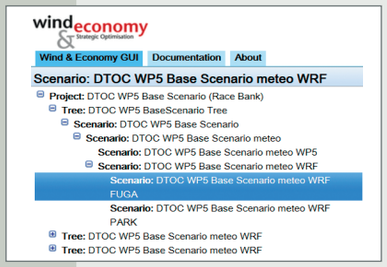
Our new software tool, Wind & Economy, supports your challenging work with the seamlessly integrated modelling of wind climate, large scale and localized wind farm effects, electrical loss calculations and derivation of economic key figures.



A clearly organized workflow supports you in the management of the set of all wind farm variations ever to be considered during the life time of your project. Using LCOE, the Levelized Cost of Energy, as a economic performance key indicator helps you to benchmark different approaches and select your optimised design. In addition, the detailed knowledge of the uncertainties of energy production and LCOE support the management of financial risks.

Leading edge meteorological and wind farm models, taken together with a consideration of the uncertainty of energy production and the cost of energy, make your results waterproof and bankable.

Optimisation Support



Having hundreds of variations of the wind farm layout is not rare during the optimisation process of offshore wind farms. In order to support you in handling these different configuration options as efficiently as possible, we have defined a workflow which organizes many different farm variants in a development tree.

For this purpose, Wind & Economy defines farm "scenarios" consisting of wind climate, turbine types, hub height, models used to calculate the energy production, electrical grid layout and economic parameters.

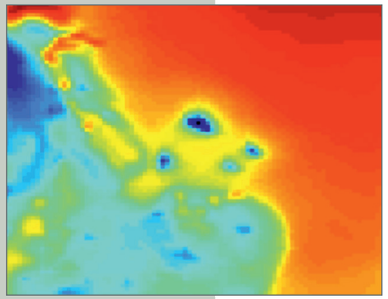
These scenarios, organized in trees, help you in keeping track of your valuable work and the development process. Comparative reporting of the results from a number of scenarios supports you in selecting the right track towards your optimised wind farm.

DTOC Energy Production Report

EON, 2014 — Reference LCOE: 13.5 ct/kWh — Reference Scenario: BWII - WAsP

	Scenario Shortname	BWII - WAsP *	BWII - FLaP	BWII - WAsP 100m
Comment		Calculations with WAsP	Calculations with FLaP	Calculations with WAsP, hub height: 100m
	Last Update	2014.04.22 14:30	2014.04.22 16:30	2014.04.23 11:05
Turbines				
	Turbine Manufacturer	Areva	Areva	Areva
	Turbine Type	M5000	M5000	M5000
	Nominal Power [kW]	5000	5000	5000
	Rotor Diameter [m]	116	116	116
	Hub Height [m]	90	90	100
Farm				
	Number of Turbines	80	80	80
	Nominal Power Wind Farm [MW]	400	400	400
Results				
	AEP Gross [GWh/a]	1'758.2	1'747.6	1'846.1
	AEP Farm [GWh/a]	1'613.8	1'600.9	1'702.6
	AEP Net [GWh/a]	1'495.0	1'483.1	1'577.1
	Capacity Factor [%]	46.1%	45.7%	48.6%
	Wind Farm Efficiency	91.8%	91.6%	92.2%
	Availability	96.0%	96.0%	96.0%
	Electrical Losses	3.50%	3.50%	3.51%
	LCOE [Cent/kWh]	13.5	13.4	14.2
	LCOE [%]	+100.00%	+99.20%	+105.50%
	delta LCOE [%]	+0.00%	-0.80%	+5.50%

Wind Resource

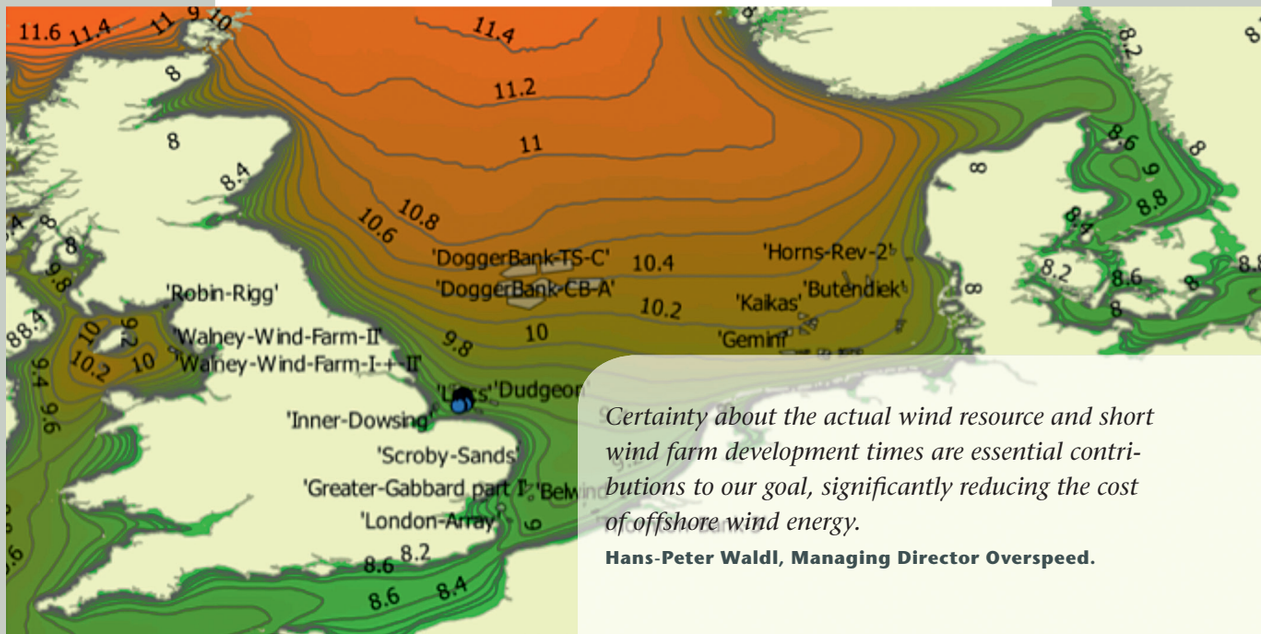


For most offshore applications, the wind resource for the target wind farm is non-uniform, and in most cases it is influenced significantly by existing or future wind farm installations.

Wind & Economy uses a specialised meso-scale model to calculate the long term wind climate in the area under consideration, with and without taking into account surrounding wind farms.

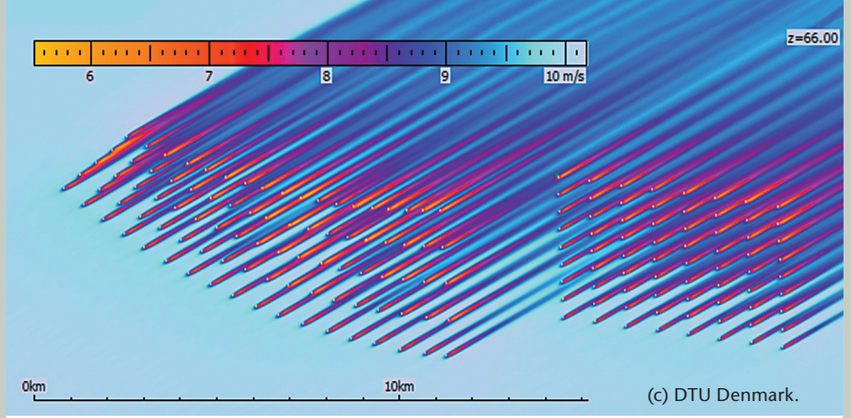
These model calculations give an immediate insight into

- variations of the wind resource over the wind farm area
- energy lost by wake effects from surrounding wind farms
- particular effects from large wind farm installations, including how they influence their own wind resource



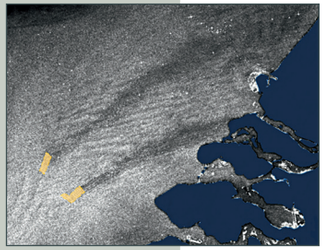
Certainty about the actual wind resource and short wind farm development times are essential contributions to our goal, significantly reducing the cost of offshore wind energy.

Hans-Peter Waldl, Managing Director Overspeed.



(c) DTU Denmark.

Wake Losses in Large Offshore Farms



RADARSAT-2 from Data and Products © MacDonald, Dettewiler and Associates Ltd.

Today we know that wake effects in offshore wind farms are much more pronounced and long lasting than in on-shore installations.

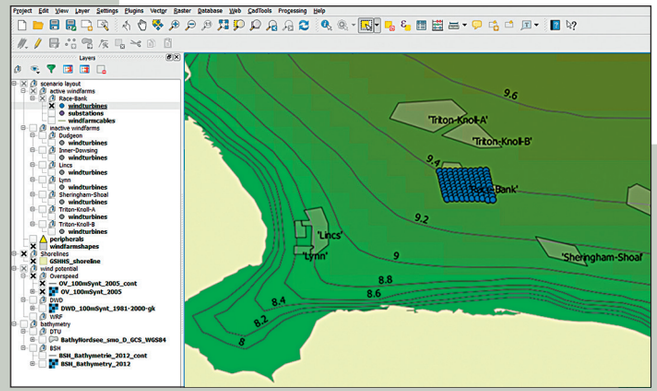
To support your work by accurate modelling results, we have integrated the wind farm and wake model, FUGA, into our modelling platform. FUGA is optimised for offshore applications and, in particular, is able to model long distance wakes as they occur within and downstream from large offshore wind farm installations.

GIS Integration Offshore Wind Farm

Many tasks which must be performed in order to optimise offshore wind farms are well supported by Geographical Information Systems, GIS. To benefit from this approach, we have included an open source GIS, the QGIS software, into the Wind & Economy workflow as one possible frontend.

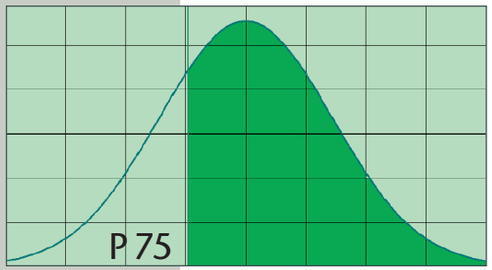
By using this approach, you will be able to

- edit turbine layout
- visualize local and large-scale wind resources and energy production
- edit turbine types and other parameters
- optimise the cable layout
- calculate electrical losses
- select grid connection options
- consider environmental protection areas
- include additional information such as maps of water depth, exclusion areas, shipping lanes and others into your planning work.



Economic Modelling and Risk Management Support

Uncertainty	Value
Anemometer uncertainty	2.40%
Anemometer installation/incident flow	1.00%
Long-term correlation	2.10%
Spatial balancing	5.00%
Long-term representativeness	3.00%
Calculation method (extrapolation)	4.30%
Future wind variability (1 year)	1.80%
Future wind variability (10 years)	3.60%
Total uncertainty	8.94%



For all offshore applications, there are two main key performance indicators: the return on investment and the uncertainty of these profits.

For each wind farm variant, Wind & Economy provides you with the LCOE, the Levelized Cost of Energy. On this basis, you may decide whether additional investments, e. g. in a higher hub height, lead to a sufficient increase in energy production and are thus economically feasible.

By integrating wind resource calculations, wind farm modelling, economic modelling and uncertainty calculations into a single tool, the uncertainty of production and LCOE for each wind farm variant can be estimated. An uncertainty module takes into account the uncertainty of the expected energy production and the prices of wind farm components, finally resulting in so-called POEs (probability of exceedance) for different financial risk levels.

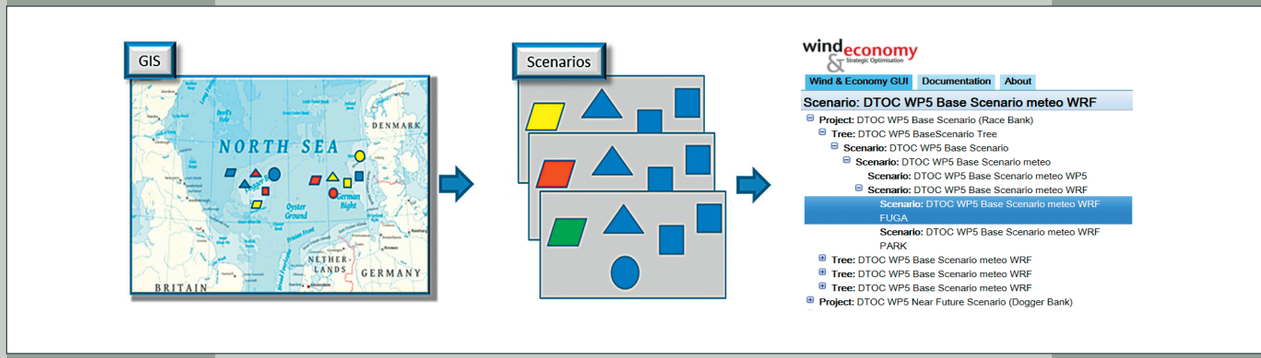
Finally, it's all about economics and risks.
That's why we supported the integration of economic tools into Wind & Economy.
Jan Matthiesen, The Carbon Trust.

Web-based Multi-User Platform

For all offshore wind farm projects, a group of people work together closely to cover the different technologies and design steps.

Wind & Economy follows a clear multi-user approach which supports the cooperation of your project teams and helps you to reduce friction, time effort and budget at the different interfaces of the respective work packages.

The Wind & Economy software, including most calculation models, runs centrally on a company server. Employee access is granted on project-based user access and a fine grained user rights management.



Spin-off from Current Research

The Wind & Economy software is a spin-off of the EU funded R&D project DTOC, the Design Tool for Offshore Wind Farm Cluster. This project, initiated and led by the European Energy Research Alliance (EERA), brings models from leading edge research together with the practical needs and experiences of high-impact industry partners.

A robust, efficient, easy to use and flexible tool created to facilitate the optimised design of individual and clusters of offshore wind farms.

The EERA-DTOC project mission.

A great advantage of the close cooperation of researchers, end-users and software developers is the coupling of meteorological, wind farm effect and economical models which are not only from leading edge research and optimised for large offshore wind clusters, but are also verified with actual off-shore applications and measurements.

Wind & Economy:
A spin-off from EERA-DTOC

Strategic Planners

As a strategic planner, the Wind & Economy software supports you in defining areas for new offshore clusters, optimising onshore grid connections, and helps to simulate ancillary services like power balancing and voltage support from dispersed offshore wind farms.

In particular, GIS integration helps you to factor in the restrictions for wind farm development, such as those in environmentally sensitive areas, and the optimal use of the wind resource.

For strategic planners, the interaction between wind farms within wind farm clusters may be an essential point for assessing offshore wind development areas and determining the minimum distances between farms.

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A spin-off from EERA-DTOC

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Technical University of Denmark

DTU

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