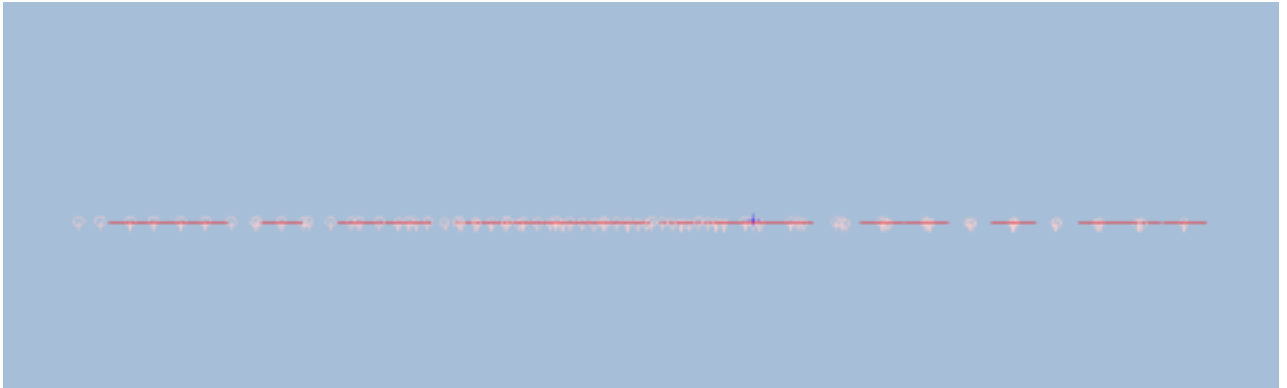
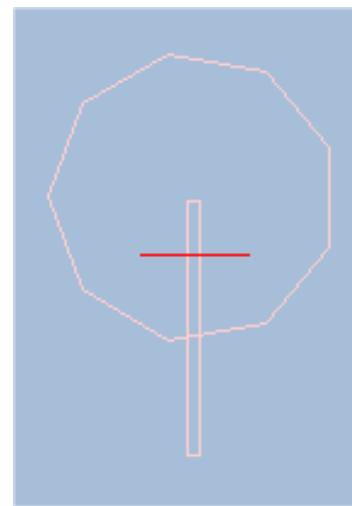


SEAWIND – project description:

Butendiek, Germany, 240 MW (80 x 3 MW)



Stylistic photomontage showing the visible part of the WTGs seen from Westerland, Sylt based on standard 45 mm focal length camera. Photo point is shown on map with green lines. Due to earth rounding only the upper half of rotor will be visible, indicated by red line. Below a heavy zoom at the closest WTG show that from 1.5 m a.s.l. around 20% of the 80 m high tower will be visible.



Project description

The proposed project is 35 km offshore outside Sylt, an island in the North Sea NW of Germany. The project consists of a 5 rows with 6-24 WTGs in total 80 WTGs. With 3 MW WTGs (size not yet decided), 240 MW will be installed. Each WTG is here assumed with a hub height of 80 m and a rotor diameter of 90 m. Calculations show that around 905 GWh could be produced annual. The proposed layout has 966 m spacing (10.7 rotor diameters) between rows, 478 (5.3 RD in row). The foundation type is assumed to be monopile at a water dept around 20 m.

The project description and the calculations performed are of initial nature and must be further consolidated.

Facts on layout proposal and estimated investment costs

WTG size layout specification and price

Total installed power	240 MW	Distanse in RD	
Number of rows	5	966	10.7
WTGs per row)*	16	478	5.3
Number of WTGs	80	Hub height	RD (m)
Size of WTG	3 MW	80	90
Price information in this case are very rough estimates			
Price for WTGs, installed (k€)	220,000	917	€/kW

Foundation, specification and cost estimate:		240 MW						
Type of foundation	Monopile							
Number of foundations:	80							
Water debt (m)	20 RD	HH						
WTG-size (MW, rotor diameter, hub height)	3	100	95	Debt#1	Debt#2	Debt#3	Debt#4	Debt#5
Ice risk (yes/no)	No							
100 year max wind gust (m/s)	?							
100 year max wave height (m)	?							
Tidal difference (m)	?							
	For all k€	k€/per pcs.	€/kW	Per foundation, debt dependend				
Fixed price, design cost,								
Fixed price, building/shipping facilities								
Fixed ground prepare cost								
Variable ground prepare cost								
Variable, building cost								
Installation cost								
SUM	80,000	1000.005	333.3					

Figure 1 Foundation costs are based on estimates so far.

	Number or length (m)	Voltage(kV)	mm²	Material	Lines/cable	Prices k€		
						For all	Per unit or per meter, €	€/kW
Sea cable, from wind farm to shore	35500	150	630	CU	Cable	17,750	500	74
In row cables	3864	30	300	CU	Cable	386	100	2
Rows to collect point cables	7170	30	300	CU	Cable	717	100	3
Cable roll out/Wash down, variable	46534					2,327	50	10
Cable roll out/wash down, fixed cost						500	500,000	2
Total number of WTG connectors	80					2,000	25,000	8
Off shore HV station	1	150/30 kV				15,000	15,000,000	63
Connection (electrical work)								
Other fixed costs						2,000	2,000,000	8
Other variable costs								
From shore to HV-grid								
HV station (if needed)								
Connection (electrical work)								
Compensation (reactive power)								
Other fixed costs						34,320	34,320,000	143
Other variable costs								
						75,000		313

Figure 2 The sum is based on project calculations, but division into different parts is a rough estimate.

Total budget for 240 MW wind farm

	k€	€ per kW	Percent
WTGs	220,000	917	54%
Foundation	80,000	333	20%
Grid connection	75,000	313	19%
Planning and permissioning	12,135	51	3%
Organisation, management	8,090	34	2%
Miscellaneous (e.g. risk, reserve)	9,274	39	2%
TOTAL	404,500	1,685	100%

Note: Cost estimates are based on estimates made by the project initiative group

Expected energy production, and PPA

The energy calculation based on wind data from Danish onshore experience. The WASP calculation model is used from the WindPRO software tool, where the whole project is modeled. The calculation shows 905 GWh/year. From this uncertainty, grid losses and availability losses shall be withdrawn – probably around 12% at present stage, which makes almost 800 GWh/y, which is the estimate based on more detailed evaluations by Techwise.

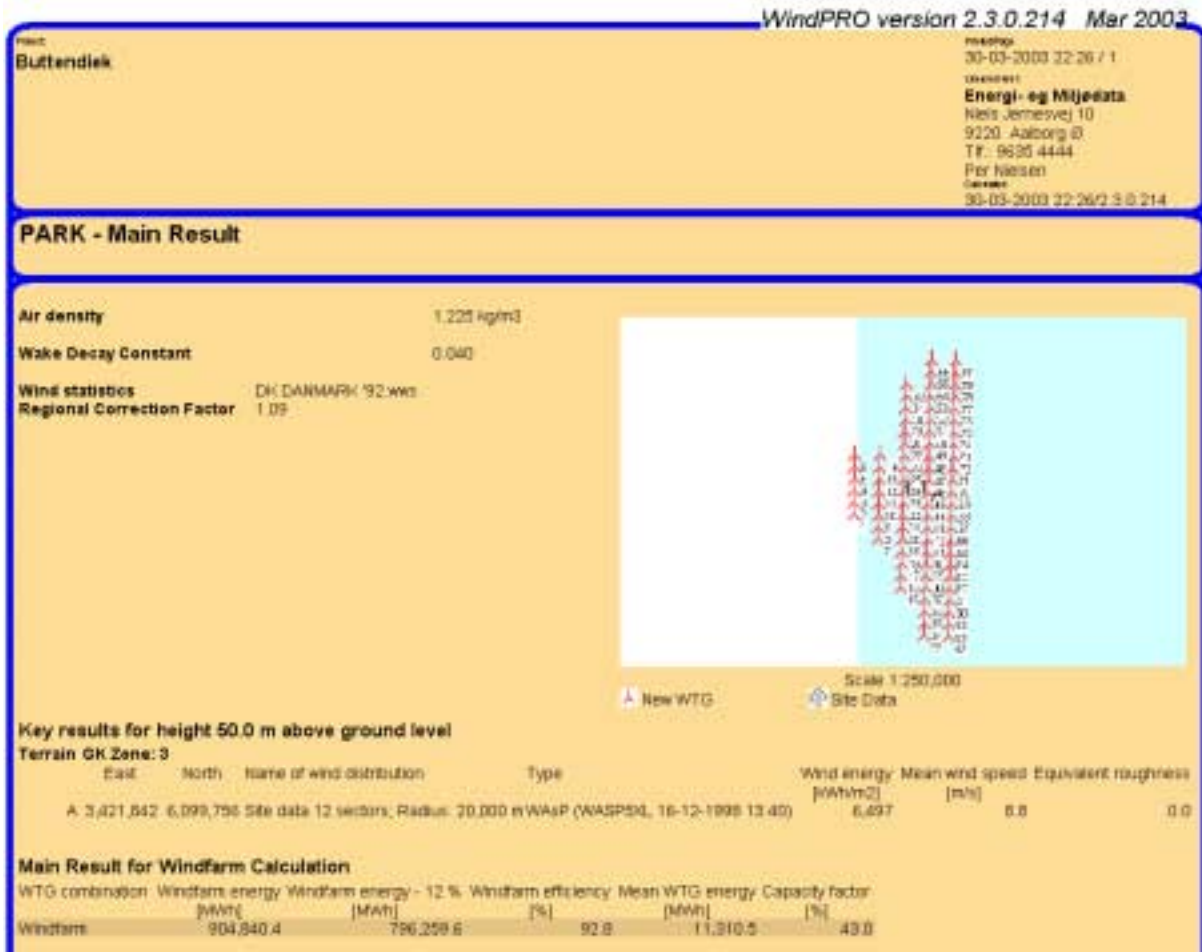


Figure 3 The energy calculation printout from WindPRO software.

Knowledge from existing onshore wind farms near site combined with the Horns Rev (first large Offshore project in North Sea in DK installed end 2002) experience that now start to come, a more certain estimate can be made with relative limited effort. Installation of wind measurement mast at site would be preferable.

German off shore PPA	Number of months	In years	Price paid per kWh (start 2006)
Increased subsidy	158	13.1	8.6
Decreased subsidy			5.7

Figure 4 The price paid per kWh are fixed in Germany for 20 years. For Off shore projects installed no later than 2006 outside three nautical miles outside baseline used to demarcate territorial waters, the increased price is at least 9 years (5 year on shore),

Operation costs and economic feasibility

Based on onshore experience following figures have been used in the calculations:

Operation cost	onshore	offshore estimate
Insurance	5 €/kW/y	10 €/kW/y
Service and maintenance	10 €/kW/y	18 €/kW/y
Adm. and management	3 €/kW/y	5 €/kW/y
SUM/year	18 €/kW/y	33 €/kW/y
Per WTG:		1.0 €/kWh/y
Decommissioning	50 k€/WTG	0.7 €/kW/y

Figure 5 Operation cost used in calculation. The resulting 1 €/kWh match well the DK utilities expectations for the calculated DK projects. The decommissioning costs is set relative low, but there should be good reasons to believe in that instead of decommissioning, repowering would be more likely.

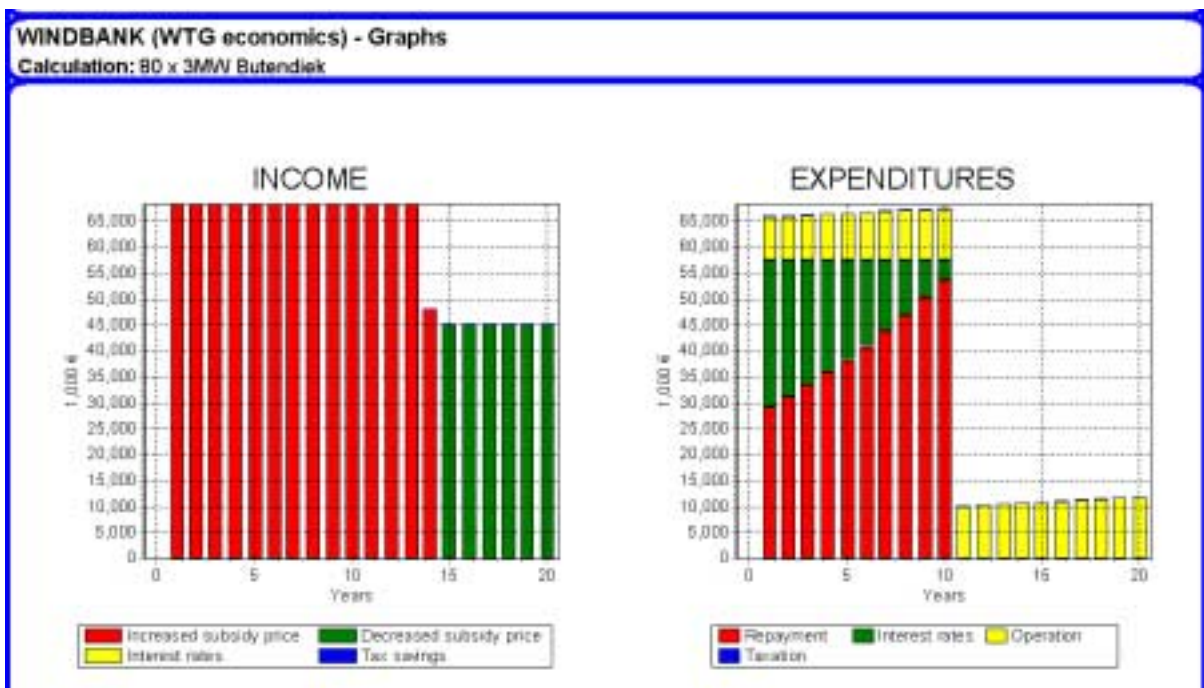


Figure 6 With the above estimated price development a payback time of 9.7 years will be expected. Tax calculations is not included, but these will typically have a positive influence on the pay back time due to tax credits from loans.

RATIOS

	€/kW	€/m ²	€/MWh
Preliminary expenses	1,685	-	508
O/M costs average €/years	34	-	10
Energy production kWh/Years	3,318	-	-

Minimum life span for redemption of loan	9.7 Years
Simple pay back time	7.4 Years
Net present value for share	366 €
Net present value in % of investment	72.0 %
Production price at calculation interest 6.0%	0.06 €/kWh

Figure 7 One share is here 1000 kWh/year, an investment of 508€

Infrastructure, environmental aspects, time schedule etc.



Figure 8 The wind farm shown on top of the map from North sea offshore show that the wind farm is within the important bird area zone, but detailed studies has confirmed that the site is accepted.

Environment impact assessment

Subsurface life

Fish

Birds

Guinea pig, seal et. al.

The conclusion is that none of the above topics will be disturbed in a way that rejects the project proposal.

Security regarding ship collision

The conclusion is that the risk is very low due to the remote location relative to main ship traffic.

Visual impact

Due to the long distance to nearest shore position at Sylt, the earth rounding influence, combined with prevailing weather conditions, the wind park will only be visual in very limited time and only a small part of it.

Fishing

Shrimp fishing will be reduced and compensation to the shrimp fishers will be negotiated.

Time schedule

The remaining contracts and financing including sale of the project for small investors will be done during 2003-2004. In 2003 the first part, the grid connection will start construction. In 2005 the off shore construction is planned.

The methodology and presentation of this case study is established as part of ALTENER Contract No. 4.1030/Z/01-103/2001. For further information and discussion please contact the project coordinator Green Globe Energy I/S or EMD on e-mail: hansb@post8.tele.dk or euroscan@post.tele.dk or pn@emd.dk.