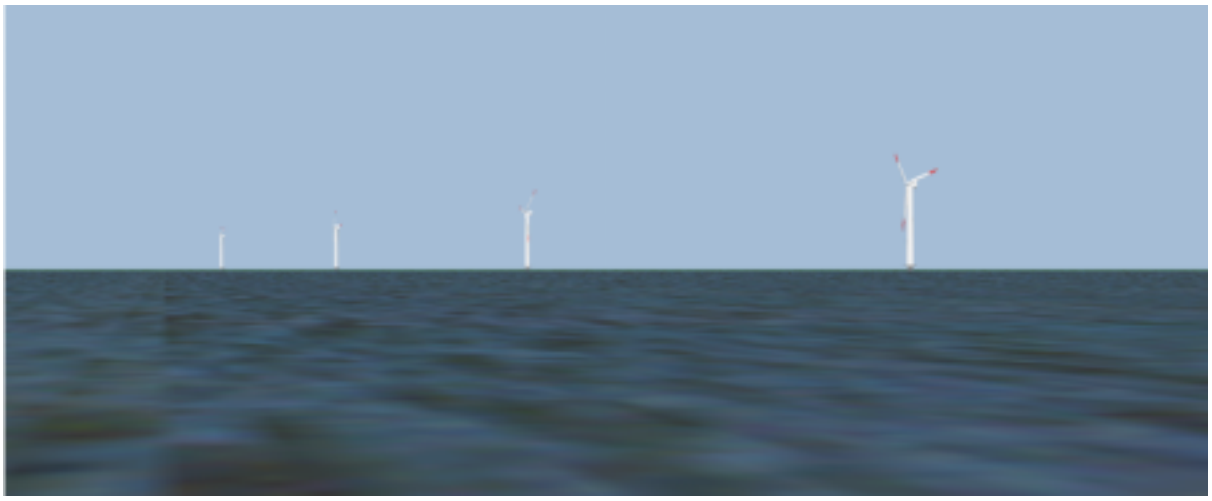
SHANNON, EI, 20 MW (4 x 5 MW)



Photomontage showing the visibility from coastline at shore grid connection point based on standard 45 mm focal length camera.

Project description

The proposed project is 1.5 km offshore in the “Mouth of Shannon”. The proposed project consists of 4x 5 MW WTGs, which makes 20 MW in all. Each WTG is assumed with a hub height of 110 m and a rotor diameter of 115 m. Some very rough preliminary calculations show that around 75 GWh could be produced annual. The proposed layout has 1000 m spacing (8.7 rotor diameters). Grid connections are assumed obtained with an offshore 1.5 km 38 kV sea cable + a 11.5 km direct 38 kV lines on shore to a 110 kV station, which should be capable to take 25 MW. The foundation type is assumed to be monopole at a water dept less than 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	**20**	**MW**	Distanse	in RD	
Number of rows	1		0	-	
WTGs per row)*	4		1000	8.7	
Number of WTGs	4		Hub height	RD (m)	
Size of WTG	5	MW	110	115	
Price information in this case are very rough estimates					
Price for WTGs, installed (k€)	**17,000**	**850**	**€/kW**		

Figure 1 No experience with 5 MW WTGs so far, so the 2-3 MW experience is just up scaled.

Foundation, specification and cost estimate: **20 MW**

Type of foundation	Monopile						
Number of foundations:	4						
Water debt (m)	20	RD	HH				
WTG-size (MW, rotor diameter, hub height)	5	115	110	Debt#1	Debt#2	Debt#3	Debt#4
Ice risk (yes/no)	No						
100 year max wind gust (m/s)	?						
100 year max wawe 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	10,000	2500	500				

Figure 2 Foundation costs are very roughly estimates while no detailed data on water, weather and sea bottom conditions are available so far. Due to the low number of WTGs rater high p.u. price is assumed.

Grid connection:

		Number or length (m)	Voltage(kV)	mm^2	Material	Lines/cable	Prices k€ For all	Per unit or per meter, €	€/kW
Off shore									
	Sea cable, from wind farm to shore	1500	38	300	CU	Cable	150	100	8
	In row cables	0	38	300	CU	Cable	-	100	-
	Rows to collect point cables	3000	38	300	CU	Cable	300	100	15
	Cable roll out/Wash down, variable	4500					225	50	11
	Cable roll out/wash down, fixed cost						200	200,000	10
	Total number of WTG connectors	4					100	25,000	5
	Off shore HV station	0					-		-
	Connection (electrical work)								
	Other fixed costs						300	300,000	15
	Other variable costs								
On shore									
	From shore to HV-grid	11500	38				1,035	90	52
	HV station (if needed)								
	Connection (electrical work)								
	Compensation (reactive power)								
	Other fixed costs						250	250,000	13
	Other variable costs								
Total							2,560		128

Figure 3 In this calculation a 38 kV cable to nearest assumed 150 kV grid is included. Needs detailed analyses.

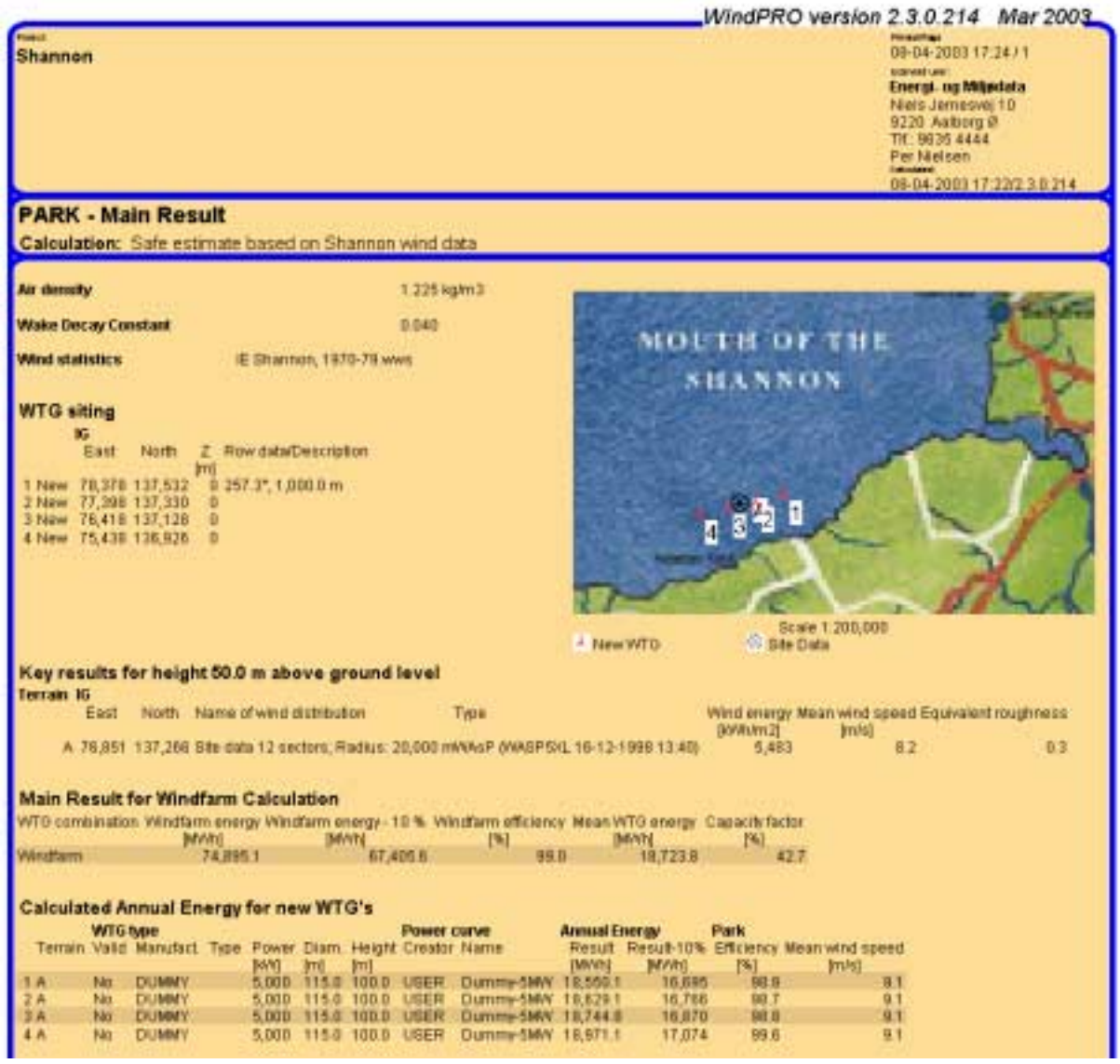
Total budget for 20 MW wind farm

	k€	***€ per kW***	***Percent***
WTGs	17,000	850	48%
Foundation	10,000	500	28%
Grid connection	2,560	128	7%
Planning and permissioning	1,056	53	3%
Organisation, management	1,056	53	3%
Miscellaneous (e.g. risk)	3,519	176	10%
TOTAL	35,190	1,760	100%

Note: Cost estimates are based on rough scaling of mainly experience from Danish offshore projects. The risk is estimated higher due to the non-approved WTG size.

Expected energy production, and PPA

The energy calculation based on wind data from nearest EU-Windatlas data at Shannon – this should be a quite safe estimate while the Shannon data is measured around 60 km more towards east and the wind climate has shown to increase towards west. There are WTGs at Beal Hill close to the site – these could give very precise indications on the local energy level. The WAsP calculation model is used from the WindPRO software tool, where the whole project is modeled. The onshore surface roughness towards east has been taken into consideration in the calculation that shows 75 GWh/year. From this uncertainty, grid losses and availability losses shall be withdrawn – but this is probably fully included in the conservative wind data.



WindPRO version 2.3.0.214 Mar 2003

Shannon

08-04-2003 17:24 / 1

Energi- og Miljødata
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08-04-2003 17:22/2.3.0.214

PARK - Main Result

Calculation: Safe estimate based on Shannon wind data

Air density	1.225 kg/m3
Wake Decay Constant	0.040
Wind statistics	IE Shannon, 1970-79 wws

WTG siting

	IG East	North	Z [m]	Row data/Description
1 New	78,378	137,532	0	257.3°, 1,000.0 m
2 New	77,398	137,330	0	
3 New	76,418	137,128	0	
4 New	75,438	136,926	0	

Scale 1:200,000

Key results for height 50.0 m above ground level

Terrain	IG East	North	Name of wind distribution	Type	Wind energy [kWh/m2]	Mean wind speed [m/s]	Equivalent roughness
A	78,851	137,266	Site data 12 sectors; Radius: 20,000 m	WAsP5XL 16-12-1998 13:40	5,483	8.2	0.3

Main Result for Windfarm Calculation

WTG combination	Windfarm energy [MWh]	Windfarm energy - 10 % [MWh]	Windfarm efficiency [%]	Mean WTG energy [MWh]	Capacity factor [%]
Windfarm	74,895.1	67,406.6	99.0	18,723.8	42.7

Calculated Annual Energy for new WTG's

	WTG type Terrain	Valid	Manufact	Type	Power [kW]	Diam [m]	Height [m]	Power curve Creator	Name	Annual Energy Result [MWh]	Result-10% [MWh]	Park Efficiency [%]	Mean wind speed [m/s]
1	A	No	DUMMY		5,000	115.0	100.0	USER	Dummy-5MW	18,550.1	16,695	98.9	9.1
2	A	No	DUMMY		5,000	115.0	100.0	USER	Dummy-5MW	18,629.1	16,766	98.7	9.1
3	A	No	DUMMY		5,000	115.0	100.0	USER	Dummy-5MW	18,744.8	16,870	98.8	9.1
4	A	No	DUMMY		5,000	115.0	100.0	USER	Dummy-5MW	18,971.1	17,074	99.6	9.1

Figure 4 The energy calculation printout from WindPRO software.

PPA:

8.4 €c/kWh first 15 years reserved for 50 MW offshore in AER VI – this is inflated with consumer price index. Bid with lowest price will get accept first.

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	35	€/kW/y
Adm. and management	3	€/kW/y	5	€/kW/y
SUM/year	18	€/kW/y	50	€/kW/y
	Per WTG:		1.3	€c/kWh/y
Decommissioning	50	k€/WTG	0.5	€/kW/y

Figure 5 Operation cost used in calculation. The resulting 1.3 €c/kWh is around 30% higher than utilities expectations for the calculated DK projects. The reason is the small number of WTGs and the unproven WTG type. 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.

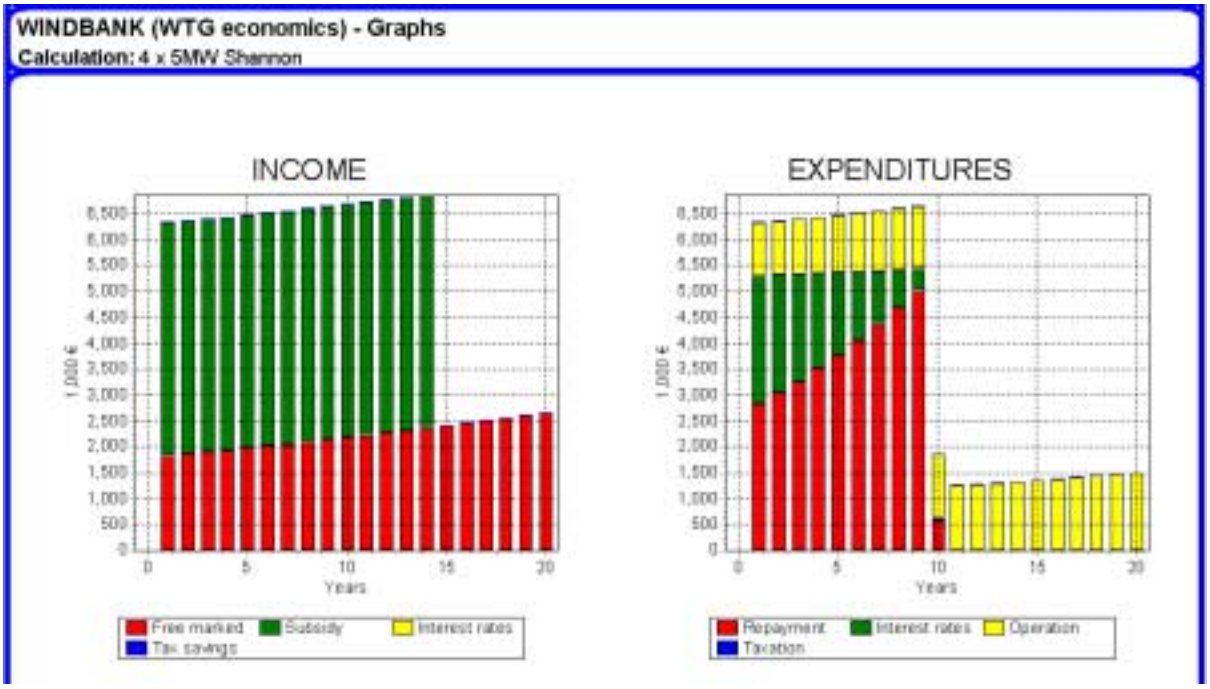

Figure 6 With the above estimated price development a payback time of 9.1 years will be expected. Tax calculations is not included, but these will typically have a positive influence on the pay back time due to tax credits from loans. Note only a part of the subsidy price is inflated with 2% inflation (safe price dev.)

RATIOS

		/kW	/m2	/MWh
Preliminary expenses	€	1,760	-	470
O/M costs	average €/years	51	-	14
Energy production	kWh/Years	3,745	-	-

Minimum life span for redemption of loan	9.1 Years
Simple pay back time	7.1 Years
Net present value for share	301 €
Net present value in % of investment	64.1 %
Production price at calculation interest 6.0%	0.06 €/kWh

Figure 7 One share is here 1000 kWh/year, an investment of 470€.