

## **SEAWIND – project description:**

### **Aigues Mortes, 72 MW (24 x 3 MW) parallel row-layout**



*Photomontage showing the WTGs seen from coastline based on standard 45 mm focal length camera. Photo point is shown on map with green lines giving the photo angle.*



### **Project description**

The proposed project is around 4 km offshore in the Montpellier region in southeastern France. The project consists of a matrix 8 x 3 WTGs, in total 24 WTGs. With 3 MW WTGs, 72 MW will be installed. Each WTG is here assumed with a hub height of 90 m and a rotor diameter of 98 m. Calculations show that around 268 GWh could be produced annual, but with very uncertain wind data. The proposed layout has 882 m spacing (9 rotor diameters) between rows, 686 m in row (7 RD). The foundation type is assumed to be monopile at a water dept from 10-20 m.

## Facts on layout proposal and estimated investment costs

WTG size layout specification and price

Total installed power	<b>72 MW</b>	Distanse in RD	
Number of rows	3	882	9.8
WTGs per row )*	8	686	7.6
Number of WTGs	24	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€)	<b>61,200</b>	<b>850</b>	<b>€/kW</b>

Foundation, specification and cost estimate:

		72 MW				
Type of foundation	Monopile					
Number of foundations:	24					
Water debt (m)	20 RD	HH				
WTG-size (MW, rotor diameter, hub height)	3	100	95	Debt#1	Debt#2	Debt#3
Ice risk (yes/no)	No					
100 year max wind gust (m/s)	?					
100 year max wave height (m)	?					
Tidal difference (m)	?					
		Debt#4	Debt#5			
Fixed price, design cost,						
Fixed price, building/shipping facilities						
Fixed ground prepare cost						
Variable ground prepare cost						
Variable, building cost						
Installation cost						
SUM	24,000	1000.005	333.3			

**Figure 1 Foundation costs are very roughly estimates while no detailed data on water, weather and sea bottom conditions are available so far.**

Grid connection:

		Number or length (m)	Voltage(kV)	mm <sup>2</sup>	Material	Lines/cable	Prices k€ For all	Per unit or per meter, €	€/kW
Off shore	Sea cable, from wind farm to shore	8000	30	630	CU	Cable	4,000	500	56
	In row cables	4802	30	300	CU	Cable	480	100	7
	Rows to collect point cables	1764	30	300	CU	Cable	176	100	2
	Cable roll out/Wash down, variable	10566					528	50	7
	Cable roll out/wash down, fixed cost						500	500,000	7
	Total number of WTG connectors	24					600	25,000	8
	Off shore HV station	0	150/30 kV				-	15,000,000	-
	Connection (electrical work)								
	Other fixed costs						1,000	1,000,000	14
	Other variable costs								
On shore	From shore to HV-grid								
	HV station (if needed)								
	Connection (electrical work)								
	Compensation (reactive power)								
	Other fixed costs						500	500,000	7
Other variable costs									
Total							7,785		108

**Figure 2 No detailed specifications available, but 2 x 30 kV lines in parallel is assumed sufficient for connection for nearest 30 kV line.**

Total budget for 72 MW wind farm

	k€	€ per kW	Percent
WTGs	61,200	850	61%
Foundation	24,000	333	24%
Grid connection	7,785	108	8%
Planning and permissioning	3,009	42	3%
Organisation, management	2,006	28	2%
Miscellaneous (e.g. risk, reserve)	2,300	32	2%
<b>TOTAL</b>	<b>100,300</b>	<b>1,393</b>	<b>100%</b>

Note: Cost estimates are based on rough scaling of mainly experience from Danish offshore projects.

## Expected energy production, and PPA

The energy calculation based on wind data from EU-Windatlas data at Perpignan get a calculated mean wind speed level at 9.2 m/s in 50 m h.a.s.l. This is probably some optimistic. The WASP calculation model is used from the WindPRO software tool, where the whole project is modeled. The onshore surface roughness has been taken into consideration in the calculation that shows 252 GWh/year. From this uncertainty, grid losses and availability losses shall be withdrawn – especially due to the lack of local wind data, 20% at present stage is withdrawn, which makes 202 GWh.

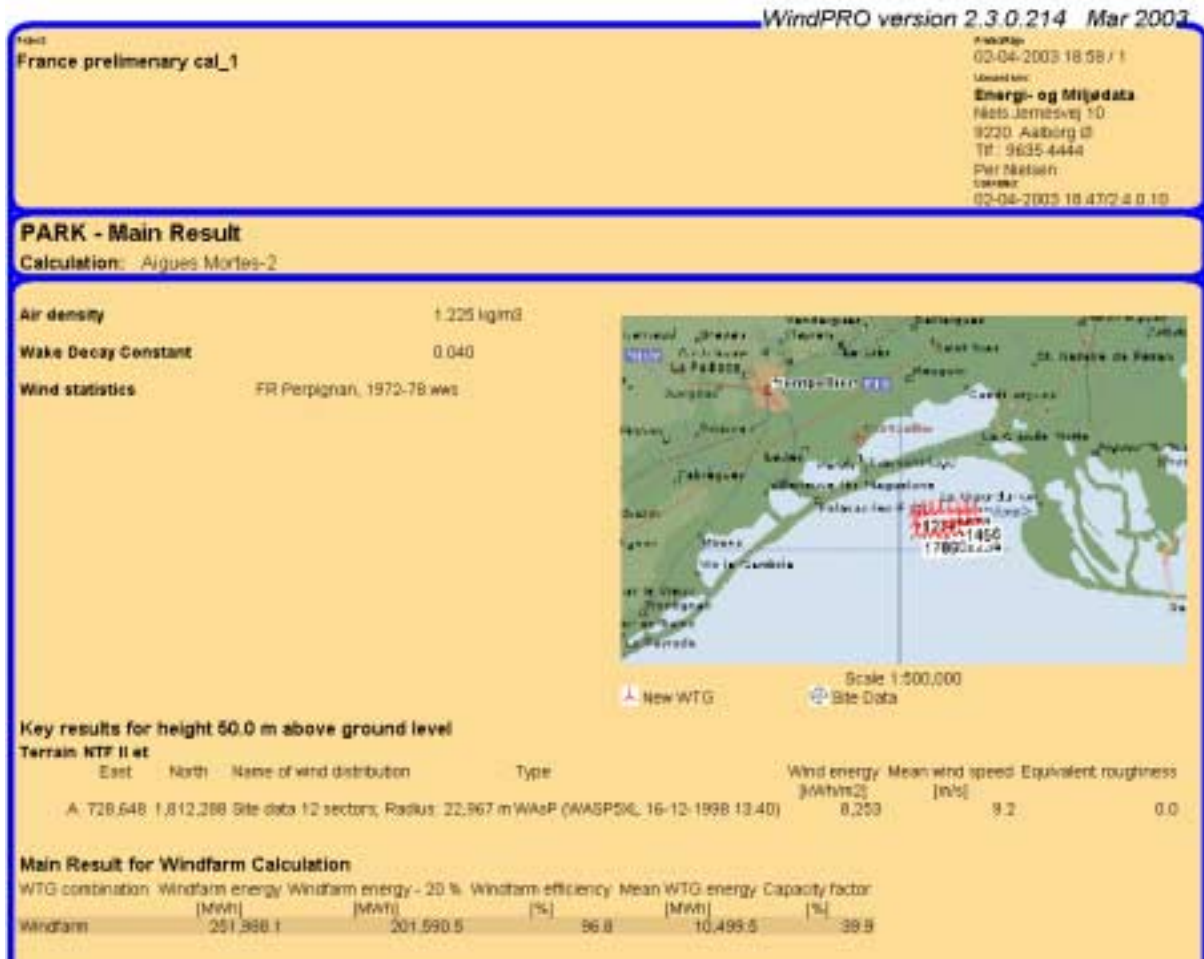


Figure 3 The energy calculation printout from WindPRO software.

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.

## Power purchase agreement

For offshore wind farms no regulations is known so far, so the estimates from Spain is used. Here analyses indicates that a level of 6.3 €/kWh should be a realistic level. This value is used in the economic calculation with an inflation of 2% per year. But this is an uncertain factor that shall be evaluated further.

## 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:		1.2 €/kWh/y
Decommissioning	50 k€/WTG	0.8 €/kW/y

Figure 4 Operation cost used in calculation. The resulting 1.2 €/kWh is a little more than 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.

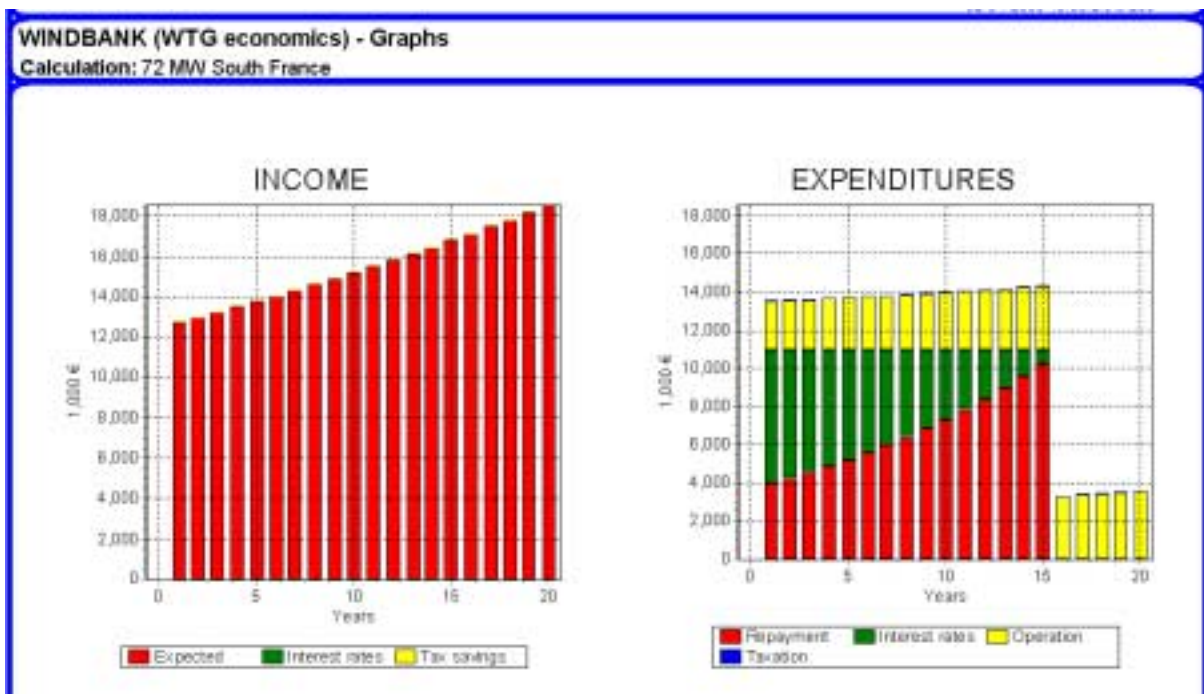


Figure 5 With the above estimated price development a payback time of 14.1 years will be expected. Tax calculations are not included. The feasibility is not looking to promising, more investigations that indicate reduced costs, better energy production or higher PPA will be needed.

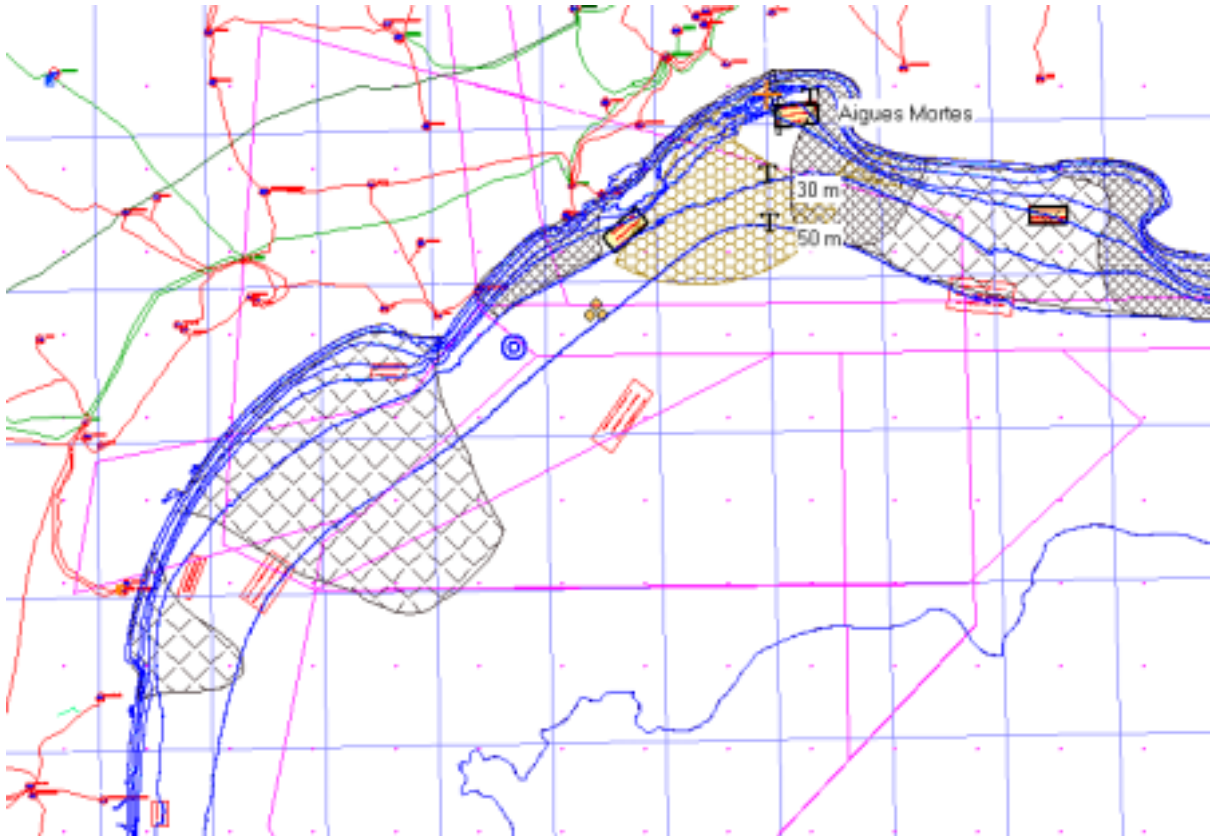
## RATIOS

	€/kW	/m <sup>2</sup>	/MWh
Preliminary expenses	1,393	-	498
O/M costs average €/years	34	-	12
Energy production kWh/Years	2,800	-	-

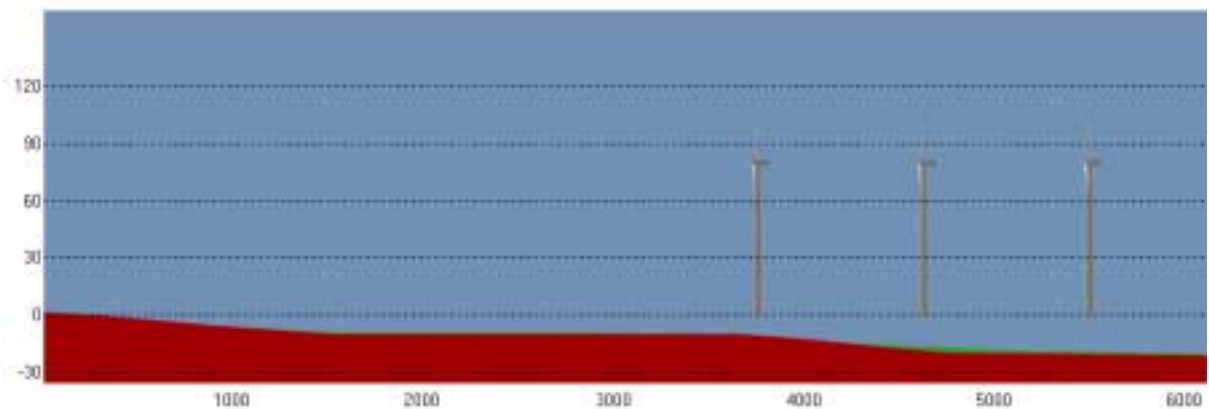
Minimum life span for redemption of loan	14.1 Years
Simple pay back time	10.0 Years
Net present value for share	2,241 €
Net present value in % of investment	56.3 %
Production price at calculation interest 6.0%	0.06 €/kWh

Figure 6 One share is here 1000 kWh/year, an investment of 498€

**Infrastructure, environmental aspects etc. needs investigations.**



**Figure 7** A map with different restriction zones and the proposed sites for offshore wind farms (red boxes). Due to the fast increasing water dept, probably only a few of the sites will be realistic with present technology. The red lines show 30 kV grid and green the 150 kV grid lines. Blue lines are water dept.



**Figure 8** The seabed profile from shore including the 3 rows of WTGs

The Environmental Impact Assessment will be a major part of the needed project documentation.

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](mailto:hansb@post8.tele.dk) or [euroscan@post.tele.dk](mailto:euroscan@post.tele.dk) or [pn@emd.dk](mailto:pn@emd.dk).