716033
17 maart 2017

PRODUCTIEBEREKENING WINDPARK OOSTPOLDER

Provincie Groningen

Definitief

Duurzame oplossingen in
energie, klimaat en milieu

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- Pondera adviseert altijd om de windmetingen ter plekke uit te voeren, om zo de grootste zorgvuldigheid en kleinste onduidelijkheid in de berekeningen te garanderen. Wanneer dergelijke gegevens niet beschikbaar zijn, baseert Pondera haar gebruikte gegevens van het lokale windklimaat op de best beschikbare windsnelheidsgegevens en/of een schatting daarvan. De beschikbaarheid en kwaliteit van deze gegevens heeft directe consequenties voor de kwaliteit en onzekerheden van het onderzoek. Pondera is niet verantwoordelijk voor verlies of schade dat wordt geleden door opdrachtgever en/of derden, geleden uit conclusies die gebaseerd zijn op gegevens die niet van Pondera afkomstig zijn of die niet door Pondera zijn gebruikt ter voorbereiding van het onderzoek.

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INHOUDSOPGAVE

1 INLEIDING

In opdracht van de Vereniging Windpark Oostpolder is een productieberekening uitgevoerd voor een op te richten windpark in deelgebied Oostpolder in de provincie Groningen. Het windpark wordt aangeduid met de naam “Windpark Oostpolder”.

In het kader van de m.e.r. en de ruimtelijke procedure is gevraagd het windaanbod te bepalen en modelberekeningen te maken voor de jaarlijkse productie en verliezen van Windpark Oostpolder. De berekeningen worden uitgevoerd voor drie alternatieven (1b, 2b, 3b) die toegelicht zijn in Tabel 1.1.

Tabel 1.1 Drie alternatieven voor Windpark Oostpolder

Alternatief		Referentie windturbine	Aantal windturbines	Geïnstalleerd vermogen [MW]	Ashoogte [m]	Rotordiameter [m]
1	*b*	Enercon E-141 EP4	14	58,80	165	141
2	*b*	Enercon E-126 EP4	15	63,00	135	126
3	*b*	Enercon E-103 EP2	23	54,05	120	103

Een windturbine ‘vangt’ wind om de rotor te laten draaien en hiermee elektriciteit op te wekken. De windsnelheid achter de windturbine zal afnemen waardoor er een negatief effect optreedt op de productie van nabijgelegen windturbines binnen de invloedsfeer van de voorste windturbine. Dit negatief effect op de windsnelheid achter een windturbine wordt ook wel het “wake-effect” genoemd. In het onderzoek naar productierendement worden de productieverliezen die optreden door wake-effecten en andere factoren (elektrische verliezen, stilstand door reparaties, enz.) meegenomen in de jaarlijkse elektriciteitsproductie.

De energieopbrengst van windturbines is een positief effect van een windpark. Dit effect wordt echter beïnvloed door toepassing van mitigerende maatregelen voor andere thema’s zoals slagschaduw en geluid die de energieproductie negatief beïnvloeden. De mate van beïnvloeding dient meegenomen te worden in de analyse om de energieopbrengsten goed te beoordelen. De toepassing van mitigerende maatregelen zijn meegenomen in dit rapport en er is rekening gehouden met verliezen door middel van windturbine aanpassingen zoals het stil zetten van windturbines of bronsterkte verminderingen door het toerental te verlagen en/of de bladhoek te verdraaien.

Voor de productieberekeningen is gebruik gemaakt van de rekenmodellen *WindPRO*® versie 3.1.579 en *WAsP*® versie 11.2. In *WindPRO*® is een model van de locatie opgesteld, bestaande uit een topografische kaart van de locatie en de omgeving, obstakels in de omgeving, de windturbinelocaties, de hoogtelijnen en de ruwheidskartering. *WAsP*® wordt gebruikt als berekeningspakket om het windveld (verdeling en turbulentie) om te rekenen naar de locatie op ashoogte.

1.1 Beschrijving locatie

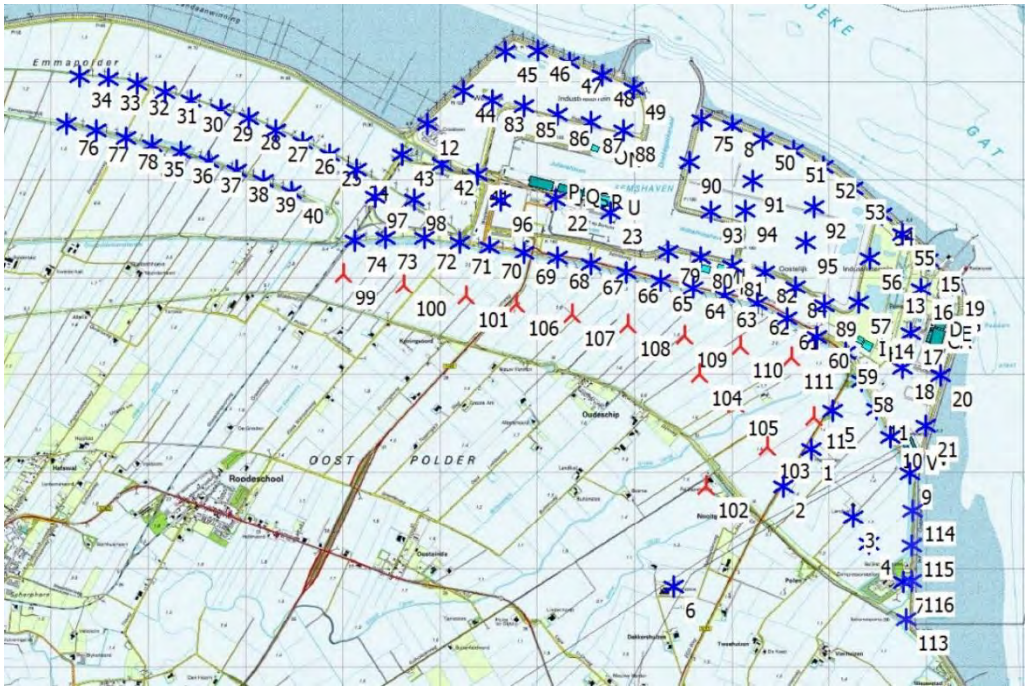
Windpark Oostpolder zal worden gerealiseerd ten zuiden van het geluidsgezoneerde industrieterrein Eemshaven in de provincie Groningen, zie Figuur 1.1. Dichtbij gelegen dorpen zijn Oudeschild (circa 650 m tot dichtstbijzijnde windturbine), Koningsoord (500 m), Nooitgedacht (500 m), en op grotere afstand Roodeschool (circa 2,5 km) en Oosteinde (2,8 km). De nabije omgeving van de locatie bestaat voornamelijk uit industriële activiteiten in het noorden en oosten, terwijl het zuiden en westen bestaat uit polderlandschap met landbouwgebied met veelal verspreide woningen.

Figuur 1.1 Locatie Windpark Oostpolder

1.2 Bestaande windturbines in het gebied

Er zijn 93 windturbines aanwezig rondom de locatie Windpark Oostpolder. Verder worden 9 windturbines geplaatst als onderdeel van autonome ontwikkelingen in het gebied. In totaal zijn er 102 windturbines in de productieberekeningen meegenomen. De ligging van de windturbines is aangegeven in Figuur 1.2. Detailinformatie over deze windturbines (windturbinetype, RD-coördinaten, ashoogte, rotordiameter) is te vinden in bijlage 1 in de WindPro rapporten. Conform de uitgangspunten van het MER zijn de windparken Eemshaven Zuidoost en Oostpolderdijk meegenomen zijnde de autonome situatie.

Figuur 1.2 De bestaande en toekomstige windturbines (blauwe symbolen) rondom de locatie Windpark Oostpolder die meegenomen zijn in de productieberekeningen



1.3 Windparkopstelling

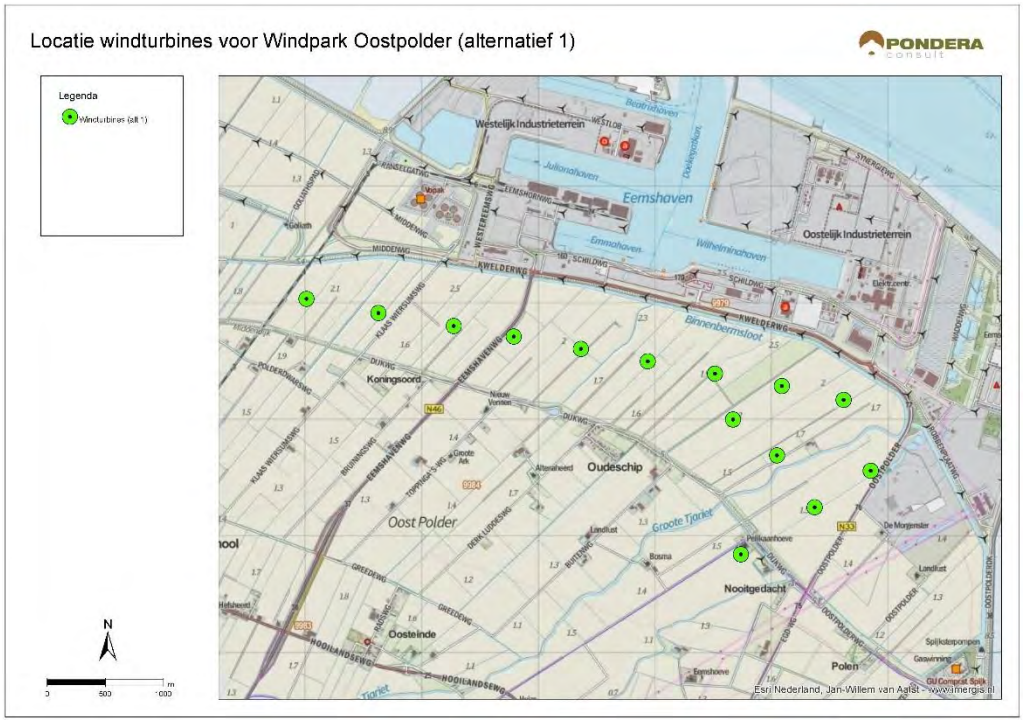
De drie alternatieven van Windpark Oostpolder hebben verschillende opstellingen en windturbine aantallen. In Tabel 1.2 zijn de RD coördinaten van de windturbine opstellingen aangegeven en in Figuren 1.3, 1.4 en 1.5 zijn de drie alternatieven in kaart gebracht.

Tabel 1.2 Coördinaten windturbines van de drie alternatieven van Windpark Oostpolder

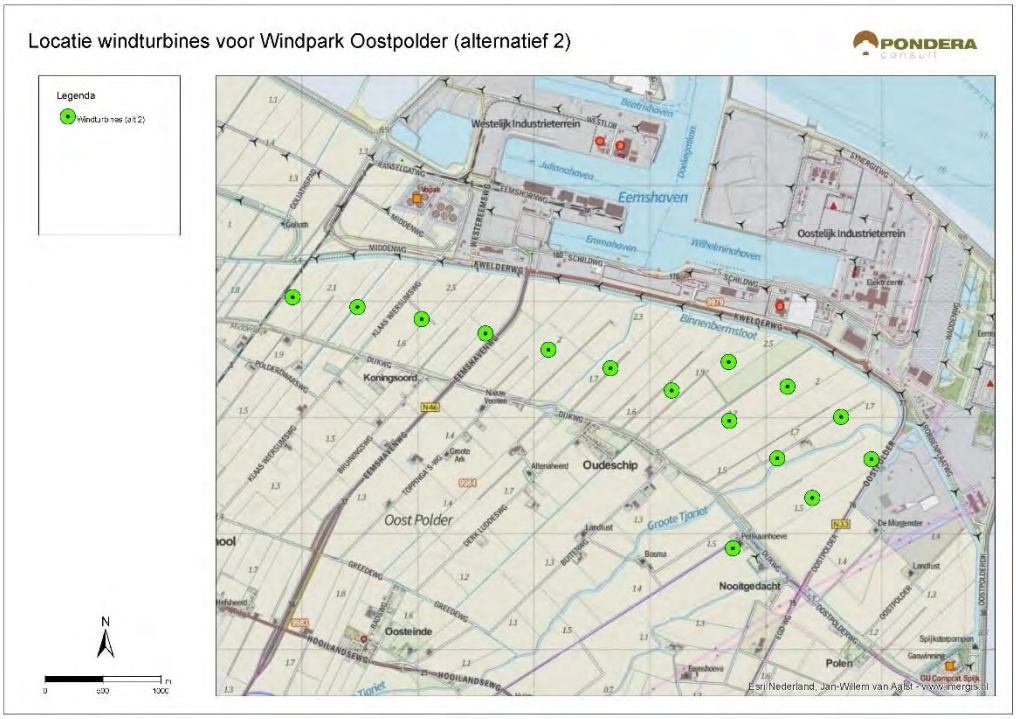
Alternatief 1b			Alternatief 2b			Alternatief 3b		
Windturbine nr.	RD coördinaten		Windturbine nr.	RD coördinaten		Windturbine nr..	RD coördinaten	
101	248012	607033	201	251679	606481	301	251506	606506
102	248630	606913	202	252186	606268	302	251889	606391
103	249275	606800	203	252650	606008	303	252274	606282
104	249790	606711	204	252910	605642	304	252657	606168
105	250365	606604	205	247921	607039	305	247940	607100
106	250941	606498	206	248478	606954	306	248327	606997
107	251516	606392	207	249033	606849	307	248713	606893
108	252091	606286	208	249583	606726	308	249099	606789
109	252621	606167	209	250125	606585	309	249486	606686
110	252854	605560	210	250662	606425	310	249872	606582
111	251671	605999	211	251188	606234	311	250258	606479
112	252049	605693	212	251684	605973	312	250645	606375

113	252372	605247	213	252097	605651	313	251031	606272
114	251738	604844	214	252401	605310	314	251418	606168
			215	251717	604875	315	251804	606064
						316	252190	605961
						317	252918	605667
						318	251710	605754
						319	252090	605637
						320	252518	605402
						321	251726	605411
						322	252113	605145
						323	251703	604895

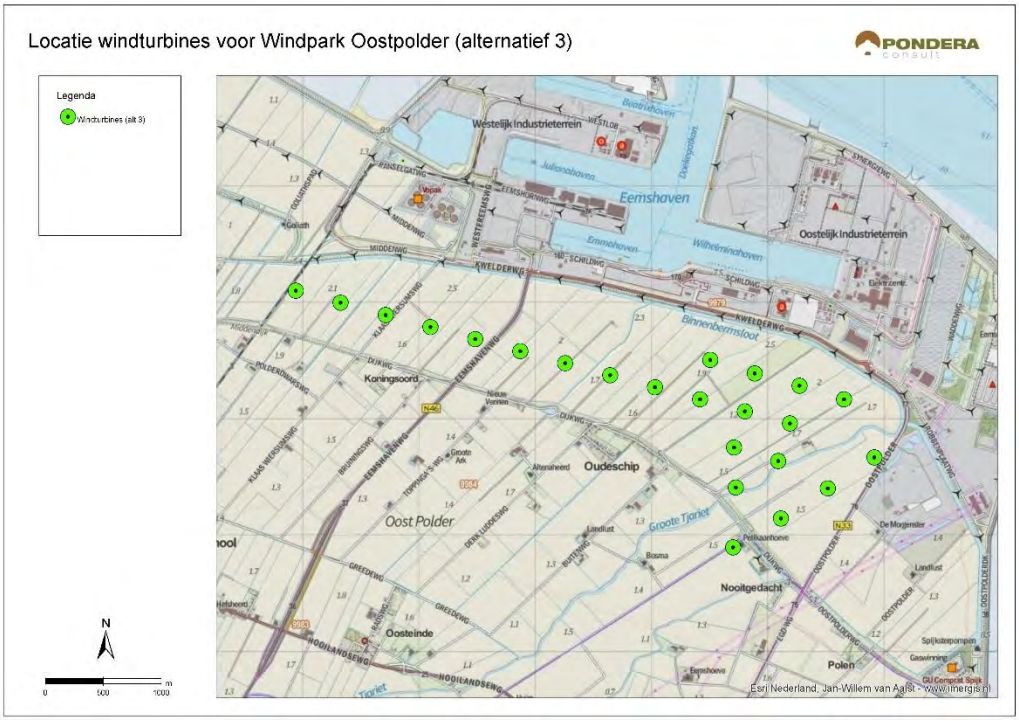
Figuur 1.3 Windpark Oostpolder opstelling voor alternatief 1b



Figuur 1.4 Windpark Oostpolder opstelling voor alternatief 2b



Figuur 1.5 Windpark Oostpolder opstelling voor alternatief 3b



1.4 Gegevens referentieturbines Windpark Oostpolder

Enercon E-141 EP4 – 4,2 MW

De Enercon E-141 EP4 heeft een rotordiameter van 141 m met drie rotorbladen. Het toerental van de rotor is continu variabel tussen circa 4 en 10,6 tpm. Het nominale generatorvermogen is 4,2 MW. De windturbine wordt hier geplaatst op een conische mast waardoor de rotoras circa 165 m boven het maaiveld komt. Het hoogste punt van de rotor wordt circa 236 m hoog.

Enercon E-126 EP4 – 4,2 MW

De Enercon E-126 EP4 heeft een rotordiameter van 127 m met drie rotorbladen. Het toerental van de rotor is continu variabel tussen circa 5 en 11,6 tpm. Het nominale generatorvermogen is 4,2 MW. De windturbine wordt hier geplaatst op een conische mast waardoor de rotoras circa 135 m boven het maaiveld komt. Het hoogste punt van de rotor wordt circa 199 m hoog.

Enercon E-103 EP2 – 2,35 MW

De Enercon E-103 EP2 heeft een rotordiameter van 103 m met drie rotorbladen. Het nominale elektrische vermogen is 2.350 kW. Het toerental van de rotor is continu variabel tussen circa 4,8 en 15,0 tpm. De windturbines worden geplaatst op conische buismasten waardoor de rotoras circa 120 m boven het maaiveld komt. Het hoogste punt van de rotor wordt circa 171,5 m hoog. De windturbine begint te draaien bij een windsnelheid van circa 3 m/s. Bij windsnelheden boven 28 m/s wordt de rotor gestopt uit veiligheidsoverwegingen. De grootste breedte van het blad is circa 3,6 m en nabij de tip op 90% radius circa 0,83 m breed.

2 METHODIEK

Er zijn drie soorten gegevens nodig voor het bepalen van energieproductie uit wind. Ten eerste zijn technische kenmerken en gegevens nodig van de windturbines zoals afmetingen en vermogensproductiecurves. Meer informatie is beschikbaar gemaakt in Bijlage 1 voor de vermogensproductie- en thrustcurves van de windturbines van alle drie alternatieven. De tweede soort informatie die nodig is, is winddata afkomstig uit metingen om een windklimaat te bepalen. De laatste soort gegevens die nodig zijn, zijn landoppervlakeigenschappen die invloed hebben op de windsnelheid en -richting.

Op de locatie zijn windmetingen beschikbaar van april 2007 tot en met januari 2009 afkomstig van een Essent Wind Nederland B.V. (nu RWE) meetmast op 100 m boven maaiveld. De dichtstbijzijnde KNMI meetstation bevindt zich in Lauwersoog op een afstand van 34 km tot Windpark Oostpolder. Het meetstation leverde windmetingen op 10 m boven maaiveld van de jaren 1991 tot en met 2016. Het KNMI meetstation werd gebruikt om het twee jarige meetmast windklimaat te corrigeren.

In *WindPRO*® is een model van de locatie opgebouwd, bestaande uit een topografische kaart van de locatie en omgeving, de nieuwe windturbine locaties per alternatief, de hoogtelijnen van de locatie en omgeving, de ruwheidskartering van de omgeving en alle obstakels en bestaande windturbines rondom de locatie.

2.1 Hoogtelijnen

Voor de hoogtelijnen van de locatie is in het model SRTM online 1-arc data (Shuttle Radar Topography Mission) geïmporteerd met een raster van 100 x 100 km.

2.2 Oppervlakteruwheid

Voor de oppervlakteruwheid van de locatie is in het model DataForWind online data (European Roughness Contour Data) geïmporteerd met een raster van 100 x 100 km.

2.4 Obstakels

Er zijn in totaal 23 obstakels meegenomen als gebouwstructuren in de Eemshaven ten noorden van Windpark Oostpolder. De obstakels variëren in hoogte van 20 tot 120 m.

2.5 Wake-effect

Productieverliezen door de wake-effecten van zowel de nieuwe windturbines (intern wake-effect) als die van de 102 bestaande en toekomstige windturbines (extern wake-effect) zijn beide meegenomen in dit rapport.

3 WINDKLIMAAT

Het lokale windklimaat is gebaseerd op windstatistieken van de nabijgelegen RWE meetmast in de Eemshaven en gegevens van meteorologische KNMI station Lauwersoog (Figuur 3.1). De afstanden van de meetmast en KNMI meetstation tot het windpark bedragen respectievelijk 2 en 34 km. De wind data van de RWE meetmast bestaat uit meetgegevens van 2 jaar gedurende de periode 25 april 2007 tot en met 31 januari 2009 van onder andere de windsnelheid en -richting op 100 m boven maaiveld. Lauwersoog KNMI station bestaat uit meetgegevens van 25 jaar gedurende de periode 1 januari 1991 tot en met 1 januari 2017.

Figuur 3.1 Locaties van de meetstations gebruikt in dit MER

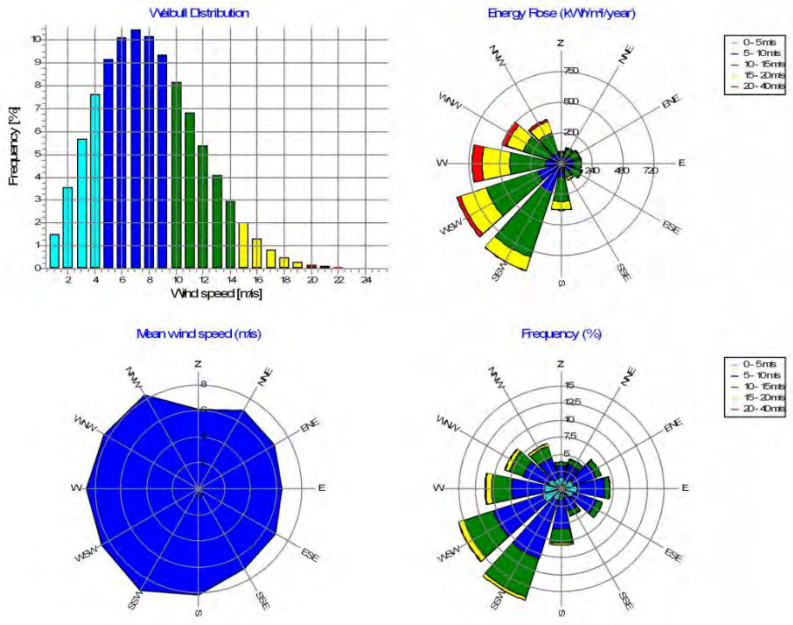
Het windklimaat van de RWE meetmast is gecorrigeerd op basis van windmeetgegevens afkomstig van KNMI meetstation Lauwersoog. De gemiddelde windsnelheid in Lauwersoog voor de twee jarige periode van 25 april 2007 tot en met 31 januari 2009 is berekend op 6,40 m/s. De 25 jarige gemiddelde is berekend op 6,34 m/s. Dit geeft aan dat de twee jarige gemiddelde 1% hoger lag dan de 25 jarige gemiddelde. Op basis hiervan is de twee jarige windklimaat van de RWE meetmast gecorrigeerd met een correctiefactor van 0,99.

Op basis van de verschillende invoerparameters is het lokale lange termijn windklimaat berekend. De gemiddelde windsnelheid op 100 meter hoogte op locatie is berekend op 8,0 m/s met Weibull verdeling parameters A=9,0 en k=2,3. De heersende windrichting op locatie is zuid-zuid-west (ZZW), waarbij de hoogste windsnelheid ook in zuid-zuid-west (ZZW) wordt verkregen. In Tabel 3.1 en Figuur 3.2 is het berekende windklimaat op een hoogte van 100 m gegeven. Verder zijn de Weibull parameters van het windklimaat voor de verschillende ashoogtes van de drie alternatieven in Tabel 3.2 weergegeven.

Tabel 3.1 Berekend windklimaat Windpark Oostpolder op 100 m; cijfermatig

Windsector		v [m/s]	A [m/s]	k [-]	Frequentie [%]
0	N	6,2	6,9	1,9	4,0
1	NNO	6,9	7,9	2,3	4,5
2	ONO	6,8	7,6	2,6	6,1
3	O	6,5	7,3	2,6	7,1
4	OZO	6,9	7,8	2,5	6,3
5	ZZO	7,1	7,9	2,2	4,2
6	Z	8,1	9,2	2,5	8,2
7	ZZW	9,0	10,1	3,1	17,0
8	WZW	8,6	9,7	2,4	15,8
9	W	8,7	9,8	2,1	11,2
10	WNW	8,4	9,5	2,1	8,7
11	NNW	8,4	9,4	2,2	6,9
Totaal		**8,0**	**9,0**	**2,3**	**100,0**

Figuur 3.2 Berekend windklimaat Windpark Oostpolder op 100 m; grafisch



Tabel 3.2 Weibull parameters van het windklimaat op ashoogtes van de drie alternatieven van Windpark Oostpolder

Alternatief	Ashoogte [m]	v [m/s]	A [m/s]	k [-]
1b	165	9,2	10,4	2,3
2b	135	8,7	9,8	2,3
3b	120	8,4	9,5	2,3

4 PRODUCTIE

In het onderzoek is bepaald welke opbrengsten en verliezen worden verwacht. Hiervoor zijn modelberekeningen uitgevoerd met *WindPRO*® versie 3.1.579 en *WAsP*® 11.2.

De bruto energieproductie (P50) wordt bepaald aan de hand van de windsnelheidsverdeling per windrichting gekarakteriseerd door de Weibullverdeling en de Weibullverdeling parameters: de schaalfactor (A) en de vormfactor (k). Op basis hiervan is met de gecertificeerde vermogenscurve van de windturbine de bruto energieproductie van het Windpark Oostpolder bepaald. De opbrengst van de windturbines wordt, behalve door het windaanbod/ klimaat op locatie en de vermogenscurve van het windturbinetype, ook door de onderlinge afstanden tussen de overige windturbines bepaald. Doordat de (overige) windturbines turbulentie in de lucht veroorzaken ontstaan wake-effecten en een afname van de windsnelheid achter de windturbines.

4.1 Verliezen

De netto energieproductie (P50) wordt bepaald door rekening te houden met mogelijke parkverliezen in de bruto productie. Verliezen worden onder andere veroorzaakt door niet-beschikbaarheid, prestatie gerelateerde zaken, elektriciteitsverliezen, omgevingseffecten en door inkorten/vermindering van het vermogen van een windturbine of de tijd dat een windturbine draait.

In het onderzoek naar akoestiek en slagschaduw voor Windpark Oostpolder zijn de voorzieningen voor geluid bepaald voor alle drie alternatieven. Er is gekozen om in specifieke perioden de instellingen van specifieke windturbines te wijzigen om aan de normstelling te voldoen. De geluidsbronsterkten worden gereduceerd waardoor ook de productievermogen gereduceerd wordt. Voor alternatieven 1b en 3b zijn geluidsmitigatiewijzigingen doorgevoerd. Voor alternatief 2b was dit niet nodig. De wijzigingen voor 1b en 3b zijn respectievelijk aangegeven in Tabellen 4.1 en 4.2. In deze tabellen worden de instellingen voor geluidvoorzieningen gepresenteerd waarmee op alle toetspunten (naast de referentie toetspunten eveneens voor alle andere 202 toetspunten) wordt voldaan aan de norm L_{den}=47 dB en L_{night}=41 dB.

In het onderzoek naar akoestiek en slagschaduw voor Windpark Oostpolder zijn slagschaduw berekeningen uitgevoerd door het bepalen van de zonneschijnduur en windrichtingen uit meetgegevens van KNMI meetstations. De hinderduur aan slagschaduw voor alle gevoelige objecten binnen twaalf maal de rotor diameter is bepaald voor de drie alternatieven van Windpark Oostpolder. De slagschaduw hinderduur wordt gereduceerd naar 0 uren bij gevoelige objecten die een hinderduur hebben van meer dan 6 uren. Het aantal woningen waarvoor is gemitigeerd voor slagschaduw (d.m.v. stilstand) bedraagt 89, 77 en 69 woningen voor respectievelijk de alternatieven 1b, 2b en 3b.

Voor slagschaduw is het worst-case scenario aangenomen. In werkelijkheid kan de totale stilstandsduur met een zonneschijnsensor beperkt worden door de windturbine alleen te stoppen op geprogrammeerde tijden indien ook tegelijkertijd de zon schijnt. Een zonneschijnsensor wordt gesimuleerd in *WindPRO*® door de berekende productieverlies door

stilstand te reduceren naar 30%, wat uit praktijkervaring leidt tot realistischer verliezen door stilstand.

Tabel 4.1 Geluidsbronsterktewijzigingen per windturbine in alternatief 1b

Turbine nr.	Type	dag	avond	nacht
		07:00 – 19:00 uur	19:00 – 23:00 uur	23:00 – 07:00 uur
101	E-141 EP4	--	--	--
102	E-141 EP4	--	--	--
103	E-141 EP4	--	--	--
104	E-141 EP4	--	--	--
105	E-141 EP4	--	--	--
106	E-141 EP4	--	--	--
107	E-141 EP4	--	--	--
108	E-141 EP4	--	--	--
109	E-141 EP4	--	--	1 MW
110	E-141 EP4	--	--	1 MW
111	E-141 EP4	--	--	--
112	E-141 EP4	--	--	--
113	E-141 EP4	--	--	--
114	E-141 EP4	--	--	--

Tabel 4.2 Geluidsbronsterktewijzigingen per windturbine in alternatief 3b

Turbine nr.	Type	dag	avond	nacht
		07:00 – 19:00 uur	19:00 – 23:00 uur	23:00 – 07:00 uur
301	E-103 EP2	--	--	Is
302	E-103 EP2	--	--	Is
303	E-103 EP2	Is	IIs	IIs
304	E-103 EP2	Is	IIs	IIs
305	E-103 EP2	Is	IIs	IIs
306	E-103 EP2	Is	Is	Is
307	E-103 EP2	IIs	IIs	IIs
308	E-103 EP2	IIs	IIs	IIs
309	E-103 EP2	IIs	IIs	IIs
310	E-103 EP2	IIs	IIs	0.4MW
311	E-103 EP2	IIs	IIs	0.4MW
312	E-103 EP2	IIs	IIs	IIs
313	E-103 EP2	IIs	IIs	IIs
314	E-103 EP2	IIs	IIs	IIs
315	E-103 EP2	--	--	--
316	E-103 EP2	--	--	--
317	E-103 EP2	IIs	IIs	0.4MW
318	E-103 EP2	IIs	IIs	IIs
319	E-103 EP2	IIs	IIs	0.4MW
320	E-103 EP2	IIs	IIs	IIs
321	E-103 EP2	IIs	IIs	IIs
322	E-103 EP2	--	--	--
323	E-103 EP2	--	--	--

4.2 Resultaat

In de berekeningen voor de netto productie (P50) van de drie alternatieven van Windpark Oostpolder is voor de verliezen rekening gehouden met de voorgenoemde situatie in paragraaf 4.1 en onderstaande uitgangspunten en waarden in Tabellen 4.3 en 4.4. In bijlage 1 zijn de volledige berekeningsresultaten gegeven. In bijlage 2 zijn de berekende verliezen gegeven.

Tabel 4.3 Overzicht berekende energieproductie Windpark Oostpolder

Algemene uitgangspunten			
Windturbinetype	Alternatief 1b Enercon E-141 EP4-4.200		
	Alternatief 2b Enercon E-126 EP4 TES-4.200		
	Alternatief 3b Enercon E-103 EP2-2.350		
Wake vervalconstante	Berekend met N.O. Jensen model en een vervalconstante 0,062 (open landbouw gebied)		
Gebruikte winddata	Voor windrichting en verdeling: RWE Essent Wind B.V. meetmast in de Eemshaven (april 2007 – januari 2009) gecorrigeerd met KNMI data van meetstation Lauwersoog (1991-2016)		
Opmerkingen	P50 opbrengstberekening ter vergelijking van 3 verschillende alternatieven. Berekend met verliezen door verschillende factoren, zoals wake-effect van bestaande windturbines in het gebied en effecten van slagschaduw en geluidhinder.		
Specifieke uitgangspunten			
Alternatief	**1b**	**2b**	**3b**
Windturbinetype	Enercon E-141 EP4-	Enercon E-126 EP4	Enercon E-103 EP2-
Rotordiameter [m]	141	126	103
Ashoogte [m]	165	135	120
Aantal windturbines	14	15	23
Geïnstalleerde vermogen	58,8	63,0	54,05
Uitkomsten			
Windsnelheid op ashoogte	9,2	8,7	8,4
Bruto productie [GWh/jr]	302,4	281,3	247,1
Verliezen totaal [GWh/jr]	52,2	47,4	66,9
Netto energieproductie	250,2	233,9	180,2
Vollasturen (P50) [uur/jr]	4.256	3.712	3.334

Tabel 4.4 Detailoverzicht van de verliezen voor de drie alternatieven voor Windpark Oostpolder

Verliezen		**Enercon E-141 EP4-4.200**	**Enercon E-126 EP4 TES-4.200**	**Enercon E-103 EP2-2.350**
Wake-effecten				
- Wake-effecten door Windpark Oostpolder	Berekening	- 4,9 %	-5,1%	- 8,2 %
- Wake-effecten door bestaande en toekomstige windparken	Berekening	- 4,2 %	- 5,9 %	- 5,9 %
Niet-beschikbaarheid				
- Windturbine	Inschatting	- 3,0 %	- 3,0 %	- 3,0 %
- Balance of plant	Inschatting	0 %	0 %	0 %
- Grid	Inschatting	0 %	0 %	0 %
- Overig	Inschatting	0 %	0 %	0 %
Elektrisch				
- Netverliezen	Inschatting	- 2,0 %	- 2,0 %	- 2,0 %
- Eigen gebruik windturbine	Inschatting	0 %	0 %	0 %
Omgeving				
- Bladdegradatie	Aanname	- 0,5 %	- 0,5 %	- 0,5 %
- Icing maatregelen	Aanname	- 0,5 %	- 0,5 %	- 0,5 %
- Site toegang beperkingen	Aanname	0 %	0 %	0 %
- Extreme weersomstandigheden	Aanname	0 %	0 %	0 %
- Bosaangroei	Aanname	0 %	0 %	0 %
- Overig				
Prestaties				
- High wind hysteresis	Inschatting	- 0,5 %	- 0,5 %	- 0,5 %
- Power curve-aanpassingen	Inschatting	0 %	0 %	0 %
Inkorting				
- Geluid	Berekening	- 2,4 %	0 %	- 9,1 %
- Schaduw	Berekening	- 0,3 %	- 0,3 %	- 0,2 %
- Vogels / Vleermuizen	Berekening	0 %	0 %	0 %
- Externe veiligheid	Berekening	0 %	0 %	0 %
- Overig	Berekening	0 %	0 %	0 %
Overig	Berekening	0 %	0 %	0 %
Verliezen totaal		- 17,3 % / 52,2 GWh/jr	- 16,9 % / 47,4 GWh/jr	- 27,1 % / 66,9 GWh/jr
Netto energieproductie (P50) [GWh/jr]		**250,2**	**233,9**	**180,2**
Vollasturen (P50) [uur/jr]		**4.256**	**3.712**	**3.334**

5 VOORKEURSALTERNATIEVEN

5.1 Inleiding

Op basis van de analyses op verschillende milieuaspecten in het MER, zijn twee voorkeursalternatieven (VKA) gekozen.

Het eerste voorkeursalternatief (VKA1) bestaat uit 15 windturbines met een maximale ashoogte van 165 meter en een maximale rotordiameter van 145 meter. Het tweede voorkeursalternatief (VKA2) bestaat uit 20 windturbines met een maximale ashoogte van 165 meter en een maximale rotordiameter van 145 meter. In VKA2 worden enkele bestaande windturbines van Innogy verwijderd en worden nieuwe turbines nabij deze locaties geplaatst. De kenmerken van de voorkeursalternatieven zijn toegelicht in Tabel 5.1.

Tabel 5.1 Voorkeursalternatieven (VKA1 en VKA2)

Alternatief	Referentie windturbine	Aantal windturbines	Geïnstalleerd vermogen [MW]	Ashoogte [m]	Rotordiameter [m]
VKA1	Enercon E-141 EP4	15	63,00	165	141
VKA2	Enercon E-141 EP4	20	84,00	165	141

5.2 Windparkopstellingen

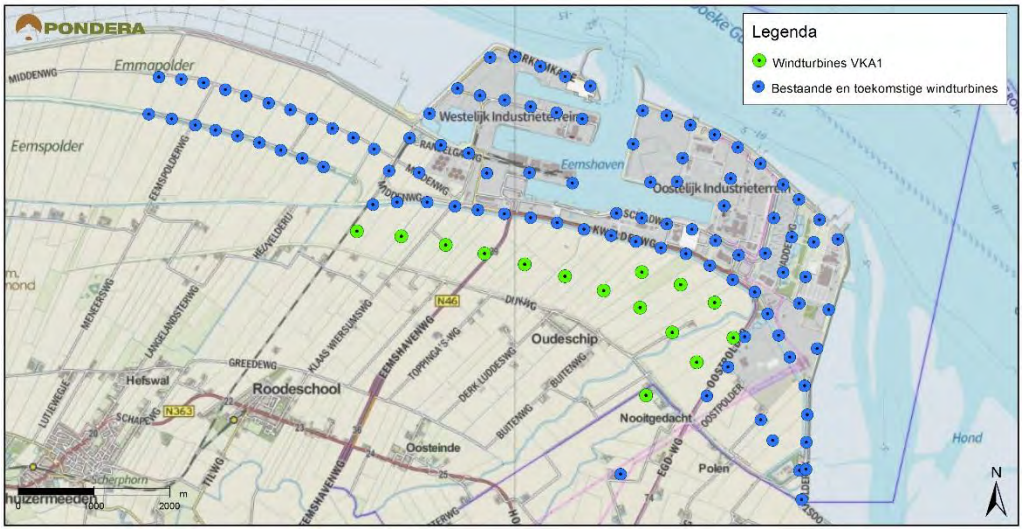
In Tabel 5.2 zijn de RD-coördinaten van de windturbineopstellingen van VKA1 en VKA2 aangegeven. In Figuur 5.1en Figuur 5.2 zijn respectievelijk VKA1 en VKA2 in kaart gebracht.

Tabel 5.2 RD-coördinaten van de windturbines van VKA1 en VKA2

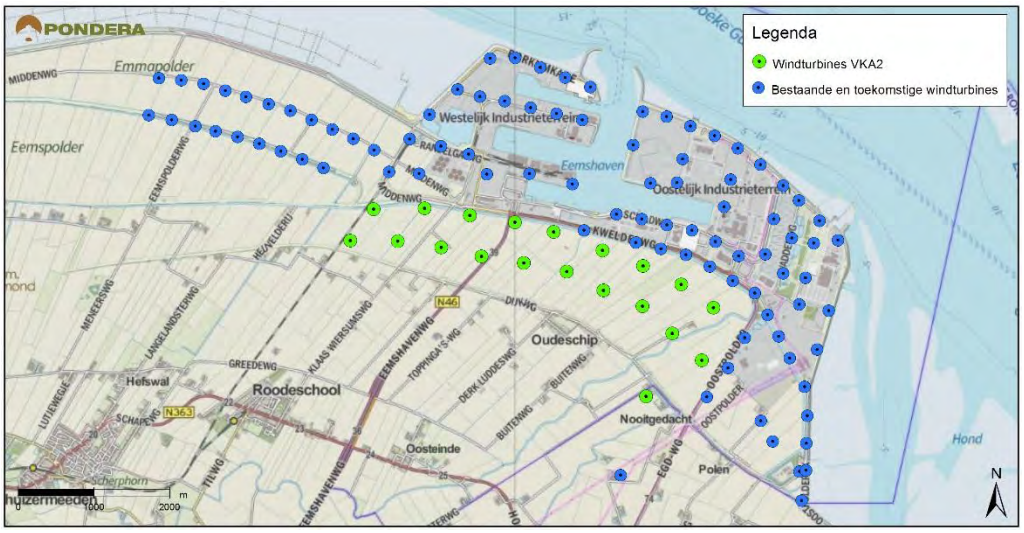
VKA1			VKA2		
Windturbine nr.	RD coördinaten		Windturbine nr.	RD coördinaten	
101	251679	606481	101	250684	606500
102	252191	606316	102	251170	606252
103	252640	606079	103	251688	606042
104	252891	605613	104	252082	605684
105	247910	607020	105	252469	605331
106	248478	606954	106	251732	604852
107	249033	606849	107	249560	606703
108	249597	606724	108	250117	606616
109	250131	606584	109	251693	606576
110	250661	606425	110	252197	606333
111	251175	606238	111	252625	606025
112	251655	606010	112	251157	606782
113	252082	605684	113	247827	606909

114	252404	605290	114	248133	607325
115	251732	604852	115	248805	607337
			116	248451	606902
			117	249405	607243
			118	249027	606820
			119	250512	607025
			120	249999	607151

Figuur 5.1 VKA1 met de bestaande en toekomstige windturbines in het gebied



Figuur 5.2 VKA2 met de bestaande en toekomstige windturbines in het gebied



5.3 Productieberekening VKA1

In de berekeningen voor de netto productie (P50) van VKA1 van Windpark Oostpolder is voor de verliezen rekening gehouden met het wake-effect van de 102 bestaande windturbines in de omgeving, geluid en slagschaduw mitigatiemaatregelen en de onderstaande uitgangspunten en waarden in Tabel 5.3 en Tabel 5.4. In bijlage 1 zijn de volledige berekeningsresultaten gegeven. In bijlage 2 zijn de berekende verliezen gegeven.

Tabel 5.3 Overzicht berekende energieproductie van VKA1

Resultaten	
Windsnelheid op ashoogte	9,2
Bruto productie [GWh/jr]	323,9
Verliezen totaal [GWh/jr]	50,4
Netto energieproductie (P50)	273,4
Vollasturen (P50) [uur/jr]	4.340

Tabel 5.4 Detailoverzicht van de productieverliezen voor VKA1

Verliezen VKA1		**Enercon E-141 EP4-4.200**
Wake-effecten	Berekening	
- Wake-effecten door Windpark Oostpolder	Berekening	- 5,1 %
- Wake-effecten door bestaande en toekomstige windparken	Berekening	- 4,3 %
Niet-beschikbaarheid		
- Windturbine	Inschatting	- 3,0 %
- Balance of plant	Inschatting	0 %
- Grid	Inschatting	0 %
- Overig	Inschatting	0 %
Elektrisch		
- Netverliezen	Inschatting	- 2,0 %
- Eigen gebruik windturbine	Inschatting	0 %
Omgeving		
- Bladdegradatie	Aanname	- 0,5 %
- Icing maatregelen	Aanname	- 0,5 %
- Site toegang beperkingen	Aanname	0 %
- Extreme weersomstandigheden	Aanname	0 %
- Bosaangroei	Aanname	0 %
- Overig		
Prestaties		
- High wind hysteresis	Inschatting	- 0,5 %
- Power curve-aanpassingen	Inschatting	0 %
Inkorting		
- Geluid	Berekening	- 2,6 %
- Schaduw	Berekening	- 0,4 %
- Vogels / Vleermuizen	Berekening	0 %
- Externe veiligheid	Berekening	0 %
- Overig	Berekening	0 %
Overig	Berekening	0 %
Verliezen totaal		- 15,6 % / 50,4 GWh/jr
Netto energieproductie (P50) [GWh/jr]		**273,4**
Vollasturen (P50) [uur/jr]		**4.340**

5.4 Productieberekening VKA2

In de berekeningen voor de netto productie (P50) van VKA2 van Windpark Oostpolder is voor de verliezen rekening gehouden met het wake-effect van 93 bestaande windturbines in de omgeving, op basis van een scenario waar 9 Innogy windturbines verwijderd zullen worden. Verder is er ook rekening gehouden met geluid en slagschaduw mitigatiemaatregelen en de onderstaande uitgangspunten en waarden in Tabel 5.5 en Tabel 5.6. In bijlage 1 zijn de volledige berekeningsresultaten gegeven. In bijlage 2 zijn de berekende verliezen gegeven.

Tabel 5.5 Overzicht berekende energieproductie van VKA2

Resultaten	
Windsnelheid op ashoogte	9,2
Bruto productie [GWh/jr]	432,4
Verliezen totaal [GWh/jr]	76,7
Netto energieproductie (P50)	355,6
Vollasturen (P50) [uur/jr]	4.234

Tabel 5.6 Detailoverzicht van de productieverliezen voor VKA2

Verliezen VKA2		**Enercon E-141 EP4-4.200**
Wake-effecten	Berekening	
- Wake-effecten door Windpark Oostpolder	Berekening	- 6,7 %
- Wake-effecten door bestaande en toekomstige windparken	Berekening	- 3,2 %
Niet-beschikbaarheid		
- Windturbine	Inschatting	- 3,0 %
- Balance of plant	Inschatting	0 %
- Grid	Inschatting	0 %
- Overig	Inschatting	0 %
Elektrisch		
- Netverliezen	Inschatting	- 2,0 %
- Eigen gebruik windturbine	Inschatting	0 %
Omgeving		
- Bladdegradatie	Aanname	- 0,5 %
- Icing maatregelen	Aanname	- 0,5 %
- Site toegang beperkingen	Aanname	0 %
- Extreme weersomstandigheden	Aanname	0 %
- Bosaangroei	Aanname	0 %
- Overig		
Prestaties		
- High wind hysteresis	Inschatting	- 0,5 %
- Power curve-aanpassingen	Inschatting	0 %
Inkorting		
- Geluid	Berekening	- 2,2 %
- Schaduw	Berekening	- 0,3 %
- Vogels / Vleermuizen	Berekening	0 %
- Externe veiligheid	Berekening	0 %
- Overig	Berekening	0 %
Overig	Berekening	0 %
Verliezen totaal		- 17,7 % / 50,4 GWh/jr
Netto energieproductie (P50) [GWh/jr]		**355,6**
Vollasturen (P50) [uur/jr]		**4.234**

6 BESPREKING

De Vereniging Windpark Oostpolder is voornemens het nieuwe windpark Oostpolder te realiseren in de provincie Groningen. In totaal zijn er drie alternatieven voorgesteld met 14, 15 en 23 windturbines. De onderzochte windturbines zijn van het type Enercon E-141 EP4-4.200 (ashoogte 165 m), Enercon E-126 EP4 TES-4.200 (ashoogte 135 m) en Enercon E-103 EP2-2.350 (ashoogte 120 m) voor respectievelijk alternatief 1b, 2b en 3b.

Voor dit nieuwe windpark zijn productieberekeningen uitgevoerd om de jaarlijkse productie en verliezen te bepalen.

Het aangehouden lokale windklimaat is gebaseerd op meetgegevens van een nabijgelegen meetmast in de Eemshaven. De data is gecorrigeerd voor het langjarig gemiddelde met windgegevens uit KNMI meetstation Lauwersoog. Bij de verliezen zijn onder andere de wake-effecten van alle nieuwe en bestaande windturbines meegenomen en een geluidmanagement strategie en stilstand vanwege slagschaduw.

Op grond van de uitgevoerde productieberekeningen blijkt voor het nieuwe windpark Oostpolder

- voor alternatief 1b een opbrengst van 302,4 GWh/ jr bruto en 252,6 GWh/ jr netto P50, met een aantal vollasturen van 4.256
- voor alternatief 2b een opbrengst van 281,3 GWh/ jr bruto en 237,4 GWh/ jr netto P50, met een aantal vollasturen van 3.712
- voor alternatief 1b een opbrengst van 247,1 GWh/ jr bruto en 182,7 GWh/ jr netto P50, met een aantal vollasturen van 3.334

- voor VKA1 een opbrengst van 323,9 GWh/ jr bruto en 273,4 GWh/ jr netto P50, met een aantal vollasturen van 4.340
- voor VKA2 een opbrengst van 432,4 GWh/ jr bruto en 355,6 GWh/ jr netto P50, met een aantal vollasturen van 4.234

BIJLAGE 1

INVOER EN RESULTATEN

MODEL PRODUCTIEBEREKENINGEN

Licensed user:
Pondera Consult B.V.
Welbergweg 49
NL-7556 PE Hengelo
0031742489940

Calculated:
16-3-2017 14:48/3.1.597

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 1b

Wake Model	N.O. Jensen (RISØ/EMD)

Calculation Settings

Air density calculation mode	Individual per WTG
Result for WTG at hub altitude	1,232 kg/m³ to 1,248 kg/m³
Air density relative to standard	100,6 % to 101,8 %
Hub altitude above sea level (asl)	39,9 m to 166,4 m
Annual mean temperature at hub alt.	8,0 °C to 8,8 °C
Pressure at WTGs	994,2 hPa to 1.009,6 hPa

Wake Model Parameters

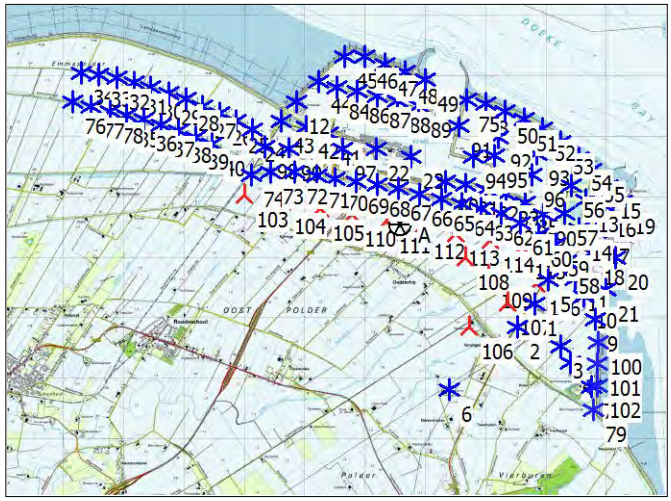
Terrain type	Wake decay constant
HH:100m Open farmland	0,062

Displacement heights from objects

Wake calculation settings

Angle [°]			Wind speed [m/s]		
start	end	step	start	end	step
0,5	360,0	1,0	0,5	30,5	1,0

Wind statistics	RWE_Oostpolder 100m-Corr099.wws
WAsP version	WAsP 11 Version 11.05.0028



Scale 1:125.000

New WTG
Existing WTG
Site Data

Key results for height 165,0 m above ground level

Terrain Dutch Stereo-RD/NAP 2000

	X (east)	Y (north)	Name of wind distribution	Type	Wind energy [kWh/m²]	Mean wind speed [m/s]	Equivalent roughness
A	250.596	606.527	Oostpolder site data	WAsP (WAsP 11 Version 11.05.0028)	7.041	9,2	1,1

Calculated Annual Energy for Wind Farm

WTG combination	Result PARK [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Specific results¤) Park efficiency [%]	Capacity factor [%]	Mean WTG result [MWh/y]	Full load hours [Hours/year]	Mean wind speed @hub height [m/s]
Wind farm	1.154.489,0	1.370.672,3	84,2	35,0	9.952,5	3.070	8,3
New WTGs only	274.872,9	302.409,7	90,9	53,3	19.633,8	4.675	9,2
Existing park WTGs only	879.616,1	1.068.262,5	82,3	31,6	8.623,7	2.773	8,2
Existing park WTGs without new WTGs	904.288,4	1.068.262,5	84,7		8.865,6		
Reduction for existing park WTGs caused by new	24.672,3						

¤) Based on wake reduced results, but no other losses included

Calculated Annual Energy for each of 14 new WTGs with total 58,8 MW rated power

Links	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Power curve Creator	Name	Annual Energy Result [MWh]	Park Efficiency [%]	Capacity factor [%]	Free mean wind speed [m/s]
103 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	20.435,5	95,02	55,5	9,14
104 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	20.121,2	93,70	54,7	9,12
105 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.971,8	92,86	54,2	9,13
106 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	20.320,4	94,86	55,2	9,07
107 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.403,2	90,03	52,7	9,12
108 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.674,7	91,07	53,4	9,15
109 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.527,5	90,45	53,0	9,14
110 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.914,3	92,21	54,1	9,16
111 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.877,6	92,01	54,0	9,16
112 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.802,0	91,38	53,8	9,18
113 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.583,0	90,28	53,2	9,19
114 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	18.905,7	86,94	51,4	9,21
115 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.001,4	87,28	51,6	9,22
116 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	18.334,8	84,59	49,8	9,17

Annual Energy results do not include any losses apart from wake losses. For expected NET AEP (expected sold production), see report Loss & Uncertainty.

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 1b

Calculated Annual Energy for each of 102 existing park WTGs with total 317,3 MW rated power

	WTG type						Power curve		Annual Energy			Park
Links	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Creator	Name	Calculated prod. without new WTGs	After New WTGs	Decrease due to new WTGs	Efficiency
				[kW]	[m]	[m]			[MWh]	[MWh]	[MWh %]	[%]
1 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	18.622,7	17.628,6	994,1 5,3	85,98
2 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.349,2	18.705,9	643,3 3,3	91,73
3 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.142,7	18.863,5	279,2 1,5	92,00
4 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.174,0	19.002,4	171,6 0,9	92,68
5 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	18.071,8	16.122,6	1.949,2 10,8	78,16
6 A	No	VESTAS	V47-660	660	47,0	40,0	EMD	Level 0 - calculated - - 07-2001	1.477,2	1.465,4	11,8 0,8	96,25
7 A	Yes	VESTAS	V52-850	850	52,0	40,0	EMD	Level 0 - calculated - 104.2 dB(A) - 07-2006	1.989,3	1.974,1	15,2 0,8	92,38
8 A	Yes	VESTAS	V117-3.45-3.450	3.450	117,0	93,5	EMD	Level 0 - Calculated - Modes 0 & 0-0S - 01-2016	12.967,1	12.840,0	127,1 1,0	84,96
9 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.706,0	7.582,6	123,4 1,6	84,61
10 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.552,7	7.367,0	185,8 2,5	82,38
11 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.445,1	7.166,0	279,1 3,7	80,19
12 A	No	2-B Energy	OTC 6 MW-6.000	6.000	140,0	105,0	USER	Turbulent power curce with TI of 8.7%	18.447,6	18.311,9	135,7 0,7	83,79
13 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	6.913,2	6.763,4	149,7 2,2	73,31
14 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	6.891,4	6.660,4	231,0 3,4	73,07
15 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.205,1	7.128,5	76,6 1,1	75,56
16 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.086,1	6.982,7	103,4 1,5	75,05
17 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.140,3	6.981,2	159,1 2,2	75,89
18 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.071,5	6.790,6	280,8 4,0	75,33
19 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.452,9	7.388,3	64,5 0,9	80,41
20 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.655,9	7.523,7	132,2 1,7	81,28
21 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.541,7	7.428,7	113,1 1,5	82,08
22 A	No	Senvion	6.2M126-6.150	6.150	126,0	114,0	USER	Calcated power curve Senvion 6.2M126	18.923,9	18.399,0	525,0 2,8	82,68
23 A	No	Senvion	6.2M126-6.150	6.150	126,0	114,0	USER	Calcated power curve Senvion 6.2M126	18.926,8	18.450,2	476,6 2,5	82,61
24 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.673,1	7.606,8	66,3 0,9	84,85
25 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.541,6	7.486,0	55,6 0,7	82,99
26 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.392,8	7.352,6	40,2 0,5	81,65
27 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.420,1	7.400,2	19,9 0,3	81,86
28 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.484,6	7.471,7	12,9 0,2	82,05
29 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.535,0	7.522,2	12,8 0,2	82,40
30 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.476,5	7.465,7	10,7 0,1	82,46
31 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.555,8	7.547,9	7,9 0,1	83,02
32 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.750,1	7.743,8	6,3 0,1	84,30
33 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.943,6	7.936,1	7,5 0,1	86,38
34 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.428,3	8.421,8	6,5 0,1	91,89
35 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.909,3	7.895,1	14,2 0,2	87,32
36 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.889,4	7.873,7	15,7 0,2	87,42
37 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.893,4	7.873,8	19,6 0,2	87,50
38 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.866,4	7.841,1	25,3 0,3	87,51
39 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.861,8	7.827,1	34,7 0,4	87,43
40 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.904,6	7.852,7	51,9 0,7	87,87
41 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.518,0	7.362,2	155,7 2,1	80,55
42 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.268,4	7.148,0	120,3 1,7	78,65
43 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.412,0	7.317,2	94,8 1,3	80,62
44 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.803,4	7.755,1	48,3 0,6	81,94
45 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.274,8	8.241,3	33,5 0,4	85,14
46 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.204,3	8.163,6	40,8 0,5	83,73
47 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.225,9	8.178,8	47,1 0,6	83,73
48 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.993,8	7.935,7	58,1 0,7	82,72
49 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.950,5	7.886,6	64,0 0,8	82,72
50 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.822,5	7.742,5	80,0 1,0	80,60
51 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.887,4	7.782,0	105,4 1,3	81,17
52 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.861,1	7.773,4	87,7 1,1	80,86
53 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.855,6	7.734,9	120,7 1,5	80,91
54 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.716,6	7.591,4	125,2 1,6	79,66
55 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.505,1	7.389,0	116,1 1,5	77,63
56 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.270,2	7.075,3	194,9 2,7	75,85
57 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.105,1	6.766,2	338,8 4,8	73,89
58 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.258,3	6.796,1	462,2 6,4	75,64
59 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.501,0	6.850,5	650,5 8,7	75,17
60 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.562,7	6.678,2	884,5 11,7	74,36
61 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.660,4	6.847,2	813,3 10,6	76,02
62 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.561,1	6.737,6	823,4 10,9	74,90
63 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.602,4	6.868,4	734,0 9,7	76,60
64 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.691,8	7.080,5	611,3 7,9	78,71
65 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.715,1	7.122,0	593,1 7,7	79,76
66 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.859,2	7.360,5	498,7 6,3	82,04
67 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.845,8	7.268,3	577,5 7,4	80,89
68 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.779,6	7.241,6	538,0 6,9	81,50
69 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.761,8	7.264,5	497,2 6,4	81,91
70 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.711,7	7.159,9	551,7 7,2	80,86
71 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.742,1	7.310,3	431,8 5,6	82,83
72 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.697,6	7.181,8	515,8 6,7	81,73
73 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.781,2	7.403,9	377,3 4,8	83,74
74 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.055,1	7.584,9	470,3 5,8	86,52
75 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	100,0	EMD	Level 0 - official - Mode 0 - 08/2014	8.075,2	7.989,3	85,9 1,1	83,36
76 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	12.800,1	12.794,4	5,7 0,0	94,33
77 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	12.289,5	12.282,5	7,0 0,1	90,80
78 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	11.992,1	11.980,3	11,8 0,1	89,34
79 A	Yes	VESTAS	V117-3.6-3.600	3.600	117,0	117,0	EMD	Level 0 - Calculated - Modes PO1 & PO1-0S - 01-2016	15.257,1	15.182,0	75,1 0,5	96,66
80 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.313,7	7.949,3	364,4 4,4	76,53
81 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.222,2	7.877,7	344,5 4,2	75,63
82 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.181,9	7.723,9	458,0 5,6	73,96
83 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.255,6	7.830,9	424,8 5,1	74,28

To be continued on next page...

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 1b

...continued from previous page

	WTG type						Power curve		Annual Energy			Park
Links	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Creator	Name	Calculated prod. without new WTGs	After New WTGs	Decrease due to new WTGs	Efficiency
				[kW]	[m]	[m]			[MWh]	[MWh]	[MWh %]	[%]
84 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.733,7	8.660,5	73,2 0,8	81,19
85 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.121,8	7.616,8	505,0 6,2	73,21
86 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.781,2	8.699,7	81,5 0,9	81,46
87 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.822,1	8.727,9	94,2 1,1	81,96
88 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.752,0	8.655,1	96,9 1,1	81,01
89 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.895,2	8.774,5	120,7 1,4	82,41
90 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.130,7	7.584,8	545,8 6,7	72,66
91 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	9.087,9	8.946,6	141,3 1,6	83,10
92 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.377,8	8.251,6	126,2 1,5	77,65
93 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.474,5	8.322,2	152,3 1,8	78,01
94 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.516,5	8.309,3	207,2 2,4	78,43
95 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.425,9	8.219,4	206,4 2,4	77,68
96 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.377,8	8.146,6	231,2 2,8	76,85
97 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.445,4	8.201,5	243,9 2,9	79,37
98 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.474,3	8.308,3	166,0 2,0	82,09
99 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.271,9	8.073,5	198,4 2,4	79,78
100 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.344,3	8.246,6	97,7 1,2	87,76
101 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.514,6	8.457,6	57,0 0,7	90,15
102 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.611,5	8.558,7	52,8 0,6	91,51

WTG siting

		Dutch Stereo-RD / NAP 2000			
		X (east)	Y (north)	Z [m]	Row data/Description
1	Exist	252.819	605.227	-0,3	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (244)
2	Exist	252.538	604.846	0,0	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (245)
3	Exist	253.250	604.530	0,0	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (246)
4	Exist	253.410	604.258	0,2	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (247)
5	Exist	253.038	605.625	0,3	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (248)
6	Exist	251.401	603.815	-0,1	VESTAS V47 660 47.0 !O! hub: 40,0 m (TOT: 63,5 m) (264)
7	Exist	253.765	603.860	1,8	VESTAS V52 850 52.0 !O! hub: 40,0 m (TOT: 66,0 m) (265)
8	Exist	252.007	608.545	1,6	VESTAS V117-3.45 3450 117.0 !O! hub: 93,5 m (TOT: 152,0 m) (266)
9	Exist	253.830	604.979	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (267)
10	Exist	253.634	605.359	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (268)
11	Exist	253.487	605.644	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (269)
12	Exist	248.875	608.572	2,5	2-B Energy OTC 6 MW 6000 140.0 !#! hub: 105,0 m (TOT: 175,0 m) (270)
13	Exist	253.662	606.943	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (271)
14	Exist	253.548	606.476	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (272)
15	Exist	254.026	607.172	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (273)
16	Exist	253.954	606.875	2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (274)
17	Exist	253.843	606.417	2,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (275)
18	Exist	253.758	606.067	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (276)
19	Exist	254.272	606.915	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (277)
20	Exist	254.151	605.985	2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (278)
21	Exist	253.996	605.473	0,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (279)
22	Exist	250.194	607.795	4,3	Senvion 6.2M126 6150 126.0 !O! hub: 114,0 m (TOT: 177,0 m) (280)
23	Exist	250.760	607.657	3,1	Senvion 6.2M126 6150 126.0 !O! hub: 114,0 m (TOT: 177,0 m) (281)
24	Exist	248.142	608.104	-1,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (282)
25	Exist	247.865	608.255	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (283)
26	Exist	247.590	608.377	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (284)
27	Exist	247.311	608.501	-1,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (285)
28	Exist	247.034	608.625	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (286)
29	Exist	246.747	608.713	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (371)
30	Exist	246.447	608.805	-2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (288)
31	Exist	246.172	608.890	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (289)
32	Exist	245.885	608.978	0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (290)
33	Exist	245.590	609.026	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (291)
34	Exist	245.294	609.056	-1,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (292)
35	Exist	246.045	608.352	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (293)
36	Exist	246.336	608.279	0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (294)
37	Exist	246.622	608.188	1,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (295)
38	Exist	246.907	608.088	-0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (296)
39	Exist	247.190	607.981	0,6	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (297)
40	Exist	247.472	607.870	0,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (298)
41	Exist	249.390	608.049	2,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (299)
42	Exist	249.023	608.155	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (300)
43	Exist	248.609	608.251	1,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (301)

To be continued on next page...

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 1b

...continued from previous page

		Dutch Stereo-RD / NAP 2000			
		X (east)	Y (north)	Z [m]	Row data/Description
44	Exist	249.242	608.904	-0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (302)
45	Exist	249.672	609.314	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (303)
46	Exist	250.005	609.324	2,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (304)
47	Exist	250.336	609.195	4,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (305)
48	Exist	250.665	609.061	1,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (306)
49	Exist	250.997	608.936	3,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (307)
50	Exist	252.323	608.418	1,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (308)
51	Exist	252.641	608.293	1,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (309)
52	Exist	252.949	608.128	2,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (310)
53	Exist	253.248	607.910	0,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (311)
54	Exist	253.547	607.637	0,6	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (312)
55	Exist	253.756	607.438	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (313)
56	Exist	253.425	607.194	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (314)
57	Exist	253.312	606.728	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (315)
58	Exist	253.341	605.928	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (316)
59	Exist	253.172	606.215	4,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (317)
60	Exist	252.880	606.379	-0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (318)
61	Exist	252.576	606.567	1,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (319)
62	Exist	252.262	606.720	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (320)
63	Exist	251.932	606.799	-2,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (321)
64	Exist	251.602	606.881	0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (322)
65	Exist	251.272	606.961	-1,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (323)
66	Exist	250.915	607.046	1,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (324)
67	Exist	250.558	607.133	1,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (325)
68	Exist	250.211	607.197	-1,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (326)
69	Exist	249.862	607.249	-0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (327)
70	Exist	249.511	607.301	0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (328)
71	Exist	249.207	607.349	0,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (329)
72	Exist	248.841	607.404	-0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (330)
73	Exist	248.444	607.403	0,6	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (331)
74	Exist	248.125	607.370	-1,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (332)
75	Exist	251.691	608.611	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 100,0 m (TOT: 141,0 m) (333)
76	Exist	245.161	608.566	0,7	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (354)
77	Exist	245.463	608.501	0,4	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (355)
78	Exist	245.775	608.421	-1,5	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (356)
79	Exist	253.792	603.479	1,0	VESTAS V117-3.6 3600 117.0 !O! hub: 117,0 m (TOT: 175,5 m) (664)
80	Exist	251.345	607.258	2,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (599)
81	Exist	251.679	607.196	1,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (600)
82	Exist	252.008	607.117	1,0	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (601)
83	Exist	252.340	607.043	3,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (602)
84	Exist	249.539	608.811	0,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (603)
85	Exist	252.654	606.896	1,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (604)
86	Exist	249.866	608.752	0,4	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (605)
87	Exist	250.208	608.666	1,0	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (606)
88	Exist	250.550	608.586	0,9	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (607)
89	Exist	250.892	608.503	2,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (608)
90	Exist	252.958	606.705	1,5	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (609)
91	Exist	251.566	608.173	4,2	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (610)
92	Exist	252.219	607.986	-0,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (611)
93	Exist	252.852	607.716	1,9	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (612)
94	Exist	251.793	607.668	1,6	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (613)
95	Exist	252.144	607.675	2,7	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (614)
96	Exist	252.765	607.355	1,6	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (615)
97	Exist	249.631	607.787	2,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (616)
98	Exist	248.339	607.818	-1,2	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (617)
99	Exist	248.736	607.792	-1,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (618)
100	Exist	253.864	604.596	0,0	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (712)
101	Exist	253.855	604.236	0,0	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (713)
102	Exist	253.850	603.877	0,2	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (714)
103	New	248.012	607.033	-0,5	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (294)
104	New	248.629	606.913	-2,2	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (295)
105	New	249.275	606.800	-1,3	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (296)
106	New	251.738	604.844	0,4	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (297)
107	New	252.372	605.247	-0,7	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (298)

To be continued on next page...

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 1b

...continued from previous page

		Dutch Stereo-RD / NAP 2000			
		X (east)	Y (north)	Z [m]	Row data/Description
108	New	251.671	605.999	0,0	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (299)
109	New	252.049	605.693	-0,1	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (300)
110	New	249.790	606.711	1,0	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (301)
111	New	250.365	606.604	-0,3	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (302)
112	New	250.941	606.498	1,4	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (303)
113	New	251.516	606.392	-0,1	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (304)
114	New	252.091	606.286	0,0	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (305)
115	New	252.621	606.167	0,7	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (306)
116	New	252.853	605.560	0,0	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (307)

Licensed user:
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Welbergweg 49
NL-7556 PE Hengelo
0031742489940

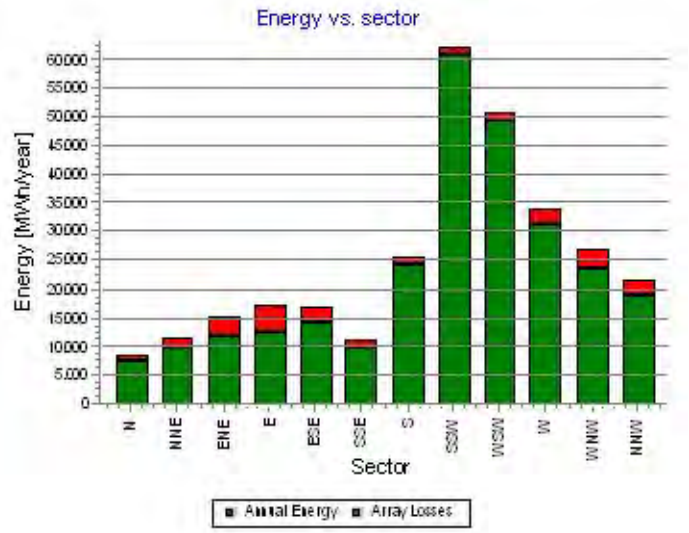
Calculated:
16-3-2017 14:48/3.1.597

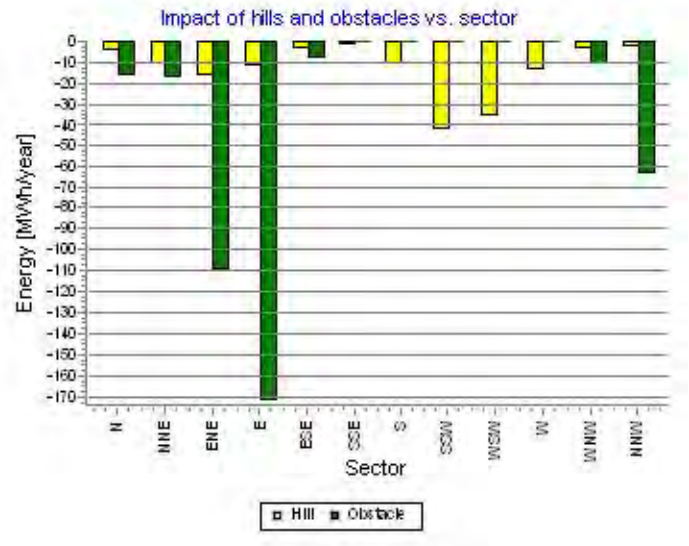
PARK - Production Analysis

Calculation: 716033 WP Oostpolder alternatief 1bWTG: All new WTGs, Air density varies with WTG position 1,232 kg/m³ - 1,248 kg/m³

Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	8.730,1	11.694,6	15.477,2	17.252,1	17.032,1	11.211,0	25.793,1	62.194,9	50.976,1	34.125,8	26.986,6	21.490,7	302.964,1
-Decrease due to obstacles	[MWh]	16,8	17,3	110,0	172,0	8,2	0,0	0,0	0,0	0,0	0,0	10,9	63,2	398,3
+Increase due to hills	[MWh]	-4,6	-10,7	-16,2	-11,6	-3,2	-1,7	-11,3	-41,8	-35,6	-13,3	-3,4	-2,5	-156,1
-Decrease due to array losses	[MWh]	1.259,7	1.618,4	3.302,1	4.360,2	2.939,3	1.139,4	1.286,5	1.274,2	1.789,4	2.584,5	3.359,7	2.623,3	27.536,8
Resulting energy	[MWh]	7.449,0	10.048,3	12.048,9	12.708,3	14.081,4	10.069,8	24.495,3	60.878,8	49.151,1	31.528,0	23.612,5	18.801,6	274.873,0
Specific energy	[kWh/m²]													1.257
Specific energy	[kWh/kW]													4.675
Decrease due to obstacles	[%]	0,2	0,1	0,7	1,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,13
Increase due to hills	[%]	-0,1	-0,1	-0,1	-0,1	0,0	0,0	0,0	-0,1	-0,1	0,0	0,0	0,0	-0,05
Decrease due to array losses	[%]	14,5	13,9	21,5	25,5	17,3	10,2	5,0	2,1	3,5	7,6	12,5	12,2	9,11
Utilization	[%]	18,7	21,0	21,9	21,6	21,0	18,2	19,4	20,4	17,5	14,4	13,8	15,0	17,8
Operational	[Hours/year]	342	388	528	612	549	361	714	1.476	1.362	960	752	598	8.642
Full Load Equivalent	[Hours/year]	127	171	205	216	239	171	417	1.035	836	536	402	320	4.675



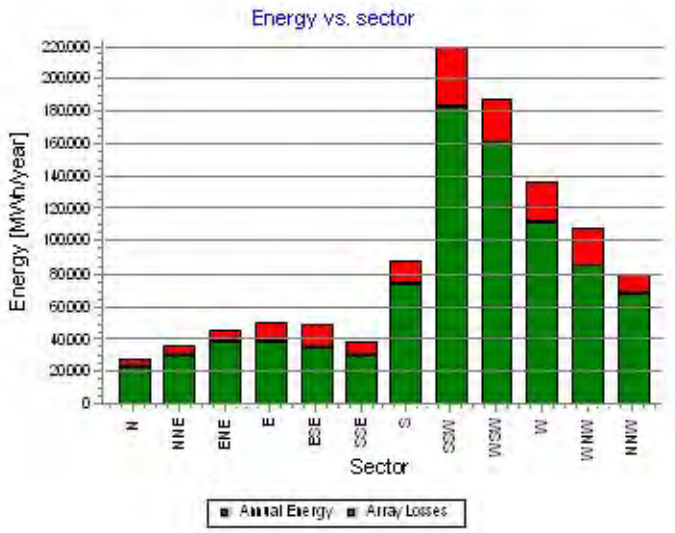


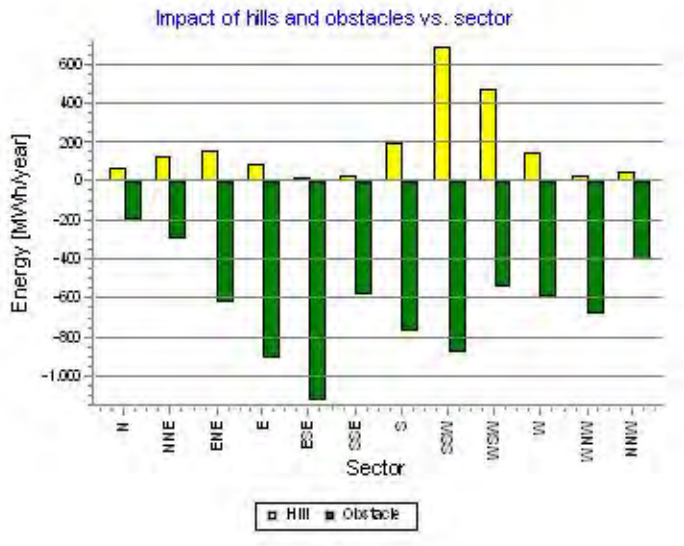
PARK - Production Analysis

Calculation: 716033 WP Oostpolder alternatief 1bWTG: All existing WTGs, Air density varies with WTG position 1,232 kg/m³ - 1,248 kg/m³

Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	27.773,1	36.183,5	46.549,9	50.905,6	50.704,9	38.783,0	89.039,8	219.772,1	187.819,5	136.783,6	109.534,6	79.965,9	1.073.816,0
-Decrease due to obstacles	[MWh]	191,0	291,8	628,3	914,8	1.125,6	585,8	774,4	882,1	550,6	594,5	680,3	401,0	7.620,2
+Increase due to hills	[MWh]	65,3	127,8	154,3	89,5	24,1	27,0	193,1	687,6	469,8	146,2	31,1	51,4	2.067,3
-Decrease due to array losses	[MWh]	4.347,1	5.800,9	7.502,9	11.566,7	14.866,2	7.394,3	14.559,2	36.043,2	27.802,0	24.228,4	23.158,2	11.377,3	188.646,4
Resulting energy	[MWh]	23.300,3	30.218,6	38.572,9	38.513,7	34.737,3	30.829,9	73.899,3	183.534,4	159.936,7	112.106,9	85.727,1	68.239,0	879.616,5
Specific energy	[kWh/m²]													1.340
Specific energy	[kWh/kW]													2.773
Decrease due to obstacles	[%]	0,7	0,8	1,3	1,8	2,2	1,5	0,9	0,4	0,3	0,4	0,6	0,5	0,71
Increase due to hills	[%]	0,2	0,4	0,3	0,2	0,0	0,1	0,2	0,3	0,3	0,1	0,0	0,1	0,19
Decrease due to array losses	[%]	15,7	16,1	16,3	23,1	30,0	19,3	16,5	16,4	14,8	17,8	21,3	14,3	17,66
Utilization	[%]	28,7	31,1	33,1	30,8	26,6	25,9	27,9	28,9	25,8	21,2	20,2	25,0	25,7
Operational	[Hours/year]	333	375	509	592	531	354	688	1.426	1.324	945	738	584	8.399
Full Load Equivalent	[Hours/year]	73	95	122	121	109	97	233	578	504	353	270	215	2.773





PARK - Power Curve Analysis

Calculation: 716033 WP Oostpolder alternatief 1bWTG: 103 - ENERCON E-141 EP4 4200 141.0 !-! Level 0 - official - 0 s- 4200kW - 04/2016, Hub height: 165,0 m

Name: Level 0 - official - 0 s- 4200kW - 04/2016
Source: Manufacturer

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type	Generator type	Specific power kW/m²
13-4-2016	EMD	29-4-2016	9-5-2016	25,0	Pitch	User defined	Variable	0,27

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HP curve comparison - Note: For standard air density and weibull k parameter = 2

Vmean	[m/s]	5	6	7	8	9	10
HP value Pitch, variable speed (2013)	[MWh]	7.749	11.582	15.194	18.346	20.965	23.032
ENERCON E-141 EP4 4200 141.0 !-! Level 0 - official - 0 s- 4200kW - 04/2016	[MWh]	7.644	11.288	14.772	17.854	20.437	22.479
Check value	[%]	1	3	3	3	3	2

The table shows comparison between annual energy production calculated on basis of simplified "HP-curves" which assume that all WTGs performs quite similar - only specific power loading (kW/m^2) and single/dual speed or stall/pitch decides the calculated values. Productions are without wake losses.
For further details, ask at the Danish Energy Agency for project report J.nr. 51171/00-0016 or see windPRO manual chapter 3.5.2.
The method is refined in EMD report "20 Detailed Case Studies comparing Project Design Calculations and actual Energy Productions for Wind Energy Projects worldwide", jan 2003.
Use the table to evaluate if the given power curve is reasonable - if the check value are lower than -5%, the power curve probably is too optimistic due to uncertainty in power curve measurement.

Power curve

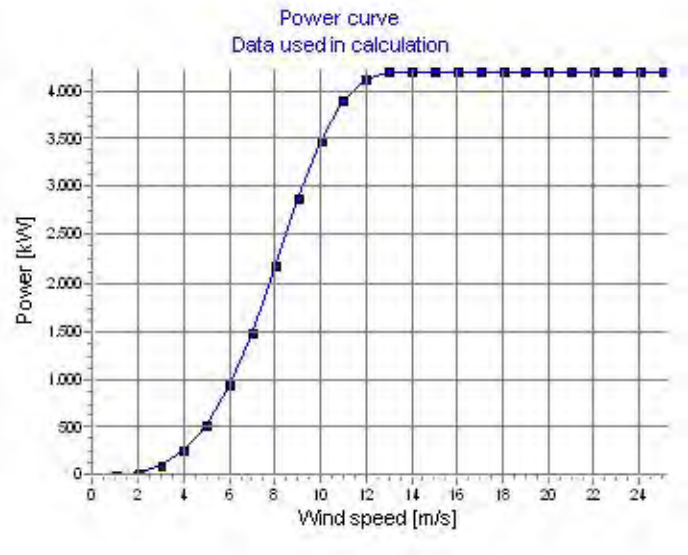
Original data, Air density: 1,225 kg/m³

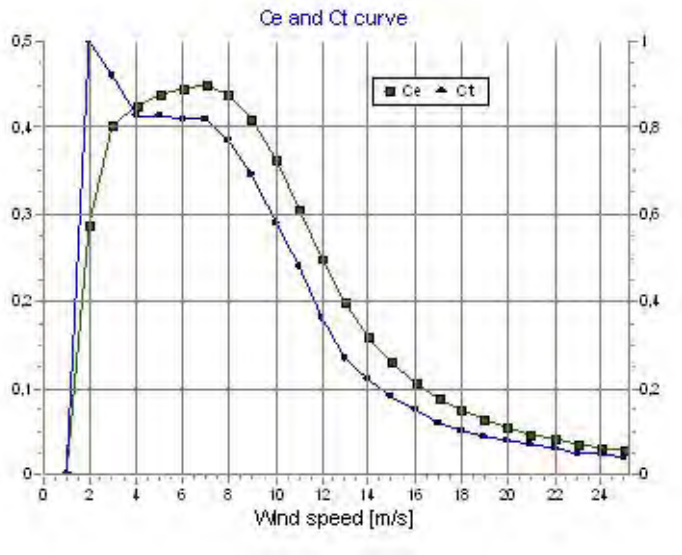
Wind speed [m/s]	Power [kW]	Ce	Wind speed [m/s]	Ct curve
0,0	0,0	0,00	0,0	0,00
0,5	0,0	0,00	0,5	0,00
1,0	0,0	0,00	1,0	0,00
1,5	0,0	0,00	1,5	0,00
2,0	22,0	0,29	2,0	1,16
2,5	54,0	0,36	2,5	1,01
3,0	104,0	0,40	3,0	0,92
3,5	171,0	0,42	3,5	0,87
4,0	260,0	0,42	4,0	0,83
4,5	376,0	0,43	4,5	0,83
5,0	523,0	0,44	5,0	0,83
5,5	703,0	0,44	5,5	0,82
6,0	920,0	0,45	6,0	0,82
6,5	1.176,0	0,45	6,5	0,82
7,0	1.471,0	0,45	7,0	0,82
7,5	1.799,0	0,45	7,5	0,80
8,0	2.151,0	0,44	8,0	0,77
8,5	2.514,0	0,43	8,5	0,74
9,0	2.867,0	0,41	9,0	0,69
9,5	3.194,0	0,39	9,5	0,63
10,0	3.481,0	0,36	10,0	0,58
10,5	3.719,0	0,34	10,5	0,53
11,0	3.903,0	0,31	11,0	0,48
11,5	4.033,0	0,28	11,5	0,41
12,0	4.119,0	0,25	12,0	0,36
12,5	4.171,0	0,22	12,5	0,31
13,0	4.196,0	0,20	13,0	0,27
13,5	4.200,0	0,18	13,5	0,24
14,0	4.200,0	0,16	14,0	0,22
14,5	4.200,0	0,14	14,5	0,19
15,0	4.200,0	0,13	15,0	0,18
15,5	4.200,0	0,12	15,5	0,16
16,0	4.200,0	0,11	16,0	0,15
16,5	4.200,0	0,10	16,5	0,13
17,0	4.200,0	0,09	17,0	0,12
17,5	4.200,0	0,08	17,5	0,11
18,0	4.200,0	0,08	18,0	0,10
18,5	4.200,0	0,07	18,5	0,10
19,0	4.200,0	0,06	19,0	0,09
19,5	4.200,0	0,06	19,5	0,08
20,0	4.200,0	0,05	20,0	0,08
20,5	4.200,0	0,05	20,5	0,07
21,0	4.200,0	0,05	21,0	0,07
21,5	4.200,0	0,04	21,5	0,06
22,0	4.200,0	0,04	22,0	0,06
22,5	4.200,0	0,04	22,5	0,06
23,0	4.200,0	0,04	23,0	0,05
23,5	4.200,0	0,03	23,5	0,05
24,0	4.200,0	0,03	24,0	0,05
24,5	4.200,0	0,03	24,5	0,04

Power, Efficiency and energy vs. wind speed

Data used in calculation, Air density: 1,232 kg/m³ New windPRO method (adjusted IEC method, improved to match turbine control) <RECOMMENDED>

Wind speed [m/s]	Power [kW]	Ce	Interval [m/s]	Energy [MWh]	Acc.Energy [MWh]	Relative [%]
1,0	0,0	0,00	0,50- 1,50	0,0	0,0	0,0
2,0	22,2	0,29	1,50- 2,50	7,9	7,9	0,0
3,0	104,8	0,40	2,50- 3,50	44,2	52,1	0,3
4,0	261,8	0,43	3,50- 4,50	139,5	191,5	0,9
5,0	526,5	0,44	4,50- 5,50	332,2	523,8	2,6
6,0	926,0	0,45	5,50- 6,50	655,2	1.179,0	5,8
7,0	1.479,9	0,45	6,50- 7,50	1.112,0	2.291,0	11,2
8,0	2.162,4	0,44	7,50- 8,50	1.645,3	3.936,3	19,3
9,0	2.879,3	0,41	8,50- 9,50	2.125,5	6.061,8	29,7
10,0	3.492,3	0,36	9,50-10,50	2.409,8	8.471,6	41,5
11,0	3.910,8	0,31	10,50-11,50	2.429,1	10.900,8	53,3
12,0	4.122,7	0,25	11,50-12,50	2.220,4	13.121,2	64,2
13,0	4.196,3	0,20	12,50-13,50	1.881,5	15.002,7	73,4
14,0	4.200,0	0,16	13,50-14,50	1.508,6	16.511,3	80,8
15,0	4.200,0	0,13	14,50-15,50	1.161,7	17.673,0	86,5
16,0	4.200,0	0,11	15,50-16,50	864,1	18.537,1	90,7
17,0	4.200,0	0,09	16,50-17,50	623,0	19.160,0	93,8
18,0	4.200,0	0,07	17,50-18,50	437,1	19.597,2	95,9
19,0	4.200,0	0,06	18,50-19,50	300,1	19.897,3	97,4
20,0	4.200,0	0,05	19,50-20,50	202,6	20.099,9	98,4
21,0	4.200,0	0,05	20,50-21,50	135,1	20.234,9	99,0
22,0	4.200,0	0,04	21,50-22,50	89,2	20.324,2	99,5
23,0	4.200,0	0,04	22,50-23,50	58,4	20.382,6	99,7
24,0	4.200,0	0,03	23,50-24,50	38,0	20.420,6	99,9
25,0	4.200,0	0,03	24,50-25,50	14,9	20.435,5	100,0





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PARK - Terrain

Calculation: 716033 WP Oostpolder alternatief 1bSite Data: A - Oostpolder site data

Obstacles:
23 Obstacles used

Roughness:
Terrain data files used in calculation:
\\sbs2011\projecten\Extern\2015\715068 WTG Intocon Eemshaven\TO\WP\ROUGHNESSLINE_713066 715068_1.wpo
Min X: 219.227, Max X: 278.331, Min Y: 577.425, Max Y: 638.717, Width: 59.104 m, Height: 61.292 m

Orography:
Terrain data files used in calculation:
\\sbs2011\projecten\Extern\2016\716033 WP Oostpolder\TO\WP\ObjectImports\713066 715068_EMDGrid_0(1).wpg
Min X: 198.208, Max X: 300.556, Min Y: 557.205, Max Y: 659.267, Width: 102.348 m, Height: 102.062 m

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PARK - Wind Data Analysis

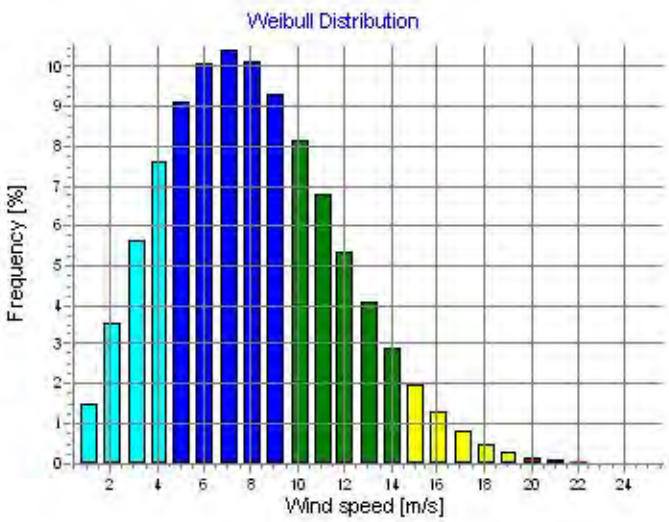
Calculation: 716033 WP Oostpolder alternatief 1bWind data: A - Oostpolder site data; Hub height: 100,0

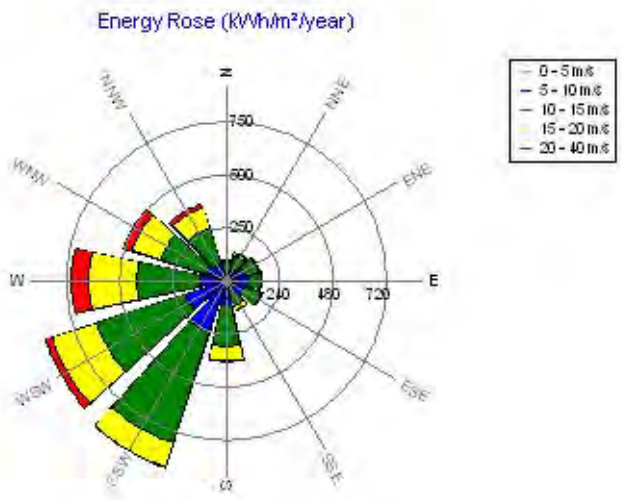
Site coordinates
Dutch Stereo-RD/NAP 2000
East: 250.596 North: 606.527

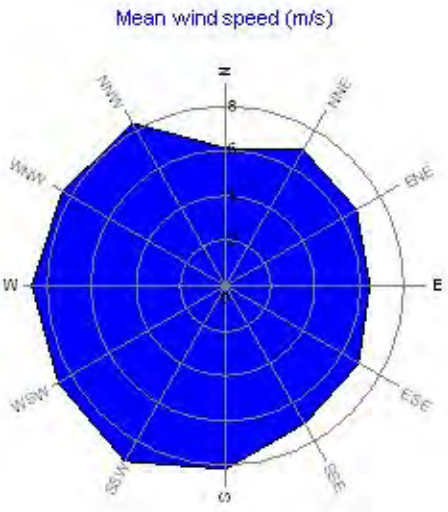
Wind statistics
RWE_Oostpolder 100m-Corr099.wws

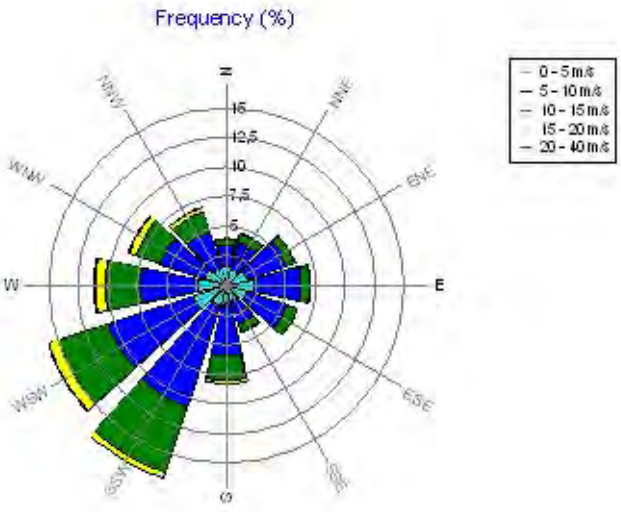
Weibull Data

Sector	Current site A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	6,90	6,13	1,854	4,0
1 NNE	7,85	6,95	2,322	4,5
2 ENE	7,60	6,75	2,545	6,1
3 E	7,30	6,48	2,553	7,1
4 ESE	7,79	6,91	2,498	6,3
5 SSE	7,97	7,06	2,115	4,2
6 S	9,18	8,14	2,486	8,2
7 SSW	10,06	9,00	3,146	17,0
8 WSW	9,71	8,61	2,393	15,8
9 W	9,77	8,65	2,068	11,2
10 WNW	9,48	8,40	2,119	8,7
11 NNW	9,43	8,35	2,209	6,9
All	9,03	8,00	2,287	100,0









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PARK - Wind Data Analysis

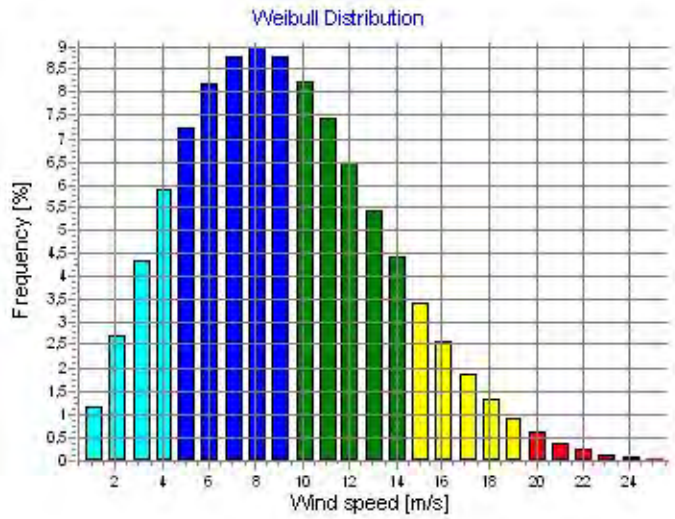
Calculation: 716033 WP Oostpolder alternatief 1bWind data: A - Oostpolder site data; Hub height: 165,0

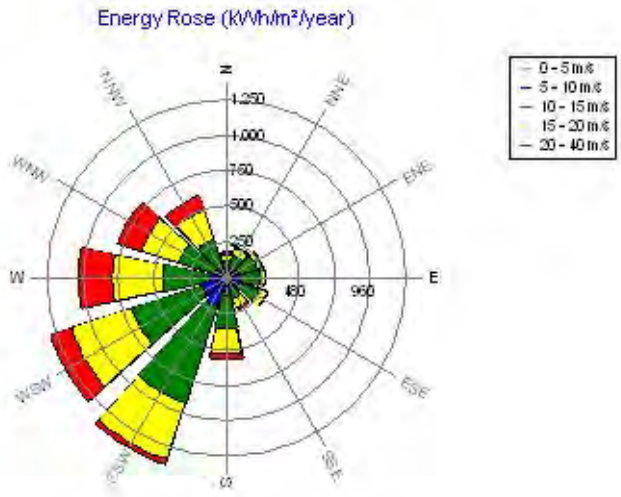
Site coordinates
Dutch Stereo-RD/NAP 2000
East: 250.596 North: 606.527

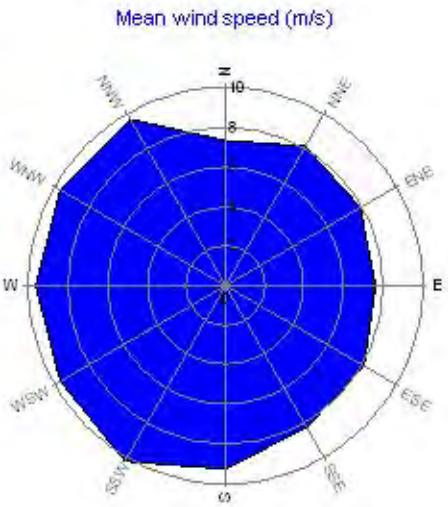
Wind statistics
RWE_Oostpolder 100m-Corr099.wws

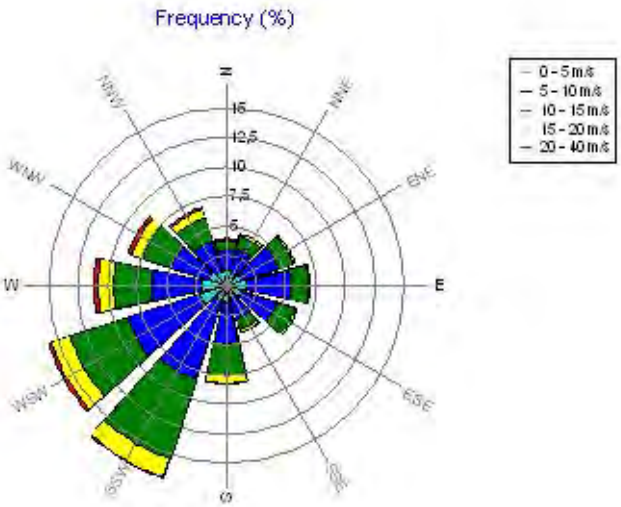
Weibull Data

Sector	Current site A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	8,26	7,34	1,795	4,0
1 NNE	9,17	8,13	2,252	4,5
2 ENE	8,91	7,90	2,467	6,1
3 E	8,54	7,57	2,471	7,1
4 ESE	9,21	8,16	2,424	6,3
5 SSE	9,31	8,25	2,049	4,2
6 S	10,47	9,28	2,420	8,2
7 SSW	11,44	10,22	3,064	17,1
8 WSW	10,93	9,68	2,334	15,8
9 W	10,92	9,68	2,029	11,1
10 WNW	10,94	9,69	2,064	8,7
11 NNW	10,90	9,65	2,143	6,9
All	10,35	9,16	2,252	100,0









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PARK - Park power curve

Calculation: 716033 WP Oostpolder alternatief 1b

Wind speed [m/s]	Power Free WTGs [kW]	Park WTGs [kW]	N [kW]	NNE [kW]	ENE [kW]	E [kW]	ESE [kW]	SSE [kW]	S [kW]	SSW [kW]	WSW [kW]	W [kW]	WNW [kW]	NNW [kW]
0,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1,5	2	1	0	0	0	0	0	1	1	2	2	2	0	0
2,5	1.767	937	947	982	927	815	706	870	1.089	1.130	1.051	860	653	845
3,5	7.809	4.775	4.907	5.076	4.910	4.352	3.880	4.677	5.235	5.423	5.220	4.387	3.741	4.459
4,5	20.492	13.626	14.223	14.550	14.376	12.828	11.512	13.255	14.353	14.775	14.531	12.712	11.442	13.436
5,5	39.751	27.593	28.558	29.151	28.775	26.050	23.768	27.078	28.999	29.631	29.269	26.088	23.650	27.217
6,5	67.607	47.642	49.332	50.193	49.423	45.083	41.354	46.755	49.964	50.953	50.317	45.266	41.292	47.104
7,5	105.183	75.122	77.821	79.148	77.921	71.242	65.490	73.758	78.681	80.178	79.154	71.419	65.382	74.360
8,5	151.844	111.111	115.335	117.247	115.582	105.879	97.361	109.256	116.035	118.074	116.752	105.596	97.063	110.417
9,5	203.878	155.439	161.706	163.914	162.120	149.110	137.335	153.338	161.681	163.886	162.729	147.916	136.802	155.418
10,5	254.172	204.467	213.561	214.708	213.445	197.690	182.643	202.788	211.928	213.002	212.548	195.273	182.568	206.676
11,5	295.884	252.094	263.153	262.531	262.531	245.442	228.095	251.756	260.479	259.664	260.352	242.551	228.552	256.434
12,5	328.309	293.440	305.312	303.329	304.214	287.964	269.422	294.270	301.515	299.533	301.075	284.706	270.163	299.352
13,5	352.228	327.688	338.644	336.624	337.911	324.130	305.993	329.418	334.369	332.510	334.236	320.713	305.692	333.439
14,5	366.434	353.260	360.524	359.229	360.482	350.682	336.254	355.866	358.731	357.412	358.410	349.153	334.929	356.867
15,5	373.869	367.574	371.499	371.058	371.510	366.265	356.817	369.482	370.850	370.305	370.562	365.595	356.392	369.530
16,5	376.957	374.851	376.405	376.228	376.365	374.305	370.138	375.873	376.269	376.060	376.110	374.119	370.028	375.736
17,5	377.452	377.133	377.416	377.388	377.408	377.018	376.215	377.334	377.412	377.378	377.391	377.046	376.130	377.289
18,5	377.442	377.423	377.447	377.448	377.444	377.415	377.340	377.441	377.442	377.443	377.444	377.422	377.334	377.443
19,5	377.425	377.429	377.430	377.431	377.429	377.429	377.429	377.430	377.427	377.429	377.429	377.429	377.429	377.432
20,5	371.407	371.409	371.410	371.411	371.409	371.408	371.408	371.409	371.408	371.409	371.409	371.409	371.409	371.412
21,5	371.391	371.395	371.396	371.397	371.394	371.393	371.393	371.395	371.393	371.394	371.394	371.394	371.395	371.398
22,5	371.379	371.380	371.381	371.382	371.380	371.379	371.380	371.380	371.379	371.380	371.380	371.380	371.381	371.382
23,5	371.369	371.370	371.372	371.372	371.370	371.369	371.369	371.370	371.369	371.370	371.370	371.370	371.371	371.373
24,5	371.390	371.380	371.365	371.368	371.378	371.384	371.382	371.379	371.390	371.385	371.386	371.380	371.369	371.365
25,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Description:
The park power curve is similar to a WTG power curve, meaning that when a given wind speed appears in front of the park with same speed in the entire wind farm area (before influence from the park), the output from the park can be found in the park power curve. Another way to say this: The park power curve includes array losses, but do NOT include terrain given variations in the wind speed over the park area.
Measuring a park power curve is not as simple as measuring a WTG power curve due to the fact that the park power curve depends on the wind direction and that the same wind speed normally will not appear for the entire park area at the same time (only in very flat non-complex terrain). The idea with this version of the park power curve is not to use it for validation based on measurements. This would require at least 2 measurement masts at two sides of the park, unless only a few direction sectors should be tested, AND non complex terrain (normally only useable off shore). Another park power curve version for complex terrain is available in windPRO.

The park power curve can be used for:

1. Forecast systems, based on more rough (approximated) wind data, the park power curve would be an efficient way to make the connection from wind speed (and direction) to power.
2. Construction of duration curves, telling how often a given power output will appear, the park power curve can be used together with the average wind distribution for the Wind farm area in hub height. The average wind distribution can eventually be obtained based on the Weibull parameters for each WTG position. These are found at print menu: >Result to file< in the >Park result< which can be saved to file or copied to clipboard and pasted in Excel.
3. Calculation of wind energy index based on the PARK production (see below).
4. Estimation of the expected PARK production for an existing wind farm based on wind measurements at minimum 2 measurement masts at two sides of wind farm. The masts must be used for obtaining the free wind speed. The free wind speed is used in the simulation of expected energy production with the PARK power curve. This procedure will only work suitable in non complex terrains. For complex terrain another park power curve calculation is available in windPRO (PPV-model).

Note:
From the >Result to file< the >Wind Speeds Inside Wind farm< is also available. These can (e.g. via Excel) be used for extracting the wake induced reductions in measured wind speed.

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Calculated:
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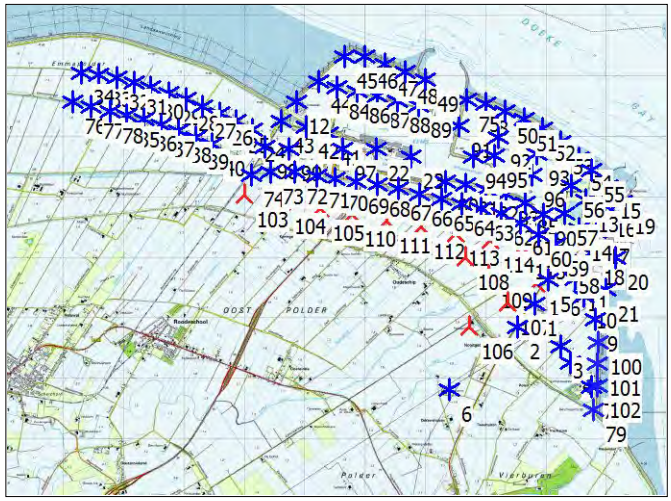
PARK - WTG distances

Calculation: 716033 WP Oostpolder alternatief 1b

WTG distances

	Z [m]	Nearest WTG	Z [m]	Horizontal distance [m]	Distance in|rotor diameters (max)	Distance in|rotor diameters (min)
1	-0,3	116	0,0	334	2,5	2,4
2	0,0	107	-0,7	434	3,2	3,1
3	0,0	4	0,2	315	2,3	2,3
4	0,2	3	0,0	315	2,3	2,3
5	0,3	116	0,0	196	1,4	1,4
6	-0,1	106	0,4	1.082	23,0	7,7
7	1,8	102	0,2	87	1,7	0,9
8	1,6	75	1,0	323	3,9	2,8
9	0,1	100	0,0	384	4,7	3,8
10	-0,4	11	1,0	321	3,9	3,9
11	1,0	58	1,0	319	3,9	3,9
12	2,5	43	1,9	417	5,1	3,0
13	-1,0	16	2,0	300	3,7	3,7
14	1,0	17	2,7	301	3,7	3,7
15	1,0	16	2,0	306	3,7	3,7
16	2,0	13	-1,0	300	3,7	3,7
17	2,7	14	1,0	301	3,7	3,7
18	-0,7	17	2,7	360	4,4	4,4
19	0,1	16	2,0	320	3,9	3,9
20	2,0	18	-0,7	401	4,9	4,9
21	0,0	10	-0,4	379	4,6	4,6
22	4,3	97	2,8	563	6,3	4,5
23	3,1	67	1,3	561	6,8	4,5
24	-1,2	25	-0,4	315	3,8	3,8
25	-0,4	26	-1,0	301	3,7	3,7
26	-1,0	25	-0,4	301	3,7	3,7
27	-1,3	28	0,2	303	3,7	3,7
28	0,2	29	1,8	300	3,7	3,7
29	1,8	28	0,2	300	3,7	3,7
30	-2,0	31	-0,7	288	3,5	3,5
31	-0,7	30	-2,0	288	3,5	3,5
32	0,3	33	0,1	299	3,6	3,6
33	0,1	34	-1,1	297	3,6	3,6
34	-1,1	33	0,1	297	3,6	3,6
35	1,8	78	-1,5	279	3,4	2,5
36	0,5	35	1,8	300	3,7	3,7
37	1,5	36	0,5	300	3,7	3,7
38	-0,2	37	1,5	302	3,7	3,7
39	0,6	38	-0,2	302	3,7	3,7
40	0,9	39	0,6	303	3,7	3,7
41	2,7	97	2,8	356	4,3	4,0
42	0,2	41	2,7	382	4,7	4,7
43	1,9	12	2,5	417	5,1	3,0
44	-0,5	84	0,1	311	3,8	3,5
45	0,2	46	2,8	333	4,1	4,1
46	2,8	45	0,2	333	4,1	4,1
47	4,8	48	1,4	355	4,3	4,3
48	1,4	49	3,2	355	4,3	4,3
49	3,2	48	1,4	355	4,3	4,3
50	1,1	8	1,6	340	4,2	2,9
51	1,4	50	1,1	342	4,2	4,2
52	2,1	51	1,4	349	4,3	4,3
53	0,8	52	2,1	370	4,5	4,5
54	0,6	55	1,8	289	3,5	3,5
55	1,8	54	0,6	289	3,5	3,5
56	-0,4	13	-1,0	345	4,2	4,2
57	-0,7	14	1,0	345	4,2	4,2
58	1,0	11	1,0	319	3,9	3,9
59	4,7	58	1,0	333	4,1	4,1
60	-0,3	115	0,7	335	4,1	2,4
61	1,7	85	1,3	338	4,1	3,8
62	-1,0	83	3,1	332	4,1	3,7
63	-2,9	82	1,0	327	4,0	3,6



Scale 1:125.000

New WTG Existing WTG

To be continued on next page...

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PARK - WTG distances

Calculation: 716033 WP Oostpolder alternatief 1b

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	Z	Nearest WTG	Z	Horizontal distance	Distance in|rotor diameters (max)	Distance in|rotor diameters (min)
	[m]		[m]	[m]		
64	0,3	81	1,8	324	4,0	3,6
65	-1,9	80	2,3	306	3,7	3,4
66	1,5	65	-1,9	367	4,5	4,5
67	1,3	68	-1,2	353	4,3	4,3
68	-1,2	67	1,3	353	4,3	4,3
69	-0,5	68	-1,2	353	4,3	4,3
70	0,5	71	0,0	308	3,8	3,8
71	0,0	70	0,5	308	3,8	3,8
72	-0,1	71	0,0	370	4,5	4,5
73	0,6	74	-1,3	321	3,9	3,9
74	-1,3	73	0,6	321	3,9	3,9
75	1,0	8	1,6	323	3,9	2,8
76	0,7	77	0,4	309	2,8	2,8
77	0,4	76	0,7	309	2,8	2,8
78	-1,5	35	1,8	279	3,4	2,5
79	1,0	7	1,8	382	7,3	3,3
80	2,3	65	-1,9	306	3,7	3,4
81	1,8	64	0,3	324	4,0	3,6
82	1,0	63	-2,9	327	4,0	3,6
83	3,1	62	-1,0	332	4,1	3,7
84	0,1	44	-0,5	311	3,8	3,5
85	1,3	61	1,7	338	4,1	3,8
86	0,4	84	0,1	332	3,7	3,7
87	1,0	88	0,9	351	3,9	3,9
88	0,9	87	1,0	351	3,9	3,9
89	2,3	88	0,9	352	3,9	3,9
90	1,5	60	-0,3	335	4,1	3,7
91	4,2	75	1,0	455	5,6	5,1
92	-0,8	95	2,7	320	3,6	3,6
93	1,9	96	1,6	371	4,1	4,1
94	1,6	95	2,7	351	3,9	3,9
95	2,7	92	-0,8	320	3,6	3,6
96	1,6	93	1,9	371	4,1	4,1
97	2,8	41	2,7	356	4,3	4,0
98	-1,2	24	-1,2	347	4,2	3,9
99	-1,1	98	-1,2	398	4,4	4,4
100	0,0	101	0,0	360	3,6	3,6
101	0,0	102	0,2	359	3,6	3,6
102	0,2	7	1,8	87	1,7	0,9
103	-0,5	74	-1,3	356	4,3	2,5
104	-2,2	73	0,6	524	6,4	3,7
105	-1,3	110	1,0	522	3,7	3,7
106	0,4	107	-0,7	751	5,3	5,3
107	-0,7	2	0,0	434	3,2	3,1
108	0,0	113	-0,1	423	3,0	3,0
109	-0,1	108	0,0	486	3,4	3,4
110	1,0	105	-1,3	522	3,7	3,7
111	-0,3	67	1,3	562	6,9	4,0
112	1,4	66	1,5	548	6,7	3,9
113	-0,1	108	0,0	423	3,0	3,0
114	0,0	62	-1,0	467	5,7	3,3
115	0,7	60	-0,3	335	4,1	2,4
116	0,0	5	0,3	196	1,4	1,4
Min	-2,9		-2,9	87	1,4	0,9
Max	4,8		3,2	1.082	23,0	7,7

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Calculated:
16-3-2017 14:48/3.1.597

PARK - Wind statistics info

Calculation: 716033 WP Oostpolder alternatief 1b

Main data for wind statistic

File	\\sbs2011\projecten\Extern\2016\716033 WP Oostpolder\TO\WP\200117\24012017\RWE_Oostpolder 100m-Corr099.wws
Name	RWE_Oostpolder 100m-Corr099
Country	Netherlands
Source	User
Mast coordinates	Dutch Stereo-RD/NAP 2000 East: 248.822 North: 608.196
Created	24-1-2017
Edited	1-2-2017
Sectors	12
WAsP version	WAsP 11 Version 11.05.0028
Displacement height	None

Additional info for wind statistic

Source data	Default Meteo data RWE
Data from	25-4-2007
Data to	31-1-2009
Measurement length	21,3 Months

Note

To get the most correct calculation results, wind statistics shall be calculated with the SAME model and model parameters, as currently chosen in calculation. For WAsP versions before 10.0, the model is unchanged, but thereafter more model changes affecting the wind statistic is seen. Likewise WAsP CFD should always use WAsP CFD calculated wind statistics.

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Calculated:
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PARK - Map

Calculation: 716033 WP Oostpolder alternatief 1b

0 1 2 3 4 km

Map: Uithuizen , Print scale 1:75.000, Map center Dutch Stereo-RD/NAP 2000 East: 249.717 North: 606.402

New WTG Existing WTG Obstacle

Project:
24_01_2017

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Calculated:
16-3-2017 14:49/3.1.597

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 2b

Wake Model	N.O. Jensen (RISØ/EMD)

Calculation Settings

Air density calculation mode	Individual per WTG
Result for WTG at hub altitude	1,236 kg/m³ to 1,248 kg/m³
Air density relative to standard	100,9 % to 101,8 %
Hub altitude above sea level (asl)	39,9 m to 136,0 m
Annual mean temperature at hub alt.	8,1 °C to 8,8 °C
Pressure at WTGs	997,9 hPa to 1.009,6 hPa

Wake Model Parameters

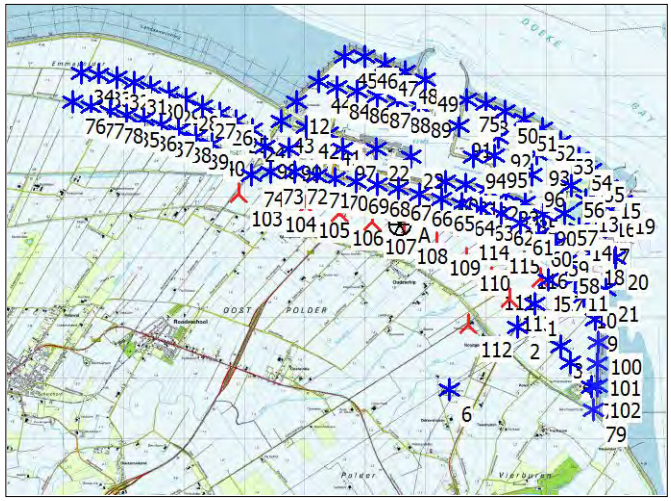
Terrain type	Wake decay constant
HH:100m Open farmland	0,062

Displacement heights from objects

Wake calculation settings

Angle [°]			Wind speed [m/s]		
start	end	step	start	end	step
0,5	360,0	1,0	0,5	30,5	1,0

Wind statistics	RWE_Oostpolder 100m-Corr099.wws
WAsP version	WAsP 11 Version 11.05.0028



Scale 1:125.000

New WTG
Existing WTG
Site Data

Key results for height 135,0 m above ground level

Terrain Dutch Stereo-RD/NAP 2000

	X (east)	Y (north)	Name of wind distribution	Type	Wind energy [kWh/m²]	Mean wind speed [m/s]	Equivalent roughness
A	250.596	606.527	Oostpolder site data	WAsP (WAsP 11 Version 11.05.0028)	6.048	8,7	1,1

Calculated Annual Energy for Wind Farm

WTG combination	Result PARK [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Specific results¤) Park efficiency [%]	Capacity factor [%]	Mean WTG result [MWh/y]	Full load hours [Hours/year]	Mean wind speed @hub height [m/s]
Wind farm	1.128.342,6	1.349.536,7	83,6	33,9	9.644,0	2.967	8,3
New WTGs only	250.458,1	281.274,2	89,0	45,4	16.697,2	3.976	8,7
Existing park WTGs only	877.884,5	1.068.262,5	82,2	31,6	8.606,7	2.767	8,2
Existing park WTGs without new WTGs	904.288,4	1.068.262,5	84,7		8.865,6		
Reduction for existing park WTGs caused by new	26.403,9						

¤) Based on wake reduced results, but no other losses included

Calculated Annual Energy for each of 15 new WTGs with total 63,0 MW rated power

Links	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Power curve Creator	Name	Annual Energy Result [MWh]	Park Efficiency [%]	Capacity factor [%]	Free mean wind speed [m/s]
103 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	17.514,2	93,85	47,6	8,67
104 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	17.165,5	92,15	46,6	8,66
105 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	17.082,2	91,35	46,4	8,68
106 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	17.050,5	91,36	46,3	8,66
107 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	17.084,2	91,31	46,4	8,68
108 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	17.052,5	91,03	46,3	8,68
109 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	16.930,7	90,34	46,0	8,68
110 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	16.892,9	90,02	45,9	8,69
111 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	16.630,3	88,77	45,2	8,67
112 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	17.530,0	94,39	47,6	8,62
113 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	16.508,4	88,28	44,8	8,66
114 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	16.254,9	86,04	44,2	8,73
115 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	16.013,7	84,55	43,5	8,75
116 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	15.905,1	83,97	43,2	8,75
117 A	No	ENERCON	E-126 EP4 TES-4.200	4.200	127,0	135,0	EMD	Level 0 - official - 0 s - 4200kW - 08/2015	14.843,0	78,56	40,3	8,73

Annual Energy results do not include any losses apart from wake losses. For expected NET AEP (expected sold production), see report Loss & Uncertainty.

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 2b

Calculated Annual Energy for each of 102 existing park WTGs with total 317,3 MW rated power

	WTG type						Power curve		Annual Energy			Park
Links	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Creator	Name	Calculated prod. without new WTGs	After New WTGs	Decrease due to new WTGs	Efficiency
				[kW]	[m]	[m]			[MWh]	[MWh]	[MWh %]	[%]
1 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	18.622,7	17.728,9	893,8 4,8	86,47
2 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.349,2	18.825,8	523,4 2,7	92,31
3 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.142,7	18.919,4	223,3 1,2	92,27
4 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.174,0	19.029,9	144,1 0,8	92,82
5 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	18.071,8	15.809,5	2.262,4 12,5	76,64
6 A	No	VESTAS	V47-660	660	47,0	40,0	EMD	Level 0 - calculated - - 07-2001	1.477,2	1.466,4	10,8 0,7	96,32
7 A	Yes	VESTAS	V52-850	850	52,0	40,0	EMD	Level 0 - calculated - 104.2 dB(A) - 07-2006	1.989,3	1.975,3	14,0 0,7	92,43
8 A	Yes	VESTAS	V117-3.45-3.450	3.450	117,0	93,5	EMD	Level 0 - Calculated - Modes 0 & 0-0S - 01-2016	12.967,1	12.863,9	103,1 0,8	85,12
9 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.706,0	7.569,1	136,9 1,8	84,46
10 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.552,7	7.350,4	202,3 2,7	82,20
11 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.445,1	7.085,3	359,8 4,8	79,28
12 A	No	2-B Energy	OTC 6 MW-6.000	6.000	140,0	105,0	USER	Turbulent power curce with TI of 8.7%	18.447,6	18.281,0	166,6 0,9	83,65
13 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	6.913,2	6.759,4	153,8 2,2	73,27
14 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	6.891,4	6.642,2	249,1 3,6	72,87
15 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.205,1	7.130,5	74,6 1,0	75,58
16 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.086,1	6.976,7	109,4 1,5	74,98
17 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.140,3	6.963,4	176,9 2,5	75,70
18 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.071,5	6.821,8	249,6 3,5	75,68
19 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.452,9	7.381,4	71,4 1,0	80,33
20 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.655,9	7.547,0	108,9 1,4	81,54
21 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.541,7	7.400,7	141,1 1,9	81,77
22 A	No	Senvion	6.2M126-6.150	6.150	126,0	114,0	USER	Calcated power curve Senvion 6.2M126	18.923,9	18.465,2	458,8 2,4	82,98
23 A	No	Senvion	6.2M126-6.150	6.150	126,0	114,0	USER	Calcated power curve Senvion 6.2M126	18.926,8	18.412,8	513,9 2,7	82,44
24 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.673,1	7.543,5	129,6 1,7	84,15
25 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.541,6	7.476,8	64,9 0,9	82,88
26 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.392,8	7.343,0	49,8 0,7	81,54
27 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.420,1	7.400,3	19,7 0,3	81,87
28 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.484,6	7.470,7	13,9 0,2	82,04
29 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.535,0	7.522,9	12,1 0,2	82,41
30 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.476,5	7.467,0	9,4 0,1	82,48
31 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.555,8	7.548,6	7,2 0,1	83,03
32 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.750,1	7.744,3	5,8 0,1	84,31
33 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.943,6	7.937,1	6,5 0,1	86,39
34 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.428,3	8.422,6	5,6 0,1	91,90
35 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.909,3	7.895,7	13,6 0,2	87,33
36 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.889,4	7.874,3	15,1 0,2	87,42
37 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.893,4	7.874,0	19,3 0,2	87,50
38 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.866,4	7.840,7	25,6 0,3	87,51
39 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.861,8	7.824,8	37,0 0,5	87,40
40 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.904,6	7.850,3	54,3 0,7	87,85
41 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.518,0	7.335,5	182,4 2,4	80,26
42 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.268,4	7.130,5	137,9 1,9	78,46
43 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.412,0	7.308,8	103,2 1,4	80,53
44 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.803,4	7.749,5	53,9 0,7	81,88
45 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.274,8	8.236,0	38,8 0,5	85,09
46 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.204,3	8.167,5	36,9 0,4	83,77
47 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.225,9	8.172,3	53,6 0,7	83,66
48 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.993,8	7.940,6	53,2 0,7	82,78
49 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.950,5	7.891,2	59,3 0,7	82,77
50 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.822,5	7.743,2	79,3 1,0	80,61
51 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.887,4	7.782,0	105,4 1,3	81,17
52 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.861,1	7.768,7	92,5 1,2	80,81
53 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.855,6	7.733,6	122,0 1,6	80,90
54 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.716,6	7.592,9	123,7 1,6	79,67
55 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.505,1	7.375,5	129,6 1,7	77,49
56 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.270,2	7.056,4	213,7 2,9	75,65
57 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.105,1	6.747,9	357,2 5,0	73,69
58 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.258,3	6.708,2	550,1 7,6	74,66
59 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.501,0	6.743,3	757,8 10,1	73,99
60 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.562,7	6.638,5	924,2 12,2	73,92
61 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.660,4	6.764,5	896,0 11,7	75,10
62 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.561,1	6.686,0	875,1 11,6	74,32
63 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.602,4	6.665,3	937,0 12,3	74,33
64 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.691,8	7.008,3	683,5 8,9	77,91
65 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.715,1	7.190,6	524,6 6,8	80,52
66 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.859,2	7.247,8	611,4 7,8	80,78
67 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.845,8	7.288,8	557,0 7,1	81,12
68 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.779,6	7.275,6	504,0 6,5	81,89
69 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.761,8	7.154,2	607,6 7,8	80,66
70 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.711,7	7.181,2	530,4 6,9	81,10
71 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.742,1	7.120,3	621,8 8,0	80,67
72 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.697,6	7.144,5	553,1 7,2	81,31
73 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.781,2	7.305,8	475,4 6,1	82,63
74 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.055,1	7.437,3	617,8 7,7	84,84
75 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	100,0	EMD	Level 0 - official - Mode 0 - 08/2014	8.075,2	7.987,3	87,9 1,1	83,34
76 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	12.800,1	12.795,0	5,2 0,0	94,34
77 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	12.289,5	12.283,0	6,5 0,1	90,80
78 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	11.992,1	11.980,9	11,3 0,1	89,34
79 A	Yes	VESTAS	V117-3.6-3.600	3.600	117,0	117,0	EMD	Level 0 - Calculated - Modes PO1 & PO1-0S - 01-2016	15.257,1	15.200,1	57,0 0,4	96,77
80 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.313,7	7.961,2	352,5 4,2	76,65
81 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.222,2	7.873,0	349,2 4,2	75,59
82 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.181,9	7.653,4	528,5 6,5	73,28
83 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.255,6	7.792,1	463,5 5,6	73,92

To be continued on next page...

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 2b

...continued from previous page

Links	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Power curve Creator	Name	Annual Energy Calculated prod. without new WTGs	After New WTGs	Decrease due to new WTGs	Park Efficiency
				[kW]	[m]	[m]			[MWh]	[MWh]	[MWh %]	[%]
84 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.733,7	8.664,2	69,5 0,8	81,23
85 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.121,8	7.566,6	555,3 6,8	72,73
86 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.781,2	8.696,0	85,2 1,0	81,43
87 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.822,1	8.722,6	99,5 1,1	81,91
88 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.752,0	8.654,7	97,2 1,1	81,01
89 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.895,2	8.786,3	108,9 1,2	82,52
90 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.130,7	7.612,0	518,6 6,4	72,92
91 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	9.087,9	8.938,6	149,3 1,6	83,03
92 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.377,8	8.247,4	130,4 1,6	77,61
93 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.474,5	8.335,5	139,0 1,6	78,13
94 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.516,5	8.325,8	190,7 2,2	78,59
95 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.425,9	8.208,7	217,1 2,6	77,58
96 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.377,8	8.131,7	246,1 2,9	76,71
97 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.445,4	8.186,1	259,2 3,1	79,22
98 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.474,3	8.258,1	216,2 2,6	81,59
99 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.271,9	7.986,2	285,7 3,5	78,92
100 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.344,3	8.267,0	77,3 0,9	87,98
101 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.514,6	8.469,2	45,4 0,5	90,28
102 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.611,5	8.567,1	44,4 0,5	91,60

WTG siting

		Dutch Stereo-RD / NAP 2000 X (east)	Y (north)	Z [m]	Row data/Description
1	Exist	252.819	605.227	-0,3	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (244)
2	Exist	252.538	604.846	0,0	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (245)
3	Exist	253.250	604.530	0,0	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (246)
4	Exist	253.410	604.258	0,2	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (247)
5	Exist	253.038	605.625	0,3	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (248)
6	Exist	251.401	603.815	-0,1	VESTAS V47 660 47.0 !O! hub: 40,0 m (TOT: 63,5 m) (264)
7	Exist	253.765	603.860	1,8	VESTAS V52 850 52.0 !O! hub: 40,0 m (TOT: 66,0 m) (265)
8	Exist	252.007	608.545	1,6	VESTAS V117-3.45 3450 117.0 !O! hub: 93,5 m (TOT: 152,0 m) (266)
9	Exist	253.830	604.979	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (267)
10	Exist	253.634	605.359	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (268)
11	Exist	253.487	605.644	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (269)
12	Exist	248.875	608.572	2,5	2-B Energy OTC 6 MW 6000 140.0 !#! hub: 105,0 m (TOT: 175,0 m) (270)
13	Exist	253.662	606.943	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (271)
14	Exist	253.548	606.476	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (272)
15	Exist	254.026	607.172	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (273)
16	Exist	253.954	606.875	2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (274)
17	Exist	253.843	606.417	2,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (275)
18	Exist	253.758	606.067	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (276)
19	Exist	254.272	606.915	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (277)
20	Exist	254.151	605.985	2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (278)
21	Exist	253.996	605.473	0,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (279)
22	Exist	250.194	607.795	4,3	Senvion 6.2M126 6150 126.0 !O! hub: 114,0 m (TOT: 177,0 m) (280)
23	Exist	250.760	607.657	3,1	Senvion 6.2M126 6150 126.0 !O! hub: 114,0 m (TOT: 177,0 m) (281)
24	Exist	248.142	608.104	-1,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (282)
25	Exist	247.865	608.255	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (283)
26	Exist	247.590	608.377	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (284)
27	Exist	247.311	608.501	-1,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (285)
28	Exist	247.034	608.625	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (286)
29	Exist	246.747	608.713	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (371)
30	Exist	246.447	608.805	-2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (288)
31	Exist	246.172	608.890	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (289)
32	Exist	245.885	608.978	0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (290)
33	Exist	245.590	609.026	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (291)
34	Exist	245.294	609.056	-1,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (292)
35	Exist	246.045	608.352	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (293)
36	Exist	246.336	608.279	0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (294)
37	Exist	246.622	608.188	1,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (295)
38	Exist	246.907	608.088	-0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (296)
39	Exist	247.190	607.981	0,6	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (297)
40	Exist	247.472	607.870	0,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (298)
41	Exist	249.390	608.049	2,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (299)
42	Exist	249.023	608.155	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (300)
43	Exist	248.609	608.251	1,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (301)

To be continued on next page...

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 2b

...continued from previous page

		Dutch Stereo-RD / NAP 2000			
		X (east)	Y (north)	Z [m]	Row data/Description
44	Exist	249.242	608.904	-0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (302)
45	Exist	249.672	609.314	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (303)
46	Exist	250.005	609.324	2,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (304)
47	Exist	250.336	609.195	4,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (305)
48	Exist	250.665	609.061	1,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (306)
49	Exist	250.997	608.936	3,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (307)
50	Exist	252.323	608.418	1,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (308)
51	Exist	252.641	608.293	1,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (309)
52	Exist	252.949	608.128	2,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (310)
53	Exist	253.248	607.910	0,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (311)
54	Exist	253.547	607.637	0,6	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (312)
55	Exist	253.756	607.438	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (313)
56	Exist	253.425	607.194	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (314)
57	Exist	253.312	606.728	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (315)
58	Exist	253.341	605.928	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (316)
59	Exist	253.172	606.215	4,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (317)
60	Exist	252.880	606.379	-0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (318)
61	Exist	252.576	606.567	1,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (319)
62	Exist	252.262	606.720	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (320)
63	Exist	251.932	606.799	-2,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (321)
64	Exist	251.602	606.881	0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (322)
65	Exist	251.272	606.961	-1,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (323)
66	Exist	250.915	607.046	1,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (324)
67	Exist	250.558	607.133	1,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (325)
68	Exist	250.211	607.197	-1,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (326)
69	Exist	249.862	607.249	-0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (327)
70	Exist	249.511	607.301	0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (328)
71	Exist	249.207	607.349	0,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (329)
72	Exist	248.841	607.404	-0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (330)
73	Exist	248.444	607.403	0,6	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (331)
74	Exist	248.125	607.370	-1,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (332)
75	Exist	251.691	608.611	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 100,0 m (TOT: 141,0 m) (333)
76	Exist	245.161	608.566	0,7	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (354)
77	Exist	245.463	608.501	0,4	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (355)
78	Exist	245.775	608.421	-1,5	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (356)
79	Exist	253.792	603.479	1,0	VESTAS V117-3.6 3600 117.0 !O! hub: 117,0 m (TOT: 175,5 m) (664)
80	Exist	251.345	607.258	2,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (599)
81	Exist	251.679	607.196	1,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (600)
82	Exist	252.008	607.117	1,0	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (601)
83	Exist	252.340	607.043	3,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (602)
84	Exist	249.539	608.811	0,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (603)
85	Exist	252.654	606.896	1,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (604)
86	Exist	249.866	608.752	0,4	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (605)
87	Exist	250.208	608.666	1,0	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (606)
88	Exist	250.550	608.586	0,9	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (607)
89	Exist	250.892	608.503	2,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (608)
90	Exist	252.958	606.705	1,5	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (609)
91	Exist	251.566	608.173	4,2	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (610)
92	Exist	252.219	607.986	-0,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (611)
93	Exist	252.852	607.716	1,9	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (612)
94	Exist	251.793	607.668	1,6	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (613)
95	Exist	252.144	607.675	2,7	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (614)
96	Exist	252.765	607.355	1,6	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (615)
97	Exist	249.631	607.787	2,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (616)
98	Exist	248.339	607.818	-1,2	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (617)
99	Exist	248.736	607.792	-1,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (618)
100	Exist	253.864	604.596	0,0	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (712)
101	Exist	253.855	604.236	0,0	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (713)
102	Exist	253.850	603.877	0,2	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (714)
103	New	247.921	607.039	0,0	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (308)
104	New	248.478	606.954	-1,0	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (309)
105	New	249.033	606.849	0,9	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (310)
106	New	249.583	606.726	-1,8	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (311)
107	New	250.125	606.585	-0,9	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (312)

To be continued on next page...

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 2b

...continued from previous page

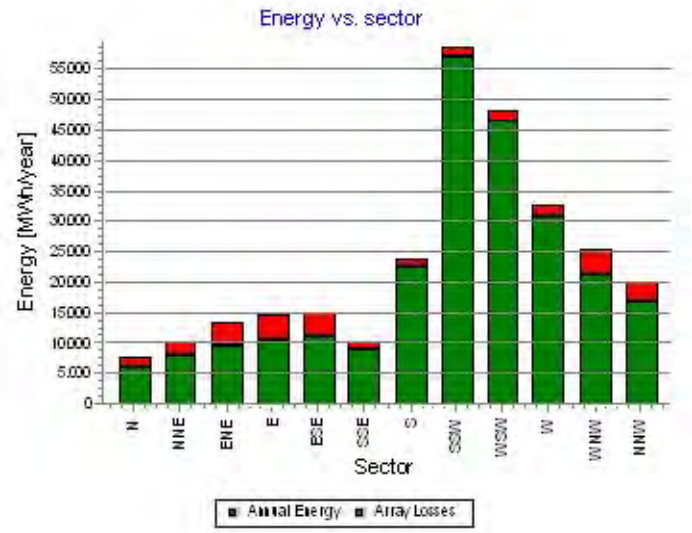
		Dutch Stereo-RD / NAP 2000			
		X (east)	Y (north)	Z [m]	Row data/Description
108	New	250.661	606.425	-1,6	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (313)
109	New	251.188	606.234	-1,0	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (314)
110	New	251.683	605.973	-0,2	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (315)
111	New	252.097	605.651	0,0	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (316)
112	New	251.717	604.874	-0,4	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (317)
113	New	252.401	605.310	-0,2	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (318)
114	New	251.679	606.481	-1,3	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (319)
115	New	252.186	606.268	0,9	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (320)
116	New	252.650	606.008	1,0	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (321)
117	New	252.910	605.642	0,3	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (322)

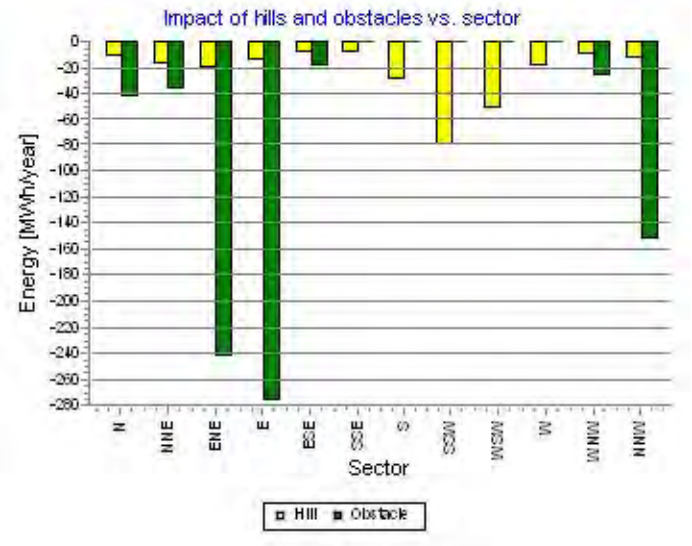
PARK - Production Analysis

Calculation: 716033 WP Oostpolder alternatief 2bWTG: All new WTGs, Air density varies with WTG position 1,236 kg/m³ - 1,248 kg/m³

Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	7.790,0	10.412,7	13.580,2	15.046,2	15.093,9	10.224,3	24.077,8	58.890,4	48.521,4	32.783,3	25.639,8	20.291,8	282.351,6
-Decrease due to obstacles	[MWh]	42,6	36,6	242,1	276,3	18,7	0,2	0,0	0,0	0,0	0,0	26,3	151,5	794,2
+Increase due to hills	[MWh]	-11,0	-17,9	-21,1	-14,1	-8,7	-8,2	-29,5	-79,4	-51,6	-18,7	-10,1	-12,9	-283,2
-Decrease due to array losses	[MWh]	1.587,3	2.189,8	3.645,3	4.158,7	3.882,3	1.070,6	1.401,8	1.648,3	1.977,0	1.826,1	4.182,1	3.246,6	30.816,1
Resulting energy	[MWh]	6.149,1	8.168,4	9.671,7	10.597,0	11.184,2	9.145,4	22.646,4	57.162,7	46.492,7	30.938,5	21.421,3	16.880,6	250.458,0
Specific energy	[kWh/m²]													1.318
Specific energy	[kWh/kW]													3.976
Decrease due to obstacles	[%]	0,5	0,4	1,8	1,8	0,1	0,0	0,0	0,0	0,0	0,0	0,1	0,7	0,28
Increase due to hills	[%]	-0,1	-0,2	-0,2	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	0,0	-0,1	-0,10
Decrease due to array losses	[%]	20,5	21,1	27,4	28,2	25,8	10,5	5,8	2,8	4,1	5,6	16,3	16,1	10,96
Utilization	[%]	21,6	23,7	24,4	24,8	23,1	22,9	24,2	25,6	21,9	18,6	17,0	18,5	21,8
Operational	[Hours/year]	337	383	520	604	542	357	704	1.455	1.344	947	742	590	8.524
Full Load Equivalent	[Hours/year]	98	130	154	168	178	145	359	907	738	491	340	268	3.976



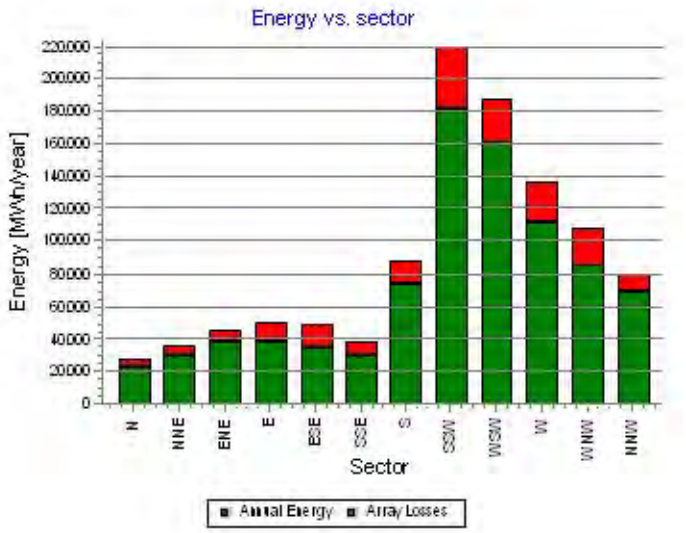


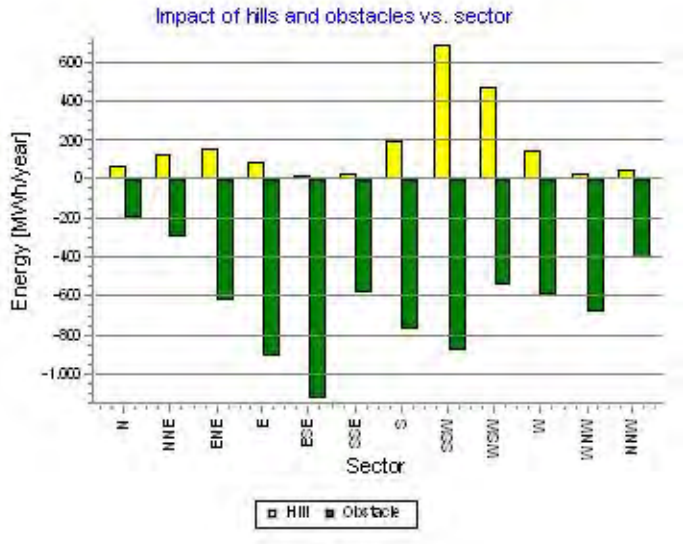
PARK - Production Analysis

Calculation: 716033 WP Oostpolder alternatief 2bWTG: All existing WTGs, Air density varies with WTG position 1,236 kg/m³ - 1,248 kg/m³

Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	27.773,1	36.183,5	46.549,9	50.905,6	50.704,9	38.783,0	89.039,8	219.772,1	187.819,5	136.783,6	109.534,6	79.965,9	1.073.816,0
-Decrease due to obstacles	[MWh]	191,0	291,8	628,3	914,8	1.125,6	585,8	774,4	882,1	550,6	594,5	680,3	401,0	7.620,2
+Increase due to hills	[MWh]	65,3	127,8	154,3	89,5	24,1	27,0	193,1	687,6	469,8	146,2	31,1	51,4	2.067,3
-Decrease due to array losses	[MWh]	4.320,6	5.803,9	7.502,9	11.566,7	14.754,1	7.396,3	14.883,3	37.208,8	27.683,3	24.395,8	23.586,8	11.275,4	190.377,9
Resulting energy	[MWh]	23.326,8	30.215,7	38.573,0	38.513,7	34.849,3	30.827,9	73.575,2	182.368,8	160.055,4	111.939,4	85.298,5	68.340,9	877.884,6
Specific energy	[kWh/m²]													1.337
Specific energy	[kWh/kW]													2.767
Decrease due to obstacles	[%]	0,7	0,8	1,3	1,8	2,2	1,5	0,9	0,4	0,3	0,4	0,6	0,5	0,71
Increase due to hills	[%]	0,2	0,4	0,3	0,2	0,0	0,1	0,2	0,3	0,3	0,1	0,0	0,1	0,19
Decrease due to array losses	[%]	15,6	16,1	16,3	23,1	29,7	19,3	16,8	16,9	14,7	17,9	21,7	14,2	17,82
Utilization	[%]	28,7	31,1	33,2	30,8	26,7	25,9	27,8	28,7	25,8	21,1	20,1	25,0	25,7
Operational	[Hours/year]	333	375	509	592	531	354	688	1.426	1.324	945	738	584	8.399
Full Load Equivalent	[Hours/year]	74	95	122	121	110	97	232	575	504	353	269	215	2.767





PARK - Power Curve Analysis

Calculation: 716033 WP Oostpolder alternatief 2bWTG: 103 - ENERCON E-126 EP4 TES 4200 127.0 !O! Level 0 - official - 0 s - 4200kW - 08/2015, Hub height: 135,0 m

Name: Level 0 - official - 0 s - 4200kW - 08/2015
Source: Enercon

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type	Generator type	Specific power kW/m²
4-8-2014	EMD	8-1-2013	15-9-2015	25,0	Pitch	User defined	Variable	0,33

According to manufacturer specification document "D0387022-1_#_de_#_Betriebsmodi_E-126_EP4___4200_kW_mit_TES.pdf", 2015-08-04

HP curve comparison - Note: For standard air density and weibull k parameter = 2

Vmean	[m/s]	5	6	7	8	9	10
HP value Pitch, variable speed (2013)	[MWh]	6.510	10.042	13.522	16.671	19.361	21.537
ENERCON E-126 EP4 TES 4200 127.0 !O! Level 0 - official - 0 s - 4200kW - 08/2015	[MWh]	6.480	9.868	13.238	16.316	18.960	21.098
Check value	[%]	0	2	2	2	2	2

The table shows comparison between annual energy production calculated on basis of simplified "HP-curves" which assume that all WTGs performs quite similar - only specific power loading (kW/m^2) and single/dual speed or stall/pitch decides the calculated values. Productions are without wake losses.
For further details, ask at the Danish Energy Agency for project report J.nr. 51171/00-0016 or see windPRO manual chapter 3.5.2.
The method is refined in EMD report "20 Detailed Case Studies comparing Project Design Calculations and actual Energy Productions for Wind Energy Projects worldwide", jan 2003.
Use the table to evaluate if the given power curve is reasonable - if the check value is lower than -5%, the power curve probably is too optimistic due to uncertainty in power curve measurement.

Power curve

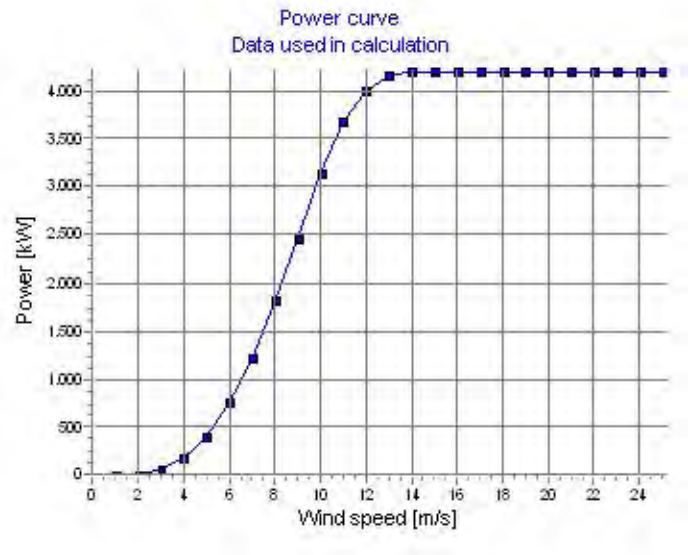
Original data, Air density: 1,225 kg/m³

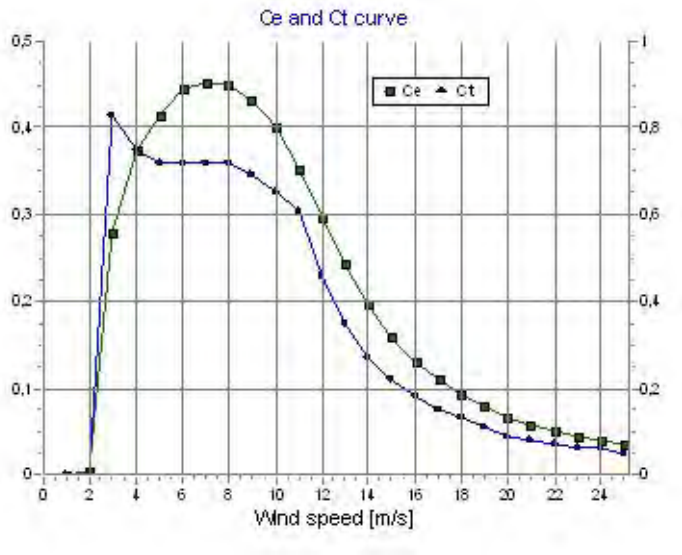
Wind speed [m/s]	Power [kW]	Ce	Wind speed [m/s]	Ct curve
1,0	0,0	0,00	1,0	0,00
2,0	0,0	0,00	2,0	0,00
3,0	58,0	0,28	3,0	0,83
4,0	185,0	0,37	4,0	0,75
5,0	400,0	0,41	5,0	0,72
6,0	745,0	0,44	6,0	0,72
7,0	1.200,0	0,45	7,0	0,72
8,0	1.790,0	0,45	8,0	0,72
9,0	2.450,0	0,43	9,0	0,69
10,0	3.120,0	0,40	10,0	0,65
11,0	3.660,0	0,35	11,0	0,61
12,0	4.000,0	0,30	12,0	0,46
13,0	4.150,0	0,24	13,0	0,35
14,0	4.200,0	0,20	14,0	0,27
15,0	4.200,0	0,16	15,0	0,22
16,0	4.200,0	0,13	16,0	0,18
17,0	4.200,0	0,11	17,0	0,15
18,0	4.200,0	0,09	18,0	0,13
19,0	4.200,0	0,08	19,0	0,11
20,0	4.200,0	0,07	20,0	0,09
21,0	4.200,0	0,06	21,0	0,08
22,0	4.200,0	0,05	22,0	0,07
23,0	4.200,0	0,04	23,0	0,06
24,0	4.200,0	0,04	24,0	0,06
25,0	4.200,0	0,03	25,0	0,05

Power, Efficiency and energy vs. wind speed

Data used in calculation, Air density: 1,236 kg/m³ New windPRO method (adjusted IEC method, improved to match turbine control) <RECOMMENDED>

Wind speed [m/s]	Power [kW]	Ce	Interval [m/s]	Energy [MWh]	Acc.Energy [MWh]	Relative [%]
1,0	0,0	0,00	0,50- 1,50	0,0	0,0	0,0
2,0	0,3	0,01	1,50- 2,50	4,6	4,6	0,0
3,0	59,1	0,28	2,50- 3,50	33,0	37,6	0,2
4,0	187,5	0,37	3,50- 4,50	116,2	153,7	0,9
5,0	405,0	0,41	4,50- 5,50	290,6	444,3	2,5
6,0	752,9	0,45	5,50- 6,50	581,1	1.025,4	5,9
7,0	1.211,9	0,45	6,50- 7,50	980,4	2.005,8	11,5
8,0	1.805,4	0,45	7,50- 8,50	1.439,3	3.445,1	19,7
9,0	2.468,8	0,43	8,50- 9,50	1.863,7	5.308,7	30,3
10,0	3.139,0	0,40	9,50-10,50	2.137,6	7.446,4	42,5
11,0	3.675,1	0,35	10,50-11,50	2.177,3	9.623,7	54,9
12,0	4.007,9	0,30	11,50-12,50	1.987,5	11.611,2	66,3
13,0	4.152,9	0,24	12,50-13,50	1.656,7	13.267,9	75,8
14,0	4.200,0	0,20	13,50-14,50	1.288,8	14.556,7	83,1
15,0	4.200,0	0,16	14,50-15,50	952,5	15.509,1	88,6
16,0	4.200,0	0,13	15,50-16,50	677,2	16.186,3	92,4
17,0	4.200,0	0,11	16,50-17,50	466,7	16.653,0	95,1
18,0	4.200,0	0,09	17,50-18,50	313,7	16.966,7	96,9
19,0	4.200,0	0,08	18,50-19,50	206,8	17.173,6	98,1
20,0	4.200,0	0,07	19,50-20,50	134,5	17.308,0	98,8
21,0	4.200,0	0,06	20,50-21,50	86,5	17.394,5	99,3
22,0	4.200,0	0,05	21,50-22,50	55,1	17.449,6	99,6
23,0	4.200,0	0,04	22,50-23,50	34,7	17.484,3	99,8
24,0	4.200,0	0,04	23,50-24,50	21,6	17.506,0	100,0
25,0	4.200,0	0,03	24,50-25,50	8,3	17.514,2	100,0





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NL-7556 PE Hengelo
0031742489940

Calculated:
16-3-2017 14:49/3.1.597

PARK - Terrain

Calculation: 716033 WP Oostpolder alternatief 2bSite Data: A - Oostpolder site data

Obstacles:
23 Obstacles used

Roughness:
Terrain data files used in calculation:
\\sbs2011\projecten\Extern\2015\715068 WTG Intocon Eemshaven\TO\WP\ROUGHNESSLINE_713066 715068_1.wpo
Min X: 219.227, Max X: 278.331, Min Y: 577.425, Max Y: 638.717, Width: 59.104 m, Height: 61.292 m

Orography:
Terrain data files used in calculation:
\\sbs2011\projecten\Extern\2016\716033 WP Oostpolder\TO\WP\ObjectImports\713066 715068_EMDGrid_0(1).wpg
Min X: 198.208, Max X: 300.556, Min Y: 557.205, Max Y: 659.267, Width: 102.348 m, Height: 102.062 m

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NL-7556 PE Hengelo
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Calculated:
16-3-2017 14:49/3.1.597

PARK - Wind Data Analysis

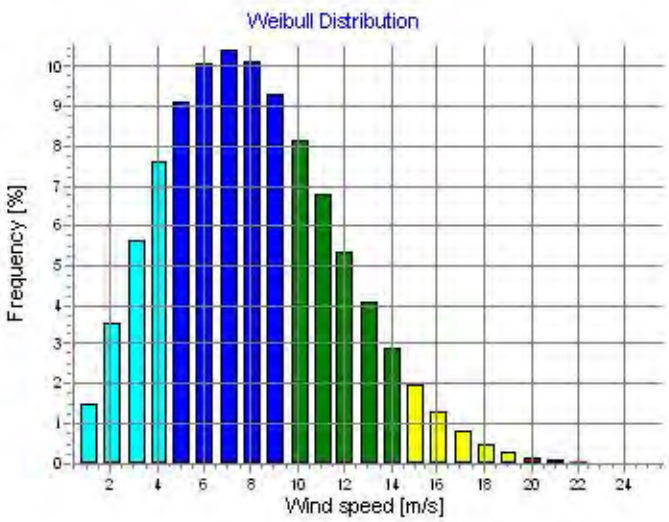
Calculation: 716033 WP Oostpolder alternatief 2bWind data: A - Oostpolder site data; Hub height: 100,0

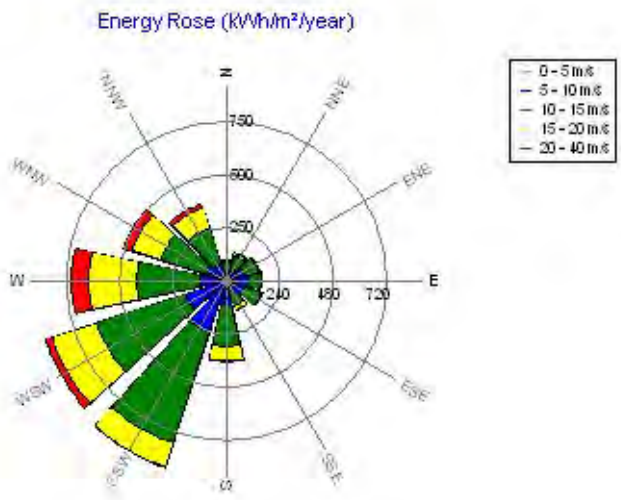
Site coordinates
Dutch Stereo-RD/NAP 2000
East: 250.596 North: 606.527

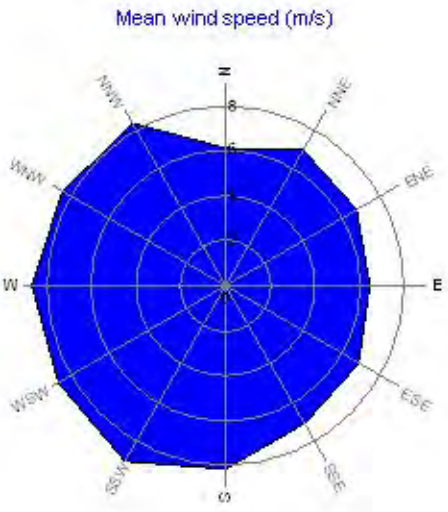
Wind statistics
RWE_Oostpolder 100m-Corr099.wws

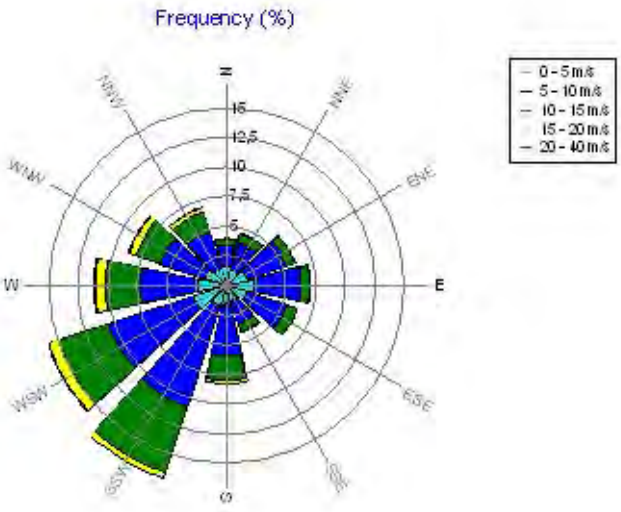
Weibull Data

Sector	Current site A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	6,90	6,13	1,854	4,0
1 NNE	7,85	6,95	2,322	4,5
2 ENE	7,60	6,75	2,545	6,1
3 E	7,30	6,48	2,553	7,1
4 ESE	7,79	6,91	2,498	6,3
5 SSE	7,97	7,06	2,115	4,2
6 S	9,18	8,14	2,486	8,2
7 SSW	10,06	9,00	3,146	17,0
8 WSW	9,71	8,61	2,393	15,8
9 W	9,77	8,65	2,068	11,2
10 WNW	9,48	8,40	2,119	8,7
11 NNW	9,43	8,35	2,209	6,9
All	9,03	8,00	2,287	100,0









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Calculated:
16-3-2017 14:49/3.1.597

PARK - Wind Data Analysis

Calculation: 716033 WP Oostpolder alternatief 2bWind data: A - Oostpolder site data; Hub height: 135,0

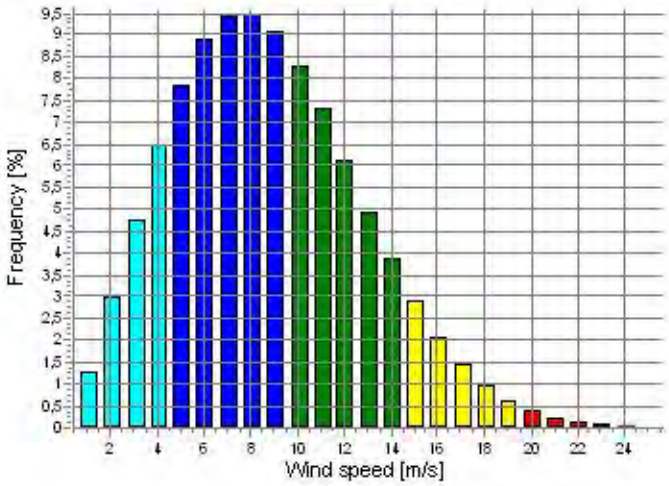
Site coordinates
Dutch Stereo-RD/NAP 2000
East: 250.596 North: 606.527

Wind statistics
RWE_Oostpolder 100m-Corr099.wws

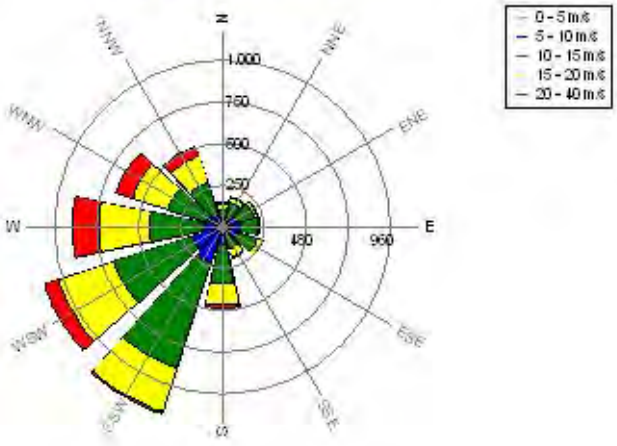
Weibull Data

Sector	Current site A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	7,73	6,87	1,814	4,0
1 NNE	8,64	7,66	2,275	4,5
2 ENE	8,40	7,45	2,494	6,1
3 E	8,07	7,16	2,498	7,1
4 ESE	8,71	7,72	2,451	6,3
5 SSE	8,77	7,77	2,072	4,2
6 S	9,95	8,83	2,443	8,2
7 SSW	10,88	9,73	3,096	17,1
8 WSW	10,44	9,25	2,357	15,8
9 W	10,45	9,26	2,045	11,1
10 WNW	10,36	9,17	2,084	8,7
11 NNW	10,32	9,14	2,166	6,9
All	9,82	8,70	2,268	100,0

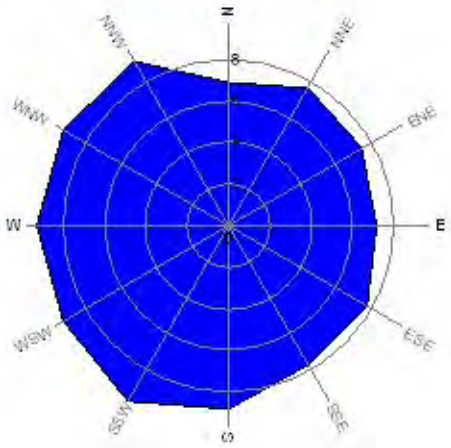
Weibull Distribution



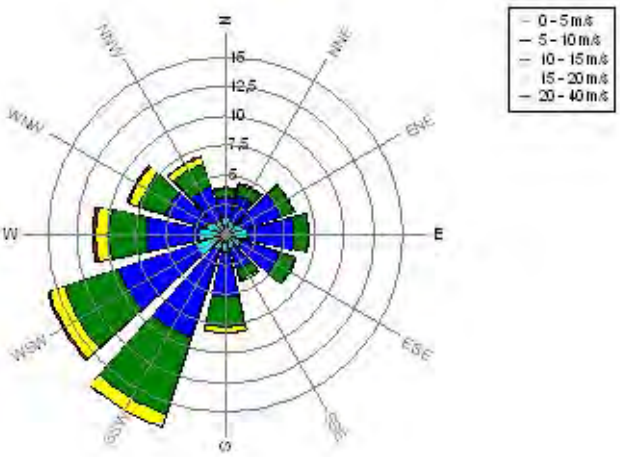
Energy Rose (kWh/m²/year)



Mean wind speed (m/s)



Frequency (%)



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Calculated:
16-3-2017 14:49/3.1.597

PARK - Park power curve

Calculation: 716033 WP Oostpolder alternatief 2b

Wind speed [m/s]	Power Free WTGs [kW]	Park WTGs [kW]	N [kW]	NNE [kW]	ENE [kW]	E [kW]	ESE [kW]	SSE [kW]	S [kW]	SSW [kW]	WSW [kW]	W [kW]	WNW [kW]	NNW [kW]
0,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2,5	1.446	773	650	652	647	604	570	749	918	942	961	832	532	601
3,5	7.240	4.323	4.309	4.398	4.387	3.940	3.439	4.316	4.752	4.872	4.833	4.139	3.299	3.988
4,5	19.622	12.977	13.215	13.450	13.528	12.236	10.601	12.810	13.736	14.095	14.129	12.487	10.554	12.627
5,5	38.514	26.708	27.058	27.452	27.494	25.213	22.364	26.573	28.177	28.722	28.828	25.927	22.370	26.075
6,5	65.756	46.475	47.218	47.743	47.643	44.039	39.384	46.219	48.878	49.679	49.829	45.252	39.545	45.599
7,5	102.472	73.375	74.760	75.576	75.405	69.821	62.659	72.965	76.986	78.147	78.294	71.338	62.880	72.236
8,5	148.535	108.486	111.101	112.322	112.124	103.948	93.303	107.950	113.403	114.963	115.147	105.178	93.383	107.437
9,5	201.087	151.883	156.530	158.027	157.953	146.776	131.878	151.347	158.039	159.735	160.128	146.926	131.658	151.657
10,5	253.143	200.715	208.520	209.236	209.465	195.617	176.365	200.368	208.019	208.803	209.665	194.186	176.431	202.769
11,5	297.042	249.498	259.954	259.204	260.036	244.547	222.543	249.720	257.669	257.070	258.566	242.200	222.969	253.696
12,5	331.139	293.334	304.979	303.041	304.119	288.742	266.549	294.402	301.424	299.861	301.739	286.192	267.251	299.048
13,5	356.098	329.898	341.097	339.003	340.273	326.678	306.825	331.610	336.437	334.874	336.704	323.596	306.658	335.844
14,5	370.634	356.865	364.491	363.155	364.381	354.581	339.539	359.388	362.094	360.729	362.033	352.888	338.342	360.821
15,5	378.069	371.623	375.698	375.250	375.710	370.451	360.826	373.486	374.783	374.197	374.604	369.631	360.457	373.724
16,5	381.157	379.007	380.606	380.428	380.565	378.505	374.274	380.027	380.390	380.173	380.265	378.268	374.183	379.936
17,5	381.652	381.330	381.616	381.589	381.608	381.218	380.404	381.531	381.605	381.571	381.588	381.243	380.326	381.490
18,5	381.642	381.623	381.647	381.649	381.644	381.615	381.540	381.641	381.642	381.643	381.643	381.624	381.537	381.643
19,5	381.625	381.629	381.630	381.632	381.629	381.629	381.629	381.630	381.627	381.629	381.628	381.630	381.631	381.632
20,5	375.607	375.609	375.611	375.611	375.609	375.608	375.608	375.609	375.608	375.609	375.608	375.610	375.611	375.612
21,5	375.591	375.595	375.596	375.597	375.594	375.593	375.593	375.595	375.593	375.594	375.594	375.595	375.597	375.598
22,5	375.579	375.580	375.582	375.582	375.580	375.579	375.580	375.580	375.579	375.580	375.580	375.580	375.582	375.582
23,5	375.569	375.570	375.572	375.572	375.570	375.569	375.569	375.570	375.569	375.570	375.569	375.570	375.572	375.573
24,5	375.590	375.580	375.565	375.568	375.578	375.584	375.582	375.579	375.590	375.585	375.586	375.582	375.569	375.565
25,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Description:
The park power curve is similar to a WTG power curve, meaning that when a given wind speed appears in front of the park with same speed in the entire wind farm area (before influence from the park), the output from the park can be found in the park power curve. Another way to say this: The park power curve includes array losses, but do NOT include terrain given variations in the wind speed over the park area.
Measuring a park power curve is not as simple as measuring a WTG power curve due to the fact that the park power curve depends on the wind direction and that the same wind speed normally will not appear for the entire park area at the same time (only in very flat non-complex terrain). The idea with this version of the park power curve is not to use it for validation based on measurements. This would require at least 2 measurement masts at two sides of the park, unless only a few direction sectors should be tested, AND non complex terrain (normally only useable off shore). Another park power curve version for complex terrain is available in windPRO.

The park power curve can be used for:

1. Forecast systems, based on more rough (approximated) wind data, the park power curve would be an efficient way to make the connection from wind speed (and direction) to power.
2. Construction of duration curves, telling how often a given power output will appear, the park power curve can be used together with the average wind distribution for the Wind farm area in hub height. The average wind distribution can eventually be obtained based on the Weibull parameters for each WTG position. These are found at print menu: >Result to file< in the >Park result< which can be saved to file or copied to clipboard and pasted in Excel.
3. Calculation of wind energy index based on the PARK production (see below).
4. Estimation of the expected PARK production for an existing wind farm based on wind measurements at minimum 2 measurement masts at two sides of wind farm. The masts must be used for obtaining the free wind speed. The free wind speed is used in the simulation of expected energy production with the PARK power curve. This procedure will only work suitable in non complex terrains. For complex terrain another park power curve calculation is available in windPRO (PPV-model).

Note:
From the >Result to file< the >Wind Speeds Inside Wind farm< is also available. These can (e.g. via Excel) be used for extracting the wake induced reductions in measured wind speed.

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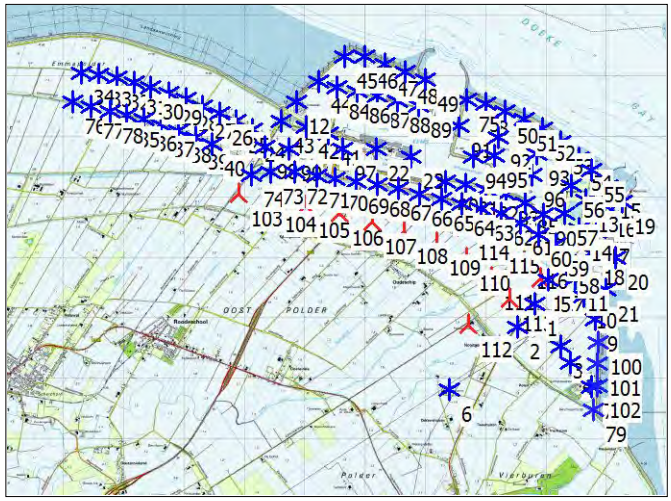
PARK - WTG distances

Calculation: 716033 WP Oostpolder alternatief 2b

WTG distances

	Z [m]	Nearest WTG	Z [m]	Horizontal distance [m]	Distance in|rotor diameters (max)	Distance in|rotor diameters (min)
1	-0,3	117	0,3	425	3,3	3,1
2	0,0	1	-0,3	473	3,5	3,5
3	0,0	4	0,2	315	2,3	2,3
4	0,2	3	0,0	315	2,3	2,3
5	0,3	117	0,3	129	1,0	0,9
6	-0,1	112	-0,4	1.105	23,5	8,7
7	1,8	102	0,2	87	1,7	0,9
8	1,6	75	1,0	323	3,9	2,8
9	0,1	100	0,0	384	4,7	3,8
10	-0,4	11	1,0	321	3,9	3,9
11	1,0	58	1,0	319	3,9	3,9
12	2,5	43	1,9	417	5,1	3,0
13	-1,0	16	2,0	300	3,7	3,7
14	1,0	17	2,7	301	3,7	3,7
15	1,0	16	2,0	306	3,7	3,7
16	2,0	13	-1,0	300	3,7	3,7
17	2,7	14	1,0	301	3,7	3,7
18	-0,7	17	2,7	360	4,4	4,4
19	0,1	16	2,0	320	3,9	3,9
20	2,0	18	-0,7	401	4,9	4,9
21	0,0	10	-0,4	379	4,6	4,6
22	4,3	97	2,8	563	6,3	4,5
23	3,1	67	1,3	561	6,8	4,5
24	-1,2	25	-0,4	315	3,8	3,8
25	-0,4	26	-1,0	301	3,7	3,7
26	-1,0	25	-0,4	301	3,7	3,7
27	-1,3	28	0,2	303	3,7	3,7
28	0,2	29	1,8	300	3,7	3,7
29	1,8	28	0,2	300	3,7	3,7
30	-2,0	31	-0,7	288	3,5	3,5
31	-0,7	30	-2,0	288	3,5	3,5
32	0,3	33	0,1	299	3,6	3,6
33	0,1	34	-1,1	297	3,6	3,6
34	-1,1	33	0,1	297	3,6	3,6
35	1,8	78	-1,5	279	3,4	2,5
36	0,5	35	1,8	300	3,7	3,7
37	1,5	36	0,5	300	3,7	3,7
38	-0,2	37	1,5	302	3,7	3,7
39	0,6	38	-0,2	302	3,7	3,7
40	0,9	39	0,6	303	3,7	3,7
41	2,7	97	2,8	356	4,3	4,0
42	0,2	41	2,7	382	4,7	4,7
43	1,9	12	2,5	417	5,1	3,0
44	-0,5	84	0,1	311	3,8	3,5
45	0,2	46	2,8	333	4,1	4,1
46	2,8	45	0,2	333	4,1	4,1
47	4,8	48	1,4	355	4,3	4,3
48	1,4	49	3,2	355	4,3	4,3
49	3,2	48	1,4	355	4,3	4,3
50	1,1	8	1,6	340	4,2	2,9
51	1,4	50	1,1	342	4,2	4,2
52	2,1	51	1,4	349	4,3	4,3
53	0,8	52	2,1	370	4,5	4,5
54	0,6	55	1,8	289	3,5	3,5
55	1,8	54	0,6	289	3,5	3,5
56	-0,4	13	-1,0	345	4,2	4,2
57	-0,7	14	1,0	345	4,2	4,2
58	1,0	11	1,0	319	3,9	3,9
59	4,7	58	1,0	333	4,1	4,1
60	-0,3	59	4,7	335	4,1	4,1
61	1,7	85	1,3	338	4,1	3,8
62	-1,0	83	3,1	332	4,1	3,7
63	-2,9	82	1,0	327	4,0	3,6



Scale 1:125.000

New WTG Existing WTG

To be continued on next page...

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PARK - WTG distances

Calculation: 716033 WP Oostpolder alternatief 2b

...continued from previous page

	Z	Nearest WTG	Z	Horizontal distance	Distance in|rotor diameters (max)	Distance in|rotor diameters (min)
	[m]		[m]	[m]		
64	0,3	81	1,8	324	4,0	3,6
65	-1,9	80	2,3	306	3,7	3,4
66	1,5	65	-1,9	367	4,5	4,5
67	1,3	68	-1,2	353	4,3	4,3
68	-1,2	67	1,3	353	4,3	4,3
69	-0,5	68	-1,2	353	4,3	4,3
70	0,5	71	0,0	308	3,8	3,8
71	0,0	70	0,5	308	3,8	3,8
72	-0,1	71	0,0	370	4,5	4,5
73	0,6	74	-1,3	321	3,9	3,9
74	-1,3	73	0,6	321	3,9	3,9
75	1,0	8	1,6	323	3,9	2,8
76	0,7	77	0,4	309	2,8	2,8
77	0,4	76	0,7	309	2,8	2,8
78	-1,5	35	1,8	279	3,4	2,5
79	1,0	7	1,8	382	7,3	3,3
80	2,3	65	-1,9	306	3,7	3,4
81	1,8	64	0,3	324	4,0	3,6
82	1,0	63	-2,9	327	4,0	3,6
83	3,1	62	-1,0	332	4,1	3,7
84	0,1	44	-0,5	311	3,8	3,5
85	1,3	61	1,7	338	4,1	3,8
86	0,4	84	0,1	332	3,7	3,7
87	1,0	88	0,9	351	3,9	3,9
88	0,9	87	1,0	351	3,9	3,9
89	2,3	88	0,9	352	3,9	3,9
90	1,5	60	-0,3	335	4,1	3,7
91	4,2	75	1,0	455	5,6	5,1
92	-0,8	95	2,7	320	3,6	3,6
93	1,9	96	1,6	371	4,1	4,1
94	1,6	95	2,7	351	3,9	3,9
95	2,7	92	-0,8	320	3,6	3,6
96	1,6	93	1,9	371	4,1	4,1
97	2,8	41	2,7	356	4,3	4,0
98	-1,2	24	-1,2	347	4,2	3,9
99	-1,1	98	-1,2	398	4,4	4,4
100	0,0	101	0,0	360	3,6	3,6
101	0,0	102	0,2	359	3,6	3,6
102	0,2	7	1,8	87	1,7	0,9
103	0,0	74	-1,3	389	4,7	3,1
104	-1,0	73	0,6	450	5,5	3,5
105	0,9	71	0,0	529	6,5	4,2
106	-1,8	107	-0,9	560	4,4	4,4
107	-0,9	108	-1,6	560	4,4	4,4
108	-1,6	109	-1,0	560	4,4	4,4
109	-1,0	114	-1,3	550	4,3	4,3
110	-0,2	114	-1,3	508	4,0	4,0
111	0,0	113	-0,2	457	3,6	3,6
112	-0,4	113	-0,2	811	6,4	6,4
113	-0,2	1	-0,3	426	3,4	3,1
114	-1,3	63	-2,9	406	4,9	3,2
115	0,9	62	-1,0	458	5,6	3,6
116	1,0	60	-0,3	436	5,3	3,4
117	0,3	5	0,3	129	1,0	0,9
Min	-2,9		-2,9	87	1,0	0,9
Max	4,8		4,7	1.105	23,5	8,7

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PARK - Wind statistics info

Calculation: 716033 WP Oostpolder alternatief 2b

Main data for wind statistic

File	\\sbs2011\projecten\Extern\2016\716033 WP Oostpolder\TO\WP\200117\24012017\RWE_Oostpolder 100m-Corr099.wws
Name	RWE_Oostpolder 100m-Corr099
Country	Netherlands
Source	User
Mast coordinates	Dutch Stereo-RD/NAP 2000 East: 248.822 North: 608.196
Created	24-1-2017
Edited	1-2-2017
Sectors	12
WAsP version	WAsP 11 Version 11.05.0028
Displacement height	None

Additional info for wind statistic

Source data	Default Meteo data RWE
Data from	25-4-2007
Data to	31-1-2009
Measurement length	21,3 Months

Note

To get the most correct calculation results, wind statistics shall be calculated with the SAME model and model parameters, as currently chosen in calculation. For WAsP versions before 10.0, the model is unchanged, but thereafter more model changes affecting the wind statistic is seen. Likewise WAsP CFD should always use WAsP CFD calculated wind statistics.

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Calculated:
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PARK - Map

Calculation: 716033 WP Oostpolder alternatief 2b

Map: Uithuizen , Print scale 1:75.000, Map center Dutch Stereo-RD/NAP 2000 East: 249.717 North: 606.402

New WTG Existing WTG Obstacle

Project:
24_01_2017

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Calculated:
16-3-2017 14:51/3.1.597

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 3b

Wake Model	N.O. Jensen (RISØ/EMD)

Calculation Settings

Air density calculation mode	Individual per WTG
Result for WTG at hub altitude	1,236 kg/m³ to 1,248 kg/m³
Air density relative to standard	100,9 % to 101,8 %
Hub altitude above sea level (asl)	39,9 m to 132,3 m
Annual mean temperature at hub alt.	8,2 °C to 8,8 °C
Pressure at WTGs	998,4 hPa to 1.009,6 hPa

Wake Model Parameters

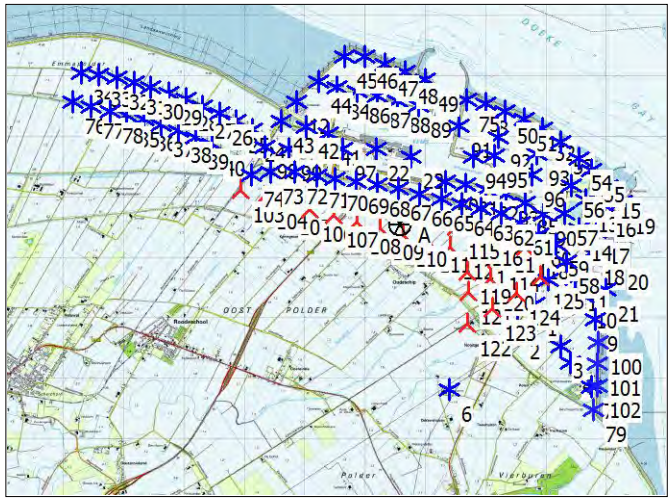
Terrain type	Wake decay constant
HH:100m Open farmland	0,062

Displacement heights from objects

Wake calculation settings

Angle [°]			Wind speed [m/s]		
start	end	step	start	end	step
0,5	360,0	1,0	0,5	30,5	1,0

Wind statistics	RWE_Oostpolder 100m-Corr099.wws
WAsP version	WAsP 11 Version 11.05.0028



Scale 1:125.000

New WTG Existing WTG
Site Data

Key results for height 120,0 m above ground level

Terrain Dutch Stereo-RD/NAP 2000

	X (east)	Y (north)	Name of wind distribution	Type	Wind energy [kWh/m²]	Mean wind speed [m/s]	Equivalent roughness
A	250.596	606.527	Oostpolder site data	WAsP (WAsP 11 Version 11.05.0028)	5.493	8,4	1,1

Calculated Annual Energy for Wind Farm

WTG combination	Result PARK [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Specific results¤) Park efficiency [%]	Capacity factor [%]	Mean WTG result [MWh/y]	Full load hours [Hours/year]	Mean wind speed @hub height [m/s]
Wind farm	1.089.643,9	1.315.323,6	82,8	33,5	8.717,2	2.935	8,2
New WTGs only	212.178,1	247.061,1	85,9	44,8	9.225,1	3.926	8,4
Existing park WTGs only	877.465,8	1.068.262,5	82,1	31,6	8.602,6	2.766	8,2
Existing park WTGs without new WTGs	904.288,4	1.068.262,5	84,7		8.865,6		
Reduction for existing park WTGs caused by new	26.822,7						

¤) Based on wake reduced results, but no other losses included

Calculated Annual Energy for each of 23 new WTGs with total 54,0 MW rated power

Links	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Power curve Creator	Name	Annual Energy Result [MWh]	Park Efficiency [%]	Capacity factor [%]	Free mean wind speed [m/s]
103 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	9.884,5	92,38	48,0	8,41
104 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	9.655,1	90,51	46,9	8,39
105 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	9.610,3	90,04	46,7	8,39
106 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	9.602,5	89,86	46,6	8,39
107 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	9.621,5	90,03	46,7	8,39
108 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	9.598,4	89,72	46,6	8,39
109 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	9.580,1	89,55	46,5	8,39
110 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	9.550,5	89,04	46,4	8,40
111 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	9.463,5	88,13	45,9	8,41
112 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	9.298,9	86,66	45,1	8,40
113 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	8.833,3	81,93	42,9	8,43
114 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	8.573,6	79,29	41,6	8,45
115 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	8.855,3	81,85	43,0	8,46
116 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	8.594,8	79,16	41,7	8,48
117 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	8.360,6	77,14	40,6	8,47
118 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	8.690,9	79,93	42,2	8,49
119 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	9.307,1	86,81	45,2	8,39
120 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	8.896,7	82,89	43,2	8,40
121 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	9.596,9	89,62	46,6	8,39
122 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	9.951,5	93,40	48,3	8,35
123 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	9.398,6	88,00	45,6	8,37

To be continued on next page...

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 3b

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Links	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Power curve Creator	Name	Annual Energy Result [MWh]	Park Efficiency [%]	Capacity factor [%]	Free mean wind speed [m/s]
124 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	8.997,9	83,71	43,7	8,41
125 A	Yes	ENERCON	E-103 EP2-2.350	2.350	103,0	120,0	EMD	Level 0 - official - OM 0s - 2350kW - 08/2016	8.255,8	76,26	40,1	8,46

Annual Energy results do not include any losses apart from wake losses. For expected NET AEP (expected sold production), see report Loss & Uncertainty.

Calculated Annual Energy for each of 102 existing park WTGs with total 317,3 MW rated power

Links	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Power curve Creator	Name	Annual Energy Calculated prod. without new WTGs [MWh]	Annual Energy After New WTGs [MWh]	Annual Energy Decrease due to new WTGs [MWh %]	Park Efficiency [%]
1 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	18.622,7	17.716,0	906,7 4,9	86,41
2 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.349,2	18.734,3	614,9 3,2	91,87
3 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.142,7	18.942,0	200,7 1,0	92,38
4 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.174,0	19.020,8	153,2 0,8	92,77
5 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	18.071,8	16.308,3	1.763,5 9,8	79,06
6 A	No	VESTAS	V47-660	660	47,0	40,0	EMD	Level 0 - calculated - - 07-2001	1.477,2	1.466,2	11,0 0,7	96,31
7 A	Yes	VESTAS	V52-850	850	52,0	40,0	EMD	Level 0 - calculated - 104.2 dB(A) - 07-2006	1.989,3	1.974,5	14,8 0,7	92,40
8 A	Yes	VESTAS	V117-3.45-3.450	3.450	117,0	93,5	EMD	Level 0 - Calculated - Modes 0 & 0-0S - 01-2016	12.967,1	12.839,0	128,1 1,0	84,95
9 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.706,0	7.592,6	113,4 1,5	84,72
10 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.552,7	7.326,5	226,3 3,0	81,93
11 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.445,1	7.144,6	300,5 4,0	79,95
12 A	No	2-B Energy	OTC 6 MW-6.000	6.000	140,0	105,0	USER	Turbulent power curce with TI of 8.7%	18.447,6	18.285,1	162,4 0,9	83,67
13 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	6.913,2	6.764,0	149,2 2,2	73,32
14 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	6.891,4	6.631,4	260,0 3,8	72,75
15 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.205,1	7.131,5	73,6 1,0	75,59
16 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.086,1	6.973,3	112,7 1,6	74,95
17 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.140,3	6.978,4	161,8 2,3	75,86
18 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.071,5	6.858,8	212,6 3,0	76,09
19 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.452,9	7.384,9	67,9 0,9	80,37
20 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.655,9	7.560,9	95,0 1,2	81,69
21 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.541,7	7.415,3	126,5 1,7	81,93
22 A	No	Senvion	6.2M126-6.150	6.150	126,0	114,0	USER	Calcated power curve Senvion 6.2M126	18.923,9	18.425,9	498,1 2,6	82,80
23 A	No	Senvion	6.2M126-6.150	6.150	126,0	114,0	USER	Calcated power curve Senvion 6.2M126	18.926,8	18.438,5	488,3 2,6	82,55
24 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.673,1	7.556,8	116,3 1,5	84,29
25 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.541,6	7.484,3	57,3 0,8	82,97
26 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.392,8	7.351,8	41,0 0,6	81,64
27 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.420,1	7.402,5	17,6 0,2	81,89
28 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.484,6	7.473,6	11,0 0,1	82,07
29 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.535,0	7.524,7	10,3 0,1	82,43
30 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.476,5	7.468,1	8,4 0,1	82,49
31 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.555,8	7.549,7	6,1 0,1	83,04
32 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.750,1	7.745,2	4,9 0,1	84,32
33 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.943,6	7.938,2	5,4 0,1	86,40
34 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.428,3	8.423,7	4,6 0,1	91,91
35 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.909,3	7.898,8	10,6 0,1	87,36
36 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.889,4	7.877,8	11,6 0,1	87,46
37 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.893,4	7.877,7	15,6 0,2	87,54
38 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.866,4	7.844,5	21,9 0,3	87,55
39 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.861,8	7.829,2	32,6 0,4	87,45
40 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.904,6	7.852,7	52,0 0,7	87,87
41 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.518,0	7.345,6	172,4 2,3	80,37
42 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.268,4	7.150,5	117,8 1,6	78,68
43 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.412,0	7.301,8	110,2 1,5	80,45
44 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.803,4	7.750,1	53,3 0,7	81,89
45 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.274,8	8.239,4	35,4 0,4	85,12
46 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.204,3	8.173,2	31,2 0,4	83,83
47 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.225,9	8.189,2	36,7 0,4	83,83
48 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.993,8	7.947,5	46,3 0,6	82,85
49 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.950,5	7.889,0	61,5 0,8	82,75
50 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.822,5	7.735,1	87,3 1,1	80,53
51 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.887,4	7.787,8	99,6 1,3	81,23
52 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.861,1	7.763,8	97,3 1,2	80,76
53 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.855,6	7.739,6	116,0 1,5	80,96
54 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.716,6	7.585,5	131,1 1,7	79,60
55 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.505,1	7.399,5	105,6 1,4	77,74
56 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.270,2	7.091,2	179,0 2,5	76,03
57 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.105,1	6.751,7	353,4 5,0	73,73
58 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.258,3	6.711,8	546,5 7,5	74,70
59 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.501,0	6.794,9	706,1 9,4	74,56
60 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.562,7	6.515,8	1.046,9 13,8	72,55
61 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.660,4	6.561,7	1.098,7 14,3	72,85
62 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.561,1	6.594,8	966,3 12,8	73,31
63 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.602,4	6.636,6	965,7 12,7	74,01
64 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.691,8	6.756,3	935,5 12,2	75,11
65 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.715,1	7.086,5	628,6 8,1	79,36
66 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.859,2	7.267,3	591,9 7,5	81,00
67 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.845,8	7.287,4	558,4 7,1	81,10

To be continued on next page...

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 3b

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	WTG type						Power curve		Annual Energy			Park
Links	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Creator	Name	Calculated prod. without new WTGs	After New WTGs	Decrease due to new WTGs	Efficiency
				[kW]	[m]	[m]			[MWh]	[MWh]	[MWh %]	[%]
68 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.779,6	7.232,3	547,3 7,0	81,40
69 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.761,8	7.213,7	548,0 7,1	81,33
70 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.711,7	7.174,5	537,2 7,0	81,03
71 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.742,1	7.185,6	556,5 7,2	81,41
72 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.697,6	7.130,8	566,8 7,4	81,15
73 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.781,2	7.173,7	607,5 7,8	81,14
74 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.055,1	7.418,5	636,6 7,9	84,62
75 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	100,0	EMD	Level 0 - official - Mode 0 - 08/2014	8.075,2	8.002,5	72,7 0,9	83,50
76 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	12.800,1	12.796,0	4,2 0,0	94,34
77 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	12.289,5	12.284,5	5,0 0,0	90,81
78 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	11.992,1	11.984,1	8,0 0,1	89,36
79 A	Yes	VESTAS	V117-3.6-3.600	3.600	117,0	117,0	EMD	Level 0 - Calculated - Modes PO1 & PO1-0S - 01-2016	15.257,1	15.204,5	52,6 0,3	96,80
80 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.313,7	7.912,5	401,2 4,8	76,18
81 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.222,2	7.734,8	487,4 5,9	74,26
82 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.181,9	7.654,5	527,4 6,4	73,29
83 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.255,6	7.733,8	521,8 6,3	73,36
84 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.733,7	8.672,7	61,0 0,7	81,31
85 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.121,8	7.521,7	600,1 7,4	72,30
86 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.781,2	8.718,1	63,1 0,7	81,64
87 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.822,1	8.744,7	77,4 0,9	82,12
88 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.752,0	8.665,6	86,4 1,0	81,11
89 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.895,2	8.792,3	102,9 1,2	82,58
90 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.130,7	7.525,3	605,3 7,4	72,09
91 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	9.087,9	8.959,6	128,3 1,4	83,22
92 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.377,8	8.235,6	142,2 1,7	77,50
93 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.474,5	8.313,8	160,7 1,9	77,93
94 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.516,5	8.290,7	225,9 2,7	78,26
95 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.425,9	8.199,6	226,2 2,7	77,49
96 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.377,8	8.101,7	276,0 3,3	76,43
97 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.445,4	8.202,4	243,0 2,9	79,37
98 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.474,3	8.269,3	205,0 2,4	81,70
99 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.271,9	8.054,8	217,1 2,6	79,60
100 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.344,3	8.263,1	81,2 1,0	87,94
101 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.514,6	8.465,7	48,9 0,6	90,24
102 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.611,5	8.567,1	44,3 0,5	91,60

WTG siting

		Dutch Stereo-RD / NAP 2000			
		X (east)	Y (north)	Z [m]	Row data/Description
1	Exist	252.819	605.227	-0,3	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (244)
2	Exist	252.538	604.846	0,0	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (245)
3	Exist	253.250	604.530	0,0	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (246)
4	Exist	253.410	604.258	0,2	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (247)
5	Exist	253.038	605.625	0,3	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (248)
6	Exist	251.401	603.815	-0,1	VESTAS V47 660 47.0 !O! hub: 40,0 m (TOT: 63,5 m) (264)
7	Exist	253.765	603.860	1,8	VESTAS V52 850 52.0 !O! hub: 40,0 m (TOT: 66,0 m) (265)
8	Exist	252.007	608.545	1,6	VESTAS V117-3.45 3450 117.0 !O! hub: 93,5 m (TOT: 152,0 m) (266)
9	Exist	253.830	604.979	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (267)
10	Exist	253.634	605.359	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (268)
11	Exist	253.487	605.644	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (269)
12	Exist	248.875	608.572	2,5	2-B Energy OTC 6 MW 6000 140.0 !#! hub: 105,0 m (TOT: 175,0 m) (270)
13	Exist	253.662	606.943	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (271)
14	Exist	253.548	606.476	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (272)
15	Exist	254.026	607.172	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (273)
16	Exist	253.954	606.875	2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (274)
17	Exist	253.843	606.417	2,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (275)
18	Exist	253.758	606.067	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (276)
19	Exist	254.272	606.915	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (277)
20	Exist	254.151	605.985	2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (278)
21	Exist	253.996	605.473	0,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (279)
22	Exist	250.194	607.795	4,3	Senvion 6.2M126 6150 126.0 !O! hub: 114,0 m (TOT: 177,0 m) (280)
23	Exist	250.760	607.657	3,1	Senvion 6.2M126 6150 126.0 !O! hub: 114,0 m (TOT: 177,0 m) (281)
24	Exist	248.142	608.104	-1,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (282)
25	Exist	247.865	608.255	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (283)
26	Exist	247.590	608.377	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (284)
27	Exist	247.311	608.501	-1,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (285)
28	Exist	247.034	608.625	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (286)
29	Exist	246.747	608.713	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (371)
30	Exist	246.447	608.805	-2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (288)

To be continued on next page...

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 3b

...continued from previous page

		Dutch Stereo-RD / NAP 2000			
		X (east)	Y (north)	Z [m]	Row data/Description
31	Exist	246.172	608.890	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (289)
32	Exist	245.885	608.978	0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (290)
33	Exist	245.590	609.026	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (291)
34	Exist	245.294	609.056	-1,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (292)
35	Exist	246.045	608.352	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (293)
36	Exist	246.336	608.279	0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (294)
37	Exist	246.622	608.188	1,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (295)
38	Exist	246.907	608.088	-0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (296)
39	Exist	247.190	607.981	0,6	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (297)
40	Exist	247.472	607.870	0,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (298)
41	Exist	249.390	608.049	2,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (299)
42	Exist	249.023	608.155	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (300)
43	Exist	248.609	608.251	1,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (301)
44	Exist	249.242	608.904	-0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (302)
45	Exist	249.672	609.314	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (303)
46	Exist	250.005	609.324	2,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (304)
47	Exist	250.336	609.195	4,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (305)
48	Exist	250.665	609.061	1,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (306)
49	Exist	250.997	608.936	3,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (307)
50	Exist	252.323	608.418	1,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (308)
51	Exist	252.641	608.293	1,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (309)
52	Exist	252.949	608.128	2,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (310)
53	Exist	253.248	607.910	0,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (311)
54	Exist	253.547	607.637	0,6	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (312)
55	Exist	253.756	607.438	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (313)
56	Exist	253.425	607.194	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (314)
57	Exist	253.312	606.728	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (315)
58	Exist	253.341	605.928	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (316)
59	Exist	253.172	606.215	4,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (317)
60	Exist	252.880	606.379	-0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (318)
61	Exist	252.576	606.567	1,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (319)
62	Exist	252.262	606.720	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (320)
63	Exist	251.932	606.799	-2,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (321)
64	Exist	251.602	606.881	0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (322)
65	Exist	251.272	606.961	-1,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (323)
66	Exist	250.915	607.046	1,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (324)
67	Exist	250.558	607.133	1,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (325)
68	Exist	250.211	607.197	-1,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (326)
69	Exist	249.862	607.249	-0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (327)
70	Exist	249.511	607.301	0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (328)
71	Exist	249.207	607.349	0,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (329)
72	Exist	248.841	607.404	-0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (330)
73	Exist	248.444	607.403	0,6	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (331)
74	Exist	248.125	607.370	-1,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (332)
75	Exist	251.691	608.611	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 100,0 m (TOT: 141,0 m) (333)
76	Exist	245.161	608.566	0,7	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (354)
77	Exist	245.463	608.501	0,4	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (355)
78	Exist	245.775	608.421	-1,5	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (356)
79	Exist	253.792	603.479	1,0	VESTAS V117-3.6 3600 117.0 !O! hub: 117,0 m (TOT: 175,5 m) (664)
80	Exist	251.345	607.258	2,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (599)
81	Exist	251.679	607.196	1,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (600)
82	Exist	252.008	607.117	1,0	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (601)
83	Exist	252.340	607.043	3,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (602)
84	Exist	249.539	608.811	0,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (603)
85	Exist	252.654	606.896	1,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (604)
86	Exist	249.866	608.752	0,4	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (605)
87	Exist	250.208	608.666	1,0	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (606)
88	Exist	250.550	608.586	0,9	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (607)
89	Exist	250.892	608.503	2,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (608)
90	Exist	252.958	606.705	1,5	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (609)
91	Exist	251.566	608.173	4,2	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (610)
92	Exist	252.219	607.986	-0,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (611)
93	Exist	252.852	607.716	1,9	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (612)
94	Exist	251.793	607.668	1,6	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (613)

To be continued on next page...

Licensed user:
Pondera Consult B.V.
Welbergweg 49
NL-7556 PE Hengelo
0031742489940

Calculated:
16-3-2017 14:51/3.1.597

PARK - Main Result

Calculation: 716033 WP Oostpolder alternatief 3b

...continued from previous page

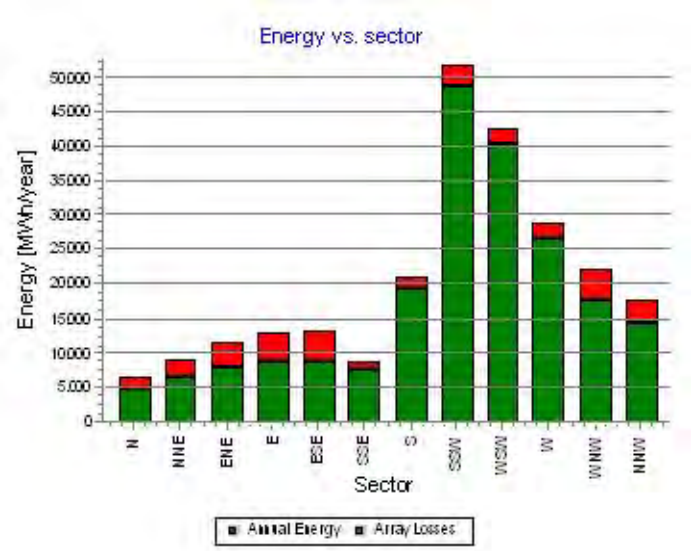
		Dutch Stereo-RD / NAP 2000			
		X (east)	Y (north)	Z [m]	Row data/Description
95	Exist	252.144	607.675	2,7	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (614)
96	Exist	252.765	607.355	1,6	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (615)
97	Exist	249.631	607.787	2,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (616)
98	Exist	248.339	607.818	-1,2	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (617)
99	Exist	248.736	607.792	-1,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (618)
100	Exist	253.864	604.596	0,0	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (712)
101	Exist	253.855	604.236	0,0	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (713)
102	Exist	253.850	603.877	0,2	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (714)
103	New	247.940	607.100	0,0	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (382)
104	New	248.327	606.996	-0,7	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (383)
105	New	248.713	606.893	-1,6	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (384)
106	New	249.099	606.789	-0,5	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (385)
107	New	249.486	606.686	-1,1	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (386)
108	New	249.872	606.582	-1,0	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (387)
109	New	250.258	606.479	-0,3	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (388)
110	New	250.645	606.375	-1,0	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (389)
111	New	251.031	606.271	-0,4	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (390)
112	New	251.417	606.168	-1,6	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (391)
113	New	251.804	606.064	-0,8	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (392)
114	New	252.190	605.961	0,9	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (393)
115	New	251.506	606.506	0,0	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (394)
116	New	251.889	606.391	1,1	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (395)
117	New	252.274	606.283	0,0	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (396)
118	New	252.657	606.168	0,2	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (397)
119	New	251.710	605.754	-2,0	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (398)
120	New	252.090	605.637	0,0	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (399)
121	New	251.726	605.411	0,2	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (400)
122	New	251.703	604.894	-0,2	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (401)
123	New	252.113	605.145	-0,2	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (402)
124	New	252.518	605.402	-0,6	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (403)
125	New	252.918	605.667	0,2	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (404)

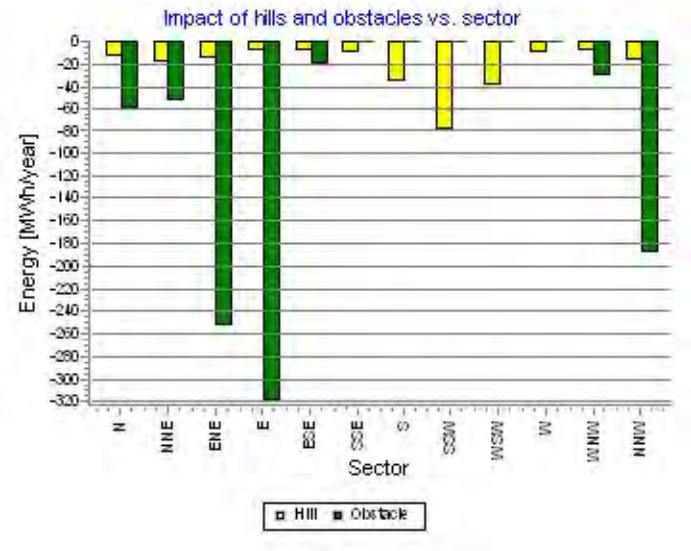
PARK - Production Analysis

Calculation: 716033 WP Oostpolder alternatief 3bWTG: All new WTGs, Air density varies with WTG position 1,236 kg/m³ - 1,248 kg/m³

Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	6.797,4	9.094,2	11.900,0	13.222,0	13.239,8	8.928,2	21.178,3	51.910,1	42.832,3	28.918,6	22.440,9	17.784,8	248.246,7
-Decrease due to obstacles	[MWh]	58,7	53,1	252,8	319,3	20,5	0,4	0,0	0,0	0,0	0,0	30,0	187,6	922,5
+Increase due to hills	[MWh]	-13,5	-18,0	-16,1	-7,7	-7,7	-10,8	-35,6	-78,1	-38,9	-10,4	-9,0	-17,2	-263,1
-Decrease due to array losses	[MWh]	1.725,0	2.380,3	3.689,1	3.961,6	4.352,0	1.077,3	1.884,0	2.976,8	2.597,6	2.290,9	4.620,7	3.327,7	34.883,0
Resulting energy	[MWh]	5.000,2	6.642,7	7.942,1	8.933,3	8.859,6	7.839,8	19.258,7	48.855,2	40.195,7	26.617,2	17.781,2	14.252,3	212.178,1
Specific energy	[kWh/m²]													1.107
Specific energy	[kWh/kW]													3.926
Decrease due to obstacles	[%]	0,9	0,6	2,1	2,4	0,2	0,0	0,0	0,0	0,0	0,0	0,1	1,1	0,37
Increase due to hills	[%]	-0,2	-0,2	-0,1	-0,1	-0,1	-0,1	-0,2	-0,2	-0,1	0,0	0,0	-0,1	-0,11
Decrease due to array losses	[%]	25,6	26,4	31,7	30,7	32,9	12,1	8,9	5,7	6,1	7,9	20,6	18,9	14,12
Utilization	[%]	19,7	21,5	22,3	23,2	20,2	21,8	22,5	23,8	20,4	17,2	15,6	17,3	20,2
Operational	[Hours/year]	342	387	527	611	548	361	712	1.473	1.361	959	751	597	8.629
Full Load Equivalent	[Hours/year]	93	123	147	165	164	145	356	904	744	492	329	264	3.926



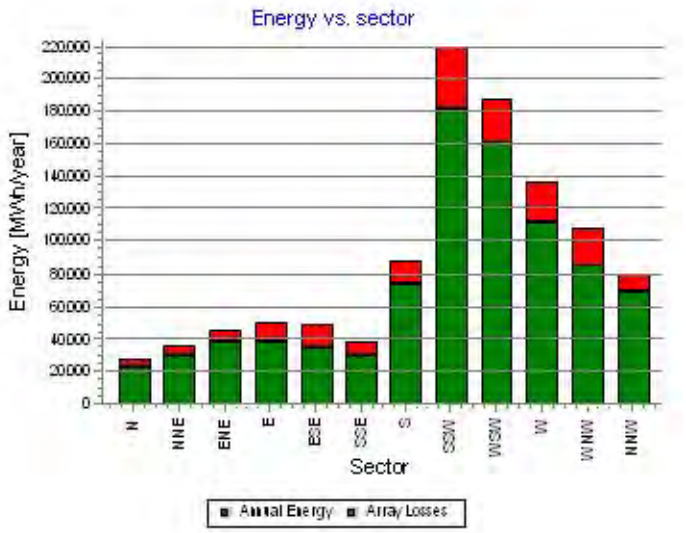


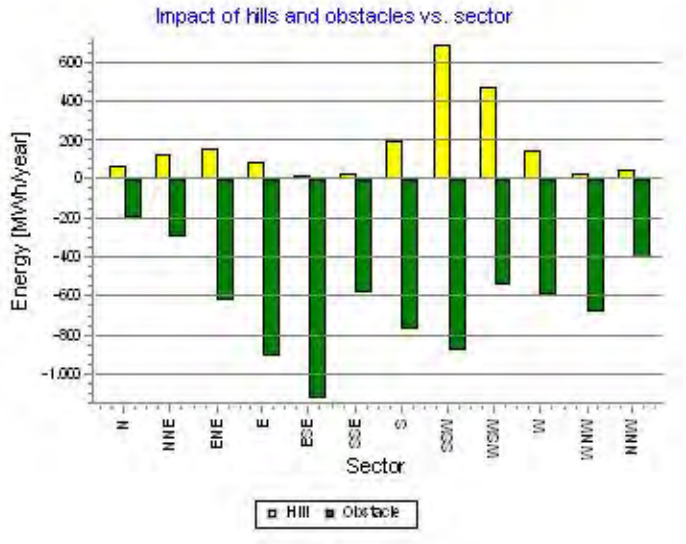
PARK - Production Analysis

Calculation: 716033 WP Oostpolder alternatief 3bWTG: All existing WTGs, Air density varies with WTG position 1,236 kg/m³ - 1,248 kg/m³

Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	27.773,1	36.183,5	46.549,9	50.905,6	50.704,9	38.783,0	89.039,8	219.772,1	187.819,5	136.783,6	109.534,6	79.965,9	1.073.816,0
-Decrease due to obstacles	[MWh]	191,0	291,8	628,3	914,8	1.125,6	585,8	774,4	882,1	550,6	594,5	680,3	401,0	7.620,2
+Increase due to hills	[MWh]	65,3	127,8	154,3	89,5	24,1	27,0	193,1	687,6	469,8	146,2	31,1	51,4	2.067,3
-Decrease due to array losses	[MWh]	4.280,5	5.778,3	7.502,9	11.566,9	14.704,9	7.480,9	15.034,9	37.544,2	27.851,8	23.849,1	23.957,9	11.244,5	190.796,7
Resulting energy	[MWh]	23.366,9	30.241,2	38.573,0	38.513,5	34.898,5	30.743,3	73.423,6	182.033,4	159.886,9	112.486,1	84.927,4	68.371,8	877.465,6
Specific energy	[kWh/m²]													1.336
Specific energy	[kWh/kW]													2.766
Decrease due to obstacles	[%]	0,7	0,8	1,3	1,8	2,2	1,5	0,9	0,4	0,3	0,4	0,6	0,5	0,71
Increase due to hills	[%]	0,2	0,4	0,3	0,2	0,0	0,1	0,2	0,3	0,3	0,1	0,0	0,1	0,19
Decrease due to array losses	[%]	15,5	16,0	16,3	23,1	29,6	19,6	17,0	17,1	14,8	17,5	22,0	14,1	17,86
Utilization	[%]	28,8	31,1	33,2	30,8	26,8	25,8	27,7	28,6	25,8	21,2	20,0	25,1	25,7
Operational	[Hours/year]	333	375	509	592	531	354	688	1.426	1.324	945	738	584	8.399
Full Load Equivalent	[Hours/year]	74	95	122	121	110	97	231	574	504	355	268	216	2.766





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Calculated:
16-3-2017 14:51/3.1.597

PARK - Power Curve Analysis

Calculation: 716033 WP Oostpolder alternatief 3bWTG: 108 - ENERCON E-103 EP2 2350 103.0 !-! Level 0 - official - OM 0s - 2350kW - 08/2016, Hub height: 120,0 m

Name: Level 0 - official - OM 0s - 2350kW - 08/2016
Source: Enercon

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type	Generator type	Specific power kW/m²
5-8-2016	EMD	25-11-2009	2-11-2016	25,0	Pitch	User defined	Variable	0,28

According to Enercon specification document D0434367-2_#_de_#_Betriebsmodi_E-103_EP2___2350_kW_mit_TES

HP curve comparison - Note: For standard air density and weibull k parameter = 2

Vmean	[m/s]	5	6	7	8	9	10
HP value Pitch, variable speed (2013)	[MWh]	4.175	6.286	8.295	10.062	11.539	12.711
ENERCON E-103 EP2 2350 103.0 !-! Level 0 - official - OM 0s - 2350kW - 08/2016	[MWh]	4.022	6.044	8.004	9.751	11.222	12.390
Check value	[%]	4	4	4	3	3	3

The table shows comparison between annual energy production calculated on basis of simplified "HP-curves" which assume that all WTGs performs quite similar - only specific power loading (kW/m^2) and single/dual speed or stall/pitch decides the calculated values. Productions are without wake losses.
For further details, ask at the Danish Energy Agency for project report J.nr. 51171/00-0016 or see windPRO manual chapter 3.5.2.
The method is refined in EMD report "20 Detailed Case Studies comparing Project Design Calculations and actual Energy Productions for Wind Energy Projects worldwide", jan 2003.
Use the table to evaluate if the given power curve is reasonable - if the check value are lower than -5%, the power curve probably is too optimistic due to uncertainty in power curve measurement.

Power curve

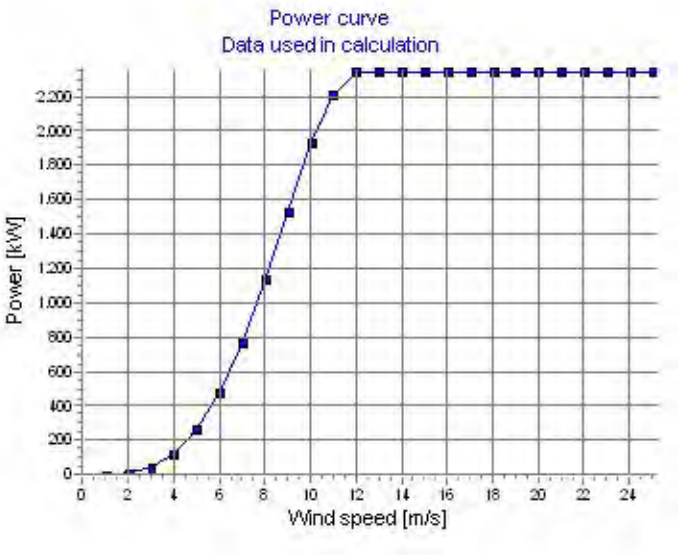
Original data, Air density: 1,225 kg/m³

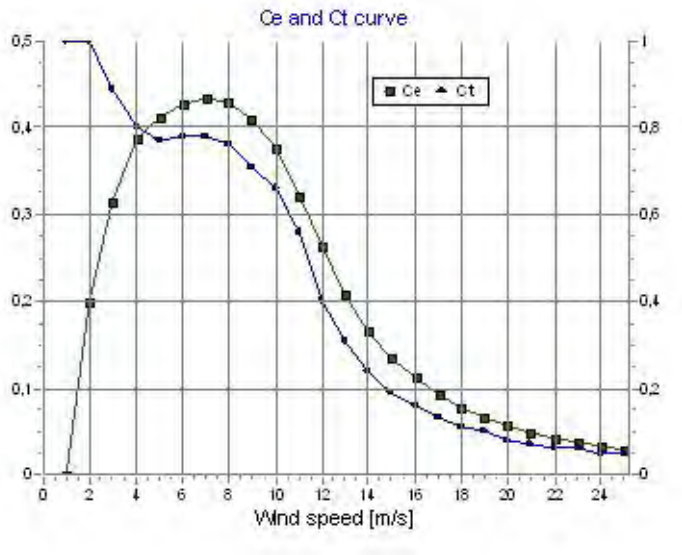
Wind speed [m/s]	Power [kW]	Ce	Wind speed [m/s]	Ct curve
0,0	0,0	0,00	2,0	1,07
1,0	0,0	0,00	2,5	0,98
1,5	0,0	0,00	3,0	0,89
2,0	8,0	0,20	3,5	0,84
2,5	22,0	0,28	4,0	0,80
3,0	43,0	0,31	4,5	0,78
3,5	79,0	0,36	5,0	0,77
4,0	126,0	0,39	5,5	0,78
4,5	188,0	0,40	6,0	0,78
5,0	263,0	0,41	6,5	0,78
5,5	357,0	0,42	7,0	0,78
6,0	470,0	0,43	7,5	0,78
6,5	605,0	0,43	8,0	0,76
7,0	758,0	0,43	8,5	0,73
7,5	937,0	0,44	9,0	0,71
8,0	1.122,0	0,43	9,5	0,68
8,5	1.326,0	0,42	10,0	0,66
9,0	1.525,0	0,41	10,5	0,64
9,5	1.733,0	0,40	11,0	0,56
10,0	1.925,0	0,38	11,5	0,47
10,5	2.073,0	0,35	12,0	0,40
11,0	2.205,0	0,32	12,5	0,35
11,5	2.294,0	0,30	13,0	0,31
12,0	2.350,0	0,27	13,5	0,27
12,5	2.350,0	0,24	14,0	0,24
13,0	2.350,0	0,21	14,5	0,22
13,5	2.350,0	0,19	15,0	0,19
14,0	2.350,0	0,17	15,5	0,18
14,5	2.350,0	0,15	16,0	0,16
15,0	2.350,0	0,14	16,5	0,15
15,5	2.350,0	0,12	17,0	0,13
16,0	2.350,0	0,11	17,5	0,12
16,5	2.350,0	0,10	18,0	0,11
17,0	2.350,0	0,09	18,5	0,10
17,5	2.350,0	0,09	19,0	0,10
18,0	2.350,0	0,08	19,5	0,09
18,5	2.350,0	0,07	20,0	0,08
19,0	2.350,0	0,07	20,5	0,08
19,5	2.350,0	0,06	21,0	0,07
20,0	2.350,0	0,06	21,5	0,07
20,5	2.350,0	0,05	22,0	0,06
21,0	2.350,0	0,05	22,5	0,06
21,5	2.350,0	0,05	23,0	0,06
22,0	2.350,0	0,04	23,5	0,05
22,5	2.350,0	0,04	24,0	0,05
23,0	2.350,0	0,04	24,5	0,05
23,5	2.350,0	0,04	25,0	0,05
24,0	2.350,0	0,03		
24,5	2.350,0	0,03		

Power, Efficiency and energy vs. wind speed

Data used in calculation, Air density: 1,238 kg/m³ New windPRO method (adjusted IEC method, improved to match turbine control) <RECOMMENDED>

Wind speed [m/s]	Power [kW]	Ce	Interval [m/s]	Energy [MWh]	Acc.Energy [MWh]	Relative [%]
1,0	0,0	0,00	0,50- 1,50	0,0	0,0	0,0
2,0	8,2	0,20	1,50- 2,50	3,6	3,6	0,0
3,0	43,7	0,31	2,50- 3,50	22,3	25,9	0,3
4,0	127,7	0,39	3,50- 4,50	76,1	102,0	1,1
5,0	266,2	0,41	4,50- 5,50	185,1	287,1	3,0
6,0	475,5	0,43	5,50- 6,50	364,1	651,2	6,8
7,0	766,5	0,43	6,50- 7,50	611,2	1.262,4	13,2
8,0	1.133,2	0,43	7,50- 8,50	888,5	2.151,0	22,4
9,0	1.538,7	0,41	8,50- 9,50	1.130,1	3.281,1	34,2
10,0	1.937,3	0,38	9,50-10,50	1.259,4	4.540,5	47,3
11,0	2.214,3	0,32	10,50-11,50	1.233,0	5.773,5	60,2
12,0	2.350,0	0,26	11,50-12,50	1.068,0	6.841,5	71,3
13,0	2.350,0	0,21	12,50-13,50	839,8	7.681,4	80,0
14,0	2.350,0	0,17	13,50-14,50	624,0	8.305,4	86,5
15,0	2.350,0	0,14	14,50-15,50	444,5	8.749,9	91,2
16,0	2.350,0	0,11	15,50-16,50	305,0	9.054,9	94,3
17,0	2.350,0	0,09	16,50-17,50	202,7	9.257,6	96,4
18,0	2.350,0	0,08	17,50-18,50	131,3	9.388,9	97,8
19,0	2.350,0	0,07	18,50-19,50	83,5	9.472,4	98,7
20,0	2.350,0	0,06	19,50-20,50	52,3	9.524,7	99,2
21,0	2.350,0	0,05	20,50-21,50	32,4	9.557,1	99,6
22,0	2.350,0	0,04	21,50-22,50	19,8	9.576,8	99,8
23,0	2.350,0	0,04	22,50-23,50	11,9	9.588,7	99,9
24,0	2.350,0	0,03	23,50-24,50	7,1	9.595,8	100,0
25,0	2.350,0	0,03	24,50-25,50	2,6	9.598,4	100,0





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Calculated:
16-3-2017 14:51/3.1.597

PARK - Terrain

Calculation: 716033 WP Oostpolder alternatief 3bSite Data: A - Oostpolder site data

Obstacles:
23 Obstacles used

Roughness:
Terrain data files used in calculation:
\\sbs2011\projecten\Extern\2015\715068 WTG Intocon Eemshaven\TO\WP\ROUGHNESSLINE_713066 715068_1.wpo
Min X: 219.227, Max X: 278.331, Min Y: 577.425, Max Y: 638.717, Width: 59.104 m, Height: 61.292 m

Orography:
Terrain data files used in calculation:
\\sbs2011\projecten\Extern\2016\716033 WP Oostpolder\TO\WP\ObjectImports\713066 715068_EMDGrid_0(1).wpg
Min X: 198.208, Max X: 300.556, Min Y: 557.205, Max Y: 659.267, Width: 102.348 m, Height: 102.062 m

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Calculated:
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PARK - Wind Data Analysis

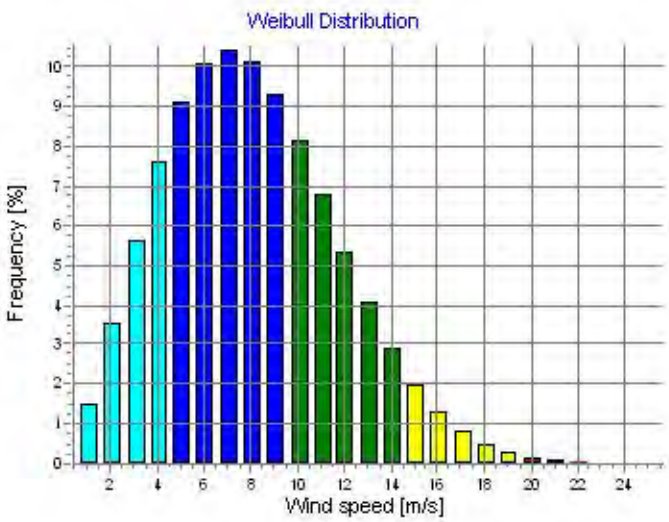
Calculation: 716033 WP Oostpolder alternatief 3bWind data: A - Oostpolder site data; Hub height: 100,0

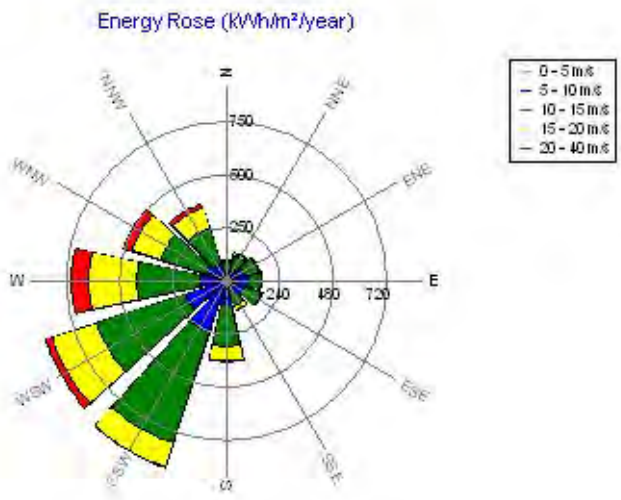
Site coordinates
Dutch Stereo-RD/NAP 2000
East: 250.596 North: 606.527

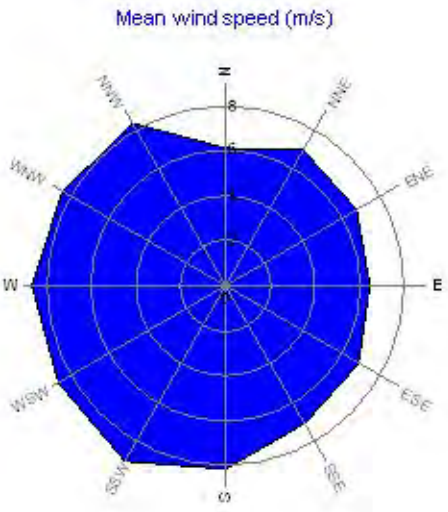
Wind statistics
RWE_Oostpolder 100m-Corr099.wws

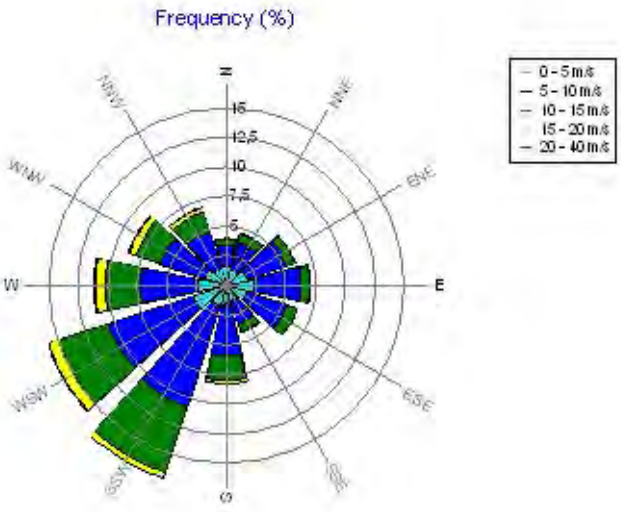
Weibull Data

Sector	Current site A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	6,90	6,13	1,854	4,0
1 NNE	7,85	6,95	2,322	4,5
2 ENE	7,60	6,75	2,545	6,1
3 E	7,30	6,48	2,553	7,1
4 ESE	7,79	6,91	2,498	6,3
5 SSE	7,97	7,06	2,115	4,2
6 S	9,18	8,14	2,486	8,2
7 SSW	10,06	9,00	3,146	17,0
8 WSW	9,71	8,61	2,393	15,8
9 W	9,77	8,65	2,068	11,2
10 WNW	9,48	8,40	2,119	8,7
11 NNW	9,43	8,35	2,209	6,9
All	9,03	8,00	2,287	100,0









PARK - Wind Data Analysis

Calculation: 716033 WP Oostpolder alternatief 3bWind data: A - Oostpolder site data; Hub height: 120,0

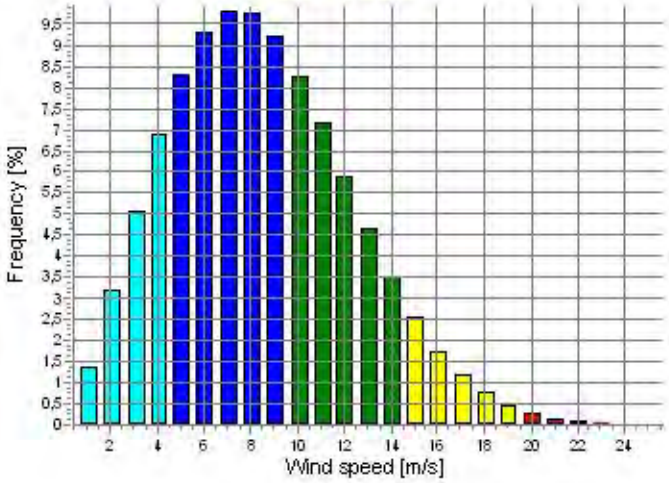
Site coordinates
Dutch Stereo-RD/NAP 2000
East: 250.596 North: 606.527

Wind statistics
RWE_Oostpolder 100m-Corr099.wws

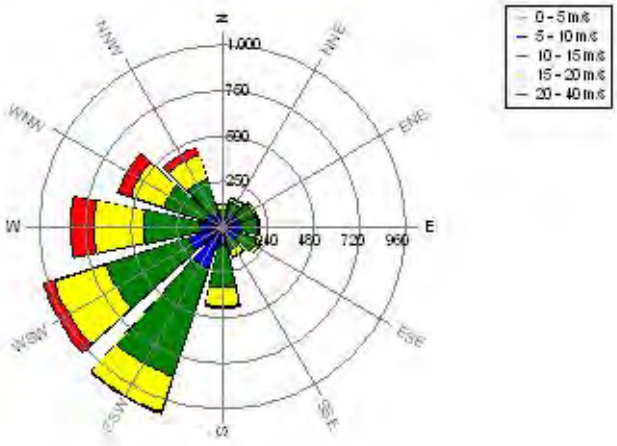
Weibull Data

Sector	Current site A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	7,41	6,58	1,830	4,0
1 NNE	8,33	7,38	2,295	4,5
2 ENE	8,09	7,18	2,514	6,1
3 E	7,78	6,90	2,518	7,1
4 ESE	8,35	7,41	2,467	6,3
5 SSE	8,46	7,49	2,088	4,2
6 S	9,65	8,56	2,459	8,2
7 SSW	10,56	9,44	3,115	17,0
8 WSW	10,15	9,00	2,369	15,8
9 W	10,18	9,02	2,053	11,1
10 WNW	10,01	8,87	2,096	8,7
11 NNW	9,97	8,83	2,182	6,9
All	9,51	8,43	2,275	100,0

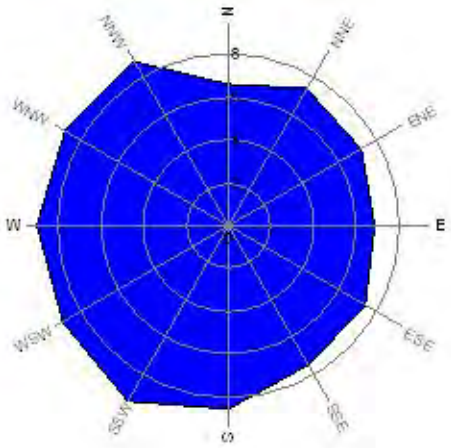
Weibull Distribution



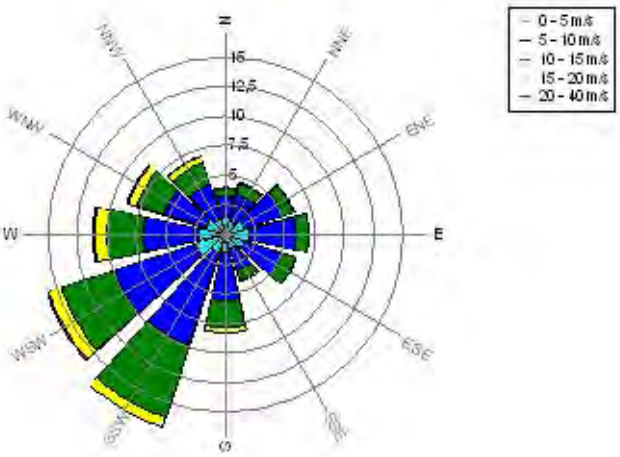
Energy Rose (kWh/m²/year)



Mean wind speed (m/s)



Frequency (%)



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PARK - Park power curve

Calculation: 716033 WP Oostpolder alternatief 3b

Wind speed [m/s]	Power Free WTGs [kW]	Park WTGs [kW]	N [kW]	NNE [kW]	ENE [kW]	E [kW]	ESE [kW]	SSE [kW]	S [kW]	SSW [kW]	WSW [kW]	W [kW]	WNW [kW]	NNW [kW]
0,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1,5	2	1	0	0	0	0	0	1	1	1	1	1	0	0
2,5	1.519	706	708	733	723	651	470	666	836	849	802	673	432	636
3,5	7.241	4.184	4.238	4.358	4.346	3.939	3.197	4.200	4.574	4.701	4.651	4.047	3.033	3.903
4,5	19.569	12.696	13.026	13.260	13.383	12.187	10.239	12.590	13.348	13.678	13.777	12.334	10.140	12.506
5,5	38.152	26.020	26.594	26.983	27.135	25.029	21.664	25.979	27.262	27.699	27.927	25.408	21.550	25.744
6,5	65.109	45.150	46.156	46.692	46.780	43.457	38.074	45.072	47.225	47.890	48.231	44.209	37.956	44.693
7,5	101.621	71.331	73.039	73.871	73.950	68.838	60.600	71.186	74.468	75.468	75.898	69.792	60.379	70.744
8,5	147.250	105.808	108.612	109.864	110.045	102.512	90.334	105.654	110.154	111.588	112.263	103.354	89.852	105.315
9,5	199.177	148.520	153.240	154.660	155.180	144.802	127.962	148.506	154.042	155.548	156.688	144.827	127.096	148.947
10,5	249.930	196.433	204.368	204.896	205.946	192.997	171.473	196.682	202.995	203.400	205.231	191.389	170.842	199.525
11,5	292.253	244.959	254.781	253.839	255.597	240.988	216.868	246.008	252.839	252.090	254.555	239.148	216.535	249.750
12,5	323.939	287.381	298.901	296.742	298.728	283.910	259.850	289.039	295.246	293.128	295.909	280.959	260.320	294.089
13,5	347.478	322.080	333.342	331.275	333.247	319.608	298.680	324.071	328.454	326.513	328.764	315.997	298.283	328.766
14,5	361.684	348.107	355.662	354.351	355.735	345.915	330.907	350.745	353.240	351.850	353.263	344.339	329.382	352.108
15,5	369.119	362.723	366.749	366.307	366.760	361.515	352.075	364.607	365.839	365.290	365.687	360.859	351.520	364.778
16,5	372.207	370.077	371.655	371.478	371.615	369.555	365.391	371.093	371.455	371.250	371.326	369.366	365.246	370.986
17,5	372.702	372.382	372.666	372.638	372.658	372.268	371.465	372.582	372.655	372.623	372.641	372.296	371.379	372.539
18,5	372.692	372.673	372.696	372.698	372.694	372.665	372.591	372.691	372.692	372.693	372.693	372.672	372.587	372.693
19,5	372.675	372.679	372.680	372.681	372.679	372.679	372.679	372.680	372.677	372.679	372.678	372.678	372.681	372.682
20,5	366.657	366.659	366.660	366.661	366.659	366.658	366.658	366.659	366.658	366.659	366.658	366.658	366.661	366.662
21,5	366.641	366.645	366.646	366.647	366.644	366.643	366.643	366.645	366.643	366.644	366.643	366.644	366.647	366.648
22,5	366.629	366.630	366.631	366.632	366.630	366.629	366.630	366.630	366.629	366.630	366.629	366.630	366.632	366.632
23,5	366.619	366.620	366.622	366.622	366.620	366.619	366.619	366.620	366.619	366.620	366.619	366.620	366.622	366.623
24,5	366.640	366.630	366.614	366.618	366.628	366.634	366.632	366.629	366.640	366.635	366.638	366.632	366.619	366.615
25,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Description:
The park power curve is similar to a WTG power curve, meaning that when a given wind speed appears in front of the park with same speed in the entire wind farm area (before influence from the park), the output from the park can be found in the park power curve. Another way to say this: The park power curve includes array losses, but do NOT include terrain given variations in the wind speed over the park area.
Measuring a park power curve is not as simple as measuring a WTG power curve due to the fact that the park power curve depends on the wind direction and that the same wind speed normally will not appear for the entire park area at the same time (only in very flat non-complex terrain). The idea with this version of the park power curve is not to use it for validation based on measurements. This would require at least 2 measurement masts at two sides of the park, unless only a few direction sectors should be tested, AND non complex terrain (normally only useable off shore). Another park power curve version for complex terrain is available in windPRO.

The park power curve can be used for:

1. Forecast systems, based on more rough (approximated) wind data, the park power curve would be an efficient way to make the connection from wind speed (and direction) to power.
2. Construction of duration curves, telling how often a given power output will appear, the park power curve can be used together with the average wind distribution for the Wind farm area in hub height. The average wind distribution can eventually be obtained based on the Weibull parameters for each WTG position. These are found at print menu: >Result to file< in the >Park result< which can be saved to file or copied to clipboard and pasted in Excel.
3. Calculation of wind energy index based on the PARK production (see below).
4. Estimation of the expected PARK production for an existing wind farm based on wind measurements at minimum 2 measurement masts at two sides of wind farm. The masts must be used for obtaining the free wind speed. The free wind speed is used in the simulation of expected energy production with the PARK power curve. This procedure will only work suitable in non complex terrains. For complex terrain another park power curve calculation is available in windPRO (PPV-model).

Note:
From the >Result to file< the >Wind Speeds Inside Wind farm< is also available. These can (e.g. via Excel) be used for extracting the wake induced reductions in measured wind speed.

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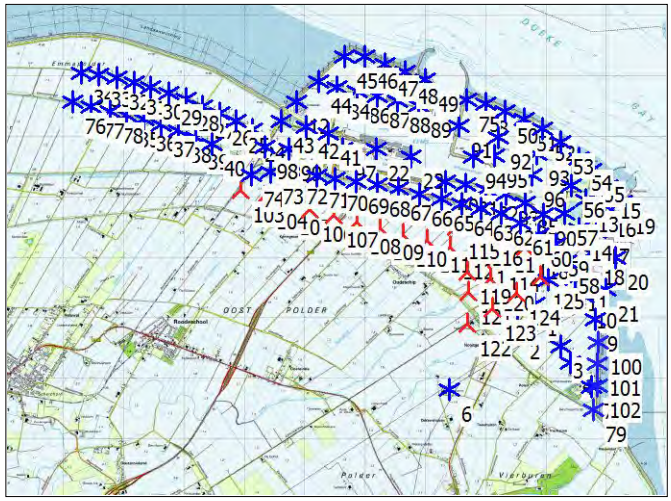
PARK - WTG distances

Calculation: 716033 WP Oostpolder alternatief 3b

WTG distances

	Z [m]	Nearest WTG	Z [m]	Horizontal distance [m]	Distance in|rotor diameters (max)	Distance in|rotor diameters (min)
1	-0,3	124	-0,6	348	3,4	2,6
2	0,0	1	-0,3	473	3,5	3,5
3	0,0	4	0,2	315	2,3	2,3
4	0,2	3	0,0	315	2,3	2,3
5	0,3	125	0,2	127	1,2	0,9
6	-0,1	122	-0,2	1.121	23,8	10,9
7	1,8	102	0,2	87	1,7	0,9
8	1,6	75	1,0	323	3,9	2,8
9	0,1	100	0,0	384	4,7	3,8
10	-0,4	11	1,0	321	3,9	3,9
11	1,0	58	1,0	319	3,9	3,9
12	2,5	43	1,9	417	5,1	3,0
13	-1,0	16	2,0	300	3,7	3,7
14	1,0	17	2,7	301	3,7	3,7
15	1,0	16	2,0	306	3,7	3,7
16	2,0	13	-1,0	300	3,7	3,7
17	2,7	14	1,0	301	3,7	3,7
18	-0,7	17	2,7	360	4,4	4,4
19	0,1	16	2,0	320	3,9	3,9
20	2,0	18	-0,7	401	4,9	4,9
21	0,0	10	-0,4	379	4,6	4,6
22	4,3	97	2,8	563	6,3	4,5
23	3,1	67	1,3	561	6,8	4,5
24	-1,2	25	-0,4	315	3,8	3,8
25	-0,4	26	-1,0	301	3,7	3,7
26	-1,0	25	-0,4	301	3,7	3,7
27	-1,3	28	0,2	303	3,7	3,7
28	0,2	29	1,8	300	3,7	3,7
29	1,8	28	0,2	300	3,7	3,7
30	-2,0	31	-0,7	288	3,5	3,5
31	-0,7	30	-2,0	288	3,5	3,5
32	0,3	33	0,1	299	3,6	3,6
33	0,1	34	-1,1	297	3,6	3,6
34	-1,1	33	0,1	297	3,6	3,6
35	1,8	78	-1,5	279	3,4	2,5
36	0,5	35	1,8	300	3,7	3,7
37	1,5	36	0,5	300	3,7	3,7
38	-0,2	37	1,5	302	3,7	3,7
39	0,6	38	-0,2	302	3,7	3,7
40	0,9	39	0,6	303	3,7	3,7
41	2,7	97	2,8	356	4,3	4,0
42	0,2	41	2,7	382	4,7	4,7
43	1,9	12	2,5	417	5,1	3,0
44	-0,5	84	0,1	311	3,8	3,5
45	0,2	46	2,8	333	4,1	4,1
46	2,8	45	0,2	333	4,1	4,1
47	4,8	48	1,4	355	4,3	4,3
48	1,4	49	3,2	355	4,3	4,3
49	3,2	48	1,4	355	4,3	4,3
50	1,1	8	1,6	340	4,2	2,9
51	1,4	50	1,1	342	4,2	4,2
52	2,1	51	1,4	349	4,3	4,3
53	0,8	52	2,1	370	4,5	4,5
54	0,6	55	1,8	289	3,5	3,5
55	1,8	54	0,6	289	3,5	3,5
56	-0,4	13	-1,0	345	4,2	4,2
57	-0,7	14	1,0	345	4,2	4,2
58	1,0	11	1,0	319	3,9	3,9
59	4,7	58	1,0	333	4,1	4,1
60	-0,3	118	0,2	307	3,7	3,0
61	1,7	85	1,3	338	4,1	3,8
62	-1,0	83	3,1	332	4,1	3,7
63	-2,9	82	1,0	327	4,0	3,6



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New WTG Existing WTG

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PARK - WTG distances

Calculation: 716033 WP Oostpolder alternatief 3b

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	Z	Nearest WTG	Z	Horizontal distance	Distance in|rotor diameters (max)	Distance in|rotor diameters (min)
	[m]		[m]	[m]		
64	0,3	81	1,8	324	4,0	3,6
65	-1,9	80	2,3	306	3,7	3,4
66	1,5	65	-1,9	367	4,5	4,5
67	1,3	68	-1,2	353	4,3	4,3
68	-1,2	67	1,3	353	4,3	4,3
69	-0,5	68	-1,2	353	4,3	4,3
70	0,5	71	0,0	308	3,8	3,8
71	0,0	70	0,5	308	3,8	3,8
72	-0,1	71	0,0	370	4,5	4,5
73	0,6	74	-1,3	321	3,9	3,9
74	-1,3	73	0,6	321	3,9	3,9
75	1,0	8	1,6	323	3,9	2,8
76	0,7	77	0,4	309	2,8	2,8
77	0,4	76	0,7	309	2,8	2,8
78	-1,5	35	1,8	279	3,4	2,5
79	1,0	7	1,8	382	7,3	3,3
80	2,3	65	-1,9	306	3,7	3,4
81	1,8	64	0,3	324	4,0	3,6
82	1,0	63	-2,9	327	4,0	3,6
83	3,1	62	-1,0	332	4,1	3,7
84	0,1	44	-0,5	311	3,8	3,5
85	1,3	61	1,7	338	4,1	3,8
86	0,4	84	0,1	332	3,7	3,7
87	1,0	88	0,9	351	3,9	3,9
88	0,9	87	1,0	351	3,9	3,9
89	2,3	88	0,9	352	3,9	3,9
90	1,5	60	-0,3	335	4,1	3,7
91	4,2	75	1,0	455	5,6	5,1
92	-0,8	95	2,7	320	3,6	3,6
93	1,9	96	1,6	371	4,1	4,1
94	1,6	95	2,7	351	3,9	3,9
95	2,7	92	-0,8	320	3,6	3,6
96	1,6	93	1,9	371	4,1	4,1
97	2,8	41	2,7	356	4,3	4,0
98	-1,2	24	-1,2	347	4,2	3,9
99	-1,1	98	-1,2	398	4,4	4,4
100	0,0	101	0,0	360	3,6	3,6
101	0,0	102	0,2	359	3,6	3,6
102	0,2	7	1,8	87	1,7	0,9
103	0,0	74	-1,3	327	4,0	3,2
104	-0,7	105	-1,6	400	3,9	3,9
105	-1,6	106	-0,5	400	3,9	3,9
106	-0,5	107	-1,1	400	3,9	3,9
107	-1,1	108	-1,0	400	3,9	3,9
108	-1,0	109	-0,3	400	3,9	3,9
109	-0,3	110	-1,0	400	3,9	3,9
110	-1,0	111	-0,4	400	3,9	3,9
111	-0,4	112	-1,6	400	3,9	3,9
112	-1,6	115	0,0	349	3,4	3,4
113	-0,8	119	-2,0	324	3,1	3,1
114	0,9	117	0,0	332	3,2	3,2
115	0,0	112	-1,6	349	3,4	3,4
116	1,1	113	-0,8	337	3,3	3,3
117	0,0	114	0,9	332	3,2	3,2
118	0,2	60	-0,3	307	3,7	3,0
119	-2,0	113	-0,8	324	3,1	3,1
120	0,0	114	0,9	339	3,3	3,3
121	0,2	119	-2,0	343	3,3	3,3
122	-0,2	123	-0,2	480	4,7	4,7
123	-0,2	121	0,2	470	4,6	4,6
124	-0,6	1	-0,3	348	3,4	2,6
125	0,2	5	0,3	127	1,2	0,9
Min	-2,9		-2,9	87	1,2	0,9
Max	4,8		3,2	1.121	23,8	10,9

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PARK - Wind statistics info

Calculation: 716033 WP Oostpolder alternatief 3b

Main data for wind statistic

File	\\sbs2011\projecten\Extern\2016\716033 WP Oostpolder\TO\WP\200117\24012017\RWE_Oostpolder 100m-Corr099.wws
Name	RWE_Oostpolder 100m-Corr099
Country	Netherlands
Source	User
Mast coordinates	Dutch Stereo-RD/NAP 2000 East: 248.822 North: 608.196
Created	24-1-2017
Edited	1-2-2017
Sectors	12
WAsP version	WAsP 11 Version 11.05.0028
Displacement height	None

Additional info for wind statistic

Source data	Default Meteo data RWE
Data from	25-4-2007
Data to	31-1-2009
Measurement length	21,3 Months

Note

To get the most correct calculation results, wind statistics shall be calculated with the SAME model and model parameters, as currently chosen in calculation. For WAsP versions before 10.0, the model is unchanged, but thereafter more model changes affecting the wind statistic is seen. Likewise WAsP CFD should always use WAsP CFD calculated wind statistics.

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PARK - Map

Calculation: 716033 WP Oostpolder alternatief 3b

Map: Uithuizen , Print scale 1:75.000, Map center Dutch Stereo-RD/NAP 2000 East: 249.717 North: 606.402

New WTG Existing WTG Obstacle

Project:
24_01_2017

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Calculated:
16-3-2017 9:08/3.1.597

PARK - Main Result

Calculation: WP Oostpolder VKA1

Wake Model	N.O. Jensen (RISØ/EMD)

Calculation Settings

Air density calculation mode	Individual per WTG
Result for WTG at hub altitude	1,232 kg/m³ to 1,248 kg/m³
Air density relative to standard	100,6 % to 101,8 %
Hub altitude above sea level (asl)	39,9 m to 166,0 m
Annual mean temperature at hub alt.	8,0 °C to 8,8 °C
Pressure at WTGs	994,3 hPa to 1.009,6 hPa

Wake Model Parameters

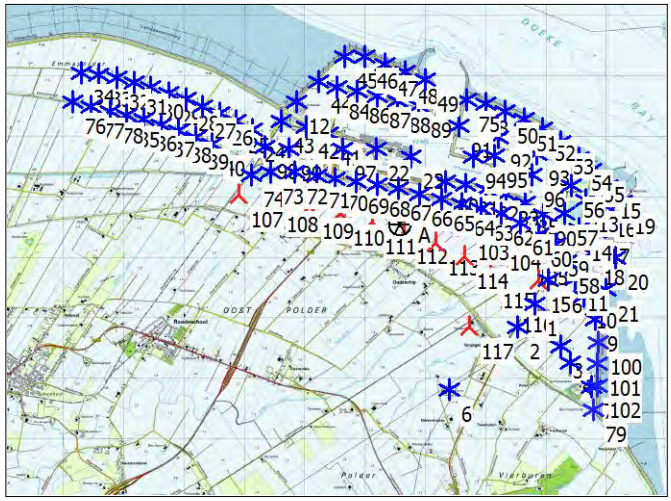
Terrain type	Wake decay constant
HH:100m Open farmland	0,062

Displacement heights from objects

Wake calculation settings

Angle [°]			Wind speed [m/s]		
start	end	step	start	end	step
0,5	360,0	1,0	0,5	30,5	1,0

Wind statistics	RWE_Oostpolder 100m-Corr099.wws
WAsP version	WAsP 11 Version 11.05.0028



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New WTG
Existing WTG
Site Data

Key results for height 165,0 m above ground level

Terrain Dutch Stereo-RD/NAP 2000

	X (east)	Y (north)	Name of wind distribution	Type	Wind energy [kWh/m²]	Mean wind speed [m/s]	Equivalent roughness
A	250.596	606.527	Oostpolder site data	WAsP (WAsP 11 Version 11.05.0028)	7.041	9,2	1,1

Calculated Annual Energy for Wind Farm

WTG combination	Result PARK [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Specific results¤) Park efficiency [%]	Capacity factor [%]	Mean WTG result [MWh/y]	Full load hours [Hours/year]	Mean wind speed @hub height [m/s]
Wind farm	1.171.467,0	1.392.130,4	84,1	35,1	10.012,5	3.081	8,3
New WTGs only	293.461,2	323.867,9	90,6	53,1	19.564,1	4.658	9,2
Existing park WTGs only	878.005,7	1.068.262,5	82,2	31,6	8.607,9	2.767	8,2
Existing park WTGs without new WTGs	904.288,4	1.068.262,5	84,7		8.865,6		
Reduction for existing park WTGs caused by new	26.282,7						

¤) Based on wake reduced results, but no other losses included

Calculated Annual Energy for each of 15 new WTGs with total 63,0 MW rated power

Links	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Power curve Creator	Name	Annual Energy Result [MWh]	Park Efficiency [%]	Capacity factor [%]	Free mean wind speed [m/s]
103 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.112,7	88,01	51,9	9,20
104 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	18.929,4	87,02	51,4	9,21
105 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	18.979,9	87,24	51,6	9,21
106 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	18.015,5	83,05	48,9	9,18
107 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	20.421,1	95,08	55,5	9,13
108 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	20.098,8	93,49	54,6	9,13
109 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.975,6	92,70	54,3	9,14
110 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.889,6	92,38	54,0	9,13
111 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.892,7	92,26	54,0	9,14
112 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.822,7	91,88	53,8	9,14
113 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.662,1	91,06	53,4	9,15
114 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.581,2	90,64	53,2	9,15
115 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.426,3	89,98	52,8	9,14
116 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.352,3	89,78	52,6	9,12
117 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	20.301,3	94,78	55,1	9,07

Annual Energy results do not include any losses apart from wake losses. For expected NET AEP (expected sold production), see report Loss & Uncertainty.

PARK - Main Result

Calculation: WP Oostpolder VKA1

Calculated Annual Energy for each of 102 existing park WTGs with total 317,3 MW rated power

	WTG type						Power curve		Annual Energy			Park
Links	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Creator	Name	Calculated prod. without new WTGs	After New WTGs	Decrease due to new WTGs	Efficiency
				[kW]	[m]	[m]			[MWh]	[MWh]	[MWh %]	[%]
1 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	18.622,7	17.609,1	1.013,6 5,4	85,89
2 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.349,2	18.741,8	607,4 3,1	91,90
3 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.142,7	18.861,9	280,8 1,5	91,99
4 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.174,0	18.999,6	174,4 0,9	92,67
5 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	18.071,8	15.890,4	2.181,5 12,1	77,03
6 A	No	VESTAS	V47-660	660	47,0	40,0	EMD	Level 0 - calculated - - 07-2001	1.477,2	1.464,4	12,8 0,9	96,19
7 A	Yes	VESTAS	V52-850	850	52,0	40,0	EMD	Level 0 - calculated - 104.2 dB(A) - 07-2006	1.989,3	1.973,1	16,2 0,8	92,33
8 A	Yes	VESTAS	V117-3.45-3.450	3.450	117,0	93,5	EMD	Level 0 - Calculated - Modes 0 & 0-0S - 01-2016	12.967,1	12.841,3	125,7 1,0	84,97
9 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.706,0	7.566,4	139,6 1,8	84,43
10 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.552,7	7.350,7	202,1 2,7	82,20
11 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.445,1	7.097,7	347,4 4,7	79,42
12 A	No	2-B Energy	OTC 6 MW-6.000	6.000	140,0	105,0	USER	Turbulent power curce with TI of 8.7%	18.447,6	18.281,4	166,2 0,9	83,65
13 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	6.913,2	6.756,1	157,0 2,3	73,24
14 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	6.891,4	6.641,3	250,1 3,6	72,86
15 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.205,1	7.123,4	81,7 1,1	75,50
16 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.086,1	6.968,7	117,3 1,7	74,90
17 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.140,3	6.964,7	175,6 2,5	75,71
18 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.071,5	6.808,3	263,2 3,7	75,53
19 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.452,9	7.381,1	71,8 1,0	80,33
20 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.655,9	7.540,7	115,2 1,5	81,47
21 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.541,7	7.400,9	140,9 1,9	81,77
22 A	No	Senvion	6.2M126-6.150	6.150	126,0	114,0	USER	Calcated power curve Senvion 6.2M126	18.923,9	18.471,2	452,8 2,4	83,00
23 A	No	Senvion	6.2M126-6.150	6.150	126,0	114,0	USER	Calcated power curve Senvion 6.2M126	18.926,8	18.397,6	529,2 2,8	82,37
24 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.673,1	7.543,2	129,9 1,7	84,14
25 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.541,6	7.473,7	67,9 0,9	82,85
26 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.392,8	7.339,2	53,7 0,7	81,50
27 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.420,1	7.398,5	21,5 0,3	81,85
28 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.484,6	7.469,1	15,5 0,2	82,02
29 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.535,0	7.520,2	14,8 0,2	82,38
30 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.476,5	7.464,7	11,7 0,2	82,45
31 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.555,8	7.546,9	8,9 0,1	83,01
32 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.750,1	7.742,8	7,3 0,1	84,29
33 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.943,6	7.934,8	8,8 0,1	86,36
34 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.428,3	8.420,4	7,9 0,1	91,87
35 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.909,3	7.891,6	17,7 0,2	87,28
36 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.889,4	7.870,5	18,9 0,2	87,38
37 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.893,4	7.870,2	23,1 0,3	87,46
38 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.866,4	7.837,2	29,2 0,4	87,47
39 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.861,8	7.821,1	40,7 0,5	87,36
40 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.904,6	7.845,0	59,6 0,8	87,79
41 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.518,0	7.349,3	168,6 2,2	80,41
42 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.268,4	7.127,6	140,8 1,9	78,43
43 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.412,0	7.316,0	96,0 1,3	80,61
44 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.803,4	7.746,5	56,9 0,7	81,85
45 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.274,8	8.235,3	39,5 0,5	85,08
46 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.204,3	8.167,5	36,8 0,4	83,77
47 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.225,9	8.170,6	55,4 0,7	83,64
48 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.993,8	7.937,0	56,8 0,7	82,74
49 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.950,5	7.887,9	62,6 0,8	82,74
50 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.822,5	7.739,2	83,2 1,1	80,57
51 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.887,4	7.772,0	115,4 1,5	81,07
52 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.861,1	7.763,3	97,8 1,2	80,76
53 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.855,6	7.725,2	130,5 1,7	80,81
54 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.716,6	7.589,3	127,3 1,6	79,64
55 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.505,1	7.371,8	133,3 1,8	77,45
56 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.270,2	7.048,4	221,8 3,1	75,57
57 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.105,1	6.757,4	347,7 4,9	73,79
58 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.258,3	6.758,4	499,9 6,9	75,22
59 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.501,0	6.818,6	682,4 9,1	74,82
60 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.562,7	6.696,0	866,7 11,5	74,56
61 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.660,4	6.786,4	874,0 11,4	75,34
62 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.561,1	6.704,1	857,0 11,3	74,52
63 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.602,4	6.729,1	873,3 11,5	75,04
64 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.691,8	7.035,8	656,1 8,5	78,21
65 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.715,1	7.180,2	535,0 6,9	80,41
66 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.859,2	7.255,6	603,7 7,7	80,87
67 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.845,8	7.291,8	554,0 7,1	81,15
68 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.779,6	7.282,3	497,3 6,4	81,96
69 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.761,8	7.175,9	585,9 7,5	80,91
70 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.711,7	7.180,1	531,5 6,9	81,09
71 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.742,1	7.213,3	528,8 6,8	81,73
72 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.697,6	7.191,7	506,0 6,6	81,85
73 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.781,2	7.359,2	422,0 5,4	83,23
74 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.055,1	7.564,6	490,5 6,1	86,29
75 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	100,0	EMD	Level 0 - official - Mode 0 - 08/2014	8.075,2	7.978,1	97,1 1,2	83,24
76 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	12.800,1	12.792,4	7,7 0,1	94,32
77 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	12.289,5	12.279,9	9,6 0,1	90,78
78 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	11.992,1	11.976,1	16,1 0,1	89,30
79 A	Yes	VESTAS	V117-3.6-3.600	3.600	117,0	117,0	EMD	Level 0 - Calculated - Modes PO1 & PO1-0S - 01-2016	15.257,1	15.181,8	75,3 0,5	96,66
80 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.313,7	7.951,6	362,1 4,4	76,56
81 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.222,2	7.861,8	360,4 4,4	75,48
82 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.181,9	7.660,4	521,5 6,4	73,35
83 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.255,6	7.776,4	479,2 5,8	73,77

To be continued on next page...

PARK - Main Result

Calculation: WP Oostpolder VKA1

...continued from previous page

	WTG type						Power curve		Annual Energy			Park
Links	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Creator	Name	Calculated prod. without new WTGs	After New WTGs	Decrease due to new WTGs	Efficiency
				[kW]	[m]	[m]			[MWh]	[MWh]	[MWh %]	[%]
84 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.733,7	8.661,5	72,2 0,8	81,20
85 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.121,8	7.559,3	562,5 6,9	72,66
86 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.781,2	8.696,8	84,4 1,0	81,44
87 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.822,1	8.715,9	106,1 1,2	81,85
88 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.752,0	8.645,9	106,1 1,2	80,93
89 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.895,2	8.775,5	119,6 1,3	82,42
90 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.130,7	7.603,1	527,6 6,5	72,84
91 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	9.087,9	8.930,0	157,9 1,7	82,95
92 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.377,8	8.242,2	135,6 1,6	77,56
93 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.474,5	8.326,9	147,5 1,7	78,05
94 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.516,5	8.308,8	207,7 2,4	78,43
95 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.425,9	8.199,4	226,5 2,7	77,49
96 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.377,8	8.120,8	257,0 3,1	76,60
97 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.445,4	8.164,6	280,8 3,3	79,01
98 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.474,3	8.288,2	186,1 2,2	81,89
99 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.271,9	8.004,9	267,0 3,2	79,11
100 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.344,3	8.247,1	97,2 1,2	87,77
101 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.514,6	8.454,0	60,6 0,7	90,11
102 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.611,5	8.554,1	57,4 0,7	91,46

WTG siting

		Dutch Stereo-RD / NAP 2000			
		X (east)	Y (north)	Z [m]	Row data/Description
1	Exist	252.819	605.227	-0,3	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (244)
2	Exist	252.538	604.846	0,0	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (245)
3	Exist	253.250	604.530	0,0	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (246)
4	Exist	253.410	604.258	0,2	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (247)
5	Exist	253.038	605.625	0,3	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (248)
6	Exist	251.401	603.815	-0,1	VESTAS V47 660 47.0 !O! hub: 40,0 m (TOT: 63,5 m) (264)
7	Exist	253.765	603.860	1,8	VESTAS V52 850 52.0 !O! hub: 40,0 m (TOT: 66,0 m) (265)
8	Exist	252.007	608.545	1,6	VESTAS V117-3.45 3450 117.0 !O! hub: 93,5 m (TOT: 152,0 m) (266)
9	Exist	253.830	604.979	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (267)
10	Exist	253.634	605.359	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (268)
11	Exist	253.487	605.644	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (269)
12	Exist	248.875	608.572	2,5	2-B Energy OTC 6 MW 6000 140.0 !#! hub: 105,0 m (TOT: 175,0 m) (270)
13	Exist	253.662	606.943	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (271)
14	Exist	253.548	606.476	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (272)
15	Exist	254.026	607.172	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (273)
16	Exist	253.954	606.875	2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (274)
17	Exist	253.843	606.417	2,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (275)
18	Exist	253.758	606.067	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (276)
19	Exist	254.272	606.915	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (277)
20	Exist	254.151	605.985	2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (278)
21	Exist	253.996	605.473	0,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (279)
22	Exist	250.194	607.795	4,3	Senvion 6.2M126 6150 126.0 !O! hub: 114,0 m (TOT: 177,0 m) (280)
23	Exist	250.760	607.657	3,1	Senvion 6.2M126 6150 126.0 !O! hub: 114,0 m (TOT: 177,0 m) (281)
24	Exist	248.142	608.104	-1,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (282)
25	Exist	247.865	608.255	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (283)
26	Exist	247.590	608.377	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (284)
27	Exist	247.311	608.501	-1,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (285)
28	Exist	247.034	608.625	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (286)
29	Exist	246.747	608.713	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (371)
30	Exist	246.447	608.805	-2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (288)
31	Exist	246.172	608.890	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (289)
32	Exist	245.885	608.978	0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (290)
33	Exist	245.590	609.026	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (291)
34	Exist	245.294	609.056	-1,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (292)
35	Exist	246.045	608.352	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (293)
36	Exist	246.336	608.279	0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (294)
37	Exist	246.622	608.188	1,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (295)
38	Exist	246.907	608.088	-0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (296)
39	Exist	247.190	607.981	0,6	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (297)
40	Exist	247.472	607.870	0,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (298)
41	Exist	249.390	608.049	2,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (299)
42	Exist	249.023	608.155	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (300)
43	Exist	248.609	608.251	1,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (301)

To be continued on next page...

Licensed user:
Pondera Consult B.V.
Welbergweg 49
NL-7556 PE Hengelo
0031742489940

Calculated:
16-3-2017 9:08/3.1.597

PARK - Main Result

Calculation: WP Oostpolder VKA1

...continued from previous page

		Dutch Stereo-RD / NAP 2000			
		X (east)	Y (north)	Z [m]	Row data/Description
44	Exist	249.242	608.904	-0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (302)
45	Exist	249.672	609.314	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (303)
46	Exist	250.005	609.324	2,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (304)
47	Exist	250.336	609.195	4,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (305)
48	Exist	250.665	609.061	1,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (306)
49	Exist	250.997	608.936	3,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (307)
50	Exist	252.323	608.418	1,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (308)
51	Exist	252.641	608.293	1,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (309)
52	Exist	252.949	608.128	2,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (310)
53	Exist	253.248	607.910	0,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (311)
54	Exist	253.547	607.637	0,6	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (312)
55	Exist	253.756	607.438	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (313)
56	Exist	253.425	607.194	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (314)
57	Exist	253.312	606.728	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (315)
58	Exist	253.341	605.928	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (316)
59	Exist	253.172	606.215	4,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (317)
60	Exist	252.880	606.379	-0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (318)
61	Exist	252.576	606.567	1,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (319)
62	Exist	252.262	606.720	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (320)
63	Exist	251.932	606.799	-2,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (321)
64	Exist	251.602	606.881	0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (322)
65	Exist	251.272	606.961	-1,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (323)
66	Exist	250.915	607.046	1,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (324)
67	Exist	250.558	607.133	1,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (325)
68	Exist	250.211	607.197	-1,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (326)
69	Exist	249.862	607.249	-0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (327)
70	Exist	249.511	607.301	0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (328)
71	Exist	249.207	607.349	0,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (329)
72	Exist	248.841	607.404	-0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (330)
73	Exist	248.444	607.403	0,6	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (331)
74	Exist	248.125	607.370	-1,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (332)
75	Exist	251.691	608.611	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 100,0 m (TOT: 141,0 m) (333)
76	Exist	245.161	608.566	0,7	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (354)
77	Exist	245.463	608.501	0,4	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (355)
78	Exist	245.775	608.421	-1,5	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (356)
79	Exist	253.792	603.479	1,0	VESTAS V117-3.6 3600 117.0 !O! hub: 117,0 m (TOT: 175,5 m) (664)
80	Exist	251.345	607.258	2,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (599)
81	Exist	251.679	607.196	1,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (600)
82	Exist	252.008	607.117	1,0	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (601)
83	Exist	252.340	607.043	3,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (602)
84	Exist	249.539	608.811	0,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (603)
85	Exist	252.654	606.896	1,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (604)
86	Exist	249.866	608.752	0,4	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (605)
87	Exist	250.208	608.666	1,0	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (606)
88	Exist	250.550	608.586	0,9	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (607)
89	Exist	250.892	608.503	2,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (608)
90	Exist	252.958	606.705	1,5	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (609)
91	Exist	251.566	608.173	4,2	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (610)
92	Exist	252.219	607.986	-0,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (611)
93	Exist	252.852	607.716	1,9	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (612)
94	Exist	251.793	607.668	1,6	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (613)
95	Exist	252.144	607.675	2,7	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (614)
96	Exist	252.765	607.355	1,6	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (615)
97	Exist	249.631	607.787	2,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (616)
98	Exist	248.339	607.818	-1,2	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (617)
99	Exist	248.736	607.792	-1,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (618)
100	Exist	253.864	604.596	0,0	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (712)
101	Exist	253.855	604.236	0,0	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (713)
102	Exist	253.850	603.877	0,2	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (714)
103	New	251.679	606.481	-1,3	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (748)
104	New	252.191	606.316	0,6	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (749)
105	New	252.640	606.079	0,0	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (750)
106	New	252.891	605.613	0,0	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (751)
107	New	247.910	607.020	-0,3	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (752)

To be continued on next page...

PARK - Main Result

Calculation: WP Oostpolder VKA1

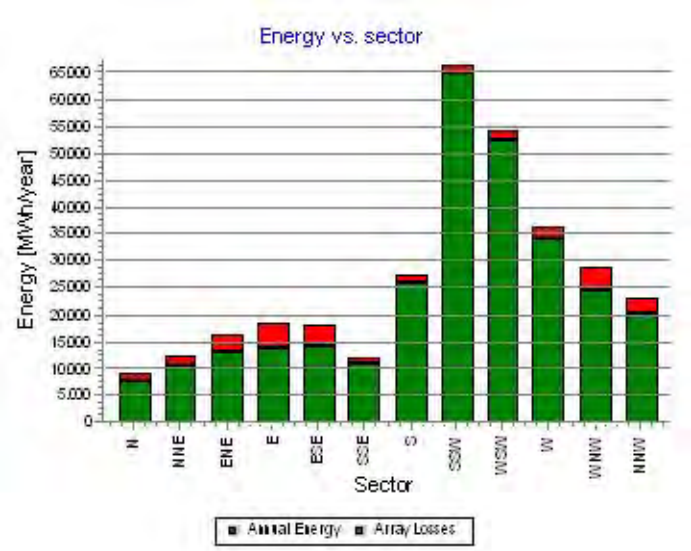
...continued from previous page

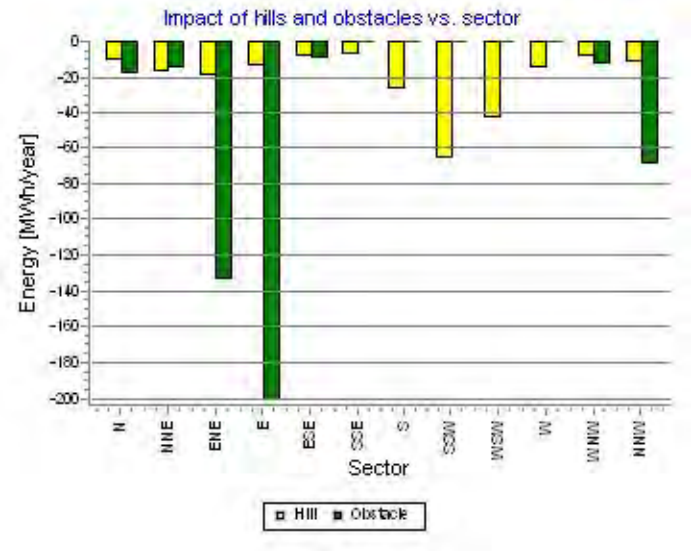
		Dutch Stereo-RD / NAP 2000			
		X (east)	Y (north)	Z [m]	Row data/Description
108	New	248.500	606.952	-1,0	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (753)
109	New	249.086	606.838	1,0	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (754)
110	New	249.597	606.724	-1,7	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (755)
111	New	250.131	606.584	-0,9	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (756)
112	New	250.661	606.425	-1,6	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (757)
113	New	251.175	606.238	-1,0	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (758)
114	New	251.655	606.010	-0,3	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (759)
115	New	252.082	605.684	-0,8	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (760)
116	New	252.404	605.290	-0,1	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (761)
117	New	251.732	604.852	0,1	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (762)

PARK - Production Analysis

Calculation: WP Oostpolder VKA1WTG: All new WTGs, Air density varies with WTG position 1,232 kg/m³ - 1,248 kg/m³
Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	9.348,6	12.525,0	16.585,3	18.479,1	18.226,8	12.000,8	27.628,0	66.625,2	54.633,8	36.588,4	28.923,9	23.009,9	324.574,8
-Decrease due to obstacles	[MWh]	17,8	14,7	134,4	201,5	9,7	0,1	0,0	0,0	0,0	0,0	12,9	68,1	459,1
+Increase due to hills	[MWh]	-10,9	-16,8	-19,7	-13,4	-8,4	-7,9	-26,5	-65,0	-43,1	-15,4	-8,8	-11,8	-247,8
-Decrease due to array losses	[MWh]	1.389,2	1.770,9	3.384,0	4.368,6	4.017,3	1.070,2	1.411,7	1.581,8	2.099,4	2.246,5	4.357,8	2.709,3	30.406,7
Resulting energy	[MWh]	7.930,7	10.722,7	13.047,2	13.895,6	14.191,4	10.922,6	26.189,8	64.978,4	52.491,4	34.326,5	24.544,3	20.220,7	293.461,3
Specific energy	[kWh/m²]													1.253
Specific energy	[kWh/kW]													4.658
Decrease due to obstacles	[%]	0,2	0,1	0,8	1,1	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,14
Increase due to hills	[%]	-0,1	-0,1	-0,1	-0,1	0,0	-0,1	-0,1	-0,1	-0,1	0,0	0,0	-0,1	-0,08
Decrease due to array losses	[%]	14,9	14,2	20,6	23,9	22,1	8,9	5,1	2,4	3,8	6,1	15,1	11,8	9,39
Utilization	[%]	18,7	20,9	22,2	22,1	19,9	18,5	19,4	20,4	17,4	14,6	13,4	15,0	17,7
Operational	[Hours/year]	342	388	528	612	549	361	713	1.475	1.363	960	752	598	8.642
Full Load Equivalent	[Hours/year]	126	170	207	221	225	173	416	1.031	833	545	390	321	4.658

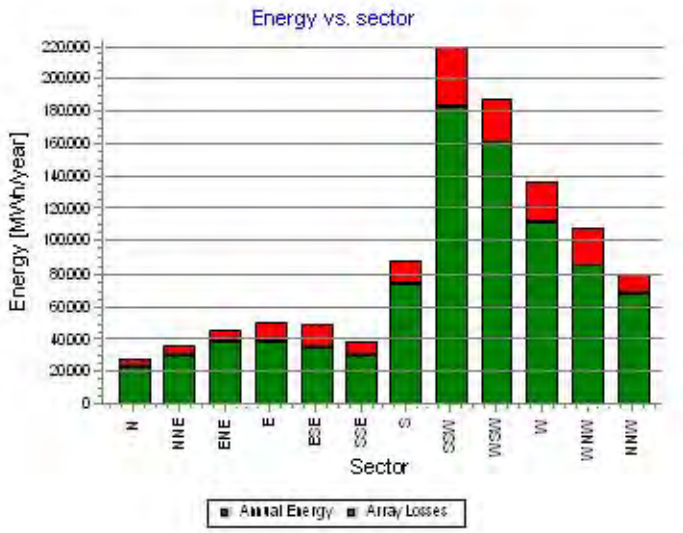


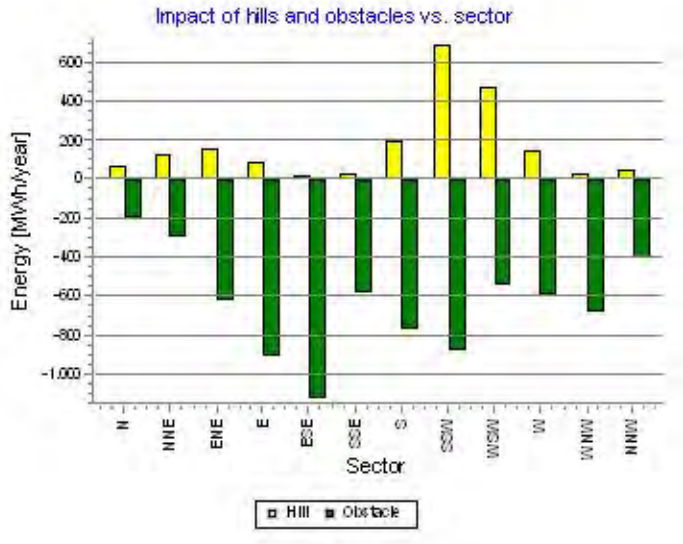


PARK - Production Analysis

Calculation: WP Oostpolder VKA1WTG: All existing WTGs, Air density varies with WTG position 1,232 kg/m³ - 1,248 kg/m³ Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	27.773,1	36.183,5	46.549,9	50.905,6	50.704,9	38.783,0	89.039,8	219.772,1	187.819,5	136.783,6	109.534,6	79.965,9	1.073.816,0
-Decrease due to obstacles	[MWh]	191,0	291,8	628,3	914,8	1.125,6	585,8	774,4	882,1	550,6	594,5	680,3	401,0	7.620,2
+Increase due to hills	[MWh]	65,3	127,8	154,3	89,5	24,1	27,0	193,1	687,6	469,8	146,2	31,1	51,4	2.067,3
-Decrease due to array losses	[MWh]	4.353,6	5.806,4	7.502,9	11.567,3	14.952,1	7.480,5	14.870,9	36.571,4	27.755,8	24.488,8	23.541,6	11.365,6	190.256,6
Resulting energy	[MWh]	23.293,9	30.213,2	38.573,0	38.513,1	34.651,3	30.743,7	73.587,6	183.006,2	159.982,9	111.846,5	85.343,7	68.250,6	878.006,1
Specific energy	[kWh/m²]													1.337
Specific energy	[kWh/kW]													2.767
Decrease due to obstacles	[%]	0,7	0,8	1,3	1,8	2,2	1,5	0,9	0,4	0,3	0,4	0,6	0,5	0,71
Increase due to hills	[%]	0,2	0,4	0,3	0,2	0,0	0,1	0,2	0,3	0,3	0,1	0,0	0,1	0,19
Decrease due to array losses	[%]	15,7	16,1	16,3	23,1	30,1	19,6	16,8	16,7	14,8	18,0	21,6	14,3	17,81
Utilization	[%]	28,7	31,1	33,1	30,8	26,6	25,8	27,8	28,8	25,8	21,1	20,1	25,0	25,7
Operational	[Hours/year]	333	375	509	592	531	354	688	1.426	1.324	945	738	584	8.399
Full Load Equivalent	[Hours/year]	73	95	122	121	109	97	232	577	504	353	269	215	2.767





PARK - Power Curve Analysis

Calculation: WP Oostpolder VKA1WTG: 103 - ENERCON E-141 EP4 4200 141.0 !-! Level 0 - official - 0 s- 4200kW - 04/2016, Hub height: 165,0 m

Name: Level 0 - official - 0 s- 4200kW - 04/2016
Source: Manufacturer

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type	Generator type	Specific power kW/m²
13-4-2016	EMD	29-4-2016	9-5-2016	25,0	Pitch	User defined	Variable	0,27

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HP curve comparison - Note: For standard air density and weibull k parameter = 2

Vmean	[m/s]	5	6	7	8	9	10
HP value Pitch, variable speed (2013)	[MWh]	7.749	11.582	15.194	18.346	20.965	23.032
ENERCON E-141 EP4 4200 141.0 !-! Level 0 - official - 0 s- 4200kW - 04/2016	[MWh]	7.644	11.288	14.772	17.854	20.437	22.479
Check value	[%]	1	3	3	3	3	2

The table shows comparison between annual energy production calculated on basis of simplified "HP-curves" which assume that all WTGs performs quite similar - only specific power loading (kW/m^2) and single/dual speed or stall/pitch decides the calculated values. Productions are without wake losses.
For further details, ask at the Danish Energy Agency for project report J.nr. 51171/00-0016 or see windPRO manual chapter 3.5.2.
The method is refined in EMD report "20 Detailed Case Studies comparing Project Design Calculations and actual Energy Productions for Wind Energy Projects worldwide", jan 2003.
Use the table to evaluate if the given power curve is reasonable - if the check value are lower than -5%, the power curve probably is too optimistic due to uncertainty in power curve measurement.

Power curve

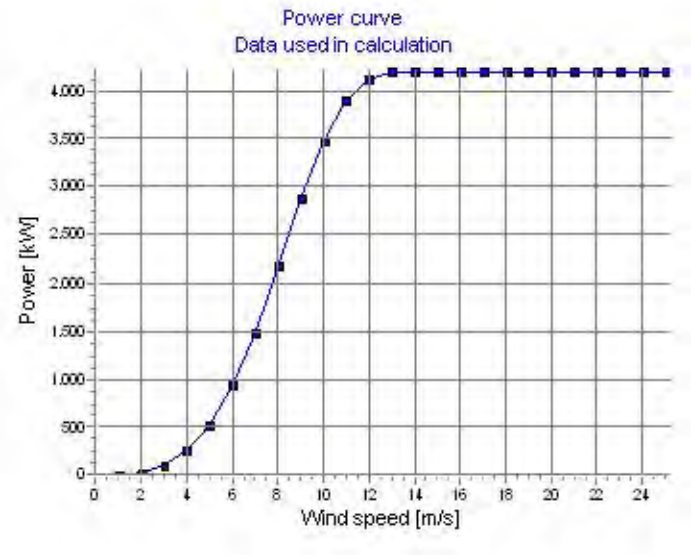
Original data, Air density: 1,225 kg/m³

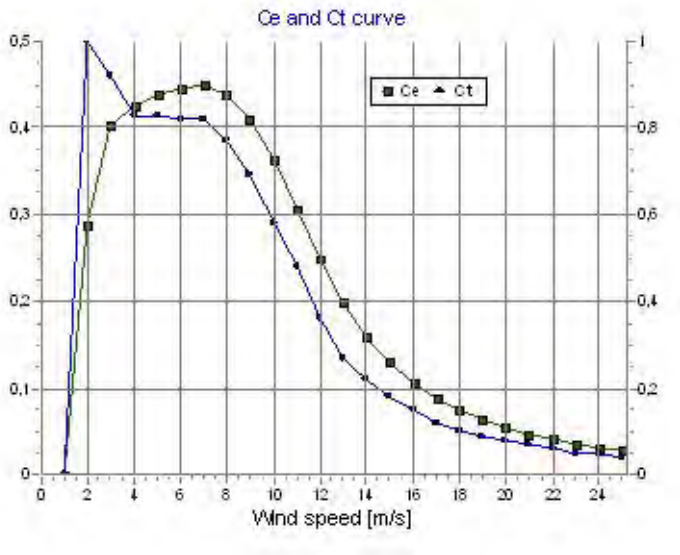
Wind speed [m/s]	Power [kW]	Ce	Wind speed [m/s]	Ct curve
0,0	0,0	0,00	0,0	0,00
0,5	0,0	0,00	0,5	0,00
1,0	0,0	0,00	1,0	0,00
1,5	0,0	0,00	1,5	0,00
2,0	22,0	0,29	2,0	1,16
2,5	54,0	0,36	2,5	1,01
3,0	104,0	0,40	3,0	0,92
3,5	171,0	0,42	3,5	0,87
4,0	260,0	0,42	4,0	0,83
4,5	376,0	0,43	4,5	0,83
5,0	523,0	0,44	5,0	0,83
5,5	703,0	0,44	5,5	0,82
6,0	920,0	0,45	6,0	0,82
6,5	1.176,0	0,45	6,5	0,82
7,0	1.471,0	0,45	7,0	0,82
7,5	1.799,0	0,45	7,5	0,80
8,0	2.151,0	0,44	8,0	0,77
8,5	2.514,0	0,43	8,5	0,74
9,0	2.867,0	0,41	9,0	0,69
9,5	3.194,0	0,39	9,5	0,63
10,0	3.481,0	0,36	10,0	0,58
10,5	3.719,0	0,34	10,5	0,53
11,0	3.903,0	0,31	11,0	0,48
11,5	4.033,0	0,28	11,5	0,41
12,0	4.119,0	0,25	12,0	0,36
12,5	4.171,0	0,22	12,5	0,31
13,0	4.196,0	0,20	13,0	0,27
13,5	4.200,0	0,18	13,5	0,24
14,0	4.200,0	0,16	14,0	0,22
14,5	4.200,0	0,14	14,5	0,19
15,0	4.200,0	0,13	15,0	0,18
15,5	4.200,0	0,12	15,5	0,16
16,0	4.200,0	0,11	16,0	0,15
16,5	4.200,0	0,10	16,5	0,13
17,0	4.200,0	0,09	17,0	0,12
17,5	4.200,0	0,08	17,5	0,11
18,0	4.200,0	0,08	18,0	0,10
18,5	4.200,0	0,07	18,5	0,10
19,0	4.200,0	0,06	19,0	0,09
19,5	4.200,0	0,06	19,5	0,08
20,0	4.200,0	0,05	20,0	0,08
20,5	4.200,0	0,05	20,5	0,07
21,0	4.200,0	0,05	21,0	0,07
21,5	4.200,0	0,04	21,5	0,06
22,0	4.200,0	0,04	22,0	0,06
22,5	4.200,0	0,04	22,5	0,06
23,0	4.200,0	0,04	23,0	0,05
23,5	4.200,0	0,03	23,5	0,05
24,0	4.200,0	0,03	24,0	0,05
24,5	4.200,0	0,03	24,5	0,04

Power, Efficiency and energy vs. wind speed

Data used in calculation, Air density: 1,232 kg/m³ New windPRO method (adjusted IEC method, improved to match turbine control) <RECOMMENDED>

Wind speed [m/s]	Power [kW]	Ce	Interval [m/s]	Energy [MWh]	Acc.Energy [MWh]	Relative [%]
1,0	0,0	0,00	0,50- 1,50	0,0	0,0	0,0
2,0	22,3	0,29	1,50- 2,50	7,1	7,2	0,0
3,0	104,8	0,40	2,50- 3,50	40,1	47,2	0,2
4,0	261,8	0,43	3,50- 4,50	126,7	173,9	0,9
5,0	526,5	0,44	4,50- 5,50	302,4	476,3	2,5
6,0	926,0	0,45	5,50- 6,50	598,2	1.074,5	5,6
7,0	1.480,0	0,45	6,50- 7,50	1.019,2	2.093,7	11,0
8,0	2.162,5	0,44	7,50- 8,50	1.515,1	3.608,8	18,9
9,0	2.879,5	0,41	8,50- 9,50	1.967,4	5.576,2	29,2
10,0	3.492,4	0,36	9,50-10,50	2.242,5	7.818,7	40,9
11,0	3.910,9	0,31	10,50-11,50	2.272,6	10.091,3	52,8
12,0	4.122,8	0,25	11,50-12,50	2.087,8	12.179,1	63,7
13,0	4.196,3	0,20	12,50-13,50	1.777,2	13.956,4	73,0
14,0	4.200,0	0,16	13,50-14,50	1.430,4	15.386,8	80,5
15,0	4.200,0	0,13	14,50-15,50	1.104,6	16.491,4	86,3
16,0	4.200,0	0,11	15,50-16,50	823,1	17.314,5	90,6
17,0	4.200,0	0,09	16,50-17,50	593,6	17.908,1	93,7
18,0	4.200,0	0,07	17,50-18,50	416,1	18.324,2	95,9
19,0	4.200,0	0,06	18,50-19,50	284,8	18.609,1	97,4
20,0	4.200,0	0,05	19,50-20,50	191,4	18.800,5	98,4
21,0	4.200,0	0,05	20,50-21,50	126,9	18.927,4	99,0
22,0	4.200,0	0,04	21,50-22,50	83,2	19.010,5	99,5
23,0	4.200,0	0,04	22,50-23,50	54,0	19.064,5	99,7
24,0	4.200,0	0,03	23,50-24,50	34,7	19.099,2	99,9
25,0	4.200,0	0,03	24,50-25,50	13,5	19.112,7	100,0





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PARK - Terrain

Calculation: WP Oostpolder VKA1Site Data: A - Oostpolder site data

Obstacles:
23 Obstacles used

Roughness:
Terrain data files used in calculation:
\\sbs2011\projecten\Extern\2015\715068 WTG Intocon Eemshaven\TO\WP\ROUGHNESSLINE_713066 715068_1.wpo
Min X: 219.227, Max X: 278.331, Min Y: 577.425, Max Y: 638.717, Width: 59.104 m, Height: 61.292 m

Orography:
Terrain data files used in calculation:
\\sbs2011\projecten\Extern\2016\716033 WP Oostpolder\TO\WP\ObjectImports\713066 715068_EMDGrid_0(1).wpg
Min X: 198.208, Max X: 300.556, Min Y: 557.205, Max Y: 659.267, Width: 102.348 m, Height: 102.062 m

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PARK - Wind Data Analysis

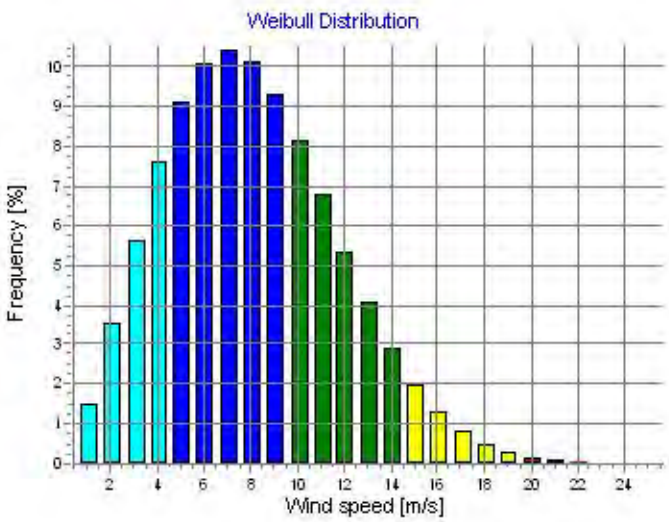
Calculation: WP Oostpolder VKA1Wind data: A - Oostpolder site data; Hub height: 100,0

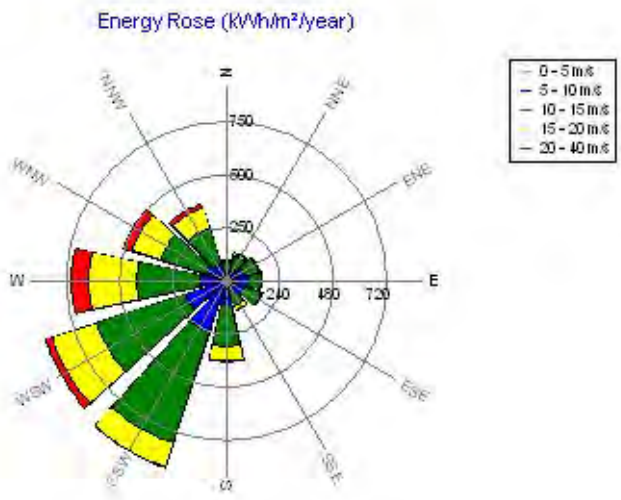
Site coordinates
Dutch Stereo-RD/NAP 2000
East: 250.596 North: 606.527

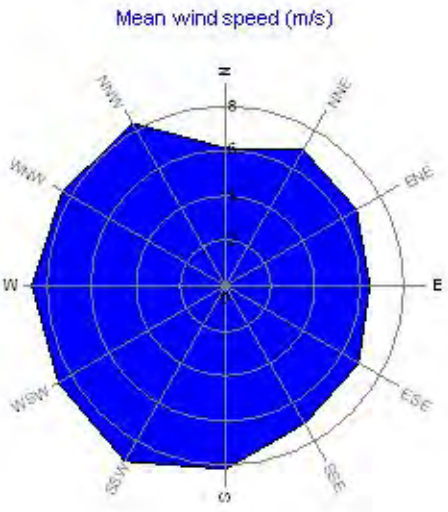
Wind statistics
RWE_Oostpolder 100m-Corr099.wws

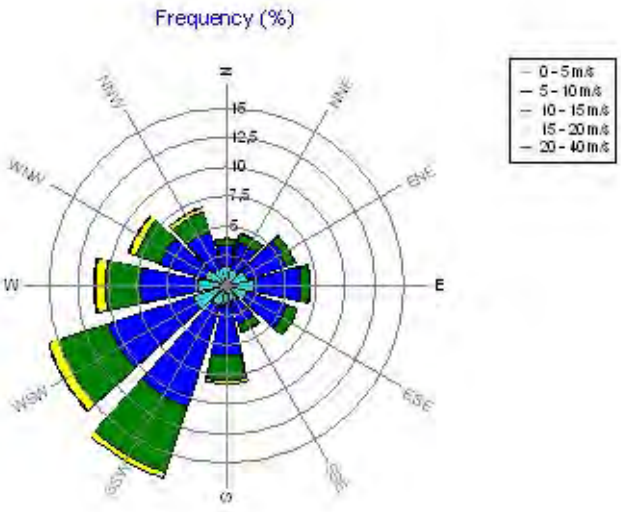
Weibull Data

Sector	Current site A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	6,90	6,13	1,854	4,0
1 NNE	7,85	6,95	2,322	4,5
2 ENE	7,60	6,75	2,545	6,1
3 E	7,30	6,48	2,553	7,1
4 ESE	7,79	6,91	2,498	6,3
5 SSE	7,97	7,06	2,115	4,2
6 S	9,18	8,14	2,486	8,2
7 SSW	10,06	9,00	3,146	17,0
8 WSW	9,71	8,61	2,393	15,8
9 W	9,77	8,65	2,068	11,2
10 WNW	9,48	8,40	2,119	8,7
11 NNW	9,43	8,35	2,209	6,9
All	9,03	8,00	2,287	100,0









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PARK - Wind Data Analysis

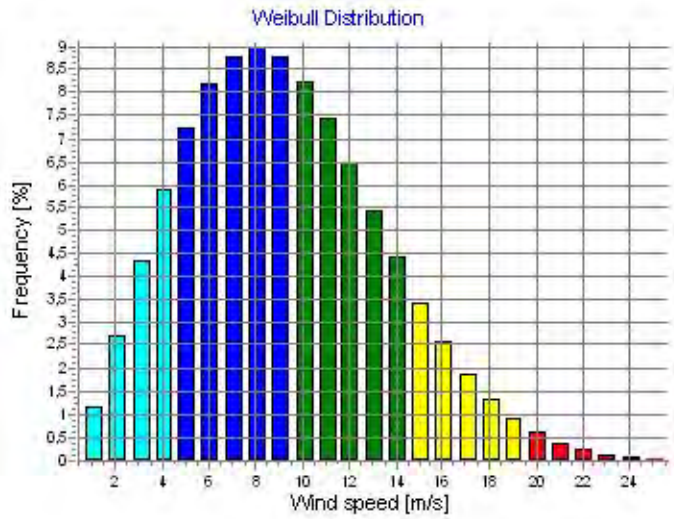
Calculation: WP Oostpolder VKA1Wind data: A - Oostpolder site data; Hub height: 165,0

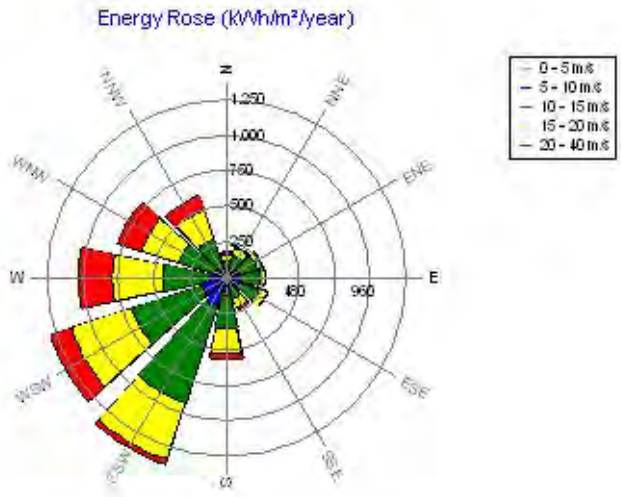
Site coordinates
Dutch Stereo-RD/NAP 2000
East: 250.596 North: 606.527

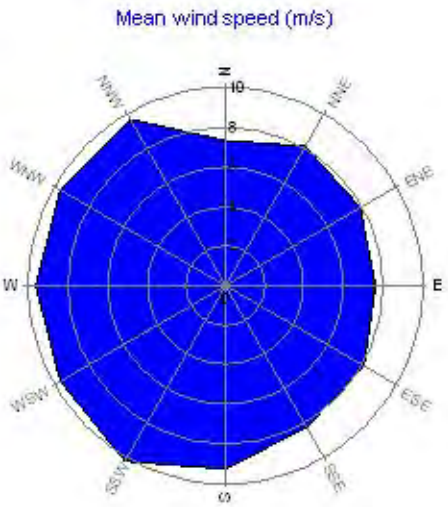
Wind statistics
RWE_Oostpolder 100m-Corr099.wws

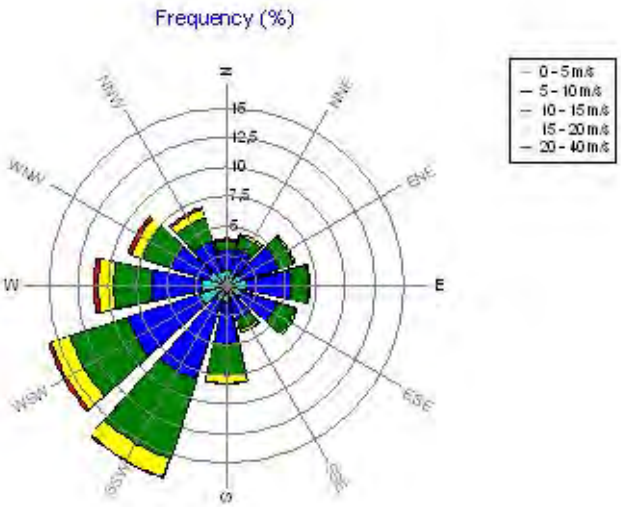
Weibull Data

Sector	Current site A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	8,26	7,34	1,795	4,0
1 NNE	9,17	8,13	2,252	4,5
2 ENE	8,91	7,90	2,467	6,1
3 E	8,54	7,57	2,471	7,1
4 ESE	9,21	8,16	2,424	6,3
5 SSE	9,31	8,25	2,049	4,2
6 S	10,47	9,28	2,420	8,2
7 SSW	11,44	10,22	3,064	17,1
8 WSW	10,93	9,68	2,334	15,8
9 W	10,92	9,68	2,029	11,1
10 WNW	10,94	9,69	2,064	8,7
11 NNW	10,90	9,65	2,143	6,9
All	10,35	9,16	2,252	100,0









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PARK - Park power curve

Calculation: WP Oostpolder VKA1

Wind speed [m/s]	Power Free WTGs [kW]	Park WTGs [kW]	N [kW]	NNE [kW]	ENE [kW]	E [kW]	ESE [kW]	SSE [kW]	S [kW]	SSW [kW]	WSW [kW]	W [kW]	WNW [kW]	NNW [kW]
0,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1,5	2	1	0	0	0	0	0	1	1	2	2	2	0	0
2,5	1.822	959	977	1.009	955	836	684	915	1.124	1.158	1.074	890	637	882
3,5	7.982	4.855	4.989	5.176	5.038	4.483	3.769	4.850	5.339	5.505	5.333	4.523	3.627	4.590
4,5	20.871	13.822	14.426	14.787	14.684	13.168	11.281	13.612	14.562	14.976	14.822	13.042	11.210	13.730
5,5	40.459	27.972	28.970	29.591	29.335	26.638	23.429	27.739	29.388	30.046	29.793	26.680	23.323	27.769
6,5	68.792	48.282	50.028	50.928	50.356	46.047	40.824	47.878	50.642	51.636	51.191	46.244	40.799	48.033
7,5	106.993	76.119	78.903	80.289	79.363	72.728	64.697	75.471	79.724	81.242	80.502	72.955	64.652	75.809
8,5	154.371	112.579	116.904	118.919	117.681	108.085	96.245	111.699	117.525	119.636	118.710	107.887	96.067	112.556
9,5	207.085	157.510	163.875	166.252	165.027	152.243	136.029	156.545	163.673	166.068	165.456	151.165	135.623	158.350
10,5	257.901	207.228	216.396	217.756	217.154	201.835	181.708	206.548	214.473	215.815	216.061	199.505	181.717	210.314
11,5	299.923	255.541	266.657	266.151	266.749	250.304	228.523	255.733	263.560	263.074	264.439	247.520	228.922	260.527
12,5	332.482	297.368	309.273	307.311	308.564	292.936	271.662	298.317	305.090	303.359	305.313	289.720	272.413	303.578
13,5	356.428	331.775	342.808	340.776	342.190	328.661	309.580	333.392	338.153	336.563	338.369	325.187	309.294	337.661
14,5	370.634	357.393	364.725	363.423	364.688	354.914	340.248	359.953	362.728	361.480	362.654	353.319	338.955	361.067
15,5	378.069	371.750	375.699	375.257	375.710	370.465	360.936	373.637	374.973	374.443	374.807	369.775	360.538	373.729
16,5	381.157	379.044	380.605	380.428	380.565	378.505	374.304	380.066	380.448	380.242	380.327	378.312	374.206	379.936
17,5	381.652	381.333	381.616	381.589	381.608	381.218	380.408	381.533	381.611	381.577	381.594	381.245	380.328	381.489
18,5	381.642	381.623	381.647	381.648	381.644	381.615	381.540	381.641	381.642	381.643	381.643	381.623	381.535	381.643
19,5	381.625	381.629	381.630	381.631	381.629	381.629	381.629	381.630	381.627	381.629	381.628	381.629	381.629	381.632
20,5	375.607	375.609	375.610	375.611	375.609	375.608	375.608	375.609	375.608	375.609	375.608	375.609	375.610	375.612
21,5	375.591	375.595	375.596	375.597	375.594	375.593	375.593	375.595	375.593	375.594	375.594	375.595	375.596	375.598
22,5	375.579	375.580	375.581	375.582	375.580	375.579	375.580	375.580	375.579	375.580	375.580	375.580	375.581	375.582
23,5	375.569	375.570	375.572	375.572	375.570	375.569	375.569	375.570	375.569	375.570	375.570	375.570	375.572	375.573
24,5	375.590	375.580	375.565	375.568	375.578	375.584	375.582	375.579	375.590	375.585	375.586	375.581	375.569	375.565
25,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Description:
The park power curve is similar to a WTG power curve, meaning that when a given wind speed appears in front of the park with same speed in the entire wind farm area (before influence from the park), the output from the park can be found in the park power curve. Another way to say this: The park power curve includes array losses, but do NOT include terrain given variations in the wind speed over the park area.
Measuring a park power curve is not as simple as measuring a WTG power curve due to the fact that the park power curve depends on the wind direction and that the same wind speed normally will not appear for the entire park area at the same time (only in very flat non-complex terrain). The idea with this version of the park power curve is not to use it for validation based on measurements. This would require at least 2 measurement masts at two sides of the park, unless only a few direction sectors should be tested, AND non complex terrain (normally only useable off shore). Another park power curve version for complex terrain is available in windPRO.

The park power curve can be used for:

1. Forecast systems, based on more rough (approximated) wind data, the park power curve would be an efficient way to make the connection from wind speed (and direction) to power.
2. Construction of duration curves, telling how often a given power output will appear, the park power curve can be used together with the average wind distribution for the Wind farm area in hub height. The average wind distribution can eventually be obtained based on the Weibull parameters for each WTG position. These are found at print menu: >Result to file< in the >Park result< which can be saved to file or copied to clipboard and pasted in Excel.
3. Calculation of wind energy index based on the PARK production (see below).
4. Estimation of the expected PARK production for an existing wind farm based on wind measurements at minimum 2 measurement masts at two sides of wind farm. The masts must be used for obtaining the free wind speed. The free wind speed is used in the simulation of expected energy production with the PARK power curve. This procedure will only work suitable in non complex terrains. For complex terrain another park power curve calculation is available in windPRO (PPV-model).

Note:
From the >Result to file< the >Wind Speeds Inside Wind farm< is also available. These can (e.g. via Excel) be used for extracting the wake induced reductions in measured wind speed.

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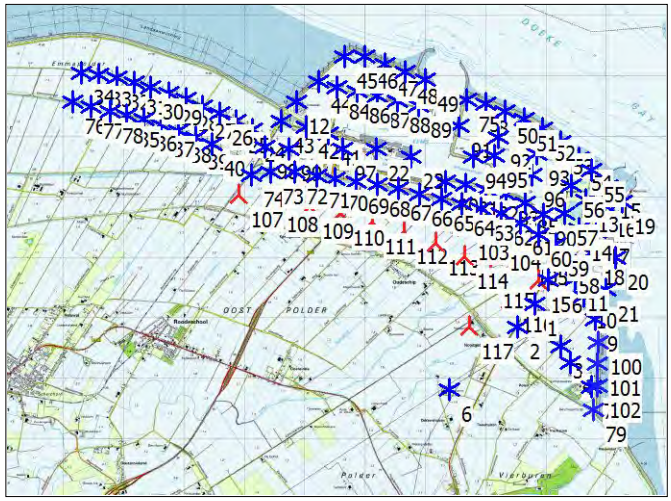
PARK - WTG distances

Calculation: WP Oostpolder VKA1

WTG distances

	Z	Nearest WTG	Z	Horizontal distance	Distance in|rotor diameters (max)	Distance in|rotor diameters (min)
	[m]		[m]	[m]		
1	-0,3	106	0,0	392	2,9	2,8
2	0,0	116	-0,1	464	3,4	3,3
3	0,0	4	0,2	315	2,3	2,3
4	0,2	3	0,0	315	2,3	2,3
5	0,3	106	0,0	148	1,1	1,0
6	-0,1	117	0,1	1.089	23,2	7,7
7	1,8	102	0,2	87	1,7	0,9
8	1,6	75	1,0	323	3,9	2,8
9	0,1	100	0,0	384	4,7	3,8
10	-0,4	11	1,0	321	3,9	3,9
11	1,0	58	1,0	319	3,9	3,9
12	2,5	43	1,9	417	5,1	3,0
13	-1,0	16	2,0	300	3,7	3,7
14	1,0	17	2,7	301	3,7	3,7
15	1,0	16	2,0	306	3,7	3,7
16	2,0	13	-1,0	300	3,7	3,7
17	2,7	14	1,0	301	3,7	3,7
18	-0,7	17	2,7	360	4,4	4,4
19	0,1	16	2,0	320	3,9	3,9
20	2,0	18	-0,7	401	4,9	4,9
21	0,0	10	-0,4	379	4,6	4,6
22	4,3	97	2,8	563	6,3	4,5
23	3,1	67	1,3	561	6,8	4,5
24	-1,2	25	-0,4	315	3,8	3,8
25	-0,4	26	-1,0	301	3,7	3,7
26	-1,0	25	-0,4	301	3,7	3,7
27	-1,3	28	0,2	303	3,7	3,7
28	0,2	29	1,8	300	3,7	3,7
29	1,8	28	0,2	300	3,7	3,7
30	-2,0	31	-0,7	288	3,5	3,5
31	-0,7	30	-2,0	288	3,5	3,5
32	0,3	33	0,1	299	3,6	3,6
33	0,1	34	-1,1	297	3,6	3,6
34	-1,1	33	0,1	297	3,6	3,6
35	1,8	78	-1,5	279	3,4	2,5
36	0,5	35	1,8	300	3,7	3,7
37	1,5	36	0,5	300	3,7	3,7
38	-0,2	37	1,5	302	3,7	3,7
39	0,6	38	-0,2	302	3,7	3,7
40	0,9	39	0,6	303	3,7	3,7
41	2,7	97	2,8	356	4,3	4,0
42	0,2	41	2,7	382	4,7	4,7
43	1,9	12	2,5	417	5,1	3,0
44	-0,5	84	0,1	311	3,8	3,5
45	0,2	46	2,8	333	4,1	4,1
46	2,8	45	0,2	333	4,1	4,1
47	4,8	48	1,4	355	4,3	4,3
48	1,4	49	3,2	355	4,3	4,3
49	3,2	48	1,4	355	4,3	4,3
50	1,1	8	1,6	340	4,2	2,9
51	1,4	50	1,1	342	4,2	4,2
52	2,1	51	1,4	349	4,3	4,3
53	0,8	52	2,1	370	4,5	4,5
54	0,6	55	1,8	289	3,5	3,5
55	1,8	54	0,6	289	3,5	3,5
56	-0,4	13	-1,0	345	4,2	4,2
57	-0,7	14	1,0	345	4,2	4,2
58	1,0	11	1,0	319	3,9	3,9
59	4,7	58	1,0	333	4,1	4,1
60	-0,3	59	4,7	335	4,1	4,1
61	1,7	85	1,3	338	4,1	3,8
62	-1,0	83	3,1	332	4,1	3,7
63	-2,9	82	1,0	327	4,0	3,6



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New WTG Existing WTG

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PARK - WTG distances

Calculation: WP Oostpolder VKA1

...continued from previous page

	Z	Nearest WTG	Z	Horizontal distance	Distance in|rotor diameters (max)	Distance in|rotor diameters (min)
	[m]		[m]	[m]		
64	0,3	81	1,8	324	4,0	3,6
65	-1,9	80	2,3	306	3,7	3,4
66	1,5	65	-1,9	367	4,5	4,5
67	1,3	68	-1,2	353	4,3	4,3
68	-1,2	67	1,3	353	4,3	4,3
69	-0,5	68	-1,2	353	4,3	4,3
70	0,5	71	0,0	308	3,8	3,8
71	0,0	70	0,5	308	3,8	3,8
72	-0,1	71	0,0	370	4,5	4,5
73	0,6	74	-1,3	321	3,9	3,9
74	-1,3	73	0,6	321	3,9	3,9
75	1,0	8	1,6	323	3,9	2,8
76	0,7	77	0,4	309	2,8	2,8
77	0,4	76	0,7	309	2,8	2,8
78	-1,5	35	1,8	279	3,4	2,5
79	1,0	7	1,8	382	7,3	3,3
80	2,3	65	-1,9	306	3,7	3,4
81	1,8	64	0,3	324	4,0	3,6
82	1,0	63	-2,9	327	4,0	3,6
83	3,1	62	-1,0	332	4,1	3,7
84	0,1	44	-0,5	311	3,8	3,5
85	1,3	61	1,7	338	4,1	3,8
86	0,4	84	0,1	332	3,7	3,7
87	1,0	88	0,9	351	3,9	3,9
88	0,9	87	1,0	351	3,9	3,9
89	2,3	88	0,9	352	3,9	3,9
90	1,5	60	-0,3	335	4,1	3,7
91	4,2	75	1,0	455	5,6	5,1
92	-0,8	95	2,7	320	3,6	3,6
93	1,9	96	1,6	371	4,1	4,1
94	1,6	95	2,7	351	3,9	3,9
95	2,7	92	-0,8	320	3,6	3,6
96	1,6	93	1,9	371	4,1	4,1
97	2,8	41	2,7	356	4,3	4,0
98	-1,2	24	-1,2	347	4,2	3,9
99	-1,1	98	-1,2	398	4,4	4,4
100	0,0	101	0,0	360	3,6	3,6
101	0,0	102	0,2	359	3,6	3,6
102	0,2	7	1,8	87	1,7	0,9
103	-1,3	63	-2,9	406	4,9	2,9
104	0,6	62	-1,0	410	5,0	2,9
105	0,0	60	-0,3	384	4,7	2,7
106	0,0	5	0,3	148	1,1	1,0
107	-0,3	74	-1,3	411	5,0	2,9
108	-1,0	73	0,6	454	5,5	3,2
109	1,0	110	-1,7	523	3,7	3,7
110	-1,7	109	1,0	523	3,7	3,7
111	-0,9	110	-1,7	552	3,9	3,9
112	-1,6	113	-1,0	546	3,9	3,9
113	-1,0	114	-0,3	531	3,8	3,8
114	-0,3	103	-1,3	472	3,3	3,3
115	-0,8	116	-0,1	509	3,6	3,6
116	-0,1	1	-0,3	420	3,1	3,0
117	0,1	116	-0,1	801	5,7	5,7
Min	-2,9		-2,9	87	1,1	0,9
Max	4,8		4,7	1.089	23,2	7,7

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PARK - Wind statistics info

Calculation: WP Oostpolder VKA1

Main data for wind statistic

File	\\sbs2011\projecten\Extern\2016\716033 WP Oostpolder\TO\WP\200117\24012017\RWE_Oostpolder 100m-Corr099.wws
Name	RWE_Oostpolder 100m-Corr099
Country	Netherlands
Source	User
Mast coordinates	Dutch Stereo-RD/NAP 2000 East: 248.822 North: 608.196
Created	24-1-2017
Edited	1-2-2017
Sectors	12
WAsP version	WAsP 11 Version 11.05.0028
Displacement height	None

Additional info for wind statistic

Source data	Default Meteo data RWE
Data from	25-4-2007
Data to	31-1-2009
Measurement length	21,3 Months

Note

To get the most correct calculation results, wind statistics shall be calculated with the SAME model and model parameters, as currently chosen in calculation. For WAsP versions before 10.0, the model is unchanged, but thereafter more model changes affecting the wind statistic is seen. Likewise WAsP CFD should always use WAsP CFD calculated wind statistics.

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PARK - Map

Calculation: WP Oostpolder VKA1

Map: Uithuizen , Print scale 1:75.000, Map center Dutch Stereo-RD/NAP 2000 East: 249.717 North: 606.402

New WTG Existing WTG Obstacle

PARK - Main Result

Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)

Wake Model	N.O. Jensen (RISØ/EMD)

Calculation Settings

Air density calculation mode	Individual per WTG
Result for WTG at hub altitude	1,232 kg/m³ to 1,248 kg/m³
Air density relative to standard	100,6 % to 101,8 %
Hub altitude above sea level (asl)	39,9 m to 166,1 m
Annual mean temperature at hub alt.	8,0 °C to 8,8 °C
Pressure at WTGs	994,3 hPa to 1.009,6 hPa

Wake Model Parameters

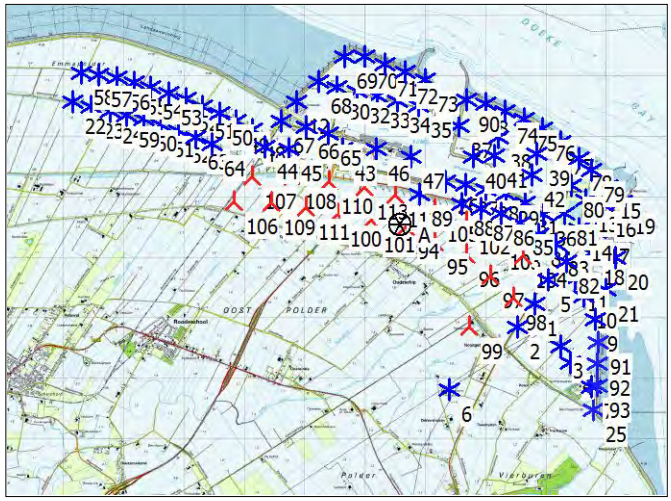
Terrain type	Wake decay constant
HH:100m Open farmland	0,062

Displacement heights from objects

Wake calculation settings

Angle [°]			Wind speed [m/s]		
start	end	step	start	end	step
0,5	360,0	1,0	0,5	30,5	1,0

Wind statistics	RWE_Oostpolder 100m-Corr099.wws
WAsP version	WAsP 11 Version 11.05.0028



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New WTG Existing WTG
Site Data

Key results for height 165,0 m above ground level

Terrain Dutch Stereo-RD/NAP 2000

	X (east)	Y (north)	Name of wind distribution	Type	Wind energy [kWh/m²]	Mean wind speed [m/s]	Equivalent roughness
A	250.596	606.527	Oostpolder site data	WAsP (WAsP 11 Version 11.05.0028)	7.041	9,2	1,1

Calculated Annual Energy for Wind Farm

WTG combination	Result PARK [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Specific results¤) Park efficiency [%]	Capacity factor [%]	Mean WTG result [MWh/y]	Full load hours [Hours/year]	Mean wind speed @hub height [m/s]
Wind farm	1.205.913,3	1.420.879,2	84,9	36,8	10.671,8	3.222	8,4
New WTGs only	389.352,5	432.361,5	90,1	52,9	19.467,6	4.635	9,2
Existing park WTGs only	816.560,8	988.517,7	82,6	32,1	8.780,2	2.813	8,2
Existing park WTGs without new WTGs	846.652,8	988.517,7	85,6		9.103,8		
Reduction for existing park WTGs caused by new	30.092,1						

¤) Based on wake reduced results, but no other losses included

Calculated Annual Energy for each of 20 new WTGs with total 84,0 MW rated power

Links	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Power curve Creator	Name	Annual Energy Result [MWh]	Park Efficiency [%]	Capacity factor [%]	Free mean wind speed [m/s]
94 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.482,5	90,15	52,9	9,16
95 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.672,6	91,10	53,4	9,15
96 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.589,2	90,56	53,2	9,16
97 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.502,6	90,33	53,0	9,14
98 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.362,5	89,78	52,6	9,13
99 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	20.340,4	94,96	55,2	9,07
100 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.675,8	91,36	53,4	9,13
101 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.608,2	90,89	53,3	9,15
102 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.002,6	87,36	51,6	9,21
103 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	18.868,2	86,70	51,2	9,22
104 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.037,6	87,53	51,7	9,21
105 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.055,3	87,65	51,8	9,21
106 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	20.321,6	94,74	55,2	9,12
107 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.679,1	91,28	53,5	9,16
108 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.276,7	89,05	52,4	9,19
109 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.820,6	92,30	53,8	9,12
110 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.156,8	88,30	52,0	9,20
111 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.717,2	91,57	53,6	9,14
112 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.059,6	87,62	51,8	9,22
113 A	Yes	ENERCON	E-141 EP4-4.200	4.200	141,0	165,0	EMD	Level 0 - official - 0 s- 4200kW - 04/2016	19.123,3	88,02	51,9	9,21

Annual Energy results do not include any losses apart from wake losses. For expected NET AEP (expected sold production), see report Loss & Uncertainty.

PARK - Main Result

Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)

Calculated Annual Energy for each of 93 existing park WTGs with total 290,3 MW rated power

Links	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Power curve Creator	Name	Annual Energy Calculated prod. without new WTGs	After New WTGs	Decrease due to new WTGs	Park Efficiency
				[kW]	[m]	[m]			[MWh]	[MWh]	[MWh %]	[%]
1 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	18.646,7	17.716,3	930,4 5,0	86,41
2 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.372,9	18.791,9	581,0 3,0	92,15
3 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.156,2	18.883,4	272,8 1,4	92,09
4 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	19.181,8	19.011,1	170,7 0,9	92,72
5 A	Yes	LAGERWEY	L136-4.5MW-4.500	4.500	136,0	132,0	USER	Lagerwey L136-4.5MW PV curve	18.095,9	17.003,3	1.092,7 6,0	82,43
6 A	No	VESTAS	V47-660	660	47,0	40,0	EMD	Level 0 - calculated - - 07-2001	1.479,8	1.463,3	16,5 1,1	96,11
7 A	Yes	VESTAS	V52-850	850	52,0	40,0	EMD	Level 0 - calculated - 104.2 dB(A) - 07-2006	1.990,3	1.973,7	16,6 0,8	92,36
8 A	Yes	VESTAS	V117-3.45-3.450	3.450	117,0	93,5	EMD	Level 0 - Calculated - Modes 0 & 0-0S - 01-2016	13.073,7	12.807,7	266,0 2,0	84,74
9 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.713,8	7.578,2	135,6 1,8	84,56
10 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.559,6	7.393,3	166,3 2,2	82,68
11 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.457,4	7.208,0	249,4 3,3	80,66
12 A	No	2-B Energy	OTC 6 MW-6.000	6.000	140,0	105,0	USER	Turbulent power curce with TI of 8.7%	18.772,6	18.370,9	401,7 2,1	84,06
13 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	6.926,2	6.776,3	149,9 2,2	73,45
14 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	6.907,2	6.677,0	230,2 3,3	73,26
15 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.214,6	7.132,0	82,5 1,1	75,60
16 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.095,3	6.980,8	114,5 1,6	75,03
17 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.152,4	7.009,7	142,7 2,0	76,20
18 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.080,1	6.866,5	213,7 3,0	76,18
19 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.460,4	7.396,3	64,1 0,9	80,49
20 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.662,4	7.575,1	87,3 1,1	81,84
21 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.546,5	7.444,2	102,3 1,4	82,25
22 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	12.801,1	12.789,0	12,1 0,1	94,29
23 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	12.290,7	12.275,4	15,3 0,1	90,75
24 A	Yes	VESTAS	V112-3.3 Gridstreame-3.300	3.300	112,0	100,0	EMD	Level 0 - Mode 0 - Estimated - 12-2013	11.993,9	11.969,8	24,1 0,2	89,26
25 A	Yes	VESTAS	V117-3.6-3.600	3.600	117,0	117,0	EMD	Level 0 - Calculated - Modes PO1 & PO1-0S - 01-2016	15.263,9	15.184,5	79,4 0,5	96,67
26 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	9.026,5	8.124,3	902,2 10,0	78,22
27 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.602,3	7.873,6	728,7 8,5	75,59
28 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.300,5	7.614,0	686,5 8,3	72,90
29 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.300,1	7.738,9	561,1 6,8	73,41
30 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.913,4	8.676,1	237,4 2,7	81,34
31 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.166,9	7.601,1	565,8 6,9	73,06
32 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.981,0	8.699,7	281,4 3,1	81,46
33 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	9.052,4	8.738,5	313,9 3,5	82,06
34 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.981,3	8.661,1	320,2 3,6	81,07
35 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	9.104,3	8.763,7	340,5 3,7	82,31
36 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.162,2	7.651,4	510,7 6,3	73,30
37 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	9.289,0	8.912,3	376,6 4,1	82,78
38 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.458,9	8.233,7	225,2 2,7	77,48
39 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.513,0	8.318,0	195,0 2,3	77,97
40 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.769,3	8.308,2	461,1 5,3	78,42
41 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.509,3	8.170,1	339,2 4,0	77,21
42 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	8.419,6	8.100,5	319,1 3,8	76,41
43 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	9.303,9	8.418,8	885,1 9,5	81,47
44 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	9.127,9	8.431,0	696,8 7,6	83,30
45 A	Yes	VESTAS	V90-3.000	3.000	90,0	105,0	EMD	Level 0 - Estimated - 107.0 dB(A) - 06-2009	9.090,5	8.330,0	760,6 8,4	82,32
46 A	No	Senvion	6.2M126-6.150	6.150	126,0	114,0	USER	Calcated power curve Senvion 6.2M126	20.356,1	18.667,4	1.688,8 8,3	83,89
47 A	No	Senvion	6.2M126-6.150	6.150	126,0	114,0	USER	Calcated power curve Senvion 6.2M126	20.342,4	18.621,4	1.721,0 8,5	83,37
48 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.813,7	7.536,9	276,8 3,5	84,07
49 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.623,2	7.483,1	140,2 1,8	82,95
50 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.434,2	7.336,9	97,3 1,3	81,48
51 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.447,7	7.392,6	55,1 0,7	81,78
52 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.500,4	7.466,8	33,6 0,4	81,99
53 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.547,7	7.516,0	31,7 0,4	82,33
54 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.484,3	7.462,1	22,2 0,3	82,42
55 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.560,5	7.545,2	15,3 0,2	82,99
56 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.753,3	7.741,1	12,1 0,2	84,27
57 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.948,0	7.932,4	15,6 0,2	86,34
58 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.432,2	8.417,7	14,5 0,2	91,85
59 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.911,0	7.887,7	23,3 0,3	87,24
60 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.891,5	7.866,8	24,7 0,3	87,34
61 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.897,1	7.866,6	30,5 0,4	87,42
62 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.874,5	7.831,3	43,2 0,5	87,40
63 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.884,6	7.814,4	70,1 0,9	87,29
64 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.984,9	7.831,2	153,7 1,9	87,63
65 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.046,1	7.471,2	574,8 7,1	81,74
66 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.684,2	7.257,0	427,2 5,6	79,85
67 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.694,7	7.403,0	291,6 3,8	81,57
68 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.926,0	7.760,7	165,3 2,1	82,00
69 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.338,2	8.239,2	99,0 1,2	85,12
70 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.281,2	8.174,5	106,7 1,3	83,85
71 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.316,2	8.170,4	145,7 1,8	83,64
72 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.086,8	7.931,9	154,9 1,9	82,68
73 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.047,6	7.895,0	152,5 1,9	82,81
74 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.898,3	7.733,0	165,3 2,1	80,51
75 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.918,0	7.767,1	150,8 1,9	81,01
76 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.892,3	7.758,3	134,0 1,7	80,71
77 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.877,6	7.728,7	148,9 1,9	80,85
78 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.734,5	7.592,0	142,5 1,8	79,67
79 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.518,1	7.394,1	124,0 1,6	77,68
80 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.288,6	7.072,7	215,9 3,0	75,83
81 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.122,1	6.809,9	312,2 4,4	74,37

To be continued on next page...

PARK - Main Result

Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)

...continued from previous page

	WTG type						Power curve		Annual Energy			Park
Links	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Creator	Name	Calculated prod. without new WTGs	After New WTGs	Decrease due to new WTGs	Efficiency
				[kW]	[m]	[m]			[MWh]	[MWh]	[MWh %]	[%]
82 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.273,3	6.895,3	378,0 5,2	76,74
83 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.516,2	6.936,0	580,2 7,7	76,11
84 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.588,6	6.745,6	843,0 11,1	75,11
85 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.695,6	6.798,6	897,0 11,7	75,48
86 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.621,8	6.771,3	850,5 11,2	75,27
87 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.715,7	6.727,4	988,3 12,8	75,02
88 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	7.973,5	7.097,4	876,0 11,0	78,90
89 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	98,4	EMD	Level 0 - official - Mode 0 - 08/2014	8.266,4	7.311,4	955,0 11,6	81,49
90 A	Yes	ENERCON	E-82 E3-3.000	3.000	82,0	100,0	EMD	Level 0 - official - Mode 0 - 08/2014	8.195,1	7.978,3	216,7 2,6	83,25
91 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.349,0	8.261,7	87,3 1,0	87,93
92 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.518,0	8.459,4	58,7 0,7	90,17
93 A	Yes	VESTAS	V100-2.0-2.000	2.000	100,0	100,0	EMD	Level 0 - Mode 0 - - 07-2013	8.614,2	8.559,1	55,1 0,6	91,51

WTG siting

		Dutch Stereo-RD / NAP 2000			
		X (east)	Y (north)	Z [m]	Row data/Description
1	Exist	252.819	605.227	-0,3	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (244)
2	Exist	252.538	604.846	0,0	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (245)
3	Exist	253.250	604.530	0,0	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (246)
4	Exist	253.410	604.258	0,2	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (247)
5	Exist	253.038	605.625	0,3	LAGERWEY L136-4.5MW 4500 136.0 !O! hub: 132,0 m (TOT: 200,0 m) (248)
6	Exist	251.401	603.815	-0,1	VESTAS V47 660 47.0 !O! hub: 40,0 m (TOT: 63,5 m) (264)
7	Exist	253.765	603.860	1,8	VESTAS V52 850 52.0 !O! hub: 40,0 m (TOT: 66,0 m) (265)
8	Exist	252.007	608.545	1,6	VESTAS V117-3.45 3450 117.0 !O! hub: 93,5 m (TOT: 152,0 m) (266)
9	Exist	253.830	604.979	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (267)
10	Exist	253.634	605.359	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (268)
11	Exist	253.487	605.644	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (269)
12	Exist	248.875	608.572	2,5	2-B Energy OTC 6 MW 6000 140.0 !#! hub: 105,0 m (TOT: 175,0 m) (270)
13	Exist	253.662	606.943	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (271)
14	Exist	253.548	606.476	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (272)
15	Exist	254.026	607.172	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (273)
16	Exist	253.954	606.875	2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (274)
17	Exist	253.843	606.417	2,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (275)
18	Exist	253.758	606.067	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (276)
19	Exist	254.272	606.915	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (277)
20	Exist	254.151	605.985	2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (278)
21	Exist	253.996	605.473	0,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (279)
22	Exist	245.161	608.566	0,7	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (354)
23	Exist	245.463	608.501	0,4	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (355)
24	Exist	245.775	608.421	-1,5	VESTAS V90 3000 90.0 !O! hub: 100,0 m (TOT: 156,0 m) (356)
25	Exist	253.792	603.479	1,0	VESTAS V117-3.6 3600 117.0 !O! hub: 117,0 m (TOT: 175,5 m) (664)
26	Exist	251.345	607.258	2,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (599)
27	Exist	251.679	607.196	1,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (600)
28	Exist	252.008	607.117	1,0	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (601)
29	Exist	252.340	607.043	3,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (602)
30	Exist	249.539	608.811	0,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (603)
31	Exist	252.654	606.896	1,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (604)
32	Exist	249.866	608.752	0,4	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (605)
33	Exist	250.208	608.666	1,0	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (606)
34	Exist	250.550	608.586	0,9	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (607)
35	Exist	250.892	608.503	2,3	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (608)
36	Exist	252.958	606.705	1,5	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (609)
37	Exist	251.566	608.173	4,2	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (610)
38	Exist	252.219	607.986	-0,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (611)
39	Exist	252.852	607.716	1,9	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (612)
40	Exist	251.793	607.668	1,6	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (613)
41	Exist	252.144	607.675	2,7	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (614)
42	Exist	252.765	607.355	1,6	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (615)
43	Exist	249.631	607.787	2,8	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (616)
44	Exist	248.339	607.818	-1,2	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (617)
45	Exist	248.736	607.792	-1,1	VESTAS V90 3000 90.0 !O! hub: 105,0 m (TOT: 150,0 m) (618)
46	Exist	250.194	607.795	4,3	Senvion 6.2M126 6150 126.0 !O! hub: 114,0 m (TOT: 177,0 m) (658)
47	Exist	250.760	607.657	3,1	Senvion 6.2M126 6150 126.0 !O! hub: 114,0 m (TOT: 177,0 m) (659)
48	Exist	248.142	608.104	-1,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (660)

To be continued on next page...

PARK - Main Result

Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)

...continued from previous page

		Dutch Stereo-RD / NAP 2000			
		X (east)	Y (north)	Z [m]	Row data/Description
49	Exist	247.865	608.255	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (661)
50	Exist	247.590	608.377	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (662)
51	Exist	247.311	608.501	-1,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (663)
52	Exist	247.034	608.625	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (664)
53	Exist	246.747	608.713	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (371)
54	Exist	246.447	608.805	-2,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (666)
55	Exist	246.172	608.890	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (667)
56	Exist	245.885	608.978	0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (668)
57	Exist	245.590	609.026	0,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (669)
58	Exist	245.294	609.056	-1,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (670)
59	Exist	246.045	608.352	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (671)
60	Exist	246.336	608.279	0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (672)
61	Exist	246.622	608.188	1,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (673)
62	Exist	246.907	608.088	-0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (674)
63	Exist	247.190	607.981	0,6	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (675)
64	Exist	247.472	607.870	0,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (676)
65	Exist	249.390	608.049	2,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (677)
66	Exist	249.023	608.155	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (678)
67	Exist	248.609	608.251	1,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (679)
68	Exist	249.242	608.904	-0,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (680)
69	Exist	249.672	609.314	0,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (681)
70	Exist	250.005	609.324	2,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (682)
71	Exist	250.336	609.195	4,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (683)
72	Exist	250.665	609.061	1,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (684)
73	Exist	250.997	608.936	3,2	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (685)
74	Exist	252.323	608.418	1,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (686)
75	Exist	252.641	608.293	1,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (687)
76	Exist	252.949	608.128	2,1	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (688)
77	Exist	253.248	607.910	0,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (689)
78	Exist	253.547	607.637	0,6	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (690)
79	Exist	253.756	607.438	1,8	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (691)
80	Exist	253.425	607.194	-0,4	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (692)
81	Exist	253.312	606.728	-0,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (693)
82	Exist	253.341	605.928	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (694)
83	Exist	253.172	606.215	4,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (695)
84	Exist	252.880	606.379	-0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (696)
85	Exist	252.576	606.567	1,7	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (697)
86	Exist	252.262	606.720	-1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (698)
87	Exist	251.932	606.799	-2,9	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (699)
88	Exist	251.602	606.881	0,3	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (700)
89	Exist	250.915	607.046	1,5	ENERCON E-82 E3 3000 82.0 !O! hub: 98,4 m (TOT: 139,4 m) (702)
90	Exist	251.691	608.611	1,0	ENERCON E-82 E3 3000 82.0 !O! hub: 100,0 m (TOT: 141,0 m) (711)
91	Exist	253.864	604.596	0,0	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (712)
92	Exist	253.855	604.236	0,0	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (713)
93	Exist	253.850	603.877	0,2	VESTAS V100-2.0 2000 100.0 !O! hub: 100,0 m (TOT: 150,0 m) (714)
94	New	250.684	606.500	-1,1	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (644)
95	New	251.170	606.252	-1,0	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (645)
96	New	251.688	606.042	0,5	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (646)
97	New	252.082	605.684	-0,8	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (647)
98	New	252.469	605.331	-2,0	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (648)
99	New	251.732	604.852	0,1	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (649)
100	New	249.560	606.703	-1,2	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (650)
101	New	250.117	606.616	-0,7	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (651)
102	New	251.693	606.576	-0,9	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (652)
103	New	252.197	606.333	0,2	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (653)
104	New	252.625	606.025	1,1	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (654)
105	New	251.157	606.782	0,0	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (655)
106	New	247.827	606.909	-0,6	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (656)
107	New	248.133	607.325	-1,0	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (657)
108	New	248.805	607.337	-0,3	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (658)
109	New	248.451	606.902	-1,3	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (659)
110	New	249.405	607.243	-0,6	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (660)
111	New	249.027	606.820	-0,6	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (661)
112	New	250.512	607.025	-1,6	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (662)
113	New	249.999	607.151	-2,3	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (663)

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Calculated:
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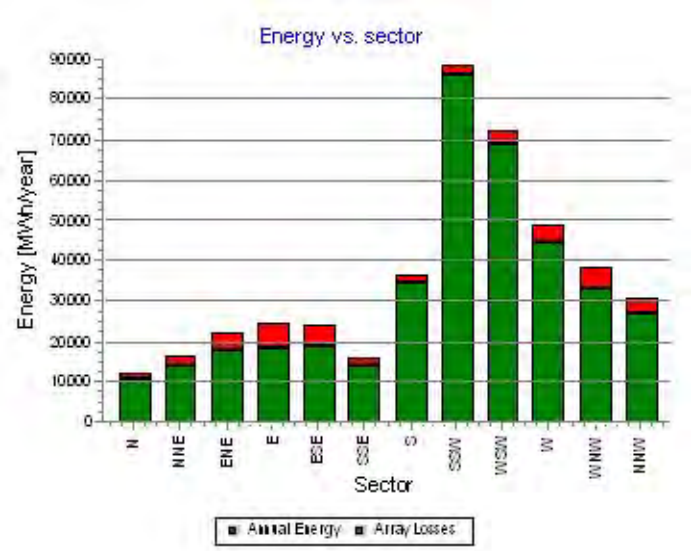
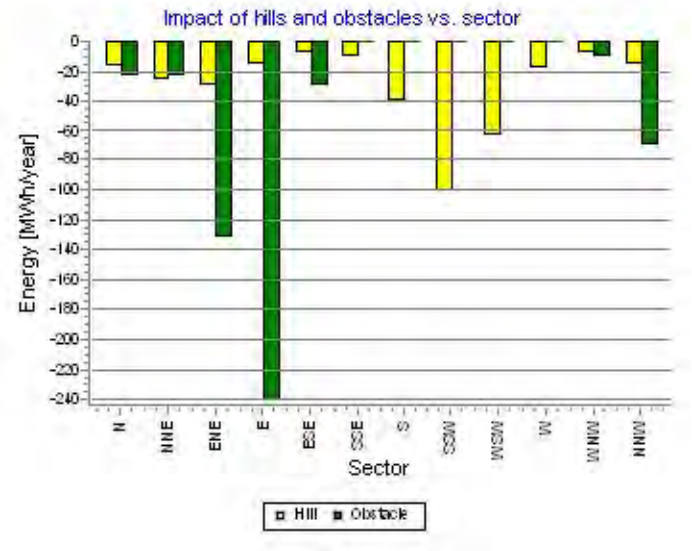
PARK - Production Analysis

Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)WTG: All new WTGs, Air density varies with WTG position 1,232 kg/m³ - 1,248 kg/m³

Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	12.511,8	16.734,6	22.245,4	24.664,8	24.038,6	15.824,7	36.834,8	88.767,9	72.749,5	49.110,9	38.912,3	30.841,2	433.236,5
-Decrease due to obstacles	[MWh]	23,2	22,6	131,1	241,0	29,1	0,1	0,0	0,0	0,0	0,0	9,9	69,5	526,4
+Increase due to hills	[MWh]	-16,5	-26,1	-29,0	-16,0	-7,7	-10,0	-39,5	-100,0	-62,7	-18,0	-8,1	-15,1	-348,5
-Decrease due to array losses	[MWh]	1.824,8	2.453,6	4.227,6	5.860,7	5.321,7	1.561,0	2.084,3	2.510,1	3.675,9	4.082,0	5.740,0	3.667,3	43.009,0
Resulting energy	[MWh]	10.647,3	14.232,3	17.857,7	18.547,1	18.680,1	14.253,7	34.710,9	86.157,8	69.011,0	45.010,9	33.154,3	27.089,3	389.352,8
Specific energy	[kWh/m²]													1.247
Specific energy	[kWh/kW]													4.635
Decrease due to obstacles	[%]	0,2	0,1	0,6	1,0	0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,12
Increase due to hills	[%]	-0,1	-0,2	-0,1	-0,1	0,0	-0,1	-0,1	-0,1	-0,1	0,0	0,0	0,0	-0,08
Decrease due to array losses	[%]	14,6	14,7	19,1	24,0	22,2	9,9	5,7	2,8	5,1	8,3	14,8	11,9	9,95
Utilization	[%]	18,6	20,7	22,3	22,1	20,1	18,7	19,3	20,3	17,2	14,1	13,2	14,9	17,6
Operational	[Hours/year]	342	387	527	612	548	361	713	1.475	1.362	963	753	599	8.641
Full Load Equivalent	[Hours/year]	127	169	213	221	222	170	413	1.026	822	536	395	322	4.635



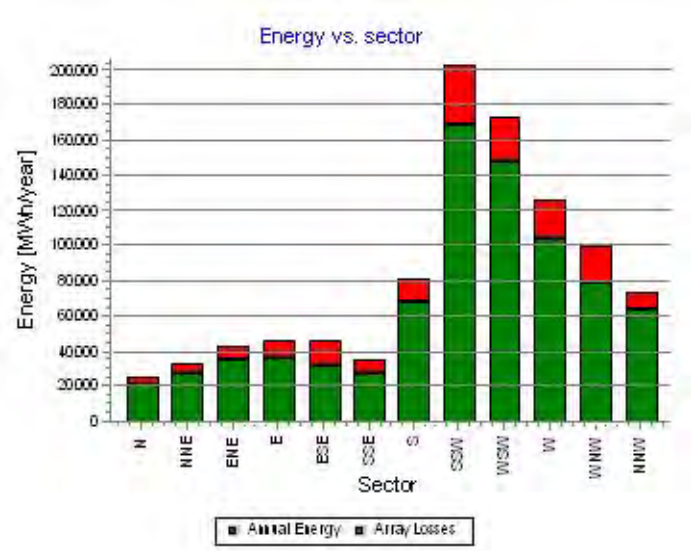


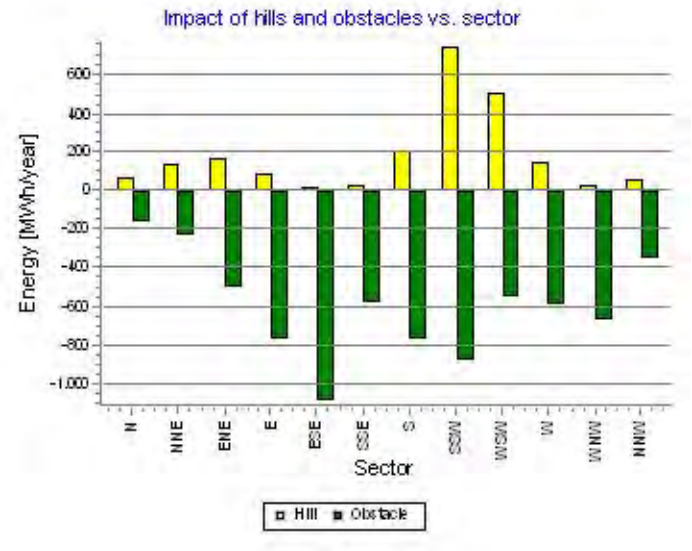
PARK - Production Analysis

Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)WTG: All existing WTGs, Air density varies with WTG position 1,232 kg/m³ - 1,248 kg/m³

Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	25.698,4	33.506,9	43.131,9	47.260,4	47.276,9	36.187,3	82.256,8	203.063,9	173.479,5	126.363,6	101.418,8	73.831,8	993.475,8
-Decrease due to obstacles	[MWh]	163,3	231,7	505,3	768,9	1.089,3	585,7	774,4	882,1	550,6	594,5	670,6	343,9	7.160,5
+Increase due to hills	[MWh]	70,6	137,7	163,9	92,3	22,9	28,4	208,6	741,8	501,1	151,1	28,8	54,8	2.202,1
-Decrease due to array losses	[MWh]	3.839,8	5.000,7	6.677,2	9.872,3	13.634,7	7.028,2	13.684,8	33.906,3	25.468,1	21.233,6	21.345,9	10.265,4	171.956,9
Resulting energy	[MWh]	21.765,9	28.412,2	36.113,4	36.711,6	32.575,7	28.601,7	68.006,2	169.017,3	147.961,8	104.686,5	79.431,1	63.277,4	816.560,7
Specific energy	[kWh/m²]													1.341
Specific energy	[kWh/kW]													2.813
Decrease due to obstacles	[%]	0,6	0,7	1,2	1,6	2,3	1,6	0,9	0,4	0,3	0,5	0,7	0,5	0,72
Increase due to hills	[%]	0,3	0,4	0,4	0,2	0,0	0,1	0,3	0,4	0,3	0,1	0,0	0,1	0,22
Decrease due to array losses	[%]	15,0	15,0	15,6	21,2	29,5	19,7	16,8	16,7	14,7	16,9	21,2	14,0	17,40
Utilization	[%]	28,7	31,3	33,2	31,4	26,6	25,4	27,6	28,5	25,6	21,2	19,9	24,9	25,6
Operational	[Hours/year]	333	374	509	591	531	354	687	1.425	1.323	944	737	583	8.391
Full Load Equivalent	[Hours/year]	75	98	124	126	112	99	234	582	510	361	274	218	2.813





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16-3-2017 9:31/3.1.597

PARK - Power Curve Analysis

Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling) WTG: 94 - ENERCON E-141 EP4 4200 141.0 !-! Level 0 - official - 0 s- 4200kW - 04/2016, Hub height: 165,0 m

Name: Level 0 - official - 0 s- 4200kW - 04/2016
Source: Manufacturer

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type	Generator type	Specific power kW/m²
13-4-2016	EMD	29-4-2016	9-5-2016	25,0	Pitch	User defined	Variable	0,27

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HP curve comparison - Note: For standard air density and weibull k parameter = 2

Vmean	[m/s]	5	6	7	8	9	10
HP value Pitch, variable speed (2013)	[MWh]	7.749	11.582	15.194	18.346	20.965	23.032
ENERCON E-141 EP4 4200 141.0 !-! Level 0 - official - 0 s- 4200kW - 04/2016	[MWh]	7.644	11.288	14.772	17.854	20.437	22.479
Check value	[%]	1	3	3	3	3	2

The table shows comparison between annual energy production calculated on basis of simplified "HP-curves" which assume that all WTGs performs quite similar - only specific power loading (kW/m^2) and single/dual speed or stall/pitch decides the calculated values. Productions are without wake losses.
For further details, ask at the Danish Energy Agency for project report J.nr. 51171/00-0016 or see windPRO manual chapter 3.5.2.
The method is refined in EMD report "20 Detailed Case Studies comparing Project Design Calculations and actual Energy Productions for Wind Energy Projects worldwide", jan 2003.
Use the table to evaluate if the given power curve is reasonable - if the check value are lower than -5%, the power curve probably is too optimistic due to uncertainty in power curve measurement.

Power curve

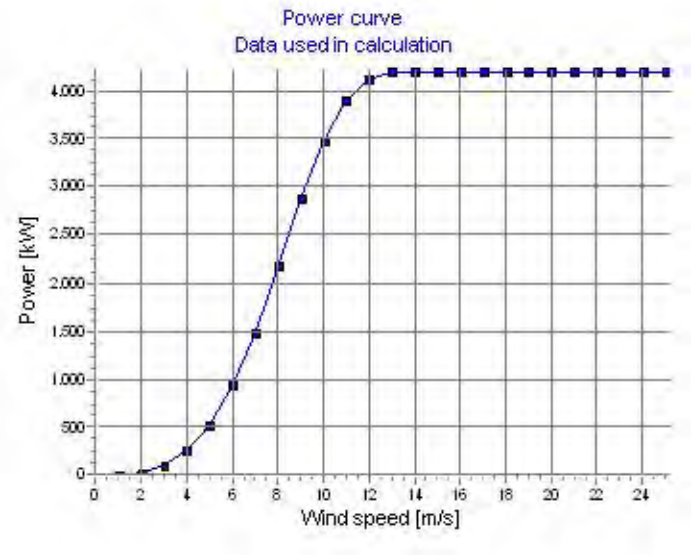
Original data, Air density: 1,225 kg/m³

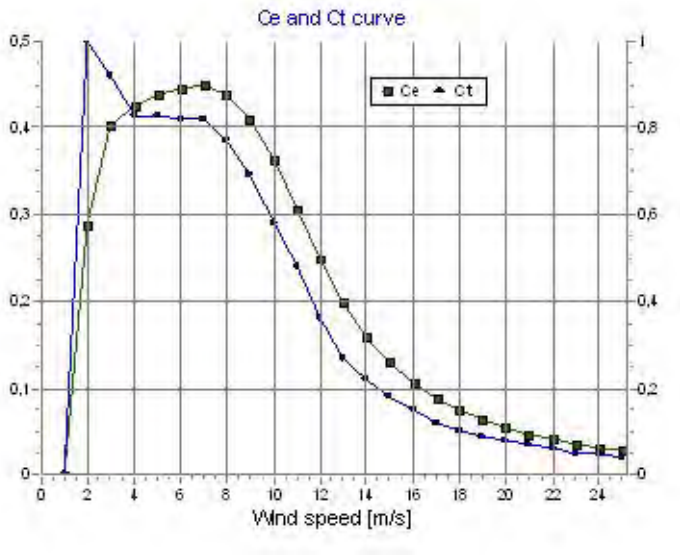
Wind speed [m/s]	Power [kW]	Ce	Wind speed [m/s]	Ct curve
0,0	0,0	0,00	0,0	0,00
0,5	0,0	0,00	0,5	0,00
1,0	0,0	0,00	1,0	0,00
1,5	0,0	0,00	1,5	0,00
2,0	22,0	0,29	2,0	1,16
2,5	54,0	0,36	2,5	1,01
3,0	104,0	0,40	3,0	0,92
3,5	171,0	0,42	3,5	0,87
4,0	260,0	0,42	4,0	0,83
4,5	376,0	0,43	4,5	0,83
5,0	523,0	0,44	5,0	0,83
5,5	703,0	0,44	5,5	0,82
6,0	920,0	0,45	6,0	0,82
6,5	1.176,0	0,45	6,5	0,82
7,0	1.471,0	0,45	7,0	0,82
7,5	1.799,0	0,45	7,5	0,80
8,0	2.151,0	0,44	8,0	0,77
8,5	2.514,0	0,43	8,5	0,74
9,0	2.867,0	0,41	9,0	0,69
9,5	3.194,0	0,39	9,5	0,63
10,0	3.481,0	0,36	10,0	0,58
10,5	3.719,0	0,34	10,5	0,53
11,0	3.903,0	0,31	11,0	0,48
11,5	4.033,0	0,28	11,5	0,41
12,0	4.119,0	0,25	12,0	0,36
12,5	4.171,0	0,22	12,5	0,31
13,0	4.196,0	0,20	13,0	0,27
13,5	4.200,0	0,18	13,5	0,24
14,0	4.200,0	0,16	14,0	0,22
14,5	4.200,0	0,14	14,5	0,19
15,0	4.200,0	0,13	15,0	0,18
15,5	4.200,0	0,12	15,5	0,16
16,0	4.200,0	0,11	16,0	0,15
16,5	4.200,0	0,10	16,5	0,13
17,0	4.200,0	0,09	17,0	0,12
17,5	4.200,0	0,08	17,5	0,11
18,0	4.200,0	0,08	18,0	0,10
18,5	4.200,0	0,07	18,5	0,10
19,0	4.200,0	0,06	19,0	0,09
19,5	4.200,0	0,06	19,5	0,08
20,0	4.200,0	0,05	20,0	0,08
20,5	4.200,0	0,05	20,5	0,07
21,0	4.200,0	0,05	21,0	0,07
21,5	4.200,0	0,04	21,5	0,06
22,0	4.200,0	0,04	22,0	0,06
22,5	4.200,0	0,04	22,5	0,06
23,0	4.200,0	0,04	23,0	0,05
23,5	4.200,0	0,03	23,5	0,05
24,0	4.200,0	0,03	24,0	0,05
24,5	4.200,0	0,03	24,5	0,04

Power, Efficiency and energy vs. wind speed

Data used in calculation, Air density: 1,232 kg/m³ New windPRO method (adjusted IEC method, improved to match turbine control) <RECOMMENDED>

Wind speed [m/s]	Power [kW]	Ce	Interval [m/s]	Energy [MWh]	Acc.Energy [MWh]	Relative [%]
1,0	0,0	0,00	0,50- 1,50	0,0	0,0	0,0
2,0	22,3	0,29	1,50- 2,50	7,4	7,4	0,0
3,0	104,8	0,40	2,50- 3,50	41,5	48,9	0,3
4,0	261,8	0,43	3,50- 4,50	131,0	180,0	0,9
5,0	526,5	0,44	4,50- 5,50	312,4	492,4	2,5
6,0	926,0	0,45	5,50- 6,50	617,2	1.109,6	5,7
7,0	1.480,0	0,45	6,50- 7,50	1.049,8	2.159,3	11,1
8,0	2.162,5	0,44	7,50- 8,50	1.557,5	3.716,9	19,1
9,0	2.879,5	0,41	8,50- 9,50	2.018,3	5.735,1	29,4
10,0	3.492,4	0,36	9,50-10,50	2.295,4	8.030,6	41,2
11,0	3.910,8	0,31	10,50-11,50	2.320,8	10.351,4	53,1
12,0	4.122,7	0,25	11,50-12,50	2.127,2	12.478,6	64,1
13,0	4.196,3	0,20	12,50-13,50	1.806,5	14.285,1	73,3
14,0	4.200,0	0,16	13,50-14,50	1.450,6	15.735,7	80,8
15,0	4.200,0	0,13	14,50-15,50	1.117,5	16.853,2	86,5
16,0	4.200,0	0,11	15,50-16,50	830,6	17.683,8	90,8
17,0	4.200,0	0,09	16,50-17,50	597,4	18.281,2	93,8
18,0	4.200,0	0,07	17,50-18,50	417,5	18.698,7	96,0
19,0	4.200,0	0,06	18,50-19,50	284,9	18.983,6	97,4
20,0	4.200,0	0,05	19,50-20,50	190,7	19.174,3	98,4
21,0	4.200,0	0,05	20,50-21,50	125,9	19.300,2	99,1
22,0	4.200,0	0,04	21,50-22,50	82,1	19.382,3	99,5
23,0	4.200,0	0,04	22,50-23,50	53,1	19.435,4	99,8
24,0	4.200,0	0,03	23,50-24,50	33,9	19.469,3	99,9
25,0	4.200,0	0,03	24,50-25,50	13,2	19.482,5	100,0





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PARK - Terrain

Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)Site Data: A - Oostpolder site data

Obstacles:
23 Obstacles used

Roughness:
Terrain data files used in calculation:
\\sbs2011\projecten\Extern\2015\715068 WTG Intocon Eemshaven\TO\WP\ROUGHNESSLINE_713066 715068_1.wpo
Min X: 219.227, Max X: 278.331, Min Y: 577.425, Max Y: 638.717, Width: 59.104 m, Height: 61.292 m

Orography:
Terrain data files used in calculation:
\\sbs2011\projecten\Extern\2016\716033 WP Oostpolder\TO\WP\ObjectImports\713066 715068_EMDGrid_0(1).wpg
Min X: 198.208, Max X: 300.556, Min Y: 557.205, Max Y: 659.267, Width: 102.348 m, Height: 102.062 m

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Calculated:
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PARK - Wind Data Analysis

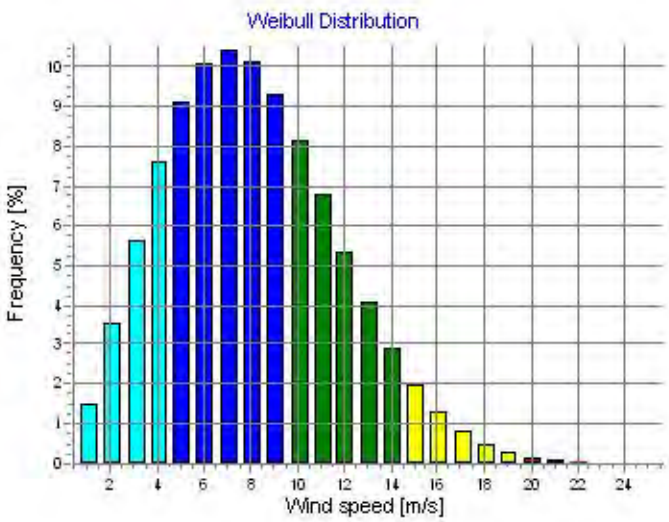
Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)Wind data: A - Oostpolder site data; Hub height: 100,0

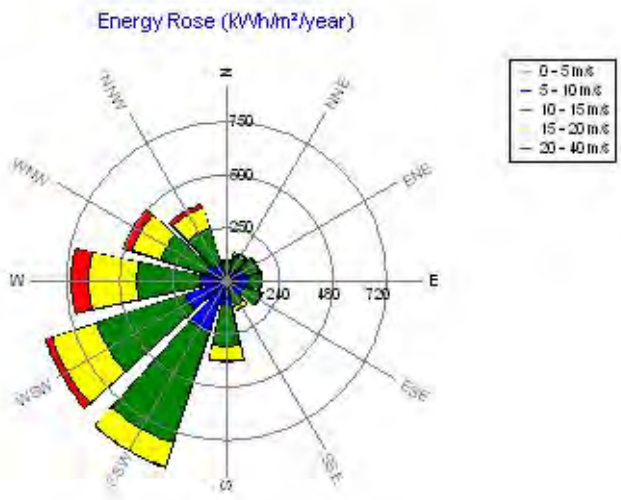
Site coordinates
Dutch Stereo-RD/NAP 2000
East: 250.596 North: 606.527

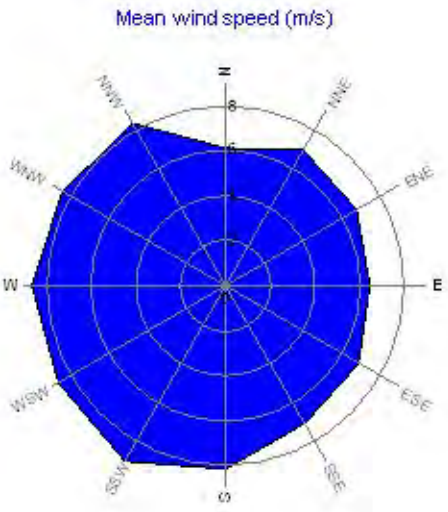
Wind statistics
RWE_Oostpolder 100m-Corr099.wws

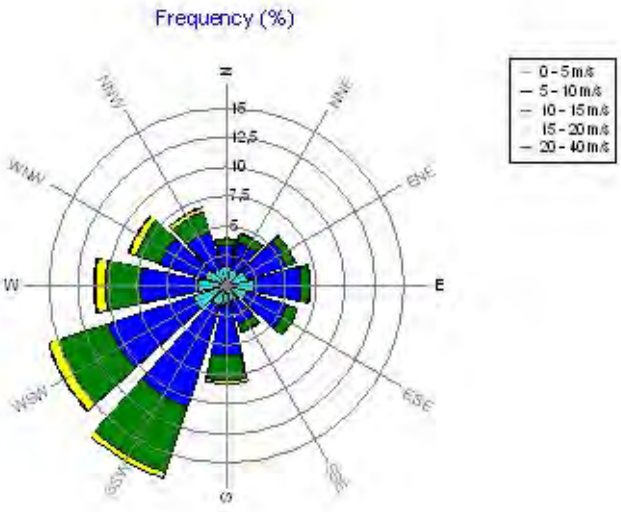
Weibull Data

Sector	Current site A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	6,90	6,13	1,854	4,0
1 NNE	7,85	6,95	2,322	4,5
2 ENE	7,60	6,75	2,545	6,1
3 E	7,30	6,48	2,553	7,1
4 ESE	7,79	6,91	2,498	6,3
5 SSE	7,97	7,06	2,115	4,2
6 S	9,18	8,14	2,486	8,2
7 SSW	10,06	9,00	3,146	17,0
8 WSW	9,71	8,61	2,393	15,8
9 W	9,77	8,65	2,068	11,2
10 WNW	9,48	8,40	2,119	8,7
11 NNW	9,43	8,35	2,209	6,9
All	9,03	8,00	2,287	100,0









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PARK - Wind Data Analysis

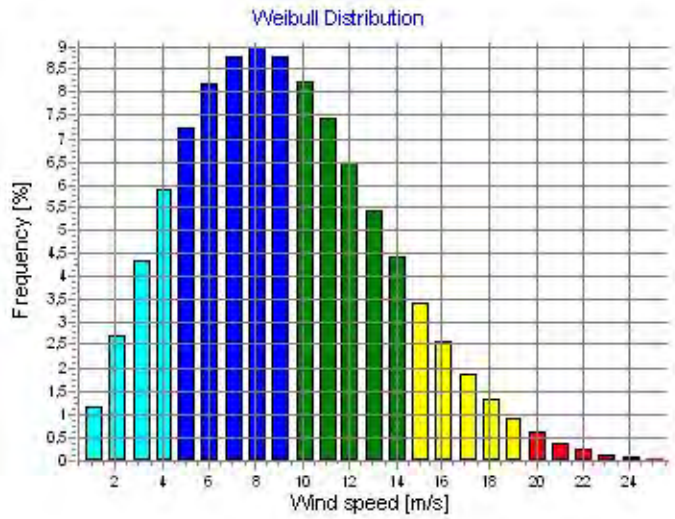
Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)Wind data: A - Oostpolder site data; Hub height: 165,0

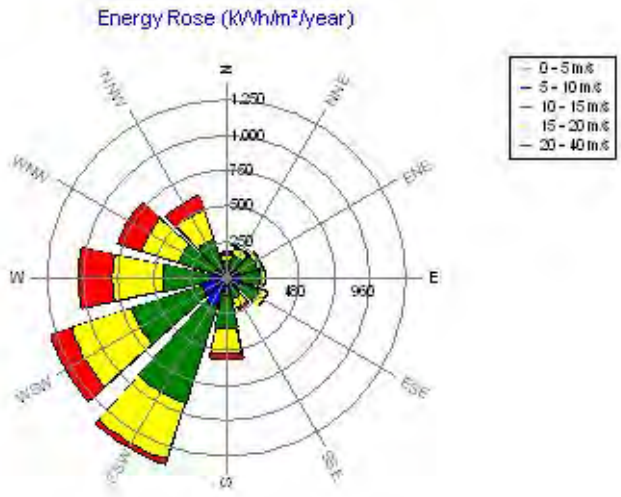
Site coordinates
Dutch Stereo-RD/NAP 2000
East: 250.596 North: 606.527

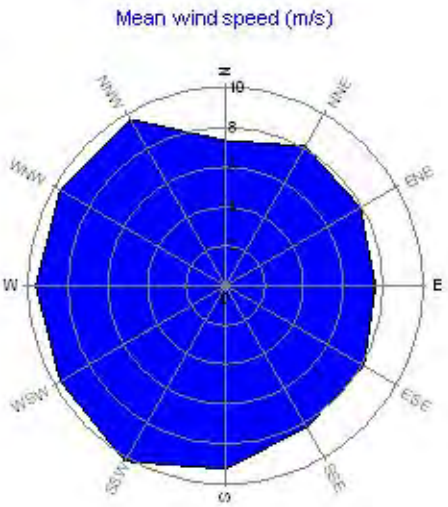
Wind statistics
RWE_Oostpolder 100m-Corr099.wws

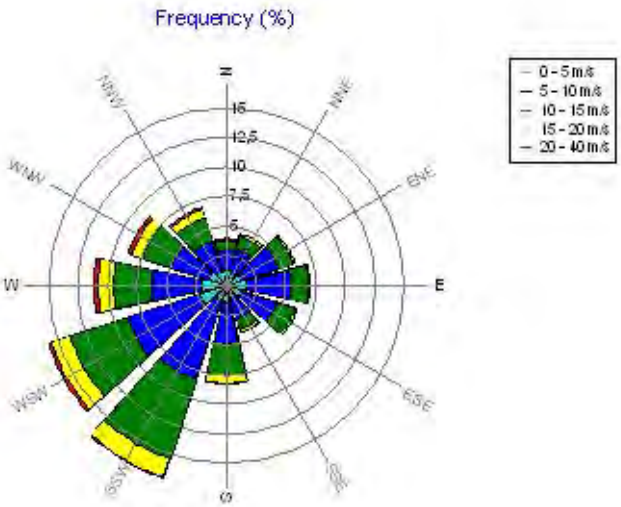
Weibull Data

Sector	Current site A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	8,26	7,34	1,795	4,0
1 NNE	9,17	8,13	2,252	4,5
2 ENE	8,91	7,90	2,467	6,1
3 E	8,54	7,57	2,471	7,1
4 ESE	9,21	8,16	2,424	6,3
5 SSE	9,31	8,25	2,049	4,2
6 S	10,47	9,28	2,420	8,2
7 SSW	11,44	10,22	3,064	17,1
8 WSW	10,93	9,68	2,334	15,8
9 W	10,92	9,68	2,029	11,1
10 WNW	10,94	9,69	2,064	8,7
11 NNW	10,90	9,65	2,143	6,9
All	10,35	9,16	2,252	100,0









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PARK - Park power curve

Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)

Wind speed [m/s]	Power Free WTGs [kW]	Park WTGs [kW]	N [kW]	NNE [kW]	ENE [kW]	E [kW]	ESE [kW]	SSE [kW]	S [kW]	SSW [kW]	WSW [kW]	W [kW]	WNW [kW]	NNW [kW]
0,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1,5	3	1	0	0	0	0	0	2	2	3	2	2	0	0
2,5	1.980	1.053	1.082	1.102	1.030	926	788	1.002	1.216	1.284	1.152	986	727	958
3,5	8.354	5.154	5.330	5.492	5.313	4.768	3.995	5.116	5.629	5.872	5.640	4.838	3.863	4.851
4,5	21.597	14.382	15.059	15.391	15.213	13.780	11.741	14.075	15.195	15.628	15.335	13.604	11.703	14.227
5,5	41.741	28.991	30.055	30.655	30.239	27.752	24.284	28.560	30.515	31.280	30.697	27.760	24.220	28.651
6,5	70.854	49.924	51.775	52.657	51.826	47.843	42.190	49.200	52.468	53.642	52.660	47.944	42.236	49.437
7,5	110.002	78.593	81.541	82.887	81.567	75.429	66.753	77.486	82.469	84.236	82.759	75.515	66.818	77.925
8,5	158.186	116.082	120.643	122.549	120.861	111.946	99.220	114.590	121.357	123.725	122.027	111.533	99.144	115.518
9,5	211.063	162.035	168.593	170.842	169.196	157.388	139.956	160.281	168.536	171.117	169.890	156.007	139.636	162.077
10,5	261.104	212.254	221.368	222.780	221.826	208.112	186.575	210.377	219.572	221.006	220.854	205.365	186.562	214.200
11,5	301.559	260.234	270.737	270.527	270.643	256.951	233.870	258.768	267.910	267.637	268.501	253.825	234.256	263.659
12,5	331.985	300.670	311.423	309.898	310.579	298.862	276.346	299.863	307.576	306.223	307.566	295.478	277.022	305.100
13,5	353.507	332.341	342.206	340.644	341.436	332.570	311.994	332.422	337.494	336.130	337.394	328.599	311.783	336.745
14,5	365.960	354.902	361.260	360.302	361.044	355.791	339.518	355.978	358.874	357.757	358.617	353.456	338.734	357.456
15,5	372.395	367.365	370.558	370.255	370.500	368.393	357.961	368.250	369.584	369.105	369.409	367.206	357.925	368.535
16,5	375.048	373.484	374.640	374.510	374.560	374.019	369.552	374.005	374.401	374.222	374.291	373.672	369.484	373.946
17,5	375.472	375.240	375.446	375.424	375.430	375.347	374.420	375.352	375.434	375.404	375.420	375.331	374.373	375.314
18,5	375.462	375.449	375.467	375.468	375.464	375.459	375.375	375.461	375.462	375.463	375.463	375.460	375.371	375.463
19,5	375.445	375.449	375.450	375.451	375.449	375.449	375.449	375.450	375.447	375.448	375.448	375.448	375.449	375.451
20,5	369.427	369.429	369.430	369.431	369.429	369.428	369.428	369.429	369.428	369.429	369.428	369.428	369.430	369.432
21,5	369.411	369.414	369.416	369.417	369.414	369.413	369.413	369.415	369.413	369.414	369.413	369.413	369.415	369.418
22,5	369.399	369.400	369.401	369.402	369.400	369.399	369.400	369.400	369.399	369.400	369.399	369.399	369.401	369.402
23,5	369.389	369.390	369.392	369.392	369.390	369.389	369.389	369.390	369.389	369.390	369.389	369.389	369.392	369.393
24,5	369.410	369.400	369.385	369.388	369.398	369.404	369.402	369.399	369.410	369.405	369.407	369.404	369.389	369.385
25,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Description:
The park power curve is similar to a WTG power curve, meaning that when a given wind speed appears in front of the park with same speed in the entire wind farm area (before influence from the park), the output from the park can be found in the park power curve. Another way to say this: The park power curve includes array losses, but do NOT include terrain given variations in the wind speed over the park area.
Measuring a park power curve is not as simple as measuring a WTG power curve due to the fact that the park power curve depends on the wind direction and that the same wind speed normally will not appear for the entire park area at the same time (only in very flat non-complex terrain). The idea with this version of the park power curve is not to use it for validation based on measurements. This would require at least 2 measurement masts at two sides of the park, unless only a few direction sectors should be tested, AND non complex terrain (normally only useable off shore). Another park power curve version for complex terrain is available in windPRO.

The park power curve can be used for:

1. Forecast systems, based on more rough (approximated) wind data, the park power curve would be an efficient way to make the connection from wind speed (and direction) to power.
2. Construction of duration curves, telling how often a given power output will appear, the park power curve can be used together with the average wind distribution for the Wind farm area in hub height. The average wind distribution can eventually be obtained based on the Weibull parameters for each WTG position. These are found at print menu: >Result to file< in the >Park result< which can be saved to file or copied to clipboard and pasted in Excel.
3. Calculation of wind energy index based on the PARK production (see below).
4. Estimation of the expected PARK production for an existing wind farm based on wind measurements at minimum 2 measurement masts at two sides of wind farm. The masts must be used for obtaining the free wind speed. The free wind speed is used in the simulation of expected energy production with the PARK power curve. This procedure will only work suitable in non complex terrains. For complex terrain another park power curve calculation is available in windPRO (PPV-model).

Note:
From the >Result to file< the >Wind Speeds Inside Wind farm< is also available. These can (e.g. via Excel) be used for extracting the wake induced reductions in measured wind speed.

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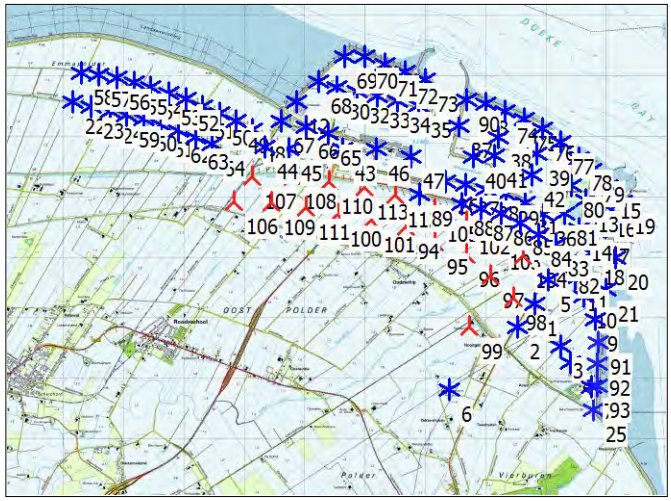
PARK - WTG distances

Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)

WTG distances

	Z	Nearest WTG	Z	Horizontal distance	Distance in|rotor diameters (max)	Distance in|rotor diameters (min)
	[m]		[m]	[m]		
1	-0,3	98	-2,0	365	2,7	2,6
2	0,0	1	-0,3	473	3,5	3,5
3	0,0	4	0,2	315	2,3	2,3
4	0,2	3	0,0	315	2,3	2,3
5	0,3	82	1,0	428	5,2	3,1
6	-0,1	99	0,1	1.089	23,2	7,7
7	1,8	93	0,2	87	1,7	0,9
8	1,6	90	1,0	323	3,9	2,8
9	0,1	91	0,0	384	4,7	3,8
10	-0,4	11	1,0	321	3,9	3,9
11	1,0	82	1,0	319	3,9	3,9
12	2,5	67	1,9	417	5,1	3,0
13	-1,0	16	2,0	300	3,7	3,7
14	1,0	17	2,7	301	3,7	3,7
15	1,0	16	2,0	306	3,7	3,7
16	2,0	13	-1,0	300	3,7	3,7
17	2,7	14	1,0	301	3,7	3,7
18	-0,7	17	2,7	360	4,4	4,4
19	0,1	16	2,0	320	3,9	3,9
20	2,0	18	-0,7	401	4,9	4,9
21	0,0	10	-0,4	379	4,6	4,6
22	0,7	23	0,4	309	2,8	2,8
23	0,4	22	0,7	309	2,8	2,8
24	-1,5	59	1,8	279	3,4	2,5
25	1,0	7	1,8	382	7,3	3,3
26	2,3	27	1,8	340	3,8	3,8
27	1,8	88	0,3	324	4,0	3,6
28	1,0	87	-2,9	327	4,0	3,6
29	3,1	86	-1,0	332	4,1	3,7
30	0,1	68	-0,5	311	3,8	3,5
31	1,3	85	1,7	338	4,1	3,8
32	0,4	30	0,1	332	3,7	3,7
33	1,0	34	0,9	351	3,9	3,9
34	0,9	33	1,0	351	3,9	3,9
35	2,3	34	0,9	352	3,9	3,9
36	1,5	84	-0,3	335	4,1	3,7
37	4,2	90	1,0	455	5,6	5,1
38	-0,8	41	2,7	320	3,6	3,6
39	1,9	42	1,6	371	4,1	4,1
40	1,6	41	2,7	351	3,9	3,9
41	2,7	38	-0,8	320	3,6	3,6
42	1,6	39	1,9	371	4,1	4,1
43	2,8	65	2,7	356	4,3	4,0
44	-1,2	48	-1,2	347	4,2	3,9
45	-1,1	44	-1,2	398	4,4	4,4
46	4,3	43	2,8	563	6,3	4,5
47	3,1	46	4,3	582	4,6	4,6
48	-1,2	49	-0,4	315	3,8	3,8
49	-0,4	50	-1,0	301	3,7	3,7
50	-1,0	49	-0,4	301	3,7	3,7
51	-1,3	52	0,2	303	3,7	3,7
52	0,2	53	1,8	300	3,7	3,7
53	1,8	52	0,2	300	3,7	3,7
54	-2,0	55	-0,7	288	3,5	3,5
55	-0,7	54	-2,0	288	3,5	3,5
56	0,3	57	0,1	299	3,6	3,6
57	0,1	58	-1,1	297	3,6	3,6
58	-1,1	57	0,1	297	3,6	3,6
59	1,8	24	-1,5	279	3,4	2,5
60	0,5	59	1,8	300	3,7	3,7
61	1,5	60	0,5	300	3,7	3,7
62	-0,2	61	1,5	302	3,7	3,7
63	0,6	62	-0,2	302	3,7	3,7



Scale 1:125.000

New WTG Existing WTG

To be continued on next page...

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PARK - WTG distances

Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)

...continued from previous page

	Z	Nearest WTG	Z	Horizontal distance	Distance in|rotor diameters (max)	Distance in|rotor diameters (min)
	[m]		[m]	[m]		
64	0,9	63	0,6	303	3,7	3,7
65	2,7	43	2,8	356	4,3	4,0
66	0,2	65	2,7	382	4,7	4,7
67	1,9	12	2,5	417	5,1	3,0
68	-0,5	30	0,1	311	3,8	3,5
69	0,2	70	2,8	333	4,1	4,1
70	2,8	69	0,2	333	4,1	4,1
71	4,8	72	1,4	355	4,3	4,3
72	1,4	73	3,2	355	4,3	4,3
73	3,2	72	1,4	355	4,3	4,3
74	1,1	8	1,6	340	4,2	2,9
75	1,4	74	1,1	342	4,2	4,2
76	2,1	75	1,4	349	4,3	4,3
77	0,8	76	2,1	370	4,5	4,5
78	0,6	79	1,8	289	3,5	3,5
79	1,8	78	0,6	289	3,5	3,5
80	-0,4	13	-1,0	345	4,2	4,2
81	-0,7	14	1,0	345	4,2	4,2
82	1,0	11	1,0	319	3,9	3,9
83	4,7	82	1,0	333	4,1	4,1
84	-0,3	83	4,7	335	4,1	4,1
85	1,7	31	1,3	338	4,1	3,8
86	-1,0	29	3,1	332	4,1	3,7
87	-2,9	102	-0,9	327	4,0	2,3
88	0,3	102	-0,9	318	3,9	2,3
89	1,5	105	0,0	358	4,4	2,5
90	1,0	8	1,6	323	3,9	2,8
91	0,0	92	0,0	360	3,6	3,6
92	0,0	93	0,2	359	3,6	3,6
93	0,2	7	1,8	87	1,7	0,9
94	-1,1	95	-1,0	545	3,9	3,9
95	-1,0	105	0,0	530	3,8	3,8
96	0,5	97	-0,8	532	3,8	3,8
97	-0,8	98	-2,0	524	3,7	3,7
98	-2,0	1	-0,3	365	2,7	2,6
99	0,1	2	0,0	805	5,9	5,7
100	-1,2	111	-0,6	545	3,9	3,9
101	-0,7	113	-2,3	548	3,9	3,9
102	-0,9	88	0,3	318	3,9	2,3
103	0,2	86	-1,0	392	4,8	2,8
104	1,1	84	-0,3	436	5,3	3,1
105	0,0	89	1,5	358	4,4	2,5
106	-0,6	107	-1,0	517	3,7	3,7
107	-1,0	106	-0,6	517	3,7	3,7
108	-0,3	45	-1,1	461	5,1	3,3
109	-1,3	107	-1,0	528	3,7	3,7
110	-0,6	100	-1,2	562	4,0	4,0
111	-0,6	100	-1,2	545	3,9	3,9
112	-1,6	89	1,5	403	4,9	2,9
113	-2,3	112	-1,6	529	3,7	3,7
Min	-2,9		-2,9	87	1,7	0,9
Max	4,8		4,7	1.089	23,2	7,7

PARK - Wind statistics info

Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)

Main data for wind statistic

File	\\sbs2011\projecten\Extern\2016\716033 WP Oostpolder\TO\WP\200117\24012017\RWE_Oostpolder 100m-Corr099.wws
Name	RWE_Oostpolder 100m-Corr099
Country	Netherlands
Source	User
Mast coordinates	Dutch Stereo-RD/NAP 2000 East: 248.822 North: 608.196
Created	24-1-2017
Edited	1-2-2017
Sectors	12
WAsP version	WAsP 11 Version 11.05.0028
Displacement height	None

Additional info for wind statistic

Source data	Default Meteo data RWE
Data from	25-4-2007
Data to	31-1-2009
Measurement length	21,3 Months

Note

To get the most correct calculation results, wind statistics shall be calculated with the SAME model and model parameters, as currently chosen in calculation. For WAsP versions before 10.0, the model is unchanged, but thereafter more model changes affecting the wind statistic is seen. Likewise WAsP CFD should always use WAsP CFD calculated wind statistics.

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Calculated:
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PARK - Map

Calculation: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)

Map: Uithuizen , Print scale 1:75.000, Map center Dutch Stereo-RD/NAP 2000 East: 249.717 North: 606.402

New WTG Existing WTG Obstacle

BIJLAGE 2

INVOER EN RESULTATEN

MODEL VERLIEZEN

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Calculated:
14-3-2017 11:00/3.1.597

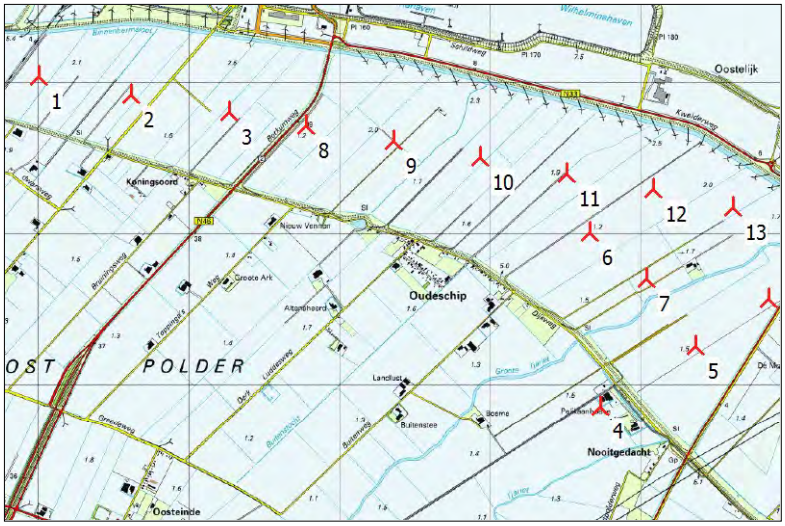
Loss&Uncertainty - Main result

Calculation: 716033 Losses alternatief 1b (Schaduw_en_geluid)

Main data for PARK

PARK calculation 3.1.597: 716033 WP Oostpolder alternatief 1b

Count	14
Rated power	58,8 MW
Mean wind speed	9,2 m/s at hub height
Sensitivity	1,1 %AEP / %Mean Wind Speed
Expected lifetime	20 Years



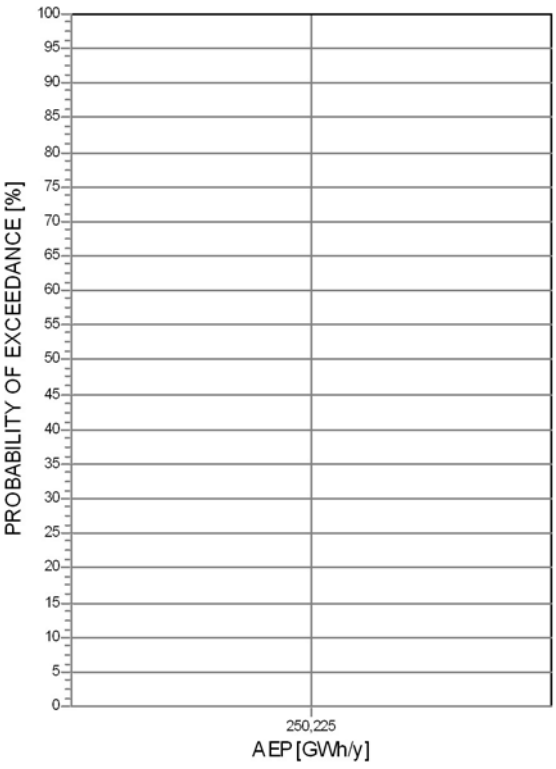
Scale: 50.000

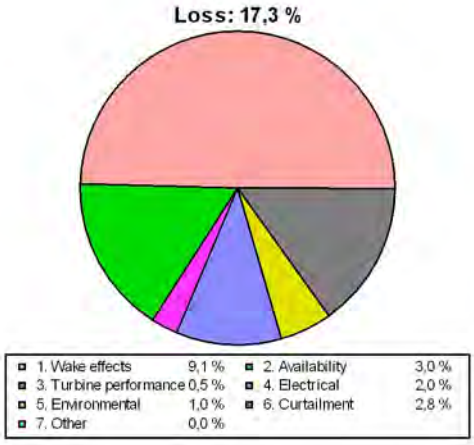
RESULTS

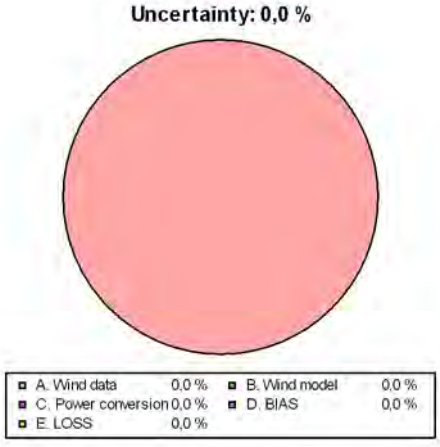
		P50
NET AEP	[GWh/y]	250,2
Capacity factor	[%]	48,6
Full load hours	[h/y]	4.256

Result details

	P50		Uncertainty
GROSS AEP *)	302,4 GWh/y		0,0 %
Bias correction	0,0 GWh/y	0,0 %	0,0 %
Loss correction	-52,2 GWh/y	-17,3 %	0,0 %
Wake loss		-9,1 %	
Other losses		-9,0 %	
NET AEP	250,2 GWh/y		0,0 %







*) Calculated Annual Energy Production before any bias or loss corrections
Assumptions: Uncertainty and percentiles (PXX values) are calculated for the expected lifetime

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Loss&Uncertainty - Assumptions and results

Calculation: 716033 Losses alternatief 1b (Schaduw_en_geluid)

ASSUMPTIONS

LOSS

		Method *)	Loss [%]	Loss [GWh/y]	Std dev**) [%]	Comment
1.	Wake effects					
	Wake effects, all WTGs	Calculation	9,1	27,5	0,0	
2.	Availability					
	Turbine availability	Estimate	3,0	9,1	0,0	
3.	Turbine performance					
	High wind hysteresis	Estimate	0,5	1,5	0,0	
4.	Electrical					
	Electrical losses	Estimate	2,0	6,0	0,0	
5.	Environmental					
	Performance degradation not due to icing	Estimate	0,5	1,5	0,0	
	Performance degradation due to icing	Estimate	0,5	1,5	0,0	
6.	Curtailment					
	Noise	Calculation	2,4	7,4	0,0	
	Flicker	Calculation	0,3	1,1	0,0	
	Birds	Estimate	0,0	0,0	0,0	Nog geen info beschikbaar
	Bats	Estimate	0,0	0,0	0,0	Nog geen info beschikbaar
7.	Other					No input
	LOSS, total		17,3	52,2	0,0	

UNCERTAINTY

		Method *)	Std dev, wind speed [%]	Std dev, AEP [%]	Comment
A.	Wind data				
	Wind measurement/Wind data				
	Long term correction				
	Year-to-year variability				
	Future climate				
	Other wind related				
B.	Wind model				
	Vertical extrapolation				
	Horizontal extrapolation				
	Other wind model related				
C.	Power conversion				
	Power curve uncertainty				
	Metering uncertainty				
	Other AEP related uncertainties				
D.	BIAS, total uncertainty			0,0	
E.	LOSS, total uncertainty			0,0	
	UNCERTAINTY, total (1y average)			0,0	
	UNCERTAINTY, total (20y average)			0,0	

VARIABILITY

Years	Variability (std dev) [%]	Total std dev [%]
1	0,00	0,0
5	0,00	0,0
10	0,00	0,0
20	0,00	0,0

RESULTS

AEP versus exceedance level / time horizon

PXX [%]	1 y [MWh/y]	5 y [MWh/y]	10 y [MWh/y]	20 y [MWh/y]
50	250.225	250.225	250.225	250.225
75	250.225	250.225	250.225	250.225
84	250.225	250.225	250.225	250.225
90	250.225	250.225	250.225	250.225
95	250.225	250.225	250.225	250.225

Loss&Uncertainty - Assumptions and results

Calculation: 716033 Losses alternatief 1b (Schaduw_en_geluid)

*) Calculation means that a calculation method available in the windPRO software is used. This still typically involve a user judgement and user data where the quality of those decides the accuracy. If calculation method is used, the values will often be different from turbine to turbine, here the average is shown, but at page "WTG results" the individual turbine results are shown.
**) For totals the std dev refers to the full AEP, otherwise std dev refers to the bias or loss component which is a fraction of the total AEP.

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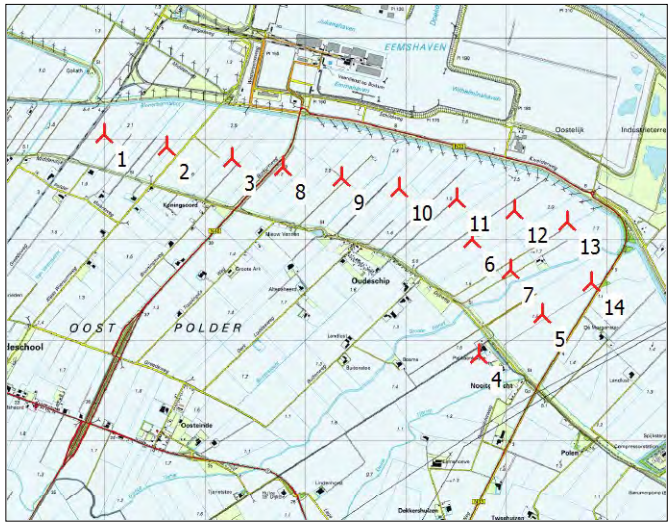
Loss&Uncertainty - WTG results

Calculation: 716033 Losses alternatief 1b (Schaduw_en_geluid)

Main data for PARK

PARK calculation 3.1.597: 716033 WP Oostpolder alternatief 1b

Count	14
Rated power	58,8 MW
Mean wind speed	9,2 m/s at hub height
Sensitivity	1,1 %AEP / %Mean Wind Speed
Expected lifetime	20 Years



Scale: 75.000

Expected AEP per WTG including bias, loss and uncertainty evaluation

	Description	User label	Calculated GROSS*) [MWh/y]	Bias [%]	Loss [%]	20 years averaging Unc. [%]	P50 [MWh/y]
1	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (294)	1	21.506,7	0,0	11,7	0,0	18.996,6
2	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (295)	2	21.474,8	0,0	12,6	0,0	18.779,5
3	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (296)	3	21.508,2	0,0	13,3	0,0	18.643,5
4	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (297)	4	21.420,3	0,0	11,7	0,0	18.918,1
5	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (298)	5	21.552,9	0,0	15,8	0,0	18.146,6
6	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (299)	6	21.604,8	0,0	15,2	0,0	18.328,4
7	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (300)	7	21.589,4	0,0	15,6	0,0	18.232,1
8	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (301)	8	21.596,7	0,0	14,0	0,0	18.576,6
9	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (302)	9	21.603,7	0,0	28,9	0,0	15.354,0
10	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (303)	10	21.669,1	0,0	29,4	0,0	15.295,1
11	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (304)	11	21.691,9	0,0	15,7	0,0	18.283,8
12	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (305)	12	21.745,7	0,0	18,8	0,0	17.665,2
13	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (306)	13	21.771,5	0,0	18,3	0,0	17.781,1
14	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (307)	14	21.674,0	0,0	20,8	0,0	17.165,8
	PARK		302.409,7	0,0	17,3	0,0	250.225,1

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Loss&Uncertainty - Noise

Calculation: 716033 Losses alternatief 1b (Schaduw_en_geluid)

Noise reduced mode is achieved by less aggressive pitching or reduction of maximum power. In both cases this results in less power production. There might also be situations where the turbine is fully stopped for fulfilling special noise requirements

Assumptions:

WTG(s)	Time From	To	Calculated power curve	Curtailed power curve
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (302)	23:00	07:00	Level 0 - official - 0 s- 4200kW - 04/2016	Level 8 - official - 1000kW - 04/2016
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (303)	23:00	07:00	Level 0 - official - 0 s- 4200kW - 04/2016	Level 8 - official - 1000kW - 04/2016

Time series used in calculation
Name: Lauwersoog_KNMI_1991_2016.10,00m -
From: 18-3-1991 1:00:00
To: 2-1-2017 23:00:00
Period: 310 months
Time step: 60 minutes
The period used is calibrated to calculate annual loss

Result

Calculated AEP before loss:	302.409,7 MWh/y
Calculated loss:	7.397,5 MWh/y
Calculated AEP after loss:	295.012,3 MWh/y
Percent loss:	2,45 %

Result

WTG	Calculated AEP GROSS [MWh]	Loss [MWh]	Percent of AEP [%]
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (294)	21.506,7	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (295)	21.474,8	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (296)	21.508,2	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (297)	21.420,3	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (298)	21.552,9	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (299)	21.604,8	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (300)	21.589,4	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (301)	21.596,7	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (302)	21.603,7	3.690,6	17,08
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (303)	21.669,1	3.706,9	17,11
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (304)	21.691,9	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (305)	21.745,7	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (306)	21.771,5	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (307)	21.674,0	0,0	0,00
TOTAL	302.409,7	7.397,5	2,45

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Loss&Uncertainty - Flicker

Calculation: 716033 Losses alternatief 1b (Schaduw_en_geluid)

Calculated losses due to shadow (flicker) loss.

Used SHADOW calculation: 3.1.597: 1b schaduw

Assumptions:
Advanced stop (light sensors etc. included). Reduced to: 30 % AEP reduction relative to worst case.

Result

WTG	Calculated AEP GROSS [MWh]	Loss [MWh]	Percent of AEP [%]
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (294)	21.506,7	156,7	0,73
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (295)	21.474,8	70,9	0,33
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (296)	21.508,2	67,1	0,31
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (297)	21.420,3	124,0	0,58
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (298)	21.552,9	27,0	0,13
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (299)	21.604,8	111,7	0,52
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (300)	21.589,4	63,4	0,29
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (301)	21.596,7	82,7	0,38
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (302)	21.603,7	111,8	0,52
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (303)	21.669,1	106,5	0,49
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (304)	21.691,9	63,8	0,29
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (305)	21.745,7	47,1	0,22
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (306)	21.771,5	14,8	0,07
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (307)	21.674,0	3,9	0,02
TOTAL	302.409,7	1.051,3	0,35

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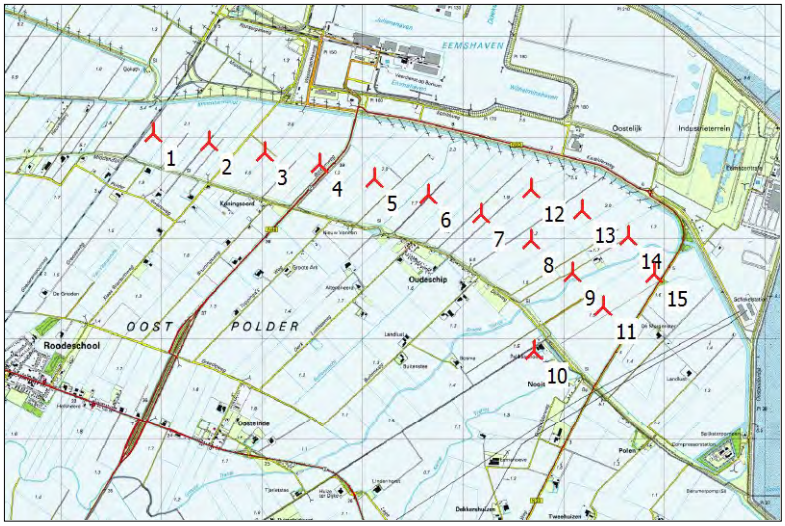
Loss&Uncertainty - Main result

Calculation: 716033 Losses alternatief 2b (Schaduw)

Main data for PARK

PARK calculation 3.1.597: 716033 WP Oostpolder alternatief 2b

Count	15
Rated power	63,0 MW
Mean wind speed	8,7 m/s at hub height
Sensitivity	1,3 %AEP / %Mean Wind Speed
Expected lifetime	20 Years



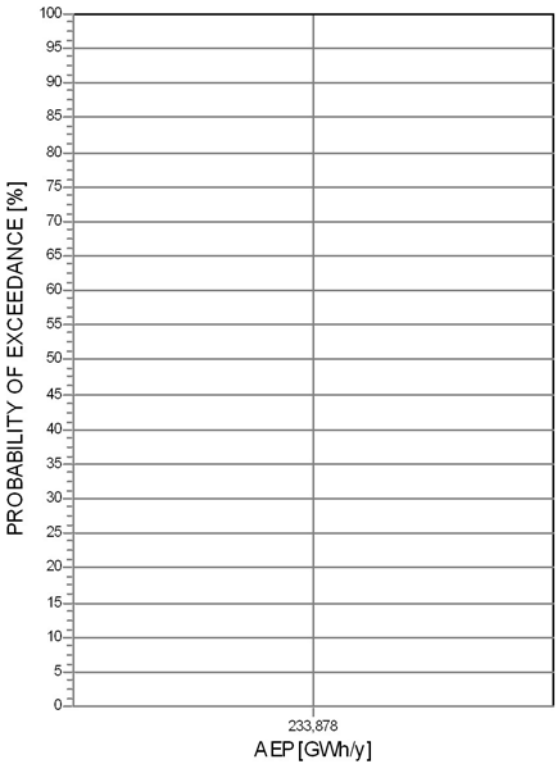
Scale: 75.000

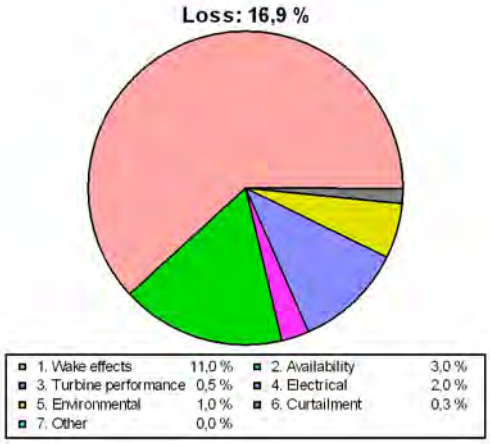
RESULTS

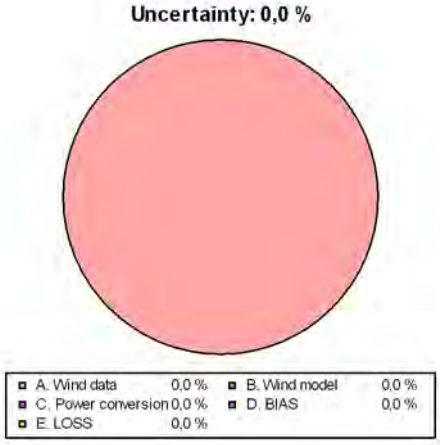
		P50
NET AEP	[GWh/y]	233,9
Capacity factor	[%]	42,4
Full load hours	[h/y]	3.712

Result details

	P50		Uncertainty
GROSS AEP *)	281,3 GWh/y		0,0 %
Bias correction	0,0 GWh/y	0,0 %	0,0 %
Loss correction	-47,4 GWh/y	-16,9 %	0,0 %
Wake loss		-11,0 %	
Other losses		-6,6 %	
NET AEP	233,9 GWh/y		0,0 %







*) Calculated Annual Energy Production before any bias or loss corrections
Assumptions: Uncertainty and percentiles (PXX values) are calculated for the expected lifetime

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Loss&Uncertainty - Assumptions and results

Calculation: 716033 Losses alternatief 2b (Schaduw)

ASSUMPTIONS

LOSS

		Method *)	Loss [%]	Loss [GWh/y]	Std dev**) [%]	Comment
1.	Wake effects					
	Wake effects, all WTGs	Calculation	11,0	30,8	0,0	
2.	Availability					
	Turbine availability	Estimate	3,0	8,4	0,0	
3.	Turbine performance					
	High wind hysteresis	Estimate	0,5	1,4	0,0	
4.	Electrical					
	Electrical losses	Estimate	2,0	5,6	0,0	
5.	Environmental					
	Performance degradation not due to icing	Estimate	0,5	1,4	0,0	
	Performance degradation due to icing	Estimate	0,5	1,4	0,0	
6.	Curtailment					
	Noise	Estimate	0,0	0,0	0,0	Niet van toepassing
	Flicker	Calculation	0,3	0,8	0,0	
	Birds	Estimate	0,0	0,0	0,0	Nog geen info beschikbaar
	Bats	Estimate	0,0	0,0	0,0	Nog geen info beschikbaar
7.	Other					No input
	LOSS, total		16,9	47,4	0,0	

UNCERTAINTY

		Method *)	Std dev, wind speed [%]	Std dev, AEP [%]	Comment
A.	Wind data				
	Wind measurement/Wind data				
	Long term correction				
	Year-to-year variability				
	Future climate				
	Other wind related				
B.	Wind model				
	Vertical extrapolation				
	Horizontal extrapolation				
	Other wind model related				
C.	Power conversion				
	Power curve uncertainty				
	Metering uncertainty				
	Other AEP related uncertainties				
D.	BIAS, total uncertainty			0,0	
E.	LOSS, total uncertainty			0,0	
	UNCERTAINTY, total (1y average)			0,0	
	UNCERTAINTY, total (20y average)			0,0	

VARIABILITY

Years	Variability (std dev) [%]	Total std dev [%]
1	0,00	0,0
5	0,00	0,0
10	0,00	0,0
20	0,00	0,0

RESULTS

AEP versus exceedance level / time horizon

PXX [%]	1 y [MWh/y]	5 y [MWh/y]	10 y [MWh/y]	20 y [MWh/y]
50	233.878	233.878	233.878	233.878
75	233.878	233.878	233.878	233.878
84	233.878	233.878	233.878	233.878
90	233.878	233.878	233.878	233.878
95	233.878	233.878	233.878	233.878

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Loss&Uncertainty - Assumptions and results

Calculation: 716033 Losses alternatief 2b (Schaduw)

*) Calculation means that a calculation method available in the windPRO software is used. This still typically involve a user judgement and user data where the quality of those decides the accuracy. If calculation method is used, the values will often be different from turbine to turbine, here the average is shown, but at page "WTG results" the individual turbine results are shown.
**) For totals the std dev refers to the full AEP, otherwise std dev refers to the bias or loss component which is a fraction of the total AEP.

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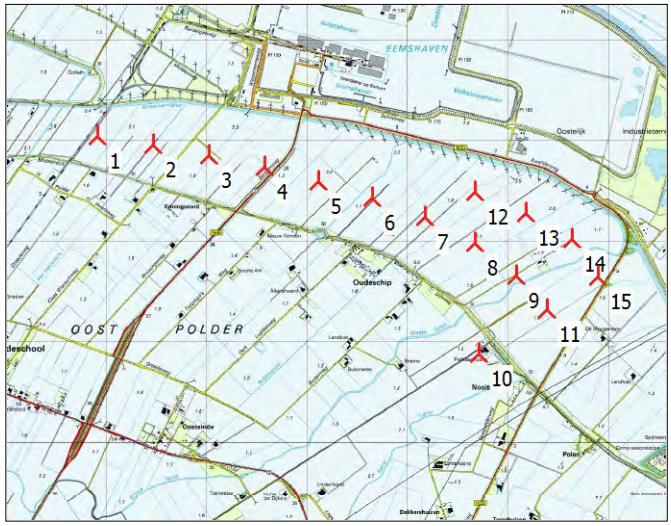
Loss&Uncertainty - WTG results

Calculation: 716033 Losses alternatief 2b (Schaduw)

Main data for PARK

PARK calculation 3.1.597: 716033 WP Oostpolder alternatief 2b

Count	15
Rated power	63,0 MW
Mean wind speed	8,7 m/s at hub height
Sensitivity	1,3 %AEP / %Mean Wind Speed
Expected lifetime	20 Years



Scale: 75.000

Expected AEP per WTG including bias, loss and uncertainty evaluation

	Description	User label	Calculated GROSS*) [MWh/y]	Bias [%]	Loss [%]	20 years averaging Unc. [%]	P50 [MWh/y]
1	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (308)	1	18.661,3	0,0	12,6	0,0	16.301,7
2	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (309)	2	18.627,3	0,0	14,0	0,0	16.020,5
3	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (310)	3	18.699,3	0,0	14,6	0,0	15.973,1
4	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (311)	4	18.662,8	0,0	14,7	0,0	15.927,7
5	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (312)	5	18.709,5	0,0	14,7	0,0	15.965,9
6	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (313)	6	18.732,3	0,0	15,4	0,0	15.847,6
7	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (314)	7	18.741,0	0,0	15,8	0,0	15.775,3
8	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (315)	8	18.766,3	0,0	16,1	0,0	15.747,2
9	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (316)	9	18.733,6	0,0	17,0	0,0	15.549,1
10	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (317)	10	18.571,2	0,0	12,0	0,0	16.341,9
11	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (318)	11	18.700,2	0,0	17,4	0,0	15.449,9
12	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (319)	12	18.892,0	0,0	19,6	0,0	15.196,9
13	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (320)	13	18.940,3	0,0	20,9	0,0	14.975,4
14	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (321)	14	18.942,2	0,0	21,4	0,0	14.891,3
15	ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (322)	15	18.894,9	0,0	26,4	0,0	13.899,2
	PARK		281.274,2	0,0	16,9	0,0	233.878,4

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Loss&Uncertainty - Flicker

Calculation: 716033 Losses alternatief 2b (Schaduw)

Calculated losses due to shadow (flicker) loss.

Used SHADOW calculation: 3.1.597: 2b receptoren binnen 6 uur

Assumptions:
Advanced stop (light sensors etc. included). Reduced to: 30 % AEP reduction relative to worst case.

Result

WTG	Calculated AEP GROSS [MWh]	Loss [MWh]	Percent of AEP [%]
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (308)	18.661,3	112,4	0,60
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (309)	18.627,3	62,0	0,33
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (310)	18.699,3	26,7	0,14
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (311)	18.662,8	45,1	0,24
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (312)	18.709,5	37,4	0,20
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (313)	18.732,3	141,5	0,76
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (314)	18.741,0	93,1	0,50
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (315)	18.766,3	84,8	0,45
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (316)	18.733,6	28,5	0,15
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (317)	18.571,2	83,1	0,45
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (318)	18.700,2	10,6	0,06
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (319)	18.892,0	30,4	0,16
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (320)	18.940,3	25,3	0,13
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (321)	18.942,2	3,1	0,02
ENERCON E-126 EP4 TES 4200 127.0 !O! hub: 135,0 m (TOT: 198,5 m) (322)	18.894,9	0,0	0,00
TOTAL	281.274,2	783,9	0,28

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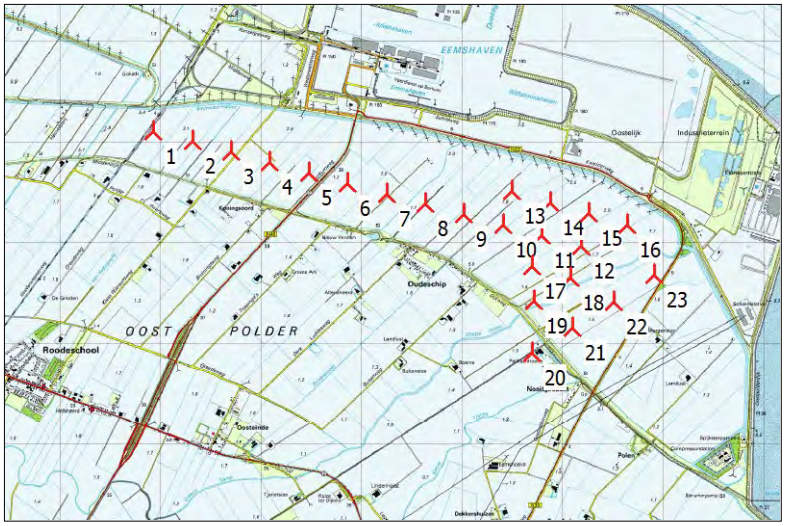
Loss&Uncertainty - Main result

Calculation: 716033 Losses alternatief 3b (Schaduw_en_geluid)

Main data for PARK

PARK calculation 3.1.597: 716033 WP Oostpolder alternatief 3b

Count	23
Rated power	54,1 MW
Mean wind speed	8,4 m/s at hub height
Sensitivity	1,3 %AEP / %Mean Wind Speed
Expected lifetime	20 Years



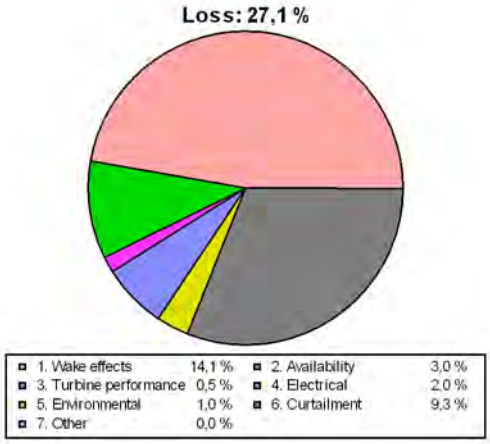
Scale: 75.000

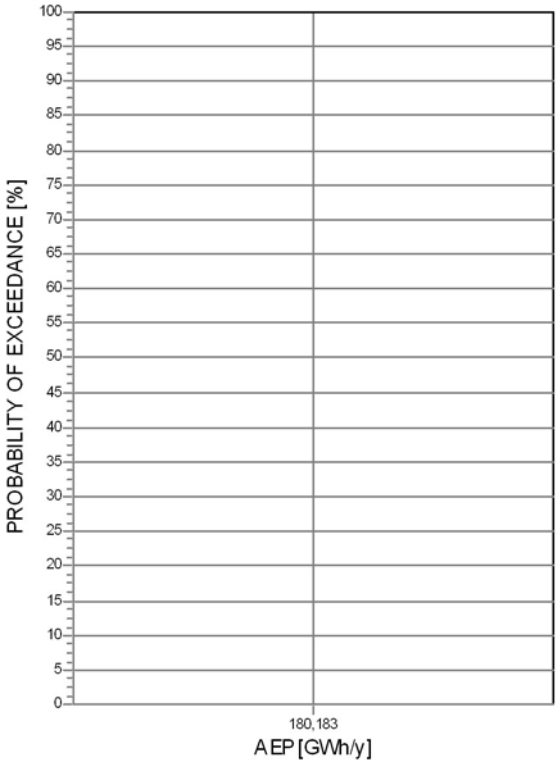
RESULTS

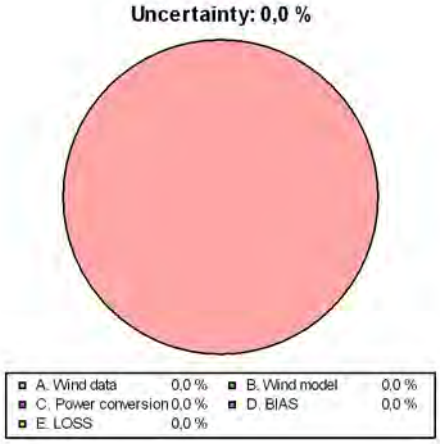
		P50
NET AEP	[GWh/y]	180,2
Capacity factor	[%]	38,1
Full load hours	[h/y]	3.334

Result details

	P50		Uncertainty
GROSS AEP *)	247,1 GWh/y		0,0 %
Bias correction	0,0 GWh/y	0,0 %	0,0 %
Loss correction	-66,9 GWh/y	-27,1 %	0,0 %
Wake loss		-14,1 %	
Other losses		-15,1 %	
NET AEP	180,2 GWh/y		0,0 %







*) Calculated Annual Energy Production before any bias or loss corrections
Assumptions: Uncertainty and percentiles (PXX values) are calculated for the expected lifetime

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Loss&Uncertainty - Assumptions and results

Calculation: 716033 Losses alternatief 3b (Schaduw_en_geluid)

ASSUMPTIONS

LOSS

		Method *)	Loss [%]	Loss [GWh/y]	Std dev**) [%]	Comment
1.	Wake effects					
	Wake effects, all WTGs	Calculation	14,1	34,9	0,0	
2.	Availability					
	Turbine availability	Estimate	3,0	7,4	0,0	
3.	Turbine performance					
	High wind hysteresis	Estimate	0,5	1,2	0,0	
4.	Electrical					
	Electrical losses	Estimate	2,0	4,9	0,0	
5.	Environmental					
	Performance degradation not due to icing	Estimate	0,5	1,2	0,0	
	Performance degradation due to icing	Estimate	0,5	1,2	0,0	
6.	Curtailment					
	Noise	Calculation	9,1	22,6	0,0	
	Flicker	Calculation	0,2	0,5	0,0	
	Birds	Estimate	0,0	0,0	0,0	Nog geen info beschikbaar
	Bats	Estimate	0,0	0,0	0,0	Nog geen info beschikbaar
7.	Other					No input
	LOSS, total		27,1	66,9	0,0	

UNCERTAINTY

		Method *)	Std dev, wind speed [%]	Std dev, AEP [%]	Comment
A.	Wind data				
	Wind measurement/Wind data				
	Long term correction				
	Year-to-year variability				
	Future climate				
	Other wind related				
B.	Wind model				
	Vertical extrapolation				
	Horizontal extrapolation				
	Other wind model related				
C.	Power conversion				
	Power curve uncertainty				
	Metering uncertainty				
	Other AEP related uncertainties				
D.	BIAS, total uncertainty			0,0	
E.	LOSS, total uncertainty			0,0	
	UNCERTAINTY, total (1y average)			0,0	
	UNCERTAINTY, total (20y average)			0,0	

VARIABILITY

Years	Variability (std dev) [%]	Total std dev [%]
1	0,00	0,0
5	0,00	0,0
10	0,00	0,0
20	0,00	0,0

RESULTS

AEP versus exceedance level / time horizon

PXX [%]	1 y [MWh/y]	5 y [MWh/y]	10 y [MWh/y]	20 y [MWh/y]
50	180.183	180.183	180.183	180.183
75	180.183	180.183	180.183	180.183
84	180.183	180.183	180.183	180.183
90	180.183	180.183	180.183	180.183
95	180.183	180.183	180.183	180.183

Loss&Uncertainty - Assumptions and results

Calculation: 716033 Losses alternatief 3b (Schaduw_en_geluid)

*) Calculation means that a calculation method available in the windPRO software is used. This still typically involve a user judgement and user data where the quality of those decides the accuracy. If calculation method is used, the values will often be different from turbine to turbine, here the average is shown, but at page "WTG results" the individual turbine results are shown.
**) For totals the std dev refers to the full AEP, otherwise std dev refers to the bias or loss component which is a fraction of the total AEP.

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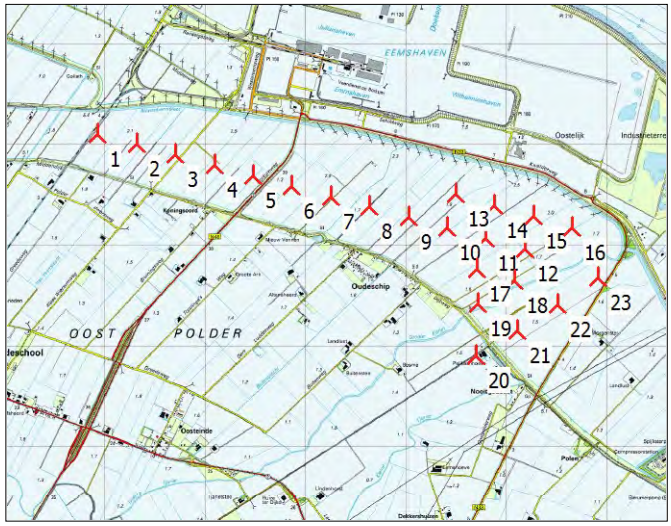
Loss&Uncertainty - WTG results

Calculation: 716033 Losses alternatief 3b (Schaduw_en_geluid)

Main data for PARK

PARK calculation 3.1.597: 716033 WP Oostpolder alternatief 3b
Count 23
Rated power 54,1 MW
Mean wind speed 8,4 m/s at hub height
Sensitivity 1,3 %AEP / %Mean Wind Speed
Expected lifetime 20 Years



Scale: 75.000

Expected AEP per WTG including bias, loss and uncertainty evaluation

	Description	User label	Calculated GROSS*) [MWh/y]	Bias [%]	Loss [%]	20 years averaging Unc. [%]	P50 [MWh/y]
1	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (382)	1	10.700,2	0,0	14,9	0,0	9.102,4
2	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (383)	2	10.667,9	0,0	16,6	0,0	8.898,7
3	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (384)	3	10.673,9	0,0	21,5	0,0	8.374,6
4	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (385)	4	10.685,7	0,0	21,7	0,0	8.364,6
5	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (386)	5	10.687,4	0,0	21,6	0,0	8.380,3
6	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (387)	6	10.698,6	0,0	20,6	0,0	8.496,4
7	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (388)	7	10.698,1	0,0	23,8	0,0	8.147,3
8	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (389)	8	10.725,5	0,0	24,4	0,0	8.107,9
9	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (390)	9	10.737,8	0,0	25,2	0,0	8.033,6
10	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (391)	10	10.730,6	0,0	39,6	0,0	6.482,1
11	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (392)	11	10.781,1	0,0	42,9	0,0	6.157,7
12	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (393)	12	10.813,4	0,0	32,5	0,0	7.299,5
13	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (394)	13	10.818,3	0,0	30,3	0,0	7.535,6
14	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (395)	14	10.858,1	0,0	32,6	0,0	7.315,4
15	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (396)	15	10.838,8	0,0	27,8	0,0	7.828,9
16	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (397)	16	10.872,8	0,0	25,2	0,0	8.138,3
17	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (398)	17	10.721,3	0,0	39,6	0,0	6.478,4
18	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (399)	18	10.732,7	0,0	29,4	0,0	7.579,0
19	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (400)	19	10.708,9	0,0	37,5	0,0	6.692,1
20	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (401)	20	10.655,0	0,0	20,6	0,0	8.465,4
21	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (402)	21	10.680,5	0,0	25,0	0,0	8.013,3
22	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (403)	22	10.749,3	0,0	21,6	0,0	8.425,7
23	ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (404)	23	10.825,2	0,0	28,6	0,0	7.730,8
	PARK		247.061,1	0,0	27,1	0,0	180.183,0

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Loss&Uncertainty - Noise

Calculation: 716033 Losses alternatief 3b (Schaduw_en_geluid)

Noise reduced mode is achieved by less aggressive pitching or reduction of maximum power. In both cases this results in less power production. There might also be situations where the turbine is fully stopped for fulfilling special noise requirements

Assumptions:

WTG(s)	Time From	Time To	Calculated power curve	Curtailed power curve
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (382)	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 1 - official - OM Is - 2150kW - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (383)	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 1 - official - OM Is - 2150kW - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (384)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 1 - official - OM Is - 2150kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (385)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 1 - official - OM Is - 2150kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (386)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 1 - official - OM Is - 2150kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (387)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 1 - official - OM Is - 2150kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 1 - official - OM Is - 2150kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 1 - official - OM Is - 2150kW - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (388)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (389)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (390)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (391)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 9 - official - OM 400kW s - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (392)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 9 - official - OM 400kW s - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (393)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (394)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (395)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (398)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 9 - official - OM 400kW s - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (399)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (400)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 9 - official - OM 400kW s - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (401)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (402)	07:00	19:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	19:00	23:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016
	23:00	07:00	Level 0 - official - OM 0s - 2350kW - 08/2016	Level 2 - official - OM IIs - 2000kW - 08/2016

Time series used in calculation

Name: Lauwersoog_KNMI_1991_2016.10,00m -
From: 18-3-1991 1:00:00
To: 2-1-2017 23:00:00
Period: 310 months
Time step: 60 minutes
The period used is calibrated to calculate annual loss

Result

Calculated AEP before loss:	247.061,1 MWh/y
Calculated loss:	22.575,3 MWh/y
Calculated AEP after loss:	224.485,8 MWh/y
Percent loss:	9,14 %

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Calculated:
14-3-2017 13:47/3.1.597

Loss&Uncertainty - Noise

Calculation: 716033 Losses alternatief 3b (Schaduw_en_geluid)

Result

WTG	Calculated AEP GROSS [MWh]	Loss [MWh]	Percent of AEP [%]
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (382)	10.700,2	143,6	1,34
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (383)	10.667,9	142,7	1,34
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (384)	10.673,9	726,8	6,81
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (385)	10.685,7	728,1	6,81
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (386)	10.687,4	728,1	6,81
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (387)	10.698,6	571,1	5,34
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (388)	10.698,1	954,3	8,92
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (389)	10.725,5	958,8	8,94
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (390)	10.737,8	960,7	8,95
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (391)	10.730,6	2.718,8	25,34
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (392)	10.781,1	2.737,8	25,39
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (393)	10.813,4	973,0	9,00
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (394)	10.818,3	974,4	9,01
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (395)	10.858,1	981,0	9,03
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (396)	10.838,8	0,0	0,00
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (397)	10.872,8	0,0	0,00
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (398)	10.721,3	2.714,4	25,32
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (399)	10.732,7	958,9	8,93
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (400)	10.708,9	2.709,5	25,30
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (401)	10.655,0	944,4	8,86
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (402)	10.680,5	949,0	8,89
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (403)	10.749,3	0,0	0,00
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (404)	10.825,2	0,0	0,00
TOTAL	247.061,1	22.575,3	9,14

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Loss&Uncertainty - Flicker

Calculation: 716033 Losses alternatief 3b (Schaduw_en_geluid)

Calculated losses due to shadow (flicker) loss.

Used SHADOW calculation: 3.1.597: 3b receptoren binnen 6 uur

Assumptions:
Advanced stop (light sensors etc. included). Reduced to: 30 % AEP reduction relative to worst case.

Result

WTG	Calculated AEP GROSS [MWh]	Loss [MWh]	Percent of AEP [%]
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (382)	10.700,2	34,4	0,32
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (383)	10.667,9	25,7	0,24
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (384)	10.673,9	15,1	0,14
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (385)	10.685,7	18,7	0,17
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (386)	10.687,4	19,8	0,18
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (387)	10.698,6	14,9	0,14
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (388)	10.698,1	30,7	0,29
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (389)	10.725,5	47,1	0,44
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (390)	10.737,8	47,0	0,44
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (391)	10.730,6	31,7	0,30
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (392)	10.781,1	23,4	0,22
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (393)	10.813,4	9,7	0,09
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (394)	10.818,3	13,9	0,13
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (395)	10.858,1	8,5	0,08
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (396)	10.838,8	0,0	0,00
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (397)	10.872,8	0,0	0,00
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (398)	10.721,3	50,0	0,47
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (399)	10.732,7	10,8	0,10
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (400)	10.708,9	33,2	0,31
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (401)	10.655,0	34,3	0,32
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (402)	10.680,5	7,5	0,07
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (403)	10.749,3	0,0	0,00
ENERCON E-103 EP2 2350 103.0 !-! hub: 120,0 m (TOT: 171,5 m) (404)	10.825,2	0,0	0,00
TOTAL	247.061,1	476,5	0,19

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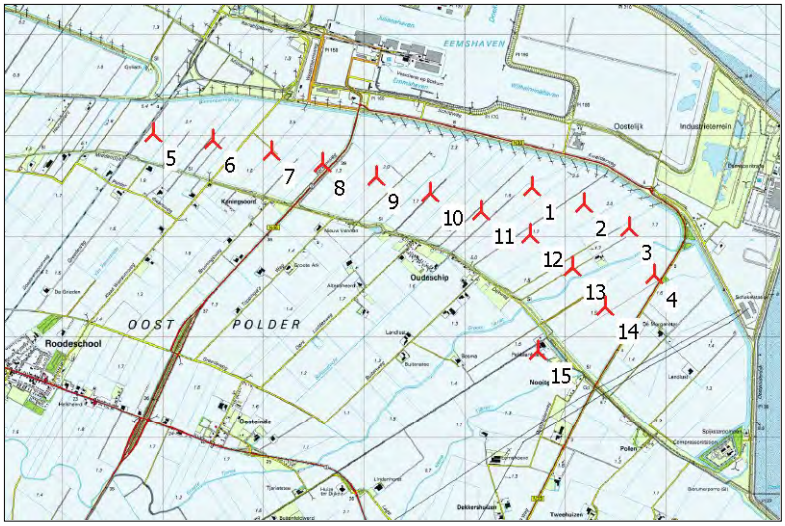
Loss&Uncertainty - Main result

Calculation: VKA1 (Schaduw_en_geluid)

Main data for PARK

PARK calculation 3.1.597: WP Oostpolder VKA1

Count	15
Rated power	63,0 MW
Mean wind speed	9,2 m/s at hub height
Sensitivity	1,1 %AEP / %Mean Wind Speed
Expected lifetime	20 Years



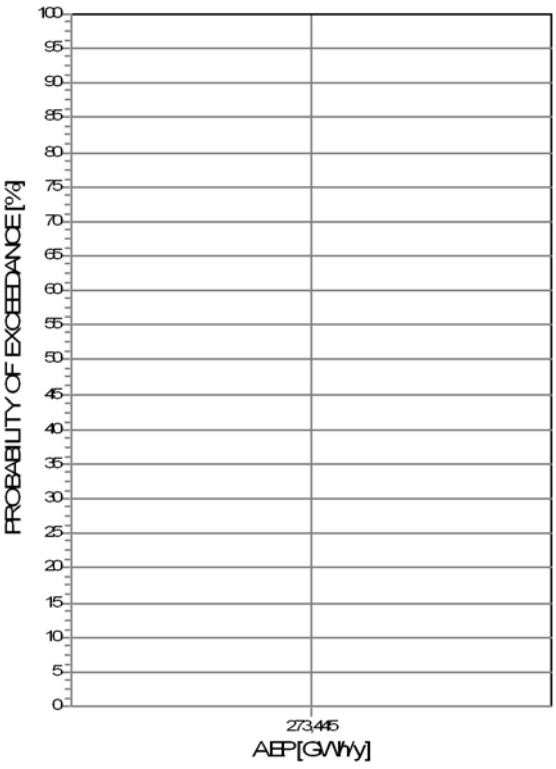
Scale: 75.000

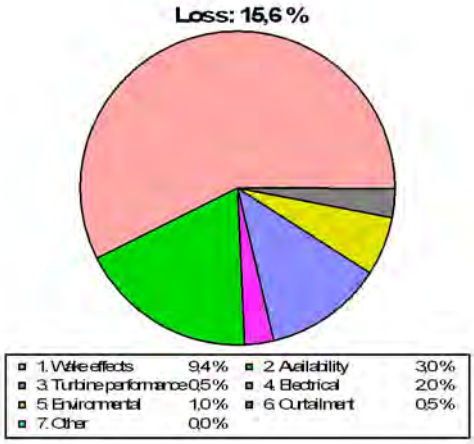
RESULTS

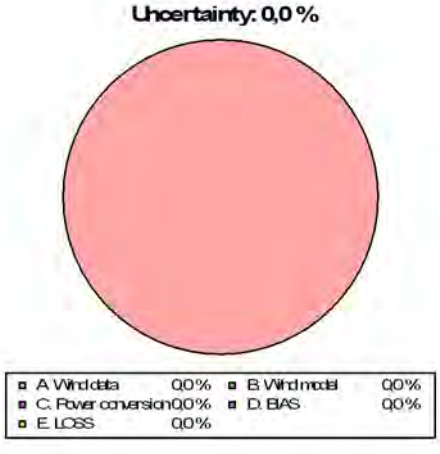
		P50
NET AEP	[GWh/y]	273,4
Capacity factor	[%]	49,5
Full load hours	[h/y]	4.340

Result details

	P50		Uncertainty
GROSS AEP *)	323,9 GWh/y		0,0 %
Bias correction	0,0 GWh/y	0,0 %	0,0 %
Loss correction	-50,4 GWh/y	-15,6 %	0,0 %
Wake loss		-9,4 %	
Other losses		-6,8 %	
NET AEP	273,4 GWh/y		0,0 %







*) Calculated Annual Energy Production before any bias or loss corrections
Assumptions: Uncertainty and percentiles (PXX values) are calculated for the expected lifetime

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Loss&Uncertainty - Assumptions and results

Calculation: VKA1 (Schaduw_en_geluid)

ASSUMPTIONS

LOSS

		Method *)	Loss [%]	Loss [GWh/y]	Std dev**) [%]	Comment
1.	Wake effects					
	Wake effects, all WTGs	Calculation	9,4	30,4	0,0	Berekend
2.	Availability					
	Turbine availability	Estimate	3,0	9,7	0,0	Schatting
3.	Turbine performance					
	High wind hysteresis	Estimate	0,5	1,6	0,0	Schatting
4.	Electrical					
	Electrical losses	Estimate	2,0	6,5	0,0	Schatting
5.	Environmental					
	Performance degradation not due to icing	Estimate	0,5	1,6	0,0	Schatting
	Performance degradation due to icing	Estimate	0,5	1,6	0,0	Schatting
6.	Curtailment					
	Noise	Calculation	0,2	0,7	0,0	Berekend
	Flicker	Calculation	0,3	0,9	0,0	Berekend
7.	Other					No input
	LOSS, total		15,6	50,4	0,0	

UNCERTAINTY

		Method *)	Std dev, wind speed [%]	Std dev, AEP [%]	Comment
A.	Wind data				
	Wind measurement/Wind data				
	Long term correction				
	Year-to-year variability				
	Future climate				
	Other wind related				
B.	Wind model				
	Vertical extrapolation				
	Horizontal extrapolation				
	Other wind model related				
C.	Power conversion				
	Power curve uncertainty				
	Metering uncertainty				
	Other AEP related uncertainties				
D.	BIAS, total uncertainty			0,0	
E.	LOSS, total uncertainty			0,0	
	UNCERTAINTY, total (1y average)			0,0	
	UNCERTAINTY, total (20y average)			0,0	

VARIABILITY

Years	Variability (std dev) [%]	Total std dev [%]
1	0,00	0,0
5	0,00	0,0
10	0,00	0,0
20	0,00	0,0

RESULTS

AEP versus exceedance level / time horizon

PXX [%]	1 y [MWh/y]	5 y [MWh/y]	10 y [MWh/y]	20 y [MWh/y]
50	273.445	273.445	273.445	273.445
75	273.445	273.445	273.445	273.445
84	273.445	273.445	273.445	273.445
90	273.445	273.445	273.445	273.445
95	273.445	273.445	273.445	273.445

*) Calculation means that a calculation method available in the windPRO software is used. This still typically involve a user judgement and user data where the quality of those decides the accuracy. If calculation method is used, the values will often be different from turbine to turbine, here the average is shown, but at page "WTG results" the individual turbine results are shown.
**) For totals the std dev refers to the full AEP, otherwise std dev refers to the bias or loss component which is a fraction of the total AEP.

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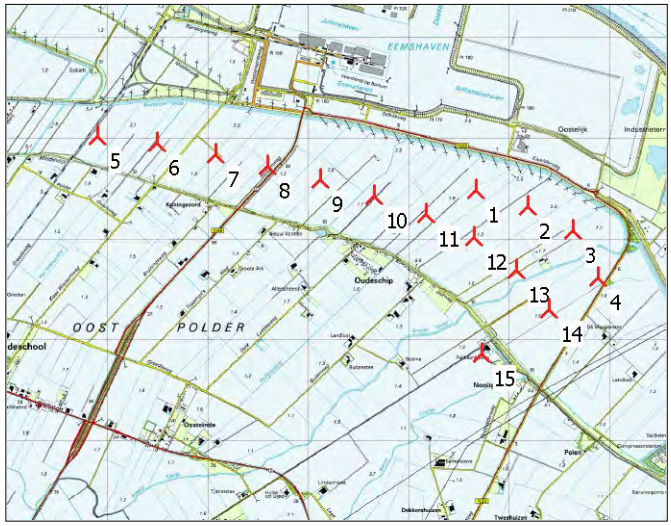
Loss&Uncertainty - WTG results

Calculation: VKA1 (Schaduw_en_geluid)

Main data for PARK

PARK calculation 3.1.597: WP Oostpolder VKA1
Count 15
Rated power 63,0 MW
Mean wind speed 9,2 m/s at hub height
Sensitivity 1,1 %AEP / %Mean Wind Speed
Expected lifetime 20 Years



Scale: 75.000

Expected AEP per WTG including bias, loss and uncertainty evaluation

	Description	Calculated GROSS*) [MWh/y]	Bias [%]	Loss [%]	20 years averaging Unc. [%]	P50 [MWh/y]
1	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (748)	21.715,7	0,0	17,7	0,0	17.868,8
2	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (749)	21.753,8	0,0	18,6	0,0	17.696,7
3	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (750)	21.756,2	0,0	18,4	0,0	17.761,8
4	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (751)	21.692,8	0,0	22,2	0,0	16.867,2
5	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (752)	21.478,8	0,0	11,7	0,0	18.973,0
6	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (753)	21.497,2	0,0	13,7	0,0	18.552,2
7	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (754)	21.547,7	0,0	13,4	0,0	18.664,2
8	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (755)	21.530,9	0,0	13,7	0,0	18.577,7
9	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (756)	21.560,9	0,0	13,7	0,0	18.608,5
10	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (757)	21.574,7	0,0	14,2	0,0	18.512,4
11	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (758)	21.591,9	0,0	16,9	0,0	17.948,1
12	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (759)	21.602,2	0,0	15,5	0,0	18.251,3
13	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (760)	21.589,3	0,0	16,0	0,0	18.143,6
14	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (761)	21.556,3	0,0	16,0	0,0	18.099,7
15	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (762)	21.419,6	0,0	11,8	0,0	18.898,5
	PARK	323.867,9	0,0	15,6	0,0	273.445,3

Loss&Uncertainty - Noise

Calculation: VKA1 (Schaduw_en_geluid)

Noise reduced mode is achieved by less aggressive pitching or reduction of maximum power. In both cases this results in less power production. There might also be situations where the turbine is fully stopped for fulfilling special noise requirements

Assumptions:

WTG(s)	Time From	To	Calculated power curve	Curtailed power curve
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (753)	23:00	07:00	Level 0 - official - 0 s- 4200kW - 04/2016	Level 1 - official - I s- 4000kW - 04/2016
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (758)	23:00	07:00	Level 0 - official - 0 s- 4200kW - 04/2016	Level 2 - official - II s- 3800kW - 04/2016

Time series used in calculation
Name: Lauwersoog_KNMI_1991_2016.10,00m -
From: 18-3-1991 1:00:00
To: 2-1-2017 23:00:00
Period: 310 months
Time step: 60 minutes
The period used is calibrated to calculate annual loss

Result

Calculated AEP before loss:	323.867,9 MWh/y
Calculated loss:	673,4 MWh/y
Calculated AEP after loss:	323.194,5 MWh/y
Percent loss:	0,21 %

Result

WTG	Calculated AEP GROSS [MWh]	Loss [MWh]	Percent of AEP [%]
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (748)	21.715,7	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (749)	21.753,8	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (750)	21.756,2	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (751)	21.692,8	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (752)	21.478,8	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (753)	21.497,2	213,5	0,99
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (754)	21.547,7	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (755)	21.530,9	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (756)	21.560,9	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (757)	21.574,7	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (758)	21.591,9	459,9	2,13
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (759)	21.602,2	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (760)	21.589,3	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (761)	21.556,3	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (762)	21.419,6	0,0	0,00
TOTAL	323.867,9	673,4	0,21

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Calculated:
16-3-2017 13:19/3.1.597

Loss&Uncertainty - Flicker

Calculation: VKA1 (Schaduw_en_geluid)

Calculated losses due to shadow (flicker) loss.

Used SHADOW calculation: 3.1.597: VKA 1 schaduw

Assumptions:
Advanced stop (light sensors etc. included). Reduced to: 30 % AEP reduction relative to worst case.

Result

WTG	Calculated AEP GROSS [MWh]	Loss [MWh]	Percent of AEP [%]
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (748)	21.715,7	34,8	0,16
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (749)	21.753,8	35,6	0,16
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (750)	21.756,2	13,7	0,06
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (751)	21.692,8	3,5	0,02
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (752)	21.478,8	167,9	0,78
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (753)	21.497,2	94,2	0,44
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (754)	21.547,7	47,4	0,22
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (755)	21.530,9	54,5	0,25
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (756)	21.560,9	22,3	0,10
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (757)	21.574,7	57,9	0,27
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (758)	21.591,9	85,7	0,40
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (759)	21.602,2	99,9	0,46
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (760)	21.589,3	56,3	0,26
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (761)	21.556,3	26,2	0,12
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (762)	21.419,6	126,0	0,59
TOTAL	323.867,9	925,9	0,29

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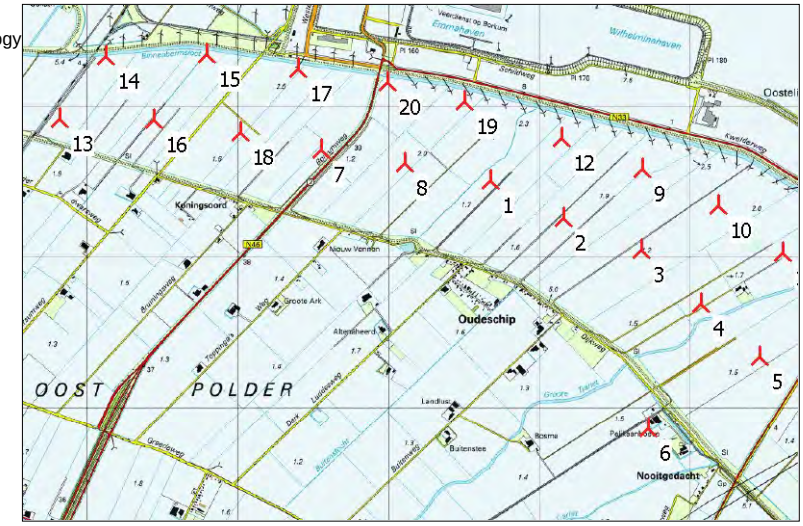
Loss&Uncertainty - Main result

Calculation: VKA 2 (Schaduw_en_geluid)

Main data for PARK

PARK calculation 3.1.597: WP Oostpolder VKA 2 (met aangepaste innogy

Count	20
Rated power	84,0 MW
Mean wind speed	9,2 m/s at hub height
Sensitivity	1,1 %AEP / %Mean Wind Speed
Expected lifetime	20 Years



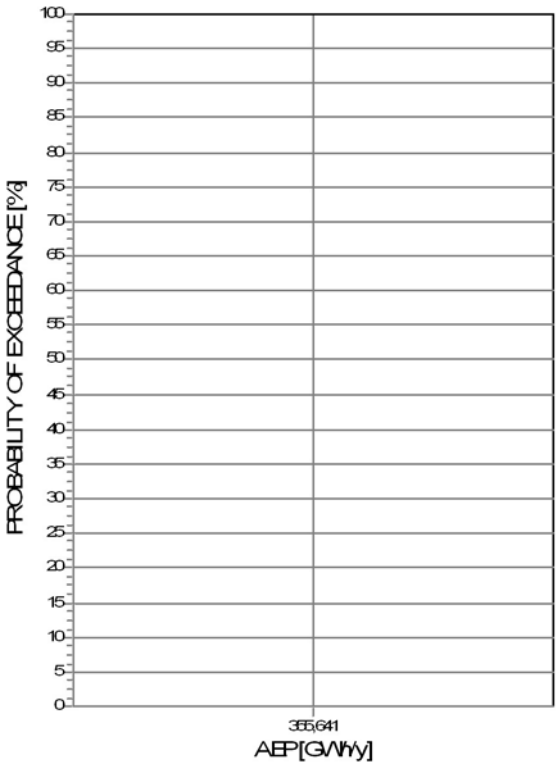
Scale: 50.000

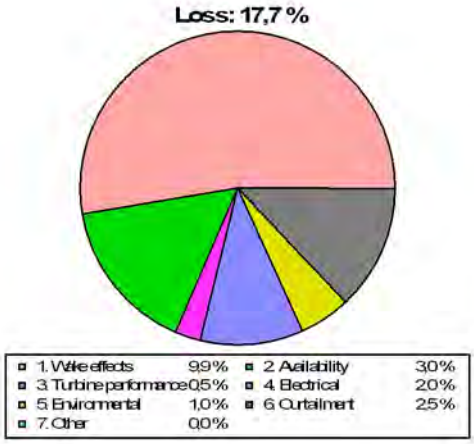
RESULTS

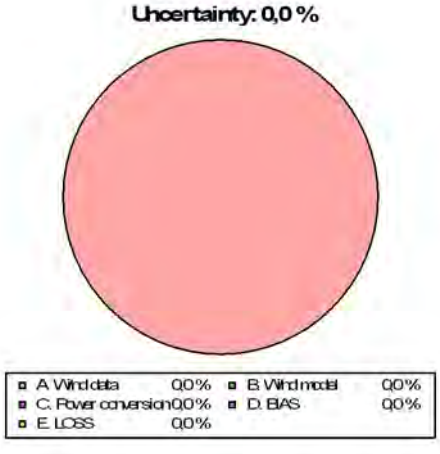
		P50
NET AEP	[GWh/y]	355,6
Capacity factor	[%]	48,3
Full load hours	[h/y]	4.234

Result details

	P50		Uncertainty
GROSS AEP *)	432,4 GWh/y		0,0 %
Bias correction	0,0 GWh/y	0,0 %	0,0 %
Loss correction	-76,7 GWh/y	-17,7 %	0,0 %
Wake loss		-9,9 %	
Other losses		-8,7 %	
NET AEP	355,6 GWh/y		0,0 %







*) Calculated Annual Energy Production before any bias or loss corrections
Assumptions: Uncertainty and percentiles (PXX values) are calculated for the expected lifetime

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Loss&Uncertainty - Assumptions and results

Calculation: VKA 2 (Schaduw_en_geluid)

ASSUMPTIONS

LOSS

		Method *)	Loss [%]	Loss [GWh/y]	Std dev**) [%]	Comment
1.	Wake effects					
	Wake effects, all WTGs	Calculation	9,9	43,0	0,0	Berekend
2.	Availability					
	Turbine availability	Estimate	3,0	13,0	0,0	Schatting
3.	Turbine performance					
	High wind hysteresis	Estimate	0,5	2,2	0,0	Schatting
4.	Electrical					
	Electrical losses	Estimate	2,0	8,6	0,0	Schatting
5.	Environmental					
	Performance degradation not due to icing	Estimate	0,5	2,2	0,0	Schatting
	Performance degradation due to icing	Estimate	0,5	2,2	0,0	Schatting
6.	Curtailment					
	Noise	Calculation	2,2	9,4	0,0	Berekend
	Flicker	Calculation	0,3	1,2	0,0	Berekend
7.	Other					No input
	LOSS, total		17,7	76,7	0,0	

UNCERTAINTY

		Method *)	Std dev, wind speed [%]	Std dev, AEP [%]	Comment
A.	Wind data				
	Wind measurement/Wind data				
	Long term correction				
	Year-to-year variability				
	Future climate				
	Other wind related				
B.	Wind model				
	Vertical extrapolation				
	Horizontal extrapolation				
	Other wind model related				
C.	Power conversion				
	Power curve uncertainty				
	Metering uncertainty				
	Other AEP related uncertainties				
D.	BIAS, total uncertainty			0,0	
E.	LOSS, total uncertainty			0,0	
	UNCERTAINTY, total (1y average)			0,0	
	UNCERTAINTY, total (20y average)			0,0	

VARIABILITY

Years	Variability (std dev) [%]	Total std dev [%]
1	0,00	0,0
5	0,00	0,0
10	0,00	0,0
20	0,00	0,0

RESULTS

AEP versus exceedance level / time horizon

PXX [%]	1 y [MWh/y]	5 y [MWh/y]	10 y [MWh/y]	20 y [MWh/y]
50	355.641	355.641	355.641	355.641
75	355.641	355.641	355.641	355.641
84	355.641	355.641	355.641	355.641
90	355.641	355.641	355.641	355.641
95	355.641	355.641	355.641	355.641

*) Calculation means that a calculation method available in the windPRO software is used. This still typically involve a user judgement and user data where the quality of those decides the accuracy. If calculation method is used, the values will often be different from turbine to turbine, here the average is shown, but at page "WTG results" the individual turbine results are shown.
**) For totals the std dev refers to the full AEP, otherwise std dev refers to the bias or loss component which is a fraction of the total AEP.

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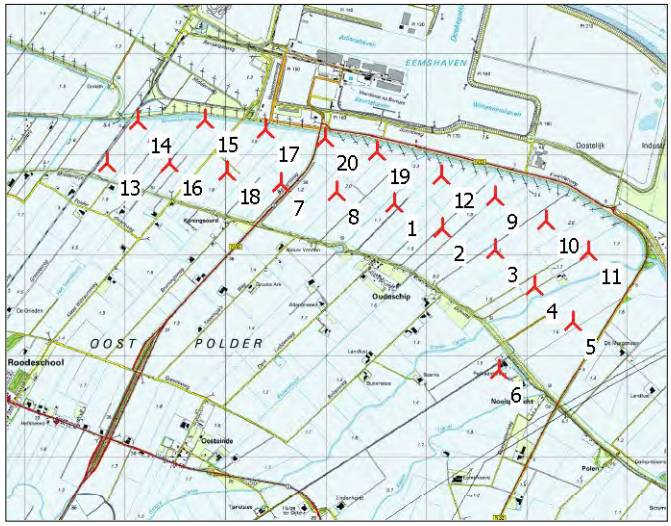
Loss&Uncertainty - WTG results

Calculation: VKA 2 (Schaduw_en_geluid)

Main data for PARK

PARK calculation 3.1.597: WP Oostpolder VKA 2 (met aangepaste innogy opstelling)

Count	20
Rated power	84,0 MW
Mean wind speed	9,2 m/s at hub height
Sensitivity	1,1 %AEP / %Mean Wind Speed
Expected lifetime	20 Years



Scale: 75.000

Expected AEP per WTG including bias, loss and uncertainty evaluation

	Description	Calculated GROSS*) [MWh/y]	Bias [%]	Loss [%]	20 years averaging Unc. [%]	P50 [MWh/y]
1	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (644)	21.610,0	0,0	16,6	0,0	18.018,6
2	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (645)	21.594,5	0,0	16,8	0,0	17.958,9
3	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (646)	21.630,9	0,0	15,6	0,0	18.264,9
4	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (647)	21.589,3	0,0	15,6	0,0	18.214,9
5	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (648)	21.566,5	0,0	16,0	0,0	18.112,2
6	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (649)	21.419,6	0,0	11,6	0,0	18.934,9
7	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (650)	21.535,7	0,0	15,5	0,0	18.192,5
8	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (651)	21.573,3	0,0	15,8	0,0	18.156,5
9	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (652)	21.752,1	0,0	18,3	0,0	17.770,5
10	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (653)	21.763,1	0,0	18,9	0,0	17.640,5
11	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (654)	21.750,9	0,0	18,1	0,0	17.815,4
12	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (655)	21.739,8	0,0	18,0	0,0	17.831,6
13	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (656)	21.450,3	0,0	12,2	0,0	18.833,9
14	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (657)	21.558,0	0,0	15,1	0,0	18.307,1
15	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (658)	21.646,4	0,0	16,8	0,0	18.016,2
16	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (659)	21.473,2	0,0	32,6	0,0	14.475,0
17	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (660)	21.695,8	0,0	17,4	0,0	17.927,8
18	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (661)	21.533,2	0,0	29,1	0,0	15.269,7
19	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (662)	21.752,2	0,0	18,0	0,0	17.840,4
20	ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (663)	21.726,6	0,0	17,6	0,0	17.893,4
	PARK	432.361,5	0,0	17,7	0,0	355.641,4

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Loss&Uncertainty - Noise

Calculation: VKA 2 (Schaduw_en_geluid)

Noise reduced mode is achieved by less aggressive pitching or reduction of maximum power. In both cases this results in less power production. There might also be situations where the turbine is fully stopped for fulfilling special noise requirements

Assumptions:

WTG(s)	Time From	To	Calculated power curve	Curtailed power curve
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (644)	23:00	07:00	Level 0 - official - 0 s- 4200kW - 04/2016	Level 1 - official - I s- 4000kW - 04/2016
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (645)	23:00	07:00	Level 0 - official - 0 s- 4200kW - 04/2016	Level 2 - official - II s- 3800kW - 04/2016
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (650)	23:00	07:00	Level 0 - official - 0 s- 4200kW - 04/2016	Level 1 - official - I s- 4000kW - 04/2016
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (651)	23:00	07:00	Level 0 - official - 0 s- 4200kW - 04/2016	Level 1 - official - I s- 4000kW - 04/2016
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (659)	23:00	07:00	Level 0 - official - 0 s- 4200kW - 04/2016	Level 9 - official - 500kW - 04/2016
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (661)	23:00	07:00	Level 0 - official - 0 s- 4200kW - 04/2016	Level 8 - official - 1000kW - 04/2016

Time series used in calculation
Name: Lauwersoog_KNMI_1991_2016.10,00m -
From: 18-3-1991 1:00:00
To: 2-1-2017 23:00:00
Period: 310 months
Time step: 60 minutes
The period used is calibrated to calculate annual loss

Result

Calculated AEP before loss:	432.361,5 MWh/y
Calculated loss:	9.409,0 MWh/y
Calculated AEP after loss:	422.952,5 MWh/y
Percent loss:	2,18 %

Result

WTG	Calculated AEP GROSS [MWh]	Loss [MWh]	Percent of AEP [%]
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (644)	21.610,0	215,0	1,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (645)	21.594,5	460,0	2,13
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (646)	21.630,9	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (647)	21.589,3	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (648)	21.566,5	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (649)	21.419,6	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (650)	21.535,7	213,9	0,99
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (651)	21.573,3	214,5	0,99
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (652)	21.752,1	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (653)	21.763,1	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (654)	21.750,9	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (655)	21.739,8	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (656)	21.450,3	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (657)	21.558,0	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (658)	21.646,4	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (659)	21.473,2	4.631,4	21,57
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (660)	21.695,8	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (661)	21.533,2	3.674,1	17,06
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (662)	21.752,2	0,0	0,00
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (663)	21.726,6	0,0	0,00
TOTAL	432.361,5	9.409,0	2,18

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Loss&Uncertainty - Flicker

Calculation: VKA 2 (Schaduw_en_geluid)

Calculated losses due to shadow (flicker) loss.

Used SHADOW calculation: 3.1.597: VKA 2 schaduw

Assumptions:
Advanced stop (light sensors etc. included). Reduced to: 30 % AEP reduction relative to worst case.

Result

WTG	Calculated AEP GROSS [MWh]	Loss [MWh]	Percent of AEP [%]
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (644)	21.610,0	52,0	0,24
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (645)	21.594,5	84,3	0,39
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (646)	21.630,9	92,7	0,43
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (647)	21.589,3	56,2	0,26
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (648)	21.566,5	22,8	0,11
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (649)	21.419,6	126,0	0,59
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (650)	21.535,7	58,0	0,27
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (651)	21.573,3	26,5	0,12
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (652)	21.752,1	29,0	0,13
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (653)	21.763,1	34,4	0,16
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (654)	21.750,9	14,3	0,07
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (655)	21.739,8	14,6	0,07
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (656)	21.450,3	220,3	1,03
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (657)	21.558,0	141,2	0,65
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (658)	21.646,4	41,7	0,19
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (659)	21.473,2	121,1	0,56
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (660)	21.695,8	13,1	0,06
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (661)	21.533,2	60,9	0,28
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (662)	21.752,2	8,9	0,04
ENERCON E-141 EP4 4200 141.0 !-! hub: 165,0 m (TOT: 235,5 m) (663)	21.726,6	16,9	0,08
TOTAL	432.361,5	1.235,0	0,29