

PARK - Main Result

Calculation: Opbrenstberekening Variant 1a

Wake Model N.O. Jensen (RISØ/EMD)

Calculation Settings
Air density calculation mode Individual per WTG
Result for WTG at hub altitude 1,234 kg/m³ to 1,234 kg/m³
Air density relative to standard 100,7 % to 100,7 %
Hub altitude above sea level (asl) 102,2 m to 103,9 m
Annual mean temperature at hub alt. 9,4 °C to 9,4 °C
Pressure at WTGs 1.000,6 hPa to 1.000,8 hPa

Wake Model Parameters
Terrain type Wake decay constant
HH: 100m Mixed farmland 0,065

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 data
Wind statistics Weight
[%]
NL Eindhoven, 1970-76.wws 72
NL Schiphol, 1970-76.wws 28

WASP version WASP 11 Version 11.04.0026

Key results for height 90,0 m above ground level

Terrain Dutch Stereo-RD/NAP 2008

X (east) Y (north) Name of wind distribution Type

					Wind energy [kWh/m ²]	Mean wind speed [m/s]	Equivalent roughness
A	161.498	415.521	Site data: WASP (3)	WASP (WASP 11 Version 11.04.0026)	3.032	7,0	1,9



New WTG

Scale 1:20.000
Site Data

Calculated Annual Energy for Wind Farm

WTG combination	Result PARK [MWh/y]	Result-10,0% [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Park efficiency [%]	Specific results ^{a)}			
					Capacity factor [%]	Mean WTG result [MWh/y]	Full load hours [Hours/year]	Mean wind speed @hub height [m/s]
Wind farm	24.864,8	22.378,3	25.867,0	96,1	33,8	7.459,4	2.960	7,2

^{a)} Based on Result-10,0%

Calculated Annual Energy for each of 3 new WTGs with total 7,6 MW rated power

Links	WTG type		Type-generator	Power, rated	Rotor diameter	Hub height	Power curve		Annual Energy		Park Efficiency [%]	Free mean wind speed [m/s]
	Valid	Manufact.					Creator	Name	Result	Result-10,0%		
1 A	Yes	LAGERWEY	L100-2.5MW-2.520	[kW]	[m]	[m]	EMD	Level 0 - - Standard mode - 04-2013	[MWh]	[MWh]	[%]	[m/s]
2 A	Yes	LAGERWEY	L100-2.5MW-2.520	2.520	100,0	98,0	EMD	Level 0 - - Standard mode - 04-2013	8.411,6	7.570	97,62	7,16
3 A	Yes	LAGERWEY	L100-2.5MW-2.520	2.520	100,0	98,0	EMD	Level 0 - - Standard mode - 04-2013	8.166,6	7.350	95,01	7,16
									8.286,6	7.458	95,74	7,18

WTG siting

Dutch Stereo-RD/NAP 2008

X (east) Y (north) Z Row data/Description
[m]

1 New	160.856	414.759	4,2	LAGERWEY L100-2.5MW	2520	100,0	!O! hub: 98,0 m (TOT: 148,0 m) (3)
2 New	161.270	414.908	4,3	LAGERWEY L100-2.5MW	2520	100,0	!O! hub: 98,0 m (TOT: 148,0 m) (4)
3 New	161.700	415.065	5,9	LAGERWEY L100-2.5MW	2520	100,0	!O! hub: 98,0 m (TOT: 148,0 m) (5)

PARK - Main Result

Calculation: Opbrenstberekening Variant 1b

Wake Model N.O. Jensen (RISØ/EMD)

Calculation Settings
 Air density calculation mode Individual per WTG
 Result for WTG at hub altitude 1,230 kg/m³ to 1,230 kg/m³
 Air density relative to standard 100,4 % to 100,4 %
 Hub altitude above sea level (asl) 138,2 m to 139,9 m
 Annual mean temperature at hub alt. 9,1 °C to 9,1 °C
 Pressure at WTGs 996,3 hPa to 996,5 hPa

Wake Model Parameters
 Terrain type Wake decay constant
 HH:150m Mixed farmland 0,059

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 data
 Wind statistics Weight
 [%]
 NL Eindhoven, 1970-76.wws 72
 NL Schiphol, 1970-76.wws 28

WASP version WASP 11 Version 11.04.0026

Key results for height 134,0 m above ground level

Terrain Dutch Stereo-RD/NAP 2008

X (east) Y (north) Name of wind distribution Type

					Wind energy [kWh/m ²]	Mean wind speed [m/s]	Equivalent roughness
A	161.498	415.521	Site data: WASP (3)	WASP (WASP 11 Version 11.04.0026)	4.308	7,9	1,9



New WTG

Scale 1:20.000
Site Data

Calculated Annual Energy for Wind Farm

WTG combination	Result PARK [MWh/y]	Result-10,0% [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Park efficiency [%]	Specific results ^{a)}			
					Capacity factor [%]	Mean WTG result [MWh/y]	Full load hours [Hours/year]	Mean wind speed @hub height [m/s]
Wind farm	43.978,6	39.580,8	45.993,4	95,6	45,6	13.193,6	3.998	7,9

^{a)} Based on Result-10,0%

Calculated Annual Energy for each of 3 new WTGs with total 9,9 MW rated power

Links	WTG type		Power, rated	Rotor diameter	Hub height	Power curve Creator Name	Annual Energy		Park Efficiency	Free mean wind speed	
	Valid	Manufact.					Type-generator	Result			Result-10,0%
1 A	Yes	NORDEX	N131/3300 DE-3.300	3.300	131,0	134,0	EMD Level 0 - official - 3300 kW - 07/2015	14.867,8	13.381	96,95	7,89
2 A	Yes	NORDEX	N131/3300 DE-3.300	3.300	131,0	134,0	EMD Level 0 - official - 3300 kW - 07/2015	14.470,5	13.023	94,51	7,89
3 A	Yes	NORDEX	N131/3300 DE-3.300	3.300	131,0	134,0	EMD Level 0 - official - 3300 kW - 07/2015	14.640,4	13.176	95,39	7,91

WTG siting

Dutch Stereo-RD/NAP 2008

X (east) Y (north) Z Row data/Description
[m]

1 New	160.856	414.759	4,2	NORDEX N131/3300 DE 3300	131,0	!-!	hub: 134,0 m (TOT: 199,5 m) (10)
2 New	161.270	414.908	4,3	NORDEX N131/3300 DE 3300	131,0	!-!	hub: 134,0 m (TOT: 199,5 m) (11)
3 New	161.700	415.065	5,9	NORDEX N131/3300 DE 3300	131,0	!-!	hub: 134,0 m (TOT: 199,5 m) (12)

PARK - Main Result

Calculation: Opbrenstberekening Variant 2a

Wake Model N.O. Jensen (RISØ/EMD)

Calculation Settings
 Air density calculation mode Individual per WTG
 Result for WTG at hub altitude 1,234 kg/m³ to 1,234 kg/m³
 Air density relative to standard 100,7 % to 100,7 %
 Hub altitude above sea level (asl) 102,0 m to 103,4 m
 Annual mean temperature at hub alt. 9,4 °C to 9,4 °C
 Pressure at WTGs 1.000,7 hPa to 1.000,8 hPa

Wake Model Parameters
 Terrain type Wake decay constant
 HH: 100m Mixed farmland 0,065

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 data
 Wind statistics Weight [%]
 NL Eindhoven, 1970-76.wws 72
 NL Schiphol, 1970-76.wws 28

WASP version WASP 11 Version 11.04.0026

Key results for height 90,0 m above ground level

Terrain Dutch Stereo-RD/NAP 2008

X (east) Y (north) Name of wind distribution Type

				Wind energy [kWh/m ²]	Mean wind speed [m/s]	Equivalent roughness
A	161.498	415.521	Site data: WASP (3)	3.032	7,0	1,9



New WTG

Scale 1:12.500
Site Data

Calculated Annual Energy for Wind Farm

WTG combination	Result [MWh/y]	Result-10,0% [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Park efficiency [%]	Specific results ^{a)}			
					Capacity factor [%]	Mean WTG result [MWh/y]	Full load hours [Hours/year]	Mean wind speed @hub height [m/s]
Wind farm	24.992,7	22.493,4	25.860,3	96,6	33,9	7.497,8	2.975	7,2

^{a)} Based on Result-10,0%

Calculated Annual Energy for each of 3 new WTGs with total 7,6 MW rated power

Links	WTG type		Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Power curve Creator	Name	Annual Energy		Park Efficiency [%]	Free mean wind speed [m/s]
	Valid	Manufact.							Result [MWh]	Result-10,0% [MWh]		
1 A	Yes	LAGERWEY	L100-2.5MW-2.520	2.520	100,0	98,0	EMD	Level 0 - - Standard mode - 04-2013	8.471,8	7.625	98,05	7,17
2 A	Yes	LAGERWEY	L100-2.5MW-2.520	2.520	100,0	98,0	EMD	Level 0 - - Standard mode - 04-2013	8.252,9	7.428	95,65	7,17
3 A	Yes	LAGERWEY	L100-2.5MW-2.520	2.520	100,0	98,0	EMD	Level 0 - - Standard mode - 04-2013	8.268,0	7.441	96,24	7,16

WTG siting

Dutch Stereo-RD/NAP 2008

X (east) Y (north) Z Row data/Description [m]

1 New	160.743	414.963	5,4	LAGERWEY L100-2.5MW 2520 100.0	!O!	hub: 98,0 m (TOT: 148,0 m) (7)
2 New	161.217	415.172	5,2	LAGERWEY L100-2.5MW 2520 100.0	!O!	hub: 98,0 m (TOT: 148,0 m) (8)
3 New	161.663	415.413	4,0	LAGERWEY L100-2.5MW 2520 100.0	!O!	hub: 98,0 m (TOT: 148,0 m) (9)

PARK - Main Result

Calculation: Opbrenstberekening Variant 2b

Wake Model N.O. Jensen (RISØ/EMD)

Calculation Settings
Air density calculation mode Individual per WTG
Result for WTG at hub altitude 1,230 kg/m³ to 1,230 kg/m³
Air density relative to standard 100,4 % to 100,4 %
Hub altitude above sea level (asl) 138,0 m to 139,4 m
Annual mean temperature at hub alt. 9,1 °C to 9,1 °C
Pressure at WTGs 996,3 hPa to 996,5 hPa

Wake Model Parameters
Terrain type Wake decay constant
User defined 0,075

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 data
Wind statistics Weight
[%]
NL Eindhoven, 1970-76.wws 72
NL Schiphol, 1970-76.wws 28

WASP version WASP 11 Version 11.04.0026

Key results for height 134,0 m above ground level

Terrain Dutch Stereo-RD/NAP 2008

X (east) Y (north) Name of wind distribution Type

A 161.498 415.521 Site data: WASP (3)

WASP (WASP 11 Version 11.04.0026)

Wind energy
[kWh/m²]
4.308

Mean wind speed
[m/s]
7,9

Equivalent roughness
1,9



New WTG

Scale 1:12.500
Site Data

Calculated Annual Energy for Wind Farm

WTG combination	Result PARK [MWh/y]	Result-10,0% [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Park efficiency [%]	Specific results ^{a)}			
					Capacity factor [%]	Mean WTG result [MWh/y]	Full load hours [Hours/year]	Mean wind speed @hub height [m/s]
Wind farm	44.354,6	39.919,1	45.993,8	96,4	46,0	13.306,4	4.032	7,9

^{a)} Based on Result-10,0%

Calculated Annual Energy for each of 3 new WTGs with total 9,9 MW rated power

Links	WTG type		Type-generator	Power, rated	Rotor diameter	Hub height	Power curve Creator Name	Annual Energy		Park Efficiency	Free mean wind speed
	Valid	Manufact.						Result	Result-10,0%		
1 A	Yes	NORDEX	N131/3300 DE-3.300	3.300	131,0	134,0	EMD Level 0 - official - 3300 kW - 07/2015	15.003,1	13.503	97,64	7,90
2 A	Yes	NORDEX	N131/3300 DE-3.300	3.300	131,0	134,0	EMD Level 0 - official - 3300 kW - 07/2015	14.643,5	13.179	95,45	7,90
3 A	Yes	NORDEX	N131/3300 DE-3.300	3.300	131,0	134,0	EMD Level 0 - official - 3300 kW - 07/2015	14.707,9	13.237	96,21	7,89

WTG siting

Dutch Stereo-RD/NAP 2008

X (east) Y (north) Z Row data/Description
[m]

1 New	160.743	414.963	5,4	NORDEX N131/3300 DE 3300	131,0	!-!	hub: 134,0 m (TOT: 199,5 m) (13)
2 New	161.217	415.172	5,2	NORDEX N131/3300 DE 3300	131,0	!-!	hub: 134,0 m (TOT: 199,5 m) (14)
3 New	161.663	415.413	4,0	NORDEX N131/3300 DE 3300	131,0	!-!	hub: 134,0 m (TOT: 199,5 m) (15)