



# Supplementary Information for Planning Applications

## Gaia-Wind 11 kW

## Table of Contents

<b>Turbine Design and Use</b>	<b>3</b>
<b>Greenhouse Gas Offsetting</b>	<b>3</b>
<b>Key Considerations for a Small Wind Turbine</b>	<b>4</b>
<b>Gaia-Wind 11 kW Turbine Footprint</b>	<b>5</b>
<b>Visual Presentation of Turbine</b>	<b>6</b>
<b>Noise Data</b>	<b>6</b>
<b>Safety Features</b>	<b>7</b>
<b>Appendix - Technical Information and Pictures</b>	<b>8</b>





## Turbine Design and Use

The Gaia-Wind turbine is in the 'small wind turbine category' and has a peak rated output of 11kW. It produces an energy yield that is practical for supplying electricity to properties such as private houses, farms, offices, small businesses and public buildings where the primary goal is to reduce the amount of electricity imported rather than generate specifically for export to the grid.

The turbine has been developed according to 'Danish design'; the design basis for most of the large commercial turbines used today. Like its bigger relatives, it has a slow rotation speed (56 rpm) which is independent of the wind speed. It also incorporates many of the control and safety features from the large turbines.

The Gaia-Wind turbine is configured to give an optimal yield in moderate wind speed sites i.e. those with an 'annual average wind speed' in the range of 4.5-7.5 m/s. As such it complements the wind conditions found in many rural areas of mainland Britain.

The turbine is connected to the grid via the electricity meter at the property. The electricity provider replaces the standard meter for an import/export model allowing the turbine owner to export energy to the grid when there is a surplus.

## Greenhouse Gas Offsetting

Typically, the Gaia-Wind turbine will generate around 30,000 kWh of green electricity per year, offsetting around 17 tonnes of CO<sub>2</sub> emissions from existing energy generation. This is sufficient to bring the carbon footprint of the average four person household back to zero (household energy use + car + air travel)

## Key Considerations for a Small Wind Turbine

Small wind turbines are generally linked with a property and as such are rarely in 'prime wind' sites as sought by commercial power generators. Nevertheless, if care is taken with regard to selection and positioning, a small wind turbine can make a significant contribution to greenhouse gas reduction as well as being an economically attractive proposition for the owner.

The following rules of thumb apply:

- There should be no, or minimal, obstructions in the direction of the prevailing wind. For most sites in the UK the prevailing wind is South West.
- Obstacles such as buildings and trees degrade wind quality by producing turbulent zones in their vicinity. These can significantly reduce the output of a turbine. It is important, therefore to select a tower of sufficient height to allow the rotor to sit above any potentially turbulent zones.
- Wind speed tends to increase with height in most locations, a phenomenon known as wind shear. This variation in velocity with altitude is most dramatic near the surface. Further, the energy in wind is proportional to the cube of the wind speed. Consequently a small change in wind speed produces a much larger change in wind energy. For example: increasing the height of a turbine rotor, from 9m to 18m will increase the expected wind speeds by 10% and the expected power generated by 34%.
- Wind energy capture is related to the area swept by the rotor eg. a 6m radius rotor sweeps an area 4 times greater than a 3m rotor. Bigger rotors generate more power.

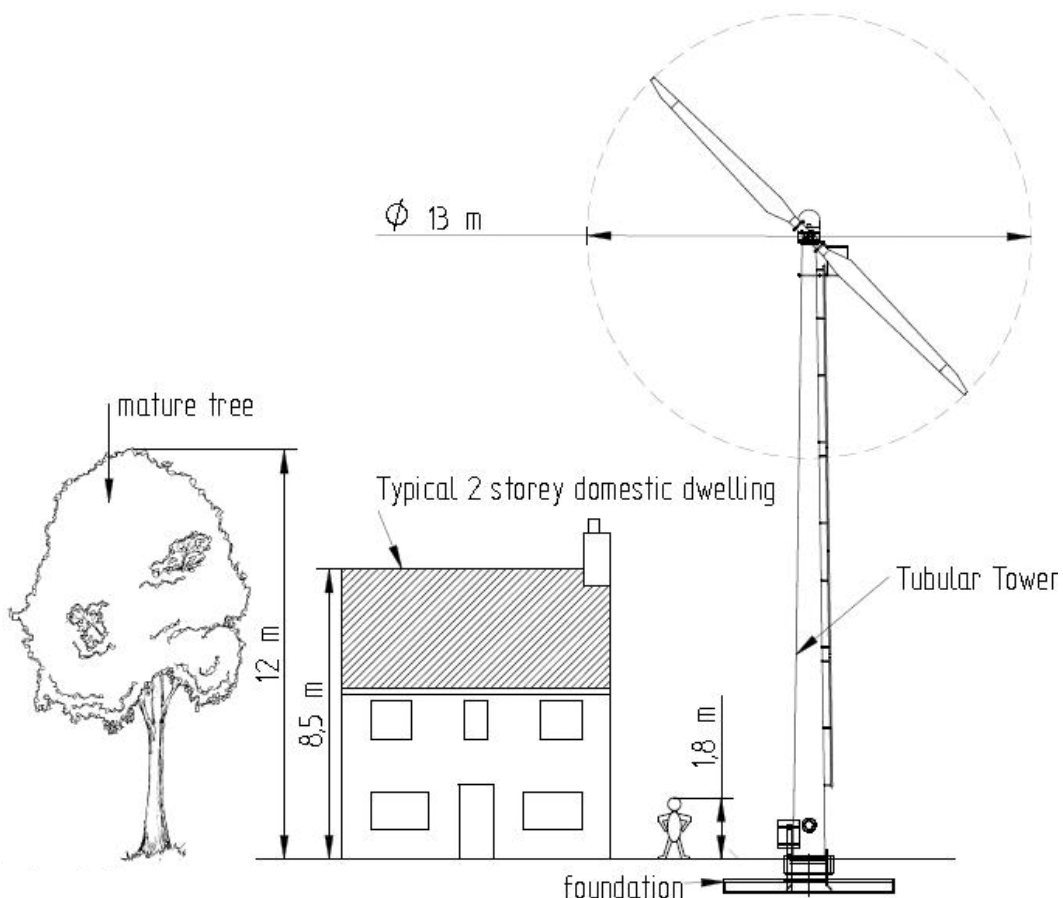
## Gaia-Wind 11 kW Turbine Footprint

**Assembly Height** - The turbine assembly is mounted on an 18m high tower. The hub of the rotor is at 18.3 m. The rotor is a twin blade design and is manufactured as a single composite unit 13m in diameter. When in the vertical position, the tip of the rotor extends to a height of 24.8m and the lowest point is 11.8m above the ground.

This is around 1/5th the height of a typical turbine found on a modern wind farm.

**Foundation** – The bottom of the tower is bolted onto a reinforced concrete base with dimensions 5 x 5 x 0.4m. This is set in a hole 1m deep with an 0.6m layer of hard packed earth on top.

**Cabling**- The turbine is connected to the building power supply at the main fuse box via an armoured cable buried at a depth of 0.75m.



## Visual Presentation of Turbine

*See technical information and pictures section*

### Comments

**Towers:** Constructed from galvanised steel in either a lattice or tubular form. The lattice form merges into backgrounds such as trees or hills. The tubular form compliments modern structures.

**Rotor:** Slow turning at nominal speed of 56 rpm (independent of wind speed). Light grey, reflection free fibreglass blades

## NOISE DATA

The table below gives indicative noise levels at various distances from the base of the turbine. The data is derived from independent measurements made at a site in Denmark .

*For full noise table see technical information and pictures section*

<b>Comparative Noise Levels</b>		
<b>Location</b>	<b>Noise dB(A)</b>	<b>Comparator</b>
tower base	56	conversational speech, 50-60 dB(A)
30m from tower	50	car at 100m driving at 40 mph, 55 dB(A)
60m from tower	45	living room, 40 dB(A)
100m from tower	40	rural night time background, 20-40dB(A)

In practice turbine noise is often masked by background noise such as wind, leaves rustling, traffic noise etc. Due to its constant and low rotational speed, the Gaia-Wind turbine is amongst the quietest in its class (the aerodynamic noise of a turbine increases exponentially with an increase in the rotational speed).

## Safety Features

The Gaia-Wind turbine has a number of safety features to ensure that the rotor speed and power generation are kept under control in all wind conditions. These exist as passive features built into the design or are actively initiated by the control system.

There are three levels of protection:

first level – passive :

- The aerodynamic design of the blades introduces a gradual stalling effect as wind speeds rise above 12 m/s. This limits power output.
- If for any reason the turbine is disconnected from the grid, a spring operated mechanical brake is released and the rotor is stopped.

Second Level – controller initiated:

- At wind speeds above 25 m/s (56 mph) the controller activates a mechanical brake. This stops the rotor turning. The brake is not released until wind speed drops consistently below 25 m/s.
- The controller will also activate the brake if an excessive vibration is detected, if the generator overheats or if there is a grid electrical fault.
- A manual override button on the controller can also be used to activate the braking mechanism

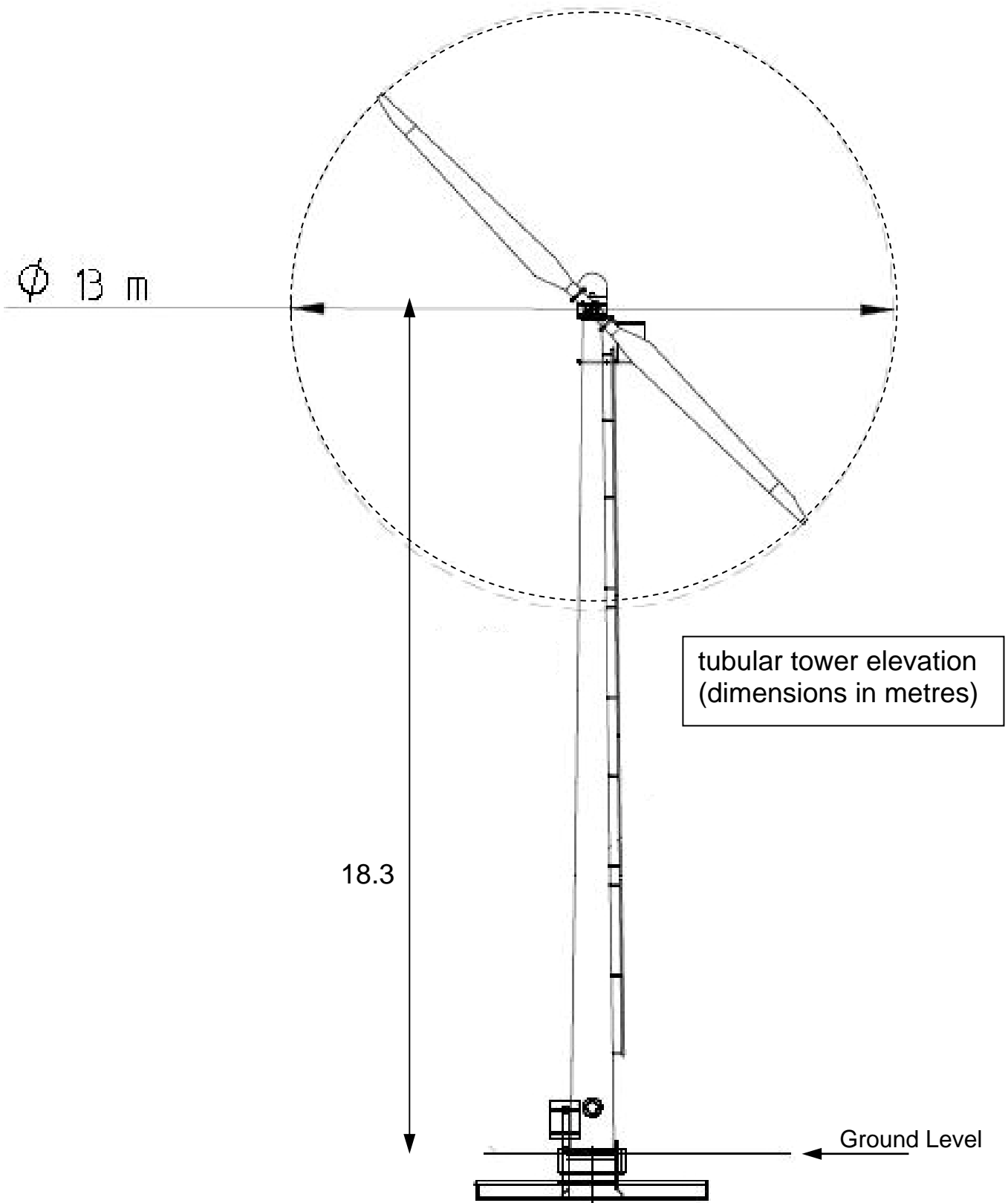
Third level – passive:

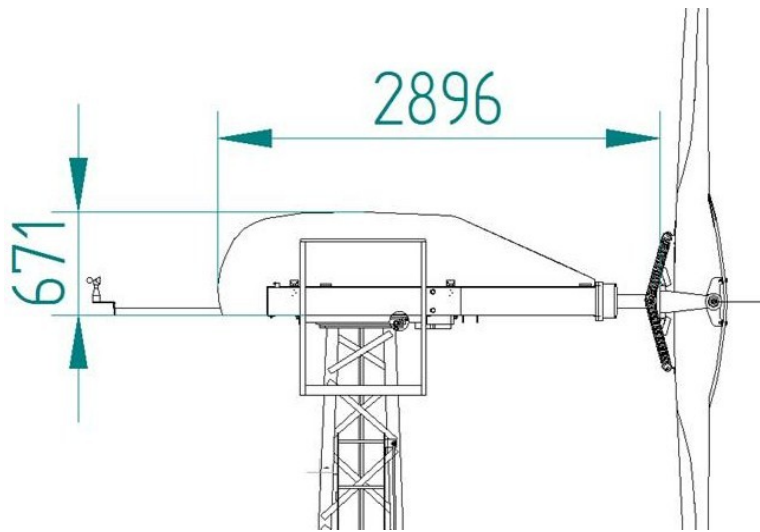
- In the extremely unlikely event that the first and second level safety mechanisms are insufficient or fail, centrifugally activated aerodynamic brakes, concealed in the rotor tips, release, spoiling the rotor aerodynamics and its subsequent ability to rotate.

# Appendix - Technical Information and Pictures

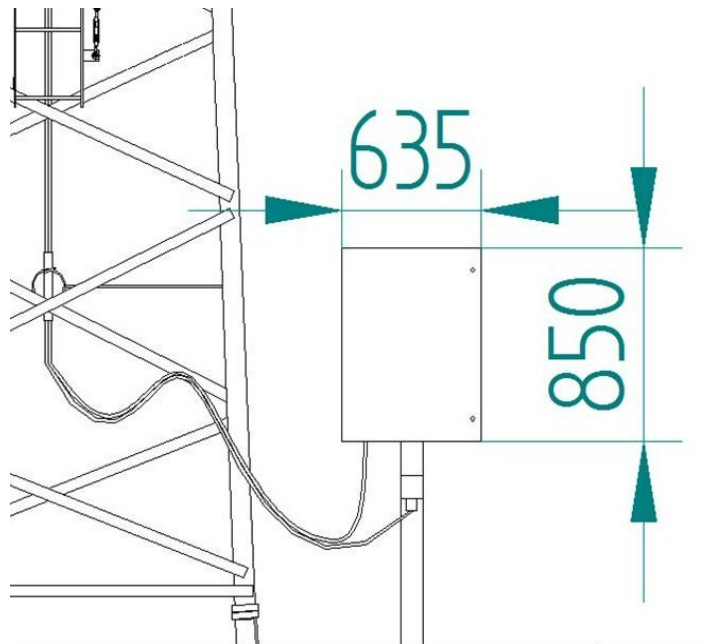
- Tower Elevation
- Nacelle and Control Box Schematic
- Control Box Pictures
- Pictures
- Noise Report
- Data Sheet








dimensions of the turbine nacelle (mm)



dimensions of the control box (mm)





**Gaia-Wind 11 kW**  
18m painted tower, light  
grey, reflection free rotor,  
standard buried foundation.

Installation of Gaia-Wind  
11kW turbine. 18m  
galvanised tower.  
Control box can be seen at  
tower base.



## **Noise emission of Gaia-Wind 11 kW turbine**

### **Noise emission report from Denmark**

The PDF file '031105\_Lydtrykskontrol\_m\_tabel.pdf' contains a summary of measurements and additional tables for transferring noise levels at the source (measurement) location to noise levels elsewhere.

The report is made by: 'Miljø- og levnedsmiddelkontrollen' dated 24-01-1996. It describes noise measurements for the Gaia-Wind 11 kW turbine, formerly known as 'K.M. Vindmøller Type Swinger T 202'. A translation of the document is given below (Danish to English).

### **TRANSLATION:**

#### **Commissioned by:**

K.M. Vindmøller, Anholtvej 3 A, 7000 Fredericia, Denmark.

#### **Subject:**

Measurement of the noise emission of the wind turbine at the address:  
Vester Søttrupvej 17, 9600 Aars, Denmark.

#### **Goal:**

To determine the sound level of the wind turbine manufactured by K.M. Vindmøller, Type Swinger T 202.

#### **Report nr.:**

M96-27.759.

#### **Consultant:**

Steen Holmgaard.

#### **Summary:**

On 20-01-06 between the hours of 12.00pm and 2.30pm measurements of the noise emission from the wind turbine at address: Vester Søttrupvej 17, 9600 Aars, was carried out. The sound level (source) of the wind turbine is:  $L_{WA.ref} = 89$  dB (A).

With reference to departmental order nr. 304 dated 14-05-91, the noise emission of the windmill in relation to a neighbour's outdoor sitting area in the open countryside must be no higher than 45 dB (A) and 40 dB(A) in a residential area.

For a maximum sound level of 40 dB (A) a distance of 108 meters has to be observed and for a maximum of 45 dB (A) a distance of 59 meters.

Signed by Lars Svendsen  
Veterinary Surgeon

Steen Holmgaard  
Environmental Technician

# Miljø- og levnedsmiddelkontrollen

Boghvedevej 34 • 8900 Randers  
Telefon 86 43 12 33 • Telefax 86 43 22 69

den 24.01.96

Rekvirent: K. M. Vindmøller  
Anholtvej 3 A  
7000 Fredericia

Vedr.: Måling af støjmissionen fra  
vindmølle på Vester Sættrupvej  
17, 9600 Års

Årsag: Bestemmelse af møllens kildestyrke på møllefabrikat  
K.M. Vindmøller Type Swinger T 202.

Journal nr.: M96-27.759

Sagsbehandler: Steen Holmgaard

## Sammendrag:

Der er den 20.01.96 kl. 12.00 - 14.30 foretaget en måling af støjmissionen fra vindmøllen på Vester Sættrupvej 17, 9600 Års.

Kildestyrken på vindmøllen er  $L_{wa,ref} = 89$  dB(A)

I henhold til bekendtgørelse nr. 304 af 14. maj 1991, må støjbelastningen fra vindmøllen ved udendørs opholdsarealer i umiddelbar tilknytning til nabo-beboelse i det åbne land, ikke overstige 45 dB(A) og i boligområder 40 dB(A).

Støjbelastningen på 40 dB(A) er overholdt i afstanden 108 meter og 45 dB(A) er overholdt i afstanden 59 meter.

  
Lars Sverrisen / Steen Holmgaard  
cyrlæge miljøtekniker

Sound pressure level for 11 kW Gaia turbine / hub height 18 m.

m.	dB(A)	m.	dB(A)	m.	dB(A)	m.	dB(A)	m.	dB(A)	m.	dB(A)	m.	dB(A)	m.	dB(A)	m.	dB(A)	m.	dB(A)	m.	dB(A)	m.	dB(A)	m.	dB(A)
1	55,99	26	51,04	51	46,27	76	42,96	101	40,46	126	38,47	151	36,80	176	35,36	201	34,09	226	32,96	251	31,93	276	30,98		
2	55,95	27	50,81	52	46,11	77	42,84	102	40,38	127	38,40	152	36,74	177	35,31	202	34,04	227	32,91	252	31,89	277	30,94		
3	55,88	28	50,59	53	45,96	78	42,73	103	40,29	128	38,32	153	36,68	178	35,25	203	34,00	228	32,87	253	31,85	278	30,91		
4	55,79	29	50,37	54	45,81	79	42,62	104	40,20	129	38,25	154	36,62	179	35,20	204	33,95	229	32,83	254	31,81	279	30,87		
5	55,68	30	50,15	55	45,66	80	42,51	105	40,12	130	38,18	155	36,55	180	35,15	205	33,90	230	32,79	255	31,77	280	30,84		
6	55,54	31	49,93	56	45,52	81	42,41	106	40,03	131	38,11	156	36,49	181	35,09	206	33,86	231	32,74	256	31,73	281	30,80		
7	55,39	32	49,72	57	45,37	82	42,30	107	39,95	132	38,04	157	36,44	182	35,04	207	33,81	232	32,70	257	31,69	282	30,76		
8	55,21	33	49,51	58	45,23	83	42,19	108	39,87	133	37,97	158	36,38	183	34,99	208	33,76	233	32,66	258	31,65	283	30,73		
9	55,02	34	49,31	59	45,09	84	42,09	109	39,78	134	37,90	159	36,32	184	34,94	209	33,72	234	32,62	259	31,61	284	30,69		
10	54,82	35	49,10	60	44,95	85	41,99	110	39,70	135	37,84	160	36,26	185	34,89	210	33,67	235	32,57	260	31,58	285	30,66		
11	54,61	36	48,90	61	44,81	86	41,88	111	39,62	136	37,77	161	36,20	186	34,83	211	33,62	236	32,53	261	31,54	286	30,62		
12	54,39	37	48,71	62	44,68	87	41,78	112	39,54	137	37,70	162	36,14	187	34,78	212	33,58	237	32,49	262	31,50	287	30,59		
13	54,16	38	48,51	63	44,54	88	41,68	113	39,46	138	37,63	163	36,08	188	34,73	213	33,53	238	32,45	263	31,46	288	30,55		
14	53,93	39	48,33	64	44,41	89	41,58	114	39,38	139	37,57	164	36,03	189	34,68	214	33,49	239	32,41	264	31,42	289	30,52		
15	53,69	40	48,14	65	44,28	90	41,49	115	39,30	140	37,50	165	35,97	190	34,63	215	33,44	240	32,37	265	31,39	290	30,48		
16	53,45	41	47,95	66	44,16	91	41,39	116	39,22	141	37,43	166	35,91	191	34,58	216	33,40	241	32,33	266	31,35	291	30,45		
17	53,20	42	47,77	67	44,03	92	41,29	117	39,14	142	37,37	167	35,86	192	34,53	217	33,35	242	32,29	267	31,31	292	30,41		
18	52,96	43	47,60	68	43,90	93	41,20	118	39,07	143	37,30	168	35,80	193	34,48	218	33,31	243	32,25	268	31,27	293	30,38		
19	52,71	44	47,42	69	43,78	94	41,10	119	38,99	144	37,24	169	35,74	194	34,43	219	33,26	244	32,21	269	31,24	294	30,34		
20	52,47	45	47,25	70	43,66	95	41,01	120	38,91	145	37,18	170	35,69	195	34,38	220	33,22	245	32,16	270	31,20	295	30,31		
21	52,23	46	47,08	71	43,54	96	40,92	121	38,84	146	37,11	171	35,63	196	34,33	221	33,17	246	32,12	271	31,16	296	30,28		
22	51,98	47	46,91	72	43,42	97	40,82	122	38,76	147	37,05	172	35,58	197	34,29	222	33,13	247	32,08	272	31,13	297	30,24		
23	51,74	48	46,75	73	43,30	98	40,73	123	38,69	148	36,99	173	35,52	198	34,24	223	33,09	248	32,04	273	31,09	298	30,21		
24	51,51	49	46,59	74	43,18	99	40,64	124	38,61	149	36,92	174	35,47	199	34,19	224	33,04	249	32,01	274	31,05	299	30,17		
25	51,27	50	46,43	75	43,07	100	40,55	125	38,54	150	36,86	175	35,41	200	34,14	225	33,00	250	31,97	275	31,02	300	30,14		

The Sound pressure level (dB(A)) for a specified distance (m) is calculated as follows:  $d = 30$  m. Distance from bottom of turbine to microphone

$h = 18$  m. Hub height

$l =$  distance to turbine

$\Delta l = \sqrt{l^2 + h^2}$  Air absorption

$\alpha_a = 0,005$  db/m Damping coefficient

$l_{pa}$  = Sound pressure level for a given distance

$l_{pa} = L_{WA,ref} - 10 \times \log(l^2 + h^2) - 8 \text{dB} - \Delta L_a$

Measuring performed by::

Miljo & Levnedsmiddelkontrollen

Boghvedevej 34

8900 Randers