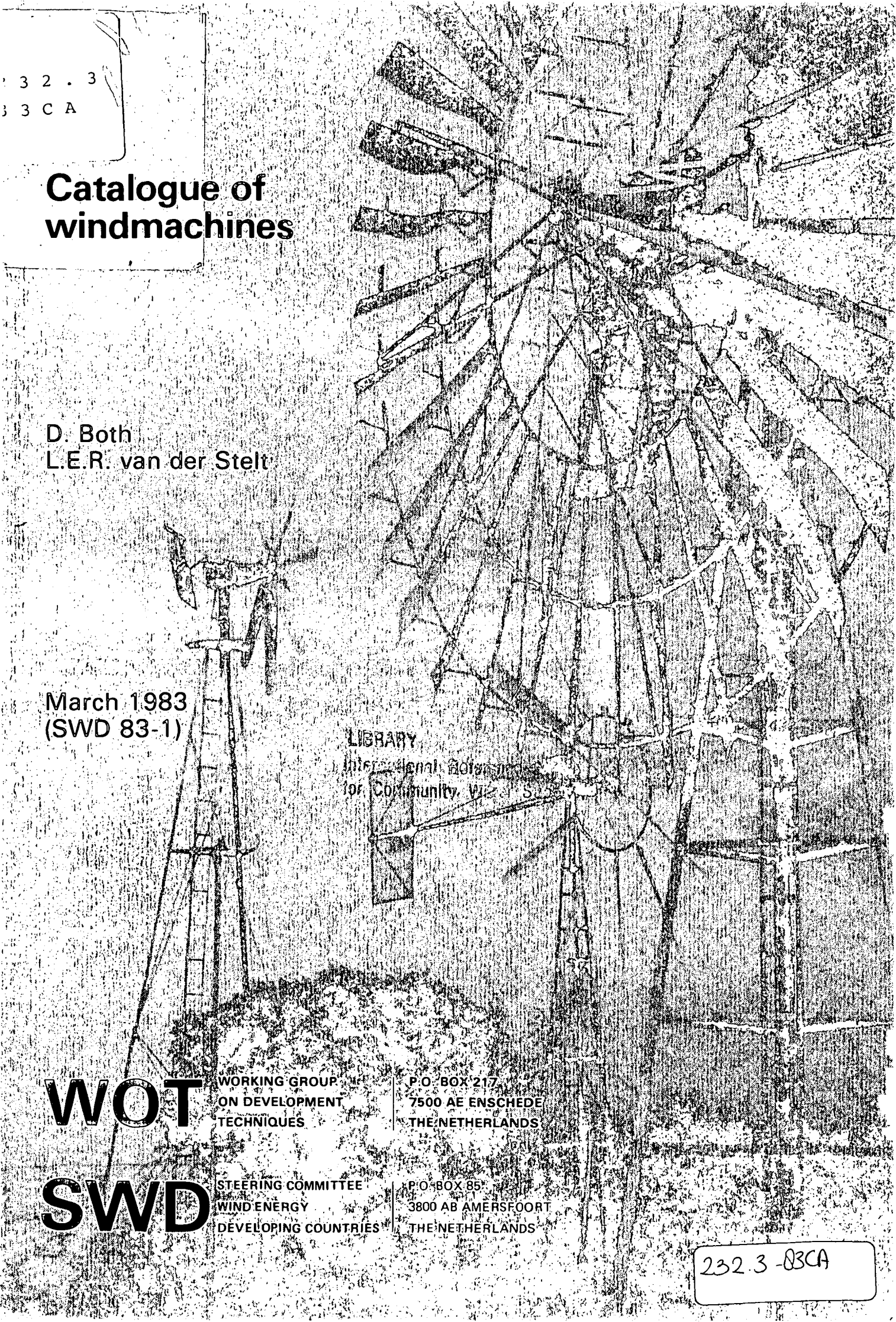
Catalogue of windmachines

D. Both
L.E.R. van der Stelt

March 1983
(SWD 83-1)



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This publication has been realized under the auspices of the Steering Committee Wind Energy Developing Countries, (SWD) by members of the Working Group on Development Techniques, WOT.

The WOT is a non-profit student volunteers organisation at the Twente University of Technology, trying to assist parties in Third World countries in their efforts to improve the situation of those groups, deprived of full opportunities for local, self-programmed and self-sustained development.
Activities of the WOT encompass wind energy, water supply and solar energy.

The SWD is financed by the Netherlands Ministry of Development Cooperation and is staffed by:
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the Twente University of Technology, and
DHV Consulting Engineers B.V., Amersfoort.

and collaborates with other interested parties.

The SWD tries to help governments, institutes and private parties in the Third World, with their efforts to use wind energy and in general to promote the interest for wind energy in Third World countries.

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1. INTRODUCTION

1.1. General

This catalogue is meant as a follow-up of the provisional catalogue issued by WOT and SWD in 1979. Since that edition seemed to fill a need, a second edition has been issued, based on manufacturers data supplied to us during the last few years. Since the market for windmills is evolving rapidly, also the supply of windmills is subject to rapid changes. Though it seems impossible to be up to date it is our intention to keep up with these changes to the extent possible. For this we need your cooperation. If users of this catalogue notice superseded or erroneous information please mention such to the editors. The same goes for manufacturers that are not yet included in this booklet.

The catalogue is meant to provide a first insight into the available windmill types and their main characteristics. We strongly advise you always to ask for more detailed information from suppliers before actually buying a windmill. A list of addresses of suppliers has been included in this catalogue. This list is far from exhaustive; per trademark basically only one supplier per country has been included, if any is known to us.

As stated, the catalogue is based on information supplied by manufacturers and dealers of windmills. This information has been included without judgement from our side. Editors and authors cannot take any responsibility for the correctness of the presented information, neither for consequences of the use of this catalogue.

The information sheets on the windmills are presented in alphabetical order according to the tradenames. Where relevant various types are included, the types being indicated on the top line of the sheets. Corresponding columns contain information on the same type.
Metrical units are used, but section 6 presents a number of conversion factors for units that are used in this catalogue. Prices are given in US-dollars and sometimes also in the currency of the suppliers' country. The prices are merely indicative, since not all suppliers indicate exactly what is included in the price, while prices may vary also per situation. Furthermore prices and currency conversion rates are liable to changes. In this catalogue currency rates of March 1983 are used.

1.2. Windmill performances

The actual useful output of a windmill in a specific situation depends on a number of items, the most important items being:
- the efficiency of the windmill system
- the size of the rotor
- the wind regime on the site
- load conditions

This section will show how to obtain an indication on the useful output of a windmill.
The overall efficiency of windmills mainly depends on the aerodynamic characteristics of the rotor, the mechanical efficiency and the matching of rotor characteristics to those of generator or pump. Though some differences occur in overall efficiencies, indications on the output

of windmill installations may be based on general assumptions.

The output increases with the area swept by the rotor i.e. with the square of the diameter (D) of the rotor. The number of blades has no significant influence on power output, but is relevant for other design characteristics, such as rotational speed, starting characteristics, etc.
The graphs on the useful output, presented furtheron, indicate the output per square meter of area swept by the rotor. Multiplying this by the total swept area 0.78 D^2 will give the useful output of a windmill.

The output of a windmill installation strongly depends on the windregime on the site and the matching of the windmill characteristics to this windregime. This catalogue presents information on the operating windspeeds and on the rated (and maximum) power.
The operating windspeeds indicate the range of windspeeds at which the windmill will produce useful energy. The windmill will start rotating at the socalled 'cut-in' windspeed, its power increasing with the windspeed upto the socalled 'rated' windspeed at which normally the maximum power output is obtained. At this windspeed for most windmills a kind of safety device will start working, limiting the output of the windmill. The windmill may still function above this windspeed upto the 'cut-out' windspeed, where the windmill will be stopped. The power that may be extracted at these high windspeeds, however, usually will be about equal to or less than the power at the rated windspeed, due to restrictive measures in the windmill to protect the same against damage. Only in some cases the power output may show a slight increase above the rated windspeed. For some windmills rated and cut-out windspeeds may coincide. Graphically a typical 'power' characteristic may be represented as in figure 1.

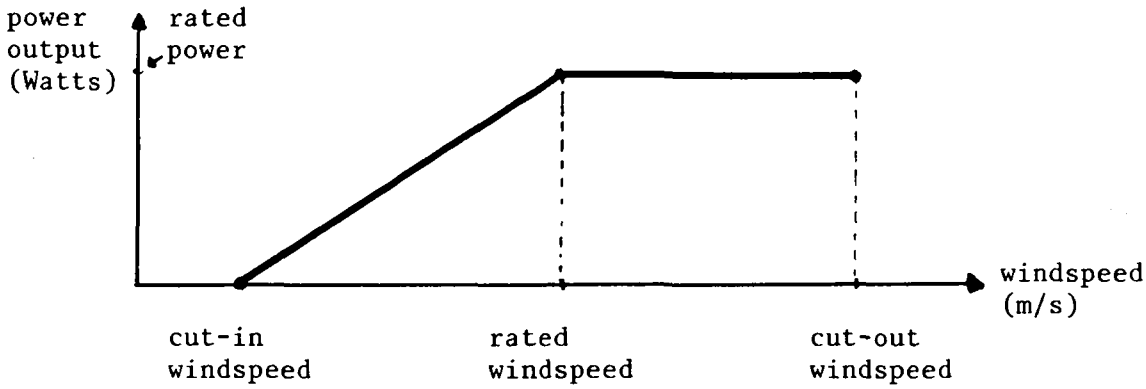


Figure 1: an example of a 'power'-characteristic of a windmill.

It is stressed that this graph is only an example and that actual power curves may show some variation.

Though differences occur a general impression on the output of windmills may be obtained, using the average windspeeds occuring on the site.
The graphs in figure 2 give an indication on the annual output of a windmill per square meter rotor swept area at various average windspeeds.
For water lifting the output (in m^3) is given for a total lifting head of 10 m. For electricity generation the output is shown in kWh.

Also the average output over a month may be obtained if the average windspeeds over such periods are known. You may use the above graphs, but have to divide the output by 12 in those cases.

For water lifting windmills the output decreases with increasing lifting head. Roughly it can be assumed that the water output flows decrease with 50% at doubling the head. Figure 3 shows the output of waterpumping windmills for various rotor diameters and lifting heads. An example is shown for the output of a 3 meter diameter windmill with a total head of 5 m. Please do realize the indicative character of the estimates. For more detailed performance analyses reference is made to other publications e.g. SWD 82-1, 'Introduction to Wind energy'(details on last pages of this booklet).

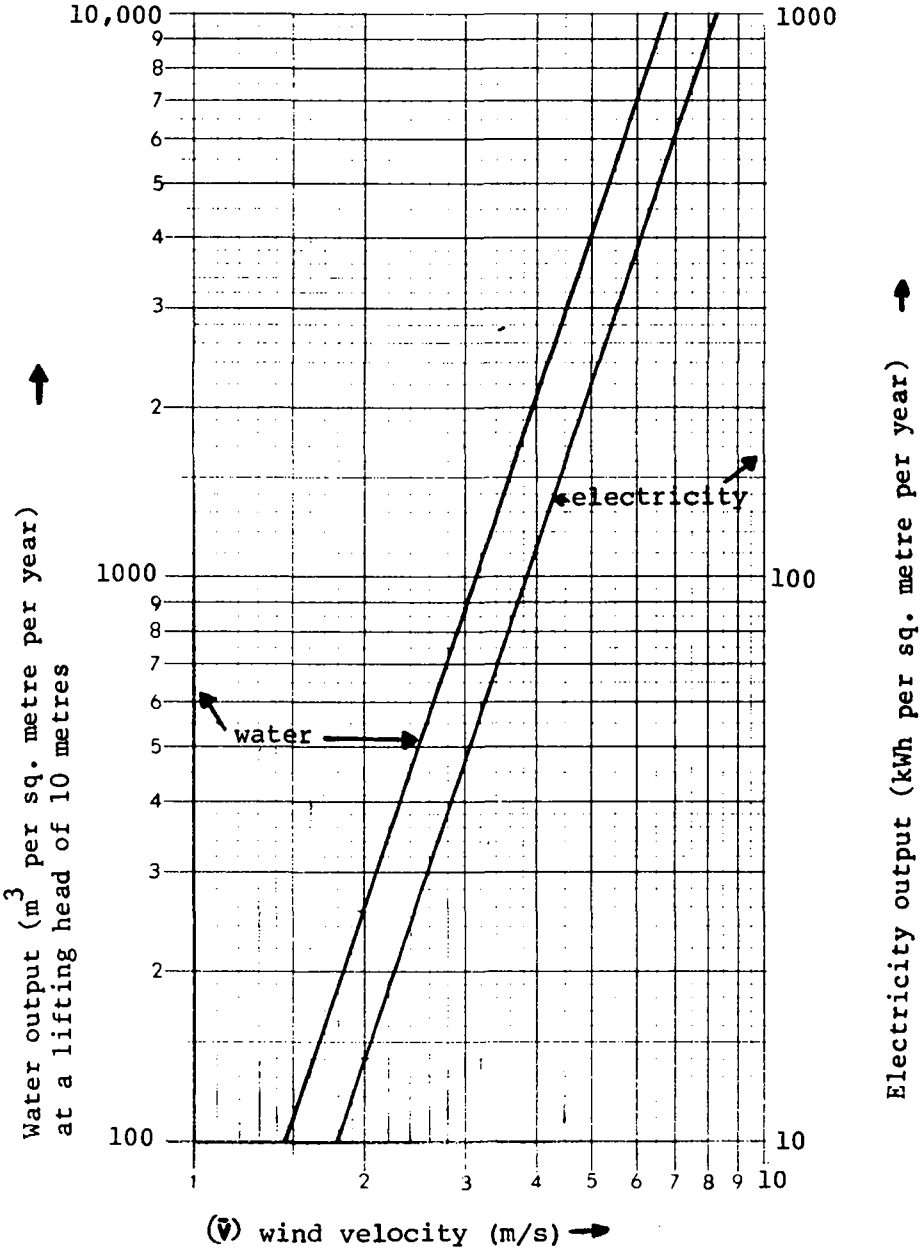


Fig.2: Annual output of windmills for waterlifting and electricity generation (estimates based on power outputs of $0.1\bar{v}^3$ and $0.2\bar{v}^3$ resp.)

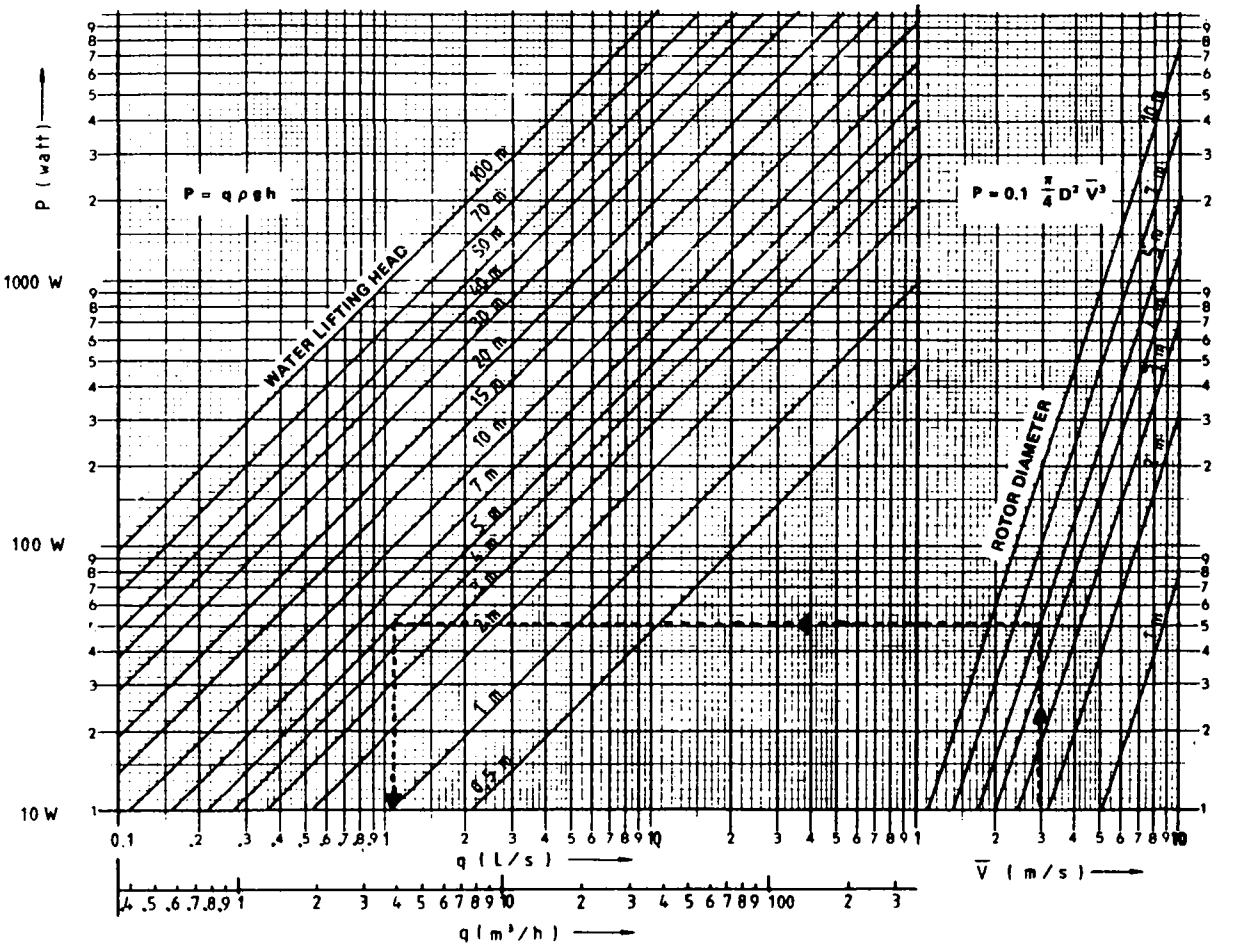


Fig. 3 Chart to estimate the output (q) of a waterpumping windmill with a given diameter (D) and a given water lifting head (h) operating in a wind regime with annual windspeed ($\bar{v}$). The chart is based upon the output estimate $P = 0.1\ v^{-3}\ W/m^2$. (source: 'Introduction to wind energy' by E.H.Lysen, SWD 82-1)

2. MANUFACTURER'S DATA

2.1. Windmills for waterlifting

AERMOTOR	802	X	A	B	D	E	F
ROTOR	: horizontal axis; upwind position by means of a tail vane; fixed pitch; 18 blades of galvanized steel; rotordiameter:						
	(m)	1.8	2.4	3.0	3.7	4.3	4.9
TRANSMISSION	: double gears and pitmans; two strokes (adjustable):						
	(mm)	139.7	203.2	254.0	304.8	355.6	406.4
		76.2	152.4	190.5	228.6	254.0	304.8
PUMPSYSTEM	: plunger pump with cilinder diameters of 44.5 - 203.2 mm						
CONTROL SYSTEMS	: rotor turns out of the wind in strong winds; outside furling device						
TOWERS	: 4-post galvanized steel tower; heights (m):						
	for X,A,B :	6.4 - 8.2 - 10 - 12.2 - 14.3					
	D,E :		8.2 - 10 - 12.2 - 14.3				
	F :			10 - 12.2 - 14.3			
WEIGHTS	: towers: 177 - 1041 kg; rotor + head:						
	(kg)	95	161	293	494	769	1111
PRICES (1982, ex works)	: towers: US $ 600 - 3600; rotor + head:						
	(US$)	831	1250	2199	3693	5973	8213
OPERATING WINDSPEEDS							
cut-in	: ± 4 m/s						
rated	: 9 m/s						
cut-out	: 11 m/s						
SUPPLIERS	:						
Aermotor, USA							

AGRO-80	(modified NAL WP-2 design)
ROTOR	: horizontal axis; upwind position by means of a tail vane; fixed pitch; 24 blades of steel; rotor diameter 4.8 m.
TRANSMISSION	: crank mechanism; adjustable stroke: 100 or 125 mm; ball bearing turntable
PUMPSYSTEM	: reciprocating pump of size 100 or 150 mm
TOWER	: 4-post steel tower; height 9 m. (also a 15 m. tower can be supplied)
WEIGHTS	: total ± 750 kg.
PRICES (1982)	: US $ ± 1500/Indian Rs. 14.000
OPERATING WINDSPEEDS:	
cut-in	: 1.7 - 2.2 m/s
SUPPLIERS	:
Agro-Aids, India	

BAKER	6	8	10	12
ROTOR	: horizontal axis; upwind position by means of a tail vane; fixed pitch; blades of galvanized steel; number of blades and rotor diameters (m):			
	(no) 20	36	30	32
	(m) 1.8	2.4	3.0	3.7
TRANSMISSION	: gears; ratio 4:1 for nr. 6, 3:1 for all others			
PUMPSYSTEM	: piston pump; brass cilinders, diameters upto 152 mm; strokes			
	(mm) 108	132	162	200
CONTROL SYSTEMS	: automatic self governing and manual shut-down			
TOWER	: 4-post galvanized steel towers; heights:			
	(m) 4.6 - 6.1 - 9.1 - 10.7 - 12.2 - 15.2 - 18.3			
WEIGHTS	: no. 1 towers for models 6 and 8 (upto 12.2 m height): 145 - 271 kg; no. 4 towers for all models (4.6 - 18.3 m heights): 190 - 560 kg; rotor + head:			
	(kg) 133	217	267	371
OPERATING WINDSPEEDS:				
cut-in	: 3.1 m/s			
rated	: 6.8 m/s			
cut-out	: 9.8 m/s			
SUPPLIERS	:			
Heller-Aller Co., USA				

BALDI Y UCELLI	
ROTOR	: horizontal axis; downwind position by means of rotor coning; 5 blades of galvanized steel; rotor diameter 4.5 m
TRANSMISSION	: crank; variable stroke (75,100 or 150 mm)
PUMP SYSTEMS	: piston pump; diameter 76.2 mm - 203.2 mm;
TOWERS	: height 9 m; painted steel
PRICES (1983)	: rotor, head, tower and pump: ± US$ 3,500;
OPERATING WINDSPEEDS:	
cut-in	: 4 m/s
rated	: 7 m/s
cut-out	: 15 m/s
SUPPLIERS	:
Baldi y Ucelli (Enermecanica), Peru	

BEAN HILL	2/27	3/88
ROTOR	: horizontal axis; upwind position by means of a tail vane; blades of galvanized sheet steel;	
	12 blades diameter 1.98 m	18 blades diameter 3.05 m
TRANSMISSION	: crank mechanism from mild steel; pump-push rod of aluminium tube	
PUMPSYSTEM	: several types available (dep. on head/situation): diaphragm, standard piston, high volume piston or borehole pumps	
TOWERS	: steel; heights:	
	4.9 m. 3-post	6.1 m. 4-post
CONTROL SYSTEMS	: rotor turns out of the wind, activated by an auxiliary side fin	
OPERATING WINDSPEEDS:		
cut-in	: 2.7 m/s	
cut-out	: 7.6 m/s	7.6 m/s
SUPPLIERS	:	
Pembrokeshire Eng., England		

BOSMAN	drainage windmill (small heads)
ROTOR	: horizontal axis; upwind position by means of a tail vane; 4 blades of galvanized steel; rotor diameter 2.4 m.
TRANSMISSION	: gears
PUMPSYSTEM	: centrifugal pump
CONTROL SYSTEMS	: rotor turns out of the wind if water level drops too much
TOWERS	: 4-post galvanized steel tower; heights 4 or 7 m
WEIGHTS	: ± 500 kg
PRICES (1982, ex works) (excl. VAT)	: incl. head, rotor, pump, tower and prefabricated well casing: Dfl. 10.500,-/US$ ± 4000.- incl. 4 m. tower Dfl. 13.100,-/US$ ± 5000.- incl. 7 m. tower
OPERATING WINDSPEEDS:	
cut-in	: ± 3 m/s
SUPPLIERS	:
Bosman, The Netherlands	

BOWJON	Bowjon	Rancher
ROTOR	: horizontal axis; upwind position by means of a tail vane; blades of galvanized steel; rotor diameters and number of blades:	
	(m) 2.4	2.4
	(no) 4	8
TRANSMISSION	: by means of a compressor; windmill does not need to stand above the well	
PUMPSYSTEM	: air injected pump; pumps for shallow resp. deep water sources; 2 cilinder pump with Rancher-model;	
CONTROL SYSTEMS	: automatic furling in high winds	
TOWERS	: pipe or lattice; height 3.66 m.	
PRICES (1982, f.o.b.)	: US$ 1200 - 1800	
OPERATING WINDSPEEDS:		
cut-in	: 2.7 - 4.5 m/s	
cut-out	: 14 m/s	
SUPPLIERS	:	
Bowjon, USA		

CLIMAX	6	8	10	12	14	18
ROTOR	: horizontal axis; upwind position by means of a tail vane; fixed pitch; 18 blades of mild steel; rotor diameter					
(m)	1.8	2.4	3	3.7	4.3	5.5
TRANSMISSION	: gears; ratio					
	4.5:1	3.6:1	3.2:1	3.0:1	3.5:1	
PUMPSYSTEM	: hydraulic/piston pump with brass, stainless steel and plastic; diameters of 40 - 125 mm					
CONTROL SYSTEMS	: automatic stalling					
TOWER	: 4-post angle-iron tower; heights (m) : 6-8-9-12-15					
WEIGHTS	: rotor + head					
(kg)	161	188	276	462	543	958
PRICES (1982 f.o.b.)	: rotor + head					
(US$)		900	980	1450	1700	4300
OPERATING WINDSPEEDS:						
cut-in	: (m/s) 2.9	1.8	3.1	3.8	4.4	
cut-out	: (m/s) 16	14	12	11	11	
SUPPLIERS	:					
Climax, South Africa						

COMET (1)

	1	2	3	4	5

ROTOR : horizontal axis; upwind position by means of a tail vane; multiple blades of galvanized (models 1-4) or painted (model 5) steel; rotor diameters:

(m)	2.4	3	3.7	4.3	4.9

TRANSMISSION : crank and rods
PUMPSYSTEM : plunger type with brass and leather (flush end and syphon type pumps also available)
CONTROL SYSTEMS : automatic governing system
TOWERS : 4-post galvanized steel towers: heights
for models 1-2: 6.1 - 15.2 m
for models 3-5: 9.1 - 18.3 m
OPERATING WINDSPEEDS:
cut-in : 3.6 m/s
cut-out : 11.2 m/s
SUPPLIERS :
Sydney Williams & Co., Australia

COMET (2)

	6	7	8	9	10	11

ROTOR : horizontal axis; upwind position by means of a tail vane; multiple blades of painted steel; rotor diameters:

(m)	5.5	6.1	6.7	7.3	8.2	9.1

TRANSMISSION : crank and rods
PUMPSYSTEM : plunger type with brass and leather (flush end and syphon type pumps also available)
CONTROL SYSTEMS : automatic governing system
TOWERS : 4-post galvanized steel towers: heights
for model 6 : 9.1 - 18.3 m.
for models 7-10: 12.2 - 18.3 m.
for model 11 : 13.7 - 18.3 m.
OPERATING WINDSPEEDS:
cut-in : 3.6 m/s
cut-out : 11.2 m/s
SUPPLIERS :
Sydney Williams & Co., Australia

DEMPSTER

	6'	8'	10'	12'	14'

ROTOR : horizontal axis; upwind position by means of a tail vane; blades of galvanized steel; fixed pitch; number of blades and rotor diameters:

(no)	15	15	24	18	18
(m)	1.8	2.4	3.0	3.7	4.3

TRANSMISSION : various pump rod strokes upto 305 mm possible; gears, running in an oil bath, with ratio:

3.6:1	3.3:1	3:1	3:1	3:1

PUMPSYSTEM : piston pump with PVC and brass; diameters up to 102 mm
CONTROL SYSTEMS : automatic safety device; pullout wire; storm stay
TOWERS : 4-post lattice type steel tower; heights:
for 6' - 10' models: 6.7 - 11.9 m; other models 9.1 or 12.2 m
WEIGHTS : rotor + head:

(kg)	118.4	169	231	534	658

towers: for 6' - 10' models: 154 - 329 kg; other 424 - 587 kg
PRICES (1982, f.o.b.) : rotor + head:

(US$)	859	1249	2155	3650	5674

towers for models:
6' - 8': US$ 695 - 1276
10' : US$ 864 - 1503
12' : US$ 1693 or 1732
14' : US$ 2216 or 2268

OPERATING WINDSPEEDS:
cut-in : 2.2 m/s
rated : 6.7 m/s (for model 6' - 8');
8.5 m/s (for others)
cut-out : 22 m/s

SUPPLIERS :
Dempster Industries, USA

GJELLERUP	GS 8	GS 75
ROTOR	horizontal axis; upwind position by means of a tail vane; 2 or 4 blades (GS 8), 12 blades (GS 75)	
PUMP SYSTEM	for GS 8 a membrane pump; placed above the ground	
SUPPLIERS		
Gjellerup Smed, Denmark		
Budgen & Ass., Canada		

EL HAYAT	7	12	20	35	40	50	80	120
ROTOR	horizontal axis; upwind position by means of a tail vane; number of blades and rotor diameters:							
(no)	6	8	12	12	12	16	16	16
(m)	1.8	1.8	2	2.8	2.8	4	5	5
PUMP SYSTEMS	maximum heights							
(m)	12	15	20	35	40	50	80	120
TOWERS	heights							
(m)	4.4	5.3	5.3	8.9	8.9	9.3	13.3	13.3
SUPPLIERS								
Onamhyd, Algeria								

HAYES	470	477	478
ROTOR	horizontal axis; upwind position by means of a tail vane; steel blades; number of blades and rotor diameters:		
(no)	8	16	20
(m)	1.8	2.5	2.6
TRANSMISSION	direct drive/crank mechanism		
PUMPSYSTEM	piston type with brass; diameters 45 mm, 51 mm, 64 mm, using strokes of 50 mm, 50 mm, 88 mm resp.		
CONTROL SYSTEMS	rotor turning out of the wind automatically		
TOWERS	single pole with stays; heights: for model 470: 4 m; other models 6 m		
WEIGHTS (packed)	complete outfit (rotor, head, pump and tower):		
(kg)	160	535	565
PRICES (1982, f.o.b.)	complete outfit (rotor, head, pump and tower):		
(NZ$)	851	2116	2308
(US$)	600	1490	1620
OPERATING WINDSPEEDS:			
cut-in (m/s)	1.6	1.6	1.6
cut-out (m/s)	11.1	8.8	8.8
SUPPLIERS			
Hayes, New Zealand			

HERTOG	low lift windmills
ROTOR	horizontal axis; upwind position by means of a tail vane; 4 steel blades; rotor diameters ± 3 - 6 m (to order)
TRANSMISSION	gears
PUMPSYSTEM	centrifugal type pumps; heads up to ± 3 m
CONTROL SYSTEMS	water level activated control; manual brake system
TOWER	4-post lattice steel tower; heights 4 - 10 m
WEIGHTS	rotor head, tower and pump (unpacked) 300 - 2000 kg
PRICES (1982, ex-works, excl. VAT)	rotor head, tower and pump: (Dfl.) 10,000 - 100,000,- (US$) 3,700 - 37,000/-
OPERATING WINDSPEEDS	
cut-in	± 3/ms
cut-out	none
SUPPLIERS	
Hertog, the Netherlands	

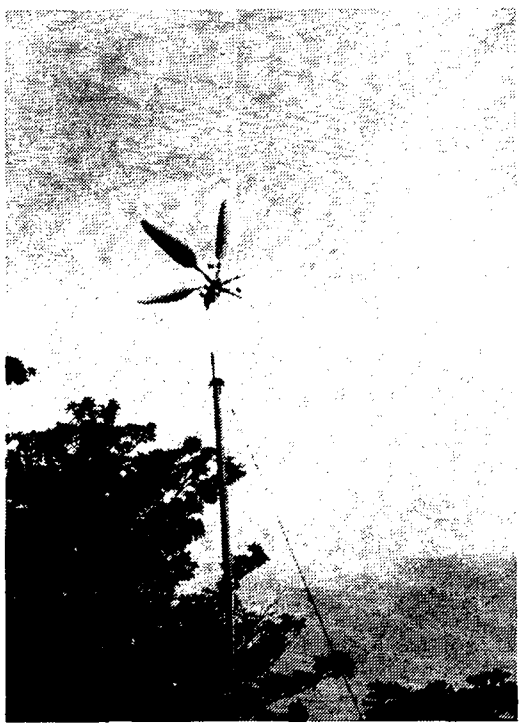
HUMBLOT (1)	Cadeteol	Supercadeteol	Junioreol	Geanteol
ROTOR	horizontal axis; upwind position by means of a tail vane; galvanized steel blades; number of blades and rotor diameters			
(no)	6(or 8)	8	12	16
(m)	1.75	1.75	2-2.75	4 or 5
TRANSMISSION	direct drive; strokes (mm) and transmission system			
(mm)	22/crank	22/crank	various	50-220
PUMPSYSTEM	piston pump; inside diameters upto 140 mm; max. heads;			
(m)	7	12	40	80
CONTROL SYSTEMS	automatic safety device by means of auxiliary side vane			
TOWERS	galvanized steel; configuration and heights (m):			
	tripod	tripod	tripod	4-post
(m)	5	5	5.25-12.30	9 or 13
PRICES (1982, ex-works, excl. VAT)	total (approx.):			
(FF)	4350-4600	4700-5000	8200-19000	36000-45000
(US$)	725-770	780-840	1360-3170	6000-7500
OPERATING WINDSPEEDS				
cut-in	± 2.5 (m/s)			
cut-out	± 10 - 12 (m/s)			
SUPPLIERS				
Eoliennes Humblot, France				

HUMBLOT (2)	Supergeanteol	Goliateol
ROTOR	horizontal axis; upwind position by means of a tail vane; galvanized steel blades; number of blades and rotor diameters	
(no)	16	20
(m)	5	8
TRANSMISSION	gears/chains; automatic greasing; adjustable ratio from 1:1 to 2:1, resp. 3:1; variable stroke:	
(mm)	50-220	200-450
PUMPSYSTEM	piston pump; inside diameters 80-300 mm; max. heads:	
(m)	120	150
CONTROL SYSTEMS	automatic safety device by means of auxiliary side vane	
TOWERS	4-post lattice tower; heights	
(m)	9 or 13	9, 13 or 17
PRICES (1982, ex-works, excl. VAT)	total (approx.):	
(FF)	42600-60000	73000-105000
(US$)	7000-10000	12100-17500
OPERATING WINDSPEEDS		
cut-in	± 2.5 m/s	
cut-out	± 10 - 12 m/s	
SUPPLIERS		
Eoliennes Humblot, France		

HUMBLOT (3)	Eolmotor 5 (two types)	
ROTOR	horizontal axis; upwind position by means of a tail vane; galvanized steel blades; rotor diameter 8 m; number of blades:	
	20	3
	fixed pitch	variable pitch
TRANSMISSION	vertical axis by means of gears/chains; automatic greasing; ratio adjustable from 4:1 to 10:1	
PUMPSYSTEM	rotational pump	
CONTROL SYSTEMS	automatic safety device by means of auxiliary side vane	
TOWERS	4-post lattice tower; heights 13 or 17 meters	
PRICES (1982, ex-works, excl. VAT)	windmill with tower, without pump (approx.):	
(FF)	106400-112500	118400-124500
(US$)	17700-18750	19700-20750
SUPPLIERS		
Eoliennes Humblot, France		

KIJITO	various types; based on ITDG (UK) design				
ROTOR	horizontal axis; upwind position by means of a tail vane; fibreglass moulded blades; 6 to 24 blades, depending on specific operating requirements; rotor diameters:				
(m)	2.44	3.66	4.88	6.10	7.32
TRANSMISSION	direct-drive, crank type				
PUMPSYSTEM	piston pump; 19 mm hollow pumprods; pump cilinders are purchased locally as required				
CONTROL SYSTEMS	automatic self-governing, activated by tail; manual furling device				
TOWERS	tripod with tower; made up in 3 m. sections of welded steel tubing; heights (standard):				
(m)	7.62	7.62	9.14	9.14	9.14
	larger towers can be supplied.				
PRICES (1982, ex works)	windmill, incl. tower:				
(KSh)	17540	28846	43851	77883	97352
(US$)	2249	3698	5622	9985	12481
OPERATING WINDSPEEDS:					
cut-in	2 m/s				
rated	various, depending on circumstances				
cut-out	11.2 m/s				
survival	31.3 m/s				
SUPPLIERS					
Bobs Harries, Kenya					
Merin, Pakistan (supplies the 7.32 m diameter windmill; uses other trademark name)					
Voltas, India (produces 6 m diameter machine, based on this design, the 'Vota'-windpump)					

LUBING	ML 015-6
ROTOR	: horizontal axis; downwind position; 6 blades of epoxy resins reinforced with glass fiber; rotor diameter 1.5 m
TRANSMISSION	: crank mechanism
PUMP SYSTEM	: membrane pump
TOWERS	: tube type steel mast, guyed; height 3 or 6 m;
PRICES (1982)	: total, with 6 m tower; US$ 600 - 650
OPERATING WINDSPEEDS:	
cut-in	: ± 3 m/s
rated	: ± 14 - 15 m/s
SUPPLIERS	:
Lubing, W. Germany	



METTERS	6 ft	8 ft	10 ft	12 ft	14 ft
ROTOR	: horizontal axis; upwind position; blades of metal; rotor diameters:				
(m)	1.8	2.4	3	3.7	4.3
PUMPSYSTEMS	: piston pump; diameters 50.8 - 101.6 mm				
CONTROL SYSTEMS	: automatic and manual furling system				
TOWERS	: lattice type tower				
SUPPLIERS	:				
M.B.P., Australia					

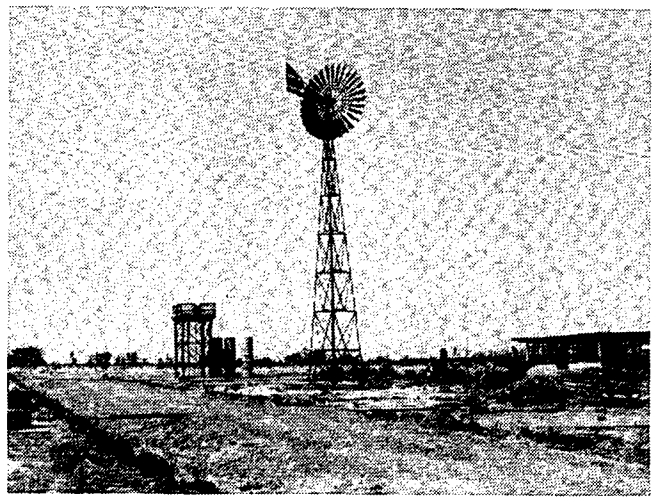
MINUANO	M-27
ROTOR	: horizontal axis; upwind position by means of a tail vane; 20 blades of galvanized steel sheet (optional: fibre-glass)
TRANSMISSION	: gear wheels in oilbath
CONTROL SYSTEMS	: automatic control against high winds
TOWERS	: 4 post-steel towers; heights 7, 10, 12 or 15 m.
SUPPLIERS	:
Minuano Indústrias Mecânicas, Brasil	

MISTRAL	
ROTOR	: horizontal axis; multibladed;
PUMP SYSTEM	: piston pump; for heights upto 40 m
TOWER	: 3-post tower; heights 4.5 - 16 m;
SUPPLIERS	:
Briau, France	

RECORD	drainage windmill (small heads), two types
ROTOR	: horizontal axis; upwind position by means of a tail vane; 4 steel blades; rotor diameter
	(m) 2.1 2.7
	Other sizes on request.
TRANSMISSION	: gearwheels, oil bath
PUMPSYSTEM	: small heads only
CONTROL SYSTEMS	: (optional) automatic cut-out at low water levels
TOWERS	: tube or lattice type; different sizes
WEIGHTS	: ± 500 kg
PRICES	: (Dfl.) ± 5000,- ± 5500,-
(1982, ex works)	(US$) ± 1900- ± 2050-
	automatic control system (water level activated) Dfl. 500,-/US$ 200 extra
OPERATING WINDSPEEDS:	
	no information available
SUPPLIERS	:
Bakker, The Netherlands	

REYMILL	10 ft	12 ft	14 ft
ROTOR	: horizontal axis; upwind position by means of a tail vane; 20 blades of painted B.I. sheet; diameters:		
	(m) 3.05	3.66	4.27
TRANSMISSION	: gears with ratio (standard, others are possible):		
	2.14:1	1.8:1	1.8:1
PUMPSYSTEM	: piston pump		
CONTROL SYSTEMS	: automatic turning out of the wind		
TOWER	: lattice; height 12 m (other heights are possible)		
WEIGHTS	: rotor + head:		
	(kg) 188	209	243
	tower: 500 kg		
PRICES	: rotor + head + tower: ± 20000 Pesos/US$ 2000 - 2200		
(1983, ex works)			
OPERATING WINDSPEEDS:			
cut-in	: 3 m/s		
SUPPLIERS	:		
Reymill Steel, Philippines			

SANIT	10	12	14	16	18	20
ROTOR	: horizontal axis; upwind position by means of a tail vane; blades of painted galvanized steel; numbers and rotor diameters:					
	(no) 30	30	30	45	45	60
	(m) 3.0	3.7	4.3	4.9	5.5	6.1
TRANSMISSION	: direct-drive; strokes 7.6 cm standard; 12.7 and 15.2 cm are optional					
PUMPSYSTEM	: piston type; diameters in the range: 8.3 - 61.0 cm; steel and brass					
CONTROL SYSTEMS	: automatic and manual					
TOWERS	: heights 15 m standard; optional 18 or 24 m; painted steel, lattice					
PRICES	: rotor + head					
(1980)						
	(US$) 960	1490	2150	2970	4020	5340
	tower					
	(US$) 830	1100	1100	1380	1380	1650
	pumps within the range US$ 180 - 1320.					
OPERATING WINDSPEEDS:						
cut-in	: 0.5 m/s					
cut-out	: 12 m/s (adjustable)					
SUPPLIERS	:					
Thai U.SA., Thailand						



NEWARK

ROTOR : horizontal axis; upwind position by means of a tail vane; steel blades; number of blades from 14 to 28; rotor diameters:

(m)	1.8	2.4	3.0	3.7	4.3	4.9	5.5	6.1

TRANSMISSION : gears; ratio 3:1 for all models
PUMPSYSTEM : piston type and syphon type; materials phosphor, bronze and steel; diameters up to 400 mm
CONTROL SYSTEMS : automatic control, wheel turning to vane
TOWERS : lattice or tube type; heights:

(m)	6.1	9.1	12.2	15.2

WEIGHTS (packed) : total, rotor, head + tower (kg) with tower of:

6.1 m	488	660	838	1092	1290	-	-	-
9.1 m	609	813	1006	1273	1524	2041	3400	3850
12.2 m	790	1025	1234	1560	1840	2380	3850	4540
15.2 m	993	1252	1483	1878	2182	2720	4310	5220

OPERATING WINDSPEEDS:
cut-in : 2 m/s
rated : 4.5 m/s
SUPPLIERS :
Wakes & Lamb Ltd., England

NEYRTEC (various models)

ROTOR : horizontal axis; upwind position by means of a tail vane; 18 blades of steel; rotor diameters:

(m)	3.05	3.50	4.85	5.50	6.10

TRANSMISSION : gearwheels and rod-crank mechanism; adjustable transmission ratio
CONTROL SYSTEMS : automatic furling in high winds;
PUMPSYSTEM : piston pump
TOWERS : 4-post steel lattice towers; heights:

(m)	12	12	15	15	15

OPERATING WINDSPEEDS:
cut-in : 3 m/s
rated : 6.5-8 m/s
cut-out : 15-20 m/s
SUPPLIERS :
Ateliers et Chantiers Navals, France

12 PU-series	12 PU 350	12 PU 500
	(based on Dutch WOT/TOOL design)	

ROTOR : horizontal axis; upwind position by mains of a tail vane; fixed pitch; 12 blades of sheet metal; rotor diameters:

(m)	3.5	5

TRANSMISSION : direct-drive crank-connecting rod system; strokes adjustable upto 16.24 cm
PUMP SYSTEM : piston type pump; various diameters
CONTROL SYSTEMS : overspeed control by auxiliary vane, dislocks main vane at high winds: mannual 'replacing'
TOWERS : 4-post steel towers; standard height:

(m)	4.5	6.5

WEIGHTS : total ± 350 kg 450 kg

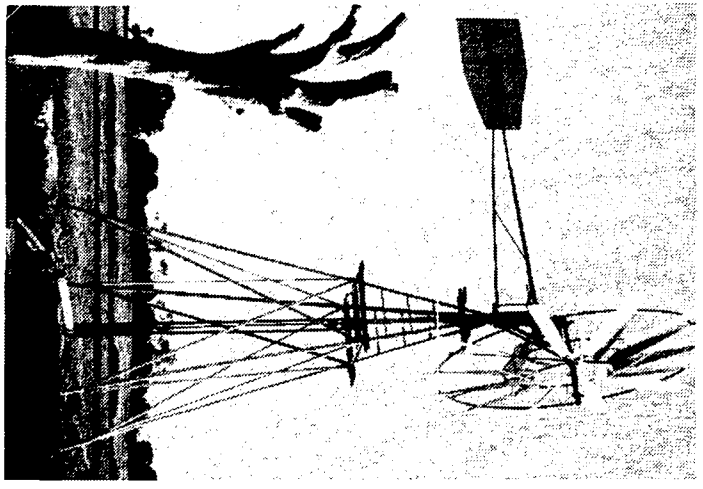
PRICES (1982, ex works, India) : total (excl. foundation)

(IRs)	± 8000 - 8500	10000 - 12000
(US$)	± 800	± 1000

OPERATING WINDSPEEDS

cut-in	2.5 - 3.5 m/s	5 m/s
rated	± 10 m/s	m/s
cut-out	± 10 m/s	m/s

SUPPLIERS :
IERT, India (North)
WORTH, India (South)



SHEET METAL KRAFT

ROTOR	: horizontal axis; upwind position by means of a tail vane; 18 blades of galvanized steel; rotor diameter 3.6 m
TRANSMISSION	: gears; ratio 3.5:1
CONTROL SYSTEMS	: spring loaded brake and tail return system on a revolving thrust mechanism
SUPPLIERS	:

Sheet Metal Kraft, Zimbabwe

SOUTHERN CROSS (1)		IZA	IZB	IZC	IZD
ROTOR	: horizontal axis; upwind position by means of a tail vane; 18 blades of galvanized steel sheet; rotor diameters:				
	(m)	1.8	2.4	3	3.7
TRANSMISSION	: IZ-models via gears and crank; ratio	4:1	3:1	2.6:1	2.3:1
PUMPSYSTEM	: piston pump with brass; diameters upto 203 mm				
CONTROL SYSTEMS	: automatic governing system with wheel turning to vane by inclined hinge				
TOWERS	: 3 post-galvanized steel angle, wire braced; heights from 6.1 m by steps of 1.52 m upto 18.3 m				
WEIGHTS (packed)	: towers 100-610 kg; rotor + head:				
	(kg)	130	190	355	510
PRICES (1983, f.o.b.)	: towers US$ 180-897; rotor + head:				
	(US$)	456	613	843	1127

OPERATING WINDSPEEDS:

cut-in	: 3.2 m/s for all models
rated	: 8.9 m/s for all models
cut-out	: 11 m/s for all models
SUPPLIERS	:

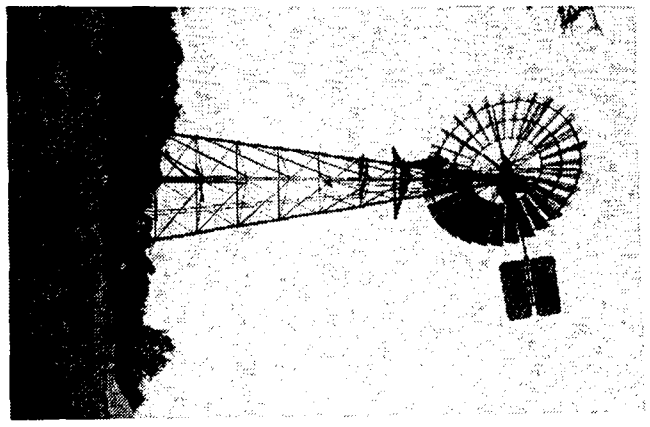
Toowoomba Foundry, Australia
Southern Cross, South Africa

SOUTHERN CROSS (2)		IZE	RF	RG	RH
ROTOR	: horizontal axis; upwind position by means of a tail vane; blades of galvanized steel; number of blades and rotor diameters:				
	(no.)	24	24	30	36
	(m)	4.3	5.2	6.4	7.6
TRANSMISSION	: IZ-models via gears and crank, others direct by crank; ratio	2.3:1	1:1	1:1	1:1
PUMPSYSTEM	: piston pump with brass; diameters upto 203 mm				
CONTROL SYSTEMS	: automatic governing system with wheel turning to vane by inclined hinge				
TOWERS	: 3 post galvanized steel angle tower, wire braced; heights from 6.1 m by steps of 1.52 m upto 18.3 m				
WEIGHTS (packed)	: towers: 295-1475 kg; rotor + head:				
	(kg)	610	1370	2085	2750
PRICES (1983, f.o.b.)	: towers: US$ 447-1931; rotor + head:				
	(US$)	1456	3626	5782	6468

OPERATING WINDSPEEDS:

cut-in	: 3.2 m/s
rated	: 8.9 m/s
cut-out	: 11 m/s
SUPPLIERS	:

Toowoomba Foundry, Australia
Southern Cross, South Africa



SPARCO

ROTOR	: horizontal axis; upwind position by means of a tail vane; raisin blades; rotor diameter 1.5 m; number of blades:		
	(no)	2	4	6
TRANSMISSION	: crank mechanism		
PUMPSYSTEM	: diaphragm or piston type pump; max. head (with piston pump):		
	(m)	10	22	16
CONTROL SYSTEMS	: manual pitch control		
TOWER	: tube type tower; height 3.3 m with possible extension upto 4.5-6 m		
PRICES (1980, ex works excl. VAT)	: total (US$)	400-500	600-700	800-900

OPERATING WINDSPEEDS:
- cut-in : 3.5 m/s
- rated : 7.5 m/s
- cut-out : 20 m/s

SUPPLIERS :
- Naesbjerg Maskincenter, Denmark
- Enertech Inc., USA
- Windpumpen-Zentrale, W.-Germany
- Technisch Handelsburo, the Netherlands

TEN-FA (various types)

ROTOR	: horizontal axis; self-adjusting to wind-direction; 6 blades
PUMPSYSTEM	: pumps of various diameters; pumping heads from 1-8 m.
TOWER	: tube type

OPERATING WINDSPEEDS:
- cut-in : ± 2 m/s

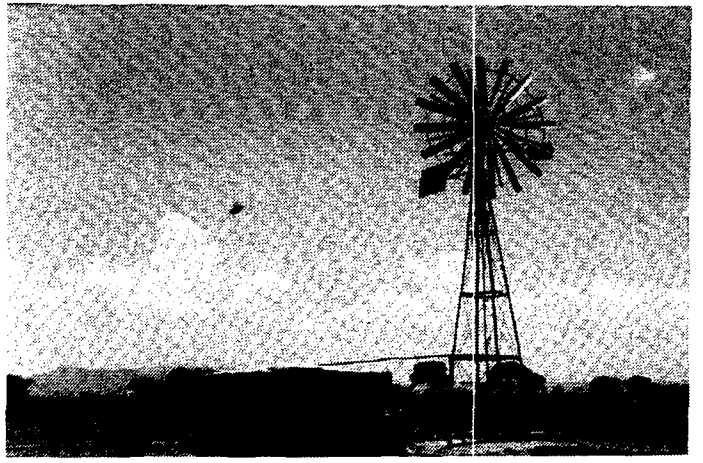
SUPPLIERS :
- Ten-fa, Taiwan

ULI-UJUZI LEO (based on WOT/TOOL-PU design) 5000

ROTOR	: horizontal axis; upwind position by means of a tail vane; 18 metal blades; rotor diameter 5 m.
TRANSMISSION	: direct-drive crank-connecting rod mechanism; strokes upto 150 mm;
PUMP SYSTEM	: single acting piston pump; diameter 78 mm;
CONTROL SYSTEM	: automatic overspeed control by auxiliary vane
TOWERS	: 4-post steel tower; height 7.7 m (height rotor shaft 8.7 m);
PRICES (1982, ex works)	: total: TSh 50000/US$ 5500

OPERATING WINDSPEEDS
- cut-in : 2.5 m/s
- rated : 6-9 m/s
- cut-out : 12 m/s

SUPPLIERS :
- Ujuzi Leo, Tanzania



TOZZI E BARDI

ROTOR	: horizontal axis; 18 blades; rotor diameters 5 or 6 m;
TRANSMISSION	: gears
PUMP SYSTEM	: piston pump; diameters 60 - 180 mm
TOWERS	: heights 12, 16 or 20 meters
PRICES (1982)	: (incl. pump) US$ ± 7500
SUPPLIERS	:
Tozzi e Bardi, Italy	

UNIMAX

		P300	P360	P500
ROTOR	: horizontal axis; upwind position by means of a tail vane; 4 galvanized steel blades; rotor diameters:			
	(m)	1.9	2.3	3.2
PUMPSYSTEM	: membrane or piston pump; max. suction head:			
	(m)	4.5	3.5	3.5
CONTROL SYSTEMS	: automatic stall, activated by centrifugal force			
TOWERS	: tube type; heights:			
	(m)	5	7	7
PRICES (1980, ex works, excl. VAT)	: (DM)	±4850,-	±7250,-	±10.000,-
	(US$)	±1975	3000,-	±4100,-
SUPPLIERS	:			
Sjorslev, Denmark				
Windpumpen-Zentrale, W.-Germany				

VARCOE

		6 ft	7 ft	8 ft	10 ft	12 ft	14 ft
ROTOR	: horizontal axis; upwind position by means of a tail vane; fixed pitch; blades of galvanized steel; number of blades and rotor diameters (m):						
	(no)	15	15	15	16	16	16
	(m)	1.8	2.1	2.4	3.0	3.7	4.3
TRANSMISSION	: direct action head available for 6 and 7 ft models with a double excentric drive; for 6, 7 and 8 ft models also double geared mill head available with ratio 4:1; for 10, 12 and 14 ft models: gear and pinion system with ratio 2.7:1						
PUMPSYSTEM	: plunger type pumps of brass or aluminium; diameters 50-125 mm; strokes: 63 mm for direct action windmills, 140 mm for double geared windmills, 190 mm for three larger windmills						
CONTROL SYSTEMS	: automatic yawing in high winds; gear lever, operated from ground level (optional)						
TOWERS	: 4-post galvanized steel towers; heights from 4.5 m up in sections of 1.5 m						
PRICES (1982, ex works)	: towers for 6, 7 and 8 ft models: US$ ± 300 for 4.5 m; US$ 345 for 6.1 m; US$ ± 430 for 7.6 m; US$ ± 560 for 9.1 m; heads for 6, 7 and 8 ft models: US$ 630-870;						
OPERATING WINDSPEEDS:							
cut-in	: ± 1.8 m/s						
cut-out	: ± 8.9 m/s						
survival	: ± 30 m/s						
SUPPLIERS	:						
Chapman and Saunders, Australia							

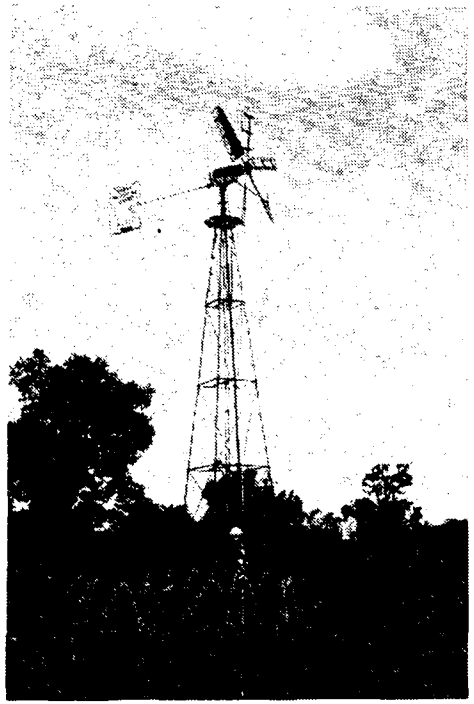
WADLER

		271	273	370	672
ROTOR	: vertical axis Savonius rotor; 2 blades of aluminium				
OPERATING WINDSPEEDS:					
cut-in	: ± 1 m/s				
survival	: ± 40 m/s				
SUPPLIERS	:				
Wadler, USA					

WEU I/3 (semi-commercial/WEU-SWD-design)

ROTOR : horizontal axis; upwind position by means of a tail vane; fixed pitch; 6 blades of galvanized steel sheet; rotor diameter 3 m.
TRANSMISSION : adjustable crank
PUMPSYSTEM : single acting suction type piston pump of steel and PVC; maximum total head ± 16 m; diameter x stroke: 100 mm x max. 100 mm. Other pump diameters available on request
CONTROL SYSTEMS : automatic furling by inclined-hinged vane system; manual (groundlevel) locking device
TOWER : 4 post angle iron structure; height 9 m.
WEIGHTS : ± 375 kg (unpacked)
PRICES : (via WEU) Sri Lankan Rs. 19500 or US$ ± 900
(1983, ex works) (in Sri Lanka: installation included in price)
OPERATING WINDSPEEDS:
- cut-in : ± 3 m/s
- rated : 7 m/s
- cut-out : 12 m/s
- survival : (in locked position) ± 40 m/s

SUPPLIERS :
- Wind Energy Unit, Sri Lanka
- Merin Ltd., Pakistan (under other trademark name)



WILKS CAM model 12

ROTOR : horizontal axis; upwind position by means of a tail vane; 24 galvanized steel blades; rotor diameter 3.65 meter
TRANSMISSION : cam lift with 270 degree lift cycle and 90 degree return cycle; ratio 3.83:1
PUMP SYSTEM : piston pump
CONTROL SYSTEMS : automatic furling in high winds (tail vane deflect)
TOWER : 4-post steel towers
OPERATING WINDSPEEDS
- cut-in : ± 2.2 m/s
- cut-out : ± 13.5 m/s
- survival : ± 67 m/s

SUPPLIERS :
- Wind Dynamics, Canada

WIND BARON Mark IV

ROTOR : horizontal axis; 18 blades; upwind position by means of a tail vane;
rotor diameter 4.9 m;
TRANSMISSION : counter balancing mechanism and tracking system
PUMP SYSTEM : piston pump
PRICES (1982) : ± US$ 15.000
OPERATING WINDSPEEDS
- cut-in : ± 1.4 m/s

SUPPLIERS :
- Wind Baron, U.S.A.

WINDSPINNER	Alston-C-Waterking (2 models)		Windspinner
ROTOR : horizontal axis; upwind position by means of a tail vane; number of blades and rotor diameters:			
(no)	16	16	8
(m)	3.0	3.6	2.4
TRANSMISSION : gears (for Alston models: running in oil bath); ratio:			
	3.4:1	3.4:1	4:1

PUMP SYSTEM : standard bore pumps; various sizes
CONTROL SYSTEMS : the Windspinner has an automatic and a manual high wind-speed-safety device; it can also be lowered easily to the ground
TOWERS : Alston-models: for post galvanized steel angle towers with heights 6 - 12 metres;
Windspinner: guyed tube tower with tripod; height 7.5 m
WEIGHTS (shipping weight) : total: 500 - 800 kg for Alston models
SUPPLIERS :
Windspinner, Australia

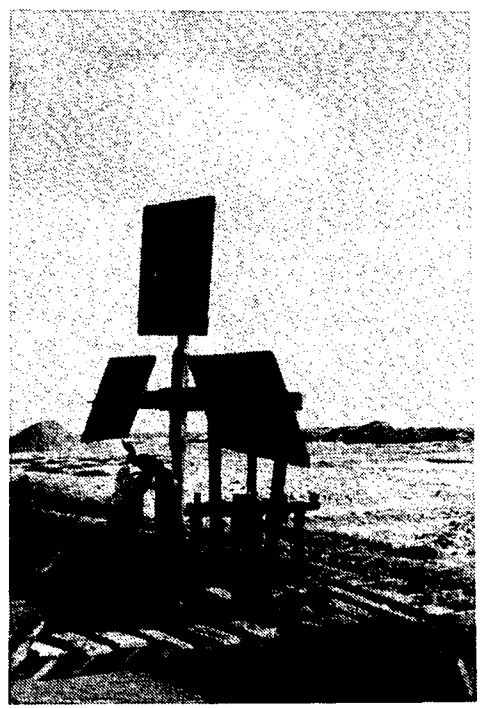
The windmills for electricity generation (see 2.2) may also be used to power electric pumpsets for waterlifting. The majority of dealers mentioned under 3.2 supply only windmills and leave it to the buyer to match this windmill with a suitable electric pumpset. Some dealers, however, offer complete sets with windmills for electricity generation coupled to electric pumpsets e.g. dealers of following trademarks:

- Aerowatt
- Elektrowatt
- Jyoti
- North Wind Power
- Polenko (WPS 5 model can be supplied with electropump, as model P4)
- Wind-Power S.J.

LOCAL MANUFACTURERS

In various developing countries windmill manufacturers exist, that are involved in construction of windmills for a particular application/situation, e.g.

* Thailand: near Chachoengsao and near Samut Songkram various windmill types are produced for low lift purposes, using a ladder pump. Diameters of the rotors go upto ± 8 meters. Main material is wood.
* Peru: in the Miramar valley wooden windmills are used for water lifting.
* Cabo Verde: on the isle of Sal wooden windmills are used in the salt pans.



2.2. Windmills for electricity generation

AEROCHARGER		5W/12	5W/24	10W/12	10W/24
ROTOR	: horizontal axis; upwind position by means of a tail vane; 14 blades of aluminium for 5W models, 10W models exist of two 5W-rotors;				
TRANSMISSION	: direct drive; ratio 1:1				
ELECTR. CONFIG.	: multiple alternator, AC or DC; 12 or 24 V (see type nrs.)				
WEIGHTS (packed)	: rotor, head + hub (kg)	13.6	13.6	18.6	18.6
PRICES (1980)	: rotor, head + hub (US $) AC	170	182	-	-
	(US $) DC	175	186	243	255
OPERATING WINDSPEEDS					
cut-in	: 4.5 m/s				
rated	: 11.2 m/s				
survival	: 89 m/s				
RATED OUTPUT	: (W)	5	5	10	10
SUPPLIERS	:				
Selectromarine, England					

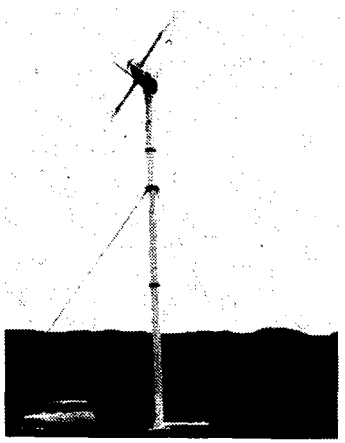
AEROCHARGER/AMPAIR		50W/12	50W/24	100W/12	100W/24
ROTOR	: horizontal axis; upwind position by means of a tail vane; 14 blades of poly-propylene for 50W models, 100W models have two rotors of this type; rotor diameter 0.66 m				
TRANSMISSION	: direct drive				
ELECTR. CONFIG.	: multiple alternator; 12 and 24 V models (see type nrs.)				
WEIGHTS	: rotor, head + hub (crated) (kg)	20.5	20.5	40	40
PRICES (1980)	: rotor, head + hub (US $) AC	400	417	-	-
	(US $) DC	407	446	603	630
OPERATING WINDSPEEDS					
cut-in	: 5.1 m/s				
rated	: 20.4 m/s				
survival	: 89 m/s				
RATED OUTPUT	: (W)	50	50	100	100
SUPPLIERS	:				
Selectromarine, England					

AEROMAN		11/11	11/22
ROTOR	: horizontal axis; downwind position; 2 blades of fibre-glass; rotor diameter 11 m		
TRANSMISSION	: gears; ratio 1:17.1		
ELECTR. CONF.	: synchronous or asynchronous machine; 3 phases; 220/380 V		
CONTROL SYSTEMS	: variable blade pitch; protection against overspeed, over-voltage and storm		
TOWERS	: conical concrete mast with steel cable bracing or 4-post lattice steel pipe tower (according to selection); standard height 10 m		
PRICES (1983, excl. VAT)	: rotor + head for		
	- connection to the grid: Dfl. 94,000/US$ 35,500		
	- independent operation : Dfl. 97,000/US$ 36,600		
OPERATING WINDSPEEDS			
cut-in	: 3.5 m/s		
rated	: 8.5 m/s		
cut-out	: 24 m/s		
survival	: 50 m/s		
RATED POWER	: (kW)	11	22
SUPPLIERS	:		
MAN, W. Germany			
Rollo, the Netherlands (supply of rotor and head only)			

AERO POLYBLADE	
ROTOR	: horizontal axis; 24 blades, rotor diameter 6.7 m;
OPERATING WINDSPEEDS	
cut-in	: 4.5 m/s
rated	: 11.2 m/s
RATED OUTPUT	: 4 kW
SUPPLIERS	:
Wind Electric Systems, USA	

AEROWATT (1)		24FP7G	60FP7G	150FP7G	100FP5G	300FP7G
ROTOR	: horizontal axis; upwind position by means of a tail vane; 2 blades of extruded aluminium alloy (for 24FP7 mode: 2 blades of polyurethane coated beechwood); on request special blade coatings against ice or sandstorms; rotor diameters:					
	(m)	1.2	1.34	2.0	3.2	3.2
TRANSMISSION	: direct drive					
ELECTR. CONFIG.	: brushless alternators; voltages: 12 or 24 V DC for first two models; for others 12, 24, 36 or 48 V DC (on request)					
CONTROL SYSTEMS	: centrifugally controlled variable pitch propellors					
TOWERS	: guyed or self supporting tubular masts					
WEIGHTS	: rotor + head (shipping weights)					
	(kg)	58	58	183	345	345
PRICES (1982, ex. works) (excl. VAT)	: rotor + head (approx.) (US$)		3000	5000		7800
OPERATING WINDSPEEDS						
cut-in	: (m/s)	2	2	2	2	2
rated	: (m/s)	7	7	7	5	7
cut-out	: (m/s)	-	-	-	-	-
survival	: (m/s)	90	90	60	60	60
RATED OUTPUT	: at control unit outlets:					
	(W)	30	60	150	100	300

SUPPLIERS :
Aerowatt, France
Alsthom, Netherlands
Automatic Power, USA



AEROWATT (2)		1200FP10G	1100FP7G	UM70	100FP5G	4100FP7G
	UM70 (type CHA) applicable for direct heating					
ROTOR	: horizontal axis; upwind position by means of a tail vane; 2 blades of extruded aluminium alloy (UM70:2 blades of coated laminated wood) on request special blade coatings against ice or sandstorms; rotor diameter:					
	(m)	3.2	5.0	7.0	9.2	9.2
TRANSMISSION	: direct-drive for 1200FP model, others with gears					
ELECTR. CONFIG.	: brushless alternators, for UM70 also asynchronous generators are possible; UM70 (type RES) may be coupled to the grid; voltages					
	(V)	24,36 48 or 120 DC	24,36 48 or 120 DC	380 AC (50 Hz)	24,36 48 or 120 DC	48,120 or 240 DC
CONTROL SYSTEMS	: centrifugally controlled variable pitch rotors					
TOWERS	: guyed or self supporting tubular masts					
WEIGHTS	: rotor + head (shipping weights):					
	(kg)	390	515	?	1530	1550
PRICES (1982, ex. works) (excl. VAT)	: rotor + head (US$)		15000			32000
OPERATING WINDSPEEDS						
cut-in	: (m/s)	2	2	3.5 - 5.3	2	2
rated	: (m/s)	10	7	6.9 - 10.4	5	7
cut-out	: (m/s)	-	-	-	-	-
survival	: (m/s)	60	60	60	60	60
	for UM70 cut-in and rated windspeeds depend on required application/type and on required rated power i.e. 2.5, 5 or 10 kW					
RATED OUTPUT	: (kW)	1.08	0.96	2.5 - 10	0.96	4

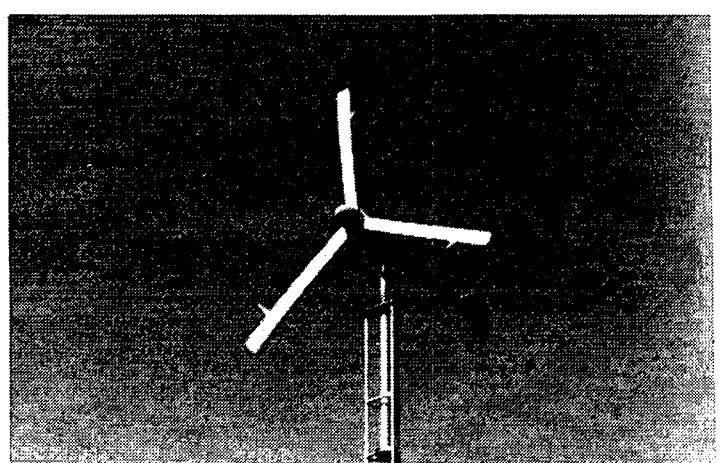
SUPPLIERS :
Aerowatt, France
Alsthom, Netherlands
Automatic Power, USA

AIRLITE	1	2	3	4
ROTOR	: horizontal axis; upwind position by means of a tail vane, except model 4 (downwind position); blades of plywood and polyurethane; number of blades and rotor diameters (m):			
	(no) 2	3	3	3
	(m) 1.8	2.4	3.2	6.1
TRANSMISSION	: V-belts			
ELECTR. CONFIG.	: model 1: 12 V DC-generator; others: 240 VAC-alternator			
TOWERS	: 4-post steel tower; heights for models 1,2 and 3: 4.6 m;			
PRICES (1980, ex works)	: towers: US$ 450; rotor + head:			
	(US$) 1235	1725	2012	
OPERATING WINDSPEEDS				
cut-in	: 3 m/s			
rated	: 8.5 - 11 m/s			
cut-out	: 20 m/s			
RATED OUTPUT	: (W) 200	600	1000	5000
SUPPLIERS	:			
* J. Taylor, England				

ALTOS	8B	12B
ROTOR	: horizontal axis; upwind position by means of a tail vane; 24 aluminum blades; rotor diameters:	
	(m) 2.4 m	3.6 m
TRANSMISSION	: concentric shaft reverse speed reduce	
ELECTR. CONFIG.	: 24 V DC (for both models) or 115 V/200 V AC; 3 phase alternator (for model 12B)	
CONTROL SYSTEMS	: automatic tail vane deflection; manual cable draw	
WEIGHTS	: total: 114 kg	136 kg
OPERATING WINDSPEEDS		
cut-in	: (m/s) 4.5	3.6
rated	: (m/s) 12.5	12.5
cut-out	: (m/s) 17.9	17.9
RATED OUTPUT	: (kW) 1.5	2
SUPPLIERS	:	
Altos corporation, USA		

ASTRAL	
ROTOR	: horizontal axis; 3 blades; rotor diameter 7.7 m
OPERATING WINDSPEEDS	
cut-in	: 3.5 m/s
rated	: 10 m/s
RATED OUTPUT	: 10 kW
SUPPLIERS	:
Astral Wilcon, USA	

BERGEY (BWC)	1000	1000 S
ROTOR	: horizontal axis; upwind position by means of a tail vane; 3 fiberglass blades; rotor diameter 2.8 m; variable pitch rotor by torsionally flexible blades with pitch weights near the tips, 'activated' by centrifugal forces	
TRANSMISSION	: direct drive	
ELECTR. CONFIG.	: permanent magnet alternator;	
	BWC 1000 :	12, 24, 36, 48 or 120 V DC;
	BWC 1000 S:	115 VAC/50Hz or 230 VAC/50Hz, 1 phase, operates in synchronisation with power grid
CONTROL SYSTEMS	: overspeed control by automatic furling; manual furling system;	
TOWERS	: guyed; lattice free-standing or tapered tube free-standing towers are available	
WEIGHTS	: rotor + head: 61 kg	
PRICES (1982) (ex-works)	: rotor + head (1000-model):	± US$ 3550-3700
	rotor + head (1000s-model):	± US$ 3900-4000
	towers (18-30 m):	± US$ 1400-2100
OPERATING WINDSPEEDS		
cut-in	: 4 m/s	
rated	: 11 m/s	
cut-out	: none, furling at 13.4 m/s	
survival	: above 52 m/s	
RATED POWER	: 1000 W; max. power 1210 W (at ± 13 m/s)	
SUPPLIERS	:	
Magnus, USA		



BERTOIA	AES-3
ROTOR	: horizontal axis; downwind position by wind-thrust-on rotor; 3 blades of anodyzed aluminium;rotordiameter 6 m;
TRANSMISSION	: direct drive
ELECTR. CONFIG.	: 120 VAC or rectified to 36 VDC;
CONTROL SYSTEMS	: automatic and manual blade pitch control
TOWERS	: cor-ten steel, heights 18-28 m;
WEIGHTS	: rotor + head: 545 kg; towers 1636-3180 kg;
PRICES	: rotor + head: US $ 7000; towers: US $ 1000-7000
(1983, f.o.b.)	
OPERATING WINDSPEEDS	
cut-in	: 3.5 m/s
rated	: 9 m/s
cut-out	: 34 m/s
RATED OUTPUT	: 1-3 kW
SUPPLIERS	:
Aesthetic Energy Systems, USA	

BONUS	18	22	30	45	55
ROTOR	: horizontal axis; upwind position by means of a servo; 3 blades of fibreglass; rotor diameters;				
(m)	10	10	10	12	15
ELECTR. CONFIG.	: asynchronous machines; two generator systems;				
CONTROL SYSTEMS	: blade tips act is brakes at high speeds; disc brakes				
TOWERS	: tubular galvanized steel tower; standard height 18 m; larger heights are possible				
PRICES	: total, excl. foundation				
(1983, excl. VAT)	NOT AVAILABLE				
OPERATING WINDSPEEDS					
cut-in	: 4 m/s				
rated	: 13.5 m/s				
RATED OUTPUT	: main generator/extra generator:				
(kW)	18.5/3	22/5.5	30/5.5	45/11	55/15
SUPPLIERS	:				
Danregn Vindkraft, Denmark					
Makon, the Netherlands					

BOUMA	11 m	16 m
ROTOR	: horizontal axis; 3 blades af fibre glass; upwind position by maens of a vane and servo-systems; rotor diameters:	
(m)	11 m	16 m
TRANSMISSION	: gears and flexible coupling	
ELECTR. CONFIG.	: asynchronous machine, coupled to the grid	
CONTROL SYSTEMS	: electronic control activating the brake at various undesired situations, e.g., too high rotational speed, too high winds, oscilliations in tower, etc.	
TOWERS	: free standing 8-sided steel case tower; heights	
(m)	16	20
PRICES	: total, excl. foundation, connections and installation:	
(1983, ex works, excl. VAT) (Dfl.)	57500	125000
(US$)	21700	47200
OPERATING WINDSPEEDS		
cut-in	: (m/s) 5	5
cut-out	: (m/s) 18	20
RATED OUTPUT	: (kW) 20	55-75
SUPPLIERS	:	
Bouma, the Netherlands		

BRUEMMER	BW08	BW11	BW21	BW41	BW51	BW120
ROTOR	: horizontal axis; models 11 and 21 operate in upwind position by means of a tail vane; models 41, 51 and 120 operate in downwind position; blades of sheet metal; number of blades and rotor diameters (m):					
(no.)	3	2	6	3	3	3
(m)	0.8	1.6	2.7	4.2	5.4	12
TRANSMISSION	: gears					
ELECTR. CONFIG.	: 220/380 VAC, 50 Hz (for three larger models) at favourable wind conditions liger capacity generators can be incorporated					
CONTROL SYSTEMS	: model 21 has an automatic yawing system; models 41, 51 and 120 have a variable pitch systems					
TOWERS	: steel tube with guy wires; heights:					
(m)	?	6	6 or 9	6 or 9	6 or 9	9
OPERATING WINDSPEEDS						
cut-in	: 3 m/s					
rated	: 8m/s					
RATED OUTPUT	: (W) 30	200	500	1200	300	10000
SUPPLIERS	:					
Bruemmer (H.), W. Germany						

CARTER Model 25

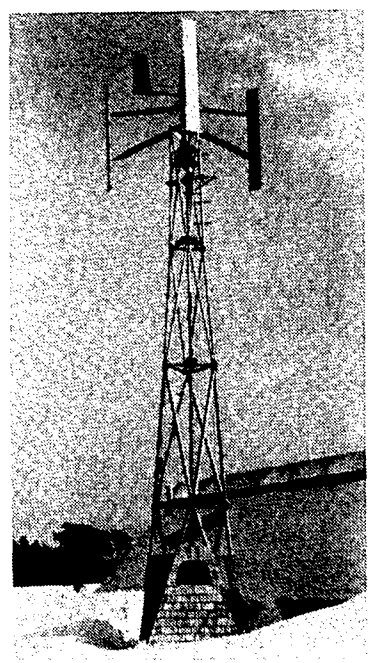
ROTOR : horizontal axis; downwind position;fixed pitch; 2 blades of fibreglass with PVC-foam; rotordiameter 9.75 m
TRANSMISSION : helical double reduction gears; ratio 15.38:1
ELECTR. CONFIG. : induction type generator; 220 or 440 VAC, 60Hz, 1 or 3 phases
CONTROL SYSTEMS : mechnical, blade feathering activated by centrifugal force, causing each blade to pitch to stall; manual disc brake system
TOWERS : tube type with 4 guy wires; height 18.3 m.
WEIGHTS : rotor + head: 346 kg; tower + gin pole: 907 kg; packed: 1300 kg
PRICES (1982) : rotor, head and tower: ± US$ 30 000
OPERATING WINDSPEEDS
cut-in : 3.6-4 m/s
rated : 11.6 m/s
cut-out : none
survival : 45 m/s (design)
RATED OUTPUT : 25 kW (max 30 kW at 13.5 m/s)
SUPPLIERS :
Carter (Jay) Enterprises, USA

CHALK 360 TLN

ROTOR : horizontal axis; 36 blades; rotor diameter 3.5 m.
OPERATING WINDSPEEDS
cut-in : 4 m/s
rated : 13.4 m/s
RATED OUTPUT : 1 kW
SUPPLIERS :
Chalk Wind Systems, USA

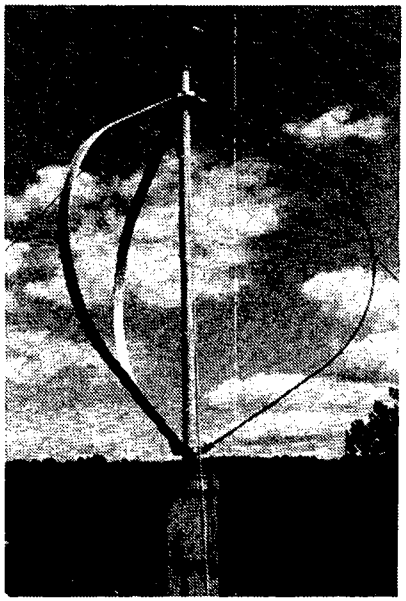
CYCLOTURBINE

ROTOR : vertical axis; 3 blades (NACA 0015); self-starting; cyclic blade pitch motion activated by means of a wind tracking vane; rotor diameter 3.6 m
ELECTR. CONFIG. : Winco alternator
CONTROL SYSTEMS : centrifugal overspeed control
TOWERS : octaedrical (pipe) tower
WEIGHTS : rotor: 50.5 kg
OPERATING WINDSPEEDS
cut-in : 3.1 m/s
rated : 10.7 m/s
RATED OUTPUT : 2 kW
SUPPLIERS :
Pinson Energy, USA



DAF-Indal various types

ROTOR : vertical axis; 3 bladed Darrieux rotor (aluminium); rotor heights from 4.6 m;
MAX. OUTPUT : 3 kW and higher
SUPPLIERS :
DAF-Indal, Canada



DANSK VINDMØLLE A30

ROTOR : horizontal axis; 3 blades of glass fibre; rotor diameter 12 m.
TRANSMISSION : gear and V-belt; ratio 1:20
ELECTR. CONFIG. : asynchronous generator; 6 pol. 30 kW 3 phase 380 V; for connection to the grid;
CONTROL SYSTEMS : servo yawing system; mechanical brake and aerodynamic speed limiter (spoilers)
TOWERS : lattice tower; height 18 m
WEIGHTS : rotor + head: 2000 kg; tower: 1600 kg;
PRICES (1980) : rotor + head: US$ 24,725;
OPERATING WINDSPEEDS
cut-in : 5 m/s
rated : 20 m/s
cut-out : 30 m/s
RATED OUTPUT : 30 kW
SUPPLIERS :
Dansk Vindmøllefabrik, Denmark

DRAGONFLY

ROTOR : horizontal axis; upwind position by means of a tail vane; 4 blades of wood; rotor diameter 2.44 m; also available 3 blade rotor with 2.79 m diameter
TRANSMISSION : V-belt; ratio 2.66:1
ELECTR. CONFIG. : rebuilt Chrysler 12V 40A model 7000 automatic alternator
CONTROL SYSTEMS : automatic and manual stalling system by a horizontal hinge
WEIGHTS : rotor + head: 20 kg
PRICES (1980, f.o.b.) : rotor + head (Kit, not balanced): US$ 200; complete with alternator: US$ 350
OPERATING WINDSPEEDS
cut-in : 4.5 m/s
rated : 9 m/s
cut-out : 17.9 m/s
RATED OUTPUT : 240-300 W (400-600 W at 17.9 m/s)
SUPPLIERS :
Dragonfly Wind Electric

DUNLITE 1 2 5

ROTOR : horizontal axis; upwind position by means of a tail vane; 3 blades of galvanized sheet steel (model 1+2) or wood (model 5); rotor diameters:

(m)	3.1	3.7	5.6

TRANSMISSION : gears;
ELECTR. CONFIG. : 3 phase brushless alternators; voltages

(VDC)	12	24/32/48/110	110

CONTROL SYSTEMS : automatic blade feathering by variable pitch; hand brakes
TOWERS : 3-post steel braced, galvanized; heights 12.2-21.3 m;
WEIGHTS : towers 420-450 kg; rotor + head: 240-290 kg;
OPERATING WINDSPEEDS

cut-in	(m/s)	6.1	3.6	6.9
rated	(m/s)	16.5	11	21.3
cut-out	(m/s)		none	
survival	(m/s)		26	36

RATED OUTPUT : (kW) 1 2 5
SUPPLIERS :
Dunlite, Australia
Alternate Energy, USA
Enertech, USA

DW-WINDMACHINES		DW200G	DW400-G
ROTOR	:	horizontal axis; upwind position by means of a tail vane; 12 galvanized steel blades; rotor diameters:	
	(m)	2	4
TRANSMISSION	:	gears running in oil; adjustable stroke	
CONTROL SYSTEMS	:	automatic furling in high winds	
PUMP SYSTEM	:	piston pump with brass cilinders	
TOWERS	:	4-post steel towers	
PRICES (1982)	:	total (appr.)	
	(IRS)	13500	225000
	(US$)	1350	2250
OPERATING WINDSPEEDS:			
cut-in	:	2 - 2.5 m/s	
rated	:	± 7 m/s	
SUPPLIERS	:		
Auto Spare Ind., India			

ECOWATT		
ROTOR	:	horizontal axis; multi-blade rotor with diameter of 10.2 m
PRICES (1983)	:	approx. US$ 20750
RATED POWER	:	15 kW
SUPPLIERS	:	
Ecowatt, France		
Nedergie, the Netherlands		

ELEKTRO (1)		W50	W250
ROTOR	:	vertical axis; 6 blades; heights and diameters:	
	(m)	1 x 0.75	1.3 x 0.66
ELECTR. CONFIG.	:	voltages:	
	(VDC)	6/12/24	12/24/36
CONTROL SYSTEMS	:	none	
WEIGHTS	:	rotor, head + generator	
	(kg)	35	70
PRICES (1982, ex works, ex VAT)	:	rotor, head + generator:	
	(US$)	± 1650	± 2100
SUPPLIERS	:		
Elektro, Switzerland			
Coops & Nieborg, the Netherlands			

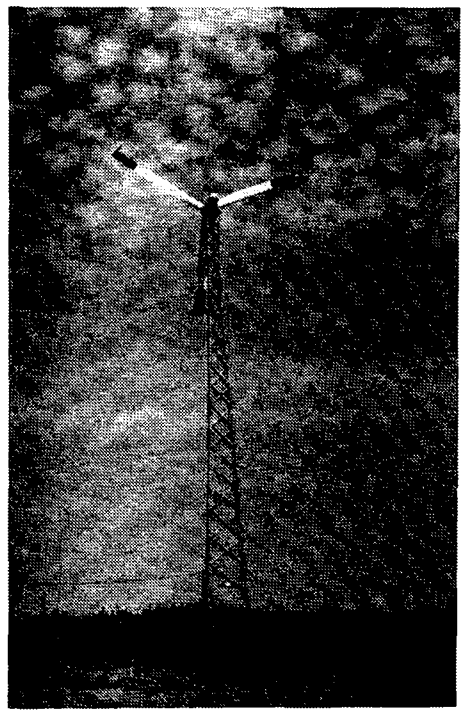
ELEKTRO (2)		WV	05	15	25	35	50	120
ROTOR	:	horizontal axis by means of a tail vane; blades of wood; number of blades and rotor diameters (m)						
	(no.		2	2	2	3	3	3
	(m)		2.5	3	3.6	4.4	5	6
TRANSMISSION	:	direct drive for 2-bladed windmills; gears for others;						
ELECTR. CONFIG.	:	brushless 3 phase AC permanent magnet alternator;						
	(VDC)		12/24/ 36	24/36/ 48	36/48/ 110	48/60/ 110	60/110	110
	(VAC)		-	-	110/90	125/220	125/220	125/220
CONTROL SYSTEMS	:	self feathering blades; half automatic and full automatic system are applicable; handbrake						
TOWERS	:	tubular types with heights of 7.5 10 m; 3 or 4-post self supporting lattice towers of 9 - 20.5 m; all galvanized steel; for the smaller models over-house towers and tower-top adaptor for a wooden pole are also available						
WEIGHTS	:	towers: 130 - 500 kg; rotor + head:						
	(kg)		53	130	165	230	250	310
PRICES (1982, ex works, ex VAT)	:	towers: US$ 600-2500; rotor, head + generator (excl. control panels):						
	(US$)		2400	2600	3350	4500	5200	7800
OPERATING WINDSPEEDS								
cut-in	:	(m/s)	3.2	3.2	3.2	3.2	3.2	3
rated	:	(m/s)	8.5	12.2	12.2	12.2	12.2	13.8
cut-out	:	(m/s)	25	25	25	20	20	20
RATED OUTPUT	:	(W)	500	1000	2200	3800	5400	10000
SUPPLIERS	:							
Elektro, Switzerland								
Coops en Nieborg, the Netherlands								
Alternate Energy Systems, USA								

ELEKTROMAT	HD 06512	HD 312	HD 324
ROTOR	: horizontal axis; upwind position by means of a tail vane; 2 blades of poly-urethaan; diameter 2.4 m (1.44 mm for HD 06512)		
TRANSMISSION	: direct-drive		
ELECTR. CONFIG.	: AC-generator, 16 poles; 12 VDC (for HD 324:24 VDC)		
CONTROL SYSTEMS	: automatic blade pitch control by means of centrifugal force		
TOWERS	: galvanized angle iron tower; height 4 m		
WEIGHTS	: total 150 kg; packed 205 kg		
PRICES	: total:		
(1982, ex works)	(US$)	1650	± 1800-1850
OPERATING WINDSPEEDS			
cut-in	: (m/s) 3	4	4.5
rated	: (m/s) 10	10	14
RATED OUTPUT	: ± 280 W (± 65 W for HD 06512)		
SUPPLIERS	:		
Elektromat, W. Germany			

ELEKTROWATT	
ROTOR	: horizontal axis; upwind position by means of a tail vane; 4 blades of steel or aluminium; rotor diameter 2.7 m;
TRANSMISSION	: single pulley
ELECTR. CONF.	: alternator; 12 Volts; battery storage or driving of an electro pump (12 V, 10 A)
TOWER	: 4-post hub contruction; height ± 2 m; to be mounted on existing objects e.g. rooftop, watertank, pipe
OPERATING WINDSPEEDS	
cut-in	: ± 15 m/s
MAX. OUTPUT	: 360 Watts
SUPPLIERS	:
Watt Hydro Electric Systems, Philippines	

ENAG	1	2
ROTOR	: horizontal axis; upwind position by means of a tail vane; number of blades and rotor diameters (m)	
	(no)	2	3
	(m)	2.35	2.55
ELECTR. CONFIG.	: 24/30 VDC	
CONTROL SYSTEMS	: centrifugal blade feathering	
TOWERS	: tube type;	
OPERATING WINDSPEEDS		
cut-in	: 4 m/s	
rated	: 9-10 m/s	
survival	: 40 m/s	
RATED OUTPUT	: (W) ± 500	
SUPPLIERS	:	
Enag S.A., France		

ENERTECH	1500	1800	4000
ROTOR	: horizontal axis; down wind position; fixed pitch; 3 blades of wood; rotor diameters:		
	(m) 4	4	6
TRANSMISSION	: gears		
ELECTR. CONF.	: 115 VAC, 1 phase, induction generator (for model 1500);		
OPERATING WINDSPEEDS			
cut-in	: (m/s)	4.5	4.5	3.8
rated	: (m/s)	9.5	10.7	
RATED OUTPUT	: (kW)	1.5	2	4
SUPPLIERS	:			
Enertech Co., USA				



FIASA

ROTOR	: horizontal axis; 2 blades of wood; rotor diameter 2.05 m
ELECTR. CONF.	: generator, 12 VDC
TOWER	: lattice tower; height ± 3 m
PRICES (1983)	: approx. US$ 870
RATED OUTPUT	: 400-500 Watts
SUPPLIERS	:
FIASA, Argentina	

FLOWIND

ROTOR	: vertical axis Darrieux rotor; two blades; rotor height 27.5 m;
SUPPLIERS	:
Flowind Corp. U.S.A.	

FMN - Forces Motrices Neuchateloises

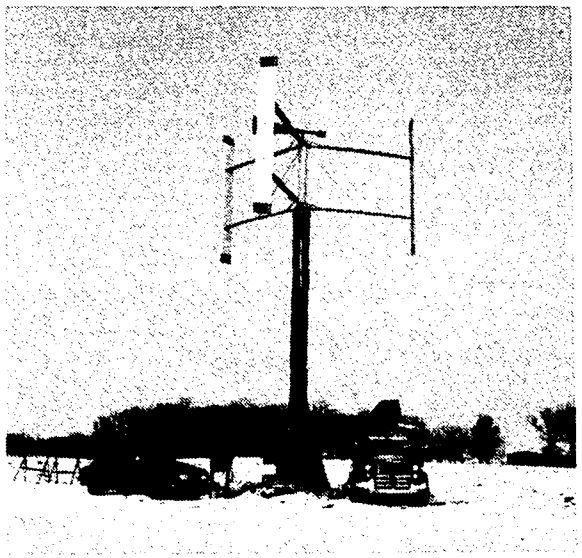
ROTOR	: horizontal axis; upwind position by means of a tail vane; 2 blades of thermoplastic resin and fibreglass; rotor diameter 5 m.
ELECTR. CONFIG.	: permanent magnet rotor without brushes, 3 x 380 VAC; 50 Hz nominal
CONTROL SYSTEMS	: mechanical device limitating the rotational speed
TOWERS	: pole of tubular steel elements of 3 m each
OPERATING WINDSPEEDS	
cut-in	: 4 m/s
rated	: 10 m/s
cut-out	: 41 m/s
survical	: 41 m/s
SUPPLIERS	:
FMN (Panensa), Switzerland	

GALE 4000

ROTOR	: horizontal axis; 2 blades, rotor diameter 12 m
OPERATING WINDSPEEDS	
cut-in	: 2.2 m/s
rated	: 6.0 m/s
RATED OUTPUT	: 4 kW
SUPPLIERS	:
The Gale Co., USA	

GIROMILL 15/2

ROTOR	: vertical axis; 3 blades of aluminium of 5.5 m length; rotor diameter 9 m; blades are coated to prevent corrosian by salty wind
TRANSMISSION	: gearbox 1 : 30
ELECTR. CONFIG.	: AC-alternator; 3 phase 380/220 V
CONTROL SYSTEMS	: centrifugal brakes; security brake (also far off control)
TOWERS	: Corten A steel tube; height 9.94 (total height 14.3 m)
WEIGHTS	: total: 4500 kg
PRICES	: total (excl. foundation): ± US$ 24.500/-
(1982, ex works; excl. VAT)	
OPERATING WINDSPEEDS	
cut-in	: 4.5 m/s
rated	: 13 m/s
cut-out	: 25 m/s
survival	: 40 m/s
RATED OUTPUT	: 15 kW
SUPPLIERS	:
Dansk Vindkraft Industrie, Denmark	
Raalter Project Beheer, the Netherlands	



H-ENERGIESYSTEMEN		HE1000	HE1500	HE2000
ROTOR	: horizontal axis; upwind position by means of a servo-system; 3 blades of glass fibre reinforced polyester; rotor diameters;			
	(m)	10	15	20
TRANSMISSION	: two-stage gears system; ratio depends on situation			
ELECTR. CONF.	: 3 phase asynchronous machine			
CONTROL SYSTEMS	: servo turns rotor out of the wind at high windspeeds			
TOWERS	: tapered tube type tower, galvanized steel; free standing; heights:			
	(m)	15	20	20
PRICES (1983, ex works, ex VAT)	: total (excl. foundation) (approx.):			
	(Dfl.)	55,000	115,000	220,000
	(US$)	20,750	43,400	83,000
OPERATING WINDSPEEDS				
cut-in	: depends on situation			
rated	: depends on situation			
cut-out	: 17 m/s			
survival	: 40 m/s			
RATED POWER	: (kW)	15-30	30-75	55-135
SUPPLIERS	:			

H-Energiesystemen, the Netherlands

HINTON		3A	3B	3C
ROTOR	: horizontal axis; upwind position by means of a tail vane; 2 blades of epoxy fibreglass; rotor diameters 3.4 m			
TRANSMISSION	: gears; ratio 21:1 (for 3A and 3B), 10:1 (for 3C)			
ELECTR. CONFIG.	: synchronous alternator (for 3A and 3B), induction generator (for 3C); voltages			
	(V)	120 DC	48 DC	120 AC
CONTROL SYSTEMS	: air brake by 2 small centrifugally operated governing blades			
TOWERS	: 3 post with height 7.6 m; pedestal type with height 12.2 m			
WEIGHTS	: rotor + head			
	(kg)	65	65	80
	packing for rotor + head : 5 kg			
PRICES (1980, f.o.b.)	: rotor + head			
	(US$)	1895	1995	2085
	towers: 3-post tower: US$ 369, pedestal: US$ 550			
OPERATING WINDSPEEDS				
cut-in	: 4.5 m/s			
rated	: 13 m/s			
RATED OUTPUT	: (kW)	3	3	2-3
SUPPLIERS	:			

Hinton Research, USA

HUMBLOT	Ideolec 80	400	600	800	900	2000
ROTOR	: horizontal axis; upwind position by means of a tail vane; blades of ..; number of blades and rotor diameters (m):					
	(no)	2	3	3	3	3	2
	(m)	1.4	3.6	2.5	3.2	3.6	4.55
TRANSMISSION	: direct drive (models 80,600), gears (models 400, 900, 2000) or direct elastic coupling (models 800, 900)					
ELECTR. CONFIG.	: models 80 and 400 high-rpm generator, 12 or 24 VDC; other models low-rpm generator, 24 VDC; also inverters to 220 VAC, single phase are available					
CONTROL SYSTEMS	: automatic; manual stall					
TOWERS	: 4-post galvanized steel towers; heights up to					
	(m)	6	8	8	8	8	12.5
WEIGHTS	: rotor, head + generator:					
	(kg)	17					
PRICES (1982, ex works, ex VAT)	: rotor, head + generator (approx.):					
	(FF)	8.750	18.500	16.000	18.150	17-21.000	
	(US $) ±	1300	2750	2400	2700	2500-3150	
	towers up to (approx.):					
	(FF)	5.000	7.000	7.000	7.000	7.000	
	(US $)	750	1050	1050	1050	1050	
	model 2000: rotor, head, generator, control panel and 4.5 m tower FF 48.000/US $ 7150; tower extension up to FF 6.000/ US $ 900						
MAX. POWER	: (W)	80	400	600	800	900	1500
SUPPLIERS	:						
Humblot Eoliennes, France							

HUMBLOT	Ideolec (+ Eolchauf) 3000	5000	Eolmotor 5000
ROTOR	: horizontal axis; upwind position by means of a tail vane; 3 blades; rotor diameters:		
	(m)	4.55	8	8
TRANSMISSION	: for Ideolec/Eolchauf types: gears, ratio adjustable from 1:2.5 to 1:12 1:4 to 1:10		
	for Eolmotor: vertical rotating axis, generator to be mounted in the tower		
ELECTR. CONFIG.	: 24 VDC	220/380, 3 phases	220/380, 3 phases or 48 VDC
CONTROL SYSTEMS	: automatic		
TOWERS	: 4-post galvanized steel towers; heights up to		
	(m)	12.5	17	17
PRICES (1982, ex works, ex VAT)	: rotor, head, generator and control panel and 4.5 resp. 5 m tower (type Ideolec):		
	(FF)	57.000	123.000	
	(US $)	± 8500	± 18300	
	rotor, head and generator and 4.5 resp. 5 m tower (type Eolchauf, for water heating):		
	(FF)	49.800	111.000-113.000	
	(US $)	± 7400	± 16.400-16.800	
	rotor + head for Eolmotor: FF 103.000/US $ 15.300		
	generator 48 VDC FF 14.300/US $ 2150		
	alternator 220/380 V, 3 phases, FF 10.000/US $ 1500		
	towers extensions up to		
	(FF)	6.200	12.700	12.700
	(US $)	950	1900	1900
MAX. POWER	: (W)	1500	5000	5000
SUPPLIERS	:			
Humblot Eoliennes, France				

HWT		6	9	12	15
ROTOR	: horizontal axis; 8 blades; rotor diameters:				
	(m)	5.5	6.1	6.7	7.3
OPERATING WINDSPEEDS					
cut-in	: 3.9 m/s				
rated	: 11.0 m/s				
RATED OUTPUT	: (kW)	6	9	12	15
SUPPLIERS	:				
Environmental Energies, USA					

JACOBS	
ROTOR	: horizontal axis; 3 blades; rotor diameter 7 m
PRICES (1982)	: ± US$ 20,000 (tower included);
OPERATING WINDSPEEDS	
cut-in	: 3.2 m/s
rated	: 12 m/s
RATED OUTPUT	: 10 kW
SUPPLIERS	:
Jacobs Wind Electric, USA	

JWP		6W	65W	3kW	10kW
ROTOR	: vertical axis; 2 blades, Savonius type rotor; can be supplied with wind collecting plates; heights:				
	(m)		1.2	2.5	
TRANSMISSION	: over-drive gear				
ELECTR. CONFIG.	: (VDC)	6	24	24	24
TOWER	: no tower, only a small pedestal				
CONTROL SYSTEMS	: automatic control against overcharging of batteries				
PRICES	: vertical axis windmills (total, excl. batteries):				
	(with wind coll. plates) (US$)			20,000	60,000
	(without " " ") (US$)			18,000	30,000
	propellor type: (US$)			15,000	30,000
OPERATING WINDSPEEDS					
cut-in	: (m/s)	5		2(3)	2(3)
rated	: (m/s)			10(13.5)	10(13.5)
cut-out	: (m/s)			40	40
survival	: (m/s)			60	60

(values between brackets indicate speeds of windmills 'without' collecting plates, other values indicate 'with'-plate types)
Propellor types start at ± 3 m/s, with rated speed of 9 m/s.

RATED OUTPUT	:	6W	65W	3kW	10kW
	(propellor types have 3kW and 10kW)				
SUPPLIERS	:				
Japan Wind Power Generators Co., Japan					

JYDSK	JV 55 A 15
ROTOR	: horizontal axis; upwind position by means of a tail vane; 3 blades of fibre glass reinforced polyester; rotor diameter 8.4 m
TRANSMISSION	: gearbox; ratio 12.9 : 1
ELECTR. CONFIG.	: asynchronous generator; 3 x 380 V; can be connected to the grid
CONTROL SYSTEMS	: electronic control of blade pitch angle; mechanical disk brake
TOWERS	: steel tube with steel guy wires
OPERATING WINDSPEEDS	
cut-in	: 4.5 m/s
rated	: 10 m/s
SUPPLIERS	:
Jydsk Vindkraft, Denmark	

JYOTI		40	100	350	1000
ROTOR	: horizontal axis; upwind position by means of a tail vane; seasoned teakwood blades with FRP coating; fixed pitch; number of blades and rotor diameters (m):				
	(no)	2	2	3	3
	(m)	2.4	2.7	5.9	
TRANSMISSION	: gears with total ratio of 1:	6.75	11	4	8
ELECTR. CONF.	: for models 40 and 100: DC-generator, 12 Volts; for models 350 and 1000: 3 phase, 110 V variable speed generator; models 350 and 1000 can be supplied with variable speed motor electrical pumpset				
CONTROL SYSTEMS	: automatic yawing in high winds by offset axis and spring-loaded tail vane; a manual brake is also provided				
WEIGHTS	: total (shipping weight):				
	(kg)	230	300	750	1300
PRICES (1983, excl. VAT)	: total (rotor, head, generator and tower):				
	(IRs)	4,995	7,995	21,995	92,000
	(US$)	525	850	2,500	10,000
OPERATING WINDSPEEDS					
cut-in	: 2.2 - 2.8 m/s				
rated	: 4.4 m/s				
cut-out	: ± 11 m/s				
survival	: ± 42 m/s				
RATED OUTPUT	: (W)	40	100	350	1000
MAX. OUTPUT	: (W)	150	250	1200	3400
SUPPLIERS	:				
Jyoti, India					

KAMAN	40
ROTOR	: horizontal axis; 2 blades; rotor diameter 19.5 m
OPERATING WINDSPEEDS	
cut-in	: 4.5 m/s
rated	: 9 m/s
RATED OUTPUT	: 40 kW
SUPPLIERS	:
Kaman Aerospace, USA	

KEDCO (1)		1200	1600	1205	1605
ROTOR	: horizontal axis; downwind position; 3 blades of aluminium; rotor diameters:				
	(m)	3.7	4.9	3.7	4.9
TRANSMISSION	: gears; ratio 8.75:1				
ELECTR. CONFIG.	: alternator, voltage				
	(V DC)	12	12	24	24
CONTROL SYSTEMS	: automatic blade feathering by mechanical control; automatic vibration sensing shut-off; ground shut-off/reset cables				
WEIGHTS	: domestic shipping crate: ± 68 kg; rotor + head:				
	(kg)	92	98	92	98
PRICES (1980, f.o.b.)	: rotor + head				
	(US$)	3300	3900	3350	3950
OPERATING WINDSPEEDS					
cut-in	: (m/s)	3.1	3.1	3.5	3.1
rated	: (m/s)	10	7.6	10	8.9
cut-out	: (m/s)	31	26.5	31	26.5
RATED OUTPUT	: (kW)	1.2	1.2	1.2	1.9
SUPPLIERS	:				
Kedco, USA					

KEDCO (2)		1210	1610	1620	1840
ROTOR	: horizontal axis; downwind position; 3 blades of aluminium; rotor diameter:				
	(m)	3.7	4.9	4.9	5.5
TRANSMISSION	: gears, ratio	8.75:1	8.75:1	8.75:1	14.75:1
ELECTR. CONFIG.	: for model 1840: DC alternator 48 V; for others: permanent magnet generator with variable voltage up to:				
	(V DC)	180	180	200	-
CONTROL SYSTEMS	: automatic blade feathering by mechanical control; automatic vibration sensing shut-off; ground shut-off/reset cables				
WEIGHTS	: domestic shipping crate ± 68 kg; rotor + head:				
	(kg)	114	121	133	119
PRICES (1980, f.o.b.)	: rotor + head				
	(US$)	3600	4200	4500	4975
OPERATING WINDSPEEDS					
cut-in	: (m/s)	4.9	4.4	4.9	4.5
rated	: (m/s)	11.6	10	11.1	11.2
cut-out	: (m/s)	31	26.5	26.5	26.5
RATED OUTPUT	: (kW)	2	2	3	5
SUPPLIERS	:				
Kedco, USA					

KONGSTED	
ROTOR	: horizontal axis; upwind position by means of a tail vane; 3 blades of laminated wood (pitch pine) and 8 mm Bowa Veneer; rotor diameter 10 m
TRANSMISSION	: gearbox
ELECTR. CONFIG.	: asynchronous; 3 x 380 V, 50 Hz
CONTROL SYSTEMS	: farthest part of the blades acts as an air brake
TOWERS	: height 18 m
WEIGHTS	: rotor + head: ± 2000 kg; tower: ± 3000 kg
OPERATING WINDSPEEDS	
cut-in	: 4 m/s
rated	: 5 m/s
cut-out	: 14 m/s
survival	: 45 m/s
SUPPLIERS	:
Egebjerggård (O & K. Hansen), Denmark	

KURIANT KE5/15K

ROTOR	: horizontal axis; upwind position by means of a servo; 3 blades of glass fibre; rotor diameter 10 m
TRANSMISSION	: gears
ELECTR. CONF.	: asynchronous machines;
CONTROL SYSTEM	: blade tip act as air brake; hydraulic drum brakes
TOWERS	: guyed lattice mast; height 12 m (15 or 18 m optional)
PRICES (1983, excl. VAT)	: total with 12 m tower, excl. foundation: (Dfl.) 50.000/US$ 18900
OPERATING WINDSPEEDS	
cut-in	: ± 4 m/s
RATED POWER	: (kW) 15 kW
SUPPLIERS	:

Kuriant Maskinfabrik, Denmark
Nedergie, the Netherlands

Lagerwey
v.d. Loenhorst

LAGERWEY V/D LOENHORST single and multi wind turbines

ROTOR	: horizontal axis; upwind position by means of an impeller; 3 blades of wood; diameter 10.6 m; other models are available, using the same rotors, installed as twins (or more) on one mast
TRANSMISSION	: gears, ratio 17:1;
ELECTR. CONFIG.	: asynchronous generator, 3 x 380 VAC, 50 Hz; operates in connection with the grid; also synchronous machines can be supplied
CONTROL SYSTEMS	: variable pitch
TOWERS	: steel tubes; heights 18, 24 or 36 m
PRICES (1983, ex-works, excl. VAT)	: standard 10.6 m windmill with 24 m tower (excl. foundation): Dfl. ± 75.000 / US$ ± 28.300; prices of multi-wind turbines at request
OPERATING WINDSPEEDS	
cut-in	: ± 4 m/s
rated	: 10-12 m/s
cut-out	: ± 30 m/s
RATED OUTPUT	: 10-15 kW or multiple of this for multi-wind turbines
SUPPLIERS	:

Lagerwey v/d Loenhorst, the Netherlands

LMW

ROTOR	: horizontal axis; upwind position by means of a tail vane; 2 wooden blades (for model 800 also 3 blades and/or polyester blades are possible); rotor diameter:			
	(m)	2.0	2.2	
ELECTR. CONF.	: 12 or 24 VDC			
CONTROL SYSTEMS	: for model 600: (ecliptic) yawing system for model 800: pitch control system			
TOWERS	: can be mounted on mast			
PRICES (1983, excl. VAT)	: rotor, haed and generator (approx):			
	(Dfl)	1270	1860	
	(US$)	480	700	
OPERATING WINDSPEEDS				
cut-in	: 4 m/s			
rated	: 15 m/s			
RATED POWER	: (W)	600	800	2200
SUPPLIERS	:			

LMW, the Netherlands

LUBING	M 022-3G
ROTOR	: horizontal axis; downwind postion, 3 blades of epoxy resins reinforced with glass fibre; 3 additional small blades for easy start-up; rotor diameter 2.2 m;
TRANSMISSION	: two stage gears in oil-bath
ELECTR. CONFIG.	: brushless AC-generator; 24 V DC
CONTROL SYSTEMS	: automatic centrifugal governor
TOWERS	: tubular aluminium mast; heights 6,9 or 12 m; hub height 1 m
OPERATING WINDSPEEDS	
cut-in	: 3.5 - 4 m/s
MAX. OUTPUT	: 400 W
SUPPLIERS	:
Lubing, W.-Germany	

LWT		8	14	21	26	50
ROTOR	: horizontal axis; 4 blades; rotor diameters:					
	(m)	2.4	4.3	6.	7.7	14.8
OPERATING WINDSPEEDS						
cut-in	: (m/s)	4.9	5.4	5.4	5.4	5.4
rated	: (m/s)	11.6	11.6	11.6	11.6	11.6
RATED OUTPUT	: (kW)	2.5	8	12	26	100
SUPPLIERS	:					
Lebost, Turbines, USA						

McDONNEL	Giromill
ROTOR	: vertical axis; 3 blades; rotor diameter 17.7 m
OPERATING WINDSPEEDS	
cut-in	: 5.4 m/s
rated	: 9 m/s
RATED OUTPUT	: 40 kW
SUPPLIERS	:
McDonnel Aircraft, USA	

MEGATECH	W1P A1
ROTOR	: horizontal axis; 2 blades; rotor diameter 2.0 m
OPERATING WINDSPEEDS	
cut-in	: 2.7 m/s
rated	: 12.2 m/s
RATED OUTPUT	: 0.4 kW
SUPPLIERS	:
Megatech, USA	

MEHRKAM		40 kW	100 kW
ROTOR	: horizontal axis; downwind position; 6 blades of aluminium;		
	diameters	10.7 m	18 m
TRANSMISSION	: gears		
ELECTR. CONFIG.	: induction generator; all voltages available		
CONTROL SYSTEMS	: electrical yawing system; overspeed brake; automatic gust control (shut-down)		
TOWERS	: tube; height	12-18 m	19.5 m
WEIGHTS	: rotor + head	1200 kg	3000 kg
	tower	2040 kg	4800 kg
PRICES (1980)	: total US$	22230/-	60000/-
OPERATING WINDSPEEDS			
cut-in	: 3 m/s		
rated	: 11 m/s		
cut-out	: 17.5 m/s		
MAX. OUTPUT	: (kW)	40	100
SUPPLIERS	:		
Mehrkam, USA			

MILLVILLE	10-3-Ind./SE.
ROTOR	: horizontal axis; upwind position by means of a tail vane; 3 blades of aluminium; diameter 7.6 m
TRANSMISSION	: gearbox, 3 stages; ratio 24:1;
ELECTR. CONFIG.	: AC-induction generator, nominal 60 Hz (10-3-Ind. model); output voltage 115-230 V AC
CONTROL SYSTEMS	: mechanical, blade feathering, rotor turns edgewise to excessive winds
TOWERS	: tube; heights 12.2 - 30.5 m
WEIGHTS	: rotor 104 kg;
OPERATING WINDSPEEDS	
cut-in	: 4 m/s
rated	: 11 m/s
cut-out	: 27 m/s
survival	: 54 m/s
RATED OUTPUT	: 10 kW
SUPPLIERS	:
Millville Windmills, USA	

MULTIMETAAL	
ROTOR	: horizontal axis; downwind position; 3 blades; rotor diameter 11 m;
ELECTR. CONF.	: asynchronous machine; to be connected to the grid
PRICES (1983, excl. VAT)	: total with 20 m tower (excl. foundation): Dfl. 77.000 / US$ ± 30.000
MAX. POWER	: 22 kW
SUPPLIERS	:
Multimetaal, the Netherlands	

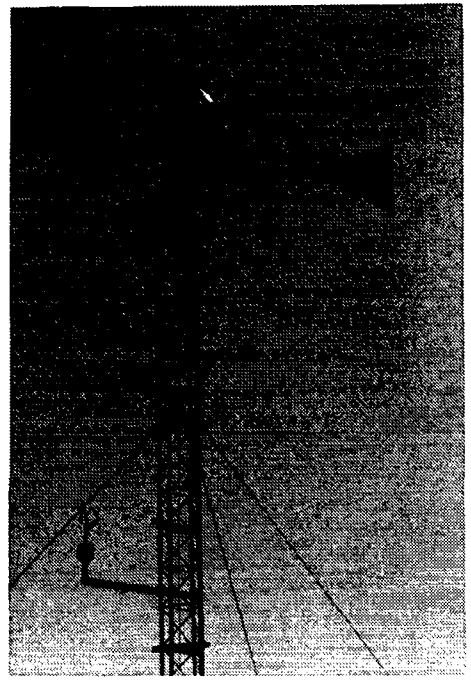
NEYRTEC	
ROTOR	: horizontal axis; downwind position; 3 blades; rotor diameters 8 - 35 m
TRANSMISSION	: gearwheels; ratio adjustable from 27 - 31:1
ELECTR. CONFIG.	: for 35 m diameter: 3000 V AC or DC
CONTROL SYSTEMS	: variable pitch
OPERATING WINDSPEEDS	
cut-in	: 3.5 - 5 m/s
cut-out	: ± 20 m/s
RATED OUTPUT	: 5 - 100 kW
SUPPLIERS	:
Alsthom - Atlantique Neyrtec, France	

NOAH		30/90	15/45	45/130
ROTOR	: horizontal axis; upwind position by means of a tail vane; blades of aluminium or fibreglass; rotor diameters (m) and number of blades:			
	(m)	12	12	16
	(no)	6	3	3
	(also other types available 2 - 600 kW rated power)			
TRANSMISSION	: direct drive			
ELECTR. CONFIG.	: permanent magnets, 220 V			
CONTROL SYSTEMS	: electrical and mechanical			
TOWERS	: lattice type; heights 12 - 18 m			
OPERATING WINDSPEEDS				
cut-in	: (m/s) 3			
rated	: (m/s) 9			
cut-out	: (m/s) 15			
RATED OUTPUT	: (kW)	30	15	45
	(kW, max)	90	45	130
SUPPLIERS	:			
Noah Energie Systeme, W-Germany				

NORDTANK		TN 1	TN 2	TN 3	TN 4	TN 5
ROTOR	: horizontal axis; 3 blades of glassfibre reïnforced polyester; rotor diameters					
	(m)	11	11	15	15	17
TRANSMISSION	: gears					
ELECTR. CONFIG.	: two generators asynchronous machines, 3-phase, 380 - 400 V; to be connected to the general grid;					
CONTROL SYSTEMS	: electronic vane control; centrifugally controlled brakes at blade tips;					
TOWERS	: Holland towers; heights					
	(m)	18	18	18	18	22
PRICES (1983, excl. VAT)	: total, incl. tower, excl. foundation: Dfl. 90,000 - 135,000/US$ 34,000 - 51,000					
RATED OUTPUT	: (kW)	22	30	45	55	55
	and (kW)	7.5	7.5	11	11	11
SUPPLIERS	:					
* Jydsk Tankwagen, Denmark						
* Tolsma 2000, The Netherlands						

NORDVESTSJAELLAND		VM 10	VM 15
ROTOR	: horizontal axis; upwind position by means of a tail vane; 3 blades of laminated wood (model VM 10) or glasfiber (model VM 15); rotordiameter 10 m and 15 m resp.		
TRANSMISSION	: gears	17:1	20:1
ELECTR. CONFIG.	: 2 asynchronous machines; 3x380 V		
CONTROL SYSTEMS	: stall overspeed control; automatic shut-down		
TOWERS	: lattice; height 18 m		
WEIGHTS	: rotor + head	1500 kg	3200 kg
	tower	2100 kg	3900 kg
PRICES (1980)	: total (US$)	20000	35000
OPERATING WINDSPEEDS			
cut-in	: (m/s)	4 - 5	5 - 6
rated	: (m/s)	12	12
cut-out	: (m/s)	18	18
MAX. OUTPUT	: (kW)	22	55
SUPPLIERS	:		
Nordvestsjaelland, Denmark			

NORTH WIND	HR 2
ROTOR	: horizontal axis; upwind position by means of a tail vane; 3 blades of sitka spruce; diameter 5m.
TRANSMISSION	: direct drive
ELECTR. CONF.	: synchronous alternator (Lundell type); 3 phases; output voltage 24, 32, 48, 110 or 220 V DC
CONTROL SYSTEMS	: overspeed control by variable axis rotor control system (VARCS): the rotor/alternator assembly pitches back to the vertical axis
TOWER	: height 12 m (minimum); lattice; guyed or self-supporting towers manufactured by Unarco Rohn Tower Co.
WEIGHTS	: rotor + head 365 kg; tower (12 m) 545 kg
PRICES (1982)	: total: ± US$ 12,000
OPERATING WINDSPEEDS:	
cut-in	: 3.6 m/s
rated	: 9 m/s
cut-off	: 47 m/s
survival	: 74 m/s
RATED OUTPUT	: 2000 Watts
SUPPLIERS	:
* North Wind Power, USA	



North Wind

P.I.	Aerogenerator	P.I. 6 m
ROTOR	: vertical axis; rotor diameter, length of blades and blade material:	
	(rotor) 4.5 m	6 m
	(blade) 3 m	3 m
	(material) coated wood	al alloy + plastic with glas reinf.
CONTROL SYSTEMS	: variable geometry; electronic load control	
TOWERS	: aluminium tube	flanged steel tube
	heights (m) 4.75	7
SUPPLIERS	:	
P.I. Specialist Eng., England		

POLENKO	WPS-A/SM	5	10	11	16	18
ROTOR	: horizontal axis; upwind position by means of two impellers; 3 blades of epoxy coated steel sheet; fixed pitch; rotor diameters:					
	(m)	5	9.7	11.5	16	18
TRANSMISSION	: gears					
ELECTR. CONFIG.	: A-types have asynchronous generators for direct connection to the grid; SM-types have synchronous generator for autonomous operation; the windmills have two generators; 220/380 VAC, 3 phase; the WPS5 can also be supplied with electropump (as model P4);					
CONTROL SYSTEMS	: tip flap control, brakes (automatic and manual); protection against over/under voltage, open circuit or cable failure, overload, over/under speed, frequency variation					
TOWERS	: tubular steel, tapered tower; standard heigt 19.5 m (height rotor shaft 20 m); higher towers available (upto 30 m); for WPS5 standard height is 10 m (rotor shaft height);					
PRICES (1983, ex works, excl. VAT)	: rotor, head, generator, standard tower + control system: for A-machines (approx):					
	(Dfl.)	19,600	54,600	99,400	136,000	205,000
	(US$)	7,400	20,600	37,500	51,300	77,400
	for SM-machines (approx):					
	(Dfl.)	21,200	64,500	112,500	148,500	222,500
	(US$)	8,000	24,300	42,500	56,000	84,000
OPERATING WINDSPEEDS						
cut-in	: (m/s)		3.2	3.3	3.4	
rated	: (m/s)		9.5	11.6	11.2	
cut-out	: (m/s)		20	20	20	
RATED OUTPUT	: (KW)	3.5	20	40	60	100
SUPPLIERS	:					
Polenko, the Netherlands						

POLYMARIN	VAWT 15
ROTOR	: vertical axis; 2 blades; rotor diameter 15 m
ELECTR. CONF.	: direct current machine with mutator
TOWERS	: height 21.5 m for total installation
PRICES (1982, excl. VAT)	: total (excl. foundation):
	Dfl. 300,000 / US$ 113,200
OPERATING WINDSPEEDS	
rated	: 17 m/s
RATED OUTPUT	: ± 100 kW
SUPPLIERS	:
Polymarin, the Netherlands	

PONCELET	4550	8000
ROTOR	: horizontal axis; upwind position by means of a tail vane; 3 blades of fibreglass; rotor diameters:	
	(m) 4.55	8
TRANSMISSION	: gears in oil bath; ratio	
	6.2	10.9
ELECTR. CONFIG.	: 28 V DC	220 - 380 V AC
CONTROL SYSTEMS	: variable pitch; manual brake system	
TOWERS	: lattice type; heights 12 - 18 m	
WEIGHTS	: rotor + head (kg) 250	700
	tower (kg) 800	1500
PRICES (1980, f.o.b.)	: rotor + head (US$): 5000	12000
	tower (US$): 2000	3300
OPERATING WINDSPEEDS		
cut-in	: (m/s) 4	3
rated	: (m/s) 8	9
cut-out	: (m/s) 25	25
SUPPLIERS	:	
Poncelet (Ets.), Belgium		

RIISAGER	37	45	55	75/22	90/22	34/125
ROTOR	horizontal axis; upwind position by means of two impellers; 3 blades of fibreglass; rotor diameters:					
(m)	14	14	14	16	16	16
TRANSMISSION	gears					
ELECTR. CONFIG.	asynchronous machines; 3 phases, 380 V					
CONTROL SYSTEMS	blade tips act as air brake; mechanical disc brakes;					
TOWERS	4-post galvanized steel tower; standard height 18 m (other heights are possible)					
PRICES (1983)	total, excl. foundation (approx.):					
(US$)	49500	51500	53800			
OPERATING WINDSPEEDS						
cut-in	5.5 - 6 m/s					
rated	10 - 11.5 m/s					
cut-out	20 - 24 m/s					
RATED POWER	main generator/extra generator					
(kW)	37	45	55	72/55	90/22	34/125
SUPPLIERS						
Riisager, Denmark						
Verbakel, the Netherlands						

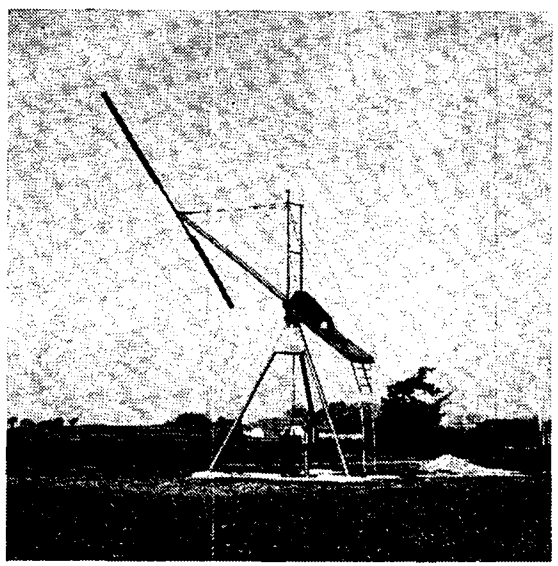
SANCKEN	various models
ROTOR	horizontal axis; 3 blades
OPERATING WINDSPEEDS	
cut-in	2.2 m/s
rated	13.4 m/s
RATED OUTPUT	0.1 kW, 0.5 kW, 1 kW
SUPPLIERS	
Sancken Wind Electric, USA	

SENCENBAUGH	500-14	500-14 HDS	1000-14
ROTOR	horizontal axis; upwind position by means of a tail vane; 3 blades of 'Sitka Spruce' wood; rotor diameters:		
(m)	2.03	2.03	3.65
TRANSMISSION	direct	direct	helical gears ratio 1:3
ELECTR. CONFIG.	(VDC) 12/24/48	12	12/24/48
	1000-14 model has a 3 phase, 6 pole alternator, rectified to DC		
CONTROL SYSTEMS	all models fully turning out of the wind		
TOWERS	'Rohn' tower available in selfsupporting and guyed models; heights 15 to 30 m		
PRICES (1983, f.o.b.)	rotor + head:		
(US$)	2295	1780	3600
	towers from US$ 950 up to US$ 2600		
OPERATING WINDSPEEDS			
cut-in	(m/s) 3.8	3.8	3.1
rated	(m/s) 9.8	9.8	9.8
survival	(m/s) 58	45	35.8
RATED OUTPUT	(rated, W) 500	500	1000
	(max., W) 600	550	1200
	(at 13.4 m/s) 900 (24V)		
SUPPLIERS			
Sencenbaugh, USA			

POULSEN 30/5.5

ROTOR	: rotor axis inclined 30° to horizontal; downwind position; 2 blades of extruded aluminium; rotor diameter 13 m
TRANSMISSION	: gears 1:12.5
ELECTR. CONFIG.	: main generator: asynchronous, 4 poles; auxiliary generator; asynchronous, 8 poles, comes into operation at low windspeeds; 3 x 380 V
CONTROL SYSTEMS	: mechanical disc brake + centrifugally activated blade tip drag flaps; stalls at 36 kW; automatic shut-down in case of power failure
TOWERS	: tripod with heights of 6 m; height of the rotor centre 12 m
WEIGHTS	: rotor + head: 1100 kg; tower 350 kg
PRICES (1980)	: US$ 20000
OPERATING WINDSPEEDS	
cut-in	: 3.5 m/s
rated	: 10 m/s
MAX. OUTPUT	: 36 kW
SUPPLIERS	:

Poulsen (U.), Denmark



PROENGIN G4 G7DH

ROTOR	: vertical axis Darrieux type rotor; 3 blades of light anodic oxidized alloy and stainless steel; diameter x heights;		
	(m)	0.2 x 0.33	0.2 x 0.65
ELECTR. CONF.	: AC-generator (brushless); 12 or 24 V DC output		
TOWER	: not included; to be mounted on mast or rigid support		
WEIGHTS	: (kg)	2.7	4.2
PRICES (1982, incl. VAT)	: for 12 V/24 V:		
	(Dfl.)	885/965	1540/1635
	(US$)	335/365	580/615
SUPPLIERS	:		

Proengin, France
Hoebee, the Netherlands

REINKE

ROTOR	: horizontal axis; 3 blades; rotor diameter 5.8 m
OPERATING WINDSPEEDS	
cut-in	: 2.5 m/s
rated	: 11 m/s
RATED OUTPUT	: 5 kW
SUPPLIERS	:

American Energy Savers, USA

SKY-HAWK	SH2	SH4
ROTOR	horizontal axis; upwind position by means of a tail vane; 3 blades of sitka spruce with stainless steel leading edge; rotor diameters:	
	(m) 4.1	4.6
TRANSMISSION	direct drive	
ELECTR. CONFIG.	DC-generator, slow speed, 6 poles, 4 brushes, self-excited; several output voltages	
CONTROL SYSTEMS	variable pitch speed control; manual shut-down (automatic shut-down optional); lightning protection	
TOWERS	guyed, free standing and tapered (UNARCO-Rohn or Valmont Ind.)	
WEIGHTS	rotor + head: 220 kg, resp. 272 kg	
PRICES (1980)	rotor + head	
	(US$) 6045	7995 (standard)
	6545	8500 (Sea Breeze)
	7750	10095 (High Reliabilily)
OPERATING WINDSPEEDS		
cut-in	3.6 m/s	
rated	10.1 m/s	
cut-out	22 m/s	
survival	22 m/s	(recommended manual shut-down)
RATED OUTPUT	4 kW	
SUPPLIERS		
Independent Energy Systems, USA		

SMEDEMESTERMØLLEN (= NIVE-møllen)	1	2	3	4
ROTOR	horizontal axis; upwind position by means of two impellers; 3 blades of glassfibre reinforced polyester; rotor diameter:			
	(m) 10	10	12	16
TRANSMISSION	gearbox;			
ELECTR. CONFIG.	asynchronous generator; connected to the grid; output voltage 3 x 380 V + 0			
CONTROL SYSTEMS	farthes part of the blades is acting as an air-brake in case of overspeed; electric control for irregularites or breakdown			
TOWERS	4-post galvanized lattice; heights 18 m (standard)			
PRICES	rotor, head, generator and tower (excl. foundation)			
(1983, excl. VAT) (US$)	22,500/-	26,250/-	30,150/-	47,600/-
OPERATING WINDSPEEDS				
cut-in	4.5 m/s			
rated	15 m/s			
RATED OUTPUT	(max., kW) 3.5/15	5.5/22	7.5/30	55
SUPPLIERS				
Smedemester, Denmark				
Wind Energy Zeeland, the Netherlands				

SOMA	8	10
ROTOR	horizontal axis; fiberglass blades; rotor diameters 2.4 m, resp. 3 m.	
ELECTR. CONF.	permanent magnet alternators, 24 V;	
CONTROL SYSTEMS	centrifugal feathering system	
RATED OUTPUT	(Watts) 600	1000
SUPPLIERS		
Soma, New Zealand		
Bowjon, USA		

SONEBJERG	SM22/12	SM30/12	SM45/12	SM55/12
ROTOR	horizontal axis; upwind position by means of two impellers; 3 blades of fibre-glass and wood; rotor diameters;			
	(m) 10	10	12	14
TRANSMISSION	gears			
ELECTR. CONF.	asynchronous machines; can be connected to the general grid; 3 phases; auxiliary generators for low windspeeds can be supplied			
CONTROL SYSTEM	automatically controlled drum brake; blade tips act as brakes			
TOWERS	4-post-galvanized steel lattice towers; heights 12, 15, 18 or 22.5 m (the latter for types 45 and 55 only)			
WEIGHTS	rotor, head, generator and 12 m tower:			
	(kg) 3100	3200	4100	5300
PRICES (1982, excl. VAT)	total, with 12 m tower, excl. foundation:			
	(Dfl.) 68270	69850	87250	97700
	(US$) ±25800	±26400	±32900	36900
OPERATING WINDSPEEDS				
rated	13 m/s			
RATED OUTPUT	main generator/extra generator			
	(kW) 22/4	30/5.5	45/7.5	55/11
SUPPLIERS				
Sonebjerg, Denmark				
Handelscompagnie, the Netherlands				

STORM MASTER	10-18-IG	10-9-IG	10-8-BC	12
ROTOR	horizontal axis (8 degrees inclination); down wind position; 3 blades of flexible fiberglass; rotor diameter 10 m; (12 m for model 12)			
TRANSMISSION	two stage helical; ratio			
	1:13.9	1:13.9	1:9.2	
ELECTR. CONFIG.	3 phase 240/480 VAC 50 or 60 Hz	1 phase 240/280 VAC	6 pole 48/120/ 240 VAC	
CONTROL SYSTEMS	variable pitch			
TOWERS	needle type			
WEIGHTS	rotor, head + tower: ± 430 kg			
PRICES (1980)	rotor, head + tower (approx.) US$ 20,000 - 22,000 (for models 10)			
OPERATING WINDSPEEDS				
cut-in	m/s	4	4	3
rated	m/s	11	9	8
cut-out	none			
RATED OUTPUT	(kW)	18	9	8
SUPPLIERS				
Wind Power Systems, USA				

SUNFLOWER	57 kW
ROTOR	vertical axis; 3 blades of aluminium; heights; rotor diameter 19.2 m;
TRANSMISSION	V-belt; ratio 28.5:1
ELECTR. CONFIG.	induction generator; 230/460 V
CONTROL SYSTEMS	overspeed brake
WEIGHTS	total ± 15,300 kg;
PRICES (1980, ex works)	total (US $) 50,000/-
OPERATING WINDSPEEDS	
cut-in	5.4 m/s
rated	13.4 m/s
cut-out	26.9 m/s
survival	
RATED OUTPUT	57 kW
SUPPLIERS	
Sunflower, USA	

SUNFLOWER	1500	WW 8 kW
ROTOR	horizontal axis; downwind position; 3 blades; material of the blades and rotor diameters:	
(material)	wood	aluminium
(m)	4	10
TRANSMISSION	gears (2-stage) 11.4:1	direct drive 1:1
ELECTR. CONFIG.	induction generator 115 V AC	alternator 230 V AC
CONTROL SYSTEMS	automatic shut-down by mechanical brake	pitch control
TOWERS	wood pole	steel tube
	heights: optional	
WEIGHTS	rotor + head	
(kg)	136	544
PRICES (1980, ex. works)	rotor + head (approx.)	
(US$)	3495	15000
OPERATING WINDSPEEDS		
cut-in (m/s)	4	4
rated (m/s)	9.3	8.9
cut-out (m/s)	17.9	
survival (m/s)	44.7	
RATED OUTPUT (kW)	1.5	
(max. kW)	1.75 (at 12.1 m/s)	10 kW
SUPPLIERS		
Sunflower Power, USA		

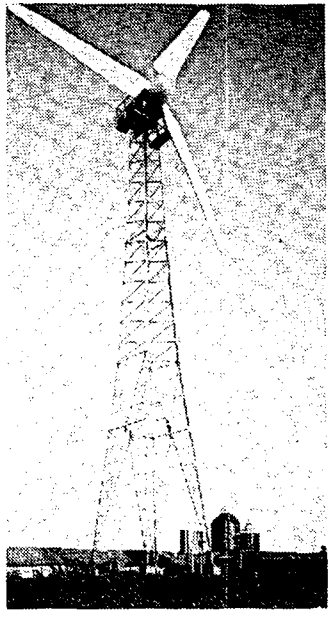
TORNADO	
ROTOR	: horizontal axis; upwind position by means of a tail vane; two blades of epoxy impregnated wood; rotor diameter 2 m.; multi-vane starter propellor;
TRANSMISSION	: direct drive
ELECTR. CONFIG.	: 24 V DC nominal; 3 phase, permanent magnet, brushless generator with silicon diode rectification; (other voltage available)
CONTROL SYSTEMS	: centrifugal air brake and manual parking brake
TOWERS	: galvanised steel lattice tower; height 4 m standard (other heights available);
WEIGHTS	: rotor + head: ± 50 kg; tower ± 100 kg
PRICES (1981, excl. VAT)	: total (without batteries), with 4 m. tower: £ ± 900 / US$ ± 1500
OPERATING WINDSPEEDS	
cut-in	: 4 m/s
rated	: 12 m/s
cut-out	: 14 m/s
RATED OUTPUT	: 500 Watts (max. 1000 Watts)
SUPPLIERS	:
Tornado Wind Generators, England	
Trimble Windmills, England	

TRIMBLEMILL (for heating elements)	
ROTOR	: horizontal axis; upwind position by means of a tail vane; 8 blades (3 front, 5 rear in contrarotation); rotor diameter 6 m
TRANSMISSION	: direct-drive
ELECTR. CONFIG.	: multiple AC-alternator with contrarotation of magnet and coil assemblies
CONTROL SYSTEMS	: automatic furling in high winds; electrical cut-out
TOWERS	: ductile iron unitary construction; standard height 9.3 m
WEIGHTS	: rotor + head ± 500 kg; tower ± 1000 kg
PRICES (1982, ex works)	: total approx. US $ 14,000 - 15,000
OPERATING WINDSPEEDS	
cut-in	: 4,5 m/s
rated	: 10 m/s
cut-out	: 23.6 m/s
survival	:±44 m/s (design)
RATED OUTPUT	: 5000 Watts (at 240 Volts)
MAX. OUTPUT	: 12500 Watts (at 565 Volts)
SUPPLIERS	:
Trimble Windmills, England	

TUMAC		5	10	7050	10
ROTOR	: vertical axis; 3 blades; rotor diameters:				
	(m)	5	10	7.5	10
OPERATING WINDSPEEDS					
cut-in	: m/s			4.7	
rated	: m/s			7.8	
RATED OUTPUT	: (kW)	5	5	6.8	20
SUPPLIERS	:				
Tumac, USA					

VEDANA		VEAS-8	VEAS-30
ROTOR	: horizontal axis; upwind position by means of a tail vane; blades of aluminium, number of blades and rotor diameters		
	(no)	2	3
	(m)	9	17
TRANSMISSION	: planet; ratio;	1:13	1:23
ELECTR. CONFIG.	: induction type generator; 220/380 V;		
CONTROL SYSTEMS	: stall resp. pitch control		
TOWERS	: for VEAS-8: tube; heights 14, 18 or 24 m		
WEIGHTS	: rotor + head:		
	(kg)	900	2000
	towers:		
	(kg)	1000	10.500
PRICES (1980)	: rotor + head: (US$)	9000/-	31,000/-
	towers: (incl. foundation blocks):		
	(US$)	2200/-	10000/-
OPERATING WINDSPEEDS			
cut-in	: m/s	4	4
rated	: m/s	11	10
cut-out	: m/s	20	20
RATED OUTPUT	: (kW)	7.1/15	30/45
SUPPLIERS	:		
Vedana, Denmark			

VENDELBO		10	15
ROTOR	: horizontal axis; upwind position by means of a tail vane; 5 blades of steel plate, covered with poly-paste; rotor diameters (m)	5.5	7
TRANSMISSION	: gears; ratio 1:20		
ELECTR. CONFIG.	: Markom-generator, self-inducing; 380/220 V, 3 phases		
CONTROL SYSTEMS	: blade pitch control by centrifugal force		
TOWERS	: angle iron; heights: (m)	10	12
PRICES (1980)	: rotor, head + tower: (US$)	5500	
RATED OUTPUT	: (max, kW)	10	15
SUPPLIERS	: Vendelbo Trapper, Denmark		



Vestas

VESTAS		HVK10	HVK15
ROTOR	: horizontal axis; upwind position by means of an electronic vane system; 3 blades of glass fibre; rotor diameters; (m)	10	15
TRANSMISSION	: gears		
ELECTR. CONF.	: two asynchronous machines; 380 VAC		
CONTROL SYSTEMS	: blade tips, centrifugally controlled, act as brake system		
TOWERS	: 4-post-galvanized steel tower; heights (m)	18 or 24	18 or 22
PRICES (1983, excl. VAT)	: excl. foundation, with towers 24 resp. 22 m: (Dfl.)	125,000	167,000
	(US$)	± 47,200	± 63,000
OPERATING WINDSPEEDS			
cut-in	: (m/s)	4	4
rated	: (m/s)	14	12.5
cut-out	: (m/s)	22-26	22-26
RATED OUTPUT	: (kW)	30/5.5	55/7.5
SUPPLIERS	: Vestas, Denmark; Intransit, the Netherlands		

VOITH		WEC	10	50
ROTOR	: horizontal axis; 2 blades; rotor diameters: (m)		11.5	24
ELECTR. CONFIG.	: 220 V AC; asynchronous generator, to be connected to a grid;			
TOWERS	: tube type; heights upto 30 m;			
WEIGHTS	: (kg)		1500	6750
OPERATING WINDSPEEDS				
rated	: (m/s)		8	8
RATED OUTPUT	: (kW)		11	58
SUPPLIERS	: VOITH, W. Germany			

VOLUND	15 kW
ROTOR	horizontal axis; downwind position; 2 blades of glass fibre reïnforced polyester; rotor diameter: 8 m;
TRANSMISSION	gears;
ELECTR. CONFIG.	asynchronous generator; 380 V
CONTROL SYSTEMS	automatic pitch control
TOWERS	tube type; height: 18 m;
WEIGHTS	rotor + head:
	(kg) 20,000 50,000
	towers:
	(kg) 6,000 14,000
PRICES	rotor, head + tower (excl. foundation):
(1982, excl. VAT)	± Dfl. 55,000/± US$ 21,000
OPERATING WINDSPEEDS	
cut-in	4 m/s
rated	11 m/s
RATED OUTPUT	15kW
SUPPLIERS	
Volund, Denmark	
'Alphen'-handelsmij., the Netherlands	

WESCO	A 30	A 55
ROTOR	horizontal axis; upwind position by means of a tail vane; 3 blades; rotor diameters:	
(m)	3	5.5
TRANSMISSION	gears; ratio:	1:4	1:8
ELECTR. CONFIG.	3 phases, nominal 380-415 V, 50 Hz	
CONTROL SYSTEMS	variable pitch feathering mechanism; parking brake	
TOWERS	hollow steel, octagonal tower, climbing pegs.; height 9.4 m	
WEIGHTS	rotor + head:	
(kg)	150	225
towers:		
(kg)	425	425
OPERATING WINDSPEEDS		
cut-in	3.5-5 m/s	
rated	10 m/s	
cut-out	50 m/s	
survival	55 m/s	
RATED OUTPUT	(kW)	1.2	4.5
SUPPLIERS		
Wesco-Wind Energy Supply Co, England		

WHIRLWIND	A	3000	AA
ROTOR	horizontal axis; upwind position by means of a mechanical yaw drive system; 2 blades of Sitka spruce; rotor diameters:		
(m)	3.66	4.27	5.5
TRANSMISSION	chain		
ELECTR. CONFIG.	3 phase; voltages		
(V)	32 or 120		32, 120 or 240
CONTROL SYSTEMS	mechanical yaw drive system		
WEIGHTS	rotor + head:		
(kg)	40		72
OPERATING WINDSPEEDS			
cut-in	3.6 m/s		
rated	11.2 m/s		
cut-out	22.4 m/s		
survival	44.7 m/s		
RATED OUTPUT	(KW)	2	3	4
SUPPLIERS			
WhirlWind, USA			

WIMO	W104	W108	W112
ROTOR	horizontal axis; downwind position; 1 blade of reinforced glassfibre; rotor diameter(s)		
(m)	4	8	12
ELECTR. CONF.	asynchronous or synchronous machines; can be connected to the grid;		
CONTROL SYSTEMS	automatic blade pitch control; hydraulic disc-brakes		
TOWERS	tube type; guyed; height 12.3 m.		
OPERATING WINDSPEEDS:			
cut-in	(m/s)		4.5
rated	(m/s)	8	9.7
RATED POWER	(kW)	10	15
SUPPLIERS			
Böwe, W. Germany			
Aadee, the Netherlands			

WINCHARGER		200 W	450 W
ROTOR	: horizontal axis; upwind position by means of a tail vane; 2 blades of wood; rotor diameter:		
	(m)	1.83	2.44
ELECTR. CONFIG.	: 12 or 24 VDC (options); generator with enclosed collector ring		
CONTROL SYSTEMS	: air brake govenar		
TOWERS	: 4-post steel tower; height 3 m.		
WEIGHTS	: (kg)	60	91
PRICES (1982, USA)	: total (excl. batteries)		
	(US$)	± 500-600	± 800-900
OPERATING WINDSPEEDS			
cut-in	: (m/s)	4-4.4	4.8
rated	: (m/s)	10	10
RATED OUTPUT	:	200 W	450 W
SUPPLIERS	:		
Winco (Dyna), USA			
SIM, the Netherlands			

WIND CRAFT		2500	BM 671
ROTOR	: horizontal axis; 3 blades; rotor diameter 4.6 m		
OPERATING WINDSPEEDS			
cut-in	: 4.9 m/s		
rated	: 11.6 m/s		
RATED OUTPUT	: (kW)	2.5	4
SUPPLIERS	:		
Bircher Machine, USA			

WINDFOS		22	30	45	55	75
ROTOR	: horizontal axis; upwind position 3 blades of polyester/ glassfiber; rotor diameters:					
	(m)	10.6	13.2	15.0	16.8	19.4
TRANSMISSION	: high pression helical gear					
ELECTR. CONFIG.	: 380/220 VAC (50 Hz); other voltages on request					
CONTROL SYSTEMS	: automatic control					
TOWERS	: tube type; heights 13-40 meter					
OPERATING WINDSPEEDS						
cut-in	: 4 m/s					
rated	: 13 m/s					
cut-out	: 25 m/s					
RATED OUTPUT	: (rated, kW)	22	30	45	55	75
	(max, kW)	25	34	50	61	83
SUPPLIERS	:					
Windfos, Denmark						

WIN(D)GEN 25		255-100	255-48
ROTOR	: horizontal axis; (10° inclination); downwind position; 3 blades of fiberglass covered aluminium; rotor diameter 12.2 m		
TRANSMISSION	: ratio 1:27.2		
ELECTR. CONFIG.	: 3 phase 60 HZ	110 VDC or 230 or 460 VAC	48 VDC or 230 or 460 VAC
CONTROL SYSTEMS	: dihedral angle in spars; servo motor control + fail safe braking		
TOWERS	: Rohn-towers; free standing heigts: 18.3 (optional: 24.4 or 30.5 m)		
WEIGHTS	: rotor + head ± 1200 kg; tower ± 800 kg;		
PRICES (1980)	: rotor, head + tower: US$ 25,000-28,000		
OPERATING WINDSPEEDS			
cut-in	: (m/s)	4 (DC-model)	4 (DC-model)
		7 (AC-model)	7 (AC-model)
cut-out	: (m/s)	7 (DC-model)	7 (DC-model)
		22 (AC-model)	22 (AC-model)
RATED OUTPUT	: (at 11.2. m/s, W)		
		DC 5,000	2,700
		AC 25,000	25,000
SUPPLIERS	:		
Wind Engineering Corporation, USA			

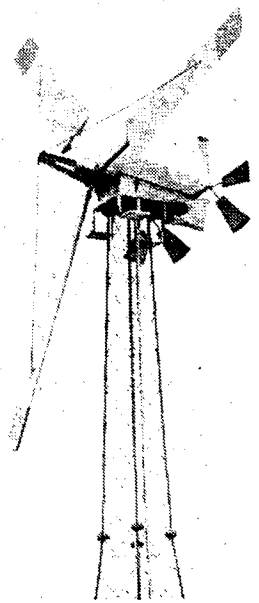
WIND JENNY	4500	6500	8500
ROTOR	: horizontal axis; upwind position by means of a tail vane; 3 blades of fibreglass laminate, poly urethane core; rotor diameter 6.25 m		
TRANSMISSION	: encased, double reduction, helical gears; ratio	13.95 :1	9.87 :1
ELECTR. CONFIG.	: output 240 V AC, 60 Hz		
CONTROL SYSTEMS	: electronic blade pitch control; overspeed control card loss of power control		
TOWERS	: UNARCO Rohn towers; self-supporting; heights 12.2-20 m		
WEIGHTS	: rotor + head:		
	(kg)	313	253
	towers: (18 m)		
	(kg)	714	714
PRICES	: rotor + head:		
(1980)	(US$) 7995		11995
	towers:		
	(US$) 1465-3860		
OPERATING WINDSPEEDS			
cut-in	: m/s 4		
rated	: m/s 8.9		11.2
cut-out	: m/s 44.7		
survival	: m/s 44.7		
RATED OUTPUT	: related kW	6	8
	max kW	8	8

SUPPLIERS :
Product Development Institute, USA

WIND MASTER	10kW8	20kW12	100kW22	150kW22
ROTOR	: horizontal axis; upwind position by means of electric control system; 3 blades of glass fibre reinforced polyester; rotor diameters;			
	(m) 8	12	21.8	21.8
TRANSMISSION	: gears with ratio (various stage):			
	1:16	1:20	1:35.5	1:31.5
ELECTR. CONF.	: asynchronous machines; 220/380 V, 50 Hz; to be connected to the grid; synchronous machines can be supplied also			
CONTROL SYSTEM	: hydraulic blade with pitch control			
TOWERS	: conical steel tubes, galvanized; various heights; standard:			
	(m) 20	20	23	23
PRICES (1982, excl. VAT, ex-works)	: total with tower, excl. foundation (approx.):			
	(Dfl.) 63,900	82,500	387,500	425,000
	(US$) 24,100	31,100	146,200	160,400
OPERATING WINDSPEEDS				
cut-in	: (m/s) 3-4	3-4	3-4	3-4
rated	: (m/s) 10	10	11.4	12.5
cut-out	: (m/s) 22	22	25	25
RATED OUTPUT	: (kW) 10	20	100	150
MAX. OUTPUT	: (kW) 10	20	110 (at 12-13 m/s)	165 (at 12-13 m/s)

SUPPLIERS :
HMZ, Belgium
Rietschoten (van) & Houwens, the Netherlands
Wind Master, USA

WINDMATIC		VM10S	VM12S	VM14S
ROTOR	: horizontal axis; upwind position by means of two impellers; 3 blades of laminated wood and glass fibre; rotor diameters:			
	(m)	10.2	12.5	14.5
TRANSMISSION	: gears			
ELECTR. CONF.	: main generator is a mains-connected asynchronous machine; 380/440 VAC, 50/60 Hz			
CONTROL SYSTEMS	: automatically controlled disc-brake on slow revolving shaft; security wind brakes in blades			
TOWERS	: 4-post lattice steel towers; heights 18 or 22.5 m			
PRICES (1983, excl. VAT)	: (excl. foundation) with 18 m tower:			
	(Dfl.)	± 88,200	105,400	132,100
	(US$)	± 33,300	39,800	49,800
OPERATING WINDSPEEDS				
cut-in	: 4-5 m/s			
rated	: 12 m/s			
cut-out	: above 48 m/s			
RATED OUTPUT	: main generator / extra generator (low power):			
	(kW)	22/4	30/5.5	55/7.5
SUPPLIERS	:			
Windmatic, Denmark				
Dynaf, the Netherlands				



WIND MULE

ROTOR	: vertical axis (Savonius-type)
OPERATING WINDSPEEDS	
cut-in	: 5.4 m/s
rated	: 10.1 m/s
RATED OUTPUT	: 3.7 kW
SUPPLIERS	:
American Freedom Fuel, USA	

WINDPAQ

ROTOR	: horizontal axis; upwind position by means of impellers; 3 blades of wood; rotor diameter 11 m
TRANSMISSION	: gears, ratio 20.8:1
ELECTR. CONF.	: asynchronous machine; can be connected to the grid
CONTROL SYSTEM	: automatic furling in high winds or grid power cuts; variable pitch controlled by centrifugal force
TOWERS	: galvanized steel tube; height ± 18 m
PRICES (1983, excl. VAT)	: total (excl. foundation): Dfl. 47,900/US$ 18,100
MAX. OUTPUT	: 17 kW
SUPPLIERS	:
Paques, the Netherlands	

WIND-POWER S.J. (for heating purposes)

(also available as elektropump for water supply)	
ROTOR	: horizontal axis; upwind position by means of a tail vane; 16 blades of poly-urethane; rotor diameter 6.3 m
TRANSMISSION	: gears, running in oil-bath, ratio 1:30
ELECTR. CONF.	: synchronous machine; 3 x 380 V + OV
CONTROL SYSTEM	: hydraulic overspeed control
TOWERS	: 4-post galvanized bolted angle iron construction; heights 13.5-14 m
WEIGHTS	: total ± 1150 kg
PRICES (1982, incl. VAT)	: total, excl. foundation: US$ ± 9000
OPERATING WINDSPEEDS	
cut-in	: ± 4 m/s
rated	: ± 13-14 m/s
SUPPLIERS	:
Wind-Power S.J., Denmark	
Elektromat, W. Germany	

WIND-STREAM

ROTOR	: horizontal axis; upwind position by means of a tail vane; 2 blades of sitka spruce wood;
ELECTR. CONF.	: low rpm-generator; for battery charging
CONTROL SYSTEMS	: automatic: rotor tilts back in high wind and returns to operating position
PRICES (1983)	: total ± US$ 359/-
OPERATING WINDSPEEDS	
cut-in	: ± 4.5 m/s
MAX. POWER	: ± 100 Watts
SUPPLIERS	:
Thermax, USA	
Thermax, Canada	

WIND TITAN

		DC20	DC200	DC500	DC1200	DC4000	AC4000
ROTOR	: horizontal axis; upwind position by means of a tail vane; number of blades and rotor diameters (m):						
	(no)	3	2	2	2 or 4	4	4
	(m)	0.8	1.8	2.4	4.2	5.4	7.6
OPERATING WINDSPEEDS:							
cut-in	: 3.4 - 3.8 m/s						
rated	: ± 11.2 m/s						
RATED OUTPUT	: (kW)	0.02	0.2	0.5	0.9-1.4	4.5	3.8
SUPPLIERS:							
TWR Enterprises, USA							

WINDVANG

		50.4	80.15	125.40	160.60
ROTOR	: horizontal axis; downwind position; 3 blades of glass fibre reinforced polyester; rotor diameters;				
	(m)	5.2	8.2	12.7	16
TRANSMISSION	: gears				
ELECTR. CONF.	: asynchronous machines; to be connected to the grid (low voltage)				
CONTROL SYSTEM	: hydraulic pitch control				
TOWERS	: cilindrical galvanized steel tube; heights:				
	(m)	12	16	18	20
PRICES (1983, excl. VAT)	: total (excl. foundation):				
	(Dfl.)	24,000/ 32,000	68,000	98,000	140,000
	(US$)	±9,000/ 12,000	±26,000	±37,000	±53,000
MAX. OUTPUT	: (kW)	4	15	40	60
SUPPLIERS	:				
Berewoud Energie, the Netherlands					

WINDWORKS Windworker 10

ROTOR	: horizontal axis; downwind machine; 3 blades of aluminum and composite fibreglass; rotor diameter 10m
TOWERS	: tubular steel tower
WEIGHTS	: total ± 450 kg;
PRICES (1982)	: total ± US$ 25,000 - 30,000
OPERATING WINDSPEEDS:	
cut-in	: 3.5 m/s
rated	: 9 m/s
RATED OUTPUT	: 10 kW
SUPPLIERS:	
Windworks, USA	

WINWAY

ROTOR	: horizontal axis; 3 blades; rotor diameter 7.1 m
OPERATING WINDSPEEDS:	
cut-in	: 3.6 m/s
rated	: 31 m/s
RATED OUTPUT	: 20 kW
SUPPLIERS:	
Fayette, USA	

ZEPHYR tetrahelix S

ROTOR	: horizontal axis; 2 blades; rotor diameter 0.61 m
OPERATING WINDSPEEDS	
cut-in	: 5.4 m/s
rated	: 11.2 m/s
RATED OUTPUT	: 7 W
SUPPLIERS	:
Zephyr Wind Dynamo Co, USA	

3. ADDRESSES OF SUPPLIERS

3.1. Waterlifting windmills

Supplier	Available trademark(s)
* Aermotor Water Systems P.O. Box 1364 Conway, Arkansas 72032 U.S.A. (ph. 501-329-9811)	Aermotor (Aeromotor)
* Agro-Aids 27, Shrungar shopping centre Mahatma Ghandi Road, Bangalore 560001 INDIA (ph. 563006)	Agro
* Alsthom - Atlantique Neyrtec Ateliers et Chantiers Navals B.P. 103, 71103 Chalon-sur-Saône FRANCE	Neyrtec
* Alston : see Windspinner	
* Auto Spare Industries/Wind Machines Division C-7 Industrial Estate Pondicherry 605 004 INDIA	DW-Windmachines
* Baker : see Heller - Aller	
* Bakker, Gebr. Zevenpelsen 25 8651 BT IJlst THE NETHERLANDS (ph. 05155-1253)	Record
* Baldi y Ucelli S.R. Ltda. Apartado 375, Av. Los Cocos D-7 Piura PERU (ph. 32-7282)	Baldi y Ucelli
* Bean Hill : see Pembrokeshire Eng.	
* Bobs Harries Eng. Ltd. Karamaini Estate P.O. Box 40, Thika KENYA (ph. Thika 47234/47250)	Kijito
* Bosman waterbeheersing en milieuverbetering B.V. P.O. Box 3701 3265 ZG Piershil THE NETHERLANDS (ph. 01869-1316)	Bosman

Supplier (waterlifting windmills)	Available trademark(s)
* Bowjon 220 West Mercer St, Suite 204 Seattle, Washington 98119 U.S.A. (ph. 206-283-0827)	Rancher, Bowjon
* Briau S.A. B.P. 43 37009 Tours Cedex FRANCE (ph. 47613817)	Mistral
* Budgen & Associates 72 Broadview, Pointe Claire, Quebec H9R 324 CANADA (ph. 514-695-4073)	Gjellerup
* Chapman & Saunders Pty., Ltd. P.O. Box 819, 25 Crouch Street South Mount Gambier, S.A. 5290 AUSTRALIA (ph. 259566)	Varcoe
* Climax windmills (Pty.) Ltd. P.O. Box 74 1930 Vereeniging SOUTH AFRICA	Climax
* Comet : see Sidney Williams	
* Dempster Industries Inc. 711 South Sixth Street, P.O. Box 848 Beatrice, Nebraska 68310 U.S.A. (ph. 402-223-4026)	Dempster
* DW-Windmachines : see Auto Spare Ind.	
* Enertech Inc. P.O. Box 420 Norwich, VT 05055 U.S.A. (ph. 802-649-1145)	Sparco
* Gjellerup Smed (F. Sørensen) Kirkevaenget 3 7400 Herning DENMARK (ph. 07-116073)	Gjellerup
* El Hayat : see Onamhyd	
* Hayes, Ernest (N.Z.), Ltd. P.O. Box 23, 789 Main South Rd. 042 Christchurch NEW ZEALAND (ph. 496-089)	Hayes

Supplier (waterlifting windmills)	Available trademark(s)
* Heller-Aller Co. Corner of Oakwood & Perry Str. S Napoleon, OH 43545 U.S.A. (ph. 419-592-1856)	Baker
* Hertog, B. Julianastraat 10-14 2751 GD Moerkapelle THE NETHERLANDS (ph. 01793-1329)	Hertog
* Humblot Eoliennes 8 Rue d'Alger Coussey, 88300 Neufchateau FRANCE (ph. 29-940909)	Humblot
* IERT (Institute of Engineering and Rural Technology) National Wind Energy R & D centre (polytechnic) Allahabad, 211002 UP INDIA	12 PU-series
* Kijito : see Bobs Harries Eng.	
* Lubing Maschinenfabrik Postfach 110, D-2847 Barnstorf W. GERMANY (ph. 05442-625)	Lubing
* M.B.P. (S.A.) Pty. Ltd Salvado Road Wembley, West. Austr. 6014 AUSTRALIA	Metters
* Minuano Indústrias Mecânicas Rua Arlindo Nobrega de Almeida, 400 Vila Saô Luiz BRASIL (ph. 482-5128)	Minuano
* Merin Ltd. Dada Chambers, M.A. Jinnah Road Karachi 2 PAKISTAN (ph. 231332/233595/221783)	WEU-design, 7.3 m-design (see Kijito)
* Metters : see M.B.P.	
* Mistral : see Briau	
* Naesbjerg Maskincenter Kirkediget 8, Naesbjerg DK-6800 Varde DENMARK	Sparco

Supplier (waterlifting windmills)	Available trademark(s)
* Newark : see Wakes & Lamb	
* Neyrtec : see Alsthom Atlantique	
* Onamhyd Office National du Materiel Hydraulique Unit 'El Hayat', B.P. 30 Laghouat ALGERIA (ph. 725907/724388)	El Hayat
* Pembrokeshire Eng. Services Ltd. Keeston House, Keeston Haverfordwest, Pembs. ENGLAND (ph. Camrose 348)	Bean Hill
* 12 PU-windmills : see IERT, WORTH	
* PumpOmat : see Windpumpen-Zentrale	
* Rancher : see Bowjon	
* Record : see Bakker	
* Reymill Steel Products Sta. Rosa Nueva Ecija PHILIPPINES (ph. 641)	Reymill
* Sanit: see Thai U-SA	
* Sheet Metal Kraft 14 Coventry Street, L.I.S. Belmont P.O. Box 1840, Bulawayo ZIMBABWE (ph. 74100/74106)	SMK (Sheet Metal Kraft)
* Sjørslev Maskinforretning Sjørslev DK-8620 Kjellerup DENMARK	Unimax
* Sidney Williams & Co. Ltd. Williams Parade, P.O. Box 22 Dulwich Hill N.S.W. AUSTRALIA 2203 (ph. 560-4000)	Comet
* Southern Cross : see Toowoomba	
* Southern Cross Windmill and Engine Co. Nuffield Street Bloemfontein SOUTH AFRICA	Southern Cross

Supplier (waterlifting windmills)	Available trademark(s)
* Sparco : see Enertech, Windpumpen-Zentrale, Technisch Handelsburo Pompen	
* Stewards & Lloyds : see Climax	
* Ten-Fa Iron Works 70, Kuag Fu Road Chia-Li Chen, Tainan Hsien TAIWAN (ph. 111-215)	Ten-Fa
* Thai U-SA Industrial Tactory 2 Rim Khlong Prapa, Prachara 2 Dusit, Bangkok 8 THAILAND (ph. 5852560/5854815)	Sanit
* Toowoomba Foundry Pty, Ltd. P.O. Box 109 Toowoomba, Qld. 4350 AUSTRALIA (ph. 32-3122)	Southern Cross
* Tozzi e Bardi Via Norvegia 16 Grosseto ITALY (ph. 0564/28401)	Tozzi e Bardi
* Ujuzi Leo Industries (ULI) P.O. Box 7146 Arusha, TANZANIA	Ujuzi
* Varcoe : see Chapman & Saunders	
* Voltas Ltd. P.O. Box 900, Ballard Estate Bombay 400038 INDIA (ph. 268131)	Vota (see Kijito)
* Vota : see Voltas	
* Wadler Manufacturing Co. Inc. Route 2, P.O. Box 76 Galena, KS 66739 U.S.A. (ph. 316-783-1355)	Wadler

Supplier (waterlifting windmills)	Available trademark(s)
* Wakes & Lamb Ltd. Millgate works Newark, Nottinghamshire ENGLAND (ph. Newark 704464)	Newark
* *Wilks Cam : see Wind dynamics*	
* Wind Baron 3702 W. Lower Buckeye Road Phoenix, Arizona 85009 U.S.A. (ph. 602-269-6900)	Wind Baron
* Wind Dynamics Inc. Box 506 Coleman, Alberta TOK-OMO CANADA (ph. 403-563-3101)	Wilks Cam
* Wind Energy Unit Water Resources Board, P.O. Box 34 Colombo 7 SRI LANKA (ph. 592668)	WEU
* Windpumpen Zentrale Luetthoern 51 D-2330 Eckernfoerde WEST-GERMANY (ph. 04351/42024)	Unimax, Sparco
* Windspinners, Pty. Ltd. P.O. Box 215 Lilydale, Victoria 3140 AUSTRALIA (ph. 03-7301681)	Windspinner, Alston
* WORTH (Workshop for the rehabilitation and training of the handicapped) P.O. Box 93 49K-Madurai Rd, Tiruchirapalli INDIA	12 PU-series

On following trademarks no information was available at the time the catalogue was printed:

* "AbaChem"
  AbaChem Eng. Ltd.
  Northern Road
  Newark, Notts NG 242EH
  ENGLAND (ph. 0636 76483)

Supplier (waterlifting windmills)	Available trademark(s)
* "Catavento" Empresa Brasileira de Equipamentos Industriais e Agricolas Ltda. Ce 021 KM06 Maranguape 10 Distrito Industrial do Ceara BRASIL	
* Las Gaviotas Pasea Bolivar No. 20-90 Bogota COLOMBIA (ph. 241 9967)	
* "Oasis" Ets. Poncelet & Cie B.P. 1 10380 Plancy l'Abbaye FRANCE	
* "Parish Windmill" KMP Manufacturing Co. Inc. P.O. Box 441 Earth, TX 79031 USA	
* "Pwani" Pwani Fabricators P.O. Box 83381, Mwabundu Road Industrial Area, Mombasa KENYA (ph. 24991)	

3.2. Electricity generating windmills

Supplier	Available trademark(s)
* Aadee-mondial Glanerbeekweg 197 - P.O. Box 385 7500 AJ Enschede THE NETHERLANDS (ph. 053-338300)	Wimo
* Aerocharger: see Selectromarine	
* Aeroman: see MAN	
* Aero Polyblade: see Wind Electric Systems	
* AeroWatt 37 Rue Chanzy 75011 Paris FRANCE (ph. 371-35-78)	AeroWatt
* Aesthetic Energy Systems 644 Main Street Bally, PA 19503 USA (ph. 215-845-7096)	AES/Bertoia
* Airlite: see Taylor J.	
* 'Alphen' - Handelsmij. B.V. P.O. Box 18 3440 AA Woerden THE NETHERLANDS (ph. 03480-20254)	Vølund
* Alsthom - Atlantique Neyrtec 75, Rue Général Mangin Grenoble 61X - 38041 FRANCE	Neyrtec
* Alsthom - CGE Koninginnegracht 64, P.O. Box 85860 2508 CN Den Haag THE NETHERLANDS (ph. 070-608810)	AeroWatt
* Alternate Energy Systems 150 Sandwich Street Plymouth, MA 02360 USA (ph. 617-747-0771)	Elektro, Dunlite, Wincharger
* Altos Corporation P.O. Box 905 Boulder, Co 80306 USA	Altos

Supplier (electr. gen. windmills)	Available trademark(s)
* American Energy Savers 912 St. Paul Road, P.O. Box 1421 Grand Island, NE 68801 USA (ph. 308-382-1831)	Reinke
* American Freedom Fuel, Inc. 5601 Dewey Hill Road, Suite 302 Minneapolis, MN 55435 USA (ph. 612-944-3936)	Wind Mule
* Ampair: see Selectromarine	
* Astral/Wilcon P.O. Box 291 Milbury, MA 01527 USA	Astral
* Automatic Power, Inc. P.O. Box 18738 Houston, TX 77023 USA (ph. 713-228-5208)	AeroWatt
* Bergey: see Magnus	
* Berewoud energie Castor 97 3902 SG Veenendaal THE NETHERLANDS (ph. 08385-14151)	Windvang
* Bertoia: see Aesthetic Energy Systems	
* Bircher Machine, Inc. P.O. Box 97 Kanopolis, KS 67454 USA	Wind Craft
* Bonus: see Danregn and Makon	
* Bouma B.V. Stevinstraat 11 1704 RN Heerhugowaard NETHERLANDS (ph. 02207-17905)	Bouma
* Bowjon Inc. 2829 Burton Ave, Burbank, CA 91504 USA	Soma
* Brümmer Windkraftanlagen KG Mühlenstrasse 1 - 8 3522 Bad Karlshafen 2 Helmarshausen W. GERMANY (ph. 05672-820)	Brümmer

Supplier (electr. gen. windmills)	Available trademark(s)
* Böwe Maschinenfabrik GmbH Haunstätter Str. 112 8900 Augsburg 1 W. GERMANY	Wimo
* Le Carbone Lorraine Nederland B.V. Zomerhofstraat 58 3032 CM Rotterdam THE NETHERLANDS (ph. 010-653433)	AeroWatt
* Carter (Jay) Enterprises Inc. P.O. Box 684 Burkburnett, TX 76354 USA (ph. 817-569-2238)	Carter
* Chalk Wind Systems P.O. Box 446 St. Cloud, Fl. 32769 USA (ph. 305-892-7338)	Chalk
* Coops & Nieborg B.V. Productieweg 3 9601 MA Hoogezand THE NETHERLANDS (ph. 05980-95500)	Elektro
* Cycloturbine: see Pinson	
* DAF Indal Ltd. 3570 Hawkestone Road Mississauga Ontario CANADA L5C 2V8 (ph. 416-275-5300)	DAF-Indal
* Danregn Vindkraft a/s 7330 Brande DENMARK (ph. 07-181570)	Bonus
* Dansk Vindkraft Industrie aps (DVI) Vendevej 6 Buresø, 3550 Slangerup DENMARK (ph. DK 03183439)	Dansk Vindkraft (DVI)
* Dansk Vindmøllefabrik ApS (O. Rasmussen) Strandholtvej 24, Skellerup 9500 Hobro DENMARK (ph. 08-555222)	Dansk Vindmølle
* Dragonfly Wind Electric P.O. Box 57-M Albion, Ca 95410 USA (ph. 707-937-4710)	Dragonfly

Supplier (electr. gen. windmills)	Available trademark(s)
* Dunlite Electrical Products Co. 28 Orsmond St. Hindmarsh AUSTRALIA (ph. 46-3832)	Dunlite
* Dynaf B.V. Kwakelkade 29, P.O. Box 54 1800 AB Alkmaar THE NETHERLANDS (ph. 072-118641)	Wind-Matic
* Ecowatt (Eoliennes) Beyssac 47200 Marmande FRANCE	Ecowatt
* Egebjerggärd (O. & K. Hansen) Gammel Gang 2, Kongsted 4293 Dianalund DENMARK (ph. 03-560213)	Kongsted
* Elektro GmbH St. Gallerstrasse 27 CH 8400 Winterthur SWITZERLAND	Elektro
* Elektromat (Windpumpen Zentrale) D-2341 Brodersby/Kappeln W.-GERMANY (ph. 4644-1274)	Elektromat, Wind-Power (S.J.)
* Enag S.A. Route de Pont l'Abbé 29000 Quimper FRANCE (ph. 16-98-954425)	Enag
* Enertech Corporation P.O. Box 420 Norwich, VT 05055 USA (ph. 802-649-1145)	Enertech, Dunlite
* Environmental Energies Inc. P.O. Box 73, Front Street Copemish, MI 49645 USA (ph. 616-378-2921)	HWT
* Fayette Manufacturing Corp. P.O. Box 567 Clearfield, PA 16830 Winway USA (ph. 814-765-1631)	Winway

Supplier (electr. gen. windmills)	Available trademark(s)
* FIASA (Fabrica Implementos Agricolas) Hortiguera 1890 1406 Buenos Aires ARGENTINA	FIASA
* Flowind Corp. 21414, 68th Ave South Kent, Washington 98031 USA (ph. 206-872-8500)	Flowind
* Forces Motrices Neuchateloises (FMN) Panensa S.A., Les Vernets Ch - 2035 Corcelles SWITZERLAND (ph. 038 30 11 11)	FMN
* Gale Company, The P.O. Box 27 Lake Geneva, WI 53147 USA	Gale
* Giromill: see Dansk Vindkraft a.o.	
* Handelscompagnie B.V. Laanweg 5, P.O. Box 484 3200 AL Spijkenisse THE NETHERLANDS (ph. 01880-20388)	Sonebjerg
* H-Energiesystemen B.V. Ahuislanden 58 7542 AM Enschede THE NETHERLANDS (ph. 053-771590)	HE
* Hinton Research 417 Kensington Salt Lake City, UT 84115 USA (ph. 801-487-3896)	Hinton
* HMZ Rellestraat 2 3800 Sint Truiden BELGIUM (ph. 32-11-68-06-66)	Wind Master
* Hoebée (Scheepswerf B.V.) Postbus 293, Merwedestraat 56 3300 AG Dordrecht THE NETHERLANDS (ph. 078-130088)	Proengin

Supplier (electr. gen. windmills)	Available trademark(s)
* Humblot 8 Rue d'Alger Coussey 88300 Neufchateau FRANCE	Humblot
* HWT: see Environmental Energies	
* Independent Energy Systems, Inc. 6043 Sterrettania Road Fairview, PA 16415 USA (ph. 814-833-3567)	Sky-Hawk
* Intransit De Hondert Margen 6, P.O. Box 87 2678 ZH De Lier THE NETHERLANDS (ph. 01745-4141)	Vestas
* Jacobs Wind Electric Co., Inc. Marketing Office 2180 W. 1st Suite 410 Fort Meyers, Fl 33901 USA (ph. 813-481-3113)	Jacobs
* Japan Wind Power Generator Co. Sudo BLDG. 1-4-2 Nakameguro Meguro-Ku, Tokyo 153 JAPAN (ph. 710-0121)	JWP
* Jydsk Vindkraft ApS Kalvhavevej 30 DK - 8763 Rask Molle DENMARK (ph. (05) 678928)	Jydsk
* Jyoti Ltd. (Energy Division) Tandalja, Vadodara 391410 INDIA (ph. 59518/59618)	Jyoti
* Kaman Aerospace Corp. Old Windsor Road Bloomfield, CT 06002 USA (ph. 203-242-4461)	Kaman
* Kedco Inc. 9016 Aviation Boulevard Inglewood, Ca. 90301 USA (ph. 213 776 6636)	Kedco
* Kongsted: see Egebjerggärd	

Supplier (electr. gen. windmills)	Available trademark(s)
* Kuriant Alfred Christensen Industriarealef 54 - 60 DK. 6999 Ulfborg DENMARK	Kuriant
* Lagerwey, Van de Loenhorst Garderbroekerweg 175 3774 JD Kootwijkerbroek NETHERLANDS (ph. 03423-2265)	Lagerwey v.d. Loenhorst
* Lebost Turbines, Inc. Environmental Energy Systems 1116 Warburton Avenue Yonkers, NY 10701 USA (ph. 914-423-8414)	LWT
* LMW (Dolf Haavecost) Zuidesch 5 9304 TW Lieveren THE NETHERLANDS (ph. 05908-16100)	LMW
* Lubing Maschinenfabrik Postfach 110 2847 Barnstorf W.-GERMANY (ph. 05442-625)	Lubing
* LWT: see Lebost	
* Magnus 3500 Devon Avenue Chicago, IL 60659 USA (ph. 312-679-6070)	Bergey (BWC)
* Makon Windenergie Nijverheidsweg 19 3471 CZ Kamerik THE NETHERLANDS (ph. 03481-1873)	Bonus
* MAN - Dept. EA P.O. Box 500620 D-8000 München 50 W. GERMANY	Aeroman
* McDonnell Aircraft Co. P.O. Box 516 St. Louis, MO 63166 USA (ph. 314-232-7998)	McDonnel

Supplier (electr. gen. windmills)	Available trademark(s)
* Megatech Corp. 29 Cook Street Billerica, MA 01866 USA (ph. 617-273-1900)	Megatech
* Mehrkam Energy Development Co. 179 East Road 2 Hamburg, PA 19526 USA (ph. 215-562-8856)	Mehrkam
* Millville Windmills & Solar Equipment Co. P.O. Box 32, 10335 Old Drive Millville, Ca. 96062 USA (ph. 916-547-4302)	Millville
* Multimetaal Constructie B.V. Nijverheidsweg 3c 1785 AA Den Helder THE NETHERLANDS (ph. 02230-33679)	Multimetaal
* Nedergie B.V. Lijnbaan 1, P.O. Box 54 4250 DA Leerdam THE NETHERLANDS (ph. 01835-3854)	Ecowatt, Kuriant, a.o.
* Neyrtec: see Alstom-Atlantique	
* Noah Energie Systeme GmbH Gielsdorferstrasse 16 D.5300 Bonn 1 Messdorf W.-GERMANY (ph. 02242-2543-613712)	Noah
* Nordtank - Jydsk Tankwagen Ind. 8444 Balle DENMARK	Nordtank
* Nordvestsjaellands Energivaerksted Ringstedvej 189 4300 Holback DENMARK (ph. 03-479135)	Nordvestsjaelland
* North Wind Power Co. P.O. Box 315 Wuzen, VT 05674 USA (ph. 802-496-2955)	North Wind
* Paques B.V. T. de Boerstraat 11, Postbus 52 8560 AB Balk NETHERLANDS (ph. 05140-3441)	Windpaq
* Pembrokeshire: see 3.1.	

Supplier (electr. gen. windmills)	Available trademark(s)
* P.I. Specialist Engineers Ltd. The Dean Alresford Hants ENGLAND (ph. 096273-4262)	P.I.
* Pinson Energy Corp. P.O. Box 7 Marston Mills, MA 02648 USA (ph. 617-477-2913)	Cycloturbine
* Polenko B.V. Remmerden 9 3911 TZ Rhenen THE NETHERLANDS (ph. 08376-9008)	Polenko
* Polymarin B.V. Nijverheidsweg 7 1671 GC Medemblik THE NETHERLANDS (ph. 02274-3044)	Polymarin
* Poncelet, Etablissements 49A-51 Rue Plaine d'Aviation 1140 Bruxelles BELGIUM (ph. 02-215-29-47)	Poncelet
* Poulsen, Ulrik ApS/Innoventic Strandvejen 666 DK-2930 Klampenborg DENMARK (ph. 01-636566)	Poulsen
* Product Development Institute 4445 Talmadge Road Toledo, OH 43623 USA (ph. 419-472-2136)	Wind Jenny
* Proengin 3 Avenue du Colifichet 78290 Croissy-sur-Seine FRANCE (ph. 976-23-14/29-56)	Proengin
* Raalter Projektbeheer B.V. Hellendoornseweg 15 8106 AH Mariënheem (Raalte) THE NETHERLANDS (ph. 05720-1002)	Giromill
* Reinke: see American Energy Savers	
* Rietschoten (Van) & Houwens Sluisjesdijk 155, P.O. Box 5054 3008 AB Rotterdam THE NETHERLANDS (ph. 010-871911)	Wind Master

Supplier (electr. gen. windmills)	Available trademark(s)
* Riisager Oxholm Møllecenter ApS Øland DK-9460 Broust DENMARK	Riisager
* Rollo B.V. P.O. Box 275 2501 CG Den Haag THE NETHERLANDS (ph. 070-469711)	Aeroman
* Sancken Wind Electric, Inc. 4140 Skylark Kingman, AZ 86401 USA (ph. 602-757-2526)	Sancken
* Selectromarine/Ralph Howe Marketing Ltd. New Orchard and High Street Poole Dorsee ENGLAND	Ampair, Aerocharger
* Sencenbaugh Wind Electric P.O. Box 11174, 253 Polaris Avenue Palo Alto, Ca 94306 USA (ph. 415-964-1593)	Sencenbaugh
* SIM-Holland Antwerpseweg 10 2800 AJ Gouda THE NETHERLANDS (ph. 01820-14851/19855)	Wincharger
* Sky-Hawk: see Independent Energy Systems	
* Smedemestermøller/NIVE Dansk Smedemester Forening Svoldrupvej 18 9640 Farsoe DENMARK	Smedemester
* Soma Windmills Ltd. P.O. Box 94 Russell NEW ZEALAND	Soma
* Sonebjerg Maskinfabrik a/s Sonebjerg, DK 6000 Kolding DENMARK (ph. 455522799)	Sonebjerg
* Storm Master: see Wind Power Systems	

Supplier (electr. gen. windmills)	Available trademark(s)
* Sunflower Power Co. Route 1, Box 93-A Oskaloosa, Kansas 66066 USA (ph. 913-597-5603)	Sunflower
* Taylor J. 88 Hull Road, Woodmansey Beverly, N. Humberside HU 17 OTH ENGLAND (ph. 0482-885950)	Airlite
* Thermax Co., One Mill Street Burlington, VT 05401 USA (ph. 802-658-1098)	Windstream
* Thermax 39 Main Street Vankleek Hill, Ont. KOB 1RO CANADA (ph. 613-678-3322)	Windstream
* Tolsma B.V. Fabrieksweg 7, P.O. Box 165 8300 AD Emmeloord THE NETHERLANDS (ph. 05270-14755)	Nordtank
* Tornado Wind Generators 23 Sayer Way Knebworth, Herts AL6 OUV ENGLAND	Tornado, Trimblemill
* Trimble Windmills NEI Clarke Champman Ltd., Victoria Works Gateshead, Tyne & Waer NE 8 3HS ENGLAND (ph. 0623 784501)	Trimblemill, Tornado
* Tumac Industries. 650 Ford Street Colorado Springs, Co 80915 USA (ph. 303-596-4400)	Tumac
* TWR Enterprises 72 West Meadow Lane Sandy, UT 84070 USA	Wind Titan
* Vedana Vindmøller ApS Dag Hammarskjølds Alle 23 2100 Copenhagen DENMARK (ph. 01-388622)	Vedana

Supplier (electr. gen. windmills)	Available trademark(s)
* Vendelbo Trapper - Arne Brogaard Gølstrup Hede 33 9480 Løkken DENMARK (ph. 08-996244)	Vendelbo
* Verbakel J & A, B.V. Veilingweg 9 2675 BR Honselersdijk THE NETHERLANDS (ph. 01740-28444)	Riisager
* Vestas-Møllefabrik DK 6940 Lem DENMARK (ph. 07-341188)	Vestas
* Voith Windenergy Converter Alexanderstrasse 2 D-7920 Heidenheim W.-GERMANY (ph. 07321-3291)	Voith
* Vølund-Fibreglass Techn. Div. Marsk Stigsvej 4 DK-8800 Viborg DENMARK (ph. 456623499)	Vølund
* Watt Hydro Electric Systems, Inc. Lot 1, Block 1, St. Joseph Road Almanga, Las Piñas Metro Manila THE PHILIPPINES	ElekroWatt
* Wesco-Wind Energy Supply Comp. Ltd. Iroko House, Bolney Avenue Peacehaven, Sussex ENGLAND (ph. 07914-5051)	Wesco
* WhirlWind Power Comp. 5030 York St. Denver, Co 80216 USA (ph. 303-595-8491)	WhirlWind
* Wimo: see Aadee	
* Wincharger: see Winco	
* Winco, Div. of Dyna Technology 7850 Metro Parkway Minneapolis, MN 55420 USA (ph. 612-853-8400)	Wincharger
* Wind Craft: see Bircher	

Supplier (electr. gen. windmills)	Available trademark(s)
* Wind Electric Systems, Inc. P.O. Box 473 Santa Clara, Ca 95052 USA (ph. 408-243-0241)	Aero Polyblade
* Wind Energie Zeeland Fransjesweg 11 4434 NA Kwadendamme THE NETHERLANDS (ph. 01194-360)	Smedemester
* Wind Engineering Corp. Airport Industrial Area Box 5936 Lubbock, TX 79417 USA (ph. 806-763-3182)	Win(d)gen
* Windfos Nordvestvej 4 9000 Aalborg DENMARK (ph. 08-139215)	Windfos
* Wind Jenny: see Product Developm. Inst.	
* Windkraft-Zentrale D-2341 Brodersby/Kappeln W. GERMANY (ph. 04644-1274)	Wind-Power S.J.
* Wind Master 106 K Street, Suite 200 Sacramento, California 95814 USA (ph. 916 443-0511)	Wind Master
* Wind-Matic Industrivej Nord 15, Birk DK 7400 Herning DENMARK (ph. 07-127700)	Wind-Matic
* Wind Mule: see American Freedom Fuel	
* Windpaq: see Paques	
* Wind-Power. S.J. ApS Suderbovej 4 DK 9900 Frederikshaven DENMARK (ph. 08-430033)	Wind-Power S.J.
* Wind Power Systems, Inc. 8630 Production Avenue, P.O. Box 17323 San Diego, Ca 92121 USA (ph. 714-566-1806)	Storm Master

Supplier (electr. gen. windmills)	Available trademark(s)
* Windworks, Inc. Route 3, Box 44A Mukwonago, WI 53149 USA (ph. 414-363-4088)	Windworker
* Wind Titan: see TWR	
* Windvang: see Berewoud	
* Winway: see Fayette	
* Zephyr Wind Dynamo Comp. P.O. Box 241 21 Stamwood Street Brunswick, ME 04011 USA (ph. 207-725-6534)	Zephyr Tetrahelix

Suppliers of windmills for electricity generation with outputs larger than 100 kW

Of the suppliers mentioned previously in this catalogue following suppliers also supply windmills with capacities of more than 100 kW

* Mehrkam, USA
* Polenko, the Netherlands
* Sunflower, USA
* VOITH, W. Germany
* Vølund, Denmark

Other suppliers:

* The Bendix Corp.
  Bendix Center, P.O. Box 5060
  Southfield, Michigan 48037
  USA (ph. 313-827-5000)
* FDO - Technische Adviseurs B.V.
  P.O. Box 379
  1000 AJ Amsterdam
  THE NETHERLANDS (ph. 020-262011)
* Sir Henry Lawson-Tancred, Sons & Co. Ltd.
  Aldborough Manor
  Boroughbridge, North Yorks Y05 9EP
  ENGLAND (ph. 09-12-3223 or 2716)
* Westinghouse Electr. Corp.
  P.O. Box 10864
  Pittsburg PA 15236
  USA (ph. 412-892-5600 and 653-6197)
* Wind Turbine Generators (WTG) Inc.
  251 Elm Street
  Buffalo N.Y. 14203
  USA (ph. 716-856-4300)

4. RANKING OF WINDMILLS ACCORDING TO ROTOR SIZE

4.1. General

This section presents lists with a ranking of the windmills according to their rotor diameters. Please notice that not all windmills from section 2 could be included, since not all diameters are known.
Vertical axis windmills have been mentioned seperately.

4.2. Windmills for waterlifting

Trademark	Ø (m)
Lubing	1.5
Sparco	1.5
Aermotor	1.8
Baker	1.8
Climax	1.8
Dempster	1.8
El Hayat	1.8
Hayes	1.8
Humblot	1.8
Metters	1.8
Newark	1.8
Southern Cross	1.8
Varcoe	1.8
Unimax	1.9
Bean Hill	2.0
El Hayat	2.0
Humblot	2.0
Record	2.1
Varcoe	2.1
Humblot	2.3
Unimax	2.3
Aermotor	2.4
Baker	2.4
Bosman	2.4
Bowjon	2.4
Climax	2.4
Comet	2.4
Dempster	2.4
Kijito	2.4
Metters	2.4
Newark	2.4
Southern Cross	2.4
Varcoe	2.4
Windspinner	2.4
Hayes	2.5
Humblot	2.5
Hayes	2.6
Record	2.7
El Hayat	2.8
Humblot	2.8

Trademark	Ø (m)
Aermotor	3.0
Baker	3.0
Bean Hill	3.0
Climax	3.0
Comet	3.0
Dempster	3.0
Hertog	3.0
Metters	3.0
Newark	3.0
Neyrtec	3.0
Reymill	3.0
Sanit	3.0
Southern Cross	3.0
Varcoe	3.0
WEU	3.0
Windspinner	3.0
Unimax	3.2
Neyrtec	3.5
12 PU 350	3.5
Sheet Metal	3.6
Windspinner	3.6
Aermotor	3.7
Baker	3.7
Climax	3.7
Comet	3.7
Dempster	3.7
Kijito	3.7
Metters	3.7
Newark	3.7
Reymill	3.7
Sanit	3.7
Southern Cross	3.7
Varcoe	3.7
Wilks Cam	3.7
El Hayat	4.0
Humblot	4.0
Aermotor	4.3
Climax	4.3
Comet	4.3
Dempster	4.3

Trademark	Ø (m)
Metters	4.3
Newark	4.3
Reymill	4.3
Sanit	4.3
Southern Cross	4.3
Varcoe	4.3
Baldi	4.5
Agro	4.8
Aermotor	4.9
Comet	4.9
Kijito	4.9
Newark	4.9
Neyrtec	4.9
Sanit	4.9
Wind Baron	4.9
El Hayat	5.0
Humblot	5.0
12 PU 500	5.0
Tozzi	5.0
Ujuzi Leo	5.0
Southern Cross	5.2
Climax	5.5
Comet	5.5
Newark	5.5
Neyrtec	5.5
Sanit	5.5
Hertog	6.0
Tozzi	6.0
Comet	6.1
Kijito	6.1
Newark	6.1
Neyrtec	6.1
Sanit	6.1
Southern Cross	6.4
Comet	6.7
Comet	7.3
Kijito	7.3
Southern Cross	7.6
Humblot	8.0
Comet	8.2
Comet	9.1

No sizes available from:
Gjellerup
Minuano
Mistral
Ten-Fa

Bosman has sizes from 3 - 6 m.

Wadler has vertical axis windmills (sizes unknown).

4.3. Windmills for electricity generation

Trademark	Ø (m)	Trademark	Ø (m)	Trademark	Ø (m)
Zephyr	0.6	Dragonfly	2.8	HWT	5.5
Aerocharger/	0.7	Elektro	3.0	Kedco	5.5
Ampair		Soma	3.0	Vendelbo	5.5
Bruemmer	0.8	Wesco	3.0	Wesco	5.5
Wind Titan	0.8	Dunlite	3.1	Whirlwind	5.5
AeroWatt	1.2	AeroWatt	3.2	Dunlite	5.6
AeroWatt	1.3	Airlite	3.2	Reinke	5.8
Elektromat	1.4	Humblot	3.2	Jyoti	5.9
Humblot	1.4	Hinton	3.4	Bertoia	6.0
Bruemmer	1.6	Chalk	3.5	Elektro	6.0
Airlite	1.8	Altos	3.6	Enertech	6.0
Wincharger	1.8	Elektro	3.6	LWT	6.0
Wind Titan	1.8	Humblot	3.6	Trimblemill	6.0
AeroWatt	2.0	Dunlite	3.7	Airlite	6.1
DW-Windm.	2.0	Kedco	3.7	HWT	6.1
Megatech	2.0	Sencenbaugh	3.7	Wind Jenny	6.3
LMW	2.0	Whirlwind	3.7	Wind-Power	6.3
Sencenbaugh	2.0	DW-Windm.	3.7	(S.J.)	
Tornado	2.0	Enertech	4.0	Aero Polyblade	6.7
FIASA	2.1	Sunflower	4.0	HWT	6.7
LMW	2.2	Wimo	4.0	AeroWatt	7.0
Lubing	2.2	Skyhawk	4.1	Jacobs	7.0
Airlite	2.4	Bruemmer	4.2	Vendelbo	7.0
Altos	2.4	Wind Titan	4.2	Winway	7.1
Bruemmer	2.4	LWT	4.3	HWT	7.3
Dragonfly	2.4	Whirlwind	4.3	Millville	7.6
Elektromat	2.4	Elektro	4.4	Wind Titan	7.6
Enag	2.4	Humblot	4.6	Astral	7.7
Jyoti	2.4	Poncelet	4.6	LWT	7.7
LWT	2.4	Skyhawk	4.6	Humblot	8.0
Soma	2.4	Wind Craft	4.6	Poncelet	8.0
Wincharger	2.4	Kedco	4.9	Vølund	8.0
Wind Titan	2.4	AeroWatt	5.0	Wimo	8.0
Elektro	2.5	Elektro	5.0	Wind Master	8.0
Humblot	2.5	FMN	5.0	Windvang	8.2
Enag	2.6	North Wind	5.0	Jydsk	8.4
Bruemmer	2.7	Polenko	5.0	Vedana	9.0
Elektrowatt	2.7	Windvang	5.2	AeroWatt	9.2
Jyoti	2.7	Bruemmer	5.4	Polenko	9.7
Bergey	2.8	Wind Titan	5.4	Carter	9.8

Trademark	Ø (m)
Bonus	10.0
H-Energie	10.0
Kongsted	10.0
Kuriant	10.0
Nordvestsjaell.	10.0
Smedemester	10.0
Sonebjerg	10.0
Stormmaster	10.0
Sunflower	10.0
Vestas	10.0
Windworks	10.0
Ecowatt	10.2
WindMatic	10.2
Lagerwey	10.6
Windfos	10.6
Mehrkam	10.7
Aeroman	11.0
Bouma	11.0
Multimetaal	11.0
Nordtank	11.0
Windpaq	11.0
Polenko	11.5
Voith	11.5
Bonus	12.0
Bruemmer	12.0
Dansk Vindm.	12.0
Gale	12.0
Noah	12.0
Smedemester	12.0
Sonebjerg	12.0
Stormmaster	12.0
Wimo	12.0
Windmaster	12.0
Windgen	12.2
Wind-Matic	12.5
Windvang	12.7
Poulsen	13.0
Windfos	13.2
Riisager	14.0
Sonebjerg	14.0
Wind-Matic	14.5
LWT	14.8
Bonus	15.0
H-Energie	15.0
Nordtank	15.0
Nordvestsjaell	15.0
Vestas	15.0
Windfos	15.0
Bouma	16.0
Noah	16.0
Polenko	16.0
Riisager	16.0
Smedemester	16.0
Windvang	16.0
Windfos	16.8
Nordtank	17.0
Vedana	17.0
Mehrkam	18.0
Polenko	18.0
Windfos	19.4
Kaman	19.5
H-Energie	20.0
Wind-Master	21.8
Voith	24.0

No information on
(part of) the windmills from:

Jyoti
JWP
Neyrtec (Ø 8 - 35 m)
Sancken
Windstream

Vertical axis windmills

Cycloturbine
DAF Indal
Elektro
Flowind
Giromill
JWP
McDonnell
P.I.
Polymarin
Proengin
Sunflower
Tumac
Windmule

5. GLOSSARY

ITDG - Intermediate Technology Development Group (U.K.)
NAL - National Aeronautic Laboratory (India)
SWD - Steering Committee Wind Energy Developing Countries (the Netherlands)
TOOL - Technical development with developing countries (the Netherlands)
WEU - Wind Energy Unit (Sri Lanka)
WOT - Working group development techniques (the Netherlands)

6. CONVERSION FACTORS

General

1 ft = 0.3048 m
1 inch = 25.4 mm
1 imp gallon = 4.546 l
1 US gallon = 3.785 l
1 MPH = 0.447 m/s (MPH = miles per hour)
1 knot = 0.514 m/s
1 lbs = 0.4536 kg

Common values

ft	m	inch	mm	imp galls/day	m^3/h	l/s	MPH	m/s
6	1.83	1½	38.1	1000	0.19	0.05	5	2.2
8	2.44	1¾	44.5	2000	0.38	0.11	6	2.7
10	3.05	2	50.8	3000	0.57	0.16	7	3.1
12	3.66	2¼	57.2	4000	0.76	0.21	8	3.6
14	4.27	2½	63.5	5000	0.95	0.26	9	4.0
16	4.88	2¾	69.9	6000	1.14	0.32	10	4.5
18	5.49	3	76.2	7000	1.33	0.37	12	5.4
20	6.10	3¼	88.9	8000	1.52	0.42	14	6.3
22	6.71	4	101.6	9000	1.70	0.47	16	7.2
24	7.32	5	127.0	10000	1.89	0.53	18	8.0
25	7.62	6	152.4	20000	3.79	1.05	20	8.9
27	8.23	7	177.8	40000	7.58	2.10	22	9.8
30	9.14	8	203.2	60000	11.37	3.16	25	11.2
40	12.19	9	228.6	80000	15.15	4.21	30	13.4
50	15.24	10	254.0	100000	18.94	5.26	50	22.4