Presented at

Auroville
Green Practices

Seminar and Site Visits
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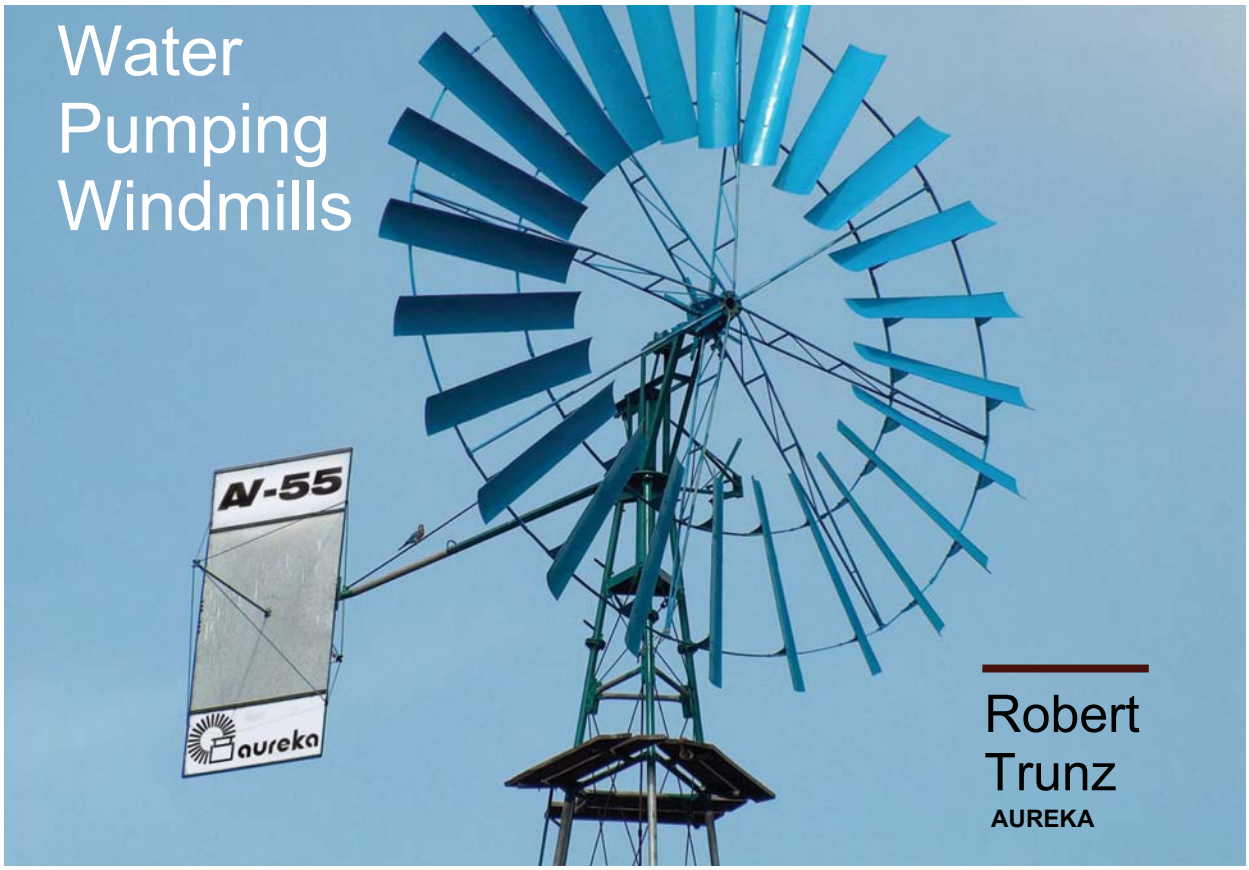
Water Pumping Windmills



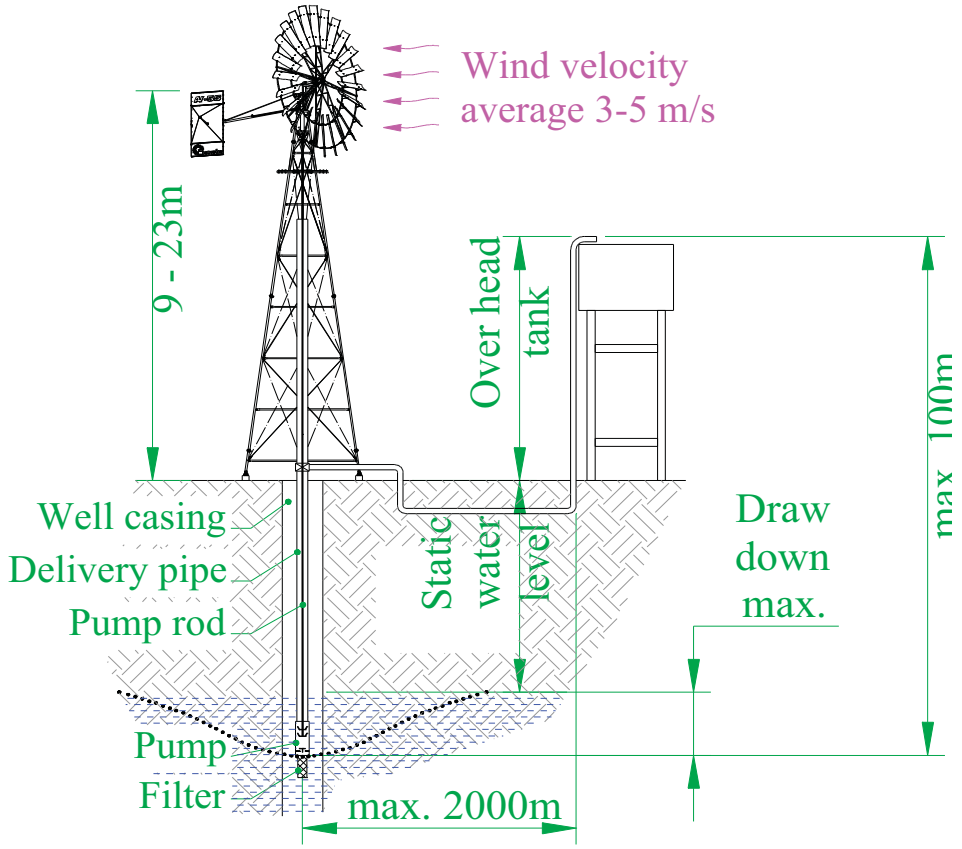
Robert Trunz
AUREKA

Why Windmills?

- Windpumps are wind driven machines for pumping water.
- Total independence from the Electricity Board
- No electricity bills
- No expenditure for diesel
- Environmentally friendly

Why Windmills?

- Cost competitive compared to diesel and solar.
- Windpumps are the most economic method of pumping water in rural areas where the average wind speed is greater than about 3 m/s, and no grid power is available.
- Windpumps have a long life potential, typically 20 years for a well-made and well-maintained machine.



The Beaufort Scale

Force	Name	Definition	Speed range (m/s)
0	Calm	Smoke rises vertically	0
1	Light air	Direction shown by smoke, but not vane	1
2	Light breeze	Wind felt on face, leaves rustle	2-3
3	Gentle breeze	Leaves, small twigs & flags in motion	4-5
4	Moderate	Raises dust & paper, small branches move	6-8
5	Fresh breeze	Small trees in leaf sway	9-11
6	Strong breeze	Large branches move, wires whistle	11-14
7	Near gale	Whole trees move, walking slightly impeded	14-17
8	Gale	Breaks twigs off trees, walking difficult	17-20

Windspeed range applicable for windpumps

Windspeed range applicable for electricity generation

Matching valve

The AV55 windpums incorporate a new rage of high performance piston pumps. These pumps have an advanced technological feature called the matching valve that increases the overall efficiency of the windpump by 50% compared to conventional windpumps.

Advantages

- Simple design
- Requiring no extra maintenance
- Low cut-in windspeed
- Improved overall efficiency $C_p\eta$ over a wider range of windspeed

Increase in water output

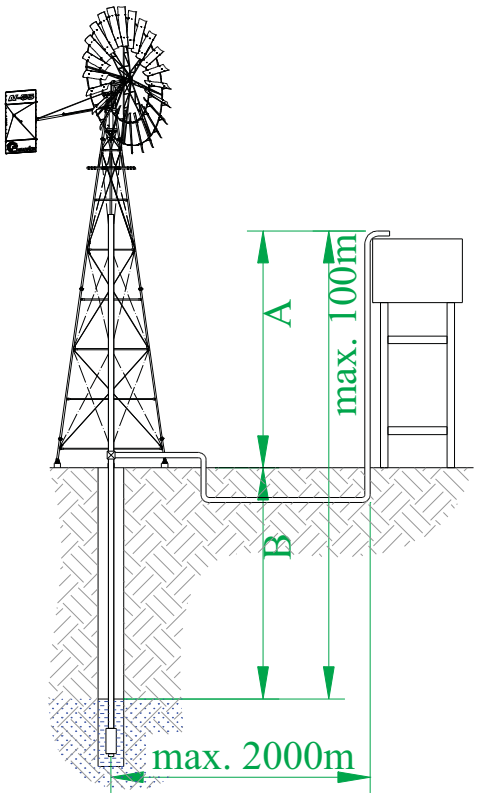
Matching valve compared with conventional drive

Wind km/h	Conventional drive 140 mm Water output l/h	Matching valve with counterweight in rotor 227 mm Increase in water output	
		l/h	%
3.5	0	179	-
7	20	560	-
10	512	863	59
13	1089	1581	45
16	1541	2323	51
19	2034	2982	46

Vertical Installation

Tilt-up Installation

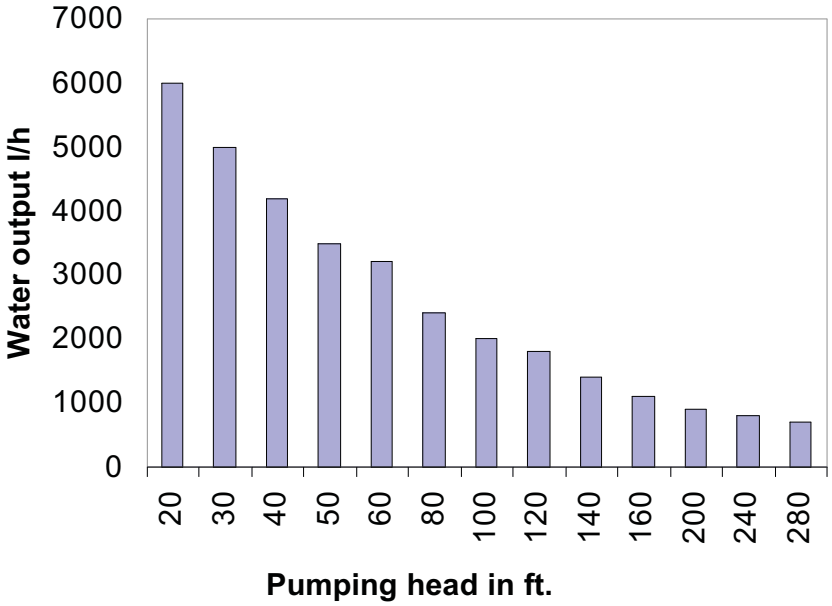
of AV%% windmill tower



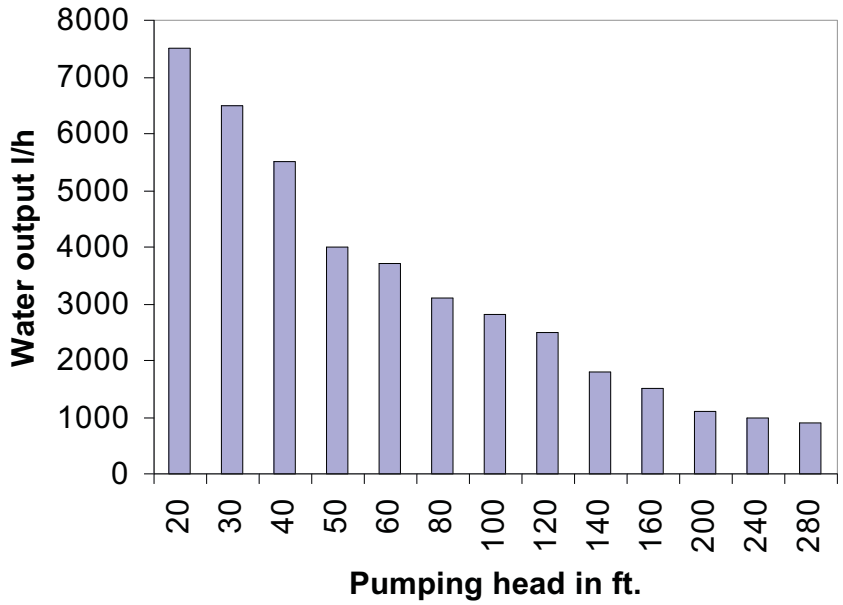
Range applications

- The windmill can be used for pumping water from deep borewells, max. 100m depth with the AV55 and 70 m depth with the AV45 - as well as for low lift high volume output from shallow wells.
- For pumping underground or surface water into a tank or reservoir which is located higher than the windmill head
- For pumping underground water into a tank which is not as high as the windmill head.

AV55 Output performance at 4 m/s windspeed



AV55 Output performance at 5 m/s windspeed



Windpump maintenance

A comprehensive Maintenance Manual is provided with each windpump

1.Windmill and tower

- Minimal maintenance required
- Greasing of all bearings (two times a year)
- Checking for any loose bolts and nuts (two times a year)

Cost per year : Rs. 500.00

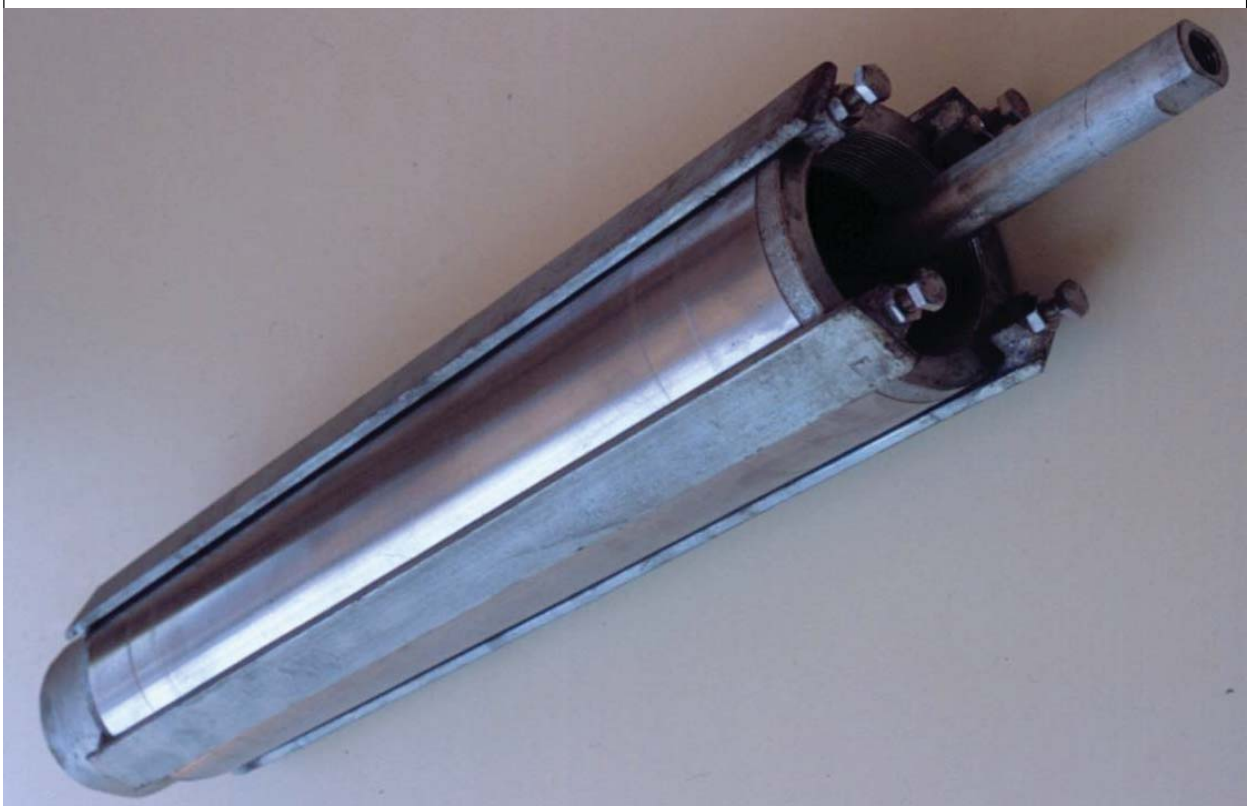
Windpump maintenance

2. Maintenance of pump, pump rods and delivery pipe

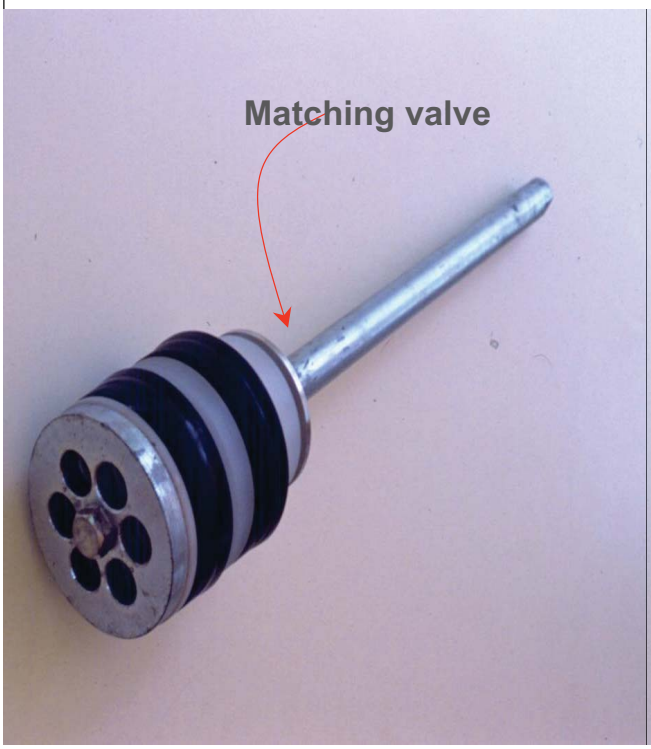
Depends on a number of factors
Quality or water is crucial (Sand in the water of saline water)

Average cost per year varies from Rs.3000 – Rs.5000.

Pump



Piston



Foot Valve

Conclusions:

Comparing the ALLC of the system

From a government point of view:

- windpumping is a good option, provided that large windpumps are used, second generation windpumps can compete with electric pumps in areas with an average windspeed of 4 m/sec, or above.

From a user's point of view:

- Second generations windpumps can compete with electric pumps if windpumps are subsidized.

The conclusion for the present situation is that in fact no alternative pumping system is competitive with electric pumping as long as electricity is given for free.

Windpump Market Study

Halcrow Gilbert Associates Ltd.

Pumping Technology	Water output x head (m^4)	Macro – Econ Alcc US$ cts/m^4	Micro – Econ Alcc UC$ cts/m^4
Electric			
2 hours pumping/day	540	0.17	0.12
4 hours pumping	1080	0.11	0.06
8 hours pumping	2160	0.08	0.03
Diesel			
5 hours pumping	1000	0.17	0.17
PV	150	0.79	0.36
Windpump			
2nd gen. Aureka, rotor Ø 5.5 m			
V = 3 m/sec.	433	0.27	0.12
V = 4 m/sec	1028	0.10	0.05
1st gen. Yellow tail copy rotor Ø 3 m			
V = 3 m/sec.	116	0.75	0.38
V = 4 m/sec	277	0.31	0.16

Table 4.6 Cost of Alternative Pumping Methods

An Economic Comparison

Before this farmer purchased the AV55 windpump, he used a compressor pump. The site has no access to electricity and as the ground water table was to deep for a jet-pump, he had to use a compressor pump.

Diesel Compressor Pump:

Engine Field Marshal		: 10 HP
Compressor		: 7.5 HP
Output		: 2500 liter/h
Diesel consumption		: 1 liter/h
Diesel price	1993	: Rs.15.00/liter
Running time	6 months/year	: 30 h / week
	3 months/year	: 20 h / week
	3 months/year	: 10 h / week
Cost of diesel compressor pump complete	1993	: Rs. 25,000/-
Water output per year		: 29,25,000 liter
Diesel cost per year		: Rs. 17,550/-

	Diesel Pump	AV55 Windpump
Output per year	29.25 lakh liter	36.50 lakh liter
Diesel cost/year	Rs.17,550	-
Capital Investment	Rs.25,000	Rs.86,240

If you calculate how much money the user would have to spend on diesel to pump 36.5 lakh liters, which is the yearly output of the windmill, you will get a figure of Rs. 21,900 .

So in less then 5 years his windmill is paid off.

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