Wind Water Pump (Windmill) Output

Hydraulic power, flow and daily water volume of a mechanical or electrical wind pump from rotor size, mean wind speed, power coefficient, pump efficiency and head.

Method: Wind power with an energy pattern factor applied to pumping

Input parameters

Unit system: SI

Parameter	Value	Unit
Rotor diameter	5.0000	m
Mean wind speed	5.0000	m/s
Rotor power coefficient (multi-blade about 0.3)	0.30000	
Transmission and pump efficiency	60.000	%
Energy pattern factor (mean of U³ over Ū³; Rayleigh 1.91)	1.9100	
Total pumping head	20.000	m
Air density	1.2000	kg/m³

Calculated results

Parameter	Value	Unit
Mean wind power through the rotor	2.8127	kW
Mean hydraulic power	0.50629	kW
Mean flow	9.2928	m³/h
Water per day	223.03	m³

Notes for this case

• Mean hydraulic power = ½ρAK_eŪ³C_Pη_p; flow = P_h/(ρ_wgH) with water density 1,000 kg/m³. Mechanical windmills start at low wind but stall or furl in strong winds, so real daily output is usually below this mean-power estimate; use a tank for storage.

Formula and method

$$\bar{P}_h = \frac{1}{2}\rho\frac{\pi D^2}{4}K_e\bar{U}^3 C_P\eta_p, \quad \bar{Q} = \frac{\bar{P}_h}{\rho_w g H}$$

Variables

D	Rotor diameter	m
$\bar{U}$	Mean wind speed	m/s
C_P	Rotor power coefficient (multi-blade about 0.3)	-
η_p	Transmission and pump efficiency	-
K_e	Energy pattern factor (mean of U³ over Ū³; Rayleigh 1.91)	-
H	Total pumping head	m
ρ	Air density	kg/m³
$\bar{P}_w$	Mean wind power through the rotor	W
$\bar{P}_h$	Mean hydraulic power	W
$\bar{Q}$	Mean flow	m³/s
V_d	Water per day	m³

Method and standards

Wind pumping energy balance.

Assumptions and limits

- Mean-power estimate; constant efficiencies.

References

Wind power with an energy pattern factor applied to pumping

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/environmental/wind-power/wind-water-pump-output

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.