Wind Turbine Yaw Misalignment Power Loss

Power and annual energy lost when a wind turbine rotor is misaligned with the wind, by the cosine-power law with an adjustable exponent.

Method: Cosine law for yawed rotors

Input parameters

Unit system: SI

Parameter	Value	Unit
Yaw misalignment	8.0000	°
Exponent (3 by momentum theory; measured about 1.8–2.5)	2.0000	
Annual energy when aligned	9,000.0	MWh
Fraction of the year below rated with this error	70.000	%

Calculated results

Parameter	Value	Unit
Power ratio $\cos^n\gamma$	98.063	%
Power loss below rated	1.9369	%
Annual energy lost	122.03	MWh

Notes for this case

- $P = P_0\cos^n\gamma$: momentum theory gives n = 3; field measurements on large turbines suggest about 1.8–2.5. Above rated, pitch control recovers the loss, so only the below-rated share of energy is affected.

Formula and method

$$\frac{P}{P_0} = \cos^n\gamma, \quad \Delta E = Ef\left(1 - \cos^n\gamma\right)$$

Variables

γ	Yaw misalignment	rad
n	Exponent (3 by momentum theory; measured about 1.8–2.5)	-
E	Annual energy when aligned	J
f	Fraction of the year below rated with this error	-
P/P_0	Power ratio $\cos^n\gamma$	-
$1 - P/P_0$	Power loss below rated	-
ΔE	Annual energy lost	J

Method and standards

Yawed rotor power.

Assumptions and limits

- Steady yaw offset; uniform inflow.

References

Cosine law for yawed rotors

Report details

Report reference	FCC-NPSJ-NH4P (the same inputs always give the same reference)
Generated	23 November 2026, 17:34 UTC
Calculator	Wind Turbine Yaw Misalignment Power Loss
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
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-yaw-misalignment-power-loss

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.