Pumped Storage: Energy, Generating Hours and Round-trip Efficiency

Energy generated and energy needed for pumping from reservoir volume and head, generating hours and flow at rated power, and the round-trip cycle efficiency.

Input parameters

Unit system: SI

Parameter	Value	Unit
Live storage volume	4,000,000	m³
Gross head	300.00	m
Conduit head loss as a share of gross head (each direction)	3.0000	%
Turbine-generator efficiency	90.000	%
Pump-motor efficiency	88.000	%
Rated generating power	250.00	MW
Water density	1,000.0	kg/m³

Calculated results

Parameter	Value	Unit
Energy generated	2,853.7	MWh
Energy needed for pumping	3,826.1	MWh
Round-trip efficiency	74.586	%
Generating hours at rated power	11.415	h
Flow at rated power	97.338	m³/s
Energy density of the water	2.5684	kJ/kg

Notes for this case

- Reservoir level changes are averaged into the gross head. Typical modern plants achieve 75–80 % round-trip efficiency.

Formula and method

$$E_g = \rho g V H (1 - h_L/H)\eta_{tg}, \quad E_p = \frac{\rho g V H (1 + h_L/H)}{\eta_{pm}}, \quad \eta_{rt} = \frac{E_g}{E_p}$$

Variables

V	Live storage volume	m³
H	Gross head	m
h_L/H	Conduit head loss as a share of gross head (each direction)	-
η_{tg}	Turbine-generator efficiency	-
η_{pm}	Pump-motor efficiency	-
P	Rated generating power	W
ρ	Water density	kg/m³
E_g	Energy generated	J
E_p	Energy needed for pumping	J
η_{rt}	Round-trip efficiency	-
t_g	Generating hours at rated power	s

Q_g	Flow at rated power	m³/s
e	Energy density of the water	J/kg

Method and standards

Potential-energy balance of a two-reservoir pumped storage scheme.

Assumptions and limits

- Average head; constant efficiencies.

Report details

Report reference	FCC-91Q6-RGET (the same inputs always give the same reference)
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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/boilers-power-plant/hydro-power/pumped-storage-energy

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.