Steam Turbine Steam Rate (kg/kWh)

Theoretical and actual steam rate of a steam turbine in kg/kWh, and the steam flow needed for a given electrical output (IAPWS-IF97).

Method: IAPWS R7-97(2012) IF97; first law of thermodynamics

Input parameters

Unit system: SI

Parameter	Value	Unit
Inlet steam pressure (absolute)	45.000	bar
Inlet steam condition	Superheated at the temperature below	
Inlet steam temperature (superheated only)	400.00	°C
Exhaust pressure (absolute)	400.00	kPa
Turbine isentropic efficiency	75.000	%
Gearbox and generator efficiency	95.000	%
Electrical output wanted	2,000.0	kW

Calculated results

Parameter	Value	Unit
Actual steam rate	9.2527	kg/kWh
Steam flow for the output	18,505	kg/h
Theoretical steam rate	6.5925	kg/kWh
Isentropic enthalpy drop	546.07	kJ/kg

Formula and method

$$TSR = \frac{1}{h_1 - h_{2s}} \qquad ASR = \frac{1}{(h_1 - h_{2s})\,\eta_i\,\eta_g} \qquad \dot{m}_s = ASR \cdot P_{el}$$

Variables

p_1	inlet pressure, absolute	Pa
state	dry saturated or superheated inlet	–
T_1	inlet temperature (superheated)	K
p_2	exhaust pressure, absolute	Pa
η_i	turbine isentropic efficiency	–
η_g	gearbox and generator efficiency	–
P_{el}	electrical output wanted	W
ASR	actual steam rate	kg/J
TSR	theoretical steam rate	kg/J
$\dot{m}_s$	steam flow for the output	kg/s
$h_1 - h_{2s}$	isentropic enthalpy drop	J/kg
$h_1\$, \$h_{2s}$	inlet and isentropic exhaust enthalpy	J/kg

Method and standards

Steam rate from the isentropic enthalpy drop (FireCAD IAPWS-IF97) and the turbine and generator efficiencies. Shown in kg/kWh; 1 kWh = 3.6 MJ.

Assumptions and limits

- Single expansion, constant efficiencies, steady flow.

References

- IAPWS R7-97(2012) IF97
- first law of thermodynamics

Report details

Report reference	FCC-2HVC-QM94 (the same inputs always give the same reference)
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Method last reviewed	11 November 2026
Software release	FireCAD Calc, release of 17 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/boilers-power-plant/turbines-cycles/turbine-steam-rate

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.