Cogeneration Heat-to-Power Ratio, EUF and PES

Heat-to-power ratio, energy utilisation factor, electrical and thermal efficiencies and primary energy saving of a cogeneration (CHP) plant.

Method: Directive 2012/27/EU Annex II (primary energy savings formula); standard cogeneration definitions

Input parameters

Unit system: SI

Parameter	Value	Unit
Net electrical output	20.000	MW
Useful heat delivered to process	60.000	MW
Fuel heat input	110.00	MW
Reference efficiency of separate power generation Enter the reference value that applies to your fuel, country and year.	45.000	%
Reference efficiency of separate heat (boiler)	90.000	%

Calculated results

Parameter	Value	Unit
Heat-to-power ratio	3.0000	
Energy utilisation factor (overall efficiency)	72.727	%
Electrical efficiency	18.182	%
Thermal (heat) efficiency	54.545	%
Primary energy saving against separate production	1.00000	%

Formula and method

$$\frac{Q}{P} \qquad EUF = \frac{P+Q}{F} \qquad \eta_e = \frac{P}{F} \qquad \eta_h = \frac{Q}{F}$$

$$PES = 1 - \frac{1}{\frac{\eta_h}{\eta_{ref,h}} + \frac{\eta_e}{\eta_{ref,e}}}$$

Variables

P	net electrical output	W
Q	useful heat delivered	W
F	fuel heat input	W
$\eta_{ref,e}$	reference efficiency of separate power	–
$\eta_{ref,h}$	reference efficiency of separate heat	–
Q/P	heat-to-power ratio	–
EUF	energy utilisation factor	–
η_e	electrical efficiency	–
η_h	thermal efficiency	–
PES	primary energy saving	–

Method and standards

Standard cogeneration ratios; primary energy saving by the formula of Directive 2012/27/EU Annex II, with the reference efficiencies entered by you. The Directive applies the formula to the cogeneration part of the plant only (electricity from cogeneration found by its Annex I, with harmonised reference values and correction factors). Here it is applied to the totals you enter, so for a plant with a condensing tail or bypass it overstates PES unless you enter the cogeneration part alone.

Assumptions and limits

- Annual or steady-state totals in one consistent basis; useful heat only.

References

- Directive 2012/27/EU Annex II (primary energy savings formula)
- standard cogeneration definitions

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/boilers-power-plant/turbines-cycles/cogeneration-heat-to-power

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.