Geothermal Direct-Use Heating Output and Fuel Saved

Heat from a geothermal well for district or process heating, the annual energy, the fuel and CO2 it displaces from a boiler, and the net saving after pumping.

Method: Direct-use heat and displaced fuel balance

Input parameters

Unit system: SI

Parameter	Value	Unit
Geothermal water flow	144,000	kg/h
Supply temperature	85.000	°C
Return (reinjection) temperature	45.000	°C
Annual load factor	45.000	%
Efficiency of the boiler replaced	88.000	%
Fuel emission factor (kg CO_2 per GJ; gas 56)	56.100	
Well and circulation pump power	150.00	kW
Grid emission factor (kg CO_2 per kWh)	0.40000	

Calculated results

Parameter	Value	Unit
Heat output	6.6985	MW
Heat delivered per year	26.406	GWh
Fuel displaced per year	108,023	GJ
CO_2 avoided per year, net of pumping	5.8236	t
Heat delivered per unit of pump power	44.657	

Notes for this case

• Q = ṁ(h_in − h_out) with liquid water kept above saturation pressure; fuel displaced = E/η_b; CO_2 avoided = fuel × EF − pump electricity × grid factor (kg converted to t). Water and steam properties from IAPWS-IF97.

Formula and method

$$\dot{Q} = \dot{m}(h_{in} - h_{out}), \quad E_f = \frac{\dot{Q}\, LF\, t}{\eta_b}, \quad m_{CO_2} = E_f\, EF - P_p\, LF\, t\, EF_e$$

Variables

$\dot{m}$	Geothermal water flow	kg/s
T_{in}	Supply temperature	K
T_{out}	Return (reinjection) temperature	K
LF	Annual load factor	-
η_b	Efficiency of the boiler replaced	-
EF	Fuel emission factor (kg CO_2 per GJ; gas 56)	-
P_p	Well and circulation pump power	W
EF_e	Grid emission factor (kg CO_2 per kWh)	-
$\dot{Q}$	Heat output	W
E	Heat delivered per year	J
E_f	Fuel displaced per year	J

m_{CO_2}	CO_2 avoided per year, net of pumping	kg
Q/P_p	Heat delivered per unit of pump power	-

Method and standards

Direct-use energy balance.

Assumptions and limits

- Steady flow; constant return temperature.

References

Direct-use heat and displaced fuel balance

Report details

Report reference	FCC-41VR-QQ5B (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/environmental/geothermal-ocean/geothermal-direct-use-heating

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.