Boiler Efficiency and Fuel Consumption — Report

Calculation summary | PlantCalcKit v1.0

DOCUMENT

Plant / project	**Example Plant**
Equipment tag / system	**BLR-01**
Calculation / document no.	**CALC-BE-001**
Revision	**0**
Prepared by	**Your name**
Checked by	**—**
Date	**07-Nov-2026**
Calculation basis	Fuel: Fuel gas · Indirect (heat-loss) method · HHV (gross) · Blowdown heat = useful output · Heat-loss method aligned with the publicly documented ASME PTC 4 / BS 845 style; steam and water from IAPWS-IF97; flue gas enthalpies from NASA polynomials; excess air from the flue gas oxygen (O_2 measured dry), CO corrected
Status	**✓ Inputs OK · ℹ️ 5 default value(s) in use: blowdown, humidity of the combustion air, radiation and unaccounted loss at maximum rating, lowest allowed flue gas temperature, operating hours per year**

KEY INPUTS

Input	Unit	Value used
Steam flow (boiler output)	t/h	50.0
Steam pressure at the boiler outlet	bar g	40.00
Superheated steam temperature	°C	400.0
Feedwater temperature (boiler inlet)	°C	105.0
Blowdown (% of feedwater flow)	%	2.0
Maximum continuous rating, steam (optional)	t/h	60.0
Combustion air temperature (reference)	°C	25.0
Humidity of the combustion air	g/kg	10.0
Oxygen in the flue gas (measured)	%	3.50
Carbon monoxide in the flue gas (measured)	ppm	25
Flue gas temperature at the boiler outlet	°C	165.0
Radiation and unaccounted loss at maximum rating	%	1.00
Fuel gas flow (measured), standard volume	Nm³/h	3,975
Lowest allowed flue gas temperature	°C	100.0
Operating hours per year	h/yr	8,000
Fuel price (per unit of heat, on the basis chosen)	per GJ	7.50

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RESULTS

Result	Unit	Value
Boiler efficiency (method and basis chosen)	%	83.08
Efficiency, indirect (heat-loss) method	%	83.08
Efficiency, direct (input-output) method	%	83.88
Direct minus indirect efficiency	points	+0.80
Heat absorbed by steam and blowdown	kW	38,649
Heat input from the fuel (basis chosen)	kW	46,520
Fuel consumption, mass	kg/h	3,180
Fuel consumption, standard volume (fuel gas)	Nm³/h	4,013
Steam-to-fuel ratio	kg/kg	15.72
Equivalent evaporation (from and at 100 °C)	kg/h	61,661
Carbon dioxide emitted	kg/h	8,541
Fuel heat used per year	MWh/yr	372,163
Fuel cost per year	USD/yr	10,048,396
Gross calorific value (HHV), as fired	kJ/kg	52,665
Net calorific value (LHV), as fired	kJ/kg	47,578
Excess air	%	18.0
O_2 in the dry flue gas	vol %	3.50
Water dew point of the flue gas	°C	57.1
Steam enthalpy	kJ/kg	3,212.6

HEAT-LOSS BALANCE — INDIRECT METHOD

Item	Unit (power)	% of heat input	Power
Dry flue gas (sensible heat)	kW	4.90	2,281
Hydrogen in the fuel and fuel moisture	kW	10.71	4,983
Moisture in the combustion air	kW	0.10	45
CO left in the flue gas (incomplete combustion)	kW	0.01	4
Unburned carbon in the ash	kW	0.00	0
Radiation and unaccounted losses	kW	1.20	558
Blowdown heat (loss only if chosen above)	kW	0.40	185
Total losses	kW	16.92	7,871
Boiler efficiency, indirect method	kW	83.08	38,649

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WHAT-IF — FUEL SAVING (SAME STEAM OUTPUT)

Case	Unit	Target / step	New efficiency, %	Fuel saved, %	Fuel heat saved per year	Value per year
O_2 lowered to 3.0 %	%	3	83.21	0.16	604	16,300
O_2 lowered to 2.5 %	%	2.5	83.34	0.32	1,173	31,668
O_2 lowered to 2.0 %	%	2	83.46	0.46	1,710	46,181
Flue gas lowered by 10 K	K	10	83.52	0.52	1,950	52,656
Flue gas lowered by 20 K	K	20	83.95	1.04	3,876	104,651
Flue gas lowered by 30 K	K	30	84.39	1.55	5,778	155,998
Both (A2 + B2)	–	A2 + B2	84.18	1.31	4,860	131,221

FINDINGS AND RECOMMENDATIONS

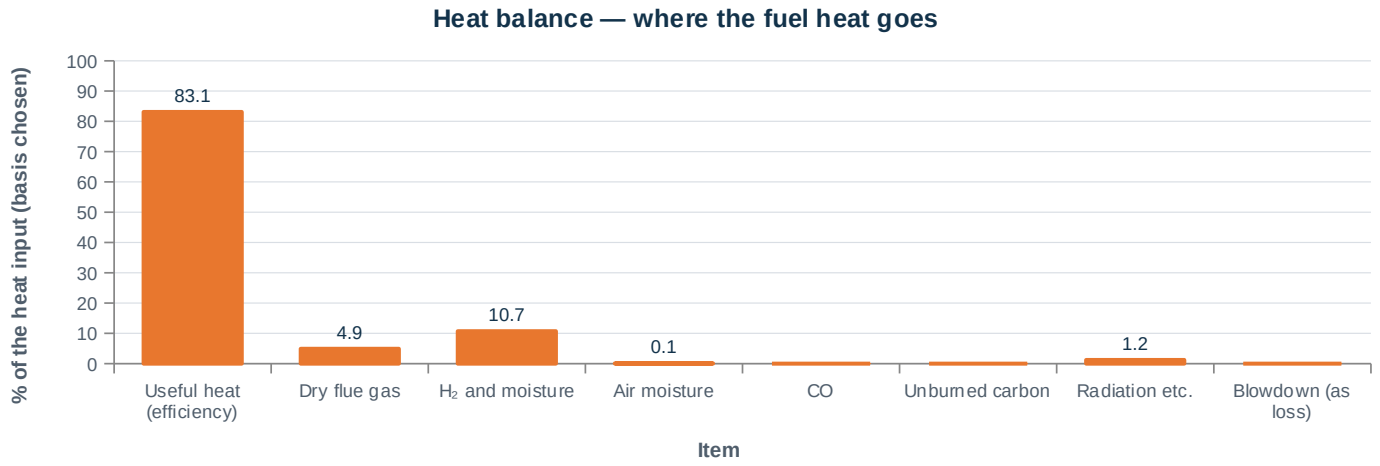
◆ **Opportunity**

Lowering the oxygen from 3.5 % to 3.0 % would save 0.16 % of the fuel (604 MWh/yr). Check the burner turn-down, CO and the margin for load swings first.

◆ **Opportunity**

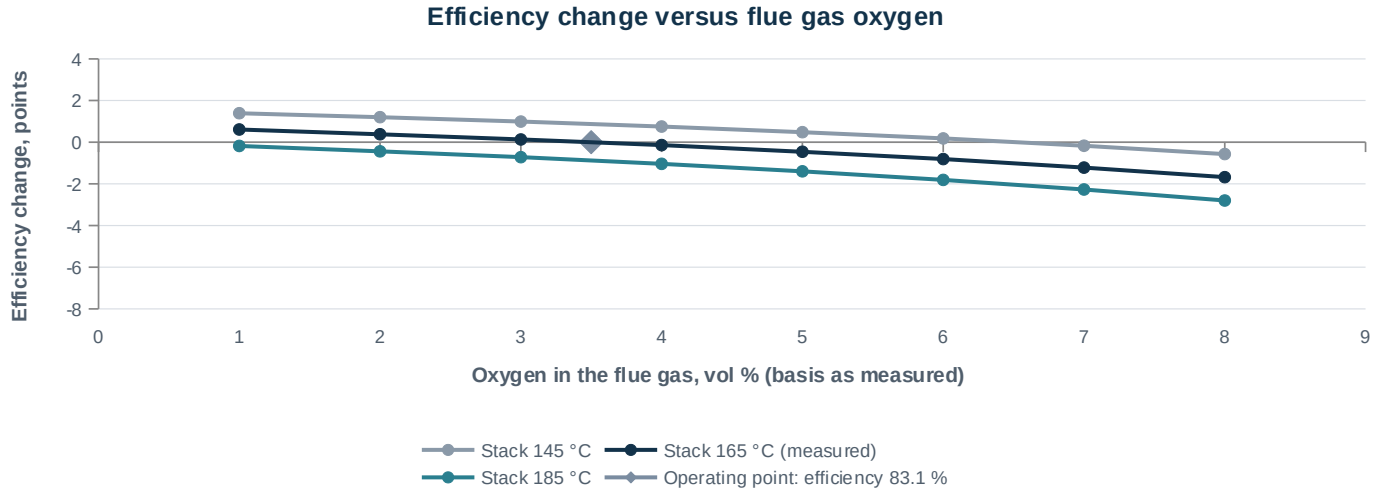
The flue gas leaves at 165 °C, 65 K above the lowest allowed value. A heat recovery step that cools it by 20 K would save 1.04 % of the fuel (3,876 MWh/yr).

CHARTS



Observations — heat balance

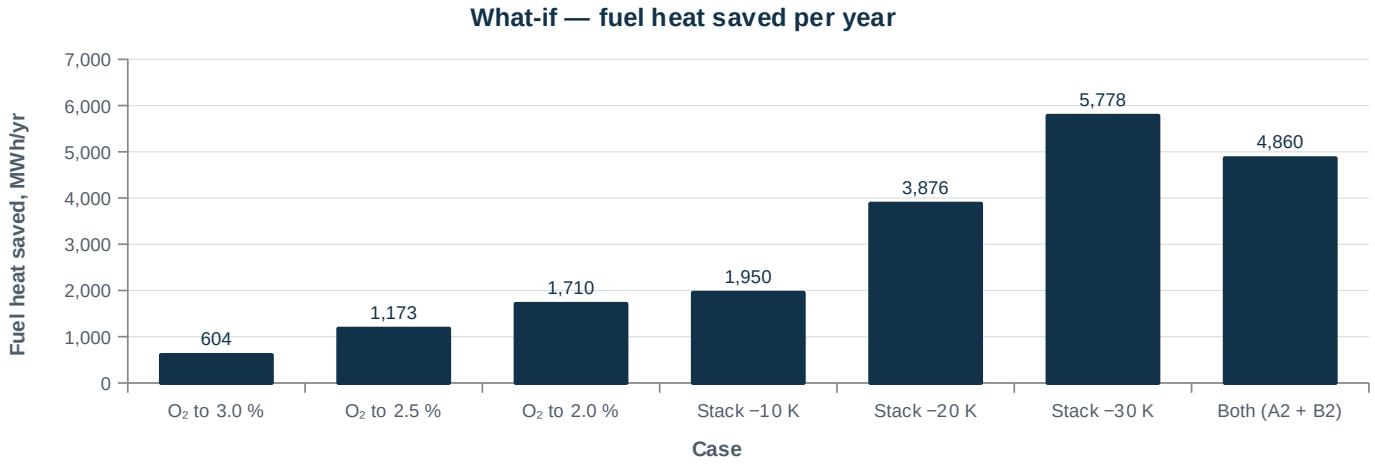
[Write your observations here]



Observations — efficiency and oxygen

[Write your observations here]

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Observations — what-if savings

[Write your observations here]

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