# Condensate Return Fuel and Water Savings

Heat, fuel and water saved by returning hot condensate to the boiler instead of using cold make-up water, per hour and per year.

**Method:** IAPWS R7-97(2012) IF97 (enthalpies)

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Condensate returned | 5,000.0 | kg/h |
| Condensate temperature at the feed tank | 90.000 | °C |
| Make-up water temperature | 30.000 | °C |
| Pressure of the water (absolute)<br>Only sets the liquid enthalpies; it must keep the condensate liquid. | 2.0000 | bar |
| Boiler efficiency (on GCV) | 80.000 | % |
| Gross calorific value of the fuel | 18,600 | kJ/kg |
| Operating hours per year | 8,000.0 | h |
| Density of the make-up water saved (for the yearly volume) | 998.00 | kg/m³ |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Fuel saved | 84.390 | kg/h |
| Fuel saved per year | 675.12 | t |
| Water saved per year | 40,080 | m³ |
| Heat recovered | 348.81 | kW |
| Condensate enthalpy | 377.07 | kJ/kg |
| Make-up water enthalpy | 125.92 | kJ/kg |

## Formula and method

$$\dot{Q} = \dot{m}_c (h_c - h_{mu}) \qquad \dot{m}_f = \frac{\dot{Q}}{\eta\, GCV} \qquad m_f = \dot{m}_f t_{op} \qquad V_w = \frac{\dot{m}_c t_{op}}{\rho}$$

### Variables

| | | |
|---|---|---|
| $\dot{m}_c$ | condensate returned | kg/s |
| $T_c$ | condensate temperature at the feed tank | K |
| $T_{mu}$ | make-up water temperature | K |
| $p$ | pressure of the water, absolute | Pa |
| $\eta$ | boiler efficiency on GCV | – |
| $GCV$ | gross calorific value of the fuel | J/kg |
| $t_{op}$ | operating hours per year | s |
| $\rho$ | water density | kg/m³ |
| $\dot{m}_f$ | fuel saved | kg/s |
| $m_f$ | fuel saved per year | kg |
| $V_w$ | water saved per year | m³ |
| $\dot{Q}$ | heat recovered | W |
| $h_c$ | condensate enthalpy | J/kg |

| | | |
|---|---|---|
| $h_{mu}$ | make-up water enthalpy | J/kg |

### Method and standards

Energy balance on the feed tank: the heat in the returned condensate above the make-up temperature no longer has to come from fuel. Enthalpies of compressed water from FireCAD's IAPWS-IF97.

### Assumptions and limits

- Heat losses of the return line and pumping energy are not deducted.
- The boiler efficiency is taken as unchanged; a hotter feed can slightly lower it when there is no economiser.
- Treatment and chemical savings are not included.
- The saving is referred to make-up water entering at $T_{mu}$ at the same point. If the make-up would otherwise be heated by deaerator steam or blowdown heat recovery, the fuel saved differs.
- The yearly water volume uses the density you enter for the make-up water (998 kg/m³ at about 20 °C by default), not the density of the hot condensate.

### References

- IAPWS R7-97(2012) IF97 (enthalpies)

## Report details

| | |
|---|---|
| Report reference | FCC-N7CB-Y235 (the same inputs always give the same reference) |
| Generated | 17 November 2026, 19:36 UTC |
| Calculator | Condensate Return Fuel and Water Savings |
| Method last reviewed | 10 November 2026 |
| Software release | FireCAD Calc, release of 17 November 2026 |
| Release checks | 2 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/steam/condensate-return-savings

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.