# Heat Pump Water Heater: Energy and Saving over Electric

Daily heat for hot water and the electricity used by a heat pump water heater and an electric heater, with the yearly saving and payback.

**Method:** Heating energy and COP comparison

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Hot water per day | 2,000.0 | L |
| Cold water temperature | 20.000 | °C |
| Hot water temperature | 60.000 | °C |
| Heat pump seasonal COP | 3.5000 | |
| Electric heater efficiency (including standing loss) | 90.000 | % |
| Days per year | 365.00 | |
| Electricity price per kWh | 8.0000 | |
| Extra cost of the heat pump | 300,000 | |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Heat per day | 91.774 | kWh |
| Heat pump electricity per day | 26.221 | kWh |
| Electric heater electricity per day | 101.97 | kWh |
| Saving per year | 221,190 | |
| Payback (years) | 1.3563 | |

### Notes for this case

• Heating water needs m c_p ΔT. An electric heater turns each kWh into slightly less than a kWh of hot water after standing losses; a heat pump moves heat from the air, delivering COP kWh of heat per kWh of electricity (seasonal COP 3–4 in warm climates). The saving is the difference in electricity over the year. Hotels, hostels and hospitals with large, steady demand recover the extra cost fastest.

## Formula and method

$$Q = \rho V c_p (T_o - T_i), \quad E_{hp} = \frac{Q}{COP}, \quad E_e = \frac{Q}{\eta_e}$$

### Variables

| | | |
|---|---|---|
| $V$ | Hot water per day | m³ |
| $T_i$ | Cold water temperature | K |
| $T_o$ | Hot water temperature | K |
| $COP$ | Heat pump seasonal COP | - |
| $\eta_e$ | Electric heater efficiency (including standing loss) | - |
| $d$ | Days per year | - |
| $c$ | Electricity price per kWh | - |
| $C_x$ | Extra cost of the heat pump | - |
| $Q_d$ | Heat per day | J |
| $E_{hp}$ | Heat pump electricity per day | J |

| | | |
|---|---|---|
| $E_e$ | Electric heater electricity per day | J |
| $\Delta C$ | Saving per year | - |
| $t_{pb}$ | Payback (years) | - |

### Method and standards

Heat pump water heater.

### Assumptions and limits

- Water density at about 50 °C; seasonal COP.

### References

Heating energy and COP comparison

## Report details

| | |
|---|---|
| Report reference | FCC-XP1Q-KQV2 (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/hvac/chillers/heat-pump-water-heater-saving

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.