# Pump Drive: Electric Motor or Back-Pressure Steam Turbine

Annual running cost of a pump driven by an electric motor or by a back-pressure steam turbine whose exhaust steam is used for process (Ganapathy Q5.08).

**Method:** Ganapathy; Steam Plant Calculations Manual; ...

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Flow | 52.239 | m³/h |
| Head | 295.66 | m |
| Liquid density | 999.00 | kg/m³ |
| Pump efficiency | 70.000 | % |
| Motor efficiency | 90.000 | % |
| Turbine mechanical efficiency | 95.000 | % |
| Boiler efficiency (same GCV or NCV basis as the fuel price) | 85.000 | % |
| Electricity price per kWh | 0.050000 | |
| Fuel price per GJ (same CV basis as the boiler efficiency) | 2.8435 | |
| Operating hours per year | 6,000.0 | h |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Pump shaft power | 60.043 | kW |
| Annual cost, motor drive | 20,014 | |
| Annual cost, steam turbine drive | 4,566.9 | |
| Annual saving with the turbine | 15,448 | |

**Notes for this case**

- Valid only if all the exhaust steam is used for process; if it is vented, charge the turbine's whole steam at boiler cost.

## Formula and method

$$P = \frac{\rho g Q H}{\eta_p}, \quad C_m = \frac{P}{\eta_m}\, t\, c_e, \quad C_t = \frac{P}{\eta_t\, \eta_b}\, t\, c_f$$

### Variables

| | | |
|---|---|---|
| $Q$ | Flow | m³/s |
| $H$ | Head | m |
| $\rho$ | Liquid density | kg/m³ |
| $\eta_p$ | Pump efficiency | - |
| $\eta_m$ | Motor efficiency | - |
| $\eta_t$ | Turbine mechanical efficiency | - |
| $\eta_b$ | Boiler efficiency (same GCV or NCV basis as the fuel price) | - |
| $c_e$ | Electricity price per kWh | - |
| $c_f$ | Fuel price per GJ (same CV basis as the boiler efficiency) | - |
| $t$ | Operating hours per year | s |
| $P$ | Pump shaft power | W |

| | | |
|---|---|---|
| $C_m$ | Annual cost, motor drive | - |
| $C_t$ | Annual cost, steam turbine drive | - |
| $C_m - C_t$ | Annual saving with the turbine | - |

### Method and standards

Ganapathy's comparison (back-pressure exhaust fully used).

### Assumptions and limits

- Exhaust steam fully used for process.
- Boiler efficiency and fuel price on one calorific-value basis (both GCV or both NCV).
- Turbine steam rate, back-pressure, capital and maintenance costs are not modelled.

### References

• Ganapathy
• Steam Plant Calculations Manual
• 2nd ed. (Marcel Dekker, 1993)
• Q5.08 (electric and steam turbine drives for pumps)

## Report details

| | |
|---|---|
| Report reference | FCC-FGZH-D6RY (the same inputs always give the same reference) |
| Generated | 17 November 2026, 19:49 UTC |
| Calculator | Pump Drive: Electric Motor or Back-Pressure Steam Turbine |
| Method last reviewed | 13 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/mechanical/pumps/pump-drive-motor-vs-steam-turbine

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.