OPEN CYCLE STEAM TURBINE

Background:

A **steam turbine** is a device that extracts thermal energy from pressurized steam and uses it to do mechanical work on a rotating output shaft. Its modern manifestation was invented by Sir Charles Parsons in 1884. Because the turbine generates rotary motion, it is particularly suited to be used to drive an electrical generator.
The steam turbine is a form of heat engine that derives much of its improvement in thermodynamic efficiency from the use of multiple stages in the expansion of the steam, which results in a closer approach to the ideal reversible expansion process.

Description of the flowsheet:

Water at 65 degree Fahrenheit, 14.7 psi and a mass flow rate of 2000 pound mass /hour is sent into a **pump** to increase its pressure to 250 psi. This water at high pressure is heated to its boiling point using a **boiler** (401 degree Fahrenheit). This vapor is now super-heated in a **heater** to 550 degree Fahrenheit to ensure that condensation of the steam doesn't occur in the adiabatic expander. This superheated vapor is sent to a **turbine** in which steam expands adiabatically and rotates the shaft which is connected to an electromagnet to produce electricity. The spent steam is sometimes recycled to be reused.

Results:

1) Energy produced in the steam turbine is **101.31988KW**

2) Energy required to raise the temperature of water to its boiling point is **684.342KW**

2) Energy required to superheat the steam is **52.743 KW.**

Conclusion:

1) Steam turbines usually operate at efficiencies around 30-40%.
2) Energy produced is almost 1/7 of total energy given to steam, hence steam should be recycled to save energy.

Reference:

https://melab.wikischolars.columbia.edu/Steam+Turbine+Power+Plant