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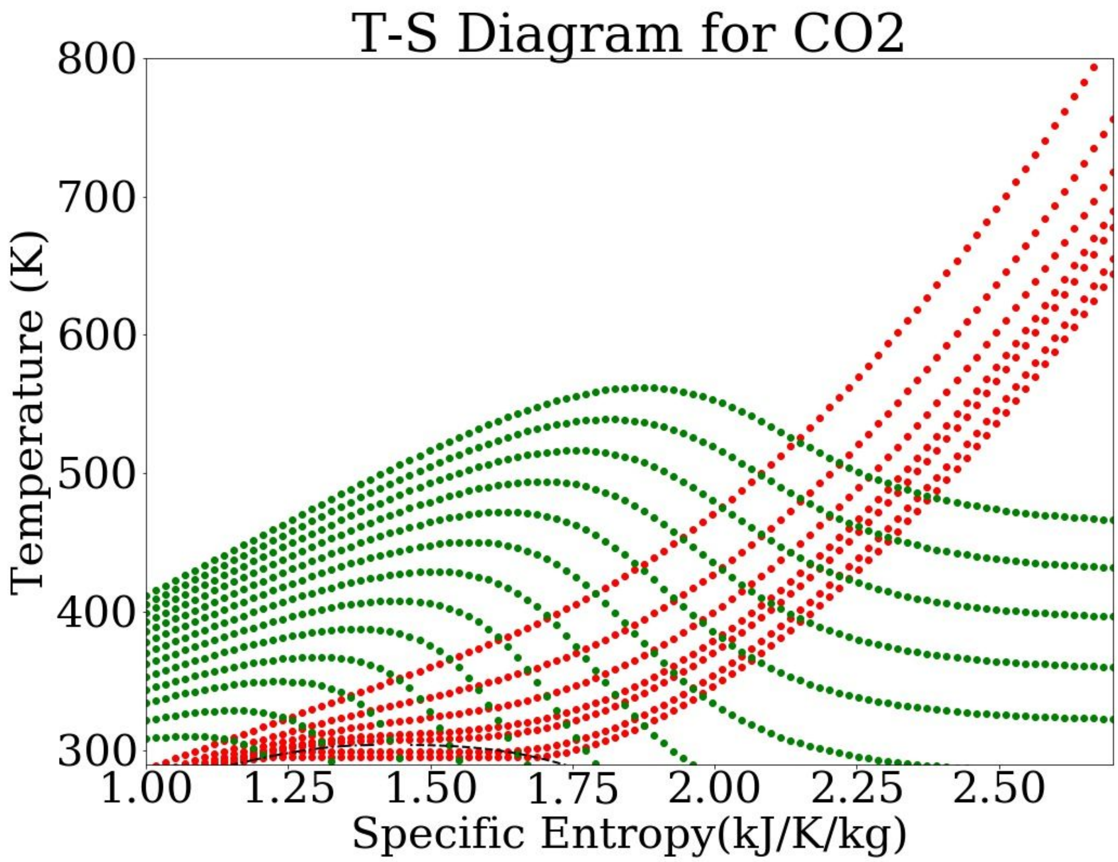
Thermodynamics Quiz 2 Report

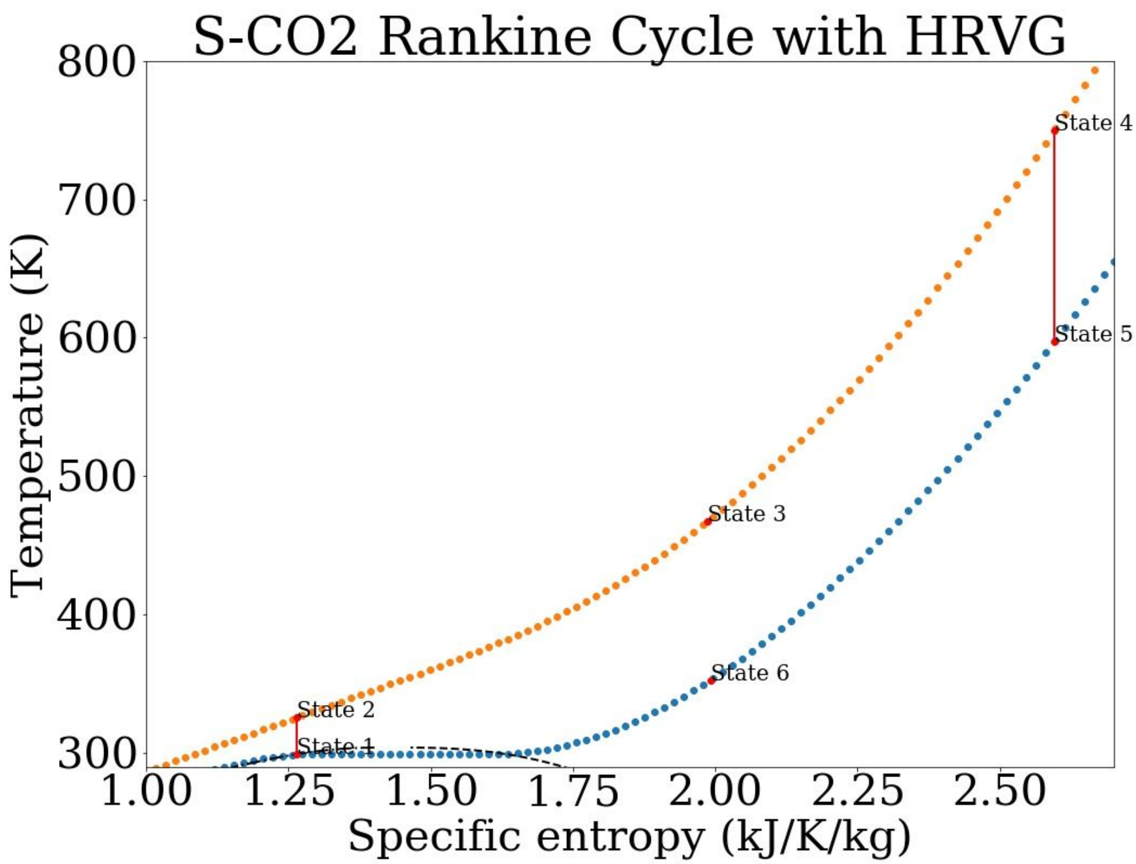
Problem 1



Here, the black dashed line is the 2 phase region. The red lines represent isobars at the specified pressures in MPa. The green lines represent lines of constant specific enthalpy at the specified values in kJ/kg.
The following critical values were obtained from CoolProp:

- Critical Temperature: 304.128 K
- Critical Pressure: 7.377 MPa
- Critical Specific Entropy: 1.423 kJ/K/kg
- Critical Specific Enthalpy: 329.138 kJ/kg

Problem 2

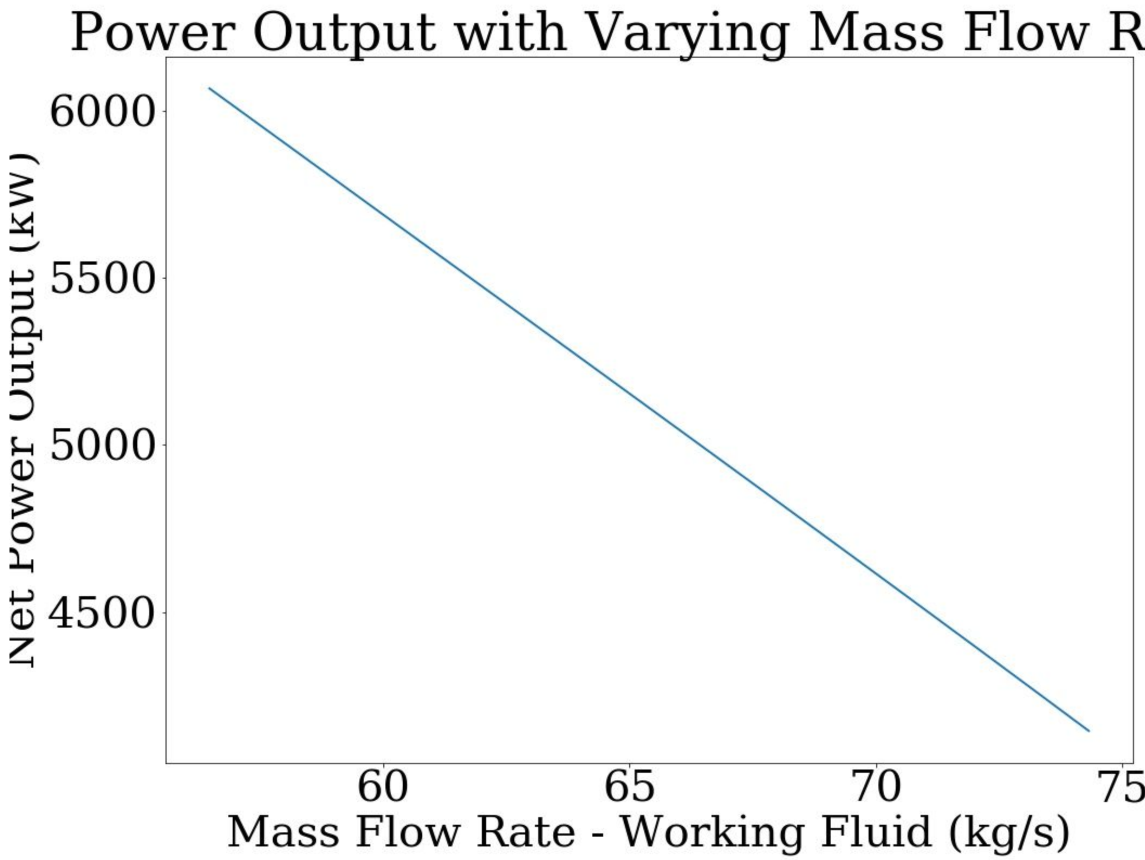


This graph shows the states of the S-CO_2 Rankine cycle. The orange line represents the high pressure (20 MPa) and the blue line represents the low pressure (6.6 MPa). Once again, the black line is the 2 phase dome from Problem 1. The red line between states 1 and 2 represents the pump and the red line between states 4 and 5 represents the turbine. The differences in enthalpies at these respective states will give information about the net power produced in the cycle. The difference in the enthalpies between states 3 and 4 will give information about the heat input required.

Knowing the net power and heat input, we can calculate the efficiency of this cycle. We can also compare this value to the efficiency of an ideal Rankine cycle with superheat with saturated liquid entering the pump at 299K.

$\eta_{S\text{-}CO2}$ = 37.87%
$\eta_{Rankine}$ = 8.34%

Problem 3



We see that a lower mass flow rate of the working fluid produces a higher net power output. This makes sense because a slower rate allows for more heat transfer in the regenerator. This causes a higher temperature before the turbine, therefore, a higher enthalpy difference between the turbine inlet and outlet