LELME2150 – Thermal cycles

Introduction to Homework 3

Date: *October 22, 2021*

Course instructor: *Prof. Yann Bartosiewicz*

Teaching assistant(s): *Antoine Laterre*

antoine.laterre@uclouvain.be

(Gauthier Limpens)

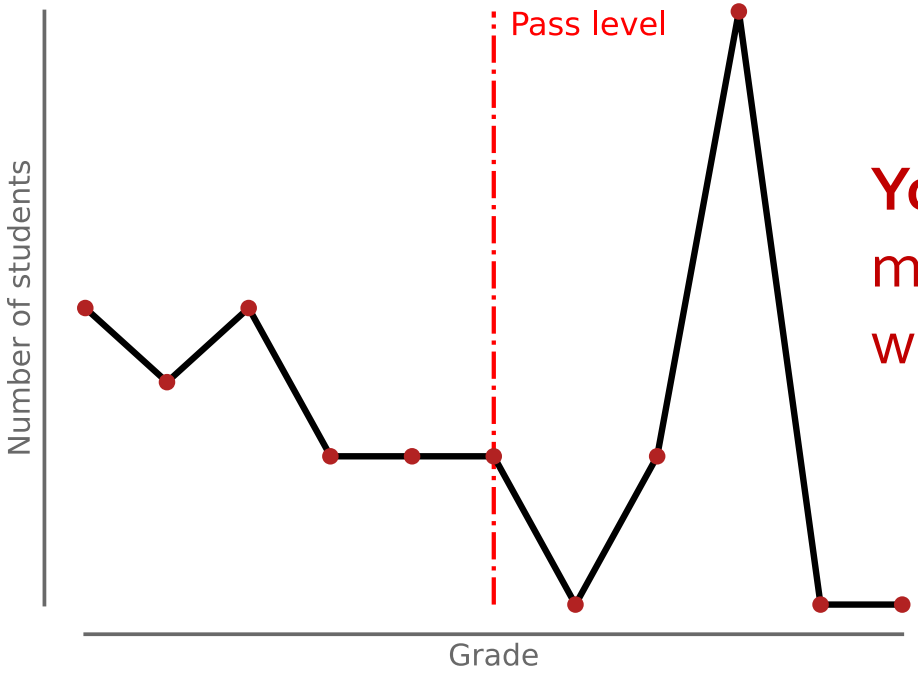
UCLouvain

iMMC

HW3 and HW4 can still raise your final grade

Distribution of the grades for HW2

Less than 50% of the students passed it…

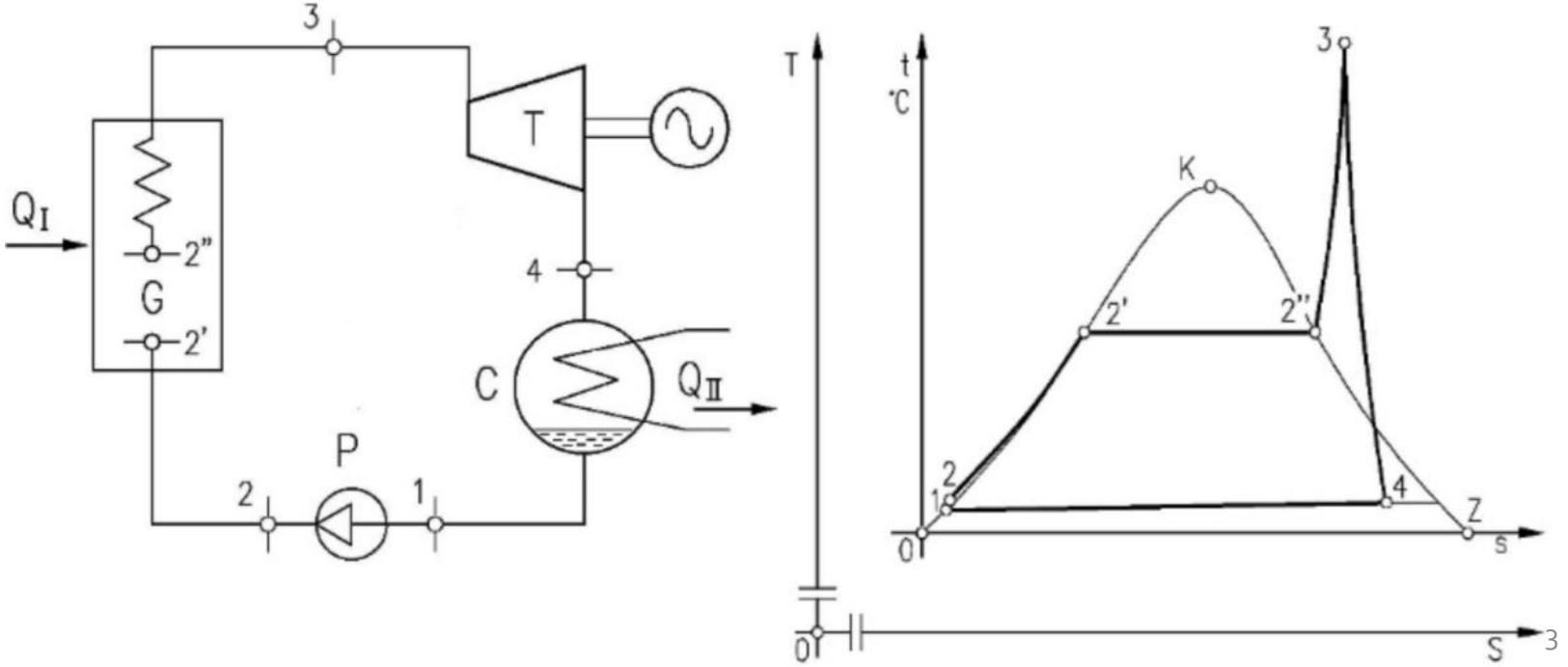


You have the opportunity to make up for it with HW3 and with the improvements of HW4!

The efficiency of the basic Rankine cycle can be improved

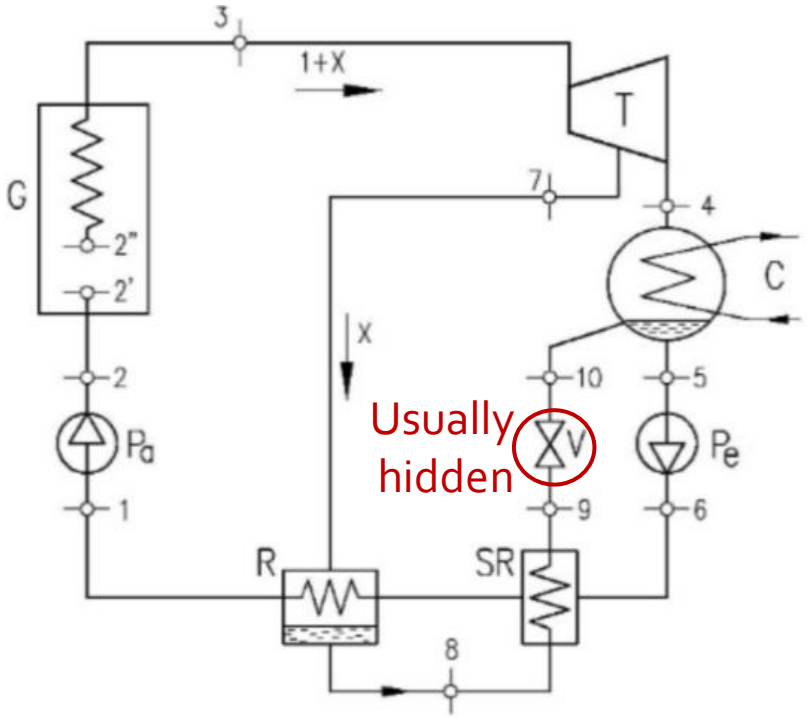
This is the system you have simulated so far

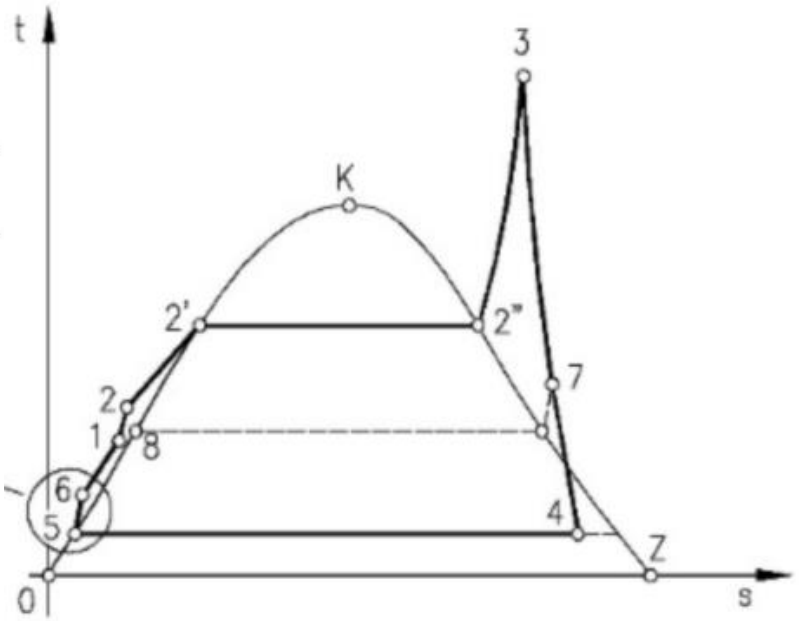
- The efficiency is quite limited;
- The thermodynamic cycle can be improved with 2 major techniques;
- In HW3, you'll add them to this cycle and quantify the improvement.



Feed-heating

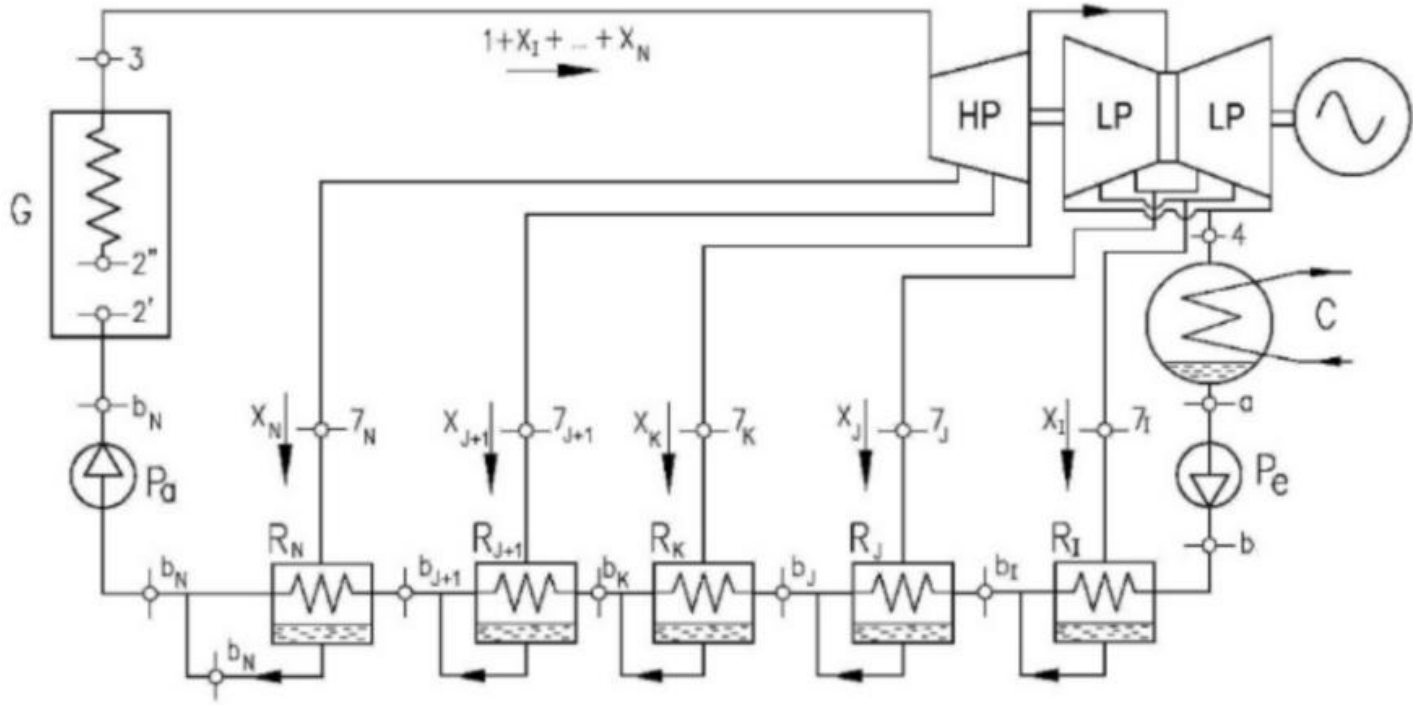
Exclude part of the steam flow from the condenser





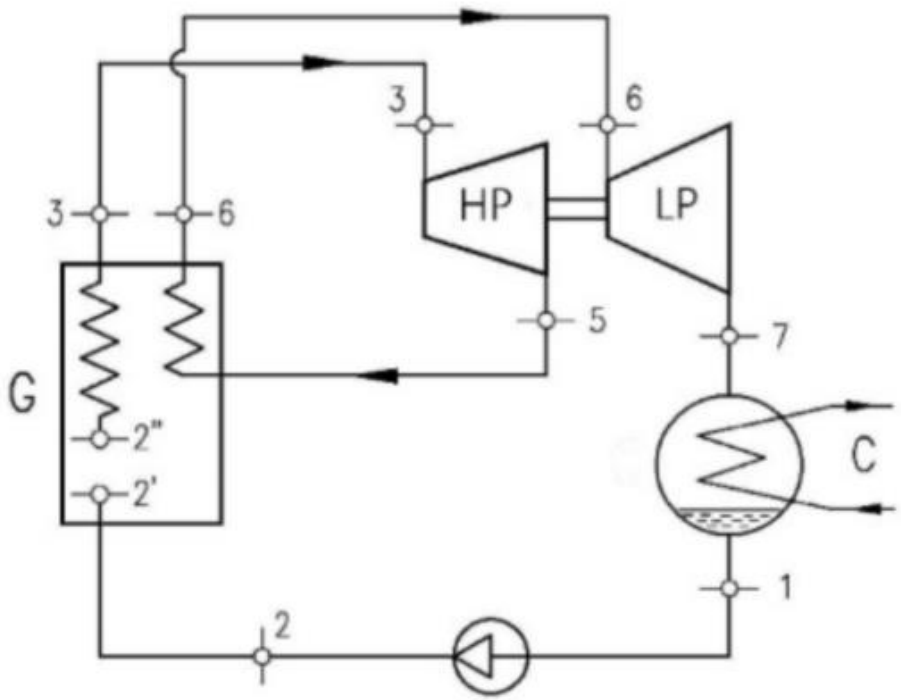
Feed-heating

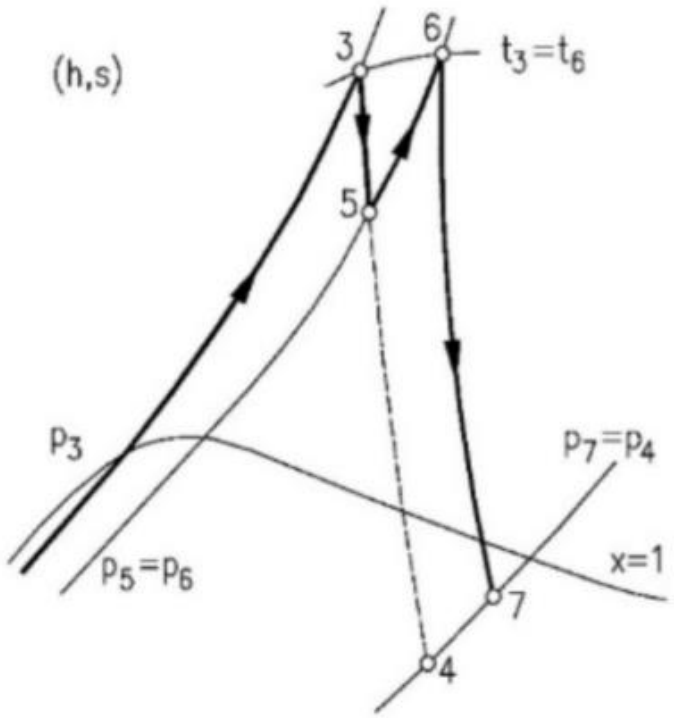
When multiple feed-heaters, it is more challenging to compute the mass flows (XMASSFLOW in HW3)



Reheating

Adopt higher pressures for the live steam

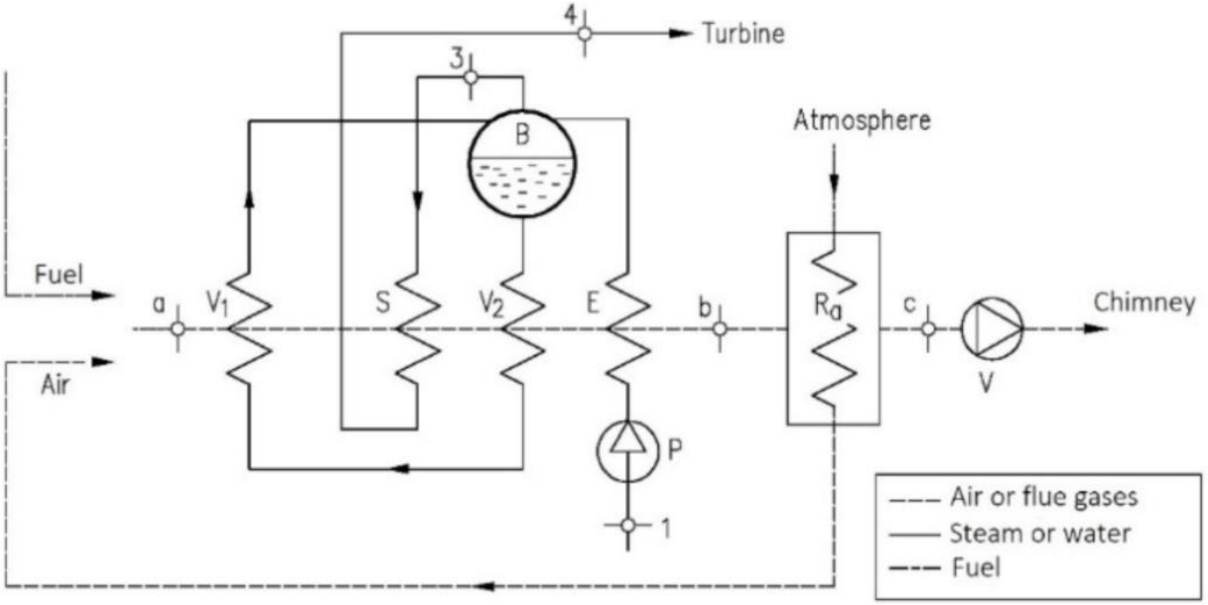




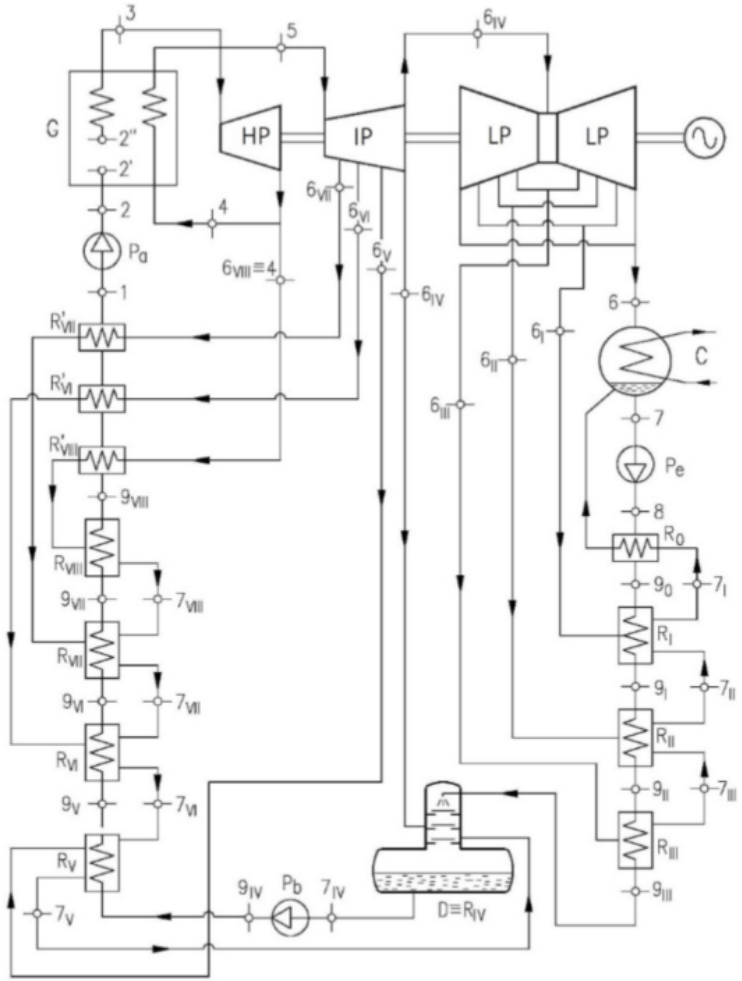
You should also have a closer look at what's inside the steam generator

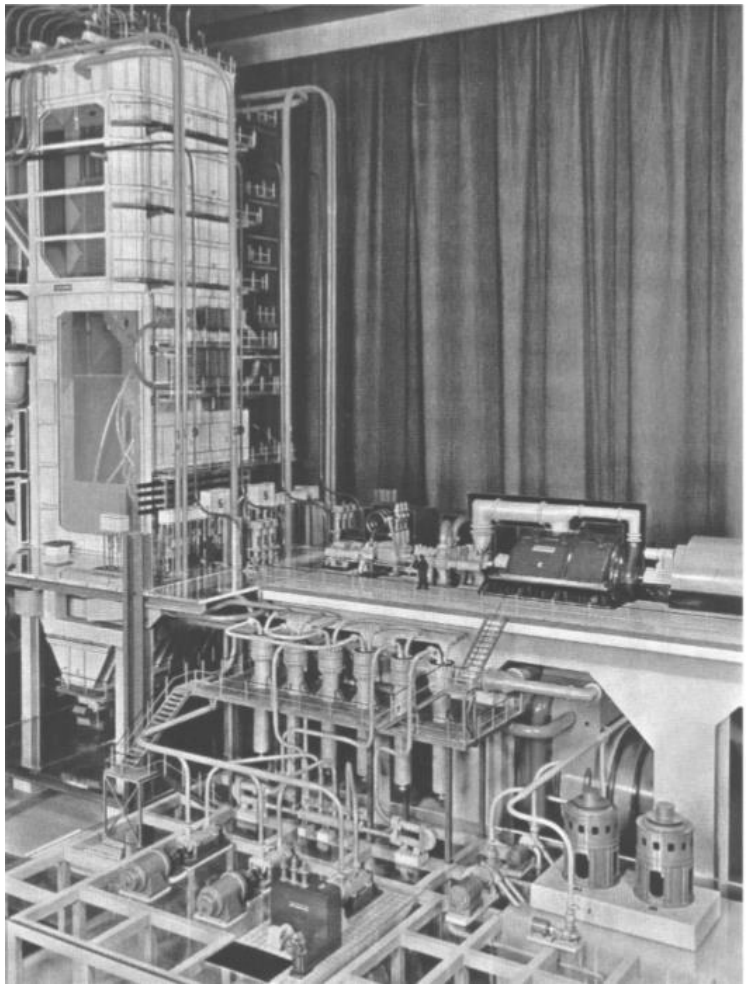
How different is the combustion in ST than in GT?

- Which fuels can you burn in your ST (**CHxYy**)?
- What is the maximum steam temperature? Why?
- What is the maximum combustion temperature? Why?
- What is the steam generator efficiency? ….

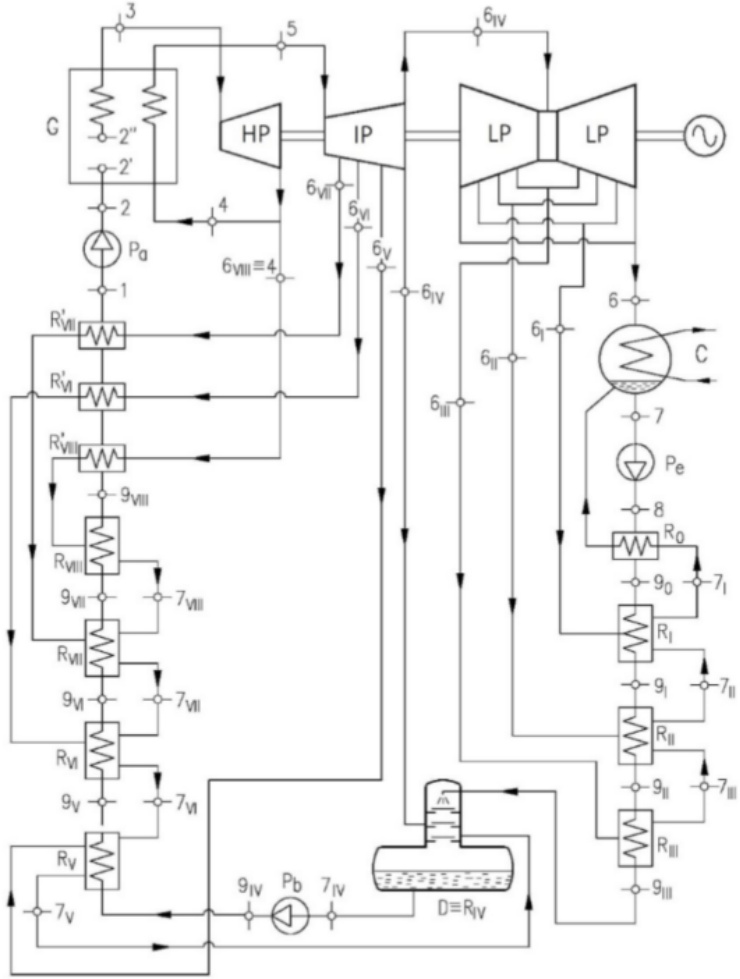


An industrial ST power plant is more similar to this one





In HW3, you will simulate it to assess its performance



What are the assumptions that can be made?

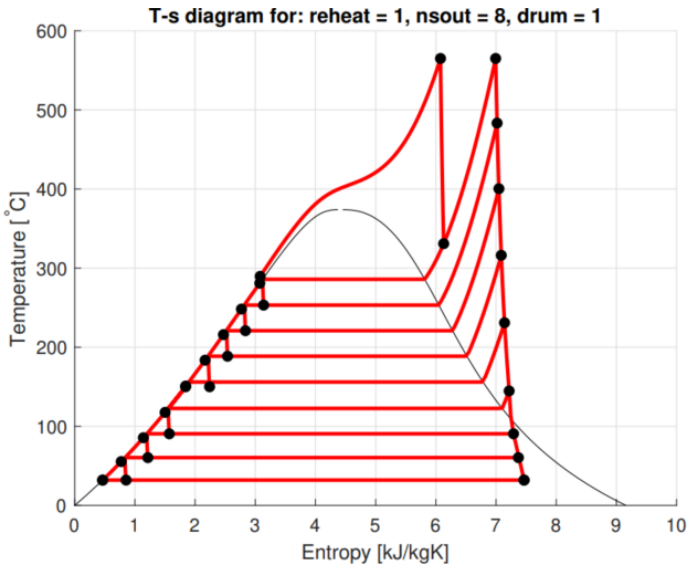
Which model to use for each component?

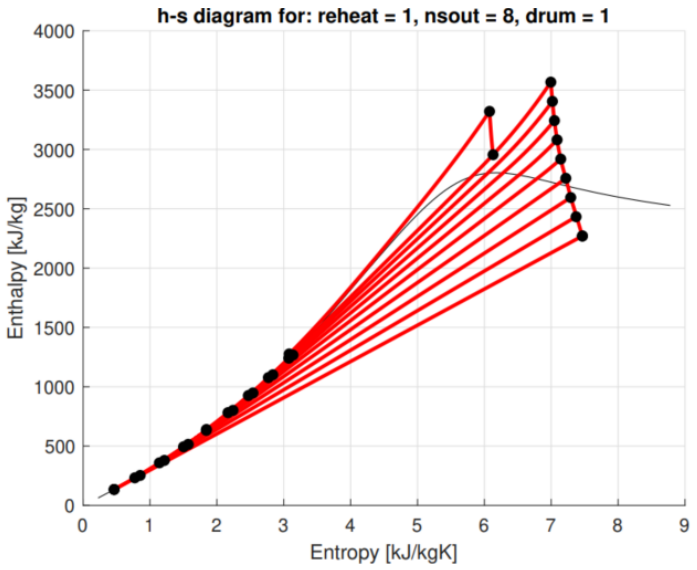
The ST function signature provides some hints to start ☺

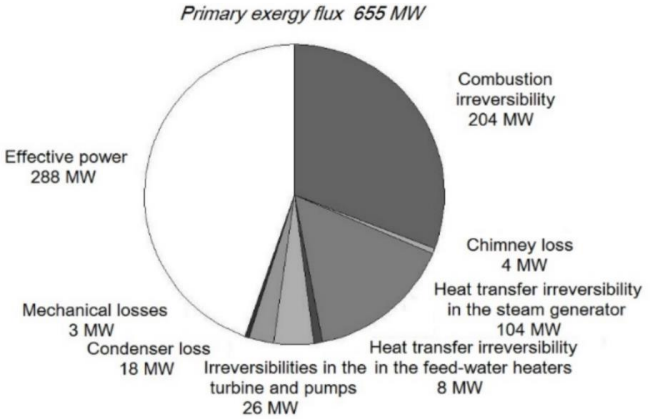
Type of expected results for HW3 Thermodynamic states (DAT)

States	t °C	p kPa	x -	h kJ/kg	s kJ/kg K	e kJ/kg
1	286.0	10000	-	1266.6	3.113	372.1
2	295.8	35000	-	1306.1	3.125	407.3
3	565.0	31000	-	3320.7	6.077	1572.1
4=6VIII	330.0	7000	-	2952.7	6.126	1189.2
5	565.0	6200	-	3574.7	7.056	1543.0
6VII	484.0	3700	-	3413.0	7.084	1373.4
6VI	400.0	2000	-	3248.3	7.129	1195.6
6V	322.0	1070	-	3097.0	7.172	1032.0
6IV	239.0	510	-	2937.8	7.219	859.4
6III	155.0	220	0.98	2777.9	7.259	688.0
6II	92.0	75	0.94	2617.2	7.328	507.3
6I	62.0	22	0.89	2472.1	7.455	324.5
6	33.0	5.0	0	2294.5	7.521	129.0
7	32.0	4.8	-	134.1	0.464	2.9
9VII	246.0	10000	-	1066.7	2.743	278.0
9VI	213.0	10000	-	914.1	2.439	212.9
9V	183.0	10000	-	780.8	2.156	162.1
9IV	150.2	10000	-	638.9	2.833	112.3
7IV	148.7	460	0	626.6	2.829	102.3
9III	123.3	460	-	516.7	2.560	69.1
9II	92.0	460	-	385.8	2.216	37.0
9I	62.0	460	-	259.9	0.856	14.8
8	32.0	460	-	134.6	0.465	2.4

Type of expected results for HW3 T-s, h-s and pies (FIG)







- Energy pie chart
- Exergy pie chart
- T-s diagram
- h-s diagram

Last remarks….

Other expected results:

COMBUSTION the combustion parameters
MASSFLOW the mass flow rates in the system
ETA the energy and exergy efficiencies
DATEN the energy losses
DATEX the exergy losses
XMASSFLOW the mass flow rates in the bleedings

This function signature is new: would you find any mistake, please contact the TA. It might thus be slightly modified in the next few days ☺

Report specification

Your report must **at least** contain the following:

- Formula used to compute the relevant parameters;
- Justification of your hypotheses;
- The numerical values used and obtained;
- The relevant graphs (including sensitivity analyses);
- Explanation to your potential issues (missing in 99% cases for HW2).

This report must be **maximum** 3 pages (+ unlimited number of pages for the figures).

Only HW3_group_xx.pdf **format will be accepted!**

The deadline is Sunday of S9

1. Go on the Moodle page of the course
    1. Download the new template Python script for the ST (ST_group_xx.py);
    2. Carefully read the signature (it has changed);
    3. Test code provided (ST_test.py). If your code can't pass this test, your grade will be automatically set to **0/10** for HW3!
2. Fill the function definition and test your code!
3. Submit your Python script + report on Moodle

Deadline?

Sunday the 14th of November (**S9**) at 23:59 + *optional Q&A session (please fill this Doodle asap).*

Only 3 weeks left!