# LELME2150 – Thermal cycles

# Introduction to Homework 4

**Date:** *November 22, 2021*

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# Goal of oral interview

Show that you master the basics about thermal cycles. For example:

- Compression and expansion models of a gas turbine?
- Distribution of energy and exergy losses in gas and steam cycles (order of magnitudes)?
- Impact of the ambient conditions (e.g. temperature) on the design and performance of power plants?
- What are the trends if I increase the pressure? Lower the temperature? …
- What are the minimum/maximum pressures and temperatures limited by?

# Goal of the homework and oral presentation

Going further in the study of thermal cycles

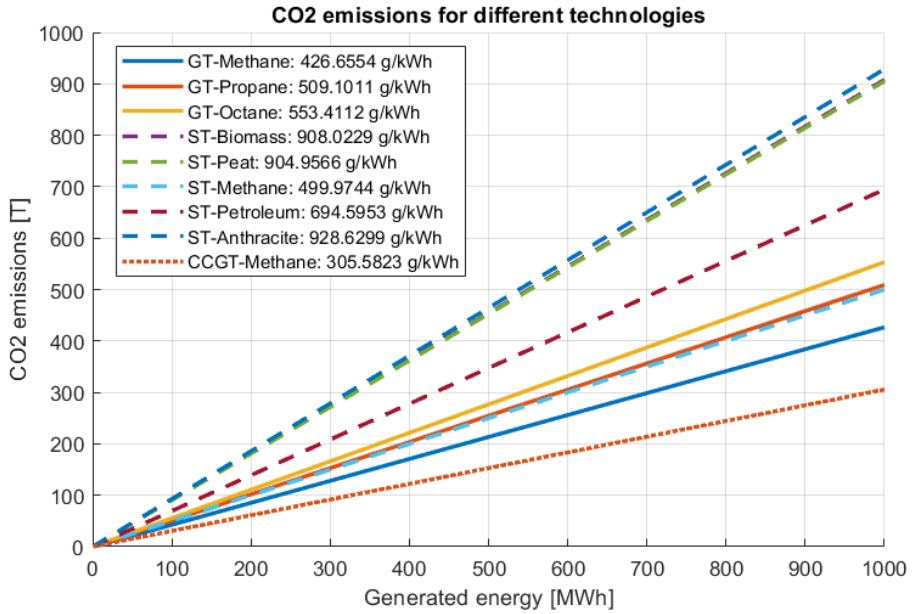
- **Fix the bugs** you had in the previous homework
- Parametric and sensitivity analyses with your models
  - Pressure and temperature levels, types of fuels,
  - …

Show **creativity** (new cycles, new applications, …)

- Simulate improved cycles (different numbers of feed-heaters, of reheating, recuperators, …)
- Improve your models (study the effect of heat and head losses in piping, …)
- Simulate new systems (working fluids, application, …)

# Example of parametric analyses conducted with your models

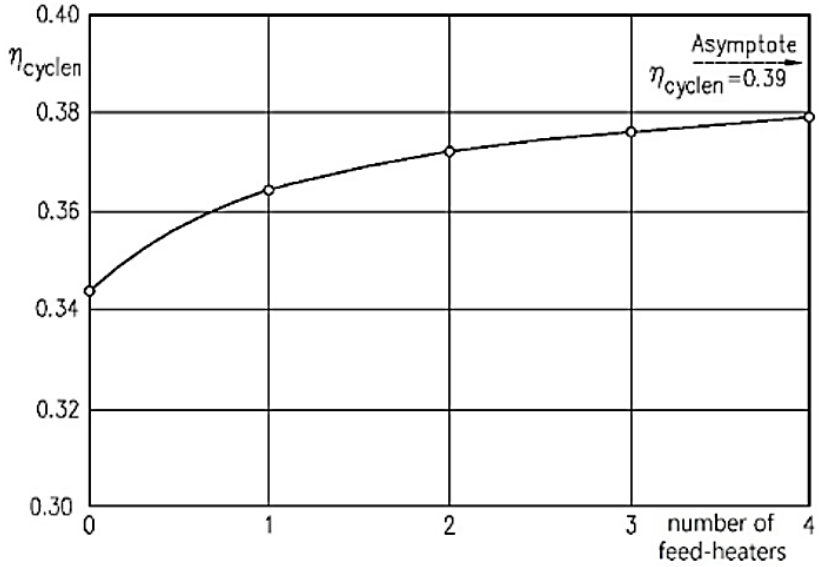
- CO2 emissions for different fuels and different technologies (comparison with literature!)

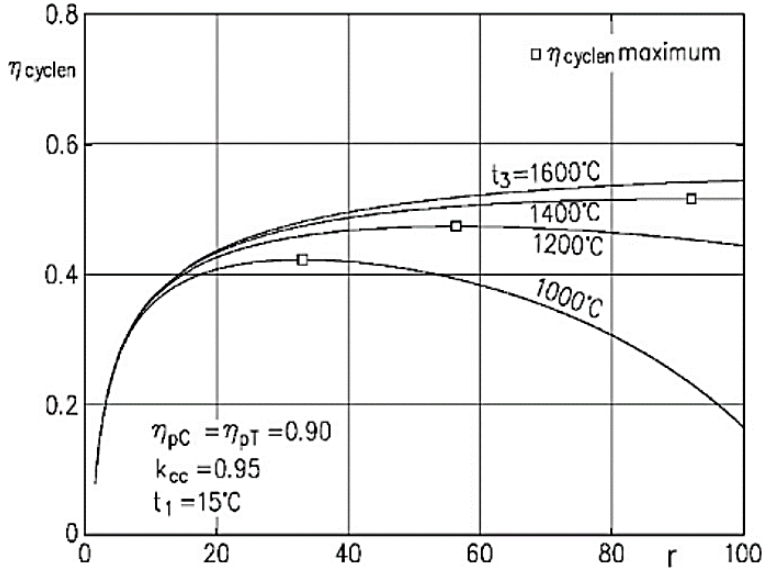



| g/kWh | FR | DK | UK | Ref. |
|---|---|---|---|---|
| **Gas** | 429 | / | / | 427 |
| **Coal** | 956 | 973 | 846 | 928 |
| **Biomass** | 983 | 922 | / | 908 |
| **CCGT** | 359 | 404 | 365 | 305 |

# Example of parametric analyses conducted with your models

- Efficiency of ST for different # of feed-heaters
- Efficiency of GT for different design parameters



# Examples of other improvements on ST (refer to book & literature)

- Different number of feed-heaters
  - Relationship of efficiency with it?
- Multiple reheating
  - One? Two? Sufficiently profitable?
- Simulation of organic Rankine cycles
  - Low grade heat sources (geothermal, waste heat, …)
- Simulation of Combined Cycles Gas Turbine
  - Steam turbine as bottoming cycle for gas turbine

# Examples of other improvements on GT (refer to book & literature)

- Simulation of externally fired gas turbines
  - Use of solid state fuels
- Simulation of recuperated gas turbine
  - Recover heat from exhaust gas with heat exchanger
- Simulation of humid air gas turbine
  - Recover heat from exhaust gas with steam
- Simulation of air-cooled blades
  - Impact on efficiency?
- Simulation of multiple staged compression
  - Comparison with single staged? Motivation?

# These are not improvements

- Solve problems to obtain correct thermodynamic states
- Solve problems related to compression and expansion models
- Solve problems related to the computation of exergy losses
- Solve problems related to the combustion model
- Solve problems to obtain correct diagrams
- Submitting a (new) report

# Your final grade for all homework is 7 points out of 20

- No improvement, no parametric analysis, wrong results: **max 3/7**
- No improvement, no parametric analysis, correct results: **max 3.5/7**
- No improvement, some parametric analyses, correct results: **max 4/7**
- Some improvements, some parametric analyses, correct results: **max 5/7**
- Many improvement (not listed above), many parametric analyses, correct results: **max 6/7**
- Creative and relevant study, impressive work: **max 7/7**

# In summary

1. Choose the improvements you want to do and fix the bugs you had in the previous homework
2. Oral presentation (*Dec. 15, 13h-17h20 in Stevin b.044*)
   - Select a slot asap on the Moodle page
   - 10' on the **strength** and **innovative** part of your work
   - 5-10' Q&A on all HW
   - Previous group will attend actively the next one
3. No report (you already made it for HW2 and HW3)
4. Submit your code (similarities will be sanctioned) and your presentation (back-up in case of problem)

**Deadline for slide and code submission?**

Wednesday December 14 (**S14**) at 23:59

Any question?

Feedback on teaching approach?