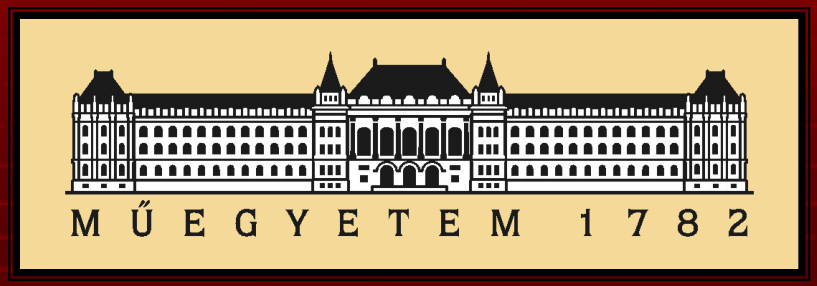

10th International Conference on
HEAT ENGINES AND ENVIRONMENTAL PROTECTION

Alcohol Based Fuel Utilisation in Micro Gas Turbine

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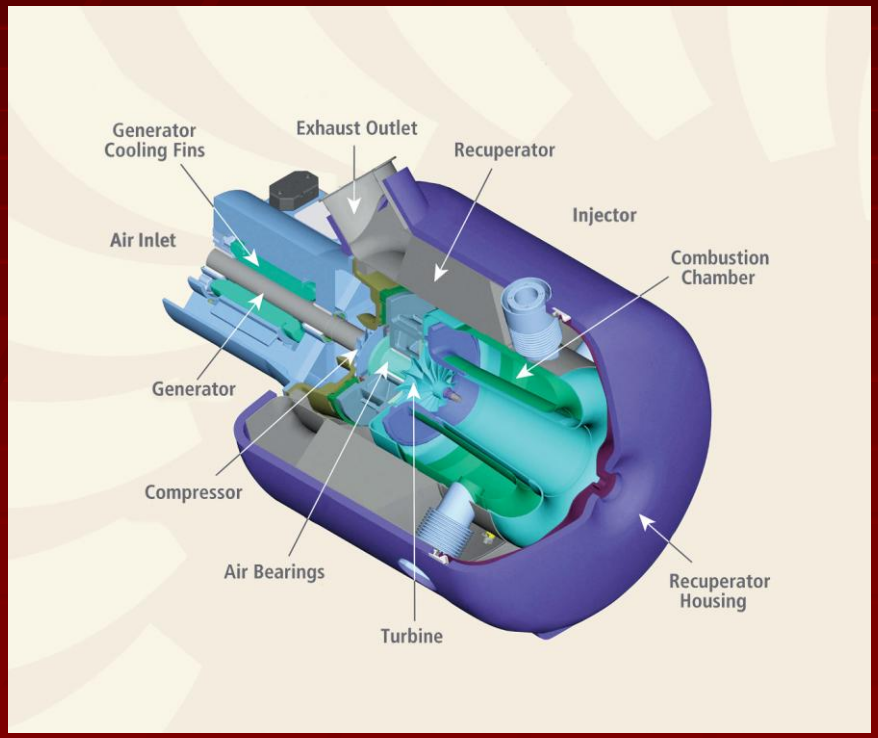
Balatonfüred

Alcoholic fuels

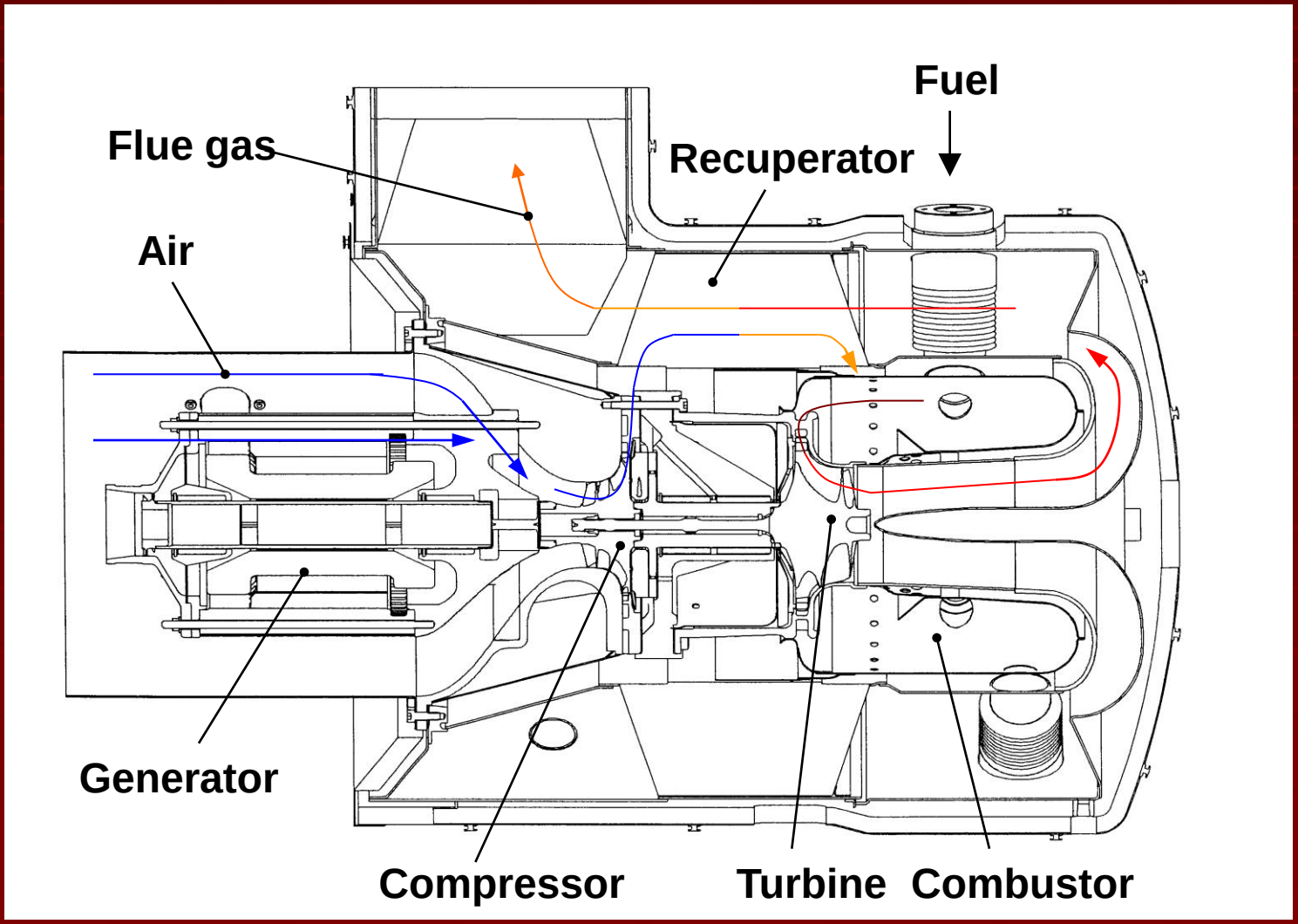
Products of distilling industry	Ethanol content in v/v%	Other materials
pre-distillate	94 ÷ 95	water, methanol, acetaldehyde
middle-distillate	96	water
post-distillate	20	water, high alcohols
Alcohol fuel	÷ 96 (100)	water, methanol, acetaldehyde, high alcohols

Capstone C 330



Electrical power	29 (± 1) kW
Rotational speed	96.000 1/min
Pressure ratio	3.5
Electrical efficiency	25 (± 2) %
Exhaust gas temperature	275 ºC
Mass flow of flue gas	0,31 kg/s

Capstone C 330



Model creating

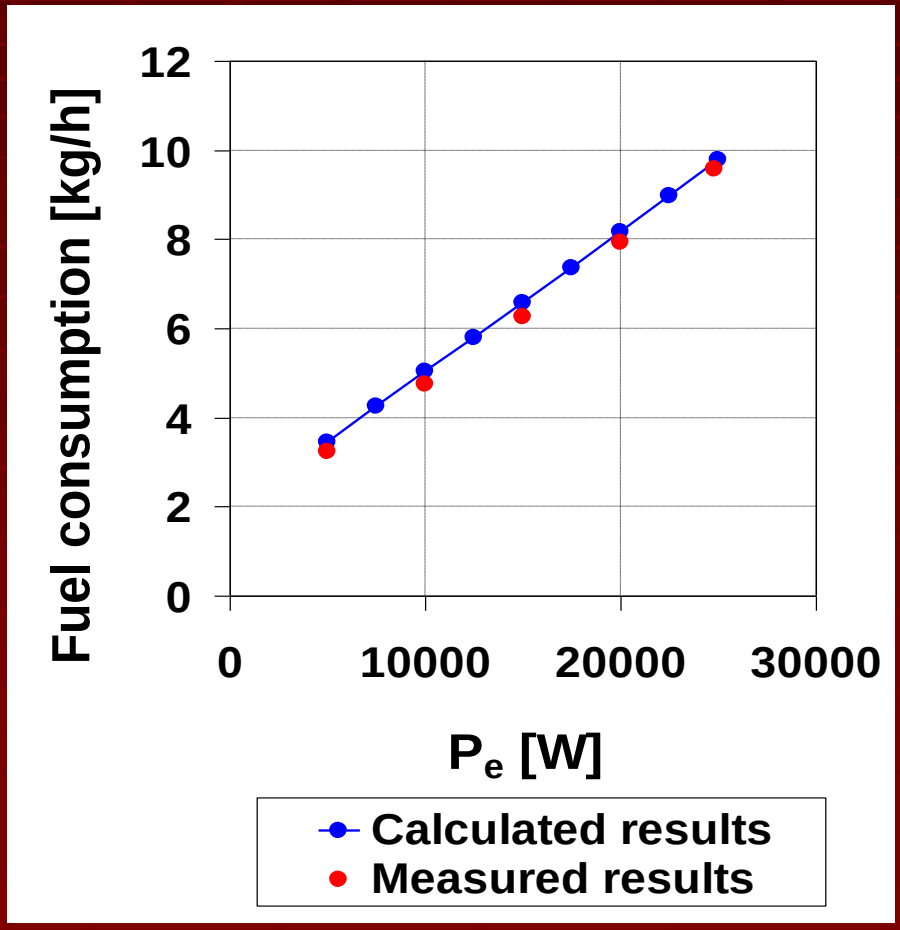
- Equations: Stoichiometric equations

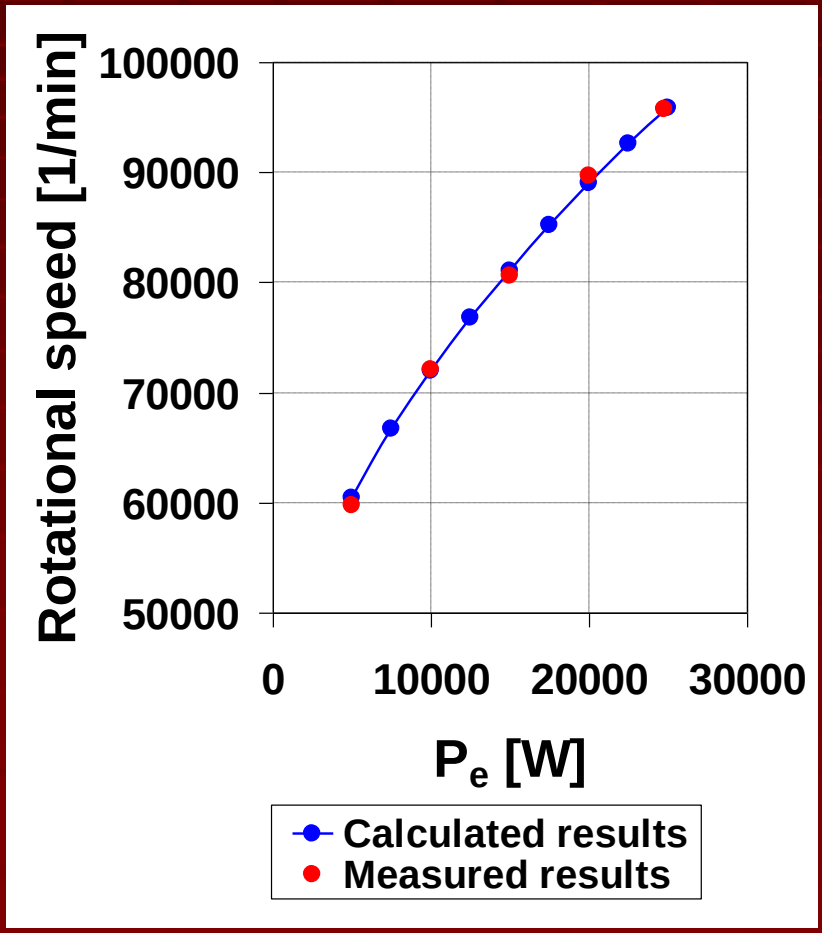
  Thermodynamic equations

  Physical properties of working fluid

- Equation system → mathematical model
- Simulation (MathCAD)
- Validation of the model

Measured and calculated results



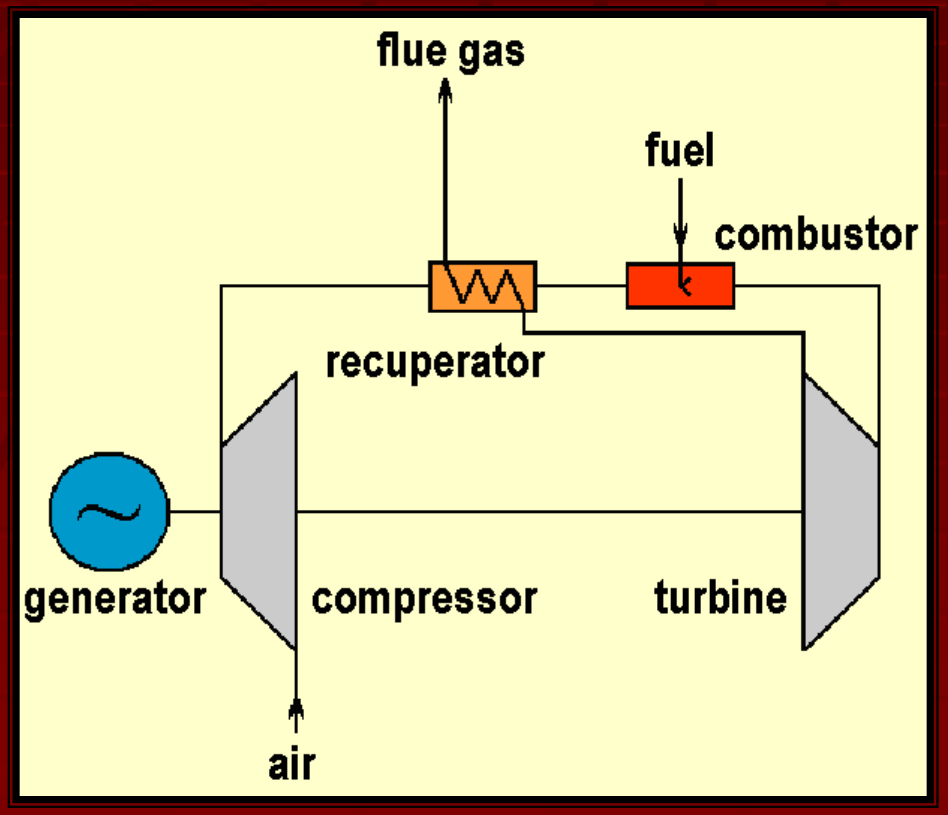


The model and its application

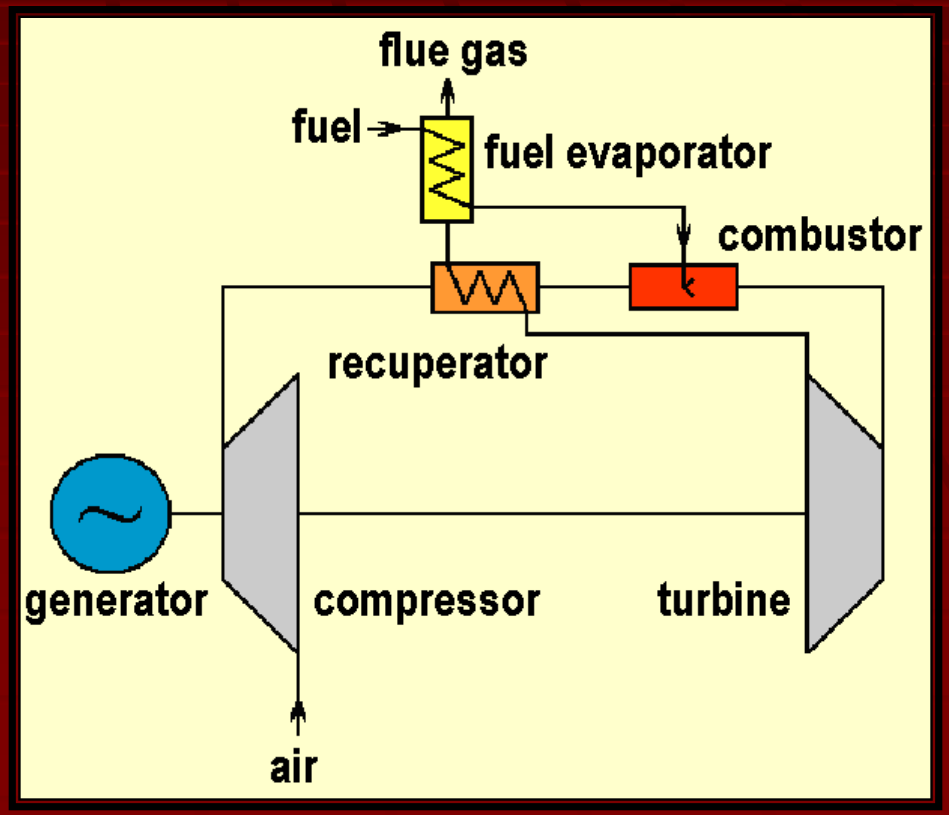
- The applied equations formulate an equation system which is the non-linear mathematical model of the micro gas turbine. The model describe steady state steady flow (SSSF) processes in a wide operational range.

- This model is capable of examining the effects of external parameter changes (for example: fuel quality change) and simulate the different operational conditions.

Fuel injection in liquid and vapor state

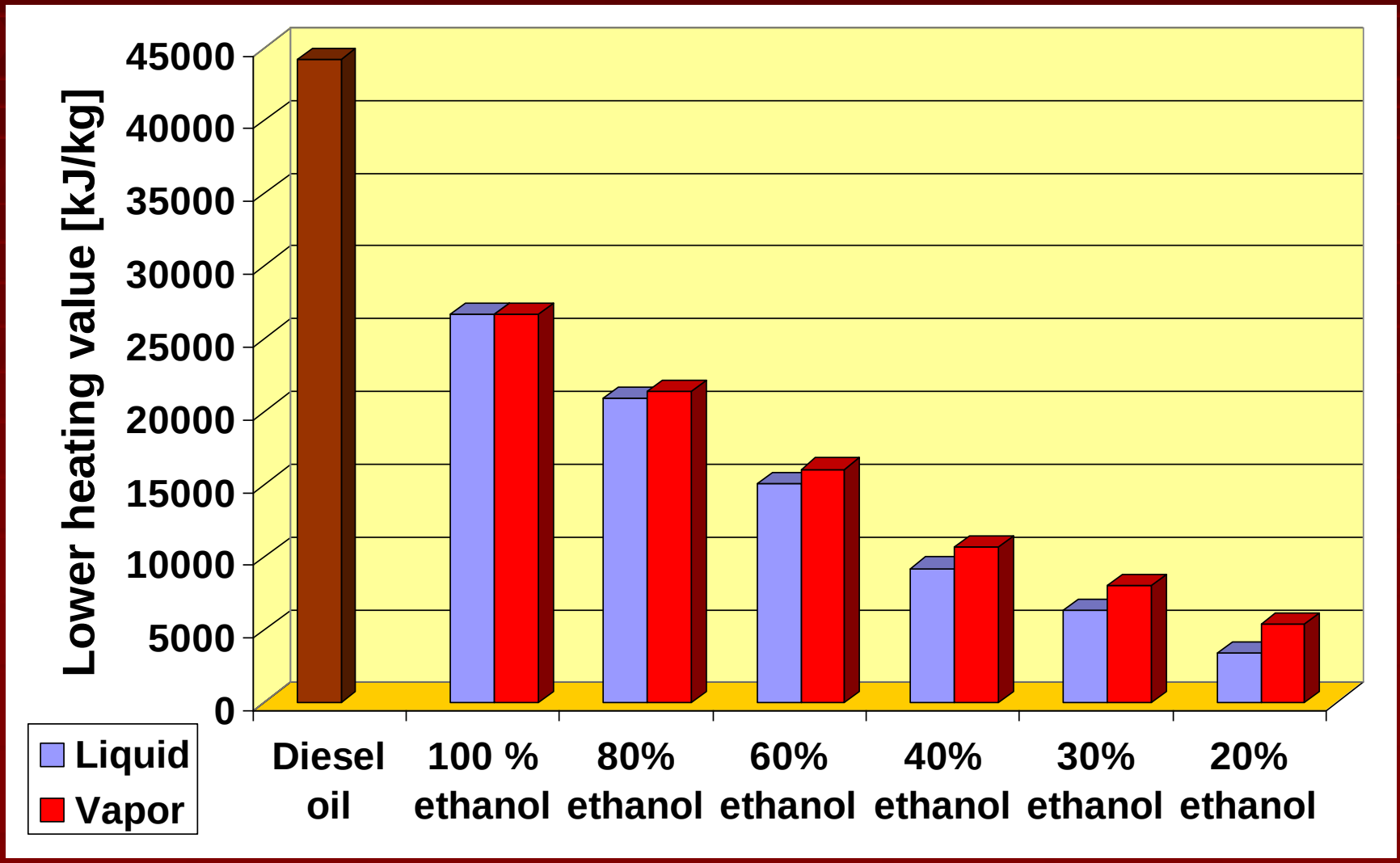


Liquid

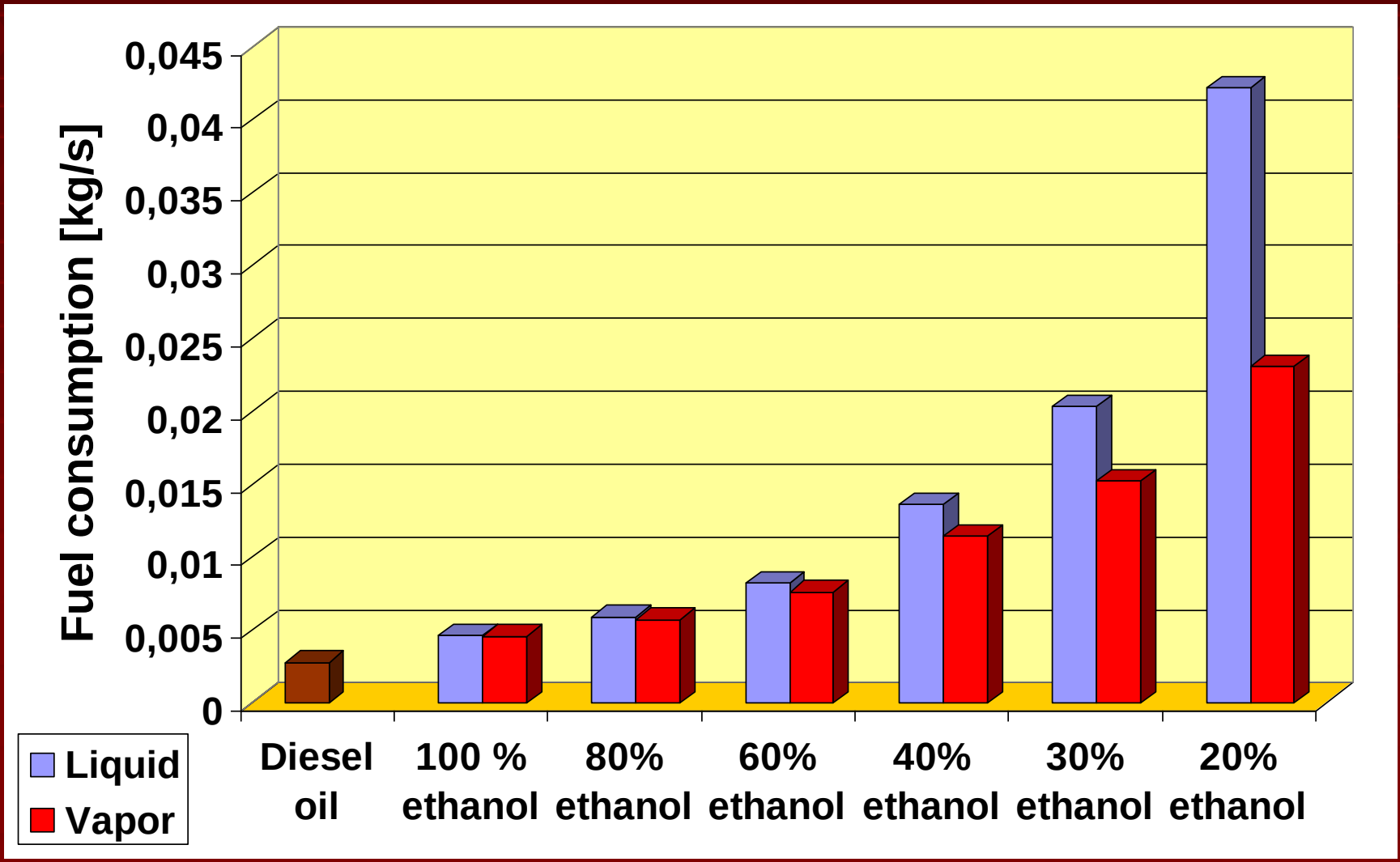


Vapor

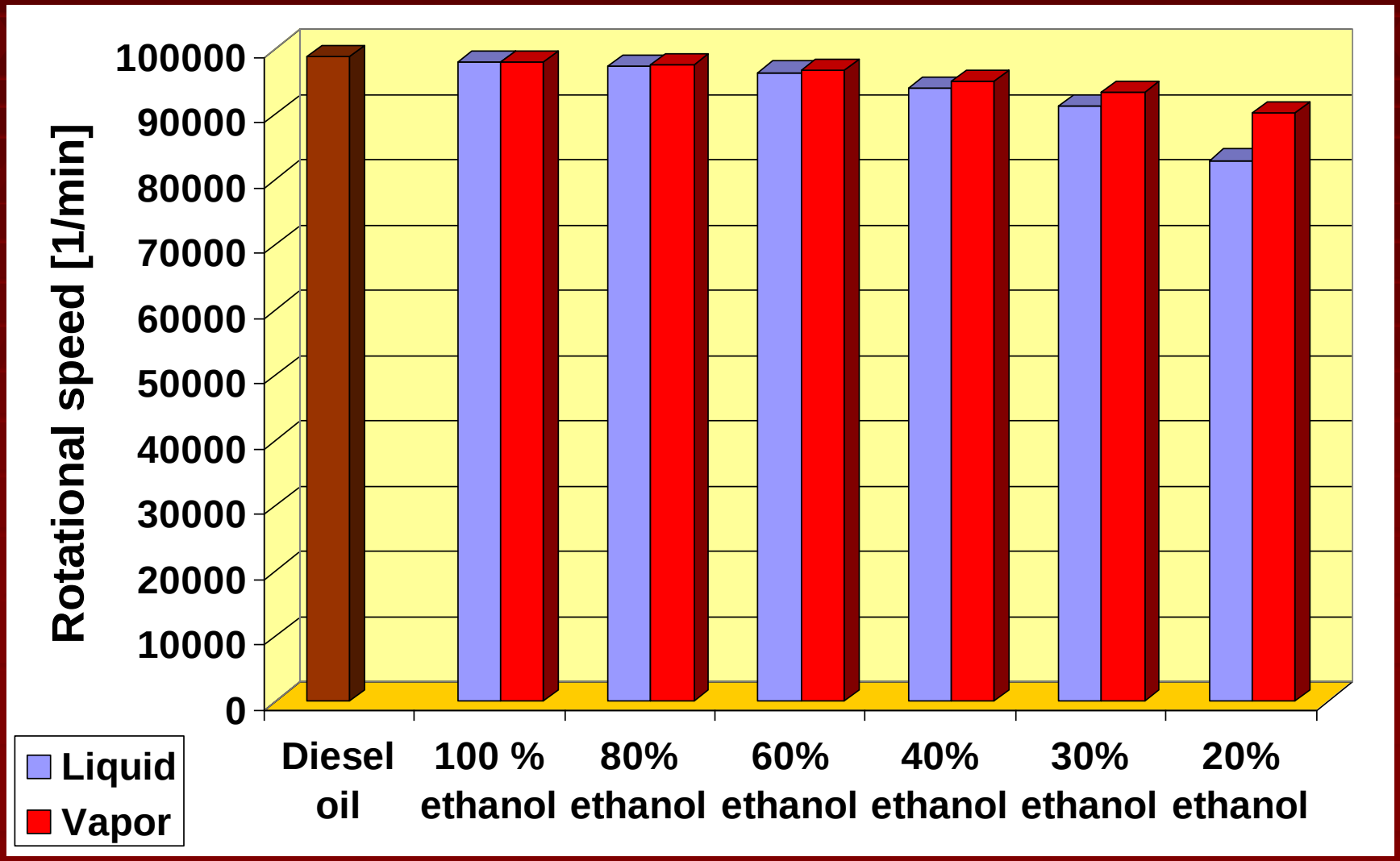
Results of the simulation



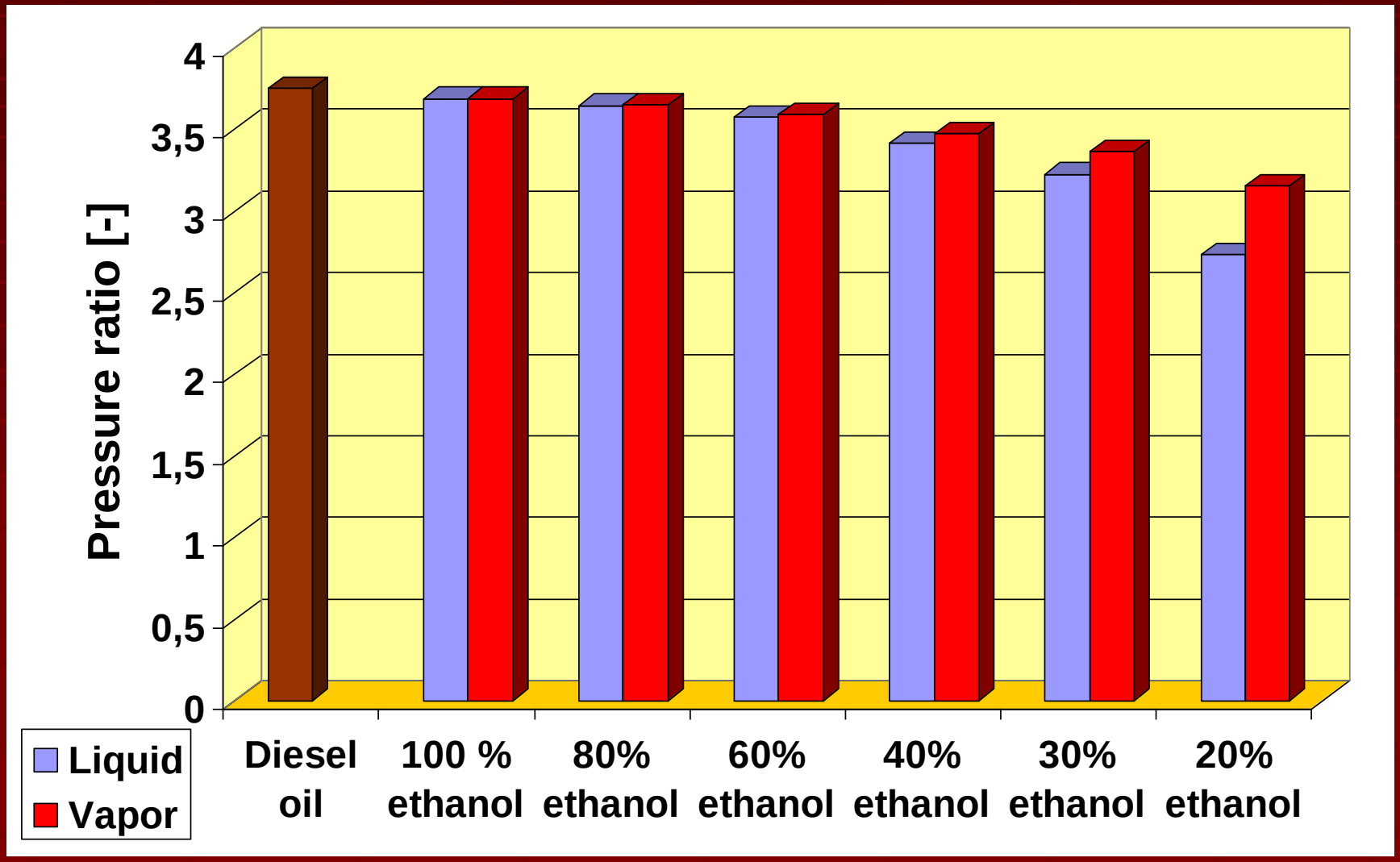
Results of the simulation



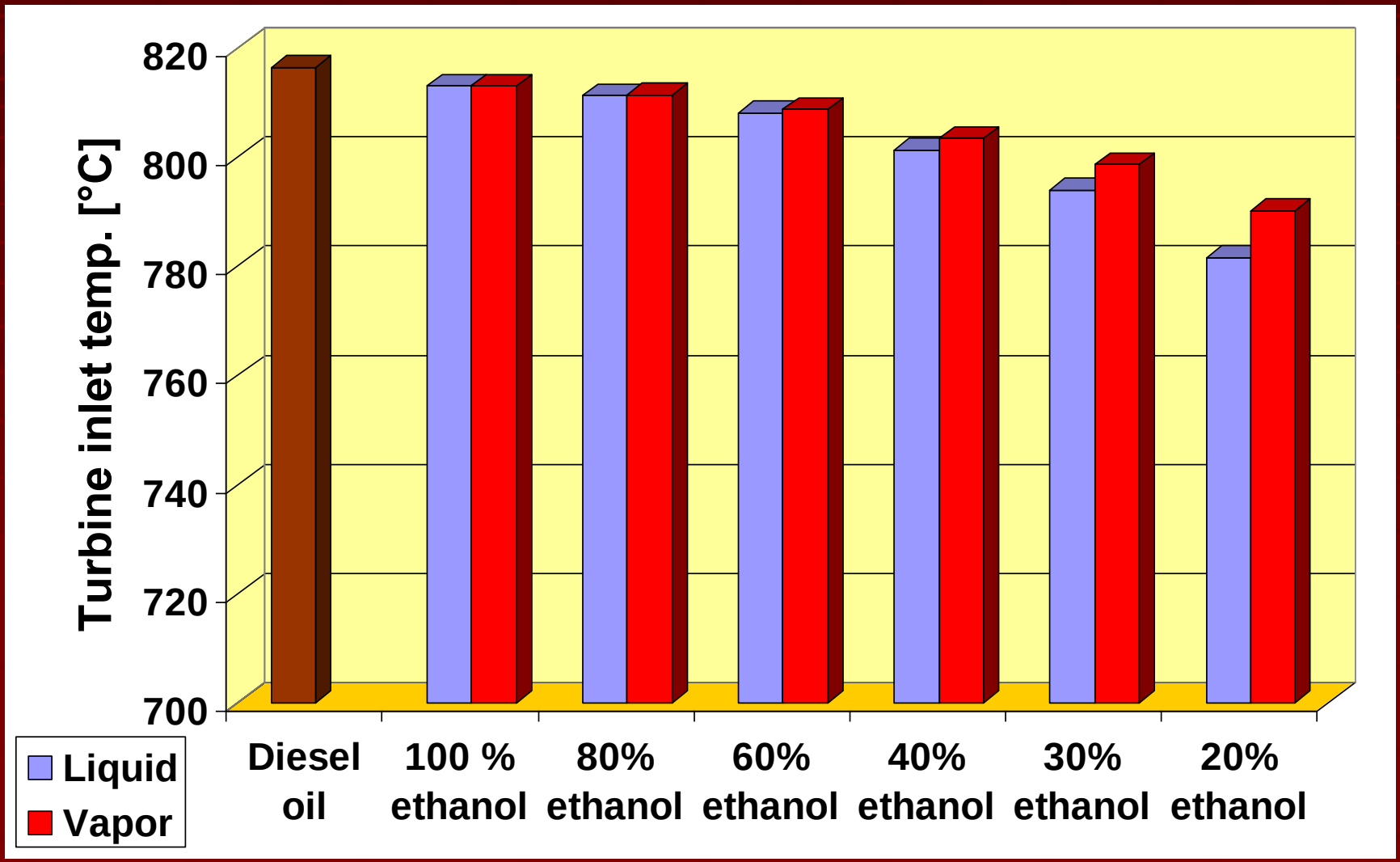
Results of the simulation



Results of the simulation



Results of the simulation



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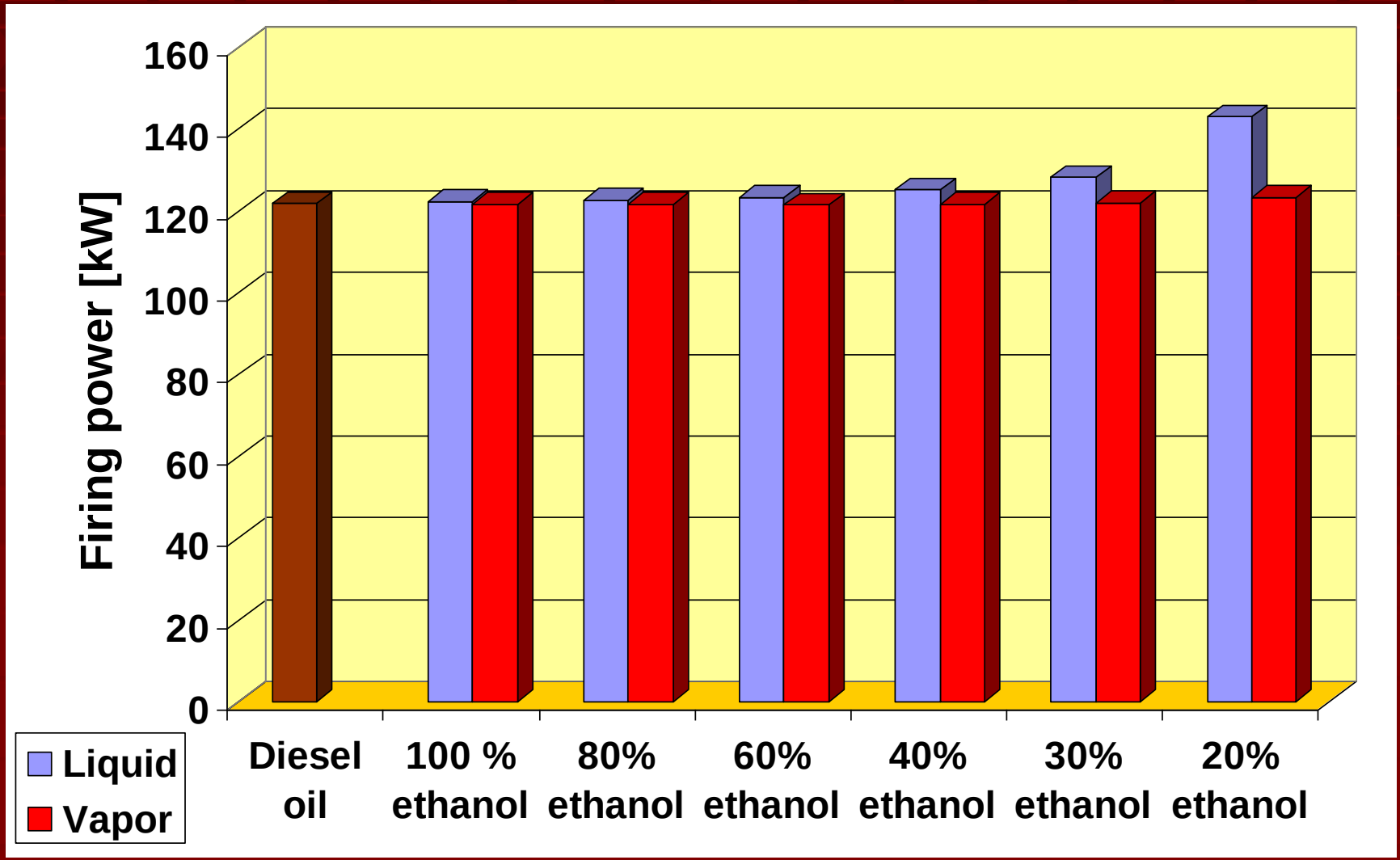
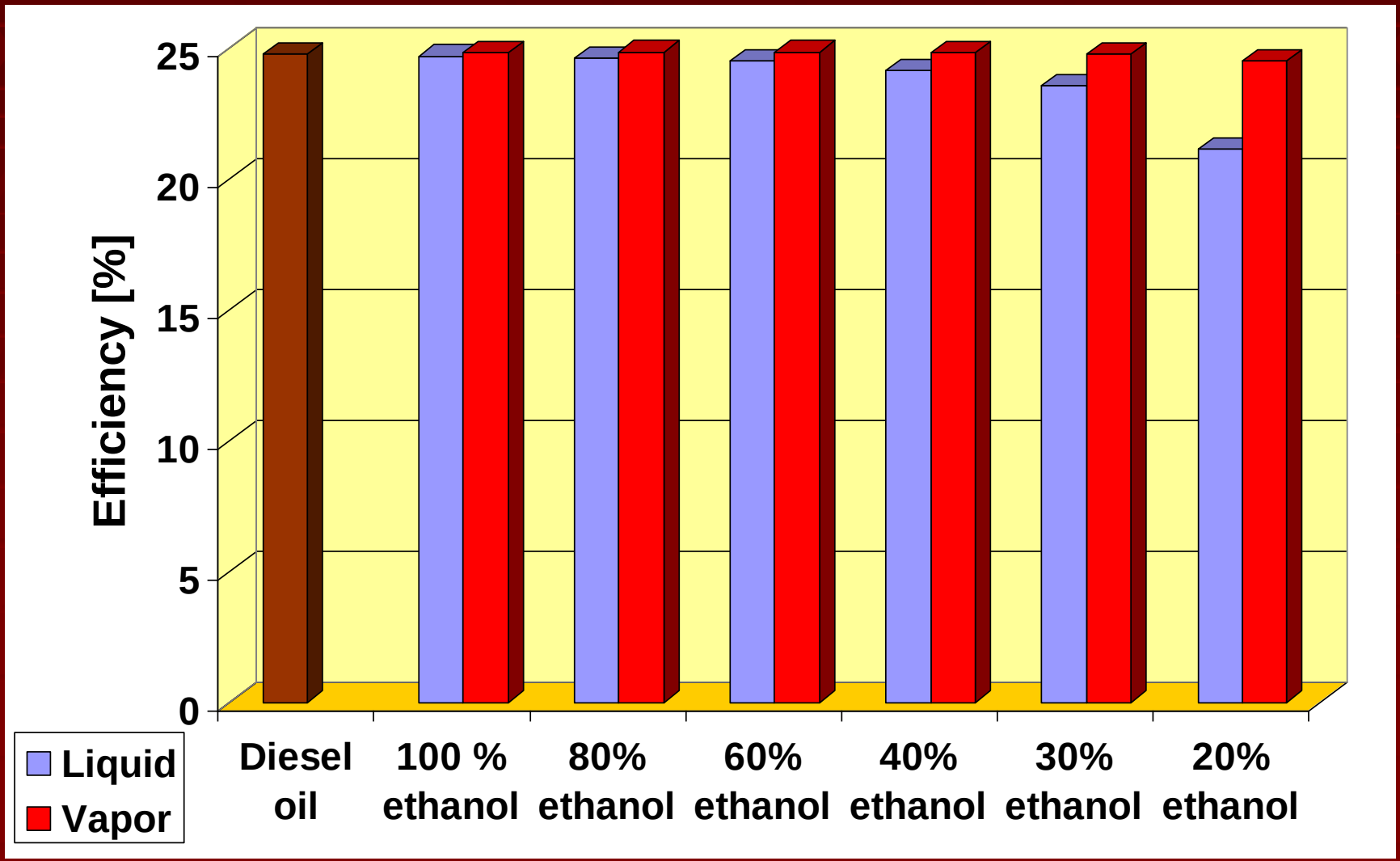
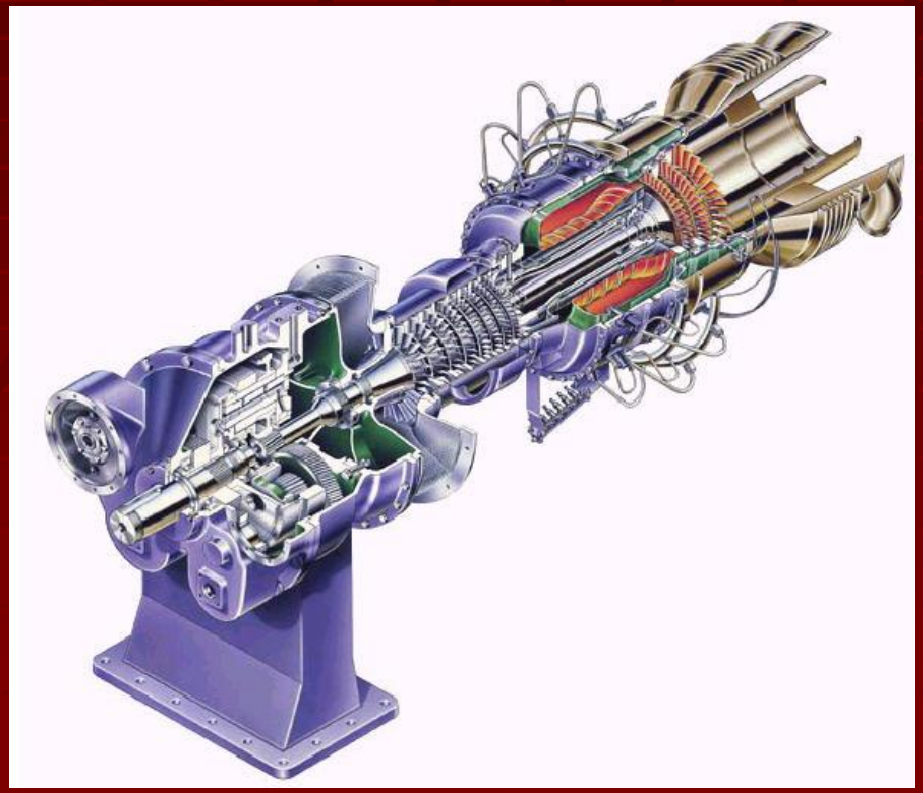


Results of the simulation

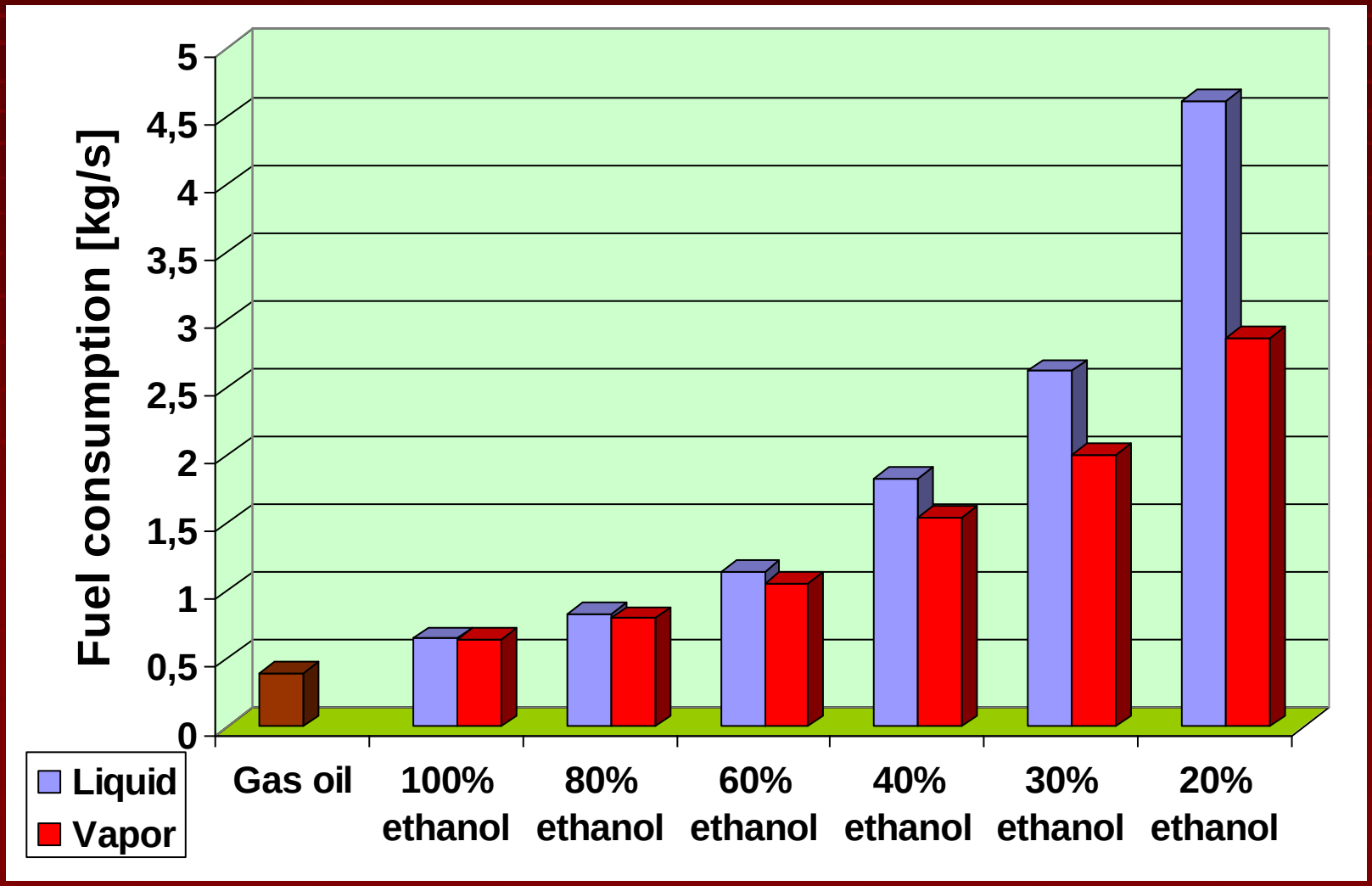


Solar Taurus 60

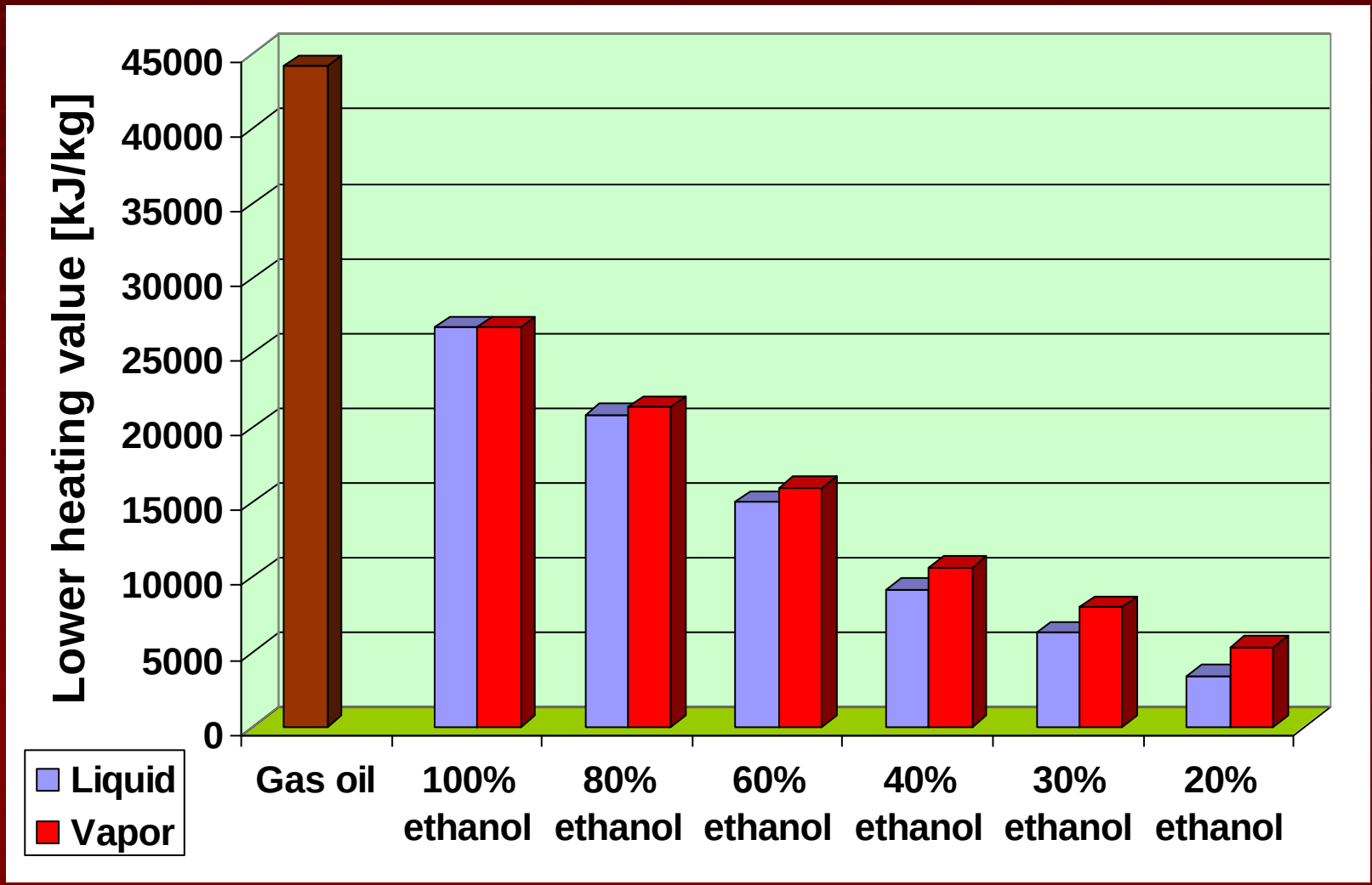


Electrical power	5,67 MW
Pressure ratio	13,4
Electrical efficiency	31,4 %
Exhaust gas temperature	510 ºC
Mass flow of air	21,5 kg/s

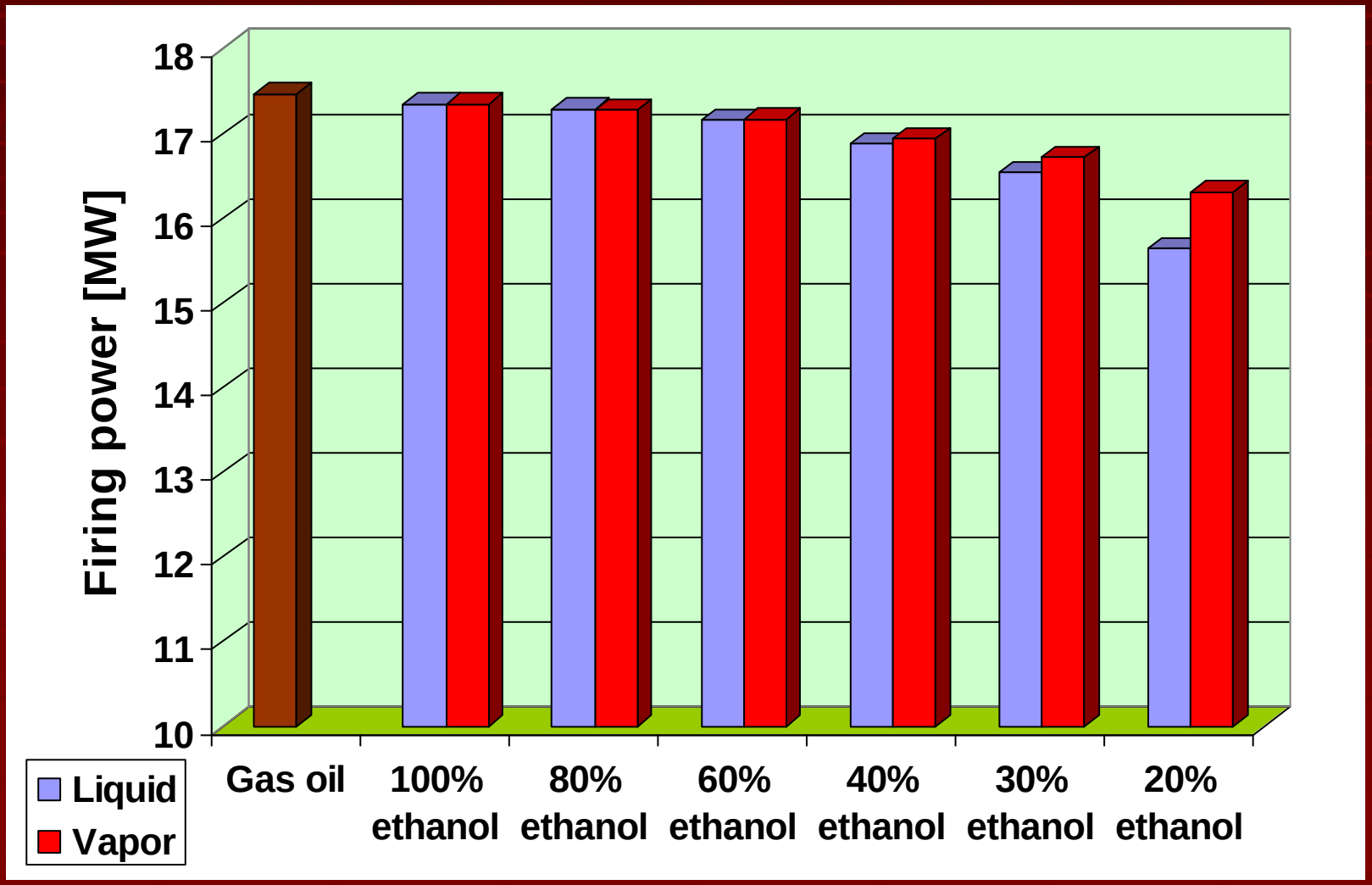
Results of the simulation



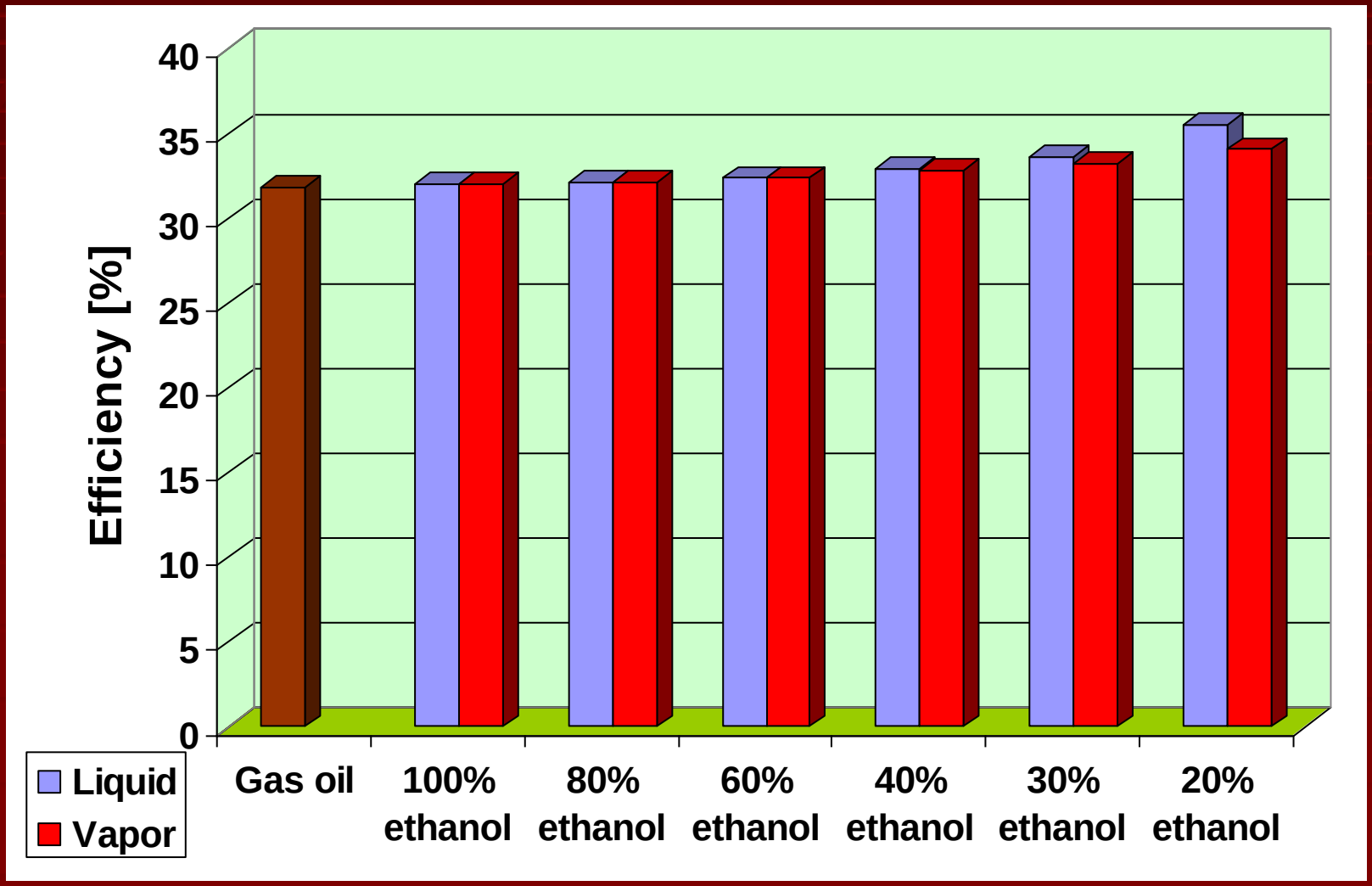
Results of the simulation



Results of the simulation



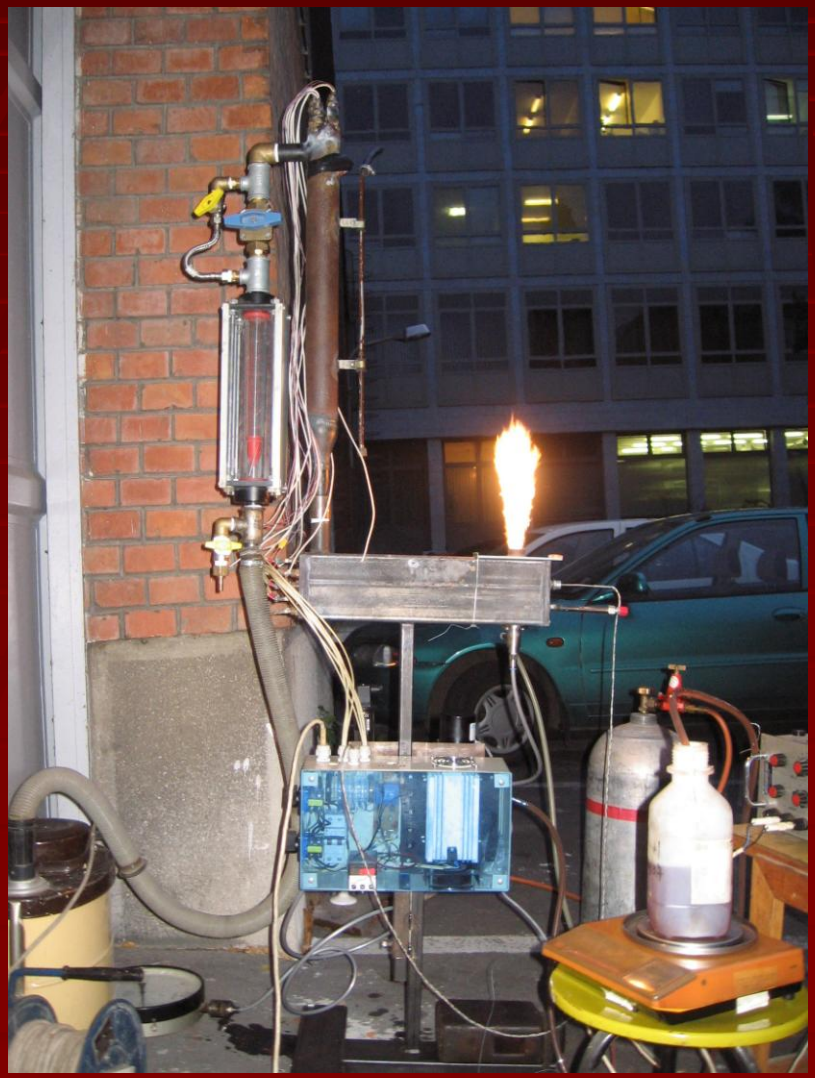
Results of the simulation



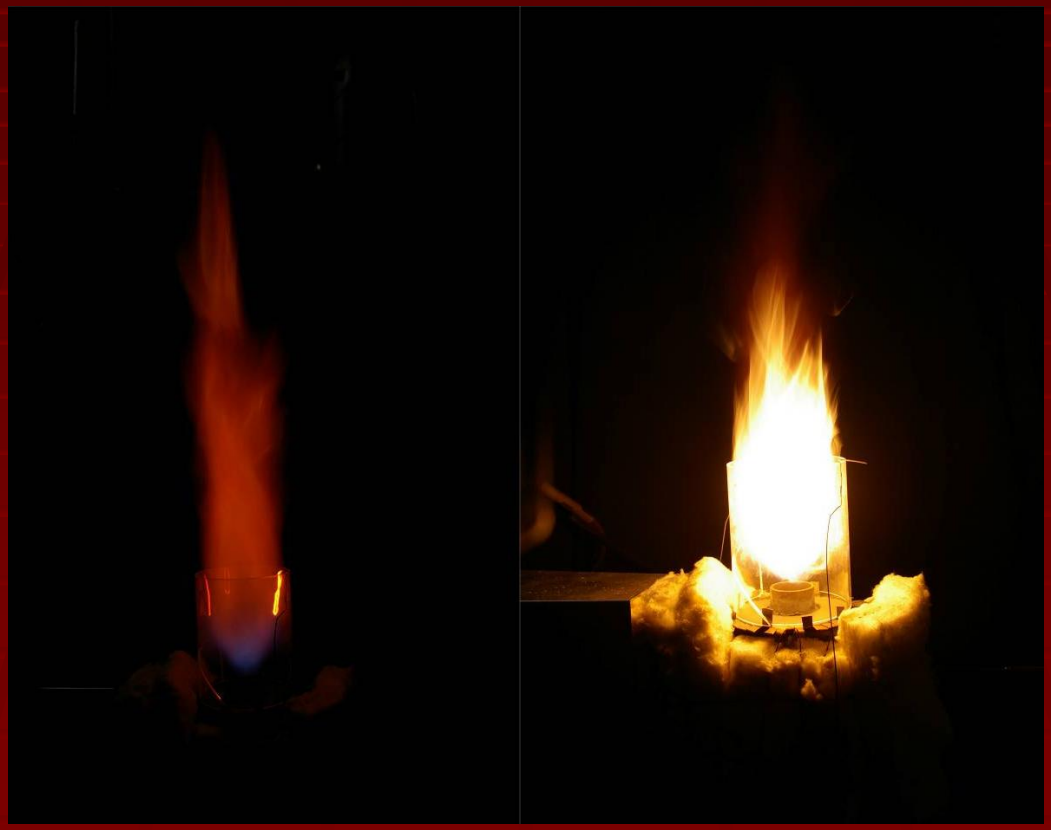
Conclusions

- The simulation showed that the utilisation of high water content liquid alcohols (compared to diesel oil) have a negative effect on the efficiency of the micro gas turbine.
- Utilisation of alcohol in vapor state did not change the efficiency of the micro gas turbine significantly.
- Firing of high water content alcohol increases the efficiency of industrial gas turbines (constant rotational speed).

Preliminary combustion tests



Combustion test of fuels



Ethanol

Gas oil

THANK YOU FOR YOUR ATTENTION!