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Optimization of biomass district heating plants

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We offer the following services:

- project development
- optimization of bio energy systems
- check measurements of wood combustion systems
- quality management
- service for the members

Content

- Background and motivation
- Technical deficiencies
- Biomass combustion
- Calculation of wood boiler capacity
- Efficiency of energy conversion and distribution
- Wood fuel logistic
- Conclusion

Background

- There are many existing local district heating plants driven by biomass combustion systems in Styria and also in Austria
- Efficient systems are necessary to have the platform for the further integration of CHP and other applications with biomass in the future
- The economic operability of such systems is the first essential point
- The lowest possible primary fuel and energy consumption is important
- The energy losses of the distribution grid should be as low as possible
- As low as possible emissions are essential
- …and also the existing plants which have been built during the last 30 years should be improved.

Biomass district heating plants

Main technical deficiencies are:

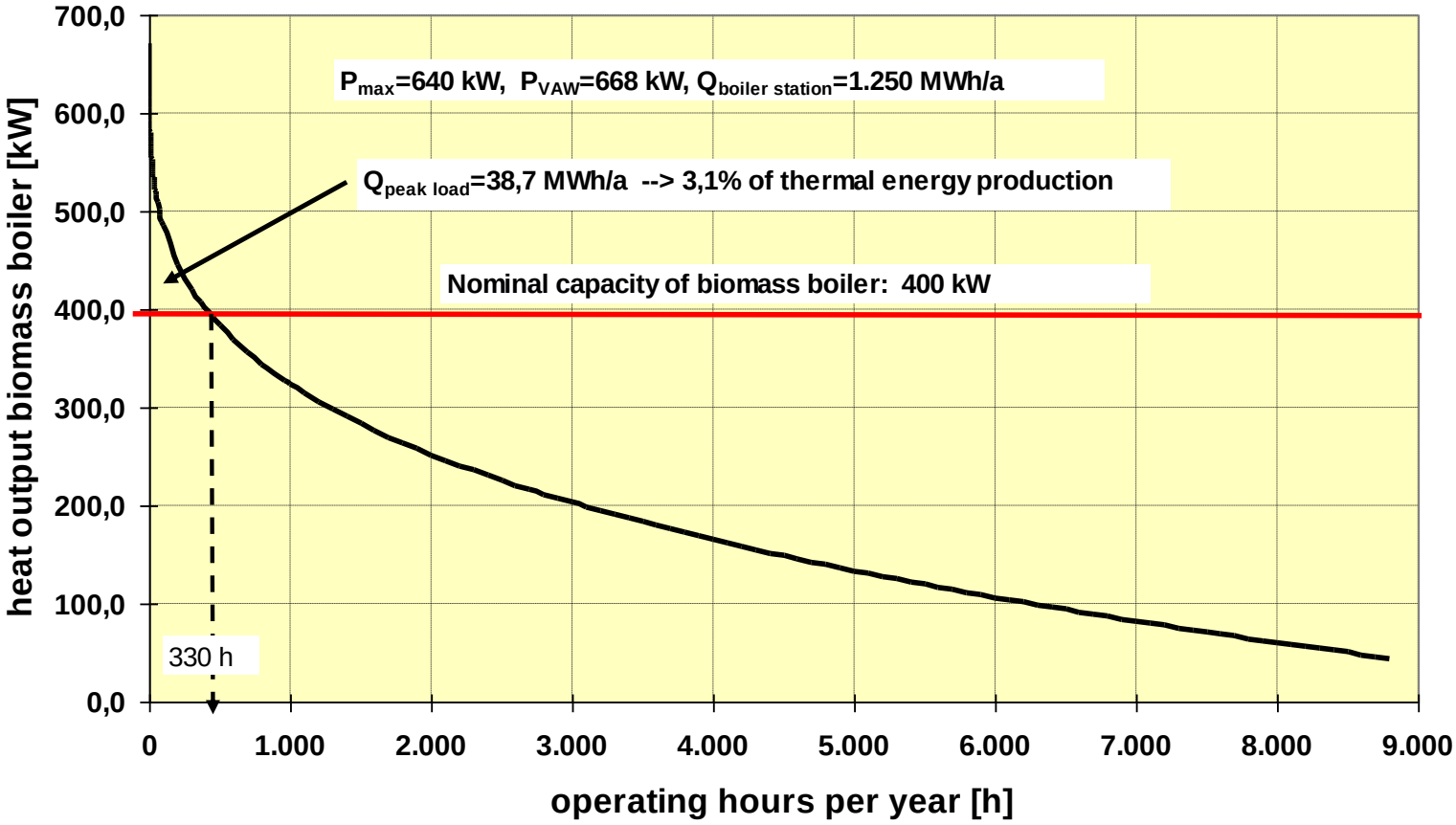
- Fuel quality does not meet the quality requirements for the installed firing
- Size of the fuel silo much bigger than necessary
- Low utilisation ratio of the wood boiler
- Reserve capacity in the heating station
- Faults in the hydraulic and the control system lead to high operation costs
- Oversized pipeline-system
- The heat demand of consumers is overestimated
- Many biomass plants cause much higher energy production costs than expected

Biomass combustion system

Note the main goals:

- Nominal load operation hours > 2.500 h/a
- Installation of Puffer systems to covering the peak load
- Boiler capacity against the maximum heat output in the grid.
- Calculate the plant capacity to get economic operability

Annual load duration curve

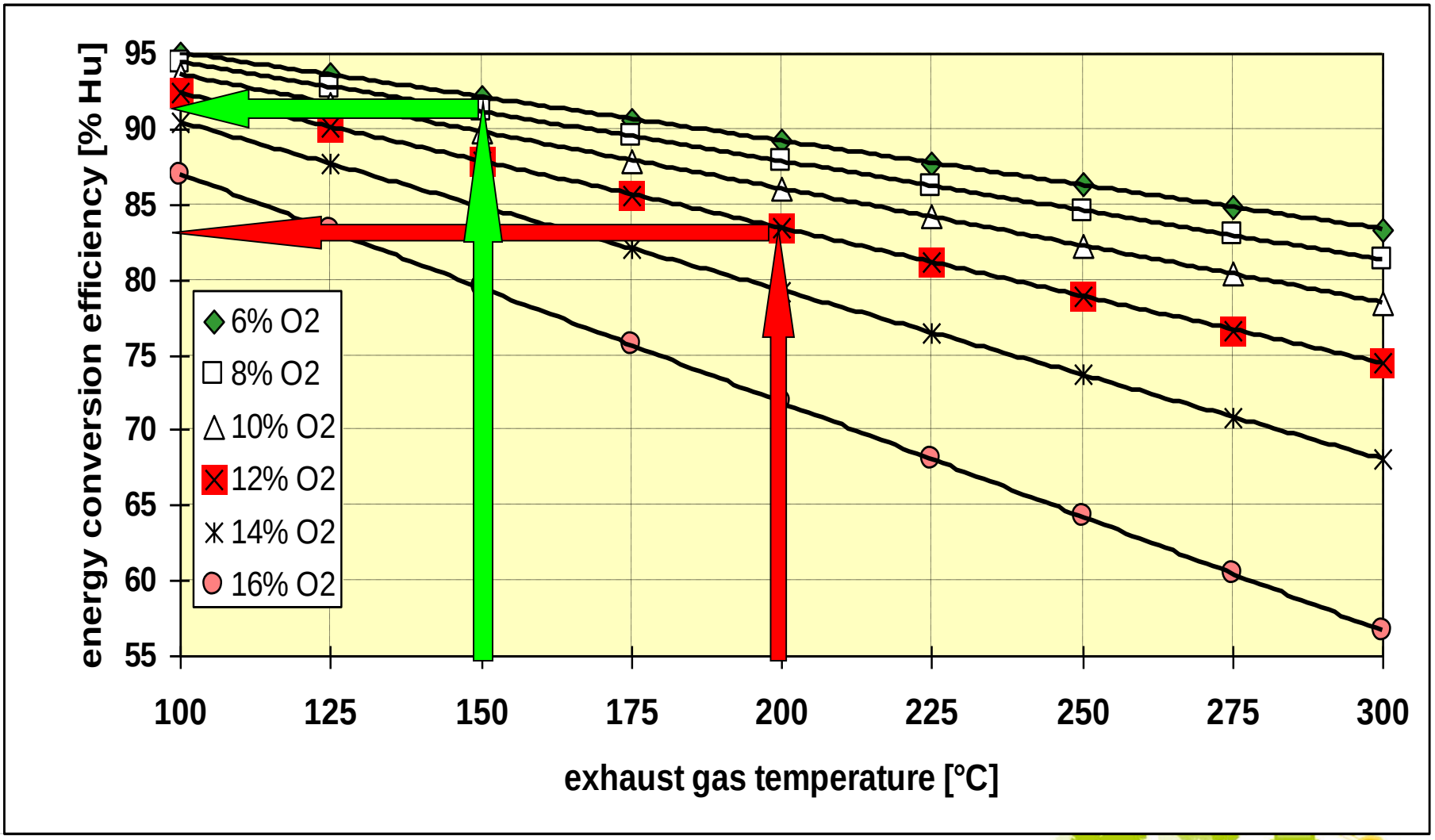


Biomass combustion system

Energy conversion – essential indicators:

- The water content of the wood fuel should be less than 30%.
- The oxygen concentration in the flue gas should be in the range of 6 – 8% O_2
- Flue gas temperature < 170 °C
- Complete combustion to reach as low as possible emissions.

Energy conversion efficiency



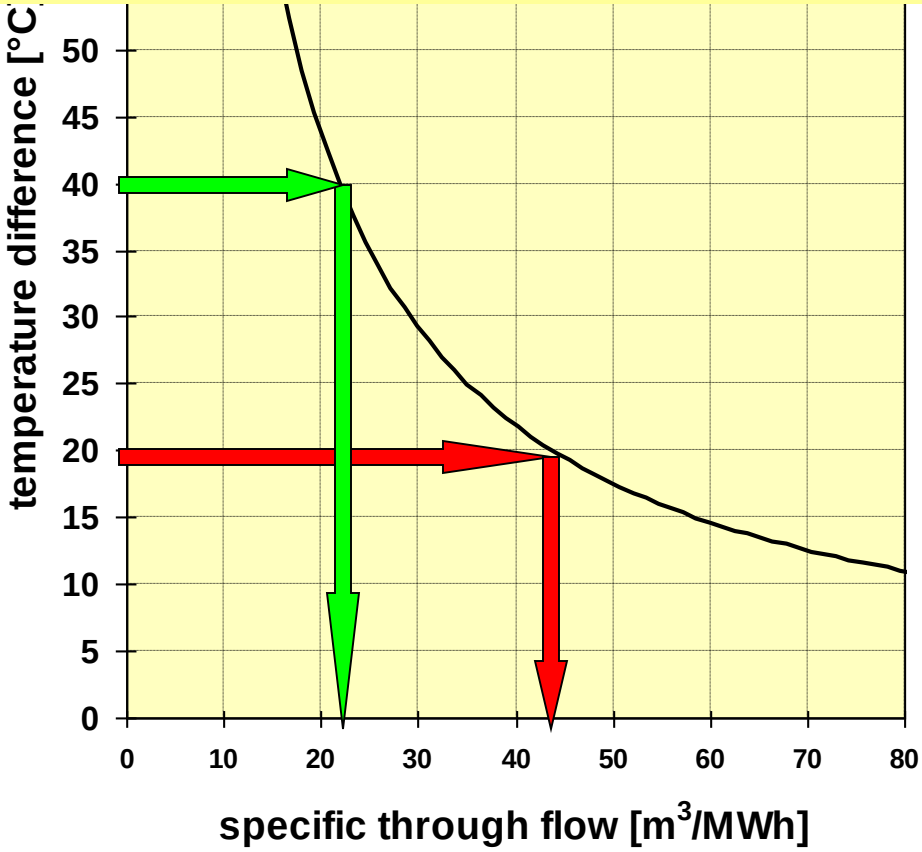
Efficient operation of the district heating grid

- Feeding temperature of the net as low as possible (depends of out door temperature and temperature level of the heating systems of the customers)
- Adaption of the secondary system by hydraulic adjustment to decrease the return flow temperature.
- Reduce the electricity demand for the pumps by frequency controlled performance and optimal control strategy → Δp-control

Specific flow rate of the grid system

Doubled flow rate→ 4-times pressure loss

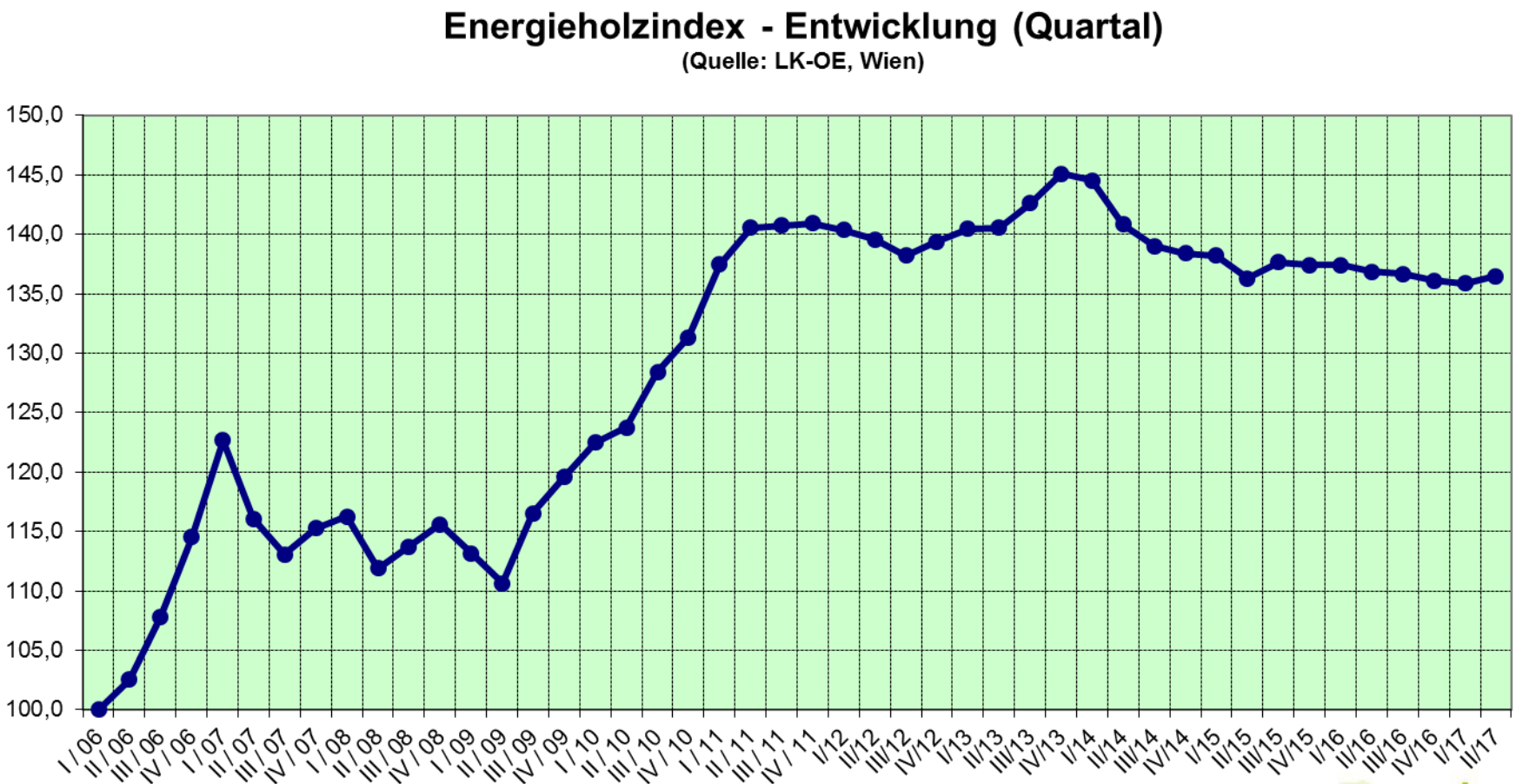
→ 8-times higher consumption of electricity!!



Efficient logistic of wood fuel

- Transportation of wood logs to the storage area
- Drying by means of ambient atmosphere
- Wood chip production directly into the fuel silo
- The water content of wood chips should be less than 30%.
- The steps of biomass logistic should be a minimum.

Index figure of wood for energy recovery



There are many other possibilities to be observed…

- Maximize the specific heat sale per meter of the district heating grid [MWh/mGrid]
- Optimize the combustion system and the emissions of the biomass boiler by improvement of the combustion systems and feeding systems parameters
- Optimisation of the electricity demand for the pumps by ideal dimensioning and frequency controlled performance of the pumps – the control strategy has an essential influence with regard to the operational costs (Δp-control and variable feeding temperature of the net)
- Adaptation and improvement of the secondary system by hydraulic adjustment to decrease the return flow temperature

There are many other possibilities to be observed…

- Check if all the hydraulic valves are in their expected position
- Check the control system of the pumps (Δp-control)
- Check the possibilities to reduce the feeding temperature of the grid in times of reduced load (variable flow temperature against of the out-door temperature)
- Periodic analyses of the heat transfer medium (water)

Conclusion

There is a significant potential to improve the efficiency of district heating systems with essential impact on:

- Biomass fuel consumption
- Other energy demand (especially electricity demand)
- Environmental issues (emissions)
- Long term availability and lifetime

Optimisation of biomass district heating systems

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Thank you very much.