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Design and operation of a local cogeneration plant supplying a multi-family house (9,5 kW electrical / 35 kW thermic power)

– a field report

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Abstract

- Introduction
- Technical concept of the plant
- Presentation of the plant “Turdanitsch 2“
- Efficiency analysis
- Financial conditions and government aid
- Conclusion

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Introduction

- Requirements for the cogeneration plant
  - Reliable heating of a multi-family house (heat load ~45KW)
  - Generation of electric power
  - Use of woodchips produced from waste wood from the own forest - carbon dioxide neutral
  - Efiicient use of the primary energy carrier
  - the plant must be able to be operated by laities
  - Low service workload and costs
  - Must be cost efficient and rentable

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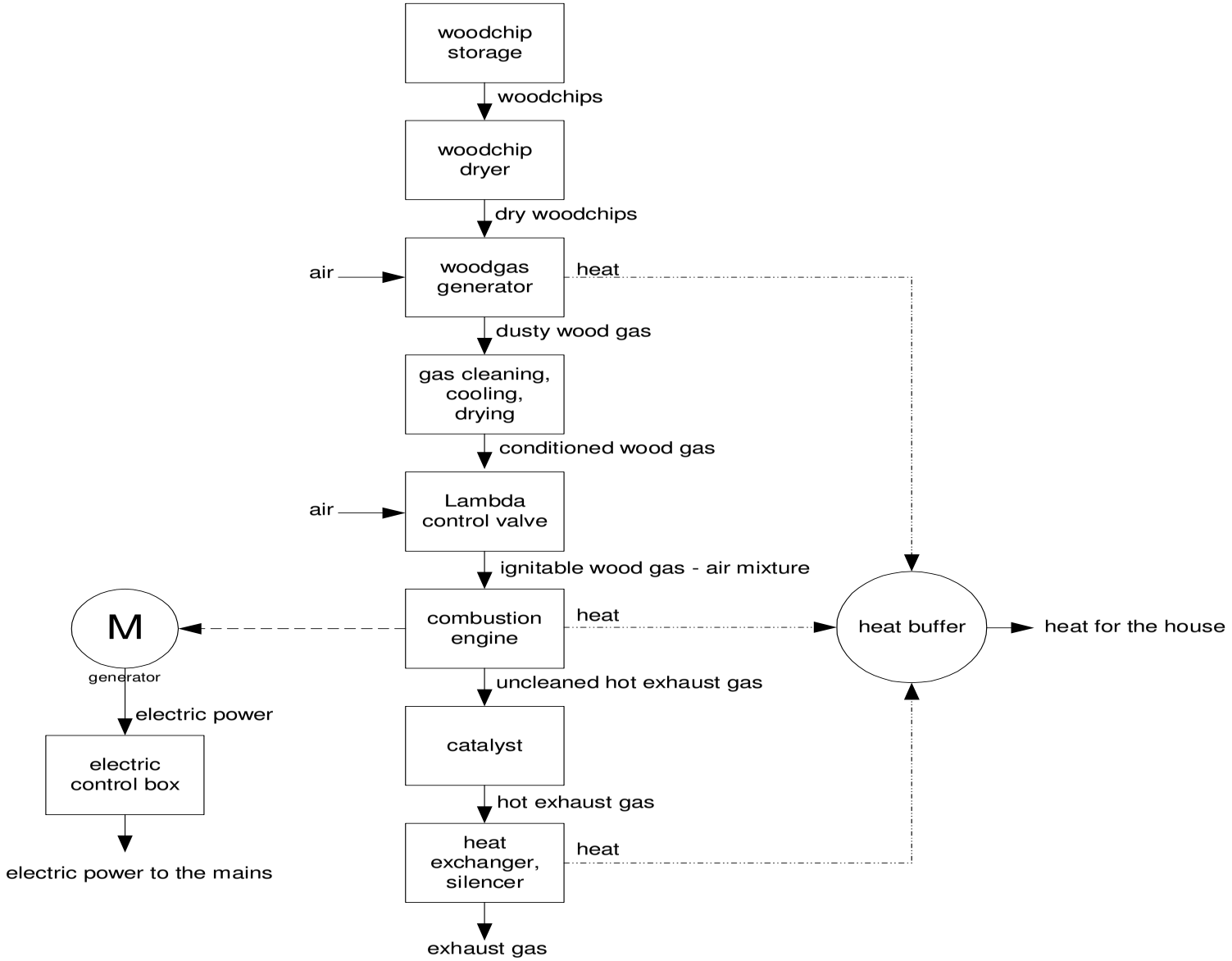
Technical concept of the plant

- Based on tar-free woodgas generation
- Fueling an internal combustion (otto) engine by woodgas
- Using the mechanic shaft power of the otto engine to drive a electric generator (induction machine)
- Mains parallel operation – selling excess electric power
- Only 9.5 kW electric power possible (Carinthian law), resultis in 35 kW thermal output power
- Operated in heat-led mode


woodchip storage
woodchips
woodchip dryer
dry woodchips
air
woodgas generator
heat
dusty wood gas
gas cleaning, cooling, drying
conditioned wood gas
air
Lambda control valve
ignitable wood gas - air mixture
M
generator
combustion engine
heat
heat buffer
heat for the house
uncleaned hot exhaust gas
electric power
catalyst
electric control box
hot exhaust gas
heat exchanger, silencer
heat
electric power to the mains
exhaust gas

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The plant “Turdanitsch 2“

- Built up in 2005 - 2006
- Connected to the grid in Summer 2006
- Operated only in winter during the heating period
- Up to now more than 3500 hours of operation
- No total breakdown, only minor afflicts till now
- Up to now over 20 MWh electric power delivered to the electric grid

The plant “Turdanitsch 2“

The plant “Turdanitsch 2“

- In the year 2008
  - 9472 kWh generated electric energy
  - 8190 kWh electric energy delivered to the grid
  - 1281 kWh of produced electric energy used by ourselves (three households and farming)
  - 6657 kWh electric energy purchased from the grid during standstill
  - 1533 kWh more electric energy produced than consumed over the year

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Efficiency analysis

Consumed amount of spruce woodchips	0,06483	m^3/h, loose
Moisture content of the woodchips	18,26	%, after dryer
Average electrical output power	6,48	kW
Maximum electric output power	9,34	kW
Average generated power	7,03	kW
Auxiliary electric power of the plant	0,55	kW
Thermal output power	26,55	kW
Electrical efficiency	13,32	%
Thermal efficiency	54,52	%
Overall efficiency	67,84	%

Possible efficiency improvements

- Optimising the gas flow through the filter system
- Increasing the compression ratio of the internal combustion engine
- Turbo- or supercharging the internal combustion engine
- Improvement of the heat exchangers to increase the thermal output power
- Reducing auxiliary electric power consumption by optimising drives and power supplys

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Financial conditions and government aid

- By now:
  - No government aid for private-built prototypes and research work
  - Whole cogeneration plant privately financed
  - Elevated rates for biomass energy guaranteed for 13 years
  - Rate depends on processed kind of wood
    - Sawmill residue : 12 Cent / kWh
    - Wood from the forest : 16 Cent / kWh

Profitability

- Figures of the year 2008
  - 1.400 € refunded for delivered elecricity
  - 1.200 € costs for woodchips if they were bought
  - Produced heat equals 2.640 €
  - Produced electricity equals 1.620 €
  - Overall produced energy: 4.260 €
    (for the cost of 1.200 € for the woodchips)
- The cogeneration plant earns 3.060 € per year
- Material costs for the prototype: ~ 10.000 €

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Conclusion

- Over 3500 hours of operation proove reliability
- Some improvements can be done to increase efficiency
- The small cogeneration plant prototype is profitable

Thank you
for your attention

Any questions?
Don‘t hesitate to contact me:

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