

ALADIN II – Highly Efficient and Near-Zero Emission Micro Combined Heat and Power Plant

Recent energy policies smooth the way for future strategies that are partly based on various renewable energy sources, such as solar or wind. However, these sources are strongly dependent on environmental factors. In this context, decentralized power generation with combined heat-and-power (CHP) units becomes increasingly popular, as those units do not only maximize energy efficiency by providing heat and

power as close as possible to the consuming household, but are also able to provide regulative power to the electricity distribution network. The research project "ALADIN II" deals with the development of a micro-CHP which not only provides a high electric efficiency, but simultaneously emits near-zero pollutant emissions.

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Goals

Vision

- Near-Zero Emissions
- High Electric Efficiency
- Fast Load Uptake
- Highly Efficient Waste Heat Utilization

Properties

- Fuel: Compressed Natural Gas (CNG)
- Engine: 1-cylinder, 325ccm³
- Operation: Full load @ 3000 rpm
- Generator: Asynchronous (cos φ = 0.93)

Strategies / Control

- Sophisticated Air/Fuel Ratio Control Algorithms
- Intelligent Operation Management
- Optimized Cold Start Strategy for Emission Reduction & Fast Warm Up

Construction

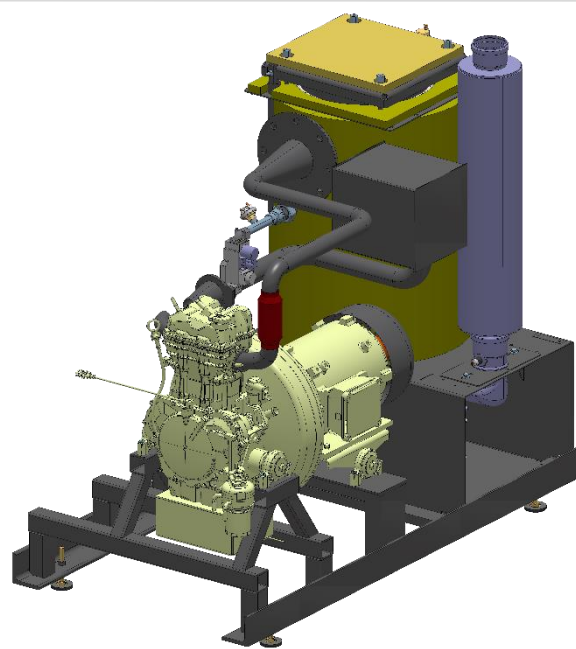


Fig. 1: Prototype Unit

Emissions

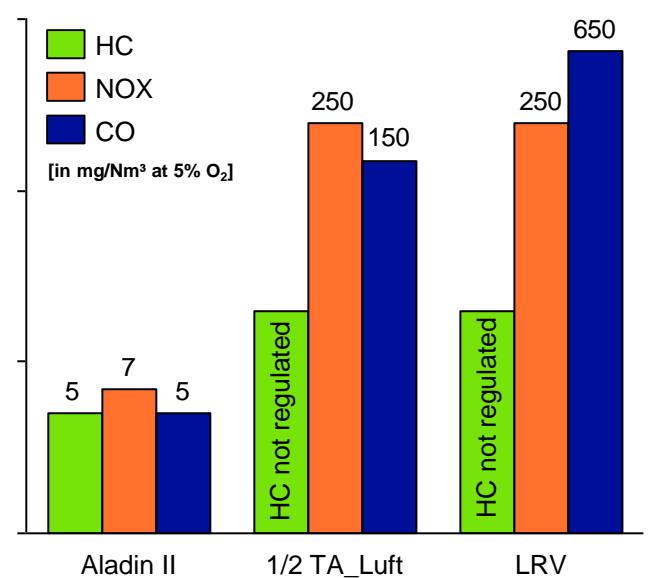


Fig. 2: Steady-State Emissions vs. Regulations

Heating / Cooling Circuit

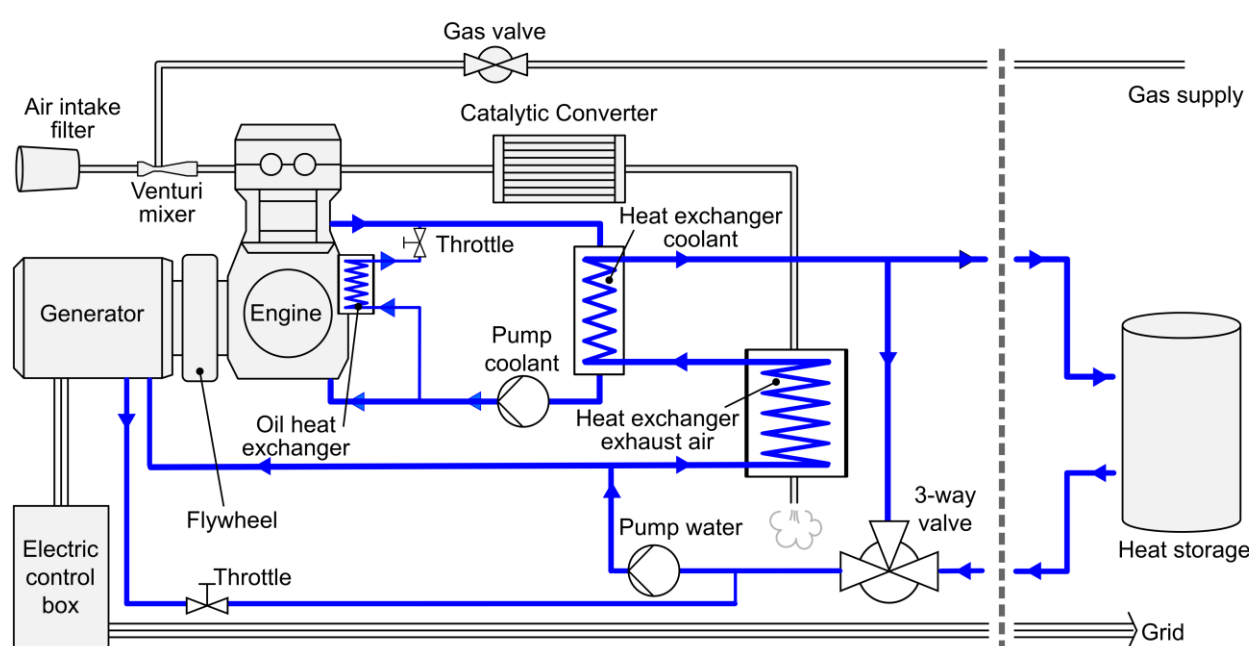


Fig. 3: Water Circuit Concept

Results to Date

Power

- $P_{el} \approx 7$ kW
- $P_{th} \approx 14$ kW (+2kW via condensing technology)

Efficiencies

- $\eta_{el} > 32\%$ (market leader: 27%)
- $\eta_{tot} \approx 98\%$

Emissions (steady-state)

- $NO_x < 10$ mg/Nm³ @ 5% O₂
- $CO < 6$ mg/Nm³ @ 5% O₂
- $HC < 6$ mg/Nm³ @ 5% O₂

Performance / Flexibility

- Time to Steady-State ≈ 10 min
- Load Uptake ≈ 10 sec (grid stabilization possible)
- Works with all types of heat storage solutions
- Suitable for both high-temperature (conventional) and low temperature (floor) heating solutions

References

Partners