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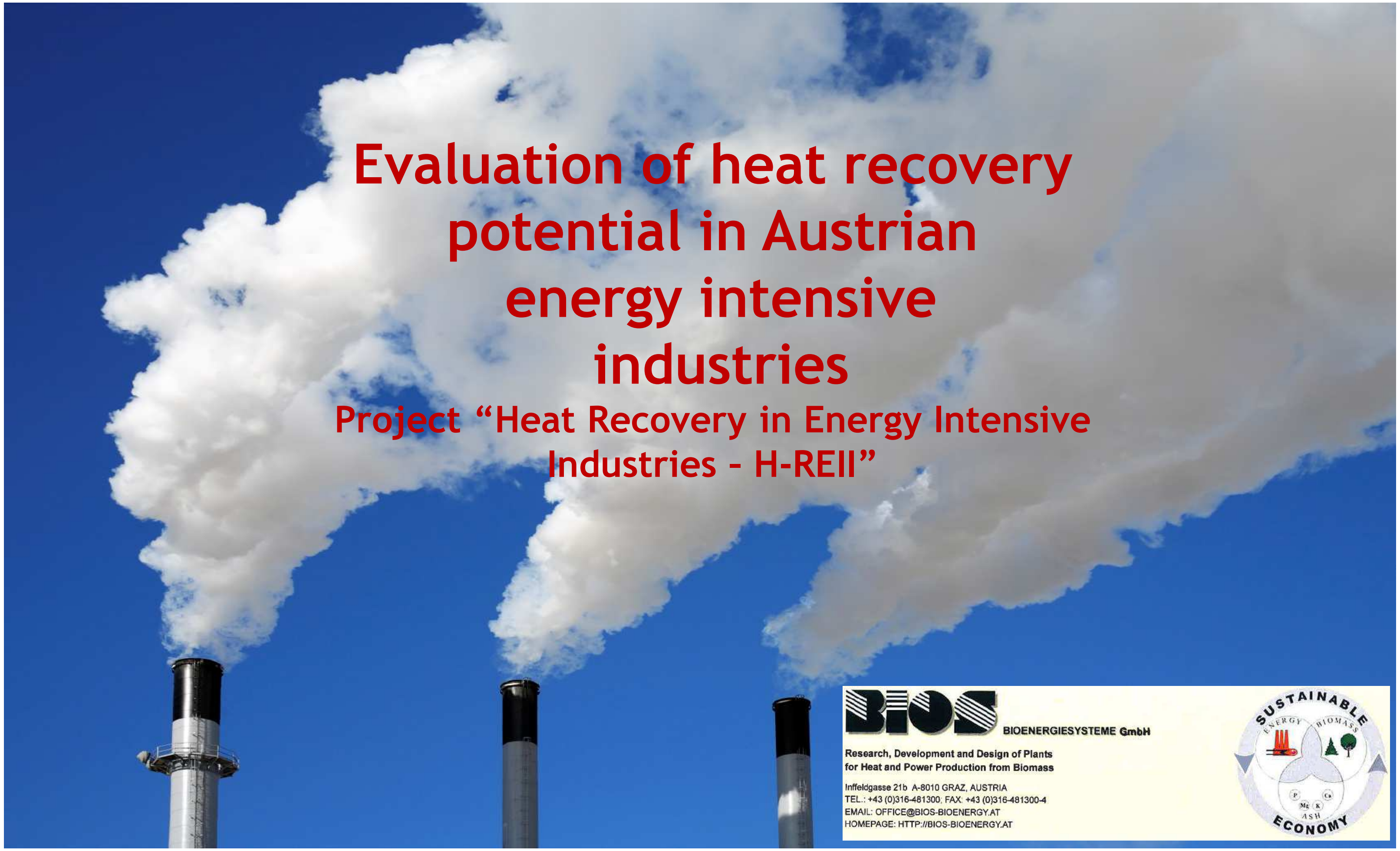

Evaluation of heat recovery potential in Austrian energy intensive industries

Project “Heat Recovery in Energy Intensive Industries – H-REII”

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Heat recovery and energy efficiency measures in industrial practice

Utilization of waste heat is practically interesting in all industrial and commercial sectors. Especially in energy intensive sectors, the use of waste heat is apparently. Heat recovery from industrial waste heat is an issue for some time in Austria and becomes more and more into focus in the last years.

Typical examples of the use of waste heat recovery in Austria are:

- building heating
- process heating or preheating of process media
- hot water treatment
- district heating

At higher temperature levels, which occur in industrial processes or from exhaust gases from gas turbines, the generation of electricity using the ORC process is a possible alternative.

Especially, if a year-round heat supply using waste heat is not possible, because there are no heat consumers, the generation of electrical energy is a good alternative.

Indeed, incentives for feed in tariff of electrical power generation due to waste heat recovery are currently not foreseen in Austria, but these heat recovery projects are supported by a certain amount of investment subsidies.

Unfortunately, in many cases the economic attractiveness (e.g.: payback time, internal rate of return) of these heat recovery projects does not fit the ideas of the management of such industrial companies.

Evaluation of the heat recovery potential in selected energy intensive industries

- Heat recovery potential for gas turbine exhaust gases:

  At 24 plant sites the gas turbines are used for electrical power generation. Almost all of these plant sites will be used for additional heat recovery for supplying process heat and heat for local district heating. Beyond these utilization of heat recovery, additional heat recovery potential is only left by a very low temperature level.

  At 12 plant sites the gas turbines are used for powering natural gas compressor stations. 8 plant sites are used as gas compressor stations at several gas transfer pipelines, which are operated by too low full load hours for economical useful heat recovery systems. However one of these plant sites is already equipped with a heat recovery system, which is designed for generating heat and electrical power.

  All in all in this industrial sector one plant shows sufficient usable waste heat potential for electrical power generation.

- Heat recovery potential in the glass industry:

  Three of the biggest plant sites in the glass industry based on the CO_2 allocation were evaluated.

  None of these plant sites shows sufficient waste heat potential for electrical power generation. Actually the remaining waste heat at the relevant plant sites are used for internal and external heat supply.

- Heat recovery potential in the iron and steel industry:

  Three of the biggest plant sites in the iron and steel industry based on the CO_2 allocation were evaluated.

  There are various waste heat sources and many of this heat sources are already energetically used. All metallurgical gases, which are generated during the iron and steel production processes, are used internal in the metallurgical plant or are used at the own power plant.

  All in all in this industrial sector one plant site was interesting for heat recovery for electrical power generation.

- Heat recovery potential in the cement and lime industry:

  Six of the biggest plant sites in the cement and lime industry based on the CO_2 allocation were evaluated.

  The plant site for lime production is operating a process technology, which has no relevant heat recovery potential at high enough temperature level.

  Four of the five plant sites in the cement industry shows enough technically feasible heat recovery potential for electrical power generation. One cement plant is already using their waste heat potential for generating heat to supply to the local district heating system.

Technically and economically preliminarily evaluation of heat recovery systems based on ORC technology for selected plant sites (1/2)

- Potential plant sites for heat recovery systems based on gas turbine exhaust gases:

  Several gas turbines drive compressors, which are used for compression of natural gas from a gas production field. The waste heat from the several heat sources is collected to a thermal oil loop and powers the ORC plant. The ORC plant is cooled by an air cooler and a cooling water loop. A heat supply on low temperature level is not foreseen.

  At this plant site a ORC plant with a nominal electrical power capacity about 5MW was considered and an annual electrical power production of about 40 GWh/a could be estimated. This could save about 6.750 t CO2/a*). The pay-back time will be slightly above 8.5 years, which is just acceptable for the company in question for a realization.

- Potential plants site for heat recovery systems based on cement plants:

  Cement plant 1:

  This system considers the waste heat from the cyclone heat exchanger of a rotary kiln. The waste heat is transferred to an thermal oil loop and powers the ORC plant. The ORC plant is cooled by an air cooler and a cooling water system. A heat supply on low temperature level is not foreseen.

  At this plant site a ORC plant with a nominal electrical power capacity of about 1.8 MW was considered and an annual electrical power production of about 11,7 GWh/a could be estimated. This could save about 1.970 t CO2/a*). The pay-back time will be slightly above twelve years, which is usually rather high for the industrial sector.

*) *CO_2 emission factor for electrical power generation considers the Austrian power plant mix of 168 g/kWhel (source: VEÖ, Eurelectric)*

Technically and economically preliminarily evaluation of heat recovery systems based on ORC technology for selected plant sites (2/2)

- Potential plant sites for heat recovery systems based on cement plants:

Cement plant 2:

This system considers the waste heat from the clinker cooler. The waste heat is transferred to a thermal oil loop and powers the ORC plant. The ORC plant is cooled by an air cooler and a cooling water system. At this plant sites two options were considered.

- Option 1 considered a cogeneration of electrical power and heat supply to a local district heating area.
- Option 2 considered only the generation of electrical power. A heat supply on low temperature level is not foreseen.

The ORC plant for option 1 was estimated with a nominal electrical power capacity of about 1.800 kW and an annual electrical power production of about 4,5 GWh/a. A additional heat production of about 20,5 GWh/a could be estimated whereat about 10,5 GWh/a could be sold as district heat. This could save about 1.230 t CO2/a[**)]

The ORC plant for option 2 was considered with a nominal electrical power capacity of about 700 kW and an annual electrical power production of about 10,2 GWh/a. This could save about 1.720 t CO2/a[*)]

The pay-back time will be about 10 years for option 1 and for option 2 around 14 years, which is rather high for both variants.

[*)] *CO_2 emission factor for electrical power generation considers the Austrian power plant mix of 168 g/kWhel (source: VEÖ, Eurelectric)*

[**)] *CO_2 emission factor for electrical power generation considers the Austrian power plant mix of 168 g/kWhel (source: VEÖ, Eurelectric) and for district heating a CO_2 emission factor of 46 g/kWh for sold heat is considered (source: Report of the GHG emissions of "Fernwärme Wien GmbH" from 2006 -2008*)

Evaluation of the actual incentive scheme for heat recovery projects and proposal for legislative measures to make such heat recovery projects economically attractive

- Current situation:

  In Austria incentives to the feed in tariff for electrical power generation due to waste heat recovery are currently not foreseen.

  These heat recovery projects are supported by investment subsidies and will be supported up to 30% of environmental investment costs. Additionally the revenues minus the associated expenses of these energy-saving measures are considered for the calculation of the subsidies. This mechanism leads to the fact that relative good economic projects achieve rather less subsidies but on the other hand rather worse economically projects obtain a relative high support.

  The aim of this priority area of support is that projects with a payback time of less than 5 years should not achieve subsidies.

  Furthermore an additional national support possibility is foreseen for promotion of pilot- or demonstration projects to introduce new or significantly improved technologies as well as projects to test the suitability of innovative application system components to demonstrate the applicability in large-scale, which can reach up to 30% of environmental investment costs. But the receiving of this support opportunity is not secured.

- Proposal for measures to make such heat recovery projects economically attractive:

  The most economic disadvantage for realization of heat recovery projects based on electrical power generation in Austria is the actual feed in tariff for electrical power. The tariffs amounts currently around 6 Cent/kWhel and partly even lower.

  Based on a standard variant considering a feed in tariff of 6 Cent/kWhel and an annual increase of the feed in tariff of 3%, a payback time of about 8.5 years is achievable.

  Considering a fixed total feed in tariff for the mentioned standard variant of 10 Cent/kWhel (feed in tariff 6 Cent/kWhel without annual price increasing and additional 4 Cent/kWhel incentive tariff) leads to a payback time below 5 years.

  Summarizing these facts, currently incentives for feed in tariff of about 4 Cents/kWhel are needed to make such heat recovery projects economically attractive.

  Unfortunately from today's perspective, such incentives will not be available in the next future in Austria.