15th International Research/Expert Conference
"Trends in the Development of Machinery and Associated Technology"
TMT 2011, Prague, Czech Republic, 12-18 September 2011

ANALYSIS THE EFFICIENCY OF MICRO COGENERATION IN TERMS OF FUELTYPES

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ABSTRACT
Promotion of cogeneration plants, based on energy demand, is one of the priorities of today. This paper gives a brief overview of the micro cogeneration plant and the efficacy of the plant. Analysis was carried out in terms of types of fuels, biomass and natural gas, in order to save primary energy and environmental protection. The conventional plants and micro cogeneration plant are analyzed, and obtained the results presented in this paper. The analysis shows that the higher efficiency and greater environmental protection achieved by the application of micro CHP cogeneration plants and renewable energy sources.
Key words: cogeneration, micro CHP, efficiency

1. INTRODUCTION
At a time when the price of primary energy, or energy sources is growing, interesting in applying energy-efficient technology is growing too, which is understandable. One of these technologies is cogeneration. In cogeneration plant electricity and heat produces concurrently from the same source of energy, which contributes to the reduction of spending primary energy.
The potential for using cogeneration as a measure for the energy saving is currently under-utilized, especially when it comes to plants' micro cogeneration. Promotion highly efficient cogeneration based on useful heat demand is a priority, considering the potential benefits of cogeneration like saving primary energy, avoiding network losses and reducing emissions (CO_2).
In order to achieve the reduction in spending electricity and emissions of harmful gases into the atmosphere, special attention should be paid to selecting cogeneration plants and the fuel also which is necessary for the operation of these plants.
This paper gives a brief description of cogeneration plants. It is analyzed the efficiency achieved by using this plants in terms of the fuel.

2. DESCRIPTION OF MICRO COGENERATION PLANTS
One of the more important technologies in the production of electricity and heat is the concurrently production of electricity and thermal energy from one fuel and one plant (cogeneration or Combined Heat and Power - CHP). From the point size of installed electric power, terms micro cogeneration a power electricity plant less than 50kW.
Micro-cogeneration or micro-DER (Distributed Energy Resource) is the name for the micro-distributed energy source. The power of this plant is less than 50kW, and it is used for supplying household and small manufacturing units. Instead that all the fuel is spent for heating, at the micro CHP, one part is used for production of electricity. This energy can be used within the household or with the permission of the network to sell it back to the same. Micro CHP has the same efficiency conversion from gas to heat like a conventional boiler to gas, and approximately it is 80%. However, about 10 ÷ 15% of energy in the micro CHP is converted into electrical energy, causing a much higher exergy and economic feasibility than the heat which is produced by burning gas in the boiler [2].

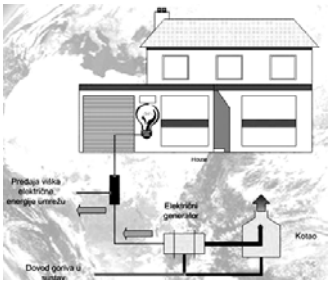

Figure 1. The Micro CHP

There are different concepts of realization of micro cogeneration Table 1. Due to installed electricity power of 50 kW, the micro-CHP principally use the following types of technologies: steam turbines, diesel engine systems, reciprocating internal combustion engines and gas, then Micro turbines, and systems with alternative (a process with a steam engine, the process's ORC) and innovation processes (fuel cells, Stirling's engine, screw steam engine with turbine cycles with hot air, etc.) [1].

Table 1. Technologies which are used in Micro CHP

CHP system	Advantages	Disadvantages	Available size
Micro-turbine	a few rumber of moving parts compact design and little weight system for colling is not required	high investment relatively low mechanical efficiency	30kW-50kW
Steam turbine	High total SKD Posibility to use any fuel posibility for having more than one level of the required heat Posibility of variation coefficients of	slowly starting low coefficient of heat	to 50kW
Fuell cells	low emission and low noise at work High SKD at maximum load	high investement smallresistance and induction of power	5kW-50kW

Today's design and development of such technology aims to achieve a lower cost and emissions of greenhouse gases with high efficiency. Technology choice depends on the type of fuel, required power and the availability of cogeneration plant.
The micro-cogeneration systems can use various fuels and heat sources. Whose characteristics vary depending on cost of the system, the cost of heat, the environmental impact, accessibility, easy for transportation and storage, maintenance and system lifetime.

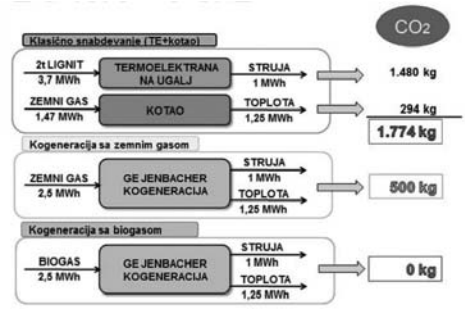

Figure 2. Displaying CO_2 emissions for conventional and cogeneration plants

Sources of heat and fuels which are used: biomass, liquefied petroleum gas, vegetable oil, solar heat source, natural gas and others. Sources of energy that have the lowest emissions are: solar energy, a biomass and natural gas.

The future of the micro-cogeneration system will depend on the price of fuel because the price increase and grow their profitability [3].

3. ANALYSIS THE EFFICIENCY OF MICRO COGENERATION IN TERMS OF FUEL TYPES

In order to prove the efficiency which is achieved by applying micro-CHP, this plant was analyzed in terms of fuel types. The analysis was performed using CHP software[1].

Two systems were analyzed: Conventional and CHP plant with the same parameters for comparison, the output of the project size and global piece of equipment. The only major difference is the type of the fuel: biomass or natural gas.

Input data: CHP technologies - micro-turbine capacity - 30 kW, number of units - 1, total CHP capacity - 30kW, Drive - 5840 hours/year.

Percentage savings for biomass: NOx = 79% tons / year = 100% SO2 tons / year, CO2 = 100% tons / year (or 211 tons / year) Fuel consumption = 11%. These savings are equivalent to eliminating 35 cars from traffic.

Percentage savings for natural (natural) gas: NOx = 79% tons / year = 100% SO2 tons / year, CO2 = 30% tons / year (or 63 tons / year) Fuel consumption = 11%. These savings are equivalent to eliminating 10 cars from traffic.

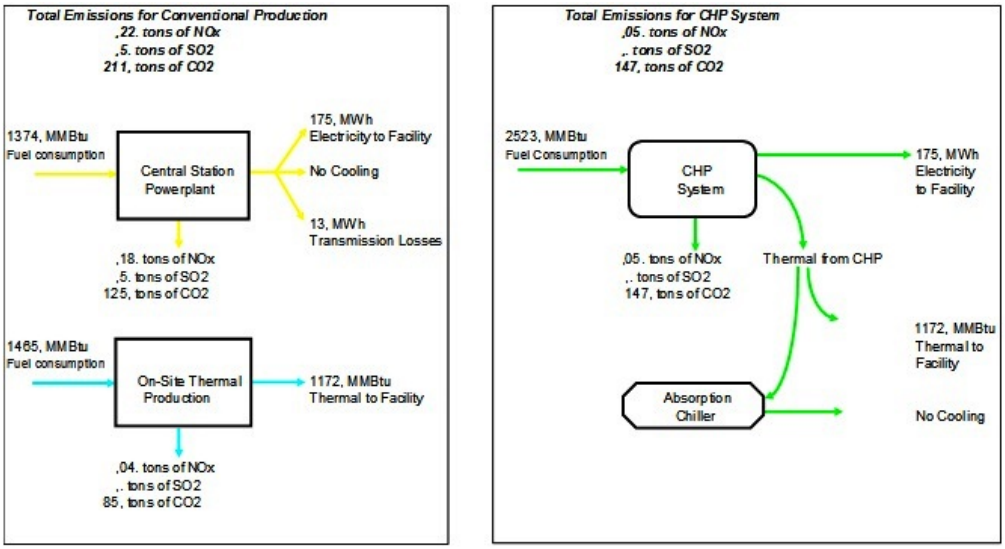

Figure 3. Comparison conventional and cogeneration plants by using natural gas as a fuel

Conversion unit: $1\ MMBtu \equiv 50.1863\ kWh$

[1] CHP Software, Environmental Protection Agency, Pennsylvania Ave., NW, Washington, USA

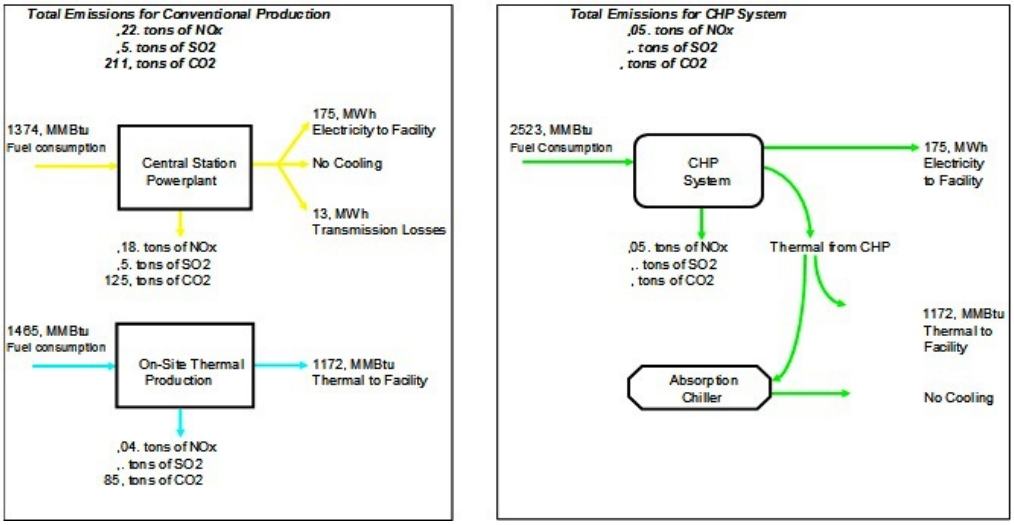

Figure 4. Comparison conventional and cogeneration plants by using biomass as a fuel

4. CONCLUSION

- Based on the analysis of the above it can be concluding the following: Micro CHP as one of the technologies for producing electricity and heat has a good foundation for further development and implementation at various facilities and locations.
- Using the micro-cogeneration it can be achieved substantial primary energy savings, reduction.
- Usage a biomass as a fuel for the protection of the environment is most efficient because it prevents the emission of CO_2 into the atmosphere.

5. REFERENCES

[1] Marković D.: Procesna i energetska efikasnost, Univerzitet Singidunum, Beograd, 2010.
[2] http://hr.wikipedia.org/wiki/Mikrokogeneracija
[3] http://powerlab.fsb.hr/osnoveenergetike/wiki/index.php?title=ENERGETSKE_TRANSFORMACIJE#Elektrane_na_biomasu_i_otpad