THE FIRST YEAR OF CIRCULAR ECONOMY IN THE FIELD OF METALLURGICAL WASTE HEAT USAGE FOR PURPOSES OF DISTRICT HEATING AND HEATING OF SANITARY HOT WATER IN RAVNE NA KOROŠKEM

(Summary)

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The project for introduction of circular economy in the field of metallurgical waste heat usage for the purposes of district heating and heating of sanitary hot water was planned and implemented in Petrol Energetika together with the Institute Jožef Stefan, the Centre of Energy Efficiency, the company SIJ Metal Ravne and the local community of Ravne na Koroškem.

The companies SIJ Metal Ravne and Petrol Energetika are both located on the area of the former Ravne Steelworks (Integrated Economic Area of Ravne - IEA Ravne). The first one is the leading producer of tool and special steel in Europe, and the second one is the leading provider of comprehensive energy and ecological solutions which produces, supplies and distributes various types of energy for the location of IEA Ravne and Štore, as well as for other local communities.

Prior to project implementation, the waste heat - which is generated by the cooling system of the electric arc furnace (EAF) - was wastefully discharged in the environment through the cooling towers. As part of revitalization of the EAF cooling system during the summer overhaul in 2015, a 4.2 MW plate heat exchanger was installed into the bypass. Petrol Energetika, the supplier and distributor of heat for the local community of Ravne na Koroškem as well as for the location of IEA Ravne including SIJ Metal Ravne, provides district heat in the combined heat and power plant located 500 m from the source of waste technological heat. Therefore, district heating was recognized as the best heat sink. The heating of sanitary hot water was also recognized as the second best heat sink which is operating for the location of IEA Ravne and sport facilities throughout the year. After the necessary equipment for usage of waste heat was installed also at the location of the combined heat and power plant in Petrol Energetika and after a successful testing and system optimization, the regular operation started at the beginning of 2016.

With the use of waste heat of temperature regime 75/55 ^{0}C, we obtained 5,116 MWh heat in the first year of operation, hereof 76,5 % in the field of district heating and 23,4 % in the field of heating the sanitary hot water. At the location of the waste heat source at SIJ Metal Ravne, we obtained 25 % from the whole available heat from the EAF cooling system (22,688.5 MWh), and 22,5 % of that available heat was utilised which is a little more than every fifth MWh of total available heat. The average distribution heat loss was 70.8 kW, the absolute loss 572.7 MWh, and the relative loss 10.1 %. The average cooling power of the EAF cooling system during steel plant operation (about 237 days or 65 % of the available time) was 3.98 MW, which is slightly less in comparison with the capacity of heat exchanger (4.2 MW) and the capacity of the distribution pipeline between the heat source and the heat sinks in the combined heat and power plant (4.15 MW).

After May 2017, when the existing three modules of co-generation plant were put out of operation and the EAF waste heat usage became our priority, the effective use of waste heat has doubled. Our target is that 50 % of district heat for the local community will be from metallurgical processes instead of being produced by the classical technology of fossil fuel.

With the waste heat usage, the principles of circular economy are utilized in practice, the competitive and sustainable supply of consumers is ensured, a reliable, long-term, sustainable and environmentally friendly 4th generation district heating system is being built, and the share of consumers' self-sufficiency has increased in the local community during the transition to a low-carbon society.

METALLURGICAL WASTE HEAT UTILIZATION FOR THE PURPOSES OF DISTRICT HEATING AND HEATING OF SANITARY HOT WATER IN RAVNE NA KOROŠKEM

Miran Fužir

1. MISSION OF PETROL ENERGETIKA

Petrol Energetika is a leading Slovenian provider of integrated energy solutions for industry, business zones and integration of industrial energetics with the energy supply of local communities (Integrated Economic Area of Ravne and Štore, trigeneration Tehnološki park Ljubljana, cogeneration Ravne, Hrastnik, Unior Zreče, Paloma, management of boiler and waste water teatment plants, utilization of waste heat in industry, supply of energy and services, implementation of institutions of public utilities, etc.

2. AN EXAMPLE OF EXCELLENT PRACTICE

Planning and realization of waste heat utilization from metallurgical processes in the field of district heating and heating of sanitary hot water on the location of Integrated Economic Area of Ravne na Koroškem (IEA Ravne) is a result of good business cooperation between the two companies SIJ Metal Ravne and Petrol Energetika.

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Prior to project implementation, the waste heat - which is generated by the cooling system of the electric arc furnace (EAF) - was wastefully discharged in the environment through the cooling towers. As part of revitalization of the EAF cooling system during the summer overhaul in 2015, a 4.2 MW plate heat exchanger was installed into the bypass. Petrol Energetika, the supplier and distributor of heat for the local community of Ravne na Koroškem as well as for the location of IEA Ravne including SIJ Metal Ravne, provides district heat in the combined heat and power plant located 500 m from the source of waste technological heat. Therefore, district heating was recognized as the best heat sink. The heating of sanitary hot water was also recognized as the second best heat sink which is operating for the location of IEA Ravne and sport facilities throughout the year. After the necessary equipment for usage of waste heat was installed also at the location of the combined heat and power plant in Petrol Energetika and after a successful testing and system optimization, the regular operation started at the beginning of 2016.

Figure 1: Electric arc furnace (source of waste heat) in SIJ Metal Ravne

Figure 2: A 4.2 MW heat exchanger near the source of waste heat in SIJ Metal Ravne

Figure 3: Distribution pipe lines (DN 200)

Figure 4: System for waste heat utilization in the field of district heating (Petrol Energetika)

Figure 5: System for waste heat utilization in the field of sanitary hot water (Petrol Energetika)

Operation of the steel plant has a very discontinuous nature, and thus the availability of waste heat, what can be seen from Figure 6. Peak heat power was about 5 MW, on an average 1.9 MW.

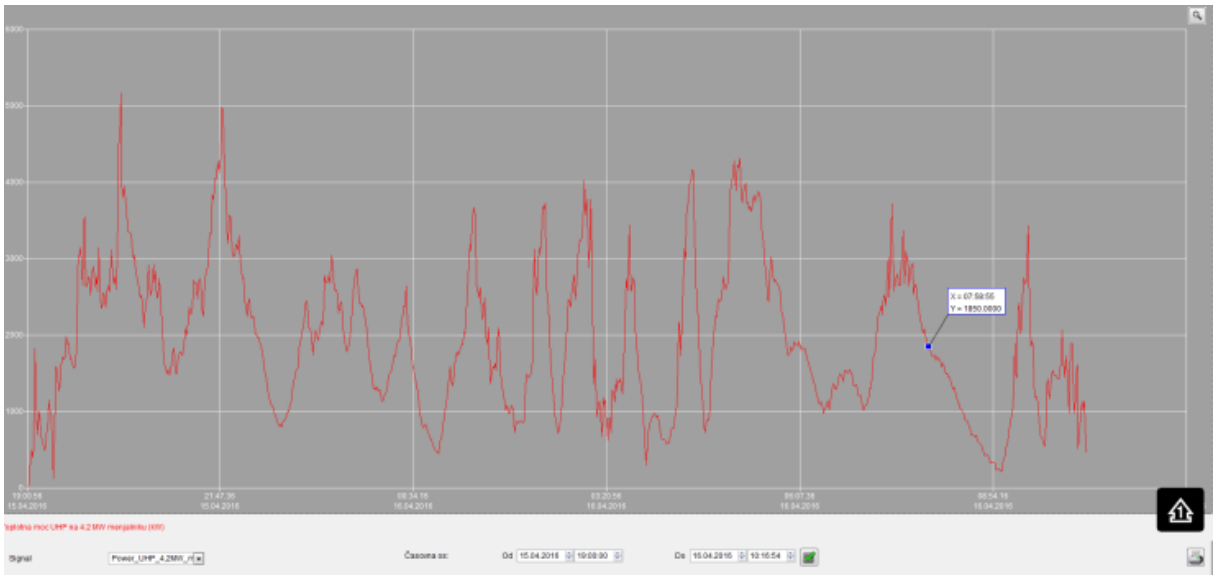

Figure 6: Actual waste heat utilization between April 15th And 16th, 2016

With the installation of heat storage near the source of waste heat the rate of utilization could be further increased, but before that the problem regarding the lack of space should be solved.

2.1 WASTE HEAT UTILIZATION TILL MAY 2017

Until the expiry of a contract for the operation of existing cogeneration (3 x 2.723 MW_{el}, 3 x 2.5 MW_{heat}) in May 2017, the latter had had a priority in operation, so the potential for waste heat utilization had been slightly lower (Figure 7).

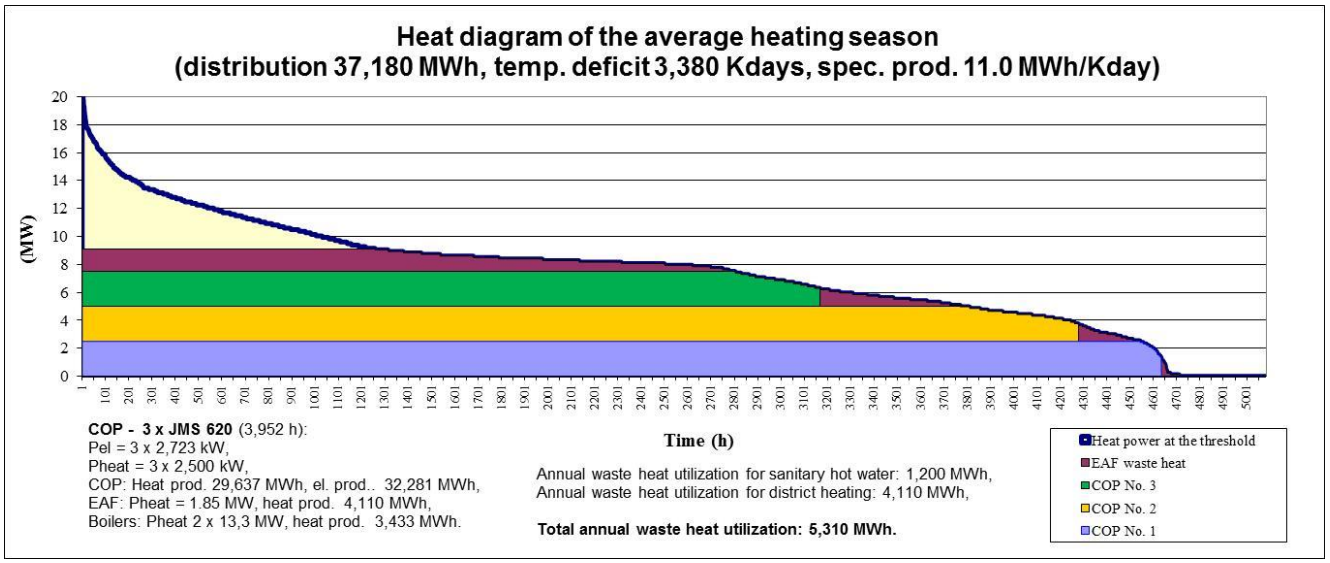

Figure 7: Heat diagram till May 2017

By utilizing of waste heat of temperature regime 75/55 ^{0}C we gained 5,310 MWh of heat in 2016 (4,110 MWh for district heating and 1,200 MWh for sanitary hot water).

Waste heat together with the COP heat covered almost 91 % of the total produced heat.

2.2 WASTE HEAT UTILIZATION AFTER MAY 2017

Due to the introduction of waste heat utilization and implementation of measures for efficient use of heat by end use customers we plan to install only one module of cogeneration during the modernization of our combined heat and power plant, therefore there it will be substantially greater potential for utilization of waste heat (Figure 8).

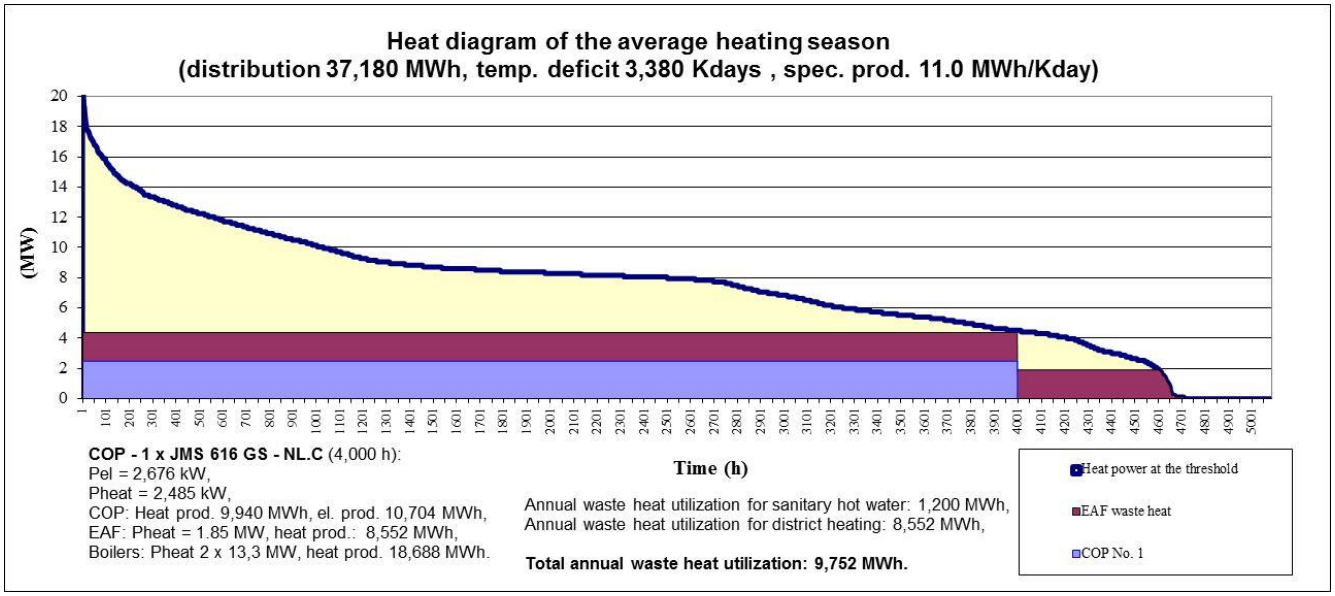

Figure 8: Heat diagram after May 2017

After May 2017 we will be able to utilize around 9,752 MWh of waste heat (8,552 MWh for district heating and 1,200 MWh for sanitary hot water). This means that every second MWh of supplied heat in the city of Ravne will have its origin in the metallurgical process instead in the conventional technology of fossil fuels transformation.

About 50 % of the total produced heat will be covered by waste heat together with the COP heat. Such a diversified production ensures the district heating system will keep the status of an efficient system.

3. CONCLUSIONS

This is the first project in Slovenia, which has by using modern technology and innovative solutions for the integration of efficient and sustainable way of heating together with the combined production of heat and electricity a future for further growth. Solution can provide industry and local communities with energy savings, air quality can be improved and benefits for society as a whole can be increased.

Factors that motivated us to find ways to utilize the highest possible share of waste heat from metallurgical processes in steel industry in the field of district heating system and sanitary hot water were the following: the opportunity of cooperation between the industry and the local community in finding innovative solutions, competitive and sustainable supply of customers, legislation, European energy trends, provision of reliable, competitive, long-term sustainable and environmentally friendly district heating system and the desire to seek for new business opportunities in raising the proportion of customers self-supply in the local community during the transition to a low carbon society.

The realization of this pilot project has shown in practice that industrial and energy-intensive economic environments in cooperation with the public research institution can be developed in a synergy with the local community and contribute to protection of our environment.