SDH solar district heating

Case study : Maribor (Slovenia)

Name of the project: District heating - Maribor

Adress of the project: Integration of solar district heating system in Maribor

Name and type of the owner: Energetika Maribor d.o.o., Public Company

Owner contact person:

Miran Rožman, Head of Research and Development Department
Tel: + 386 2 300 88 70
E-mail:miran.rozman@energetika-mb.si

Context of the study

The city of Maribor is supplied with district heat by public company Energetika Maribor. This company is also administrator of hot water district heating network - DH. Gas boiler with total power of 103 MW are used for heat production. In 2003, the cogeneration plant was built. The nominal power of cogeneration heat is 2,7 MW. The unit operates continuously throughout the year. In the next period they want to invest in solar system to increase the share of renewable energy sources and at the same time reduce the greenhouse gas emissions. They want to contribute to cleaner environment in Maribor. They also want to low the production price of heat, because the energy reconstructions of buildings reduce the heat consumption, as well as thermal power. In case of favorable loan conditions, grants and of course relevant economic alanysis, the project will be implemented.

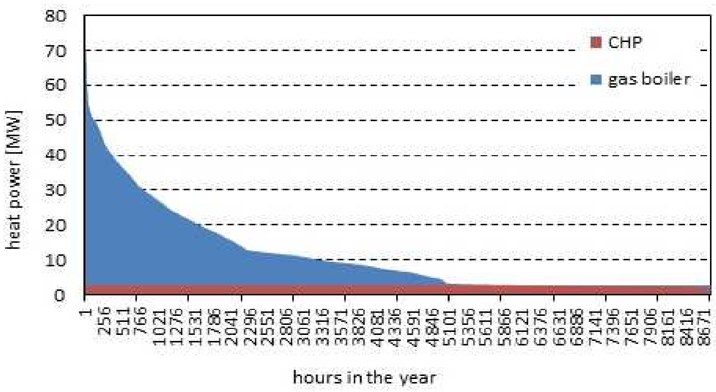
Support

There are currently no calls for tenders with grant financial incentives for new investments in renewable energy use.
Up to 30.6.2014 there is only tender for loans for environmental investment or renewable energy use. The minimum annual interest rate on the loan is three months EUROBOR + 1.5%. The maximum period loan is 15 years.

SDH plant

SDH system concept

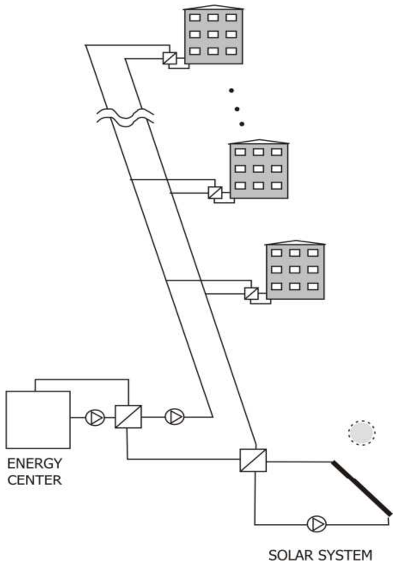
The actual measurements of DH and meteorological data from 2012 were taking into account in this analysis. During the observation year 100.548 MWh of thermal energy was produced and 23,5 % of it was produced with CHP plant. The rest of thermal energy was produced by gas boilers. On picture the required thermal power of DH in 2012 is shown. The lowest temperature at return pipe in summer is 70°C.

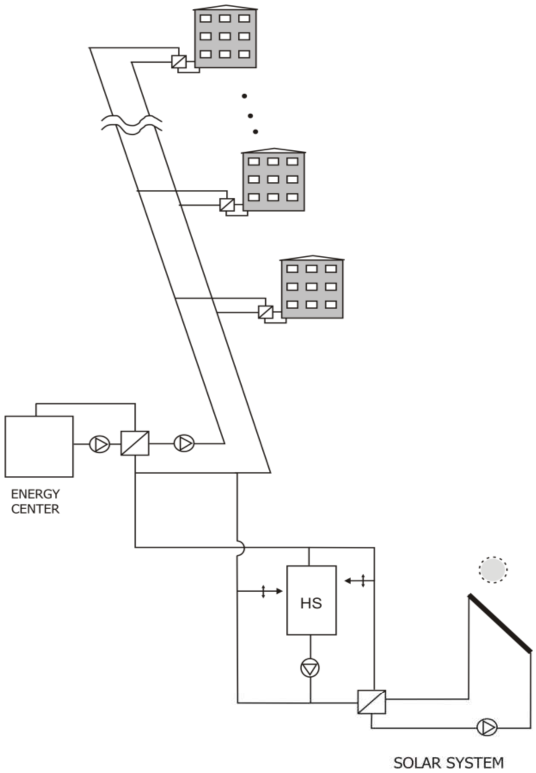


SDH technical data

The solar collectors are installed on the roof of the office building with the surface of 440 m2. Due to improper slope and orientation of the existing roof (4° inclination and orientation north-west) the solar collectors have to be installed on appropriate steel construction. Solar system is connected to the returno of DH net. Operation of CHP plant has priority over the solar system. In the analysis, two different types of solar collectors were taking into account: highly selective flat plate collectors and vacuum tube collectors. The latter are more suitable because of high temperatures in DH. We also studied the case where thermal storage is added to solar system. The problem is that in summertime heat consumption from solar system is reduced because of continued operation of CHP plant. The characteristics of the system are presented in the following table.

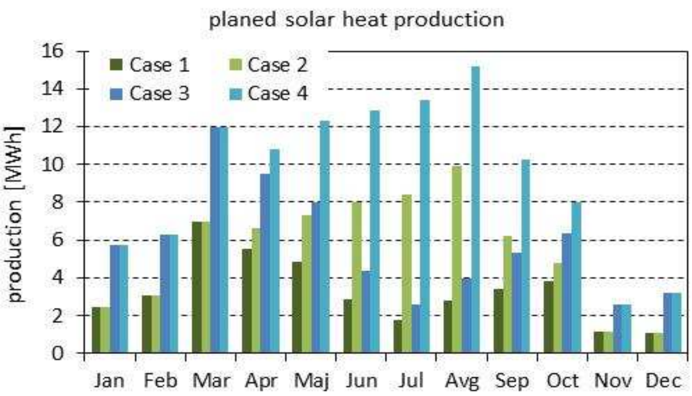
	Collector type	Surface [m^2]	HS capacity [m^3]
Case 1	FPC	170	-
Case 2	FPC	170	30
Case 3	ETC	170	-
Case 4	ETC	170	30

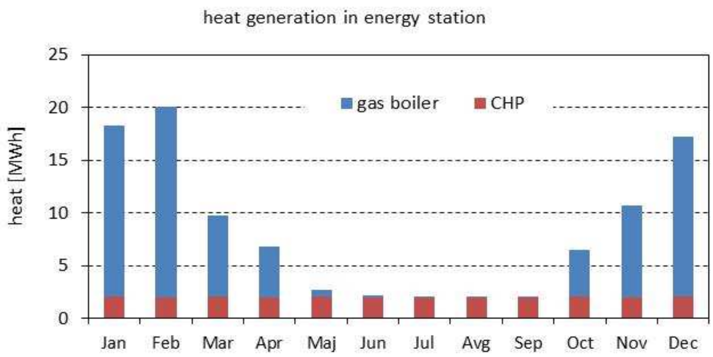


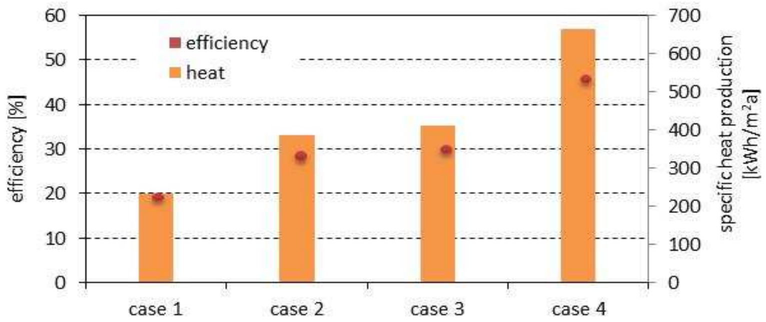


SDH energy balance (MWh)

The annual required thermal energy in DH is 100,197 MWh. 23,758 MWh of it is produced in CHP plant and the rest of it with gas boilers.







	Demand by DH [MWh/a]	Solar production [MWh/a]	Gas production [MWh/a]	Heat saving [%]	Gas saving [m^3/a]	CO_2 reduction [t/a]
Case 1	100.197	40	100.158	0,04	4.183	8
Case 2	100.197	66	100.132	0,06	6.943	13
Case 3	100.197	70	100.128	0,07	7.361	14
Case 4	100.197	113	100.085	0,11	11.871	23

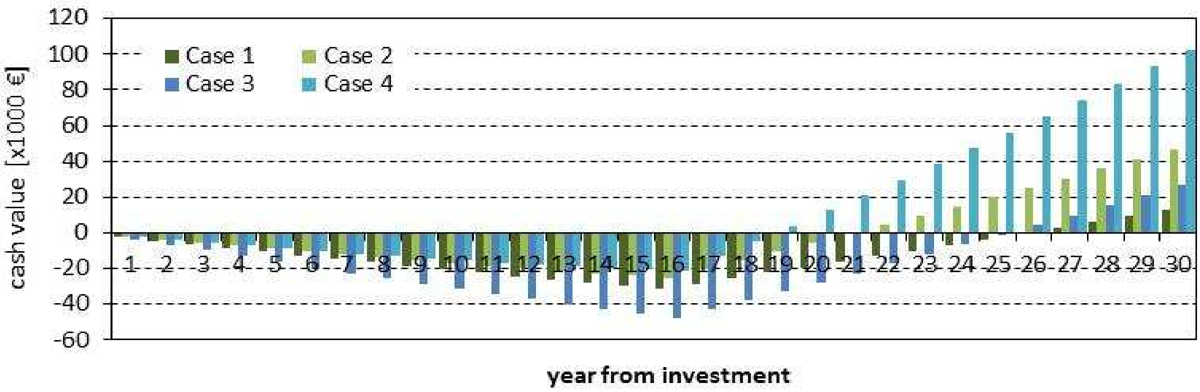
SDH economics

In economic analysis the credit financing which is defined by the call of ECO Fund is taking into account (Public call for loans for environmental investments 50PO13). Crediting period is 15 years with the annual interest rate of 1,79%. Annual operating and maintenance costs are also taking into account.

	flat - plate collectors	evacuated tube collectors
Investment solar system [€/m^2]	*360*	*585*
Investment heat storage [€/m^2]	*100*	*100*
Maintenance cost [€/MWh]	*1*	*1*

	Case 1	Case 2	Case 3	Case 4
Total investment cost [€]	61.200	77.704	98.865	115.765
Yearly capital costs [€/a]	4.663	5.958	7.577	8.873
Maintenance cost [€/a]	40	66	70	113
Heat production [MWh/a]	40	66	70	113
Solar thermal heat cost [€/MWh]	119	91	109	80

Cash flow of costs and savings is determined according to gas savings and gas price which is 0,5536 €/m^3. The 1% annual growth of gas price is included. The payback period in case 1 is 26 years, in case 2 is 21 years, in case 3 is 25 years and in case 4 is 18 years.



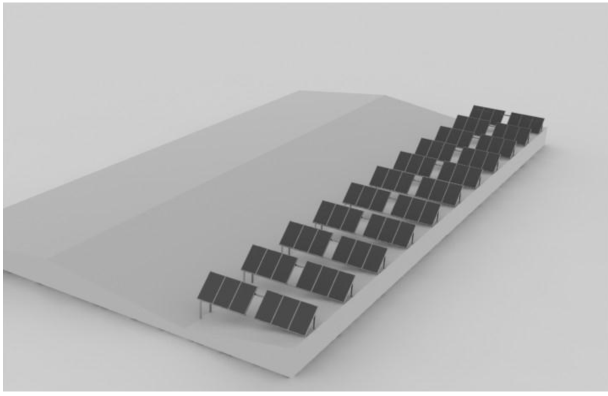
Cases 1, 2 and 3 are not economically viable because the payback period is longer than 20 years. In case 4 the payback period is 18 years. If the lifetime of the system is 20 years, the average energy price is 59,6 €/MWh. The actual price of heat in company is 63,4 €/MWh. Due to hot water district heating system, the installation of vacuum tube collectors and thermal storage is recommended. Thermal storage could also be used in time when the available heat from CHP plant is greater than heat consumption of the network. This would increase the efficiency of CHP plant. If the price of energy source growth, the payback period is shorter, as well as the cash purchase and subsidized investment are taking into account.

SDH plant opportunities & threats, benefits & limits

Opportunities & benefits: reduction of CO_2 emissions, stable energy price for the next 20 years, gas savings, reliable system with low maintenance cost, energy independence

Threats & limits: high-temperature network - low energy profitabillity of solar system, small collectors surface, no financial support - long payback period.

Photos



Authors

This factsheet was prepared by dr. Boris Vidrih, dr. Andrej Kitanovski, Tjaša Duh u.d.i. and Suzana Domjan u.d.i
University of Ljubljana, Faculty of mechanical engineering, Aškerčeva 6, 1000 Ljubljana

Supported by: Intelligent Energy Europe Programme of the European Union