Case study : IREN Piacenza (Italy)

Name of the project: Piacenza

Address of the project: Piacenza

Name and type of the owner: DH supplier

Owner contact person: Sara Moretti (Sara.Moretti@gruppoiren.it)
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A/ Context of the study

A.1/ Motivations

Due to little availability of cogenerated haet, IREN has to operate boilers almost the whole year long. In order to cover the base thermal energy demand in summer, when economics of boilers is particularly bad, IREN wants to install solar system to avoid using boilers.

A.2/ Description of the existing DH

The district heating pipelines extend for about 26 km (both supply and return pipes). The heating needs of the district heating is provided by 4 hot water boilers of 2,9 MW each (about 12 MW total) and 2 superheated water boilers of 14 MW each (28 MW total). The total thermal power installed is 40 MW. Near the DH there is a combined-cycle power plant (855 MW) that uses only natural gas. When this plant works, cogenerated heat is purchased by the DH supplier. In recent years, however, the plant has been running fewer and fewer hours.

Temperature and flow in winter are:

Tforward 105 °C
Treturn 65 °C
Flow (nominal) 100 m3/h
Flow (max) 500 m3/h

while in summer are the following:

Tforward 80 °C
Treturn 60 °C
Flow (nominale) 80 m3/h

The total annual thermal energy consumption has been 45 GWh.

A.3/ Environment data

For what concerns the weather conditions, we used Meteonorm (meteonorm.com) hourly data of air and ground temperatures, air relative humidity and solar irradiation in Piacenza. Here a summarizing table of average monthly conditions:

MONTH	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
n° Days	31	28	31	30	31	30	31	31	30	31	30	31
n° Hours Day	281	305	378	408	465	474	469	454	380	350	298	280
n° Hours Night	463	367	366	312	279	246	275	290	340	394	422	464
T ext. air max [°C]	12.3	16.7	22.0	23.5	27.2	30.6	33.5	32.8	29.9	23.9	17.8	13.9
T ext. air min [°C]	-5.3	-4.2	-2.9	-0.8	5.4	8.0	11.1	12.2	8.5	4.0	-1.2	-5.8
T ext. air ave [°C]	2.9	4.4	8.3	11.3	16.2	19.6	22.8	22.3	18.8	13.4	7.3	3.6
T ground ave [°C]	7.0	6.5	6.8	8.0	9.7	11.5	12.9	13.5	13.2	12.0	10.2	8.4
Relative Humidity [%]	81.6	75.6	70.7	75.3	72.9	73.4	71.8	72.7	75.1	78.0	80.5	81.2
Irr max H [W/m²]	406	591	740	860	1005	973	963	877	824	655	439	399
Irr ave H [W/m²]	133	197	292	318	367	392	414	368	307	194	127	110
Rad tot H [kWh/m²]	37	60	110	130	171	186	194	167	117	68	38	31

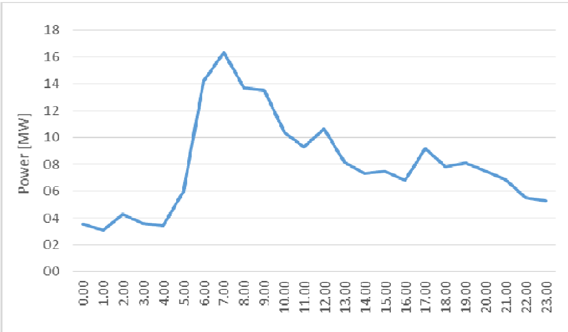
A.4/ Opportunities and barriers

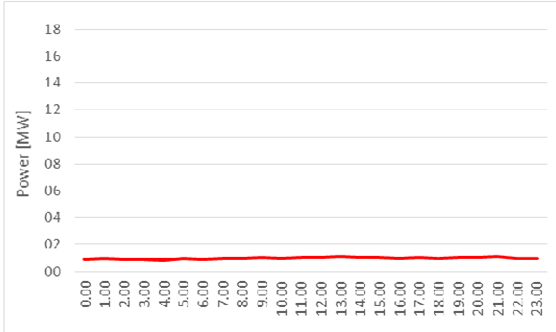
OPPORTUNITIES: high motivation in solar DH and also a large availability of land near the power station. The fact that the large cogeneration plant is working much less than expected is a strong reason for using solar.

B/ Methodology and tools used in the study

B.1/ DH load profile

An example of load profiles in winter (left) and summer (right), with a hourly timestep, has been provided directly by the DH supplier. In summer the energy need is always between 1 MW and 1.5 MW





B.2/ SDH design and sizing, energy balance

The integration of the solar plant into the DH grid is "feed-in return-->return".
TRNSYS has been used because it is more flexible than other softwares (e.g. TSOL): it's easier input meteo data and load profiles.
The solar collector field has been modelled like one single, large collector of 1000 m2. Increase in the DH grid's return temperature due to solar energy input have been evaluated.
The energetic indicators taken are:
- *solar energy produced by the solar thermal system (Esol);*
- *efficiency of the plant (Eta impianto);*
- *solar fraction(fsol).*

B.3/ Economics

Pay-back time,
Internal rate of return (IRR),
Net present value (NPV). All economic indicators have been calculated internally by IREN according to technical results provided by the case study.

C/ Results of the study

C.1/ SDH system design, energy balance and performance

Because of the solar systems works better when the return temperature of DH is lower, IREN estimates that such temperature can be reduced to 55°C in summer. A second simulation has therefore been made with such new value, with following results:

Esol	MWh	541
η_plant	%	42
fsol	%	1.1

*These results are under revision because of the optimization of TRNSYS model.

C.2/ Heat production management at network level

Solar energy is mainly used in summer in order to avoid using boilers.

C.3/ Economics at SDH level and at network level

The cost of 1000m2 of solar collector is about 370'000€. This value is between 200€/m2 and 400€/m2 that represents the unit cost of typical ground installation in Europe. Considering the ground purchase, the infrastructural costs and some other items, the amount on the solar plant is 395'000€.

Since in Italy there are national incentives, for 1000m2 of solar collector there are 275'000€ distributed in 5 years.

Adding all the items shown before, the total investment, after 5 years is 120'000€.

The pay-back time is 18 years.

The IRR is 7.8%, while the NPV is 15'438€

Authors

This factsheet was prepared by Marco Calderoni and Stefano Agosteo

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