Case study : SDH plant Bioenergiedorf Büsingen (Germany)

Name of the project:	Bioenergiedorf Büsingen
Adress of the project:	Büsingen am Hochrhein D- 78266
Name and type of the owner:	Solarcomplex AG, utility company Ekkehardstraße 10 78224 Singen
Owner contact person:	Eberhard Banholzer banholzer@solarcomplex.de

Context of the study

Solarcomplex AG is a regional energy supplier in south Germany. The aim of Solarcomplex is to transform the energy supply of the Lake of Constance area to renewable energies until 2030. One of the business models is to transform entire villages in Baden-Württemberg to 'bio energy villages' (Bioenergiedörfer) by building renewable district heating nets for heat and photovoltaic plants for electricity. All inhabitants of the villages are involved in the projects at an early stage, in order to achieve a high share of participation and connected buildings.
Büsingen is the seventh bio energy village of Solarcomplex AG. It is a German village, but situated in Swiss territory, which leads to particular legal boundary conditions under swiss economic law. In this case, a district heating net was to be built to provide the houses of Büsingen with a mix of biomass and solar heat. Solar thermal should be used to cover the heat demand in summer and the dimension of the plant foreseen was around 1000 m². Büsingen is the first German bio energy village realized with solar district heating. The plant is therefore an important best practice example for the bio energy villages in Germany. The case study on hand was extended to larger collector areas in order to explore all possibilites offered by the combination of biomass and solar for further systems or the extension of this one.

Support

Subsidy in Germany: The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) through the 'Marktanreizprogramm' (MAP) supports the development of renewable energies in the heat market: 1) large solar plants feeding into a heat net are supported with KfW loan with redemption subsidies up to 40 % of the investment cost. 2) Existing district heating nets supplying renewable heat and substations are supported via KfW loan with redemption subsidies of 60 € per meter pipe and 1800 € per substation. 3) For heat storages bigger than 10 m³, the redemption subsidy is 250 €/m³. The Federal Ministry of Economics and Technology (BMWi), together with BMU supports research activities: for especially innovative pilot plants, incentives can be obtained for investment and related research. 4) The region of Baden-Württemberg gives financial support to the realisation of heating networks in bio energy villages.

SDH plant

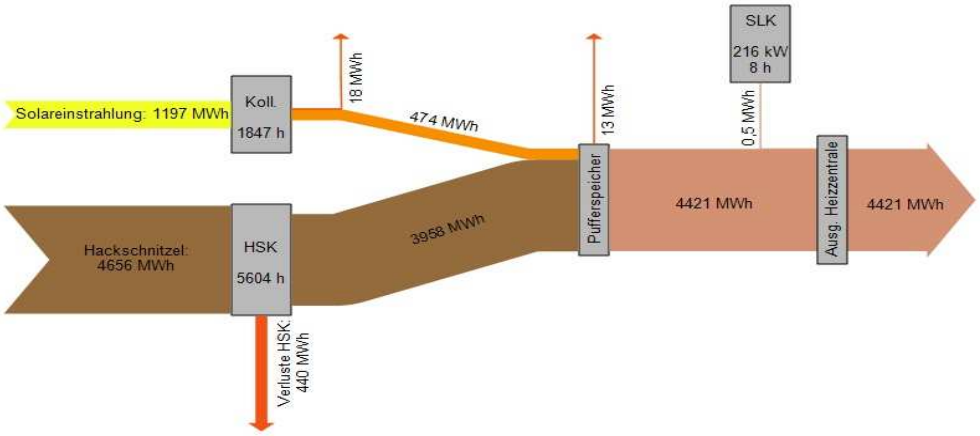
SDH system concept

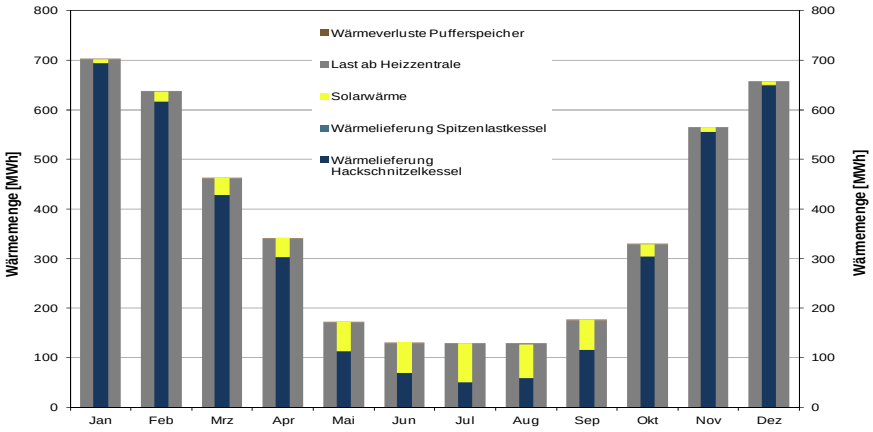
Büsingen counts around 1 400 inhabitants. The total heat demand amounts to 3524 MWh/a. The district heating net is dimensioned to have a feed-in temperature between 80 and 75 °C and a return temperature of 50 °C. The concept is to have a centralized heat production based on biomass and solar energy with a solar fraction of around 10 %. To produce this solar heat, a collector surface of approximatively 1000 m² is needed. Surface was available for ground-mounted collectors and some roof-mounted collectors beside and on the roof of the heat plant.

SDH technical data

A reference case was defined with 1000 m² of collectors oriented south with a 45° slope, net operation temperatures of 80/75 °C and a 100 m³ storage. Three collector types were compared: flat-plate collectors, high-temperature flat-plate collectors and evacuated tube collectors with CPC (coumpound parabolic concentrator). These dimensioning parameters were then varied to evaluate their impact on the performance of the system.

SDH energy balance (MWh)





For the reference case the solar fraction obtained is of 6.3% with flat -plate collectors, 10.4% with CPC collectors*.

It was also investigated, which dimensions of the solar system would be necessary to reach 100% coverage of the summer load (May to September). To attain even 90% coverage of the summer load, 3000 m² CPC collectors and a storage of 300 m³ would be needed.

* CPC: Compound Parabolic Concentrator

SDH economics

Examplary calculation of system economics (data does not correspond to actual costs for the Büsingen plant):

Solar thermal plant	280.000 €
Wood chips boiler	585.000 €
Heat network	2.000.000 €
Other infrastructure and services	850.000 €
Total investment	3.715.000 €
Subsidies (national and regional funding)	800.000 €
Yearly capital costs	200.000 €
Maintenance and operation costs	240.000 €
Yearly costs	440.000 €
Annual heat delivery	4.400 MWh
Cost of delivered heat per kWh	0,10 €

SDH plant opportunities & threats, benefits & limits

The study showed that solar district heating can be an interesting technology also in rural areas. Since the potential of biomass is limited and rising costs for wood chips influence the profitability, solar heat can help achieve long-time stable heat costs. Moreover bio energy villages will improve the regional economy (local craftsmen, building companies, consulting engineers, wood chips, etc.).

Sometimes the initiator of a bio energy village is not a company but dedicated citizens in co-operation with the community, local craftsmen, building companies and consulting engineers. As a form of organisation registered co-operatives are often chosen, which allows the citizens a high degree of co-determination and influence in combination with a limited liability. The financial ambition is not profit maximisation but to achieve a long-term favourable price (cost-covering) using renewable energies. Through the participation of the residents social cohesion is strengthened, the collaboration helps to achieve better acceptability and voluntary workings help to cut costs.

There is a need for financial support using the combination of wood chips and solar thermal plant.

Photos

Authors

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