

SUCCESS STORY:

The bakery that runs on heat from biomass

INVESTMENT CASE

Title:

Modern bakery supplied by process heat from biomass

Year (commissioned):

2016

Location:

5503 Schafisheim, Switzerland

Stakeholders:

1. The Coop Group – Investor and operator
2. Swissmill – Provider of wheat grain residues as co-firing fuel for the Schafisheim plant
3. A regional supplier of forestry wood chips – Provider of wood chips

Author:

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The Coop Group is Switzerland's largest retail and Europe's second largest wholesale company with a workforce of around 85 000 in total and 54 000 in Switzerland. In 2015, Coop built a new production and distribution center in Schafisheim with a total investment of more than Euro 500 million and 1 900 employees on the site. The existing buildings were extended by a new building measuring 185 x 100 m in size and 58 m in height, of which roughly 50 % is below ground level in a former gravel pit. The building complex incorporates a high-bay freezer warehouse and Switzerland's largest bakery and confectioner with an annual production of 60 000 tonnes of baked goods.

Why

Coop is committed to sustainability. By merging production and logistics to one single site and implementing modern technologies, significant savings in energy consumption and road transport were achieved. To additionally substitute fossil fuels, an energy production based on a biomass combustion plant was realized providing process heat for the bakery by thermal oil (hot oil is used for heat distribution, instead of steam). Since the production of the

raw materials for the bakery causes residues in the upstream milling process, the vision to use milling residues as energy for the bakery arose. The potential and technical opportunities were evaluated and a concept of co-firing wood chips and grain residues developed. Swissmill, the largest mill of Switzerland located in Zurich and owned by Coop, was involved to provide fractions of grain residues, which are of low value for other purposes. To ascertain a flexible operation of the bakery, the decision was taken to implement a concept which enables a variable energy production by 50 % wood chips and 50 % grain residues with the opportunity to switch to 100 % wood chips.

Consequently, a combustion system was designed, which enables the use of forestry wood chips from a separate silo with addition of grain residue pellets from a separate storage compartment. The thermal oil boiler and the flue gas cleaning were adopted to comply with the challenges of increased slagging and fouling and with increased NO_x emissions due to the high ash and nitrogen content of grain residues. To cover the rapid load changes of the bakery process, a gas fired peak boiler complements the heat production.

Fuel type:

- Wood chips, grain residues

Feedstock origin:

- Domestic forestry by-products/ residuals: bark, wet wood chips, etc
- Domestic agriculture, “dry” by-products / residuals: straw husk, peals, corn stoves

Conversion system:

- Boiler combustion, e.g. stand-alone boiler plant including co-firing and combined heat and power

Co-fire:

- Heat generator (i.e. boiler) is 100 percent biomass-fired.

Heating system heat sources:

- Heat generator is part of a system with fossil fuel fired boilers

Comments:

- The system applies co-firing of forestry wood chips with grain residues from the milling process.
- Process heat at close to 300° C for bakery.
- Gas fired boiler are needed for load peaks.



The building complex in Schafisheim

Since the start-up of the plant, more than 70 % of the heat production is provided by biomass and the boiler and gas cleaning are currently in an optimization phase.

The investment and its technology

On the building complex in Schafisheim, a separate building for the process heat production was erected consisting of a silo for forestry wood chips and a separate compartment of dry milling residues delivered as pellets. On the final stage of the feeding system, grain residue pellets are continuously added to the wood chips. The mixture of wood chips and grain pellets are combusted on a moving grate and the heat is extracted to generate up to 2.5 MW thermal oil at

approximately 285° C utilised for the bakery process. In addition, up to 400 kW hot water at 145° C is generated to provide other consumers on the site. (Thermal oil is used for heat distribution instead of steam).

The motivation for the plant is to substitute fossil fuels by biomass to consequently reduce the CO₂ emissions of the bakery process and contribute to the sustainability targets of the Coop Group. A special characteristic of the plant is the combined use of forestry wood chips and grain residue pellets. For this purpose, individual storage systems were installed and a continuous mixing of the fuel prior to feeding the boiler was developed. To comply with the emission limits, the boiler is equipped with an electrostatic precipitator for particle removal and an SNCR system for

Relation to Sustainable Development Goals:

8 DECENT WORK AND ECONOMIC GROWTH
Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

9 INDUSTRIAL INNOVATION AND INFRASTRUCTURE
Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

11 SUSTAINABLE CITIES AND COMMUNITIES
Make cities and human settlements inclusive, safe, resilient and sustainable

12 RESPONSIBLE CONSUMPTION AND PRODUCTION
Ensure sustainable consumption and production patterns

13 CLIMATE ACTION
Take urgent action to combat climate change and its impacts

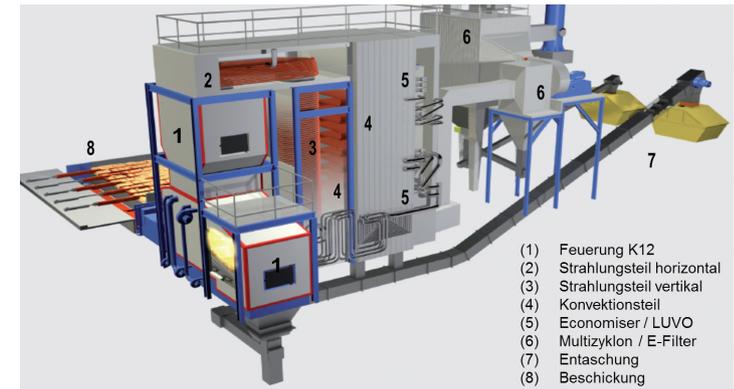
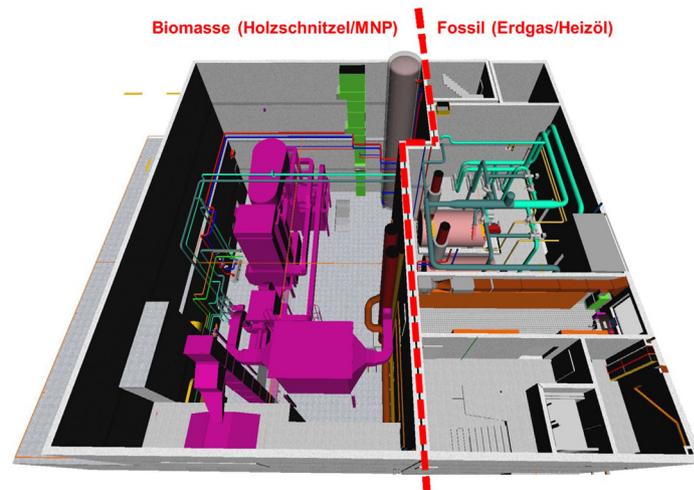
Comment:

● Compared to a fossil energy supply, the biomass plant achieves CO₂ savings of 4 000 tonnes per year.

NO_x reduction.

The total investment cost for the Schafisheim logistic and production centre finalised in 2015 refers to approximately 600 Mio. CHF (535 Mio. Euro in 2018). As part of this site, the heat production plant required an investment of 10 Mio. CHF (9 Mio. Euro), of which 45 % was for the building and 55 % for the technical infrastructure. The additional infrastructure to enable a co-firing of grain residue pellets accounts for approximately 1 Mio. CHF (0.9 Mio. Euro). The biomass plant enables CO₂ savings of 4 000 tonnes per year.

An evaluation of the whole production chain for the example of bread reveals that 30 % of the grain residues accumulated during the milling process would be enough to cover the heat production for the bakery, if the efficient energy conversion and bakery technologies as realised in the new plant in Schafisheim are applied. The Coop plant, however, is operated with 50 % to 100 % wood chips ensuring a high flexibility.



Factors behind the decision

The decision for a CO₂ neutral biomass combustion plant was driven by sustainability criteria. The additional implementation of grain residue pellets was driven by the vision to use residues from the raw material used to produce the good and therefor close the material cycle.

In Switzerland, the confederation and the cantons support efficiency measures and the substitution of fossil fuels by renewables based on a national vote on an “Energy Article” back in 1990 and a consecutive national vote on the “Energy Strategy 2050” in 2017. Consequently, the implementation of automated biomass combustion plants, often combined with district heating, has been supported. This enables a significant increase of biomass for heating in the building sector . However, the potential for sustainable energy wood available utilization in Switzerland is limited to approximately 7.5 % of today’s energy demand. In addition, two third of the potential is already utilized and consequently the remaining unused potential is low. Since modern buildings are energy efficient and can be supplied with low temperature heat, heat pumps can be efficiently used for residential heat and potentially driven with renewable electricity. On the other hand, biomass is the most promising renewable energy to provide process heat at temperatures above 100° C or even above 200° C with high thermodynamic value. Therefore, the Swiss Federal Office of

Energy (SFOE) supports innovative applications of biomass for process heat and consequently supported the present plant in the framework of a pilot and demonstration (P+D) project.

Lessons learned

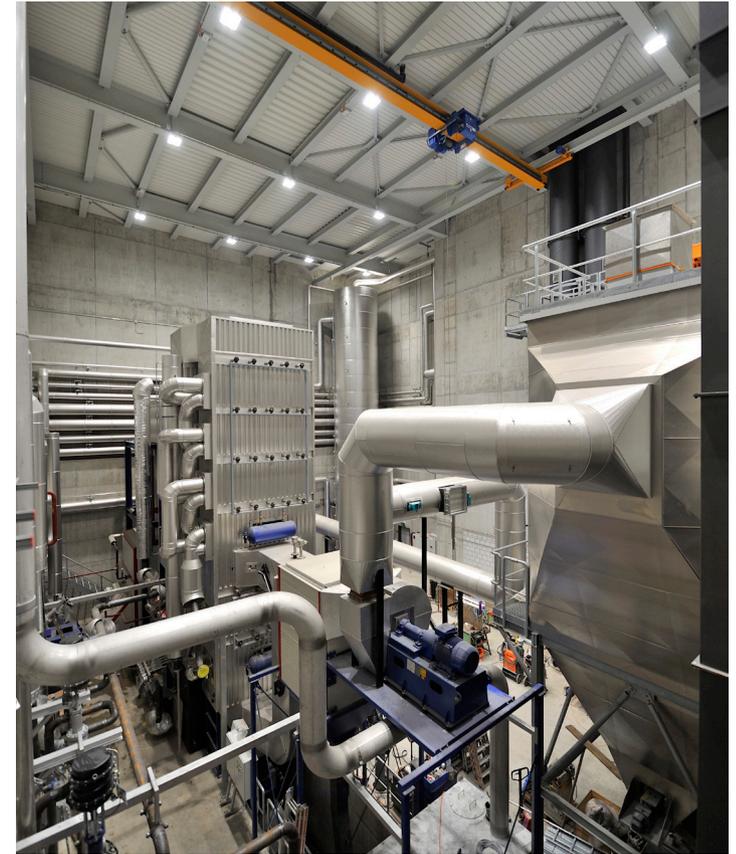
In the conceptual phase, a market evaluation in Europe was performed to identify industrial suppliers of biomass combustion plant that could handle the challenges of using high ash biomass for thermal oil production, i.e. the use of a mixture of wood chips with dry grain residue pellets. For this purpose, combustion tests on test plants of several suppliers, active in industrial applications (not only residential heat), were performed and the principal feasibility was proven in test runs of several days. The experience in practise now reveal that the challenges were underestimated. Consequently, the initially available installations did not meet the requirements, which shows that the variability of biomass fuels still a remains a challenge even for industrial suppliers.

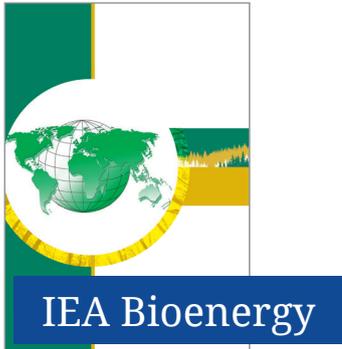
Success factors

In the current situation, CO₂ savings need to be supported. Biomass fuel needs to be available by local suppliers in a suitable form and quantity. For this purpose, regional wood chip suppliers from forestry or in cooperation with forestry are important.

Constraints

Since biomass systems exhibit higher investment cost than fossil systems, biomass systems are only favourable if a strong focus on sustainability is met and a significantly longer depreciation period is accepted by the investor. In the present case, the company's commitment to sustainability was a pre-condition for the decision to implement a biomass plant.





Web sites:

www.verenum.ch

www.holzenergie-symposium.ch

www.eicher-pauli.ch

www.coop.ch

www.ri.se

www.energimyndigheten.se/en/

www.iea.org/tcp/

www.ieabioenergy.com

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