RENEWABLE ENERGY CONCEPT FOR AN INDUSTRIAL QUARTER IN TRANSITION

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1 SUMMARY

The research project InEs creates an innovative energy supply system for a commercial district at the site of the former Bavarian porcelain factory Winterling in Schwarzenbach a.d. Saale. The starting point of the project was the redevelopment of the district with an area of six hectares and a 40,000 m² large factory complex. The objective is to achieve a high renewable share by sector coupling and integration of storage technologies. The waste heat of two existing CHP and an ORC unit is to be used for heating the building through a cellar-integrated storage tank. Organic and silicon photovoltaics as well as the use of wind power have been analysed. A life cycle assessment, which compares the refurbishment of the existing building with a comparable new building, provides information on the sustainability of the continued use of industrial buildings. In addition, legal issues for the energy supply of the tenants are investigated. Three local industrial companies (production of LED street lamps, abrasives and baker's yeast) in the vicinity are involved in the project.

2 ROOM-INTEGRATED THERMAL ENERGY STORAGE

The biogas for the two CHP is generated in an innovative process during waste water treatment of a nearby yeast factory and is transferred to the Winterling area via a gas pipe. The waste heat of the CHP and an additional ORC unit is already used for heating the Winterling building. Together with the backup gas boiler they sum up to 940 kW_{th}, as only one CHP can run simultaneously. To be able to use an even higher share of the heat, a large hot water storage will be built in a cellar. The new concept, also discussed in (Schiffmann et. al, 2020), uses the walls of the room as the static limits for the storage, see Fig. 1. They will be insulated from the inside and a liner will prevent moisture penetration into the insulation. The room is then flooded and has a water content of 1,240 m³. Different insulations materials such as PU, PIR, glass foam, cork and VIP are investigated. For the liner, PP or stainless steel sheet as well as glass-fiber reinforced plastic are the most promising approaches. CFD simulations in COMSOL Multiphysics and Simcenter STAR-CCM+ provide the basis for the selection of a suitable stratification device. The bearers in the room lead to the factor of three in the number of stratification devices so that the chambers in the upper part can all be accessed. The temperature level will be between 35 and 80 °C and three temperature layers are planned.

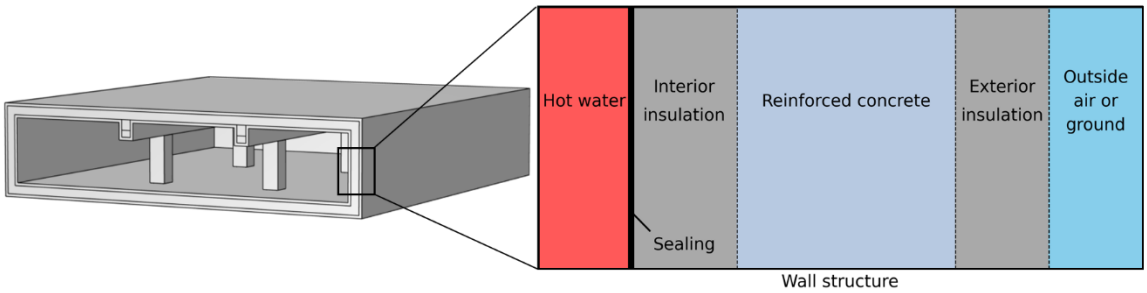

Fig. 1: Left: Sectional view of the 3D model of the cellar, right: Wall structure after transformation from concrete wall to heat storage [Source: iwe]

3 ORGANIC AND SILICON PHOTOVOLTAICS

Organic photovoltaics (OPV) as well as standard silicon photovoltaics will be installed on the area. A demonstrator of a bike garage with OPV has been successfully built to be able to load e-bikes self-sufficiently. This promotes the sustainable mobility of the employees of the companies located at Winterling area. Furthermore, OPV for a food stand and for street lamps produced by a commercial tenant of the area are under investigation. Silicon photovoltaics with 440 kW_p will be used for the large roof surfaces and a façade to reach a high share of green electricity. An additional battery storage could enlarge the autarchy of the area.

4 SMALL AND LARGE WIND TURBINES

A wind park with four turbines is located 3.5 kilometers north of the area. The first of these wind mills will loose funding of EEG in 2025. A power purchase agreement between the operator and the area or even the municipal utility could be a win-win for both parties. The operator can continue to sell his green electricity and the area as customer can enlarge the pool of renewables compared to only PV. Another possibility to use wind energy is to install a small wind turbine on the 50 meter high chimney which formerly was used for the kiln hall. A 10 kW horizontal wind turbine is investigated, especially static check-up is crucial for this special location.

5 LIFE CYCLE ASSESSMENT

A key objective of the project is to reuse as much of the existing building structure as possible. The buildings of the Winterling industrial complex were constructed over a period of approximately 100 years. The different building standards require an individual approach for modernization in order to comply with current energy efficiency regulations. This usually involves extra work compared to new buildings. However, the energy consumption for electricity, heating, ventilation and air conditioning is expected to be higher than for new buildings. To assess whether a new building is preferable to a refurbished one in terms of energy consumption, the modernised Winterling industrial complex is compared to a virtual new building of the same size. The criterion used is the CO_2 equivalent emissions over the life cycle of the building. This includes the energy required for construction, refurbishment, energy efficiency measures, waste disposal, recycling and the energy consumed during 50 years of operation. The results for the first building analysed show that renovation is the preferable option in terms of energy consumption.

6 LEGAL ASPECTS

The legal aspects mostly focus on questions concerning energy law. First of all, the best operating form for the Winterling area regarding grid connection and power supply have been examined. Questions concerning a common power supply, a common energy production and different consumption constellations have been analysed. Part of the project’s legal aspects is also the installation of charging points for electric vehicles. An examination was conducted on how a battery storage system can be installed on the site to meet the requirements given by the different partners linked via the project concept.

7 REFERENCES

Schiffmann, D. et al. (2020), GEAS Gedämmtes Abdichtungssystem STES mittels Umrüstung von bestehenden Räumen, Presentation in Innovationsgruppe Speicher / Wärmetauscher of energy-cluster.ch.