General information

The Schiestlhaus of the Austrian Tourist Club (ÖTK) is located at an altitude of 2154 [m] above sea level on a plateau directly under the main summit of the Hochschwab. It is the first large mountain refuge built to achieve passive house standards.

Figure 1 (on the left hand) The „Schiestlhaus“ in the Hochschwab Region using passive house technology, Figure 2 (on the right hand) installed micro CHP unit from KW Energietechnik Ltd.

Heat and domestic hot water supply is provided by facade-integrated solar thermal collectors (62,5 m²) and a solid fuel oven with a rated power output of 14 [kW]. 60 % of the electrical energy demand of the building should/will be covered by a PV system with a total surface area of 52,3 [m²]. The modulating rape oil micro CHP unit (max. output 14 kW_{el} / max. output 27 kW_{th}) is installed mainly for emergency purposes and for battery services.

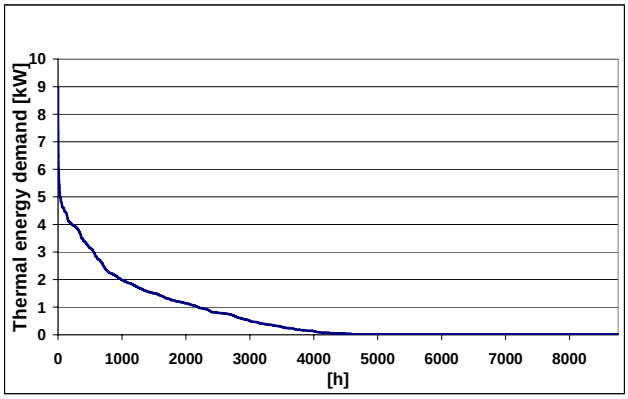
Analysis of the energy system

The analyse of the energy system included a detailed analysis of the building, the energy demand and the assessment of the economic opportunity. All required details were collected by detailed investigations by the Austrian Energy Agency. The analysis of the energy demand was assisted by the computer program “BHKW Plan” a new software tool created for the planning of CHP systems.

The following basic data were used for the analysis.

Basic input data		
Heated net floor area	353	m^2
Heat required for domestic hot water	3,85	MWh/a
Electricity demand	6570	kWh/a
Opening time	From end of May till end of October	
Climate data	Meteorological station: Austrian alps, Sea level: 1800 m	

The total thermal energy demand for heating and domestic hot water is calculated to 5,9 [MWh]; the required maximum heat demand to 9 [kW]. The installed micro CHP system from KW Energietechnik Ltd. is designed for an electricity driven operation. The total electric energy demand is covered to 40% by the micro CHP system and to 60% by the installed PV system with an electrical power output of 7,5 [kW_p]. The following figures show the annual heat demand and the average monthly electric energy demand of the “Schiestl-haus”.



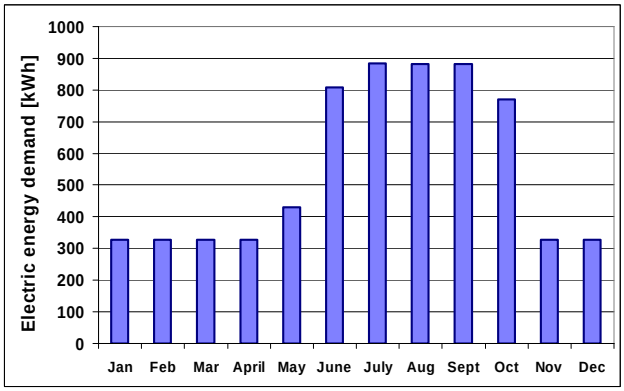


Figure 3 (on the left hand) showing the annual heat demand curve and Figure 4 (on the right hand) the average monthly electric energy demand of the “Schiestlhaus”

A minimum electricity demand occurs also during the closing time because of the energy demand for the heating and the ventilation system. The required electrical peak load of the building is reduced by an electricity management system. The electricity management system takes care that electricity consumers don’t operate simultaneously. The required electric peak load of the building is estimated by ATB Becker Ltd. – planer of the electricity system – to 11 [kW]. The three installed power inverters from SMA Technology company are able to generate a continuous power rating of 3700 [W] (each). The installed battery system (lead acid batteries) has a capacity of 2000 [Ah]. The system runs at a voltage level of 60 [V]. The average energy demand of the building is covered by the battery system. The CHP unit gets started by the electricity management system when the required electric energy demand reaches 60% of the peak load or when the battery capacity is lower than 30%. Due to the high sea level of 2154 [m] it has to be taken into account that the electric rated power output of the CHP goes down to 11,5 [kW][1]. The thermal output is rarely affected by the sea level. The heat generation during the power generation gets stored in three storage tanks with a total capacity of 2400 [l]. The heat can later be used for domestic hot water or for heating purposes of the object. The installed micro CHP unit is able to cover the thermal and the electrical peak load of the building.

The following table shows the power connection and the average daily energy consumption of the different components of the electrical system.

	Illumination	**Kitchen**	**HKLS+ARA*)**	**Other consumers**
Connection power	0,68 [kW]	Limited to 2,8 [kW]	2,41 [kW]	1,24 [kW]
Daily consumption	4075 [Wh/d]	13975 [Wh/d]	22300 [Wh/d]	3445 [Wh/d]

*) HKLS – heating, climatisation, ventilation; ARA – wastewater treatment

Profitability calculation

The economic evaluation is based on VDI 2067 and includes a comparison with an alternative energy system. For the profitability calculation the “existing” energy system of the “Schiestlhaus” consisting of solar thermal collectors, a PV system and a micro CHP unit is compared to an energy system consisting only of a micro CHP system (incl. storage tanks) and a solid fuel oven.[2] The following table summarises the different cost positions of the “existing” energy system in comparison to the micro CHP system.

Profitability calculation *)		**Micro CHP system**	**"Existing" energy system**
Capital costs	[€/a]	1914,72	4018,23
O&M costs	[€/a]	1197,10	1266,34
Fuel costs	[€/a]	1924,07	769,63
Total costs	[€/a]	**5035,90**	**6054,20**

*) For the solid fuel oven no costs have been taken into account because it is assumed that the soild fuel oven is used anyway (in both cases).

[1] Source: ATB Becker

[2] A battery system for balancing the required electrical demand is used in both cases.

The different cost positions and the cost advantage of the micro CHP system are represented by Figure 5.

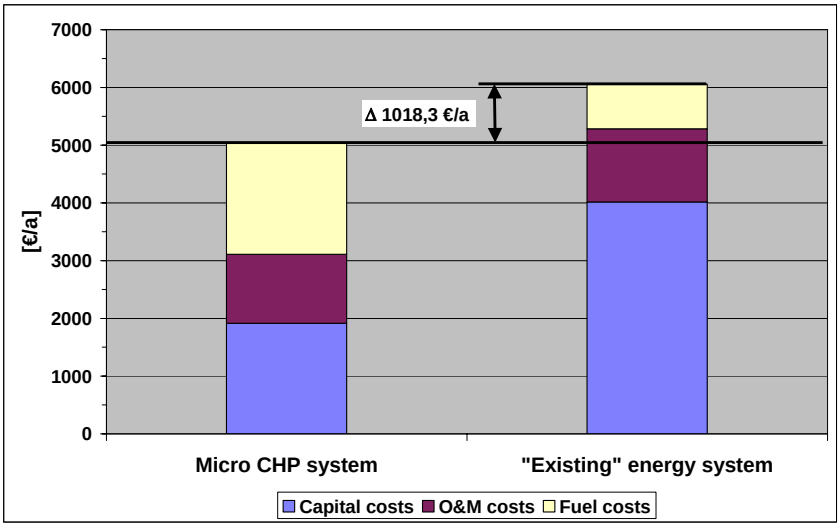


Figure 5 Profitability calculation of the “existing” energy system in comparison with a micro CHP system showing clear advantages for the micro CHP system

Conclusion

The “Schiestlhaus” is using passive house technology to lower the thermal energy demand of the building. Furthermore the “Schiestlhaus” represents a demonstration project of the Austrian RTD programme “Buildings of Tomorrow” to test several energy components like solar thermal collectors, a PV system, a solid fuel oven and a micro CHP unit in an ecological sensible area.

The analysis of the “existing” energy system of the “Schiestlhaus” proves a good technical solution covering both the thermal and electrical loads of the building. However, a modulating stand alone micro CHP system would be also an excellent technical solution offering some economic advantages. The main reasons for the economic efficiency of the stand alone micro CHP system are the lower capital costs for the micro CHP unit (including lower costs for the hot water storage tank and the battery system) in comparison to the “existing” energy system. This result would be improved for similar Austrian buildings also with no grid connection but with a better integration into the road network.