General information

The “Marianneum” is a religious centre which is located on the outskirts of Vienna. The lodge is open during the whole year. The building was renovated in 1987 and has 34 guest rooms and 66 beds. The following energy systems are installed in the “Marianneum”. For heating, domestic hot water production and electricity generation a micro CHP was integrated in 2003. The installed micro CHP from Buderus company is a modulating unit (9 - 18 kW_{el}/ 17 - 34 kW_{th}) and is fuelled with natural gas. Additionally an oil boiler with a thermal output of 116 [kW] is used to cover the thermal peak loads; furthermore two storage tanks with a volume of 1000 [l] (each) are used for the same purposes. Two heat pumps provide extra heat for the winter period. Each heat pump has a thermal output of 4,5 [kW]. For additional hot water production a thermal solar system with a collector area of 20 [m²] is installed (thermal output appr. 9.000 [kWh/a]).

Figure 1 Marianeum (Photo: Austrian Energy Agency)

Analysis of the installed micro CHP system

The analysis of the micro CHP 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	2031	m^2
Heat required for domestic hot water	6,4	MWh/a
Electricity demand	106600	kWh/a
Climate data	Meteorological station: Vienna, Austria Sea level: 171 m	

The total thermal energy demand for heating and domestic hot water which has to be supplied by the “existing” micro CHP unit and the peak load boiler is calculated to 100,1 [MWh]; the required maximum heat demand to 64 [kW]. The installed micro CHP system from Buderus company is designed for a combined oriented operation mode (taking into account both the maximum electricity and(!) heat demand). In this operation mode the micro CHP generates as much electricity as needed within the building, but only if the generated heat is required too. The total electric energy production of the micro CHP system is calculated to 42,4 [MWh/a] and is used to 100 % in the building. Figure 2 shows the annual heat demand which has to be supplied by the micro CHP and the peak load boiler, a picture of the installed micro CHP system and the amount of heat generated by the micro CHP unit. The area in which the heat generation of the micro CHP is above the heat demand curve corresponds to the charging time of the storage tanks. The operation time can be extended by the installed hot water storage tanks (with a volume of 2000 [l]). Around 53 % of the maximum thermal demand is covered by the micro CHP system.

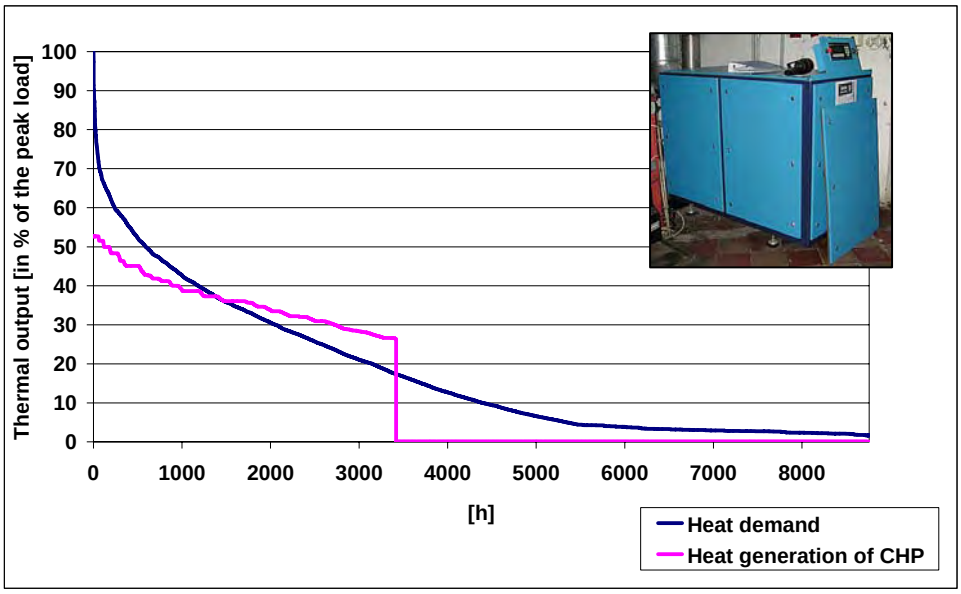

Figure 2 Annual heat demand curve (blue line) and heat generation of the micro CHP system (purple line), picture: installed micro CHP system from Buderus company

Profitability calculation

The economic evaluation is based on VDI 2067 and includes a comparison of the “existing” micro CHP system consisting of the micro CHP unit and an oil boiler to cover the peak loads with an alternative energy system. For the alternative energy system a low temperature oil boiler with a thermal output of 66 [kW] is taken into account. The following table summarises the different cost positions of the “existing” micro CHP system in comparison with the alternative energy system.

Profitability calculation		Micro CHP System	Alternative Energy System
Capital costs *)	[€/a]	2956,33	483,04
O&M costs	[€/a]	1371,56	83,81
Fuel costs	[€/a]	7695,44	7093,85
Total costs	[€/a]	**12023,32**	**7660,70**
Reimbursement of tax on fuel	[€/a]	635,78	
Avoided electric energy supply	[€/a]	5510,06	
Total revenue	[€/a]	**6145,84**	
Net costs	[€/a]	**5877,48**	**7660,70**
Specific costs of heat generation after crediting electricity generation	[€/kWh(th)]	0,0587	0,0765

*) For already installed systems and components (e.g. storage tanks, boilers,…) no capital costs are calculated.

The different cost positions and the total revenue are represented by Figure 3 showing clear advantages for the “existing” micro CHP system.

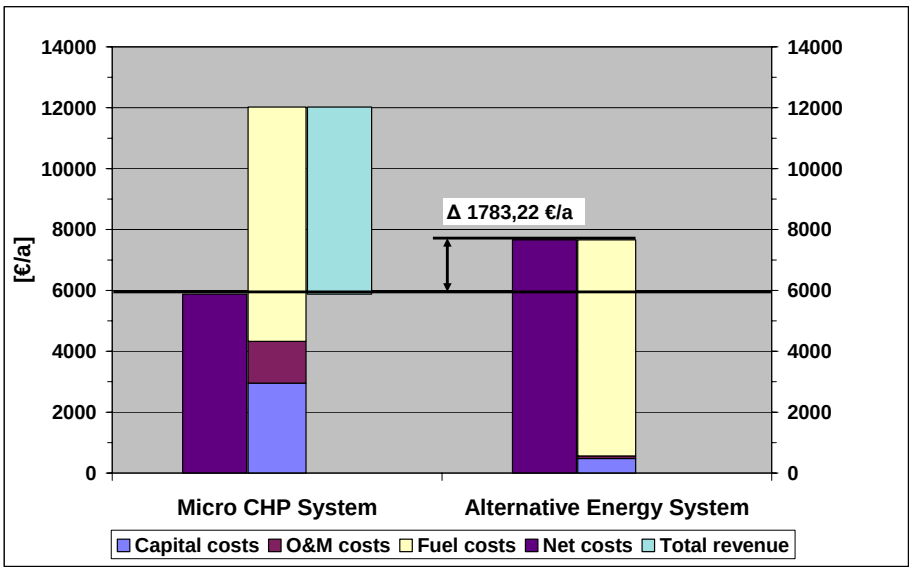

Figure 3 Profitability calculation of “existing” micro CHP system in comparison with an alternative energy system

Pay-back period

Information concerning the pay-back period is based on a dynamic calculation. Figure 4 shows the development of the accumulated discounted cash flow. The payback period for the investment in the installed micro CHP system is calculated to 7,2 years.

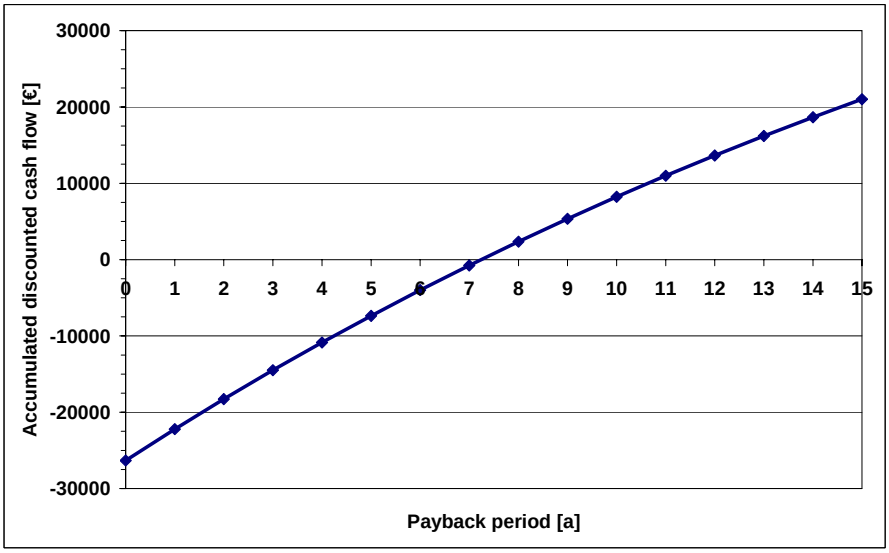

Figure 4 Accumulated discounted cash flow showing a pay-back period of 7,2 years

Conclusion

The analysis of the energy situation shows that the “existing” micro CHP unit represents a good technical and economic solution. The micro CHP supplies almost 40 % of the electricity demand of the building. Due to the frame conditions in Austria and due to the energy situation at the “Marianneum” the deployment of the micro CHP system shows an economic efficiency which leads to a pay-back period of 7,2 years. The reasons for this good pay-back period are:

- High tariff for the electric energy supply
- Significant amount of avoided electric energy supply from the grid
- Subsidy of 30 % for investment and installation costs of the micro CHP system
- Reimbursement of tax on fuel used for the micro CHP unit