

## Reka Holiday Village, Blatten Belalp, Switzerland

Newly built holiday village with three central PVT-solar supported heat pumps and one booster heat pump delivering domestic hot water to seven individual fresh water stations in the separate apartment buildings.

### Key facts

#### Building

Location	Blatten, Switzerland
Construction	December 2014
Heat distribution	Collective
Heated area	m <sup>2</sup> living
Level of insulation	MNERGIE A

#### Heat pump and source

Number of heat pumps	4
Installed capacity	270kW + 200 kW
Operation mode	monoenergetic
Heat source	Ground source
Brand and type 3 heat pumps	Viessmann KWT Vitocal 300-G Pro spec
1 high temperature heat pump	Viessmann KWT CMH2 267 spec
Refrigerant	R410A
Sound level	dB

#### Heating system

Heat demand	250,000 kWh
Heating temperature	35°C

#### Domestic hot water

Type of system	– Central generation delivering to fresh water stations
Max. Temperature	65°C
Circulation system	
Legionella measures	thermal
Number of storage tanks	7 (fresh water)
Storage size	7 x 1200 litres 1 central 8,000 litres

#### Other information

Electric energy Consumption year	400,000 kWh
Investments costs	unknown
PV installation	487 m <sup>2</sup> - 70.6 kWp
PVT installation	672 m <sup>2</sup> - 102.3 kWp

#### [REKA Feriendorf](#)

[Monitoring report](#) by Hochschule Luzern.



The Reka holiday village comprises 7 apartment buildings with a total of 50 apartments, a reception house with an indoor pool and a community house. After the holiday village opened in December 2014, its energy system was measured and optimized in detail for two years.

The holiday village is designed for around 50,000 overnight stays per year. In the first two years of operation, 38,000 (2015) and 42,000 (2016) overnight stays were recorded. The optimization of operations resulted in a significant reduction in energy requirements from the first to the second year of operation.

The heat supply is based on three heat pumps 270 kW (Viessmann KWT Vitocal 300-G Pro spec.). For the lower temperature level of 35-40°C, as well as one heat pump (Viessmann KWT CMH2 267 spec.) For 55-65°C are installed in the technical centre. The performance figures according to the manufacturer are 4.75 for the first three heat pumps with B0/W35; those with B0/W65°C on 2.5. on 4 heat pumps (270 kW) The heat pumps and storage are installed in a central technical room and a geothermal probe field with 31 probes each around 150 m (a total of 4,535 probe meters) at intervals of approx. 5m.

The hybrid photovoltaic solar thermal collectors (PVT) generate electrical and thermal energy at the same time. The heat from the PVT collectors is mainly used for the regeneration of the geothermal field. However, it can also serve as source heat for the heat pumps or be directly introduced into the low-temperature storage on the secondary side. The heat pumps, which provide the source energy from the geothermal storage or from the PVT to the desired temperature levels for building heating and hot water, are operated with the electrical energy. The useful energy is provided at two temperature levels: 35°C for building heating and 45-65°C for hot water preparation. The high temperature heat pump boosts the temperature to the level for domestic hot water, which stored in a 8000 litres storage tank in the central technical room. From there it is transported to the individual 7 apartment buildings where it is stored in fresh water stations with a capacity sufficient to serve the individual apartments.

The roofs of the 7 houses have an east-west orientation and are equipped with solar systems on both sides. The PVT system with a total of 672 m<sup>2</sup> (102.3 kWp electrical) is installed on 4 of these houses. These are roof-integrated systems with uncovered, uninsulated PVT collectors (202 Hybrid 240/900 Sky collectors and 207 Hybrid 260/900 Sky modules from Meyer Burger). A pure PV system with a total area of 487 m<sup>2</sup> (70.6 kWp electrical) is installed on three houses.

	2015 [GWh/a]	2016 [GWh/a]
Heizen	316	205
Warmwasser	119	97
Schwimmbad (Bäder, Heizung, Lüftung)	162	167
Verluste	76	94
<b>Total</b>	<b>706</b>	<b>562</b>

In the first year of operation, 26% more energy was required for building heating than calculated according to SIA 380/1. In contrast, about 55% less hot water was drawn, which varies greatly depending on the number of guests.

The thermal solar yield was 325 kWh/m<sup>2</sup> in the first year of operation, i.e. a total of 218 MWh, and 400 kWh/m<sup>2</sup> (268 MWh) in the second year of operation.

Thanks to the waste water heat recovery, some of the heat required for swimming pool and hot water was returned to the system (55% in 2015 and 51% in 2016). This means that the total energy supplied to the system for the provision of heat (heat consumption minus recovered heat) was 551 MWh/a (2015) and 427 MWh/a (2016).

The annual extraction energy of the geothermal field was 345 MWh (2015) and 273 MWh (2016). With the simplified assumption that the entire thermal solar yield was used for soil regeneration, the regeneration rate of the geothermal field was 63% (2015) and 98% (2016). The mean EWS flow temperature was 9 °C in both years. A practically complete regeneration and thus the prospect of constant long-term geothermal probe flow temperatures could be achieved in this plant with around 2.5 m<sup>2</sup> PVT area per MWh of extraction energy of the geothermal probe in the second year of operation. The average regeneration power was 60 W per probe meter and peaked at 140 W/m at inlet temperatures of 23°C. In comparison, the withdrawal power when all heat pumps are operating is 55 W/m. The thermal solar yields in the first year were significantly below the projected value of 450 kWh/(m<sup>2</sup>a). Two possible reasons for the low yields have been identified. On the one hand, three poorly cooled zones could be found in the PVT fields by thermal imaging. In the project report, this phenomenon is attributed to poor flow. However, poor contact between the heat consumer and the PV module would also have a similar impact. To improve the flow, all fields were flushed and vented. The extent to which an improvement could be achieved is not documented.

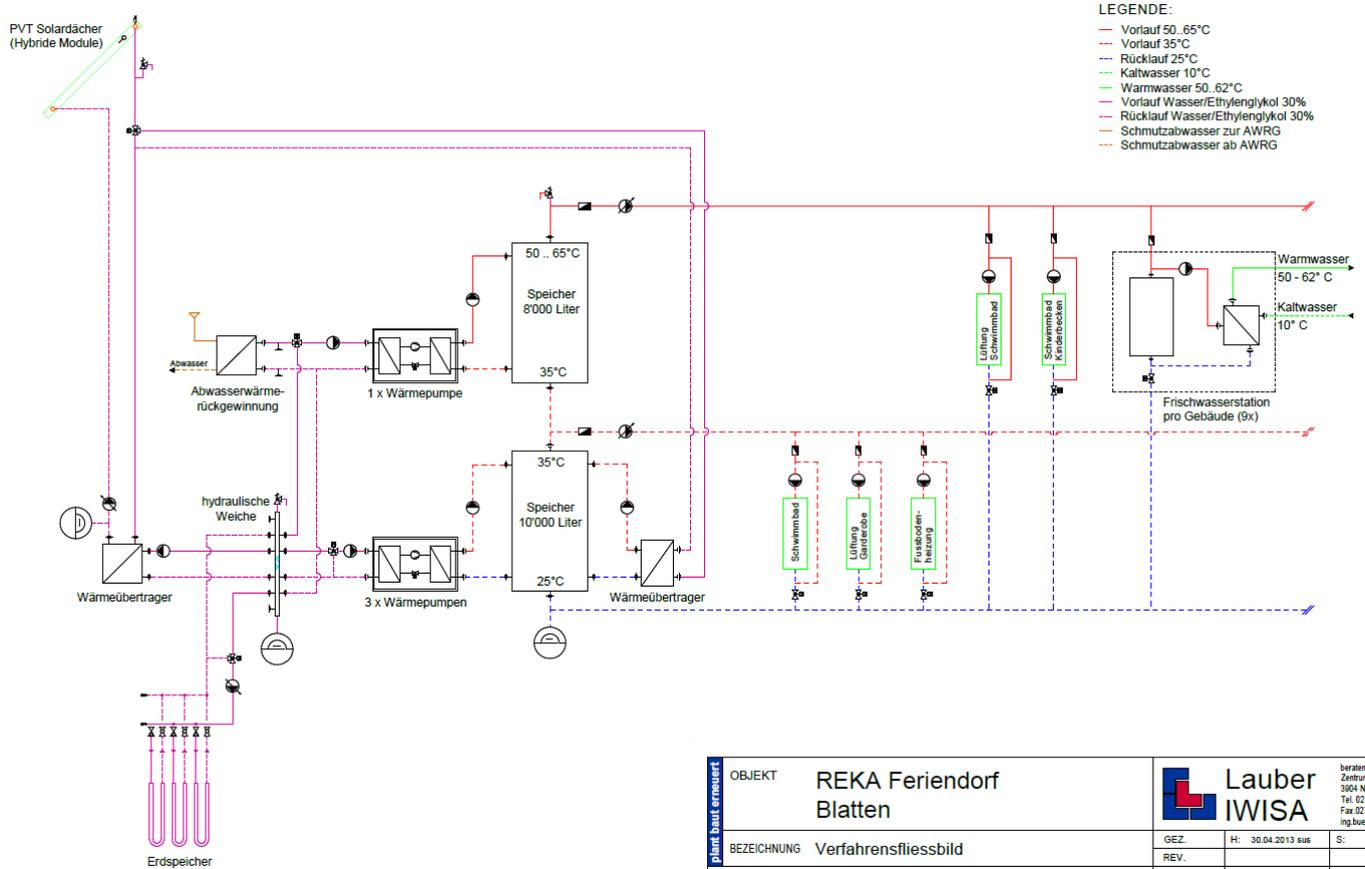
Further optimization potential was recognized in the system control. In the first phase of operation, the switch-on condition of the system was a collector temperature of 30°C. In addition, the continuous opening of the relevant switching valve took a very long time at around one hour. This has been optimized and the switch-on condition set to 20°C. According to the project report, the lower switch-on condition resulted in lower power peaks and in increased system operation at lower ambient temperatures. This is certainly a main reason for the increase in solar yield in the second year of operation. A further lowering of the switch-on criterion should be checked.

	Projekt	2015	2016	Abweichung 2016	Abweichung 2016
	[kWh/a]	[kWh/a]	[kWh/a]	[%]	[%]
Heizen	250'000	316'042	204'707	126%	82%
Warmwasser	250'000	119'392	96'797	48%	39%
Schwimmbad	100'000	162'052	166'726	162%	167%
Verluste	70'000	75'982	93'646	109%	134%
<b>Total</b>	<b>670'000</b>	<b>705'860</b>	<b>561'876</b>	<b>105%</b>	<b>84%</b>

Monitored energy use in 2015 and 2016 compared to the projected energy (Projekt) use in the design phase. It can be noted that the usage of domestic hot water (Warmwasser) is at 48% significantly lower than calculated.

In the first year of operation, 26% more energy was required for building heating than calculated according to SIA 380/1. In contrast, about 55% less hot water was drawn, which varies greatly depending on the number of guests. In the following year 2016, the need for heating energy (-44%, or -18% of the projected value) and hot water (-9%) could be drastically reduced. In contrast, more losses were reported on the transport lines. At around 2.4 kWh / person, the hot water requirement in 2015 was already below the design of 4 kWh / overnight stay, but complied with the Swiss standardization according to SIA. It was reduced to around 1.8 kWh / overnight stay in 2016 by reducing the charging temperature from 65°C to 55°C and the hot water setpoint 50°C instead of 55°C in 2016. The heating curve for heating energy was generally reduced by up to 5 K in 2016.

## Reka Holiday Village, Blatten Belalp, Switzerland, Technical details



Objekt	REKA Feriendorf		beratend: Zeitraum: 3904 Nat Tel. 027 Fax 027 ing.boero
	Blatten		
Bezeichnung	Verfahrensflussbild	GEZ.	H: 30.04.2013 aus S:
		REV.	

## Description of the technical concept

By integrating the waste water heat recovery, mainly to provide the higher temperature level, but also as a reserve for the three low-temperature heat pumps, it is difficult to understand the allocation of the energy flows. In addition, the energy meters with the prevailing small temperature differences have a large measurement inaccuracy. The waste water heat recovery is therefore assessed from the results Energy balance.

The amount of energy recovered depends on the swimming pool and hot water requirements, the latter depending on the occupancy of the apartment. The relationship between hot water and swimming pool energy for heat recovery is intended to provide information about the performance of the system.

Waste water heat recovery is particularly valuable due to the direct coupling between source energy and demand. The variability of the guests and the different hot water requirements can be elegantly balanced.

	Projekt [kWh/a]	2015 [kWh/a]	2016 [kWh/a]
Warmwasser und Schwimmbad	350'000	280'000	263'000
Wärmerückgewinnung	200'000	155'000	135'000
Leistungsindex	0.57	0.55	0.51

The evaluation of the energy processing in 2015 shows that the fourth heat pump exceeds the forecast annual performance factor of 2.5 despite high flow temperatures of an average of over 60°C. This is mainly due to the higher source temperatures on the part of waste water heat recovery. In contrast, the annual performance factor of the three low-temperature heat pumps is below expectations. The reason for this is on the one hand the higher flow temperature of up to 45°C and on the other hand it is observed that the source regulation does not exceed an evaporation temperature of around 4°C.

The high flow temperatures became necessary due to sinks (consumers) with insufficiently low return temperatures. In order to generally lower the return temperatures of the customers, the energy meters of the customers were verified as part of the monitoring in November 2015 and flow and temperatures were now recorded instead of just energy impulses. At the end of 2015 and beginning of 2016, among other things, the systems were hydraulically adjusted again, the heating curves reduced and the hot water charges limited to a maximum flow temperature of 55°C (instead of 65°C). In total, the annual performance factor of heat pumps 1 to 3 was increased from 5.29 in 2016 and that of heat pump 4 to 3.19