Mountain Dining

ROMANTIK HOTEL

MUOTTAS MURAGL

SINCE 1907

PLUS-ENERGY HOTEL IN THE ENGADIN SUNLIGHT

On 18 December 2010, the first plus-energy hotel in the Alps was opened on Muottas Muragl, overlooking Samedan. This exemplary building, situated on Switzerland's sun-blessed mountain terrace, is based on a groundbreaking energy concept. Taken over the entire year, the mountain even produces more energy than the hotel needs itself.

MUOTTAS MURAGL St. Moritz ENGADIN MOUNTAINS

THE MUOTTAS MURAGL ENERGY CONCEPT IN A NUTSHELL

- The mountain and the photovoltaic system together produce more energy per annum than the Romantik Hotel Muottas Muragl needs itself.
- In spite of increasing the heated floor space by 50 %, two-thirds less energy is required.
- Solar panels (flat-plate and pipe solar collectors) generate solar power for heating both space and water.
- Excess solar energy is stored in the thermal loop field in the ground and drawn on when required by means of a heat pump.
- The energy consumption of the hotel building is covered 100 % by solar energy, thus fully doing away with CO_2 emissions totalling 144 tonnes per annum.
- The energy supply is based on the use of five energy levels (see page 3).
- Renovation period: 10 months; construction costs: CHF 20 million.

Photo: kmu-fotografie.ch

The view over the Upper Engadin lake landscape can hardly be topped, with the lakes of Sils, Silvaplana and St. Moritz lined up like a string of pearls along the River Inn. The mountain terrace is bathed in radiant Engadin sunlight from morning to evening. At such lofty heights – nearly 2,456 metres above sea level – the air is often inhospitably cold; the heating period lasts a lengthy 330 days and the annual mean temperature is minus one degree Celsius. In comparison, Basel is on average over ten degrees warmer. In view of these harsh climatic conditions, the hotel's current consumption of 40,000 litres of fuel oil per annum is considered moderate. As a result, the planned renovation and extension of the hotel presented the experts with a number of tricky issues that needed solving.

IT ALL COMES FROM THE SUN

The client set great store by the new construction measures being sustainable. Thus the focus moved away from fossil fuels to renewable energy. Wood heating would have necessitated extensive transport, resulting in an extra burden for the railway. The option of using wind energy was seriously considered, but the volumes would have been inadequate and highly erratic, with too many downtimes. In contrast, the use of solar energy turned up trumps in the assessment – which was hardly surprising, considering the site is the second sunniest place in Switzerland. Consequently, the Romantik Hotel Muottas Muragl is wholly in line with the trends of the 21st century. "In the long term, solar energy is our only hope", declared the legendary Swiss Federal Councillor, Willi Ritschard, decades ago, commenting on viable methods of providing energy in Switzerland in the future. For Muottas Muragl, these authoritative words proved to be prophetical.

SOPHISTICATED DIFFERENTIATION

The new concept for the hotel is based on a differentiated energy supply. Energy is produced from five different sources and used in accordance with its quality – the hotter the temperature, the higher the quality level (see table). Waste heat from the refrigeration units, the kitchen and the operation of the funicular railway ranks in first place, as this heat is already available in the building without any additional help. The solar panels – installed in two different construction designs – generate the energy to provide hot water and general heating; if this is insufficient, it is supplemented by a heat pump. Heat storage is indispensable here, as by its very nature, supply and demand do not always coincide. Storage is subject to the same differentiation, with the four storage units being operated at different temperatures.

SOLAR COLLECTORS

The large solar panels channel solar heat into the building, generating a total of around 70,000 kilowatt hours per annum. The photovoltaic system installed along the railway track produces even more – between 95,000 and 105,000 kilowatt hours a year. Taking the building alone, without the coverage provided by renewable energy sources, it is evident that the newly extended and renovated building is superior to the old hotel by a factor of two calculated per square metre of heated floor space. Thus, despite being larger, the new hotel actually uses less energy than before – and even then exclusively uses solar and geothermal heating. The fact that this form of heat production is possible, without giving rise to pollution and CO_2 emissions, also makes the project particularly interesting from both an environmental and an energy perspective.

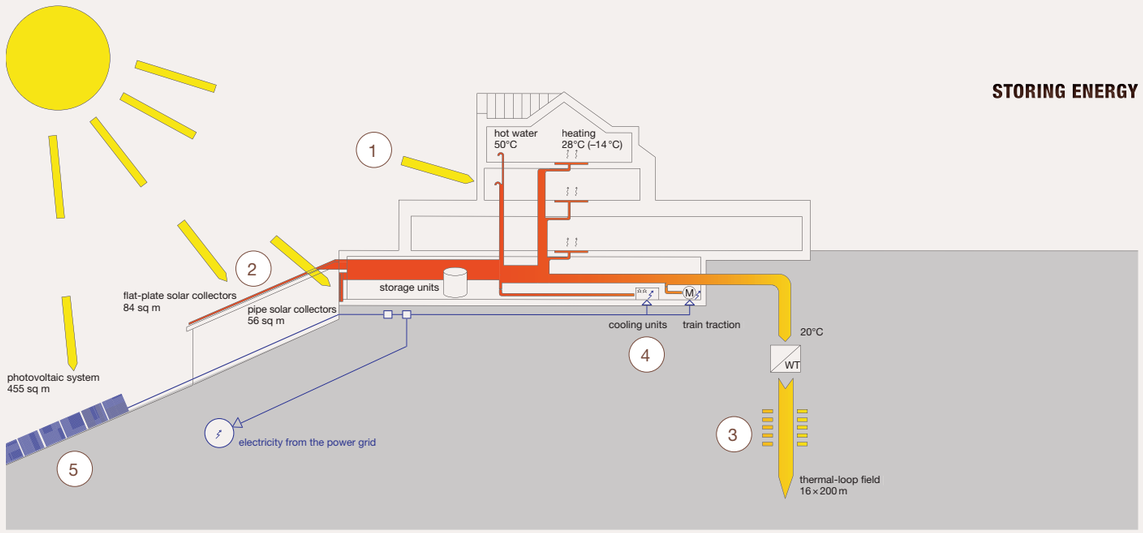
QUALITY LEVELS OF THE ENERGY PRODUCED AT THE HOTEL MUOTTAS MURAGL

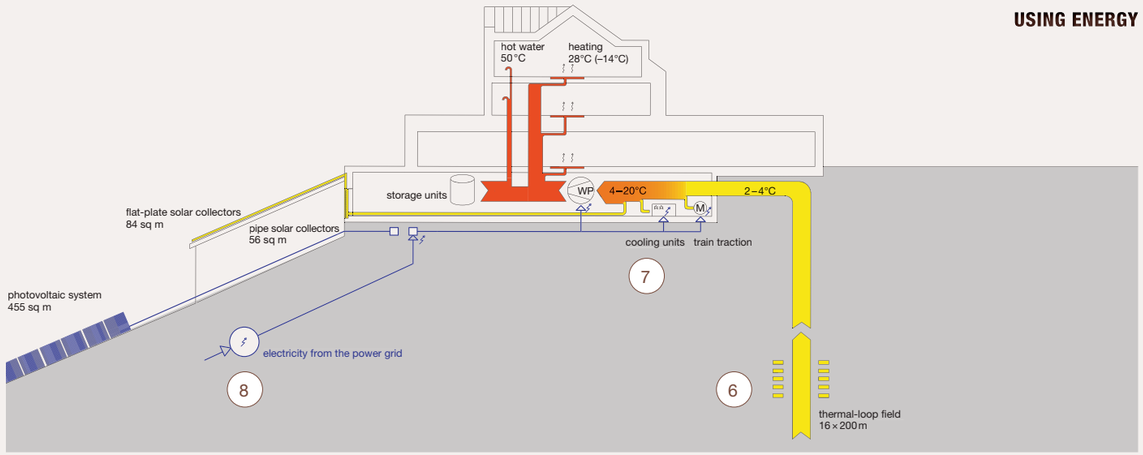
Level 1	Waste heat from the operation of the funicular railway and from the cooling units in the kitchen and storeroom (20–40°C)
Level 2	Solar energy from the 84 sq m of flat-plate solar collectors (30–80°C)
Level 3	Solar energy from the 56 sq m of pipe solar collectors (35–100°C)
Level 4	Geothermal energy from the thermal-loop field, comprising 16 thermal loops each 200 m long, via a heat pump (25–50°C)
Level 5	Electric power from the 455 sq m of photovoltaic panels installed along the railway line

Photo: kmu-fotografie.ch

The 84 sq m of flat-plate solar collectors on the roof of the railway concourse, coupled with 56 sq m of pipe solar collectors integrated perfectly into the large windows, generate thermal energy totalling 70,800 kWh per annum.

DIAGRAM SHOWING THE FLOW OF ENERGY





STORING ENERGY

- Natural sunlight shining on the window surfaces (1) is captured and stored in the building structure
- Solar energy is channelled via flat-plate and pipe solar collectors (2) and directly used to heat room space and water
- Excess solar energy is stored in the thermal-loop field (3)
- Waste heat from the cooling units and the train traction (4) is used for space heating, preheating the water and thermal-loop regeneration
- Electricity generated by the photovoltaic panels (5) is directly channelled into the system; excess energy is stored in the power grid

USING ENERGY

- Geothermal heat is collected (6) and topped up to a usable level by means of a heat pump
- Waste heat from the cooling units and the train traction (7) is used to increase the heat-pump flow temperature
- Low-temperature gain (diffuse radiation) from the solar panels is used to increase the heat-pump flow temperature
- Electricity stored in the power grid (8) is used (heat pump, operational and household power)

PASSIVE SOLAR UTILISATION

The solar panels are not the only sources of energy gain in this cutting-edge construction; the south-facing windows are also very productive. With a heat input of nearly 90,000 kilowatt hours, the passive solar gain through the windows covers 41 % of the total transmission losses through the building structure. To optimise these solar gains, appropriate materials and systems were used in the construction of the interior, with the flooring, ceiling and walls having the capacity to store heat. Moreover, as few heat-insulating elements as possible were used, in order to maximise the penetration of heat into the structure. Thus the solar heat striking the building during the day enters and is retained in the structure and reheats the areas that cool down in the evening and at night. The experts also came up with a very sophisticated solution for the floor heating. The heater unit is installed just below the surface of the floor, thereby allowing heat emission to quickly react to a rise in room temperature due to solar radiation.

3,200 METRES OF THERMAL LOOPS

Sixteen thermal loops with an average length of 200 metres, making 3,200 metres in total, supply the entire building with geothermal energy. The heat pumps use this environmentally friendly energy to heat the rooms and provide the hot water supply. Any excess solar energy is stored in the ground by the thermal loops, thus regenerating the geothermal mass, which in turn allows the heat pump to work more efficiently. This possibility to restore and recover energy is very important for the efficient long-term operation of the heating system.

TRADITION AND INNOVATION

In 1907, the Hotel Muottas Muragl was opened, together with an integrated mountain station for the funicular railway of the same name. Since then, countless visitors, including many famous and distinguished persons, have admired the breathtaking alpine scenery. However, the operational processes in both the hotel and the restaurant were unsatisfactory, not least due to the interlinked design of the annexes. The new concept has resolved these structural problems without compromising the unique identity of the location. The staff facilities, technical rooms, toilets and storage areas, as well as the funicular railway station, are located in the projecting basement area. The foundations support the historic hotel and the spacious terrace. The ground floor, next to the panoramic restaurant, houses the new and considerably larger kitchen. The careful selection of energy-saving appliances ensures that the kitchen is now much more efficient without using more energy. The two upper floors contain the 16 hotel rooms and various meeting rooms.

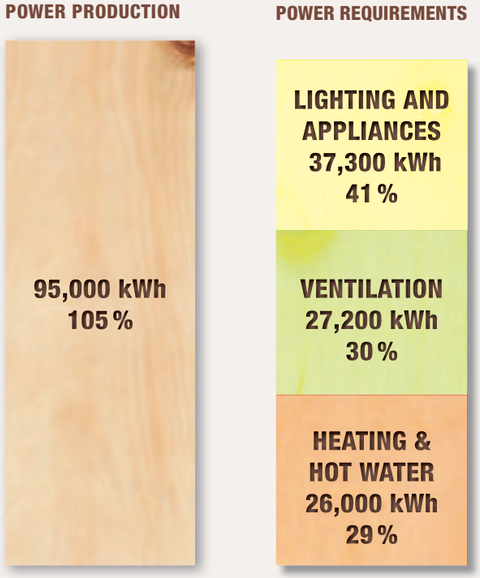
SOLAR PANELS ALONG THE RAILWAY TRACK

The funicular railway rises a good 700 metres over a distance of 2,200 metres. Photovoltaic panels have been installed along the railway track, extending over a total length of 228 metres and covering an area of 455 square metres. The favourable orientation of the railway line guarantees a high energy yield. Combining power generation with the railway track also made installation easier, as the hotel's power cables already run alongside the railway line. As a result, this history-steeped guest house in the municipality of Samedan now enjoys the use of eco-friendly electricity.

The funicular railway on Muottas Muragl, with solar panels installed along the track.

PLUS-ENERGY BUILDING

The first low-energy buildings made their debut in the 1980s in the wake of the 1973 oil crisis. Ten years later, zero-energy buildings appeared on the scene. Nowadays, the focus is on plus-energy buildings. These are concepts that generate more renewable energy for heating, hot water production and air replenishment than they actually need themselves. Plus-energy is not to be confused with the notion of self-sufficiency; for safety reasons, the hotel is also connected to the local power grid. This project is particularly laudable because it demonstrates that a plus-energy concept is possible even in such a high-alpine location. As a result, Muottas Muragl has become a shining example of sustainable energy.



A positive energy balance: comparison of power production and power requirements at the Hotel Muottas Muragl

THE ROMANTIK HOTEL MUOTTAS MURAGL WALKS OFF WITH VARIOUS ENVIRONMENTAL AWARDS

The Romantik Hotel Muottas Muragl has won not only the Swiss Solar Award 2011 in the Building Renovation category, but also the PlusEnergieBau® (PEB) Solar Award 2011, the only prize in the world for plus-energy buildings. Since 2000, the specialist magazine “htr hotelrevue” has also been acknowledging particularly outstanding projects and persons in the Swiss tourism industry with its “MILESTONE” award. In 2011, the Romantik Hotel Muottas Muragl, together with the tourist destination, Engadin Scuol Samnaun, were named winners in the Environmental Award category. For years, Bergbahnen ENGADIN St. Moritz AG has been implementing various measures to embrace the careful and sustainable use of the surrounding nature – in effect, the “employer” of a mountain railway such as this. Winning these awards reaffirms the company’s long-standing efforts and confirms that it is on the right path.

Prix solaire suisse
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PLUS® ENERGIE BAUTEN

MILESTONE 2011 • TOURISMUSPREIS SCHWEIZ • PRIX DU TOURISME SUISSE • MILESTONE 2011


Photo: Daniel Gerber


Photo: Daniel Gerber

PLUS-ENERGY HOTEL MUOTTAS MURAGL: FACTS AND FIGURES

BUILDING

Altitude	2,456 m above sea level
Heated floor space	2,514 sq m
of which is renovated/converted	1,666.3 sq m (66 %)
of which is newly built	847.3 sq m (34 %)
Building envelope: ratio of building surface to heated area	1.83

HEATING REQUIREMENTS

Heating requirements with standard air exchange	74.1 kWh/sq m
Heating requirements with effective air exchange	59.1 kWh/sq m
“Minergie” primary requirements	75.6 kWh/sq m
Limit heating requirements	113.9 kWh/sq m
Hot-water heating requirements	20.8 kWh/sq m
Total heating requirements	79.9 kWh/sq m

ELECTRICITY REQUIREMENTS (WEIGHTED VALUES IN BRACKETS)

Heat generated by heat pump	9.0 kWh/sq m (18.0 kWh/sq m)
Water heated by heat pump	1.4 kWh/sq m (2.8 kWh/sq m)
Electricity requirements ventilation	10.8 kWh/sq m (21.6 kWh/sq m)
Total electricity requirements	14.8 kWh/sq m (29.6 kWh/sq m)
Household electricity	36.0 kWh/sq m (72.0 kWh/sq m)

AIR REPLENISHMENT

Thermally relevant exterior air volume flow	0.62 m^3/sq m per hour

HEAT PRODUCTION

Thermal-loop heat pump	53.9 kWh/sq m
Solar panels	28.2 kWh/sq m
Total heat production	79.9 kWh/sq m

POWER GENERATION (WEIGHTED VALUES IN BRACKETS)

Photovoltaic (power 64 kWp)	37.8 kWh/sq m (75.2 kWh/sq m)
Surplus electricity	1.8 kWh/sq m (3.6 kWh/sq m)

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