

# Examples of source separating sanitation solutions for mountain refuges

*This paper shows three examples of source separating sanitation systems in different regions of the Alps*

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## Abstract

The paper presents 3 examples for source separating sanitation systems installed in the Alps. The examples described are 1) the Bettelwurf Hütte in Austria, 2) the Refugio Casera Bosconero in Italy, and 3) the Britannia Hütte in Switzerland. In these examples a main driver for installing source separating systems has been to reduce transport costs and not reuse.

## Introduction

In this paper we introduce 3 examples of solutions for mountain refuges that are based on source separation and treatment of separated waste streams. Separation of wastewater streams (e.g. dry toilets) lowers the pressure on water supply and reduces the environmental impact of a refuge (Weissenbacher et al., 2008). The aim of the paper is not to give a full description of the examples but to provide the interested reader with basic information. As it can be seen from the examples reuse is not the reason to implement source separating systems. However, the reduction of transport costs was the main driver for all refuges.

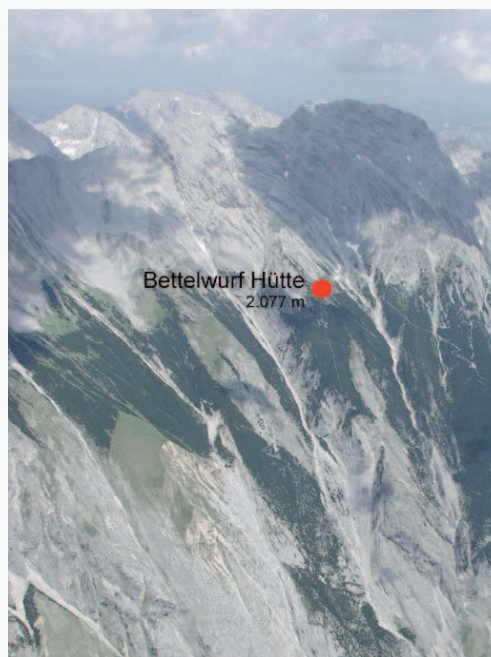
The examples presented in this paper are:

- Bettelwurf Hütte, Austria,
- Refugio Casera Bosconero, Italy, and
- Britannia Hütte, Switzerland.

## Bettelwurf Hütte, Austria ([www.bettelwurfhuette.at](http://www.bettelwurfhuette.at))

The Bettelwurf Hütte is located at 2077 m altitude in the natural protection area „Karwendel“ in Tyrol, Austria. Below the refuge is the water protection area of a nearby community (Figure 1 and Figure 2). The refuge is accessible by a 2.5 hours walk only and is open from mid-June to mid-October. Materials can be transported

to and from the refuge with a cable car. There are 3 staffs and around 3'000 daily visitors per year. The Bettelwurf Hütte has 66 beds and around 2000 overnight stays per year. Due to its location above the water protection area waste from the Bettelwurf Hütte has to be transported into the valley.



**Figure 1: Location of the Bettelwurf Hütte**  
(Picture: Amor, 2006)

## Key Messages:

- Source separating sanitation systems can be implemented at mountain refuges
- Source separating systems can reduce transport costs
- Operation and maintenance of the system as well as the engagement of the operator of the refuge are key for success



Figure 2: The Bettelwurf Hütte (Picture: Amor, 2006)



Figure 4: UDDTs (left, without separation walls) and urinals (right) during installation (Picture: Amor, 2006).

To reduce the amount of wastewater produced a urine-diverting dry toilet (UDDT) was tested in the season 2002. Although the boundary conditions for the test UDDT were quite harsh, e.g. only one toilet for all daily visitors, no separate toilets for men and women, no urinal for men and up to 150 users per day, the results were promising (Kaschka, 2005).

The results from the test UDDT have been used to optimize the design of the sanitation facility (Amor, 2006). In total 6 UDDTs and 4 urinals have been installed in the new sanitation facility. Faecal matter is collected in 60 L barrels and transported in the valley with the cable car. Wastewater from the kitchen is treated with a fat removal and soaked away.

Already in the first year of operation high acceptance of the system could be achieved. It has to be noted that the person running the refuge has huge impact on the overall performance of the system.



Figure 3: Bettelwurf Hütte with new sanitation facility and chambers for faecal matter (lower right corner) (Picture: Amor, 2006).

### Refugio Casera Bosconero, Italy

An integrated system, called Energianova, has been developed for the Refugio Casera Bosconero (Forno di Zoldo, Belluno, Italy). The refuge is situated in the Dolomiti mountains at an altitude of 1457 m. The Refugio Casera Bosconero (Figure 5) is open during the summer month only and popular among climbers. Material for the refuge including gas for the kitchen has to be transported by helicopter.

The integrated system (Figure 6) consists of the following: Wastewater is separated into greywater, urine and faecal matter. A squatting type separation toilet was installed for daily visitors (Figure 7) whereas sitting type toilets were installed for overnight guests. Furthermore kitchen wastes are shredded in a kitchen mill. The four fractions are treated using different concepts. In particular a subsurface horizontal flow vegetated bed planted with local



Figure 5: Refugio Casera Bosconero (Picture: G. Langergraber).

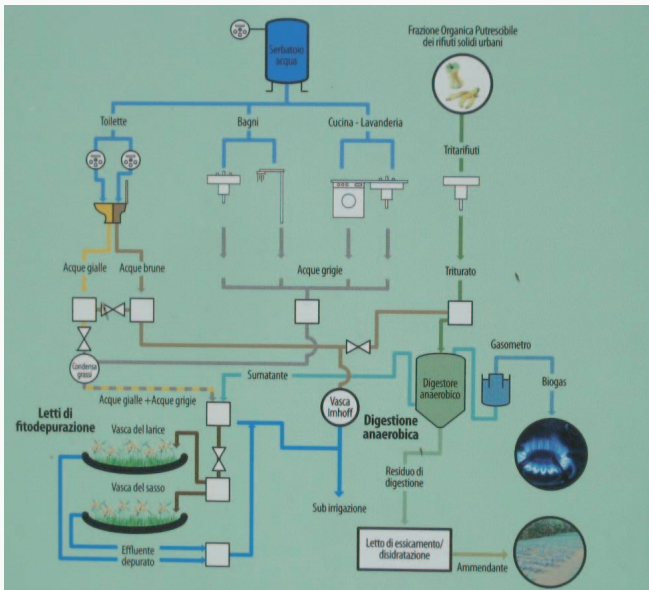


Figure 6: The integrated system (Picture: G. Langergraber).



Figure 7: Squatting type separation toilet for daily visitors (Picture: G. Langergraber).



Figure 8: The constructed wetland system (Picture: G. Langergraber).



Figure 9: The biogas plant (Picture: G. Langergraber).

vegetation (Figure 8) is installed for treating grey and yellow water. Anaerobic digestion (Figure 9) is used for treating brown water with the addition of kitchen waste, with the aim to recover energy directly available for the kitchen (Cossu et al., 2007). By producing biogas a main aim was to reduce the number of helicopter flights for transporting gas for cooking. The design of the system was carried out within a research project by the University of Padova from 2004-2006. The horizontal flow constructed wetland was built in 2006 and its performance was monitored in 2006 and 2007. The showing abatement of COD and total N were around 50 %, total P around 40 % and MBAS around 60 %. Among the local plants species, *Mentha* (mint) was the most effective in colonising the bed. The anaerobic digestion was implemented in 2007.

**Britannia Hütte, Switzerland**  
 (<http://www.britannia.ch>)

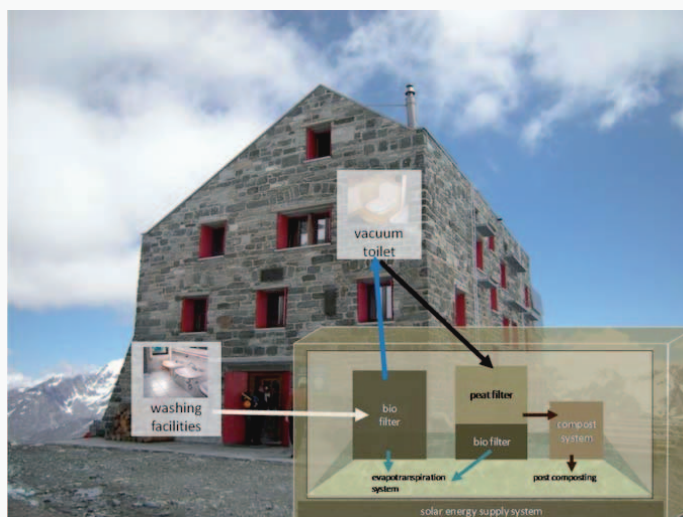
The Britannia Hütte is located in the „Walliser Alpen“ in the Swiss canton Valais at an altitude of 3030 m. The refuge is operated during the summer months only but also provides sleeping facilities during the winter season. Within the EU funded FP7-project SANBOX a novel sanitation approach for remote tourist facilities in Europe was developed. The SANBOX system aims to reach high treatment performance, recycle water and nutrients and use solar power as energy source. The vision is to come close to a self-sustaining zero effluent treatment system. The SANBOX system is currently tested at 3 different locations: 1) Secovlje Salina Nature Park, Piran, Slovenia, 2) Britannia Hütte, Saas Fee, Switzerland, and 3) Kaja Student Dormitories, Ås, Norway (SANBOX, 2011).

At the Britannia Hütte the waste from the UDDTs is collected in bins and flown by helicopter to the valley below. SANBOX tests a solution that provides more

comfort to the guests and reduces helicopter transport, local emissions and thus, the environmental footprint of the waste handling system. According to SANBOX (2011) the prototype of the system at the Britannia Hütte has the following components (Figure 10):

- Dry latrines are replaced with vacuum toilets. This technology has been proven under challenging conditions on cruise ships, buses and trains. The installed vacuum toilets need only 0.8 L water per flush and can therefore be supplied with water from kitchen and washing facilities that has been treated in a biofilter.
- Wastewater from the toilets is treated in a box, attached to the south face of the lodge. The design of the box is based on greenhouse technology. The greenhouse enables the utilization of the strong solar radiation available at this high altitude and will provide sufficient heat energy to the biological processes of the treatment system. Solar radiation will also be used to evaporate most of the wastewater stream so that the system will be near the vision of zero effluent. The solid residues of this new system will be a fraction of the old system.
- The remaining solid residues will be in the form of hygienized compost that can be reused as fertilizer for local agricultural production. To reuse the nutrients in the wastewater for onsite production of vegetables is a second vision of SANBOX in the Alps.

The practical part of the SANBOX project terminated end of June, 2011. The test of the prototype at the Britannia Hütte was successful with regards to meeting the treatment goals. However, some components needs further development, especially with respect to reduce maintenance needs and to ensure a smoother operation than during the prototype test. The system has therefore been disassembled pending further development. More information will be available on the project website (<http://www.sandbox.info/index.htm>) after the final evaluation of the project.



**Figure 10: Britannia Hütte and the SANBOX system (Picture: SANBOX, 2011).**

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