Swimming pool 'Lister Bad'	
Analysis	
Background	Hannover's largest outdoor swimming pool is also one of the most popular in the city; on hot days more than 10,000 people visit the pool. Lister Bad has a lot of attractions such as a 10-metre diving platform, a flume and a children's paddling pool. To keep swimming pool water temperature at 22°C, annual average gas consumption has been about 1,350 MWh. However as energy costs increased steadily in recent years the city facility management department looked for new solutions to reduce costs, energy consumption and environmental impact. A first feasibility study was carried out in 2001, but due to lack to funding implementation of the project was delayed. The determining factors for the installation of simple plastic solar absorbers have been: • The opportunity to fund the installation under the act2 programme • Political will to increase the share of RES in meeting energy demand in public buildings • Optimised period of use (opening period and maximum of solar radiation are identical) • High energy demand for heating the pool water could be covered by the solar absorbers • Enough roof surface available for the installation • Increasing energy prices • No shade cast on the roofs by trees.
Building Description	
Building type (year of construction, surface area, number of visitors)	Lister Bad comprises five different pools including a competition pool, fully equipped communal changing rooms and showers and disabled access changing rooms as well as other sports facilities. • Total swimming pool surface: 3.200 m² • Total Swimming pool volume: 6.800 m^3 • Open: 12-14 hours a day; • Opening period: 125 days (May to August) • Number of visits per year: 80 – 150.000
Heating system	The swimming pool water is heated by 2 gas-fired boilers each with a capacity of 650 kW, which also provide hot water for the showers. The boiler system has not been renovated since the thermal solar absorbers have been installed.
Project Description	
Aims	• Heat the pool water using solar collectors to reduce the load on the existing natural gas-fired boiler and thereby achieve non-renewable end energy savings of 450 MWh

<table>
<tr><td></td><td>(35% reduction), equivalent to 95 t of CO_2 (40% reduction) per year.[1]
• Stimulate interest in solar energy applications at other swimming pools, sports facilities and buildings in Hannover and municipalities within the region
• Raise public awareness by informing visitors with posters, flyers etc.
• Gain good monitoring data (energy consumption, building costs, maintenance costs, technical experiences).</td></tr>
<tr><td>Key points</td><td>• Political support (City Council decision for the installation of the solar collectors)
• Funding (loan, grants etc.)
• Renovation of the roof has been brought forward.
• Lightning conductor system had to be replaced in any case.

In 2006 the first feasibility study was reviewed. It was recommended to install an 1,800 m² solar absorber on the roofs of the changing and sanitary rooms. The annual heat production of the installation was estimated at 450,000 kWh.

An absorber area of 1,774 m² with solar gain of max. 600 kW was installed in the first quarter of 2007. 160 m^3/h of water are pumped directly from the different pools through the absorber and back into the pools. Since its commissioning the solar plant has run without any significant problems. In the event of insufficient solar energy the two gas boilers keep the water temperature at 22°C.</td></tr>
<tr><td>Monitoring and evaluation</td><td>The system started operation in 2007 a few weeks after the opening of the Lister Bad summer season, and so 2008 was the first year where the system was running throughout the season. In mid-April 2008 the solar system pump was started a few days before the opening of Lister Bad for the season in order to deliver as much solar heat as possible for the initial heating up of the swimming pools. The most important results are listed in the following table.

<table>
<tr><th>Year</th><th>Energy from gas boilers</th><th>Energy from the solar system</th><th>Total energy consumption</th><th>Energy per visitor</th><th>Solar fraction</th></tr>
<tr><td></td><td>MWh</td><td>MWh</td><td>MWh</td><td>kWh</td><td>%</td></tr>
<tr><td>2005</td><td>1,380</td><td></td><td>1,380</td><td>11,6</td><td></td></tr>
<tr><td>2006</td><td>1,244</td><td></td><td>1,244</td><td>9,2</td><td></td></tr>
<tr><td>2007</td><td>599</td><td>429</td><td>1,028</td><td>12,5</td><td>42</td></tr>
<tr><td>2008</td><td>475</td><td>524</td><td>999</td><td>8,4</td><td>52</td></tr>
</table>

The table shows that in the two years before the solar system was installed the total energy consumption was much higher than in the last two years. In 2005 and 2006 Lister Bad recorded many more visitors than in the 2007, which may be partly explained by much</td></tr>
</table>

[1] Calculation basis: natural gas according to GEMIS 4.14: 252 g/kWh CO_2, primary energy factor 1.37; swimming pool absorber layer, according to federal environmental authority 33.9 g/kWh CO_2, primary energy factor 0.078.

<table>
<tr><td></td><td>better weather conditions especially in the holiday period. This caused greater water turbulence and evaporation and thus higher energy consumption.

Therefore the years 2007/8 are not directly comparable with 2005/6, but the reduction in gas consumption is nevertheless evident. The solar system operation in 2008 showed that if the weather conditions in April are good enough to affect the initial heating of the pool water, then a much higher solar fraction can be achieved. In total, a solar fraction of over 50% was achieved even though weather conditions in the summer were not very good, and the specific output of the solar system, 295 kWh/m²a, was very high.

In two years of operation the solar system has saved around 950 MWh of natural gas, equivalent to a reduction in carbon dioxide emissions of 240 tonnes.

There are more savings caused by the solar collectors than expected, although the absorber area is 5% smaller than initially planned and the first two summers have been cool.</td></tr>
<tr><td>Costs & Benefits</td><td></td></tr>
<tr><td>Costs & funding</td><td>The overall cost of the installation of the solar collector and some additional constructional work amounted to 209,000 €, of which 140,000 € (approx. 80 €/m²) was for the collector.

The project received 65,000 € funding under the act2 Concerto programme; the remaining costs have been financed by a loan from the KfW bank.</td></tr>
<tr><td>Benefits</td><td>The annual cost savings for the first two years of operation have been more than 100,000 €; the results for 2008 are summarized in the following table. Payback period of the whole installation will be about three years.

<table>
<tr><td></td><td>Measured 2008</td></tr>
<tr><td>Fuel costs (€)</td><td>65.524</td></tr>
<tr><td>Saving fuel costs (€):</td><td>52.944</td></tr>
<tr><td>Increase in electricity costs (€/a):</td><td>500</td></tr>
<tr><td>Saving operating costs (€/a):</td><td>52.444</td></tr>
</table>
</td></tr>
<tr><td>Partnership details</td><td></td></tr>
<tr><td>Partners and role</td><td>• City of Hannover (energy and climate protection unit – project management; facility management department – planning and financing; sports facilities department – implementation).
• proKlima monitoring
• Contracted companies:</td></tr>
</table>

	- Engineering: IST EnergiePlan GmbH, Hannover - Construction: AST, Füssen - Solar collector: Polysol® Absorber System
Recommendations	
Barriers to overcome	• Costs arose through lack of good practice on this type of installation in the Hannover region. • No renovation of the roof needed, so no shift of costs to the maintenance budget possible • Lack of funding • Lack of experience, knowledge and qualifications of craft trade workers in the Hannover region • Low political interest • Restructuring of public swimming pool provision and concept (installing a solar absorption plant was justified on economic grounds). The structures have altered, and there was uncertainty about which pools the municipality would retain and how the operating and management structure would develop.
Lessons Learned	• With the installation of the solar absorbers the water heating policy of the pool was also changed; there was also a marked shift in awareness by the operator. Currently, on rainy days only the main swimmers' pool is heated to 22°C. The other pools are not heated as their 'customers' do not appear in cool wet weather. • Installing solar absorbers is viable for open-air pools, especially in summer, as the warmer the day the more people come to the pool. • The installation operates to the complete satisfaction of the facility management department. There have been no complaints from visitors • In the case of a feasibility study for heating the water of the swimming pools, the installation of solar collectors for sanitary purposes should also be analysed. • There is a need for more public relations work; a flyer is not enough. Only very few visitors are aware of the solar water heating. Therefore a visual display board will be erected in spring 2009 to show visitors the current warm water production, CO_2 emissions avoided etc. • There is very little maintenance needed for the installation

Pictures		
		

To know more	
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