Belgium, Herselt, August 2nd, 2005

Short Tour in a Low-energy / Renewable-energy House

Dear friend,

Some of you had to listen in the past to my stories of pain and of success in the retrofit of an old Flemish land house to a solar house. Many asked for pictures and more detail, but as said, I am very lazy regarding pictures, websites, advertising, etc. This week I made a set of pictures, you find attached. This document adds a few comments to the pictures.

What you see is ...



The house and the garage from the street, as any of the many hikers and bikers passing by our house see it. There are hundreds of such 'long' houses in the countryside of the region we live now (called the "Kempen"). Our house measures ca. 20 by 7 meters at the outside; the garage ca.7 x7 m. We bought the house in 1995 because the long sides of the constructions face the south. We had to conserve the basic construction, so the length, height, slope of the roofs, and even position and size of doors and windows was not or only slightly altered at the house. For the garage more degrees of freedom were allowed.



Approaching the house from the street side, the front of the house fully directed southwards. On this picture and the next ones you see the roof that shadows a little the south wall, but for keeping heat out the window blades are more important. Thanks to the insulation and the shadowing, the inside temperature does not pass 25°C when outside temperatures surpass 35°C. Some evening-night-early morning cooling by opening some doors or windows also helps to bring the morning temperature in hot summer days down to around 22°C. Artificial cooling is not required to obtain a high degree of comfort.

The house has a 22 m² hot water solar panel for hot water supply and for heating. The house is heated with a LPG condensing boiler or with the solar boiler, the latter always having priority. Therefore the water circuit is driven at an outgoing temperature of maximum 35° C, mostly 30° C. The ground level of the house has a floor heating circuit and the upper level a few well sized radiators. Due to the thermal integrity and the high stone mass of the house, the thermal inertia is important. When it freezes in winter (up to - 5° C/-10°C is happening but colder is rather exceptional around here), the temperature loss in the house without heating during the night (11 pm till 7 am) is about 3°C.





We continue our walk around the house at the south side, and you see the blade of the large window of the living room half closed. Also observe that we did a good investment in a future power plant site, because the south side of the roof still leaves about 70 m² over for more solar panels to come (when the technology has improved and the price of fossil fuels gone up we can install more than 5 kW PV extra).



This is the West side with a greenhouse space (we call it veranda). It has a screen on top that we open or close depending on the amount of sun and light we want to allow. It is a perfect place in Spring and Autumn and in cold summer days, but in winter we use it as a fridge, although we can heat it (e.g. for special days such as family meetings on Christmas). The veranda extends the living space most of the year with about 25m².







This is the view from the West-North corner of the house towards the garage. In the back is the house of a neighbor. The table is at the North side and we can breakfast, lunch, dinner and have chats and drinks there all day round in summertime. When rainy or cold in summer we move to the veranda.

The north side of the house owns an almost 1 meter extension of the roof, mainly to protect us for rain when we leave the house. This still has to be finished with a wood casing, so you can observe the insulation plates on top of the wall, as connection between wall and ceiling layers. You also see the only "holes" that pierce the walls of the house. This are an in/out of the balanced ventilation system (the black boxes) and an in/out for the condensing boiler (the steel pipes). During spring this year the air inlet of the gas boiler was converted in a nest by a couple of tits. It seems there is little gas heating going on



The garage also faces the south and carries a $28 \text{ m}^2/2400$ Watt-peak PV panel. It functions since July 1, 2004 and produced 2100 kWh up to June 30, 2005. I like to monitor the daily output of the panel. At best sunny June days it goes up to 15 kWh/day. In other summer days it is between 7 and 14 kWh. In winter it ranges from a little above 0 to a maximum of 4 kWh.



The full panel seen from a window at the first floor of the house. What you can't see is that inside the garage we have a 2.5 m deep basement (it was not possible to construct this in the house itself because of stability problems). In the basement we have two large freezers and several cases of the best Belgian beers (Orval, Chimay, Rochefort, Westmalle, Geuze, Duvel, etc.). We reach a high degree of autonomy in food supply because my wife loves gardening, and some meat is bought from local people that hold rabbits, sheep, deer, ducks, chickens, etc..



The electricity meter at a low of 654 kWh. In summer it is further coming down, but in winter it will go up. Anyhow over the last billing year June 04- June 05 my consumption was negative (because we came to live in the house with Christmas 2004), so the company has to pay us back ... wait and see how they handle it.

[Note added in April, 2009: More than 4 year experience later, we have experienced that we can keep our annual electricity consumption down to about 3000 kWh. The production by the panels is almost 876 kWh/kW-peak installed, i.e. an utilization factor of the nominal peak capacity of 10 per cent. For our 2.4 kW rack our production equals 2100 kWh per year. Given a subsidy of 150 euro per MWh solar output, and a price of power of the same height during the last years, we had an overall negative electricity bill of 150 euro per year. The bill of the annual 1000 liter propane gas was about 450 euro. This means that annual expenses for energy use, amounted to about 300 euro net.]



Now we entered the technical spaces of the house. On the upper floor we have a small space that houses the 600 liter solar boiler (blue cylinder) and the heat exchanger and direct current motor of the ventilation unit (white box to the right side). The solar boiler contains a sanitary water exchanger and the remainder is for space heating. The heat exchanger of the ventilation unit extracts 96% of the heat in the outgoing air flow; in summer there is a by-pass that starts automatically to avoid the extracted heat to be re-injected.



For balanced ventilation you need ducts, and we had to accommodate them in the house. Because the house is an old land house with a low upper floor at the long sides (south and north of the house), we organized two long box-rooms along the sides. We can open the boxes everywhere, but you see that some space is taken by the ducts, electricity cabling and water pipes. Here you see an insulated duct (for fresh inlet air towards the exchanger) and another one to distribute or extract air from the rooms. The natural light from an attic window falls on one of our Bakhtiari (nomad tribe of Iran) carpets.



This is a Lori Khan flat weave (gelim) from the Iranian Lori tribe in front of a part of the southern box rooms. Most of the materials we used are natural (wood, stone) but also stainless steel, bricks, etc..

The technical installation at ground level, in a corner of the laundry room. On top you see the condensing gas boiler including inside a small sanitary hot water boiler with a topheater to avoid bacterial contamination problems when the solar boiler produces low temperatures.

The pipes and valves below it are the integration of the solar and the gas systems, with priority for solar heat when available. This is monitored and steered from the box at the right side. At the bottom (the small white hoods) the valves of the various floor heating circuits, that we can adjust manually. Every part of the house has a separate circuit. The automatic 3-way valve just at the lower border of the picture mixes solar and gas heated water. When the handle points up (as on the picture and all months of the summer period) all heat is supplied by the solar panels. The white plate in the bottom corner right is the laundry machine.



Not shown in pictures are: At the northern side of the garage, the LPG gas tank is located. Next to it we plan to staple our wood for the fireplace in wintertime (see the stack on the house). As you may have observed there are a few woods around the house. The waste water from the house is directed to a reed sanitation plant. The reed asks a year to expand, but then it provides full service. The water leaving the plant is clean [April, 2009]. Neither on a picture because underground on the courtyard is our rain water tank, that provides water to flush the toilets, to rain the garden and to supply the washing machine with cold water (hot water is coming from the solar boiler).



Now we are inside the house, where you see the southern entrance door through the door from the living room. The outside doors and many inside doors are in glass to let the sunlight flow in and flow through the house.



This is the darkest place at the ground level floor: the corridor connecting the private sleeping and bathing room with the centre of the house. Thanks to the glass doors, we do not need artificial light in daytime.



From the narrow corridor you look inside my working room through a glass door. The daylight is stimulating, and I work now many days at home.



From the living room: a view on the veranda from inside. To the right is our heating system of last resort: the fire place in blue stone. When we moved at Christmas last winter the gas/solar heating system was not working properly because of mistuning. During more than a winter week we had the house easily warmed with only wood. This reveals the essential of a solar house: insulation and thermal inertia. We preserved the existing house with solid brick walls of 30cm thickness, and added at the outside 12cm (=8+4 for the crossings) mineral wool plates with another brick for the front. The walls are now 50 cm thick. The window frames are 11 cm thick Aluminum with 5 isolated rooms layered and the double-glass panes are gas filled. The roof has nearly 30 cm insulation; at some places nearly 50 cm (the tip). The walls have been cut trough at the ground to insert a 5cm Perinsul insulation layer to join the wall insulation to the floor insulation of 10cm polystyrene (2 x 5cm). We did most of the insulation works ourselves and took much care not to leave any opening in the hull around the house.



The kitchen facing the garden is used a lot because my wife likes cooking and I love good food.

This was a short trip along our solar house. We planned it in 1996 and designed the energy concept together with Cenergie colleagues (www.cenergie.be) as a demo house but due to the mess of the Belgian/Flemish administration and politics it was nearly pulled down when it was half done. It demanded 5 years of courts and related expenses amounting to more than the investment in 5 kW PV panels, to get it on track again and so it was but ready this year 2005. The house is not high tech but an amenity to live in and to visit. Maybe one day you pay it a visit.

Kind regards from Aviel and Gaby (Veerlepad 54; B-2230 Herselt)