

West Beacon Farm



West Beacon Farm is the family home of Tony and Angela Marmont; the house and land have been converted to demonstrate an integrated sustainable energy generation network, which provides independence from fossil fuels and nationwide distribution networks, as well as significantly enhancing the natural ecology of the 50 acre rural farmstead.

History and Ecology of West Beacon Farm

When Tony and Angela moved to West Beacon Farm in 1969, the land was very bleak, with few trees. The fields were hedged or dry stone walled with no protection from the weather. Their first priority was to plant a wind break of 13,000 trees during the 1st year, followed in later years by more on the outer boundaries. These have enhanced the farm and at the same time added to the uptake of carbon dioxide in the atmosphere. The ecology of the land was improved by ploughing and re-seeding hectares of permanent natural pasture which provided an income as hay or silage. Some of the fast-growing Pine and Larch are now being replaced by Oak and other deciduous trees to provide food, shelter and breeding sites for many kinds of wildlife. Biodiversity has been enriched by this and by the creation of a 2 acre lake in 1980, thus giving the site grassland, woodland and water-life.



Kestrel, Crow, Great-spotted and Green Woodpecker, Greenfinch, Dunnock, Mallard, Little Grebe, Goose, Moorhen and many more varieties of bird nest here, with the occasional excitement of Crossbill, Long-tailed Tit and Buzzard visits. Animal, insect, frog and toad life has also increased with the addition of plant and fungus species diversity.

By the 1980's environmental groups were becoming increasingly prominent, and for the first time public awareness was being raised, about the negative effects on the environment that modern human life was causing, the UK's increasing reliance on imported energy was also being highlighted. As a pilot Tony noticed that over time the ice caps on the Alps were receding; he then started to notice other changes to the global environment and it was this which sparked his interest in climate change and his firm belief that action should be taken to slow it down and reduce the damage mankind is doing to the planet before it is too late.

To reduce his use of fossil fuels Tony decided to replace the oil fired boiler in the farmhouse with a ground source heat pump system. Shortly after this he installed a 4kW wind turbine and a 3kW photovoltaic array to provide the electricity required to make the heat pump a self-sufficient system powered entirely by renewable energy.

West Beacon Farm Today

From relatively modest beginnings West Beacon Farm has now become one of the world's best examples of renewable energy in practice. West Beacon Farm demonstrates how integrated renewable energy systems combined with other sustainable practices can form an effective and reliable independent network.



The technologies used include:

- two 25kW 2-bladed wind turbines - now 17 years old
- three interlinked 1kW photovoltaic arrays
- 6 kW fixed photovoltaic arrays - now 20 years old
- hydrogen energy storage
- water conservation - no mains water connection, rainwater only source
- hydro power
- sustainable transportation - electric and hybrid cars



Farmhouse Details

A 1960s farmhouse has been renovated to form the existing house. The original walls consisted of a brick outer leaf and concrete breeze block inner leaf with an air cavity between. When the wall cavity was filled with blown insulation, it was found that in many places it was filled with construction rubble and could not be drilled into. The original roof, featuring steel I-beam trusses, has been insulated between the timber rafters with 50mm of Kingspan insulation board and 50mm of plaster board. The windows are the original timber framed double glazed units.

Heating

The Farmhouse is heated by a conventional central heating system and radiators. Rather than a standard oil or natural gas fuelled boiler however, a Biklim TOTEM Combined Heat and Power unit provides most of the heating requirements. This propane fuelled combined heat and power (CHP) unit is approximately 95 percent fuel efficient and is rated to generate 15kW of electricity and 38kW of heat. Although propane is a fossil fuel, it burns cleaner than standard fuels, with relatively low emissions of greenhouse gases. The unit also allows for the possibility of using gas from a biomass gassifier or hydrogen from an electric electrolyser.

Additional heating is generated by a water sourced heat pump system. The AB Thermis system makes use of the reasonably stable temperature of the water in the lake to heat a refrigerant with a low temperature of vaporisation. The heat pump extracts and upgrades this heat before storing it in the well insulated thermal storage tank. For every unit of electricity consumed by the heat pump and compressor, about 4.5 units of useful heat are produced. At West Beacon Farm, all of the electricity required is produced by renewable sources, which makes this heat pump one of the cleanest and most efficient home heating systems possible.

A large conservatory has been built to the west end of the house, above the engineering plant room and garage, and even on a cloudy day the air inside is heated by solar energy. A system of automatic fans and shutters control the ducted flow of this air into the main house, for passive solar heating in winter and ventilation. The heat pump system also runs through the duct which enhances its own heating/cooling performance.

A wood burning stove can provide supplementary heating to the lounge if required, although this is mainly for aesthetic purposes, the fallen wood from the planted trees is used as fuel.

Water heating is supplied by the heat pump system and supplemented by a bank of Thermomax evacuated tube solar collectors situated on the garage roof.

Lighting

Daylight is brought into many areas of the house using monodraught lightpipes. These sealed highly reflective ducts transfer daylight from a clear dome on the roof to enclosed areas such as the cloakrooms and hallways. Low energy compact fluorescent lights are used elsewhere in the house.



Energy Generation

The largest generators of sustainable energy at West Beacon Farm are two fixed pitch 2-bladed wind turbines. These are rated at 25kW each and were installed in 1990 at a cost of £60,000. Over a typical year these turbines will generate 40-50 MWh of electricity.



The second largest electricity generators are two photovoltaic cell arrays, rated at 3kW each. One array features 54 mono-crystalline cells made by a company called ARCO. The other array consists of 81 poly-crystalline cells made by Solarex and has a much larger surface area. Combined, the two arrays have been generating approximately 4.5MWh of electricity a year since their installation 20 years ago, with no decline in performance.



A lake created in the grounds provides a further source of electricity generation. A building constructed out of local stone sits at the bottom of an adjacent field, and houses two water turbine systems. The larger, which uses the 20m gross head between the turbine house and the lake, powers a 2.2kW synchronous generator. The smaller turbine is powered by the water flowing in a stream outside the building, and generates up to 850W after rainfall in the summer, and more constantly during the winter.

To prevent wildlife or debris from the stream falling into the turbine, the water passes over a Coanda effect water filter. The water passes over a vertical bank of horizontal steel wires, and any solid matter falls by gravity over the wires and back into the stream.

The lake is topped up by rainfall and by a natural spring 50m below ground. The power to pump the water to the surface is supplied by three interlinked 1kW photovoltaic arrays; the arrays make use of a novel sun tracking system to maximise their electrical generation as the sun passes overhead; this system has been shown to increase their output by 61 percent. The water is pumped from below ground when the sun shines, with approximately 4000 gallons being delivered via a fountain jet each day during the summer, and 2000 gallons in the winter.



Energy Storage

Renewable energy generation is irregular because it depends on the weather; demand for electricity varies depending on the time of day, whether it's winter or summer etc. To meet the demand for electricity constantly and reliably with renewable energy, the energy has to be stored in some form.

Batteries are used for small scale energy storage; the lead-acid battery cells at the farm provide a 200kWhr back-up.

For longer term, larger scale storage hydrogen is used. Surplus electricity is used to power a process called electrolysis which divides water into constituent parts: hydrogen and oxygen, the gasses are then stored in pressurized tanks. To convert Hydrogen back into electricity it is fed into a fuel cell where it is recombined with oxygen and as a result generates electricity and hot water.

A hydrogen storage system makes it possible to store energy created from renewable sources to



give a constant and reliable supply of power with zero CO2 emissions.

The forty-eight hydrogen storage cylinders on the farm will hold enough stored electricity to provide all the power required at the farm for three-weeks (around 4MWh).



Before the hydrogen store was established, the surplus power generated at the farm was exported and sold to national grid. From 1990 to 1999, 317MWhr of wind generated power was sold; this gave an income of almost £35k. In December 1999, the Non- Fossil Fuel Obligation scheme (NFFO), ceased and it's not now financially viable to export electricity to the grid.

Water

West Beacon Farm is not connected to the mains water network. The water comes instead from a natural spring 50 metres below ground and from rainwater.



The rainwater is collected from the rooftop in conventional guttering and then passed through a filter to remove any coarse dirt before it is stored in a 6000 litre underground storage tank. It is then filtered a further three times before being stored in a second underground tank, at this stage it is suitable for all house hold use but not for drinking. Drinking water passes through an ultra-violet filter and then a reverse-osmosis membrane purifier

before being piped to separate drinking water taps in the house.

Onsite sewage treatment using septic tanks also conserves water and energy; the naturally treated nutrients produced are used on the farmland.

Transport

The solectra electric car bought in 1997 has a range of 120 miles and a top speed of 75mph, improvements made possible by using nickel metal hydride batteries. The next development planned is to integrate a small 1-2kW fuel cell into a vehicle, which has already been shown to be technically feasible and increases performance, range and fuel economy.



The Toyota Prius hybrid purchased in 2003 combines a petrol engine with an electric motor and produces 89% less CO2 emissions than a conventional car. In performance the Prius favorably compares to a comparable car with a 1.8L petrol engine.

[For further details go to our website or ring us on 01509 610 033.](#)

