CASE STUDY

Beechenhill Farm, Ilam

Winner of Environmental Business of the Year in the Sentinel Business Awards, this organic farm is an exemplar project in reducing the environmental impact of a farming and tourism business in a protected landscape.

Features:
Insulating lime plaster with perlite.
Sheep wool insulation
Internal shutters
Low – energy lighting
Sunpipe
120 kW biomass wood pellet boiler.
Mini District Main (hot water distribution system)
All Underfloor heating.
8 kW Lightweight, flexible photovoltaic panels.
Raeburn burner conversion.
Induction hob
Electric bikes.
Rainwater harvesting. Rainwater flush toilet
Waste Recycling
Future project - a low-tech, mini-anaerobic digester using cow manure

Beechenhill Farm is a working dairy farm with ancillary visitor use that lies between Ilam and Stanshope in the Limestone Plateau Pastures of the White Peak .

The farmhouse and barns are grade 2 listed buildings. They are well detailed limestone buildings under blue clay tile roofs, with a range of modern agricultural buildings to the North.

Figure 1. Beechenhill Farm

Finding practical and appropriate ways to address rural resource efficiency, economic pressures and reduce the carbon footprint of the farm and tourism business in ways that protect the National Park is fundamental to the owners of Beechenhill:

'The pristine protected landscapes of England are under ever increasing pressure. As we face the challenges of climate change, a steadily increasing population and economic difficulties, people everywhere try to find economic solutions. Some of these solutions could increase the risk to our protected landscapes. Once we have lost them, they can never come back.

Centralised energy solutions are appropriate where there are centralised populations; however, rural areas have scattered and dispersed populations which would suit decentralised renewable energy solutions'.

Sue Prince, Owner

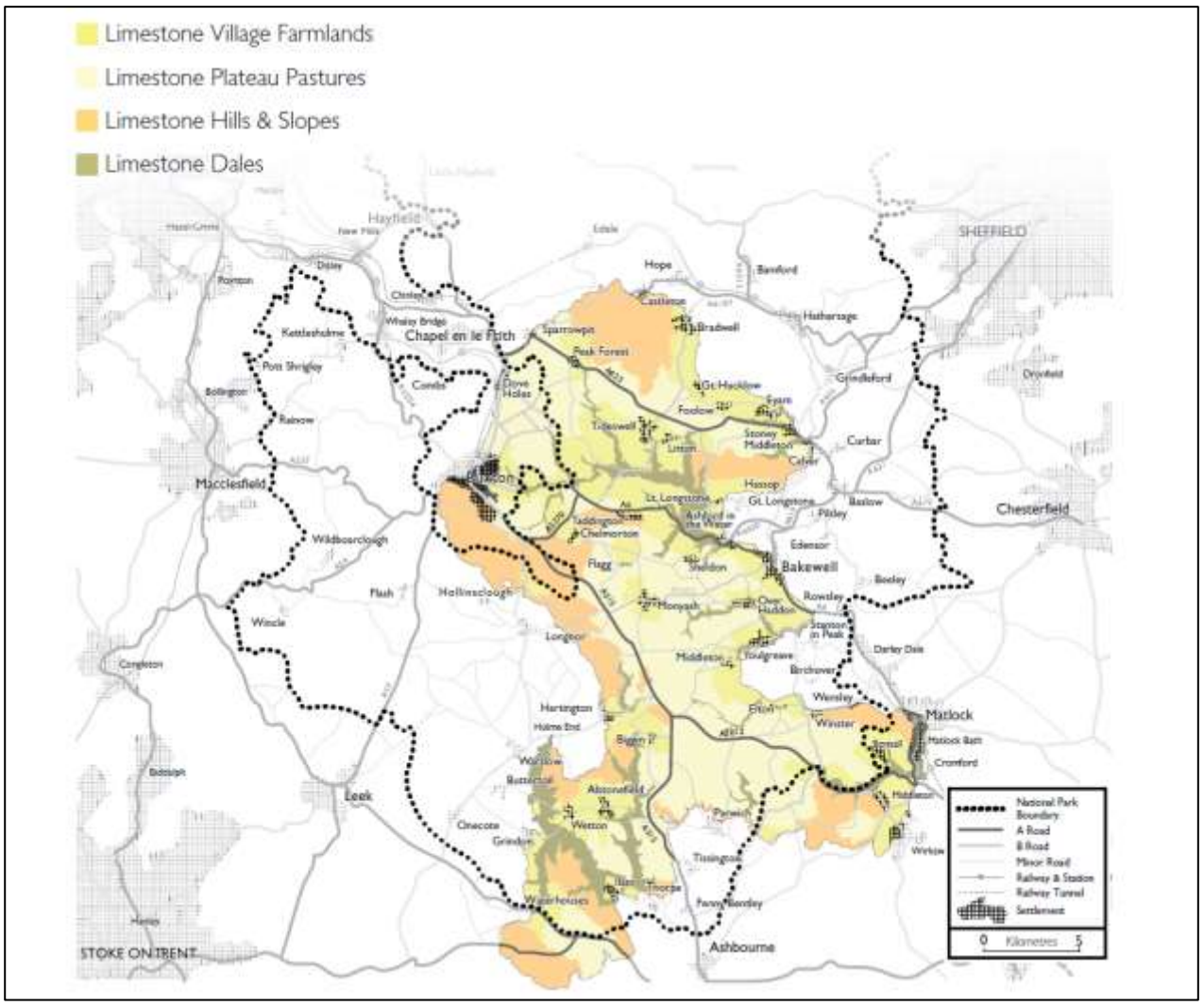

Figure 2. Landscape Character Types

Key characteristics of the Limestone Plateau Pastures are:

- A rolling upland plateau
- pastoral Farmland enclosed by limestone walls
- a regular pattern of small to medium-size rectangular fields
- localised field dewponds and farm lime kilns
- discrete tree groups and belts of trees
- isolated stone farmsteads and field barns
- medieval granges surrounded by older fields
- relic lead mining and quarrying remains
- prehistoric monuments, often on hilltops
- open views to surrounding high ground

Beechenhill Farm had two old oil boilers, six immersion heaters and one cottage with entirely electric heating. Energy costs were rising year on year, making the business increasingly unsustainable. Over the last three years, even though the business has grown, it has reduced its carbon footprint from 41 tonnes to 14.4 tonnes, and reduced its energy costs by using energy conservation methods and the installation of a range of low carbon and renewable technologies.

Insulation and draught proofing have been carried out incrementally over the years since they are the cheapest methods that have the biggest impact. Home-made **internal shutters** made from painted MDF were installed to all windows .

Figure 3 Insulated lime plaster walls conserve the internal appearance of the historic building whilst conserving energy. Home made internal shutters also conserve energy

Sheep wool insulation from a neighbour's flock was used in the loft spaces.

Figure 4 Sheeps wool insulation

Where it was important to retain original beam features, as in the Haybarn conversion, thin profile insulation was used incorporating aluminium foil. The walls were insulated with lime plaster with perlite to maintain the character of the building rather than dry lining the walls. The owners checked that the insulation values of the products used would meet building regulations requirements through discussions with the relevant district Council.

Figure 5 Insulation material that has been installed between beams in the converted barn to conserve the internal appearance of the building whilst reducing energy loss

Low energy lighting is gradually being replaced by **LED lighting** in order to reduce the consumption of electricity. The kitchen lighting, for example, has been reduced from 540 W to 90 W due to the use of LEDs. An **induction hob** has also reduced the use of electricity. When appliances need to be replaced they are being replaced with energy efficient appliances, at least A rated. The replacement of the Raeburn burner with a **new burner** has reduced by half the oil used to feed it.

Figure 6 Induction hob

To avoid the need for electric lighting during the daytime, a **sun pipe** has been installed to allow daylight into a room without windows. The external appearance of the sun pipe is that of a skylight which fits in well with the building design.

Figure 7 Sun Pipe – miimal impact on Grade II listed building

Having carried out fabric first measures to reduce carbon emissions and the cost of running the business**, low carbon and renewable energy installations** appropriate to the protected landscape were considered.

Research was carried out into the possibility of installing a wind turbine for the farm business. A feasibility study was carried out on wind speeds, which found that the optimum sites were in open fields and on the crest of the hill. It was considered that a wind turbine in either of these locations would be damaging to the landscape. Had there been a site within the cluster of listed buildings with sufficient wind speed, it would have been considered more seriously, also taking into consideration impact on the listed buildings and their setting. The owners are interested to find out how efficient ridge blade technology will be when it is more readily available as it may be possible to integrate it sympathetically into farm buildings.

Having ruled out the feasibility of a wind turbine due to the landscape sensitivity of the optimum locations, research was carried out into other more appropriate renewable energy technologies. Following initial research it was decided to further investigate:

- a wood burning boiler
- a mini district main (a hot water distribution system),
- a low tech mini bio digester dome

A 120 kW **biomass boiler and mini district main** has been installed in one of the farm buildings to heat the accommodation at Beechenhill. It replaces two oil boilers and four immersion heaters. The new system provides a ready supply of hot water to pipework in the holiday cottages that is used when needed to heat the accommodation. Wood pellets are fed automatically by auger into the firebox of the boiler and as a backup the boiler can also be manually fed with logs. The lower embodied energy and the need for more on-site storage with woodchip led the owners to choose wood pellets instead. The woodfuel boiler comprises a wood gasification heating system with integrated suction and ceramic plates with an efficient secondary combustion chamber and heat resistant catalyst. The chimney for the boiler comprises a stainless steel core with 25 mm of mineral wool insulation and the flue is clad and powder coated to match the roofing material. The storage cylinder for the water is insulated steel and has a capacity of 2000 L.

Figure 8 Wood gasification heating system and water storage cylinder

The development of the biomass boiler did not require a separate building as it has been incorporated into one of the existing portal frame farm buildings. Thick concrete block walls form the enclosure and wood store with vertical hit and miss timber cladding above the block work to match the existing construction of the building.. The enclosure was provided with a one-hour fire resistant roof and waterproof coating, since cattle are housed in the building in winter.

The possibility of the installation of either solar thermal or solar photovoltaics had been ruled out due to the fact that the roofs of the portal frame farm buildings were inadequate to carry the load of the installations, however, with the introduction of **flexible photovoltaic sheeting** to the market, it has been possible to retrofit sheeting onto the farm buildings and to generate electricity from solar sources.

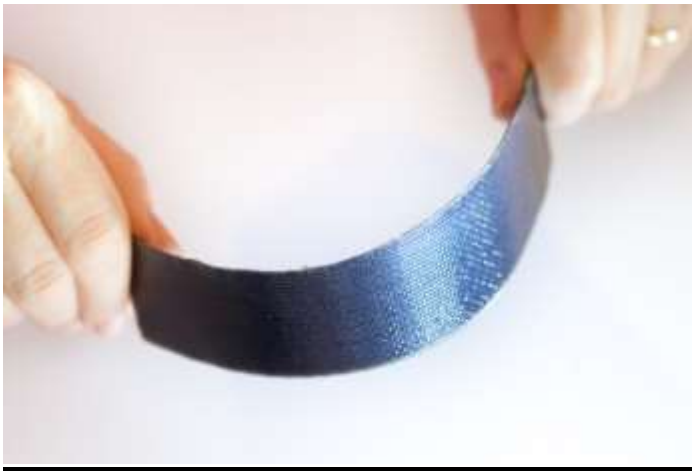

Figure 9 Flexible photovoltaic sheeting

The system involves bonding solar film to lightweight metal panels which means that it can be installed on fragile awkward shaped roofs. The benefit of using the sheeting is that it is lightweight and therefore there is no need to upgrade the roof, furthermore the original drill holes that are used to construct the roof can be used for its installation. Planning consent was granted in 2011 for 2 x 22 m lengths of the solar PV material, 2.8 m deep on the south facing slope of the agricultural building. The material of the sheeting is non- reflective and the film covers an entire section of the building without metal framing. Electrical output of the thin-film photovoltaics is monitored and energy savings in general are calculated by the owners.

Figure 10 Photovoltaic sheeting installed on portal framed building. Location of installation minimises impact on landscape surroundings

Figure 11 Rainwater harvesting for toilet flushing

Rainwater harvesting systems have been introduced for toilet flushing.

A **recycling area** is provided for guests and guests are encouraged to buy local products whilst locally sourced products are used for the bed and breakfast business.

Figure 12 Recycling area

A **mini anaerobic digester** gained planning consent in January 2009 as an experimental and educational project. The facility will have a low visual impact since it will be sited underground. It comprises a GGC 2047 model biogas plant with a capacity of 10 m^3. It will be enclosed with a dry stone wall with timber gates once the installation is complete. It is a low-tech design, with a relatively low cost, originally developed in India, which will produce methane from the manure of 10 cows. It is hoped that that it will be possible to retrofit the Rayburn in the farmhouse kitchen with the mechanisms necessary to burn the methane produced. Given the remote location of the anaerobic digester which is sited away from the farmhouse, connection to the Rayburn will depend partly on whether the length of pipework necessary will allow a satisfactory burn. The project will provide some guidance as to the potential for installation on other livestock farms.