Appendix 3

Example case studies for website

New Community Building – Over Haddon Village Hall

A new purpose built community facility to replace the existing village hall provided an opportunity for the parish to consider function, design and sustainability. Central to the design brief was:-

- Provision of a dual purpose hall
- To reduce the carbon footprint of the building.
- For the building to be as sustainable as possible.
- Provision of disabled toilet facilities and baby change.
- Better toilet and kitchen facilities.
- A design which reflected the design of the old hall on the footprint of the new building.
- A design in keeping with the area.
- Provision of green space to the front of the building.

The replacement village hall demonstrates the advantages of sustainable building design in terms of reduction in carbon emissions, running costs and water usage. It achieved an A rated Energy Performance Certificate and is a building of traditional design.

Features

High levels of insulation
Thermostats and Monitor
Energy efficient lighting
Energy efficient underfloor heating
Energy efficient underfloor heating
Air source heat pumps
Solar photovoltaic panels
Rainwater harvesting

Refurbishment of the old village hall had been considered but the fabric of the building was poor and heating was provided by 6 double bar heaters on the wall which provided less than adequate heating and for which the fuel bills were very high.

A new building with a high thermal mass was proposed to reduce carbon emmisions and to improve the ambient temperature, in order to significantly reduce running costs. Energy efficient heating and lighting systems, renewable energy installation and rainwater harvesting were also proposed.

Figure 1 LED lighting

Benefits

Use of the village hall by the local community and others has increased since it was rebuilt because it now provides a light and comfortable environment.

Use of the heating system, using the air source heat pump and under floor pipe work, has been minimal because the ambient temperature of the building is high as a result of its design and insulation.

Rainwater harvested is used to flush the toilets, which saves on water bills. If there is insufficient rainwater a valve shuts off the harvesting system and water is fed from the mains.

The photovoltaic panels supply electricity to the building: any extra electricity produced is providing a useful source of income via the “Feed In” Tariff.

Figure 2 Solar photovoltaic panels

Figure 3 Monitor demonstrates benefits of system

<u>Lessons learned</u>

The replacement village hall has been grant funded both in terms of the building fabric and the low carbon and renewable energy installations. Had been a limited budget for low carbon and renewable energy installations, the Energy Performance certificate for Over Haddon Village Hall shows how much can be achieved simply through careful design and insulation.

Originally a vertical bore ground source heat pump was specified instead of the air source heat pumps but a perched water table in the vicinity of the village hall meant that this was not feasible.

Figure 4 Air Source Heat Pump

The Energy Performance Certificate suggested that the energy performance of the building could be further improved. Recommendations in the short term, (less than 3 years) to improve the energy performance of the building included:

- Solar control measures such as the application of reflective coating or shading devices to windows.
- An optimum start / stop to the heating system.
- Replacement of T8 lamps with retrofit TS conversion kit.

Over Haddon Village Hall is a very good example of a low carbon building, which demonstrates that low carbon emissions can be achieved in a traditional style building.

The Target Emission Rate (TER) for the hall was 28.5 kg CO_2 / m² per annum, and the calculated Building Emission Rate (BER) was 11.6 kg CO_2 / m² per annum, 59% less that the Target Emission Rate. The Energy Performance Certificate for the building gave an Energy Performance Asset Rating of A7.

<u>Comments from users of the hall:</u>

"Great example of Solar power in a 'traditional style' building."
"Excellent new village hall and great that it is sustainable."

<u>Technical Details:</u>

<u>Insulation</u>

Ground floor slab – underfloor heating pipes in 75mm screed on 75mm Eco – Therm Eco Versal in 125 mm dense concrete slab “U” value = 0.18.

Walls – 100 mm cavity filled with 100mm Dritherm cavity slab32 Ultimate “U” value = 1.27.

Roofs– 170 mm Eco Therm Eco Versal between trusses with 37.5mm Eco Therm Eco – liner under trusses. “U” value = 0.14.

Low Carbon and Renewable Energy Installations.
Mitsubishi 5 kw and 14 kw Ecodan heat pumps – Annual energy performance estimated to be 13333 kwh being the running time of the heat pump based on 2400 heating hours.
Sundog Energy Powerglaz (BP Solar Modules)
Solar photovoltaic integrated panels.
Estimated annual generation – 6502.00 kw

Monitoring and Controls
Heatmiser Touch Pad Controller – Underfloor Heating.
Heatmiser Netmonitor Programmable room thermostats.
Photovoltaic energy output / carbon reduction monitor

Rainwater Harvesting System
WPL system
Polythylene tank with lid.
Filter.
Pump and control module with 2011 (?) litre mains water tank with AB air gap, a pressure sensor, pump with integrated 3 way valve and float switch.

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 .

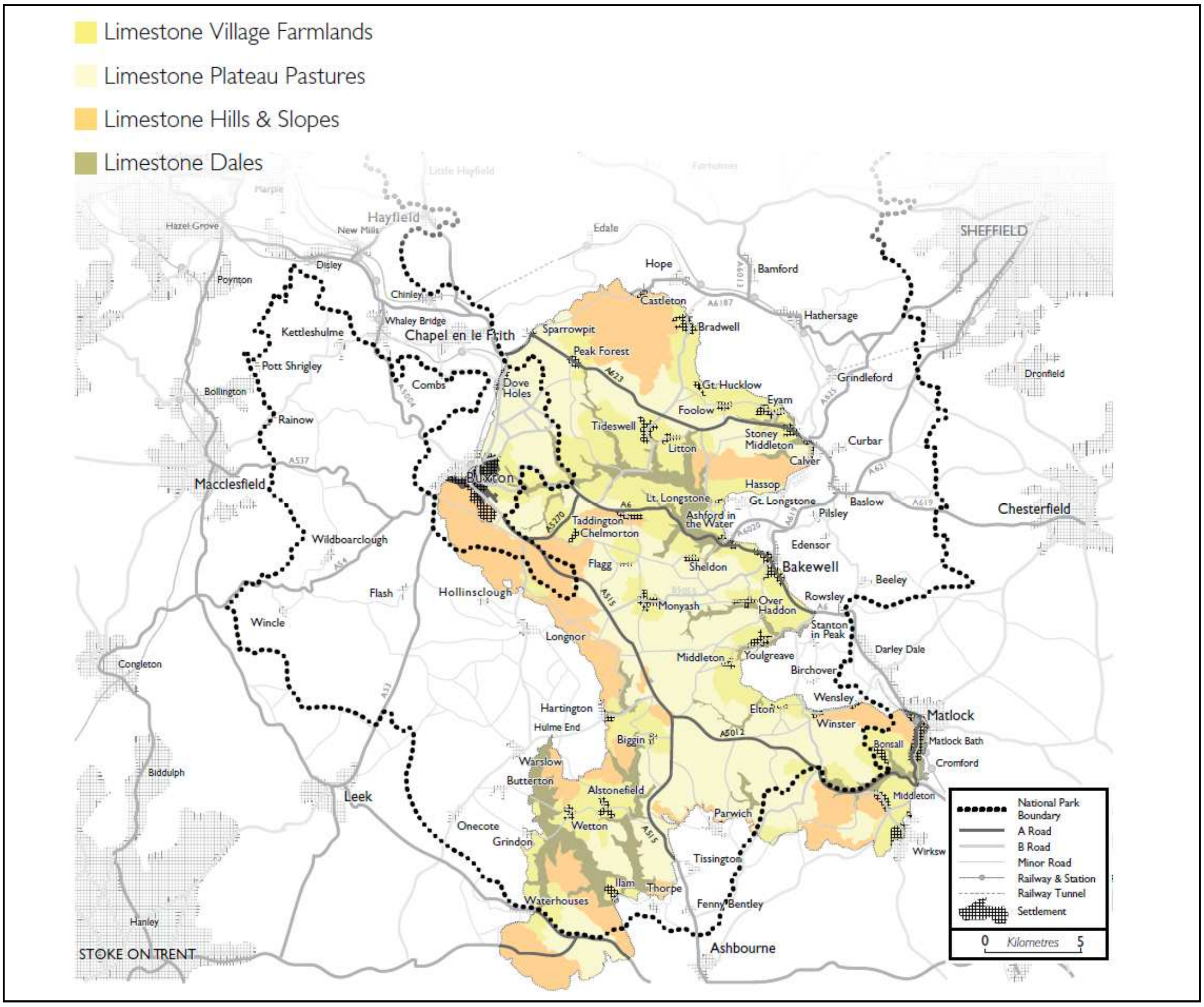
The farmhouse and barns are grade 2 listed buildings. They are well detailed limestone buildings under blue clay tile roofs, with a range of modern agricultural buildings to the North

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



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 5 Insulated lime plaster walls conserve the internal appearance of the historic building whilst conserving energy. Home made internal shutters alsoconserve energy.

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

Figure 6 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.

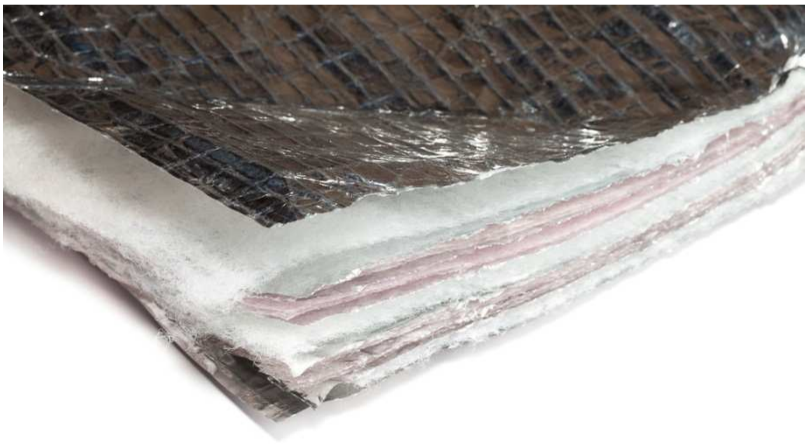


Figure 7 Insulation material that has been installed between beams in the converted barn to conserve the internal appearance of the building whilst reducing energy loss

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

Figure 8 Induction hob

A rated. The replacement of the Raeburn burner with a **new burner** has reduced by half the oil used to feed it.

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 9 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 buildings with sufficient wind speed, it would have been considered more seriously. The owners are interested to find out how efficient ridge blade technology will be when it is more readily available as it could be sympathetically integrated 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 draft plan 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 10 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.

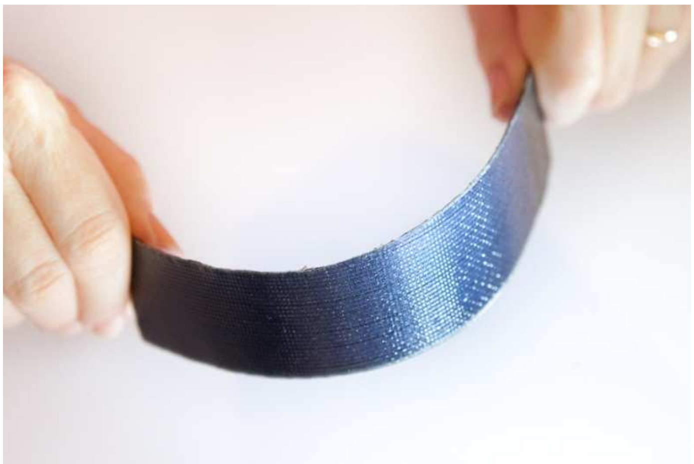


Figure 11 Flexible photovoltaic sheeting

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

Figure 13 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 you are used for the bed and breakfast business.

Figure 14 Recycling area

The **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 m³. 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.