Green Buildings in Norfolk

Volume II

21 further examples of eco-homes, energy-efficient developments and low impact community buildings

Campaign to Protect Rural England
NORFOLK

Dear Reader,

One September afternoon in 2009, deep in the heart of Norfolk, people gathered in the small village of Neatishead to celebrate the opening of a new village hall.

It could have been nothing remarkable, as many of the village halls in Norfolk were erected at the turn of the last century and are undergoing repair, restoration or, as in this case, replacement. But it was remarkable, for the New Victory Hall at Neatishead is one of the greenest community buildings in the UK, constructed primarily from reclaimed timber and locally harvested straw bales, and incorporating a ground source heat pump and a sedum roof.

And that, in a nutshell, is what this booklet is about. It's about choices - not just for today, but also for tomorrow. It's about Norfolk homeowners, businesses, housing associations, parish councils, and whole communities, having sufficient determination to make the best choices available, for sustainability and for a greener future.

Here at the Campaign to Protect Rural England in Norfolk, we have an ongoing campaign to promote local examples of buildings which demonstrate the use of renewable energy technologies and energy-efficient design. We research them, write about them, speak on them and open them up for guided tours, to help raise awareness and inspire others.

This is our second collection of 'Green Buildings in Norfolk' and it's clear that much has changed since our first edition, almost five years ago. The range of projects is more impressive than ever, as reflected by the very small scale, low impact dwellings made from cob, earth and straw (see the Cob Studio, Straw Cottage and Eco-Shed), alongside the energy-saving ideas in multi-million pound corporate investments (see Dragonfly House and Jubilee 3).

New technologies such as air source heat pumps, anaerobic digesters and micro hydro-turbines have come onto the market and are being applied by enthusiastic owners (see Station House, Copys Green Farm and Itteringham Mill). The introduction of Feed-In Tariffs has created an opportunity to be paid for the electricity you generate, making renewable energy technology, at last, a real investment opportunity for the prudent homeowner.

Housing associations, driven by central Government sustainability targets, are also getting in on the act. There are numerous social housing projects in Norfolk where energy efficient design has led to lower fuels bills for tenants (see GreenGauge Homes, Greening The Box and Skelton Road as examples). There has also been a remarkable shift towards whole community solutions, with the advent of the Transition Town movement and funding from the government's Low Carbon Community Challenge fund inspiring collaboration across all sectors and walks of life (see Reepham Low Carbon Community).

The UK Government has promised an 80% cut in carbon emissions by 2050 (from 1990 levels). If it is to meet this challenge, the buildings of this century are going to have to behave very differently to the buildings of the last. Alongside this, we will all need to change our lifestyles, travel habits, and consumer choices and share a little more with our neighbours and local communities. If you ever needed inspiration, then look no further... the people of Norfolk are making a start.

Yours,

James Frost
Director
Campaign to Protect Rural England - Norfolk

Projects are numbered 1 to 21 for ease of reference and appear accordingly within the booklet. Please use this map to identify their locations within the county.

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Itteringham Mill

Use: Private Home and Bed & Breakfast Accommodation

Location: Itteringham

Main Contact: Peter and Lis Downs, 01263 587688, downspeter@talk21.com

Features: Hydro-electric turbine, water source heat pump, solar water heating, rainwater harvesting

An 18th century former watermill, converted by the owners into a stylish family home and B&B, maximising the use of renewable energy, particularly energy from the river.

A hydro-turbine was installed in 2006, followed by a water source heat pump, and wet underfloor heating. These improvements have enabled the decommissioning of a 50kW oil boiler thereby saving the burning of 5800 litres of heating oil.

The hydro-turbine at Itteringham Mill is one of only a handful of small-scale turbines in the UK. It was designed and installed by a company in Derbyshire and can produce up to 4.4kW. It was expected that the turbine would pay for itself in 14 years, but with the rise in fuel prices and the introduction of feed-in tariffs, the owners expect the payback period to be significantly shorter.

Hot showers in the guest bedrooms were identified as the biggest consumers of the B&B's electricity, so solar hot water heating was installed, together with water-saving shower heads and low flush toilet cisterns. A disused coal cellar has been converted into a cistern for recycled rainwater for flushing toilets.

Other green improvements include massively enhanced insulation using sheep's wool, wooden sliding sash double glazing for the traditional windows, zero VOC paints, water based wax-wood treatment for all areas of new oak and low energy lighting throughout.

Approximately 25 tonnes of carbon each year has been saved by these energy saving technologies and improvements. Itteringham Mill is now essentially a carbon neutral building.

B&B, powered by the river

creating energy from farm waste

Mrs Temple's Cheese is a well known brand of Norfolk hand-made cheeses, produced at Copys Green Farm. Less well known is the owners' investment in an anaerobic digester to provide power for the farm and the dairy.

The anaerobic digester extracts energy from waste materials, including cattle manure and the whey from cheese-making, to produce electricity to feed into the grid, and heat for use around the farm. Crops grown on the farm for the cattle are also used to 'feed' the digester.

The anaerobic digester process results in about 50% of the solids in the feed material being converted to methane and carbon dioxide which is then burnt in a combined heat and power plant (CHP) for generation of electricity and heat.

Growing crops for anaerobic digestion is claimed to be five times more energy and carbon efficient than growing crops for biodiesel or bioethanol. It also has parallels with the earlier ages of farming when crops were grown as fuel for horses, which were the 'tractors' of their time.

After the energy has been extracted, all the crop nutrients remain on site and are used as liquid or fibre fertiliser on the farmland.

The heat produced provides for the farm's needs in the dairy, the farmhouse and is used for grain-drying. There is also the possibility of extending the heating system to a row of nearby cottages.

Use: Farm, dairy and cheese-making business

Location: Wighton

Main Contact: Stephen Temple, 01328 820224, sjt@jftemple.co.uk

Features: Anaerobic digester

Copys Green Farm

The Eco Barns

Use: Holiday cottages

Location: Cranmer

Main Contact: Lynne Johnson, bookings@homefarmcranmer.co.uk

Features: Wind turbine, ground source heat pumps, solar water heating, rainwater harvesting

Avocet Cottage, Coot Cottage and The Garden House are three new holiday cottages at Home Farm in Cranmer, which use 100% renewable energy sources. The cottages were created from the conversion of original farm buildings, together with a contemporary modern extension.

The new extension is insulated well beyond standard regulations, clad in Norfolk- grown green oak and maximises natural daylight by the use of heat retaining glass. On the internal walls, the owner has used environmentally-friendly, low VOC, paints.

The three Eco Barns are powered exclusively by a combination of on-site renewable energy sources, including a 20kW wind turbine, ground source heat pumps and solar panels. The wind turbine also supplies electricity for the swimming pool, other holiday cottages on the site and the farmhouse.

The swimming pool and showers are heated by solar panels which can generate temperatures of up to 120^{0}C. All water on site comes from a borehole deep in the underlying chalk aquifer, while all gutters and terraces run off into the original Victorian drainage system and back into the land.

These measures, together with the removal of two existing LPG boilers during refurbishment; have saved over 40 tonnes of CO_2 per annum and reduced the total carbon emissions output for the whole business by 40%.

This award winning, single-storey, 60m^2, rammed earth garden building was designed and built by the owner, after watching a Channel 4 TV feature on rammed earth.

Although it is widely used elsewhere in the world, rammed earth construction is still relatively uncommon in the UK, so there was limited information available from traditional sources. The owner went on to research and teach himself rammed earth building techniques from the internet and now runs regular courses on the subject.

The correct earth-sand combination is crucial to the strength of a rammed earth wall. In this case, the 26 tonnes of subsoil from the owner's garden had to be blended with 13 tonnes of additional, locally-sourced, subsoil containing a higher degree of sand composites. The owner then built a unique soil-sieving machine to grade the earth correctly.

The green roof is mainly sedum, cultivated from soft cuttings. Over 400 plugs were produced from two mother plants at an initial cost of £5.98. These plugs have since flourished and spread very successfully. Further planting has been carried out to create a bio-diverse living roof which has attracted a greater variety of wildlife and insects.

Excess rainwater not absorbed by the sedum roof is diverted and collected into an underground storage tank and used for the owner's fruit and vegetable garden.

The carbon footprint of the rammed earth walls is the equivalent of driving a car just 550 kilometres. Compare this to a traditional fired brick construction where you would produce the same carbon as driving 40,000 kilometres (or once around the world!). This project took 2,700 hours to complete and cost a total of just £2,700 in materials.

Use: Shed and Workshop

Location: Potter Heigham

Main Contact: Michael Thompson, rammed-earth@hotmail.co.uk

Features: Rammed earth construction, sedum roof, rainwater harvesting

Eco-Shed

Cob Bale Round House

Use: Private Studio

Location: Banham

Main Contact: Kate Edwards, 01493 369952, sheepie32@hotmail.com

Features: Cob and straw bale construction, sedum roof

The Cob Bale Roundhouse, designed and built by Kate Edwards in 2007, is used as a studio for workshops and meditation, It is a remarkable and pioneering building, with virtually zero-embodied energy and is exceptional in terms of its sustainability.

Cob, a mixture of sandy sub-soil, clay and straw, has been used as a building material for thousands of years all over the world It is sustainable, recyclable, non-toxic, breathable, strong and load bearing. It also has excellent thermal mass qualities, absorbing heat during the day and slowly releasing it back into the building during the evening and night.

The roundhouse, which is 22 feet in diameter, is orientated to maximise solar gain and constructed to minimise heat loss. It is made of cob and glass on the south facing walls, and straw bales in the north facing walls to maximise insulation. No heating is required in the building.

The cob walls were made entirely from sand and clay from on-site. The straw bales were from neighbouring fields, held together with hazel cut from the owner's wood. Other materials used in the building were reclaimed or from local suppliers. The shallow pitched roof is planted with sedum.

The project was worked on by a wide range of volunteers and a group attending a course on building with cob and bale. It has been visited by over 400 people since completion, thereby serving as a valuable educational example for those wanting to learn more about sustainable building techniques.

Straw Cottage

The Straw Cottage is a single storey, south facing house designed for an elderly person. It is built from load bearing straw bales sourced from three miles away and rendered with clay and lime.

The building has excellent thermal performance. The walls are straw, and the roof is well insulated with a combination of recycled plastic and recycled paper. Thermal bridging and air leakage was minimised by the construction technique and by good attention to detail during the build. The clay plaster and the heavyweight internal walls and floor give thermal mass, which helps to moderate extremes of temperature.

It is important with straw buildings that the walls are allowed to breathe. At Straw Cottage, this is achieved through the use of clay and lime plaster. Clay plaster, used on the internal walls of the cottage, has a low embodied energy as it is not fired, and it is totally recyclable because it can eventually be taken off the walls and remixed. Clay is also hydrophilic, which means it has a drying effect on the materials beneath it, and a humidity regulating effect on the atmosphere in the building.

Lime plaster, which is used on the external walls of the property, has a lower embodied energy than cement and has other significant advantages. It is more flexible, can be self healing for cracks and, over its lifetime, absorbs carbon dioxide.

Heating and hot water are provided by an air source heat pump. The cottage is ideally suited to photovoltaic panels which the owner plans to install at a later date.

Use: Private home

Location: Cawston

Main Contact: James Livingstone, james@nbea.co.uk

Features: Straw bale construction, air source heat pump

Marshams Barn

Use: Private Home

Location: Kenninghall

Main Contact: Christian Mountney, christian@mountney.me.uk

Features: Wind turbine, rainwater harvesting, ground source heat pump

Marshams Barn was formerly a traditional agricultural barn used for chicken and dairy farming. By 2003, when it was bought by current owners Christian and Jo Mountney, it had been unused for many years and was severely dilapidated, with walls and roof in danger of collapse.

With experience in, and knowledge of, the building industry, Christian made a new design for the barn, incorporating green technologies where possible. The couple then undertook almost all of the construction work themselves. Walls were stripped right back to the original brick and flint, and other building materials were salvaged and reused where possible.

A ground source heat pump and underfloor heating were installed at the earliest stages of the conversion. This has proved to be a sound investment, providing heating and hot water for the property at a significantly cheaper rate than domestic oil (typically used for rural properties not connected to mains gas).

A below-ground rainwater harvesting system was also incorporated during the conversion which collects rainwater from most of the barn's roofs and stores it in a 6000 litre below ground tank. A pump in the tank then distributes it on demand. The water is used for flushing the toilets, for the washing machine and for outside taps.

A 6kW grid-connected wind turbine was installed shortly after they moved in to the barn and the performance of this has been monitored on a weekly basis. On average the turbine provides almost half of the property's electricity requirements.

The owners now plan to install photovoltaic panels on the roof of Marshams Barn which, together with the turbine, they hope will make the property almost self-sufficient in its energy needs.

Victory House

Use: Private Home

Location: Fakenham

Main Contact: Colin Vogel, vogelvet@btconnect.net

Features: Pre-fabricated construction, solar water heating, wood pellet boiler, rainwater harvesting, photovoltaic panels

The Cambridge subsidiary of the German builders Baufritz built this house in their Bavarian factory, delivered it to Fakenham and then erected it in just 30 hours. The building is still carbon positive, even allowing for the transport to Fakenham.

The house features a high use of pre-fabricated triple-glazed panels. The insulation and structure, including the window frames, are wood, but wood grown so far north in Finland that it requires no paint, preservative or maintenance.

Solar panels provide hot water and feed the under-floor heating, with extra heat provided by a wood pellet boiler when needed. Underneath the house, prefabricated concrete slabs act as 'heat sinks' to trap heat in the day and slowly release it when the temperature cools, keeping the internal temperature stable.

The owners have also installed a ground mounted array of 3.6kW photovoltaic cells to reduce their carbon footprint even further.

All the water from the two sloping roofs, the conservatory and the large patio are collected into a 6000 litre underground tank, which is used for flushing the lavatories, feeding the washing machine, washing the car and watering the garden.

Because heating costs are so low, the owners were able to incorporate a two-storey entrance hall topped by four large skylights into the design, enabling them to stand in the heart of the house 'and watch the clouds flying by'.

Ingleside

Use: Private Home

Location: West Walton

Main Contact: Tony and Stella Richardson, ingleside@ingleside2.plus.com

Features: Rainwater harvesting, solar water heating, wind turbine, photovoltaic panels

Ingleside was built in 1954 as part of a smallholding in the village of West Walton. The present owners moved to the property in 1996 and as keen advocates of the 'reduce, re-use, recycle' principle, they wanted to extend their green living ethos to their home.

Insulating the property throughout was the first step, followed by the installation of a solar panel to provide their hot water. But concerned about limescale affecting the performance of the panel, and not wishing to install a water softener, the owners researched ways to heat rainwater from the panel, rather than mains water.

Conventional installations do not recommend using untreated rainwater for bathing and washing use, so the owners designed and built their own system, harvesting and storing 2500 gallons of rainwater in recycled oil tanks in the garden and using an off-the-shelf pump and filter. This system, involving a web of pipes linking the garden to the house, has worked successfully ever since.

A small, roof mounted wind-turbine was installed in 2006 which provides about 10% of the couple's electricity needs. In 2010, the owners invested in photovoltaic panels to generate a further supply of electricity to the home.

This is an excellent example of how a 'normal' house can be adapted, step by step, to incorporate green technologies and DIY energy-saving solutions. It is estimated that the changes made to Ingleside by the owners since they bought the property have resulted in a carbon reduction of over 70%.

After living in older properties for most of their life, retired surveyor Chris Dady and his family wanted to move to somewhere more eco-friendly. Converting their existing Georgian home proved too difficult so they decided, after extensive research into eco-design and energy efficient technologies, to build their eco-home from scratch on a nearby plot of land.

Located near the local railway station, the design of the house was influenced by the original Station House on the site and appears to be of traditional brick and render construction. However this is an illusion – the house is actually constructed of a green oak frame, only visible internally, and then clad in super-insulated panels. The brick and render is for aesthetics, not strength.

Hot water and heating for the home is provided by an air source heat pump, which acts as a reverse fridge, extracting heat from the outside air which then heats water for underfloor heating and domestic use.

Seven photovoltaic panels on the south-facing roof provide half of the owner's electricity needs. All electricity created is fed into the grid and bought by the energy supplier. The owner then buys it back, but at a cheaper rate.

An on-site well is used for storing rainwater which is used for flushing toilets.

This house demonstrates how straightforward it is to incorporate energy-saving design and technology at the construction stage of a new home.

Use: Private Home

Location: Salhouse

Main Contact: Chris Dady, cdady@supanet.com

Features: Photovoltaic panels, air source heat pump, rainwater harvesting

Station House

Horseshoe Cottage

Use: Private Home

Location: Corpusty

Main Contact: Simon Waller, simonw@clara.net

Features: Solar water heating, wood pellet boiler, photovoltaic panels

This 18th century former pub sold its last pint in 1964 and needed extensive refurbishment work when the present owners bought it in 2005.

As part of roof replacement works, the owner installed lightweight, in-roof solar thermal panels to provide hot water. The system is driven by a small photovoltaic pump and has a drain-back feature for the circulating fluid.

Hot water and heating for the property was originally provided by an oil-fired Rayburn which was expensive to run and inefficient. This was replaced with a wood-pellet boiler, saving the owner over £500 a year in fuel costs. It is also more sustainable, with the wood pellets created from carbon-neutral waste products. Unusually the wood pellet boiler is situated inside the property, looking similar to a domestic wood-burner, and was the first one of its type imported into Britain.

Photovoltaic panels have been installed on the roof of the outbuildings, funded in part by a government grant and in part by an extension to the owner's mortgage. The extra mortgage costs are more than off-set by the payments received from the owner's energy supplier, in return for the electricity generated.

Smaller, practical improvements have also been carried out. For example, a porch has been built to stop heat escaping through the front door. There are also plans to dig a well which will provide plentiful free water to supply the toilets and the washing machine.

A small, semi-detached, early 20th century farmworker's cottage, of traditional red-brick, cavity wall construction, extended and modernised by the architect owner.

The extension is designed with a mainly southerly aspect, with extensive areas of glazing to maximise solar gain. Photovoltaic roof tiles generate about half the owner's electricity requirements and fit discreetely on the south facing roof.

Heat loss from the house is low with both the extension and original cottage insulated to a high standard, mainly with recycled paper. For example, the cavity walls are filled with recycled paper insulation, supplemented by an internal insulated skin to the external walls.

The original metal windows in the cottage have been retained but secondary glazing has been installed to further reduce heat loss. The owner has also installed additional draught proofing to make the windows almost completely airtight. Heat loss through the floor of the original cottage has also been addressed through the installation of a new raised floor 10cm above the original concrete and timber flooring. The new floor has created a cavity for extra insulation and also for the running of pipes and cables.

Solar water heating panels provide domestic hot water and also some space heating from a concrete heat sink below the extension. This acts as a 'heat store' and releases heat slowly back into the living space as the outside temperature cools.

Rainwater is harvested and recycled, for use in lavatories and the garden.

Use: Private Home

Location: Kirby Bedon

Main Contact: Donal MacGarry, donalmac@hotmail.com

Features: Solar water heating, photovoltaic roof tiles, rainwater harvesting

Mill Lane

Ecostessey Park

Use: Private Homes

Location: Costessey

Main Contact: Bolsterstone PLC, 01246 260206, admin@bolsterstone.com

Features: Photovoltaic panels, rainwater harvesting

Ecostessey Park is a modern housing development of twenty-two townhouses set on a private estate in Costessey, to the north-west of Norwich. It is one of many housing estates in Norwich, yet its contemporary design and high environmental standards make it truly unique.

Each town house has been constructed to be zero-carbon, working to the Government's Code for Sustainable Homes and to BREEAM standards. As an example, the insulation of the walls, floors and roofs exceed current building regulations by at least 30%.

Appliances are AA rated and the houses are supplied by electricity from a green renewable energy tariff. Smart meters have also been fitted to each property, allowing residents to monitor and take responsibility for their electricity usage. Dual-flush toilets use rainwater for flushing, while water regulators on the taps and showers further contribute to water-efficiency. Photovoltaic panels on roofs generate electricity which is fed back to the grid, lowering fuel bills for tenants.

The introduction of the Government's Feed In Tariff scheme, which pays a higher rate for every kilowatt hour of electricity generated than when the buildings were first constructed, has prompted the developer to increase the number of photovoltaic panels on roofs, making savings all round. Low energy outdoor lighting and movement detected security lighting are also powered by an array of photovoltaic cells, further lowering demand for traditional fuels.

Communal gardens have been landscaped to enhance the ecological sustainability of the environment, with guidance from Natural England. There is a communal bike park and communal recycling area for paper, plastics, glass and compacted waste. The site, on the banks of the River Tud, offers the environmentally aware consumer a very green alternative to modern living.

The Greening-the-Box (GTB) initiative seeks to retrofit and refurbish existing social housing and make them fit for a low carbon future. It was conceived by SEArch (Sustainable Ecological Architecture Ltd) and adopted by Wherry Housing Association in partnership with Broadland District Council.

GTB Ringland is the first project and involved the adaptation of a two storey, end terrace, 1930s council house in Ringland, two miles west of Norwich. The property's annual energy consumption was originally 45,560kWh/yr, but is now expected to reduce to 9,272kWh/yr.

The initial phase of the project involved the stripping out of loose plaster, old wiring, kitchen and bathroom fittings, external doors and windows. A lean-to extension was removed and the concrete ground floors were broken up to make way for an underfloor heating system and additional insulation.

The second phase of the project focused on improving the thermal capacity of the building and reducing the reliance on fossil fuels. Modifications were made to the windows and doors and the external walls were enveloped in extra insulation. Low grade underfloor electric heating was installed to the ground floor, alongside a wood burning stove, while solar panels were mounted on the roof to heat water and generate electricity. A rainwater harvesting system was also incorporated for flushing toilets and watering the garden.

Work began in late spring 2009 and was completed in sixteen weeks. The new tenants have moved in from the identical property next door and in due course will be best placed to provide anecdotal feedback on the building's performance, alongside commissioned research.

Use: Social Housing

Location: Ringland

Main Contact: SEArch Architects, 01406 364646, molearch@searcharchitects.co.uk

Features: Solar water heating, photovoltaic panels, rainwater harvesting

Greening the Box

GreenGauge Homes

Use: Social Housing

Location: Lingwood

Main Contact: Flagship Housing Group, 01603 255400, info@flagship-housing.co.uk

Features: Solar water heating, photovoltaic panels, ground source heat pump

In 2004, social housing provider Flagship Housing Group brought together a consortium of partners to develop a cost-effective model of energy-efficient social housing. The result was Greengauge Homes.

Norfolk's first GreenGauge Homes scheme was built in Lingwood and compromises 15 homes for local families in housing need. All of the homes are south facing, timber framed with untreated larch cladding and use high levels of insulation.

Solar panels and photovoltaic panels have been added to four of the homes to heat hot water and generate electricity. Ground source heat pumps help meet the demand for energy in five others, linked to underfloor heating. Another four homes feature passive design principles, such as conservatory-style fronts (known as sunspaces) and heat recovery systems. The remaining two properties use conventional A-rated gas boilers.

In this way, the scheme at Lingwood can monitor the effectiveness of a variety of technologies directly with real tenants. Researchers from the University of East Anglia are evaluating the energy use, cost and carbon impact of the different buildings, as well as monitoring tenant attitudes and behaviour. This will help inform other Greengauge projects in the future.

Designed by architects Barefoot and Gilles and completed in 2008, the seven three-bed and eight two-bed homes will aid the long-term sustainability of the Lingwood community.

Skelton Road

Built by Saffron Housing Trust, these affordable 'kit homes' went from planning application to construction to occupancy in just six months. The homes were shipped to Diss from Sweden in kit form and constructed on site in just 11 weeks.

The homes are designed to comply with the 'passive homes' concept whereby the building uses the correct materials, orientation, glazing and insulation to maximise use of the sun's energy, while minimising heat loss. As such, the homes are oriented to the south to achieve the best solar gain, and the walls, floor and ceilings are wrapped with a special aged polyethelene vapour barrier to keep out damp and minimise drafts, helping to maintain a constant, warm, internal temperature.

Air source heat pumps supply, via a storage tank, the hot water the homes need, and an underfloor heating system. Low volume baths and showers work alongside dual flush toilets to reduce water consumption.

A high content of sustainable material has been used, mostly timber. The whole wall panels come with timber triple glazed doors and windows already installed. This 'offsite pre-engineered method' allows very effective quality control and ensures consistency of build whilst reducing build time by 80%.

The houses at Skelton Road are some of the first 'passive' style homes in the country to be built by a housing association and are an excellent example of utilising new construction methods to build sustainable affordable homes.

Although they look like ordinary semi-detached homes, they are expected to create approximately 1.5 tonnes of carbon per annum, compared to 6 tonnes in a typical home, making real savings for tenants and for the environment.

Use: Social Housing

Location: Diss

Main Contact: Saffron Housing Trust, 01508 532000, info@saffronhousing.co.uk

Features: Pre-fabricated construction, air source heat pump

Jubilee 3

Use: College Building

Location: Easton

Main Contact: LSI Architects LLP, 01603 660711, norwich@LSIarchitects.co.uk

Features: Ground source heat pump, sedum roof, solar water heating, rainwater harvesting

Known as Jubilee 3, the new teaching centre at Easton College is one of the most energy efficient education buildings in the region. Designed by LSI Architects, the building is rated to the BREEAM Excellent standard by the Building Research Establishment. The building forms part of a complex, set around a garden court, and comprises 28 teaching rooms, a 64 seat lecture theatre, a café, a social area, laboratories and offices.

The frame of the building is made primarily from glulam beams and concrete. This dense concrete structure retains the heat of the building overnight and works alongside good levels of insulation to ensure that classrooms are warm when lessons start the next morning. Windows are also timed to close automatically in the evening, sealing the building in times of low use.

A vast sloping green roof, planted with 17,500 plants of sedum moss, wild thyme and wild strawberries, provides extra insulation, as well as encouraging biodiversity and helping to slow water run-off when it rains.

The south facing wall is entirely glazed and provides natural daylighting all year round. Overhanging eaves, woven with ornamental vines and other creepers, work to cool and shade the building in the summer and draw warmth to the building in the winter. Natural ventilation methods include manually-operated sliding panels in teaching rooms, computer-controlled panels in the open learning area, and openings in the first floor corridor to encourage air movement.

A ground source heat pump draws the heat from water in a natural aquifer 100 metres below ground. The temperature (12-14ºC below ground) is then boosted by the heat pump (to 45ºC) and transferred to an underfloor heating system. Rainwater is captured and stored for use in the toilets, while solar panels on the roof of Jubilee 3, heat water for hand washing.

Students enrolling in a foundation degree in sustainable engineering will find themselves studying the environmental performance of their own classrooms. Jubilee 3 will be used as a case study as part of understanding the impact of climate change on construction technology.

Dragonfly House

Use: Offices

Location: Norwich

Main Contact: Jarrold Properties, 01603 677353

Features: Underground earth duct; natural ventilation system, solar water heating, rainwater harvesting

This state of the art office is one of two office buildings constructed simultaneously on a brownfield site in Norwich. It sits on the bank of the River Wensum, with views of Norwich Cathedral.

Dragonfly House was conceived by Jarrold and Son Ltd in partnership with the Department for Environment, Food and Rural Affairs (DEFRA) with the aim of developing a building that would meet DEFRA's green agenda.

Propane powered chillers are used to cool the temperature in the computer room. Propane has virtually no global warming impact and further ensures that the cooling requirement is much smaller than for a conventional office building.

The construction methods adopted have allowed the offices to avoid the need for large boilers and air conditioning. Underneath the building, air is drawn through an earth duct, a large pipe buried three metres underground, to help warm the building in winter and cool it in summer. Together with a natural ventilation system, high insulation levels and the use of concrete ceilings, the building maintains comfortable ambient temperatures all year round, while significantly reducing energy costs.

Rainwater which falls on the building roof, is collected, filtered and stored in an underground tank for use in flushing toilets. The storage tank can hold 30,000 litres of water and is expected to reduce mains water usage by two thirds. Rooftop solar panels are expected to heat 35% of the water used in the building and a sustainable urban drainage system reduces the risk of flooding and protects water quality. A mooring is planned to allow visitors to arrive by boat.

Designed by architects Aukett Fitzroy Robinson to be kinder on the environment, Dragonfly House is the first commercial development in Norwich to be built to the Building Research Establishment's BREEAM Excellent rating.

Cley Marshes Nature Reserve Visitor Centre

Use: Visitor Centre

Location: Cley

Main Contact: Jonathan Clarkson, Visitor Centre Manager, 01263 740008, jonathanc@norfolkwildlifetrust.org.uk

Features: Ground source heat pump, sedum roof, rainwater harvesting, wind turbine, solar water heating

This landmark building on the beautiful North Norfolk coast is used as a visitor centre for the Norfolk Wildlife Trust and located on a Site of Special Scientific Interest (SSSI), in an Area of Outstanding Natural Beauty (AONB). Its design, by LSI architects, was inspired by its immediate landscape and topography and aimed to minimise the environmental impact of the building on its surroundings.

The building is heated using a ground source heat pump and hot water is heated with a solar thermal panel.

The sedum roof, which encourages butterflies and other insects, is shaped to encourage the prevailing winds towards a 6kW wind turbine. The turbine is mounted on a 9.5m-high mast, and has a wing span of 5.5m. Energy produced by the turbine is either used immediately by the visitor centre or sold back to the grid.

There are many other energy-saving, waste-minimising measures. For example, the concrete walls are made with at least 50% recycled ingredients and the walls and floors are insulated with mineral wool, beyond statutory requirements. Rainwater is also collected for the flushing of toilets.

The carbon footprint of the building is estimated to be just 20% of the footprint of a building relying on non-renewable energy sources. As such, although Cley Marshes Nature Reserve is the oldest Wildlife Trust reserve in the county, its new visitor centre is a building designed for the future.

New Victory Hall

The greenest village hall in Norfolk must also be one of the greenest community buildings in the UK. The New Victory Hall in the village of Neatishead serves the communities of Neatishead, Irstead and Barton Turf. It has been designed to a high level of sustainability and built, in part, by the local community.

The building faces almost due south and has large windows and roof-lights to ensure that lighting requirements are minimised. All lights use low energy bulbs and the outside lights shine downwards to reduce light pollution in the night sky.

The building is timber framed using a high percentage of reclaimed timber. The frame incorporates approximately 350 locally-harvested straw bales, with the external walls rendered by hand using lime render. Local people, under expert tuition from the builders, helped moved the bales on site and render the walls.

Sedum has been planted on the main roof and over the foyer of the new hall and this has already become well established and harbours an increasing variety of insects, bees etc. The roof over the toilet block is a 'brown roof' which is simply unplanted brick rubble which, over time, gets covered with weeds and other vegetation in a completely natural process.

An underfloor heating system draws energy from a ground source heat pump, the pipes for which are laid 1.5m deep below the car park area. The rainwater soakaways from the roof have been positioned over this area so as to constantly replenish the heat in the soil.

Use: Village hall and community centre

Location: Neatishead

Main Contact: Ian McFadyen, Project Co-ordinator, 01692 630150, ian.mcfadyen@victoryhall.info

Features: Straw bale and timber construction, ground source heat pump, sedum roof

Reepham Low Carbon Community

Use: Community

Location: Reepham

Main Contact: visit www.reephamchallenge.org for details

Features: 18 projects including eco-improvements to key community buildings, a car club scheme and low-energy street lighting.

A true community effort which developed from an initial carbon audit of the town in 2005, which showed that the town's carbon emissions per capita were 48% above the national average. Only 8% of homes were properly insulated and there was an over-reliance on domestic heating oil and private transport. Something had to be done!

A 'Green Team' of concerned individuals was formed, which started the transition towards the town's commitment to low energy use. Among their first projects, supported by Reepham Rotary Club, was the Reepham Insulation Project, which installed insulation in over 100 homes in the town.

Community groups also developed a series of projects as part of an integrated plan to reduce not only carbon emissions, but also fuel and transport poverty. Trials of bio-fuel in domestic boilers took place (a world first!) and a car club was developed, offering new low emission Volkswagens for members to use on a pay as you drive basis.

A great leap forward in Reepham's low-energy ambitions occurred in 2010 when it was selected as one of the winners of the government's Low Carbon Communities Challenge (LCCC) and was given funding from the Department of Energy and Climate Change to help improve the town's energy efficiency.

Beneficiaries of the LCCC funding include the Bircham Centre, an ageing Georgian building in the Market Place, which has benefitted from new energy efficient radiators, sympathetic secondary glazing to its sash windows and low-energy lighting. These improvements have reduced the Centre's lighting and heating bills by 50% and 30% respectively.

Insulation improvements, biomass boilers, solar water heating systems, wind turbines, air source heat pumps, photovoltaic panels and ground source heat pumps are all now planned or in place at buildings and locations across the town. Together with new allotment spaces, low-energy street lighting and other carbon-saving initiatives, Reepham has become one of the most energy-efficient communities in the UK.

A 10 STEP GUIDE TO GREENING YOUR OWN HOME

1. GET INSPIRED...READ ABOUT LOCAL EXAMPLES
2. VISIT THE BUILDINGS...TAKE PART IN THE OPEN DAYS
3. DO THE RESEARCH...VISIT THE SHOWS
4. ESTABLISH A BASELINE...TAKE A HOME ENERGY CHECK
5. DO THE EASY STUFF...SMALL CHANGES DO COUNT
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9. GENERATE YOUR OWN POWER...RENEWABLE ENERGY
10. INVOLVE YOUR COMMUNITY...MAKE THE TRANSITION

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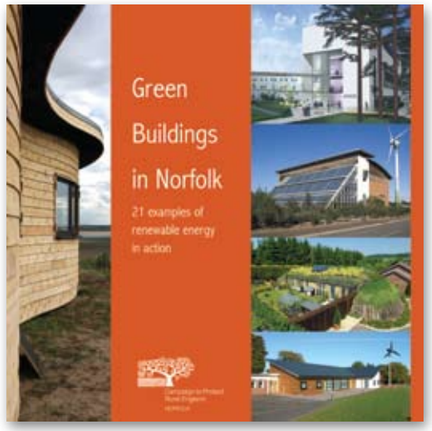

1. GET INSPIRED...READ ABOUT LOCAL EXAMPLES

Published by CPRE Norfolk in 2005, and reprinted in 2006, this 40 page full colour booklet highlights 21 of the first Norfolk buildings pioneering the use of renewable energy. Examples include a social housing scheme, a backpackers' hostel, a major office development, schools, a church, holiday accommodation, a research institute and many 'ordinary' homes. A detailed appendix on the different technologies and building techniques featured is also contained. To order free copies of Volume I and further copies of Volume II please contact the CPRE Norfolk office, or download from our website.

www.cprenorfolk.org.uk/greenbuildings

2. VISIT THE BUILDINGS...TAKE PART IN THE OPEN DAYS

Every September, CPRE Norfolk organise guided tours of eco-homes, energy-efficient public buildings and low-impact dwellings in Norfolk. Around 100 tours take place over a four day period at properties throughout the county. Many of the buildings in this booklet have taken part, with homeowners, architects and building professionals leading tours for visitors. This is a unique opportunity to get firsthand, practical information about the choice and installation of renewable energy, the use of natural building materials and the passive design of homes, from the people that are one step ahead.

If you are interested in being on the mailing list for the Green Buildings Open Days event, please send your contact details (email preferred) to the CPRE Norfolk office (details on the back page).

www.cprenorfolk.org.uk/opendays

3. DO THE RESEARCH...VISIT THE SHOWS

Locally, North Norfolk District Council has run a Green Build fair at Felbrigg Hall in the 2nd weekend of September for many years. This is an excellent place to do the research and talk to local traders and suppliers. A huge range of exhibitors attend, covering everything from insulation to beekeeping equipment!

Nationally, the Ecobuild event at Earl's Court in London in March is one of the biggest events in the world for sustainable design, construction and the built environment. A multitude of installers, traders and energy specialists from around the world take their place in the exhibition halls, with discussions, debates and demonstrations running alongside.

www.northnorfolk.org/greenbuild
www.ecobuild.co.uk

4. ESTABLISH A BASELINE...TAKE A HOME ENERGY CHECK

Using questions to establish the age, size, structure and thermal properties of your home, the Home Energy Check survey on the Energy Saving Trust website will give you a personalised report on your home's energy-efficiency. Although just a guide, it is a useful place to start and will help you consider the different ways that your building is leaking energy and the best methods to help you start saving on your fuel bills. Similar web-based tools can also calculate how much you can save from applying different measures to your home, both in CO^2 and money.

For a more specific overview of your home's energy specification and the best options for your money, you could also arrange an appointment with a green-minded architect or an energy design consultant.

www.energysavingtrust.org.uk - Home Energy Check, Energy Saving Checklist and Carbon Cutter

5. DO THE EASY STUFF...SMALL CHANGES DO COUNT

We all know to turn off appliances when they're on standby, switch to energy-efficient lightbulbs and only boil as much water as we need in the kettle, but there are endless other ways to make simple changes. For example, change to a green electricity tariff from an independent green energy company to ensure that all of the electricity supplied to your property is matched with electricity obtained from renewable energy sources. When purchasing new appliances, ensure they are A-rated for their energy-efficiency. Fit your toilet with a 'Hippo Water Saver'; a small device, free from the water companies, that sits underneath the cistern float and reduces the amount of water needed to flush the loo!

www.energysavingtrust.org.uk - At Home
www.direct.gov.uk - Environment and Greener Living
www.greenelectricity.org

6. INSULATE, INSULATE, INSULATE...GET A GRANT

Insulating and draught-proofing are normally the most cost-effective ways of bringing down energy bills. By sealing your home from unwanted heat loss you reduce the need for heating and ensure that the heat you do produce is used most efficiently. Increasing the layers of insulation in a loft, filling the space between cavity walls or solid walls, fitting a jacket around a hot water tank, investing in double glazing, and sealing windows and doors with plastic membranes, are just some of the steps you can take.

Grants for insulation are commonly available from central Government (through the Warm Front scheme in England), from energy suppliers (through the CERT scheme) and sometimes from local authorities, for households on certain benefits. The Grants and Discounts Database on the Energy Saving Trust website will give you comprehensive details of the latest available offers. The website of the National Insulation Association can then help you find your nearest approved insulation supplier.

www.warmfront.co.uk
www.energysavingtrust.org.uk - Grants and Discounts Database
www.nationalinsulationassociation.org.uk

7. CHANGE YOUR BOILER...MAKE IT EFFICIENT

The current recommended lifespan of a boiler is around 15 years and fitting an A-rated high efficiency condensing boiler with the correct heating and hot water controls can make a huge difference to your heating bills, as well as significantly cutting your home's carbon dioxide emissions (for example, boilers account for around 60% of the carbon dioxide emissions in a gas heated home).

A high efficiency condensing boiler works on the principle of recovering as much as possible of the heat which is normally wasted from the flue of a conventional (non-condensing) boiler. High efficiency condensing boilers convert 86% or more of their fuel into heat, compared to 65% for old G rated boilers. As with insulation, grants are available, for example, through the Warm Front Scheme (see Step 6).

www.warmfront.co.uk
www.energysavingtrust.org.uk - Grants and Discounts Database

8. SAVE WATER...SAVE MONEY

The average roof collects tens of thousands of litres of water each year, which then just runs straight into the drains. Investing in an underground rainwater collecting tank, or just a simple water butt for the back garden, is a great way to save water and money. Use a plumber to connect the tank or water butt to your toilets or washing machine, or simply use the rainwater for washing the car or watering the garden. Rainwater is better for plants than tap water as it is softer.

About 30% of all drinking water used in the home is flushed down the toilet every day. Low-flush and dual flush WCs are specifically designed to reduce the volume of water used during flushing and are now widely available on the market. These systems use up to 6 litres less water per flush than an old fashioned toilet – saving over 16,000 litres of water per year (enough to fill 7 red telephone boxes). And if you haven't already switched to a water meter, then do so, to ensure that you only pay for the water you use.

www.waterwise.org.uk

9. GENERATE YOUR OWN POWER…RENEWABLE ENERGY

From heat pumps to hydro-turbines, from biodigesters to solar panels, the choice of renewable energy technology to power or heat your home is improving all the time. The initial investment is still significant for many but with the introduction of the Government's Feed In Tariff (FIT) and the Renewable Heat Incentive (RHI), renewable energy is becoming much more cost-effective.

For example, under the FIT scheme, energy suppliers make regular payments to householders and communities who generate their own electricity from renewable or low carbon sources such as photovoltaic panels or wind turbines. The scheme guarantees a minimum payment for all electricity generated by the system, as well as a separate payment for the electricity exported to grid. These payments are in addition to the bill savings made by using the electricity generated on-site.

www.decc.gov.uk

www.energysavingtrust.org.uk - Generate Your Own Energy and Sell Your Own Energy

10. INVOLVE YOUR COMMUNITY…MAKE THE TRANSITION

Whether you've finished greening your own home, or haven't even started, community projects are a way of making an even bigger difference to the planet. Communities across Norfolk have done all kinds of things to make a start, from the bulk-buying of solar panels for houses in a village, initiating a Car Club scheme, making a village hall more energy efficient, running an Environment Day with stalls and exhibitions, or starting a Transition Town initiative.

Grants are available for community projects that aim to save energy. The Green Communities Team at the Energy Saving Trust can give free training and advice focused on funding and project planning, or provide technical support on renewable energy initiatives. The Low Carbon Communities Network can put you in touch with other community groups from across the country trying to make their own carbon reductions.

www.transitiontowns.org

www.lowcarboncommunities.net

www.energysavingtrust.org.uk/café

acknowledgements

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CPRE Norfolk has made every attempt to ensure that the information contained within this booklet is accurate at the time of printing. Although we cannot be held liable for any incorrect information, we will happily amend any details in future reprints.

LOTTERY FUNDED

ABOUT CPRE NORFOLK

CPRE Norfolk is the Norfolk Branch of the Campaign to Protect Rural England. Our aim is to promote the beauty, tranquillity and diversity of rural Norfolk by encouraging the sustainable use of land and other natural resources in town and country. Founded in 1933, we are one of the longest-running environmental organisations in the county.

Our Green Buildings in Norfolk campaign aims to promote positive and practical solutions to climate change and rising energy prices, focusing on local examples of good practice. Our 'Green Buildings in Norfolk' booklets have been distributed to every school, library, parish council and local authority in Norfolk, and given away to thousands of people visiting our exhibition stands at local shows and fairs. We have organised public lectures and professional networking events to help spread the word on Norfolk's green buildings, and our annual series of guided tours has given privileged access for hundreds of people seeking their own energy-saving solutions. Please see our web pages www.cprenorfolk.org.uk/greenbuildings for more information.

CPRE Norfolk is a registered charity (no. 210706) and our campaigning work would not be possible without the financial contribution of members and supporters. If you are interested in becoming a member of CPRE, or in giving a donation to help us continue this campaign, please visit www.cprenorfolk.org.uk/membership, or contact the CPRE Norfolk office to be sent an information leaflet.

Campaign to Protect Rural England
NORFOLK

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