a manifesto for sustainable heat

green alliance...

contents

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introduction

- **almost a third of the UK's carbon dioxide emissions come from heat**
- **over half of all energy in the UK is used for heat**
- **typically two thirds of the energy put into big electric power plants is lost as waste heat**

- **why do we have no strategy for producing heat more sustainably?**

Two recent reports have laid bare the imperative of tackling climate change. The IPCC's comprehensive scientific review of February 2007 demonstrated that it is 90 per cent certain that humans are behind changes in the climate and the consequences of not reducing our greenhouse gas emissions are terrifying. Earlier, in November 2006, the *Stern Review Report on the Economics of Climate Change* showed clearly that it is far more effective and financially sensible to tackle emissions now than wait until a later date.

There is no doubt that the energy sector, and our dependence on fossil fuels, is key to rising emissions. Since January 2006 the government has been conducting a comprehensive review of its energy policy in response to both this mounting threat and concerns over the security of our energy supplies in an age of diminishing UK natural gas. The next stage, the publication of an Energy White Paper, should frame the UK energy market for the coming crucial years.

Yet while the government has recognised the need to look at energy policy it has concentrated its efforts almost exclusively on the electricity sector, which produces only a third of the UK's emissions. A flick through *The Energy Challenge* was enough to impress upon even the most casual reader the lack of attention being accorded to either of the heat or transport markets. These two sectors equal or surpass electricity in terms of emissions produced, and eclipse it in the amount of energy they consume, yet are dwarfed by electricity in policy research.

This manifesto concentrates on the hidden sector of our energy supply: heat. Transport is easily separable, yet people use the words 'energy' and 'electricity' interchangeably. In pie-charts, heat is often hidden behind the words 'homes' and 'industry' and official reporting figures frequently neglect to separate out energy used by heating processes.

Heat is fundamental to our whole economy: in industry for melting, evaporating and drying processes; in our homes and businesses for warmth, hot water supply and cooking, and conversely for keeping cool in the summer. Yet because of its disparate nature heat gets overlooked.

This is a mistake. Heat produces more emissions than electricity and providing this heat in a more sustainable way is one of the cheapest options for mitigating climate change. It will also address the other three pillars of energy policy: security of supply, competitiveness and fuel poverty.

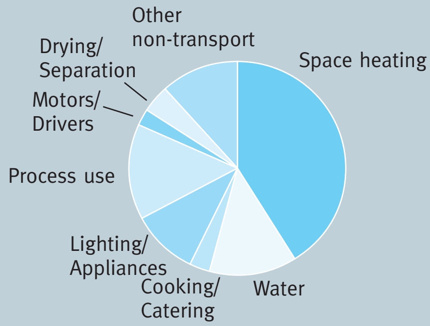
There is evidence that Whitehall and parliament are slowly waking up to the importance of addressing heat. The recent Commons Trade and Industry Committee report *Local energy – turning consumers into producers* concluded that 'low-carbon heat production is the Cinderella of energy policy'. The Office of Climate Change is carrying out a review of the sector and Alistair Darling, the Secretary of State for Trade and Industry, has been appointed lead Minister in this area. Yet the talk is that Energy White Paper will still have very little to say beyond warm words on this subject.

There is a groundswell of organisations calling for action in this area, from businesses and trade associations to NGOs and parliamentary bodies. It is time to capitalise on this momentum and push for a sustainable heat strategy.

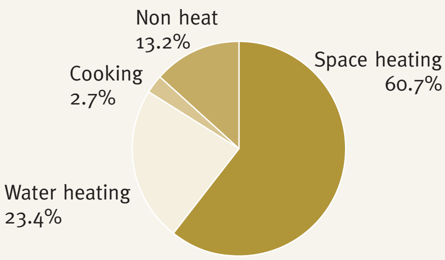
how important is heat?

To understand what benefits sustainable heat can give us, we need to understand what role heat plays in our economy. Two key facts highlight this:

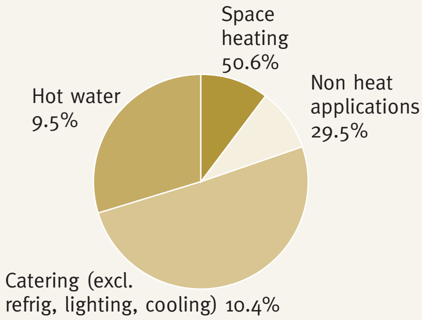
- **Heat dominates UK energy use – outside of the transport sector it accounts for 76 per cent of all the energy we use.** Three times as much as electricity. Even allowing for transport, more than half of the total energy that we use is for heating purposes.[1]
- Heat has a huge contribution to emissions - **just under a third of all UK carbon dioxide emissions came from heat in 2004.**[2]



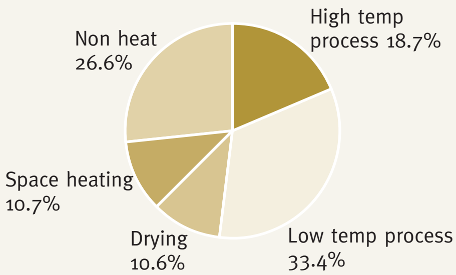
UK energy consumption by end use, excluding transport (2003)[3]



Domestic energy use, 2004[5]



Service sector energy use[6]

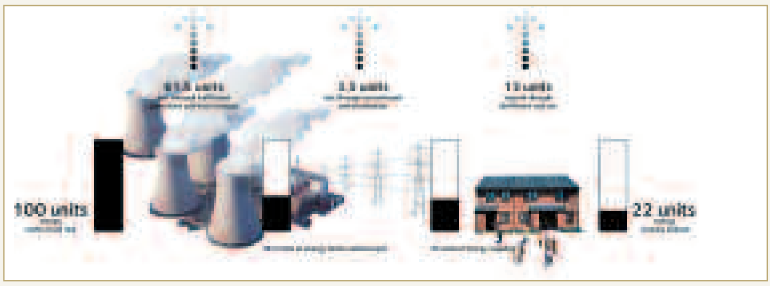


Industrial energy use[7]

The most intensive use of heat is in the domestic sector, where fuel supplied for cooking, heating and hot water together accounts for about three quarters of the energy we consume in our homes. As a result, heating the 25 million or so homes in the UK is responsible for about a quarter of the UK's total energy consumption.[4] Gas is the fuel of choice in the domestic sector, but about 4.4 million houses are still not connected to the main gas supply. These properties tend to be rural and often depend on oil for heating, which tends to be more costly and inefficient.

In the industrial sector heat is responsible for almost three quarters of total energy use, and in the commercial and public sector heat occupies a similar position.

But whilst heat is a precious commodity, it is wasted every time we generate electricity from a conventional power station. Of any 100 units of fossil fuel energy put into a conventional centralised power station, only 22 units will actually be used. Over two-thirds of this energy is lost as heat,[8] costing the UK economy over £5 billion a year.[9]



Heat is lost as electricity is generated and transmitted

the benefits of sustainable heat

Tackling heat addresses the four main pillars of energy policy:

1. To set the UK on a path to reduce emissions by 60 per cent by 2050:
32 per cent of the UK's carbon dioxide emissions in 2004 were from heat,[10] equal to those from electricity. Converting only four per cent of domestic users to renewable heat would save one million tonnes of carbon.[11]

2. To maintain the reliability of energy supplies:
In 2006 the UK moved from being a net exporter to a net importer of gas; by 2020 we could be importing up to 80 per cent of our gas needs. **60 per cent of the gas we use in the UK is to provide heat.[12]** Using a wide variety of technologies from indigenous sources would reduce our gas dependency and mean industry and householders are not vulnerable to supply interruptions and uncertain prices.

3. To promote competitive markets in the UK and beyond:
Ofgem, the electricity and gas regulator, has no remit to address competition in the heating market beyond gas. Unlike electricity and transport fuels, heat markets are naturally distributed, presenting the opportunity for the development of a diverse and competitive market.

4. To ensure that every home is adequately and affordably heated:
The price of consumer gas has risen by 35 per cent since 2003, doubling the number of people in fuel poverty to 2 million.[13] **Reducing heat demand and waste heat decreases gas bills by an average of 26 per cent.[14]** Those off the gas grid are prime targets for replacement with lower cost renewable heating.

emissions savings

The government has concentrated its efforts on reducing carbon dioxide emissions almost exclusively on the electricity sector, even though heat accounts for more emissions than electricity. At 32 per cent of all the emissions in the UK in 2004, addressing heat has huge potential for emissions reductions.[15]

There are three main ways in which action on heat can help reduce carbon dioxide emissions:

Sustainable heat offsets the burning of fossil fuels. Using renewable sources means that less fossil fuels are burnt, reducing emissions. Even where fossil fuels are used, technologies such as CHP use them more efficiently, so less is needed. Renewable heat presently accounts for only about one per cent of heat energy consumption[16] but even the most conservative analysis indicates that it could contribute up to 4.7 per cent of total UK heat demand by 2020, leading to carbon savings of around 1.2 per cent of current total UK carbon emissions.[17] The Biomass Taskforce goes beyond this, saying that renewables could contribute up to 7 per cent of UK heat demand by the earlier date of 2015.[18]

Efficiency and demand reduction measures reduce the amount of heat used or wasted in our homes and industry. Energy efficient measures in the domestic sector could save 7 million tonnes of carbon a year, equivalent to building a new 1,000MW_e nuclear power plant.[19]

Sustainable heat can drive behaviour change. Sustainable and local heat generation can help raise awareness of energy use among those installing private systems or using local ones, as shown by the Sustainable Development Commission research on local energy technologies. This can then act as a catalyst to further energy saving actions.

heating bill pushes up NHS deficit

The average hospital uses three times as much heat as electricity. The increase in energy bills from winter 2004-05 to winter 2005-06 accounted for half of the NHS deficit by summer 2006.[20]

security of supply

If we are worried about gas supplies, then what we are really concerned about is how to heat our homes in winter and keep our economy working.

> "Ukraine gas row hits EU supplies." BBC News Online, 1 January 2006

Late December 2005 and the Russian state-owned gas company, Gazprom, cuts Ukranian gas supplies. Talks had failed to solve a row over a four-fold increase in prices, and the Russians responded with drastic action.

The result? A stark realisation that much of our gas supply comes from potentially unstable regions of the world, and the UK could be vulnerable to supply cuts at any time. By 2020 it is estimated that we could be dependent on imports for as much as 90 per cent of our natural gas supply.[21] And with gas providing a huge 90 per cent of our domestic heating demand and 55 per cent of our industrial heating demand,[22] the heating of our homes and the competitiveness of our industry are particularly vulnerable to supply interruptions.

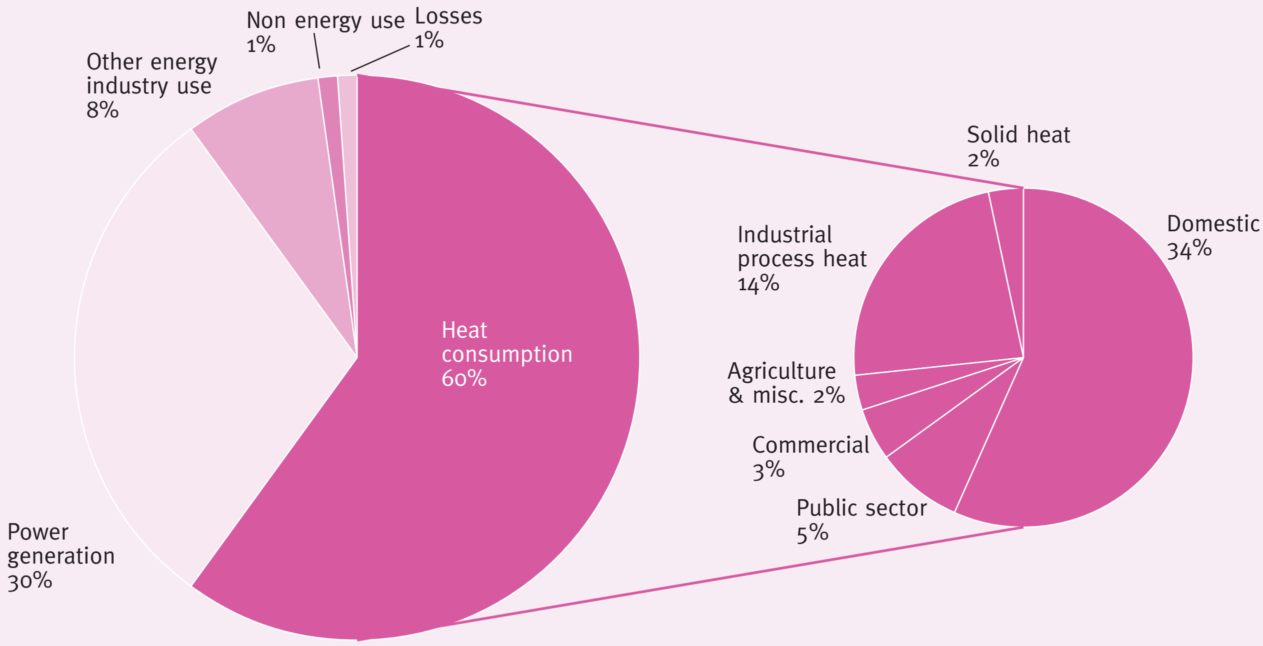
This concern was one of the key triggers for the government's energy review which concluded that one of the best ways to maintain energy reliability is through diversity in sources, supply chains and technologies and through 'home grown' energy supplies.

However, the review went on to focus on how this can be achieved through the electricity market, virtually ignoring the fact that 60 per cent of the gas we use is for generating heat.

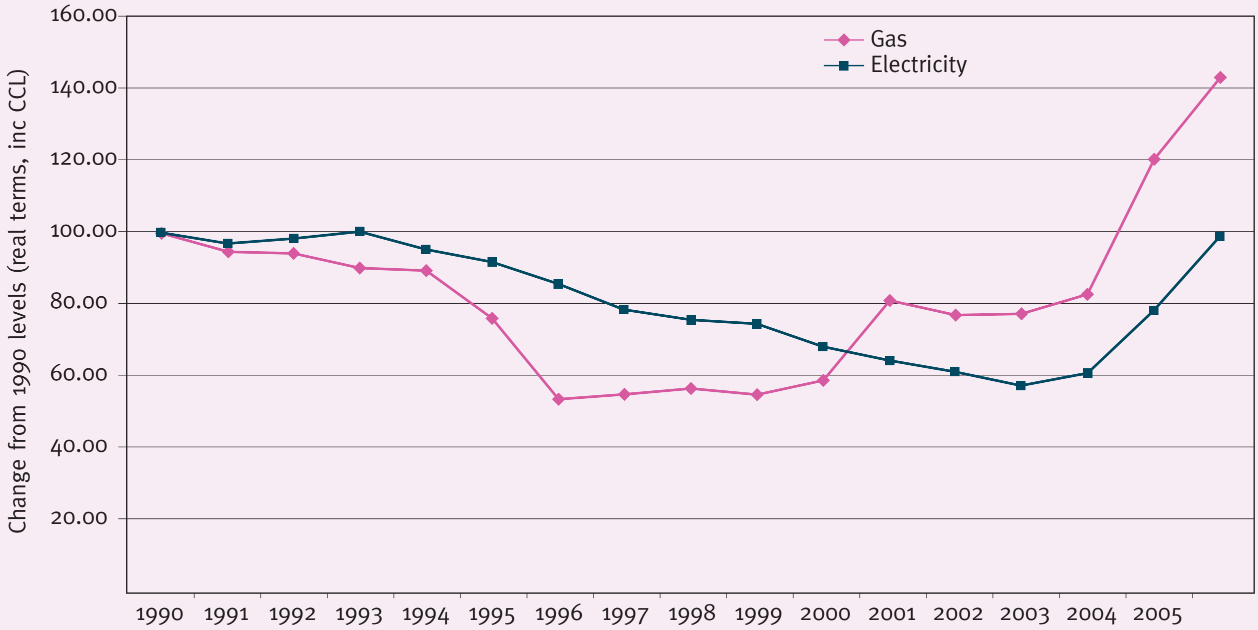
Low carbon and renewable heat helps increase the diversity of heating supplies. Harnessing energy from alternative sources such as solar, biomass or latent ground heat energy displaces the need for gas as the fuel source.

Gas may still be used, such as in some Combined Heat and Power (CHP) plants, but it is used more efficiently so less fuel is needed (good quality CHP can increase the efficiency of the fuel used to 90 per cent).[24]

Energy efficiency improvements and building design can also reduce the need for gas-fuelled heating in the first place.



Gas use in the UK by end user, 2005[23]



Industrial energy prices[25]

economic competitiveness

Rising costs of fossil fuels mean that heat accounts for an ever-increasing proportion of our national energy bill, as illustrated in the graph above. Industrial gas prices have risen a staggering 73 per cent since 2004, placing considerable economic stress on energy-intensive manufacturing processes. Sustainable heat can address this in various ways:

Increasing competitiveness, encouraging small and medium size enterprises. Ofgem, the electricity and gas regulator, has no remit to address competition in the heating market beyond gas. Although the electricity and transport markets are dominated by large companies, heat markets present the opportunity for a diverse range of businesses at various scales to become involved.

Replacing imported fuels with local jobs. Wherever the hardware is produced, a substantial part of producing sustainable heating is inherently local or regional: design, installation, training, marketing and distribution. This offers enormous opportunities for local craft industries, for agriculture, forestry and small- and medium-sized enterprises.

Deferring other investment needs. Investment in sustainable heat and heat demand reduction can also defer or avoid the need for investment in building large new centralised power stations. This is becoming increasingly risky as a result of a fast changing regulatory environment, increasing competition and the long investment time horizons needed for large infrastructure projects. It can also reduce the need for investment in strengthening an ageing network to carry rising power loads.

Increasing efficiency. Inefficiencies in our current centralised power system mean that almost half of the primary energy used for electricity generation is wasted as heat, costing UK plc over £5 billion per year. Closing this loop and joining up heat wastage with use would dramatically increase the efficiency of the fossil fuel we do use. The Carbon Trust estimates that using this wasted heat could save up to £1bn a year in the UK and an annual carbon saving potential of 7.5 million CO_2 tonnes.[26] Using biomass for heating can be over 90 per cent efficient (i.e. 90 per cent of the energy put in can be used). This compares to around 50 per cent efficiency in transport and 30 per cent in electricity. £1 in every £3 spent on heating is currently being wasted in the 10.3 million homes in the UK with inefficient insulation.[27]

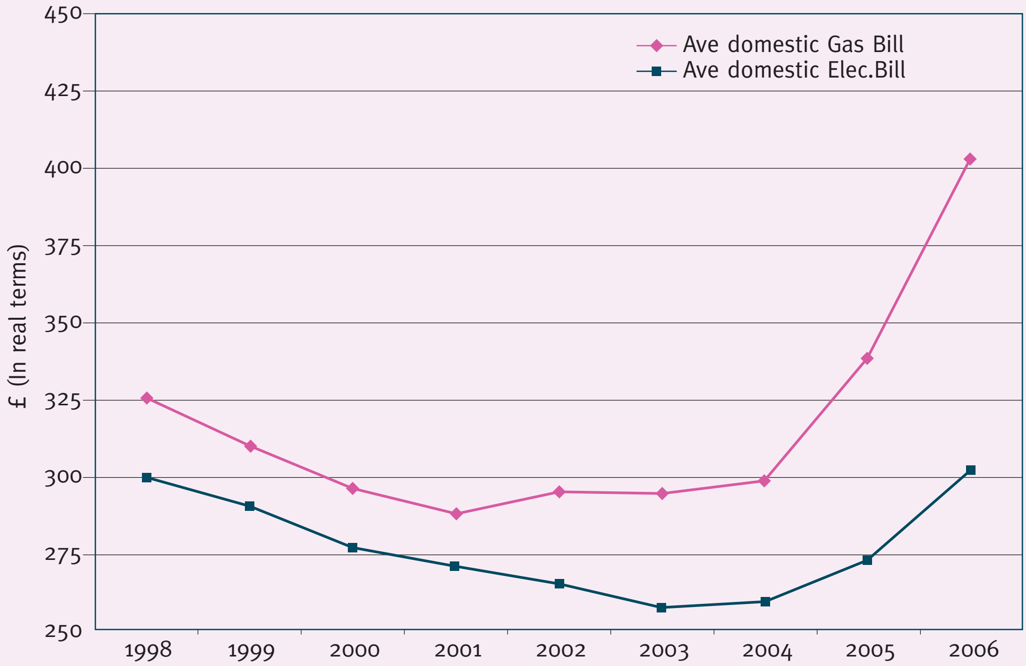
fuel poverty

It is often the poorest sectors of the population that are burdened with draughty homes and expensive electric heating. With the rise of gas and electricity prices since 2003 (gas prices soared by 91 per cent and electricity by 60 per cent), keeping a home warm is now becoming an unattainable luxury for more and more people. Energywatch estimates that there are now at least three million vulnerable households living in fuel poverty.

The government aims to eradicate fuel poverty in the UK by 2016, and to eradicate fuel poverty for vulnerable households in England by 2010, meaning that no household should have to pay more than 10 per cent of its income on fuel.[28] The aim of eradicating fuel poverty has also made sustainable heating options attractive to social housing associations (see example on page 16).

However, the extent to which the fuel poor can take advantage of these technologies is hampered by their large capital costs- an issue covered in the following chapter.

Sustainable heat generation is particularly well suited to retrofitting hard-to-heat homes. Of an estimated 23 million homes in the UK, 6 million have solid walls, which puts cost-effective cavity wall insulation off limits. 4.5 million households are off the gas network, mainly in rural areas, and have to rely on expensive electric or oil based heating. These homes are prime targets for the fuel bill savings offered by renewable heating.



Average domestic energy bill, 1998-2006[29]

what's missing? the current barriers to use

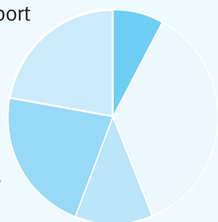
Despite the readiness of many sustainable heating technologies for the market, and the financial and emissions savings they offer, there is not the uptake that might be expected.

This is mainly due to the invisibility of heat in official energy information, an institutional set-up that does not support the supply of heat from alternative sources and a small and relatively unknown market. So even if people know about the potential gains it is seen as a risky investment for business and homeowners alike.

Milford Haven: insufficient incentives mean proposals ignore CHP possibilities
The case of the new gas power stations being built near Milford Haven highlights the lack of incentives available for CHP. The waste energy in heat from these two plants would be greater than Wales' annual electricity demand, yet plans submitted propose to capture very little of this heat. This is despite the fact that there are two large Liquid Natural Gas (LNG) terminals being constructed close by that require heat and there are already two oil refineries requiring heat at the location.

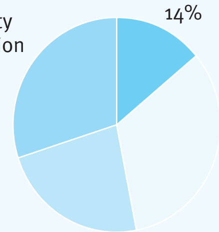
1. Where is heat?

Heat is often invisible in official energy information. Energy statistics tend to highlight the role of electricity while heat is hidden under the titles 'industrial', 'domestic' or 'service sector'. Take the two graphs below, both show energy use. The first, as presented in the Stern report, separates out power generation and transport, but heat is hidden under the terms 'other industry' and 'buildings'. The second shows clearly the proportion of emissions from the heating sector.



Emissions (2000) as presented in the Stern Report[30]

In fact, during this period 55 per cent of energy was used as heat, and over 76 per cent of non-transport energy.



Total UK net CO2 emissions by end-use (2004)[31]

There is a reporting gap on heat use. There is an insufficient database of statistics on heating, as evidenced by a quick flick through the annual energy statistics. Reliable statistics are needed to establish a baseline to measure against and monitor progress. Without regular statistics the savings to be gained will not be picked up on as easily.

Heat generation itself is often invisible. Being such an integrated part of our lives, secure heat supplies are normally taken for granted. Boilers are hidden away in basements or underneath stairs in our homes. There are no large heat power stations on the horizon to remind us of the energy source we use most. As heat is barely thought about, producing it from a different source is rarely considered.

2. The institutional set-up does not support the supply of heat from alternative sources.

The DTI and the energy regulator, Ofgem, are the axes which shapes and implements our energy policy. The structure and remit of these institutions have built upon the policy agenda of the 1990s, which focussed on the privatisation and liberalisation of the former state-owned gas and power monopolies. Ofgem's attention (notably the Gas- not heat- and Electricity Markets Authority) has focussed on driving down consumer prices through regulating the natural monopolies in gas and electricity networks and promoting competition in gas and electricity supply.

With government attention focused on gas supply the supply of heat from alternative sources exists in a policy blindspot.

public estate fails to capitalise on cost savings from renewable heat

The public estate has the potential to provide early momentum in a transition away from traditional, fossil heating to new sustainable sources. High rates of building occupancy mean effective utilisation of heating plant, driving shorter payback periods. These can be used as exemplars to show that sustainable heat offers significant savings over the lifetime of an investment.

However current practices could hinder these savings. Often energy supply is separated out from central PFI contracts. This means that there is no scope to finance the renewable plant from fossil fuel cost savings. Elsewhere, the drive for reduction in capital budgets means that the upfront costs can be deemed too great despite the year-on-year cost savings over the operating life of the plant.

3. The market is small, underdeveloped and relatively unknown.

Sustainable heat solutions are often, by their nature, small-scale and distributed. As a result customers are unaware of them as options that could reduce their energy bills and their carbon footprint. Even if they are aware, the complexity of the market, the choice of technologies and the regulations they must adhere to are overwhelming and many of the measures are viewed as capital intensive and outside of the mainstream.

We are too used to gas. A legacy of cheap and abundant North Sea gas and sustained public investment in gas production and distribution have afforded natural gas so many advantages that even in the face of rising prices and the obvious benefits of sustainable heat, alternative suppliers face many competitive disadvantages in entering the market.

inconsistent capital grant schemes can hamper investment

Capital grants are often seen as a simple and straightforward means of pump-priming a market, and are presently employed to help support renewable heating and electrical installations in the domestic sector. But many in the industry consider the current scheme counter-productive.

The experience of Howard Johns, Managing Director of Southern Solar, is a disturbing indictment of grant programmes:

'Capital grants are notorious for their stop-start effect on market demand. If customers believe that a grant may be available, they are often unwilling to commit until they have exhausted this opportunity, even if they have the ability to pay.'

'The current experience of the Low-Carbon Buildings Programme is a disaster for our company, with grants to customers rationed on a monthly basis. In March we lost £40,000 of sales that were ready to proceed but did not get their grants. Only five out of about twenty clients who were attempting to secure a grant were successful, some postpone till next month whilst others simply cancel. At a time when we should be investing to expand our business, the reality is that we are facing a loss for the month ahead and if this continues for much longer it will be difficult for us to keep our staff employed'.

Lack of knowledge of sustainable heat solutions hampers demand. Information and awareness levels about different sustainable heating technologies are still quite low and they are often presented as unreliable or financially risky. As a result, most consumers still consider sustainable heating technologies 'alternative' and they would not be considered when an investment decision, e.g. for a new heating system, is being taken.

High upfront investment costs put off consumers. Although many sustainable heating solutions have low running costs, the upfront capital needed puts off many consumers.

Support from capital grant programmes has often proved ineffective. Support to tackle capital barriers has often been via isolated capital grant programmes. Historically, such programmes have failed to deliver industry expansion as they are notoriously unreliable, operate over short timescales and offer uncertain levels of funding. Unpredictability undermines business planning and short time horizons deter investors. In the mid- and long-term, economies of scale should significantly decrease investment costs.

These issues create a 'chicken and egg' situation. Market development is hampered by low demand from consumers, making installers and builders reluctant to enter the sustainable heating business, perpetuating the limited offer on the market. As a result, many businesses across the supply chain lack the consistent sales volumes or market certainty to realise economies of scale.

Lack of qualified installers, advice givers and qualified engineers to maintain the technologies. With the diffuse pattern of supply, many businesses in the sustainable heat sector remain small and under-capitalised with a lack of skilled individuals to sell and maintain sustainable heating technologies. When the market does grow there is a risk that quality could suffer and small companies will be unable to meet demand.

the National Trust Cliveden Estate CHP scheme ends up using gas

When planning a new housing development on the Cliveden Estate, the National Trust proposed designs featuring reduced energy consumption, which were benchmarked against the EcoHomes Standards and the Green Building Guide. Insulation, heat storage and beneficial solar gain were all included, along with the installation of a CHP plant to provide a high proportion of the estate's electricity and hot water needs.

However, the National Trust faced several barriers to installing a CHP plant on the site. Ideally, it would have been fuelled by biomass woodchips but a lack of standard design meant that the plant had to be commissioned from scratch. Once this barrier had been overcome problems with fuel supply and high running and maintenance costs were reported. The decision was made to install a gas powered CHP plant instead of biomass, as EcoHomes points would be lost if electricity had been used. The plan aims to convert to a more sustainable source of fuel once the political and economic obstacles are removed.

what is sustainable heat?

Sustainable heat is heating and cooling from low carbon measures and renewable sources.

The following technologies/schemes have an important role in sustainable heat and cooling: energy efficiency measures and insulation, energy management devices, biomass heating/boilers, district heating, combined heat and power (CHP), micro-CHP, solar thermal, ground and air source heat pumps, anaerobic digestion, geothermal, absorption cooling technologies and both passive and active design measures to reduce heat demand.

reducing demand for heat

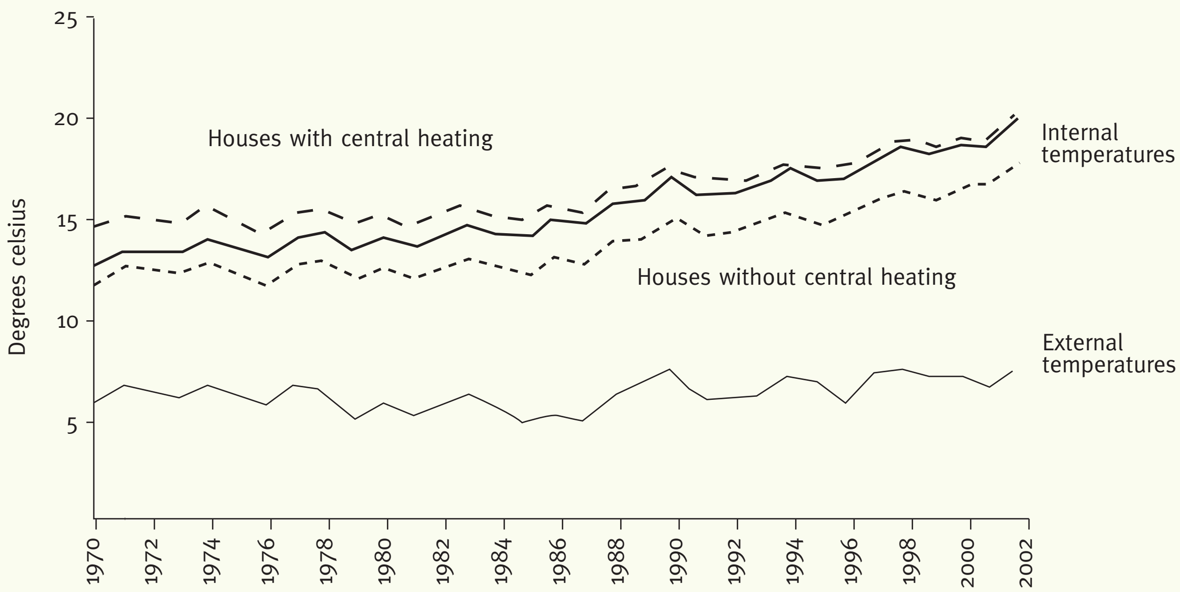
Before we look at sustainable heating technologies we need to look at managing and reducing heat demand, as the first priority in the energy hierarchy. Numerous energy standards have been published about how to achieve energy efficiency.

But while energy efficiency standards have been improving, the increased uptake of central heating has meant that people can now heat their homes and offices at the flick of a switch, often heating more rooms than needed and to a higher temperature than required.

We keep our homes warmer today. In 1990 the average temperature inside homes was 16°C but this increased to 18°C in 2004.[32] This has a dramatic impact on energy consumption, as it takes around 50 per cent more energy to heat a house to 18°C than to heat a house to 13°C (the average in 1970).[33]

designing for heat

Consideration for heat needs to be central to any new building design. Simple measures such as maximising direct solar gain (the amount of time a building gets direct sunlight) are effective at reducing the need for heating or cooling. For example, buildings can be set out in a sun-facing curve, creating a 'sunscoop', which traps solar heat and creates a warmer microclimate. Combined with thick insulation and triple glazing, this can mean that buildings may not need a conventional heating system at all and any supplementary requirements can be met by a controlled ventilation system. Heat from the sun can also be captured in sunspaces and the warm air piped around the building. Secondary measures can also be retrofitted to buildings such as solar control glazing, sun shading and reflective painting. Overhangs can be included that let in direct sunlight in winter, when the sun is lower, but block



Changes in internal and external temperature since 1970[34] it in summer. Airflows and orientating buildings based on wind direction can be used to provide natural ventilation.

National Trust – preserving heat in Stamford Brook

In partnership with Redrow Homes, the National Trust worked to build homes in Stamford Brook in a four-phase development, with phase four planned for completion in 2008. In total this will involve the construction of 710 homes with a mix of 2, 3 and 4 bedrooms. The development will also include 10 per cent affordable housing in the first three phases, rising to 25 per cent in phase four.

The development aims for high environmental standards and has achieved these in water use, promotion of public transport and respect for the surrounding natural environment. In terms of reducing demand for heat, the homes have heavily insulated floors, walls and roofs, as well as split external lintels to reduce heat loss. The layout of the development also promotes solar gain and 84 per cent of the houses will be unshaded at midday in winter.[35]

Another technique is using thermal mass. This involves building with materials such as concrete or brick, locating them in direct sunlight and painting them black. These bricks absorb and retain heat during the day and release it slowly during the night or on cloudy days. Conversely, in the summer the mass cools down during the night and retains the coolness the next day.

building for saving heat

Red Kite House is designed to be heating and cooling efficient. Its curved design and orientation captures the wind, maximising airflow through the building and supporting natural cooling processes. High-level exposed concrete ceilings on each floor act as a heat sink during the day. They are cooled by air entering through 100 motorized windows on each floor. Roof-mounted turbines draw air in through the windows on the top floor, which is the most vulnerable floor to overheating in the summer. This floor is also shaded by a south-facing canopy. Neutral solar control glass minimises solar heat gain in summer whilst maximising natural daylight.

insulation

High levels of insulation are fundamental to improving energy efficiency in buildings. It prevents winter heat loss and helps keep buildings cool in the summer. Almost all parts of a building can be insulated, from walls and lofts to windows and doorways. Cavity wall insulation is quick, clean and relatively inexpensive and is normally injected from the outside of a building through small holes. Solid walls are harder to insulate but insulating 'jackets' can be fitted externally and internally. Additionally, environmentally friendly insulation materials have become available in recent years, such as cork, recycled cellulose, flax and sheep's wool.

Up to 33 per cent of the heat produced in our homes is lost through the walls and a further third

Red Kite House, the Environment Agency West Area headquarters (image courtesy of Martin Cleveland Photography for the Environment Agency).

Installing insulation (image courtesy of the EST)

through the roof.[36] Widespread implementation of insulation could save around 7 million tonnes of carbon a year.[37] The DTI has calculated that widespread loft insulation alone could deliver savings of over 1.2m per year and it is a good investment: payback is only 2.7 years and householders get a 180 per cent return over five years.

There has been a significant increase in the thermal insulation of domestic dwellings, partly due to low cost schemes offered by energy suppliers in connection with the Energy Efficiency Commitment. However, there are still 10 million properties without cavity wall insulation, about two-thirds of the existing property stock. The main disincentive is time and effort and the difficulty of comparing payback over time with an initial upfront cost. Schemes such as British Gas's council tax reduction pilot (see case study) show the potential for fiscal incentives to raise uptake.

Other heat saving measures include draught proofing windows and doorways, as 20 per cent of all heat loss is through ventilation and draughts in a typical home.[39] Insulating pipes and hot water tanks can also cut down on heat loss; fitting a British standard 'jacket' to a hot water cylinder can reduce heat loss by around 75 per cent. Double or secondary glazing can minimise heat loss by up to a half. Radiator insulating panels can be fitted behind the radiator to lessen heat loss, as 70 per cent of radiator heat is lost into the walls.[40]

smart meters and energy management systems

Key to energy efficiency and reduction is being able to measure and manage energy. If consumers are unable to comprehend or easily see how much energy they are using it is far harder to cut their use.

incentivising insulation

British Gas had partnered with local councils around the country to offer subsidised cavity wall insulation, as part of their EEC. There are five schemes now in operation, British Gas is in discussion to set up 20 others and the government is looking into the scheme's replicability at the national level. In 2005, 200 homes in Braintree had been insulated and 90 in South Cambridgeshire (data is not yet available for other schemes). The schemes are running slightly differently but homeowners are incentivised by the offer of what is termed either 'cashback' or a council tax rebate, there are no additional costs to the resident and British Gas pays the council £50 towards each installation.[41]

The government hopes that the domestic sector can achieve 4.2 million tones of carbon savings by 2010. Installing smart meters could conservatively deliver 7 per cent of this target each year.

At their most basic, smart meters measure how much energy is used and communicate this to a display device. More elaborate meters store and communicate consumption data by time-of-use.

Smart meters show the consumer how much energy they are consuming (Image: More Associates)

Research has shown that improved consumption feedback creates a better awareness of energy use and carbon emissions, prompting a change in behaviour. Available evidence suggests smart meters can reduce energy use by between 3 and 15 per cent. Systems that also involve some sort of pay-as-you-go device have been shown to increase savings by up to 20 per cent.[42]

heating controls

Thermostats can be fitted to individual radiators to control the temperatures of individual rooms (image courtesy of the EST)

Buildings that are centrally heated can be made more efficient by upgrading heating controls. Timer switches and programmers allow heating and hot water to only come on at times when they are needed and room thermostats can automatically switch off the central heating once a certain temperature is reached.

a smarter school in Devon

Tiverton high school in Devon has implemented a metering system that provides half hourly readings of gas, electricity and water use. These can be read through a software programme on the bursar's computer. The school already has the lowest electricity use in the country but the smart meter system enabled further savings. The system identified that the heating was coming on at midnight due to a fault, as it was set to come on much later. The fault was repaired and a temperature sensor was used to measure how long it took for rooms to reach a comfortable temperature. The results showed that the heating did not need to come on until 6am, even at the coldest time of year, and the system was set accordingly, saving £3,045 per year in gas costs and large amounts of carbon emissions. The biggest saving has been in relation to water use, rather than heat, but it illustrates the potential of smart meters to identify unseen problems, which can be to do with water or heating. The system recorded high levels of water use in the area of three prefab classrooms. Two of them are not in use and the third did not need a water supply, which meant there was a leak. This was repaired and the school immediately saved £20,000 per year, which more than makes up for the £5,075 cost of the meter system.[43]

Similarly, thermostats can be fitted to individual radiators to control the temperature of rooms separately. Intelligent heat controlling devices can combine several of the above functions, as well as learning how long it takes a building to heat up in different weather conditions. Weather compensators are also available individually and are able to delay switching on the central heating on milder days.

greater control at Manchester conference centre

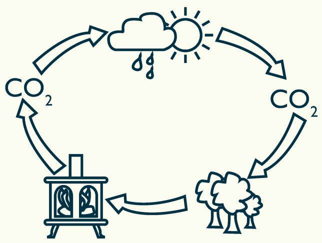
Prior to improving their heating controls, all of the conference centre's hotel rooms were heated throughout the day, to ensure they were warm if a delegate happened to return to their room. A better system of control now allows the conference centre to save energy and also allows guests to be more comfortable by providing more control over their room temperature. The system turns the heating on to ensure it is warm from 6:00 – 7:00 a.m. and again from 4:00 – 5:00 p.m., when many delegates return to their rooms. At all other times the heat is reduced to an average of 13°C and the room's occupant takes control, with a one hour boost of heat available as frequently as desired at the press of a button. The system is very easy to use and instructions are provided.[44]

supply side – providing heat from sustainable sources

For many existing buildings there is a limit to the efficiency that can be achieved through demand side measures alone. In addition to efficiency measures a crucial element of de-carbonising our heating is to provide heat from low carbon and renewable sources.

Biomass heating

Biomass, also known as 'biofuel' or 'bioenergy', is a generic term that describes the use of organic matter of recent origin to produce energy. Biomass is a simple and proven heating technology that is virtually carbon neutral, as any CO_2 that is released is counteracted by that absorbed during the plant's lifetime.[45]



The biomass cycle (image courtesy of the NEF)

Biomass can take solid or liquid form and can be produced from a variety of plant types. Solid, or dry biomass, includes wood products, energy crops such as rape and short rotation coppice products such as willow. Wet biomass includes industrial biodegradable products from food processing, such as waste cooking oil. Also included is the slurry from livestock, which is used to produce biogas (looked at separately below).

wood fuel heating at Sheffield Road flats

Barnsley Metropolitan Borough Council has adopted a preference for biomass heating and intends to apply wood heating throughout their building portfolio where space and access permits. This policy enabled the council to win first prize in the 2006 Ashden Sustainable Energy Awards.

In 2005 wood heating was installed by Econergy to provide community district heating for three tower blocks with 166 flats. This is the first of six Fröling wood boiler installations ordered by the Council and the displacement of gas use saves approximately 300 tonnes of CO_2 emissions per year. The boilers are over 90 per cent efficient and use approximately 500 tonnes of wood chip per annum, much of which is sourced locally. The combination of biomass heating and improved insulation has enabled the council to substantially reduce heating bills and address fuel poverty objectives.

Biomass can be used for space heating, for hot water and to power domestic, community and industrial CHP systems (looked at separately later). The principal market for domestic scale heating is more rural locations where there is space to accommodate the boilers- the potential market size is 1.1 million houses.[46] The cost for boilers varies depending on the fuel choice; a typical 20kW (average size required for a three-bedroom semi-detached house) pellet boiler would cost around £5,000 installed, including the cost of the flue and commissioning.[47] The fuel costs are cheaper than conventional heating fuel.

A biomass stove (image courtesy of the NEF)

Biomass is an extremely efficient way of using energy and can reach levels of 90 per cent efficiency (i.e. 90 per cent of the energy put in can be used), this compares to around 50 per cent efficiency of biomass used in transport and 30 per cent in electricity. It can also provide local economic benefits through the use of a local fuel source, and offers new economic opportunities for farmers.

IKEA keeps warm using waste biomass

3G Energi have installed a pair of wood heating systems in the recently built IKEA store in Milton Keynes, making IKEA one of the first multinational companies in the UK to implement a renewable heating system on commercial terms. The combined boiler system, with the primary one running on regionally sourced wood chips and a smaller one running on wood waste from the shop, provide IKEA with an annual cost saving of £7,500 compared to using gas at current prices. The installation also provides IKEA with a valuable use for up to 7.5 tonnes of wood waste per week, such as old pallets and wood off cuts, and results in CO_2 savings of over 1,500 tonnes per year.[48]

Anaerobic digestion

This involves the conversion of organic matter to energy by microbiological organisms in the absence of oxygen. The process produces 'biogas' (a mixture of methane and carbon dioxide), which can be used as a fuel source for heating. There are four main feed stocks suitable for anaerobic digestion: sewage, municipal solid wastes, farm wastes and food processing wastes. At present this technology contributes little to the UK heat market and is relatively unknown.

biogas in Shropshire

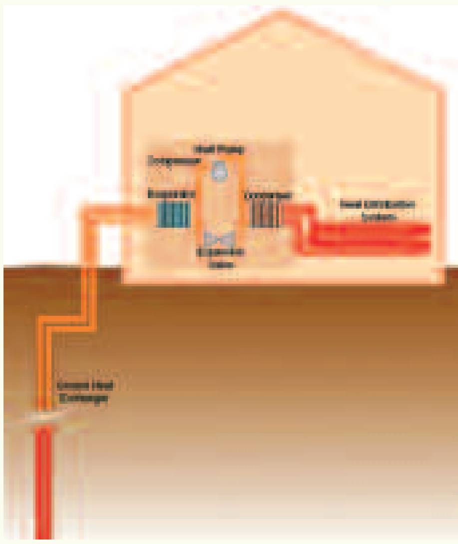
2006 was a year of development for Greenfinch Ltd., a biogas firm in Shropshire. In partnership with South Shropshire District Council, they built the UK's first large scale anaerobic digester after receiving funding from Defra's New Technology Demonstration Programme and Advantage West Midlands. Households in the area received collection bins for kitchen and garden waste and the plant receives about 5,000 tonnes of their waste per year. The biogas released in the digestion process is burnt as fuel in a CHP plant to produce heat and electricity for the biogas plant itself and the surrounding industrial estate. The pasteurised bio-fertiliser produced is on offer to local farmers.[46]

Ground source heat pumps

Ground source heat pumps (GSHP) are able to harness the earth's stable ground temperature. Warmer ground temperatures mean pumps can use the heat in the ground to provide heating during the winter and conversely the relatively lower ground temperatures in the summer can be used for cooling.

A ground loop pipe filled with water and refrigerant, which absorbs heat as it moves through the pipe, is buried underground. A heat pump- a device that can raise heat to a higher temperature- removes heat from the water and transfers it to a tank of clean water that feeds radiators, under floor heating or water storage for hot water supply.

Electricity input is required to pump the heat but, for every unit used, 3-4 units of heat are produced. The heat can therefore be said to be approximately 75 per cent renewably sourced and the level of efficiency can make heat pumps a cheaper form of heating than oil, LPG and electric storage heaters. There are little, or no, maintenance costs, the



A typical ground source heat pump (image courtesy of the EST/BRE) only requirement is ground space. A typical household system costs around £6,000 - £9,000 and can provide up to 100% of heat requirements.[50] This could provide a payback of around £640 per annum if it replaces electric heating.[51]

The market for GSHP is small but growing. About 700 units are currently installed[52] and the market potential is for up to 35,000 by 2015 and 55,000 by 2020. The system is most suitable for domestic housing not connected to the gas network and commercial properties with a stable heat demand.

ground source heat reduces bills

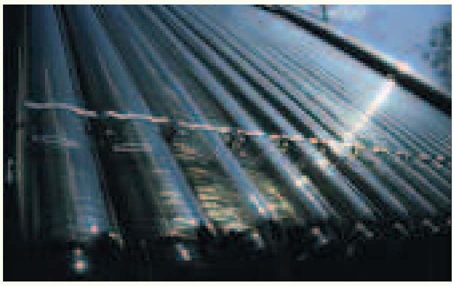
Housing associations are taking an interest in ground source heat because the pumps can reduce heating bills for tenants and are cost-competitive with oil-fired systems for new rural properties off the gas network. The Metropolitan Housing Trust installed ten Powergen systems in March 2004 in new bungalows in Nottingham, in partnership with Westleigh Developments Ltd. The system has now been successfully installed in 60 of the Trust's properties and Powergen aims to supply at least 1,000 heat pumps for installation in the social housing sector across the UK, as part of its Energy Efficiency Commitment (EEC).[53]

Another variation is the use of geothermal aquifers. These are naturally occuring geological formations containing water that has become heated by the movement of heat away from the Earth's core. The hot water can be made to flow to the surface through a borehole and can be used as a source of heat. The UK has only limited geothermal potential, as it is far from the active tectonic and volcanic areas of the Earth, so heat flows are generally low.

geothermal in Southampton

Hot seawater in a Southampton borehole rises naturally from 1,800 metres below ground to just 100 metres below the surface. The remainder of its journey is assisted by a pump and the 74° C water is then passed through an exchanger which transfers its heat to clean water. The clean, heated water then circulates through pipes to provide customers with heat, or cooled water is circulated in summer. The system provides 18 per cent of the heat in the local district heating system to customers including the City Council, a shopping centre, BBC regional offices, a five star hotel and many campuses and offices.[54]

Solar thermal water heating



Evacuated tube collectors (image courtesy of CAT)

Solar water heating systems use the sun to heat liquid from which heat is transferred for space or water heating. There are three main components to these systems: solar panels, a heat transfer system and a hot water store. Solar panels - or collectors - are fitted to the roof where they collect heat from the sun's radiation. The heat transfer system uses the collected warmth to heat water. A hot water cylinder then stores the hot water and supplies it for use.

Because solar thermal collectors can produce energy from diffuse sunlight they are ideally suited to the UK climate. Typically, systems are able to provide almost all hot water needs during the summer months and about 50 to 70 per cent year round.[55] A typical system costs between £2,000 and £2,800[56] and can bring savings of £120- £150 per year in electric heated properties, giving a payback time of approximately 24 years.[57]
There is a small but established market for the technology; 42-50,000 UK homes currently have solar thermal systems installed[58] and these are relatively easy to install by a trained plumber. There is potential, under favourable market conditions, for installations to increase to 300,000 per year by 2015 and 800,000 by 2020.[59] The systems can also be used on a larger scale but long pipe runs increase the heat loss.

solar heated water in Burton

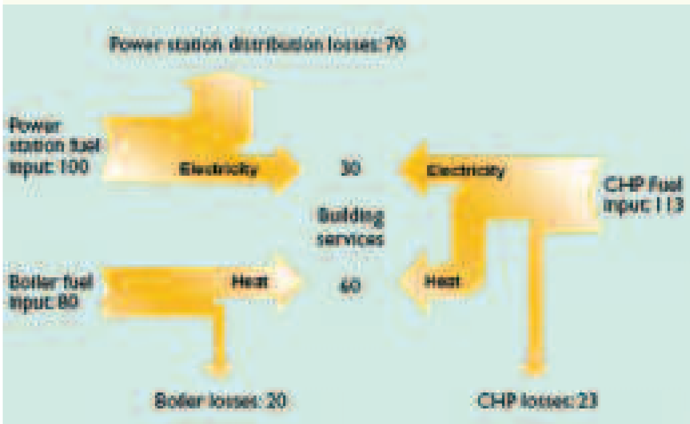
In a good example of local councils leading by example, East Staffordshire Borough Council, based in Burton on Trent, installed a Genersys Plc. solar hot water system. It provides nearly all of the hot water used by the town hall and its visitors and the council expects the system to have paid for itself in 6-8 years. Annually, the installation will save the amount of CO_2 emitted by 4 average homes per year.[60]

combined heat and power (CHP)

CHP is a fuel-efficient energy technology that generates electricity and heat, which is then captured, in the same process. Waste incineration, traditional gas or steam are all used to power CHP plants, which contrast with conventional power plants and most industrial processes where the heat produced is lost to the atmosphere. Captured heat from CHP can be used for space heating, water heating or refrigeration through highly insulated pipes.

There is major potential for CHP to be used in conjunction with community heating schemes (see page 19). CHP is applicable on a variety of scales, from city-wide development down to individual buildings. A micro-CHP unit is most commonly used to heat and power a single building. Such systems could potentially provide a cost-effective source of power and heat provided that site energy usage is sufficient.

CHP converts around 85 per cent of the raw fuel inputted into the generator into useful energy output, compared to the 25-35 per cent efficiency rates of conventional electricity generation.[61] This reduces CO_2 emissions by about 20-40 per cent and



Heat and power production from conventional sources and CHP (image courtesy of the EST/BRE)

has the potential to save substantially on energy bills. Because the generation often occurs locally there is also less potential for energy to be lost in transmission and distribution.

The UK has the potential to install 10 GW of CHP by 2010, current capacity is around 5GW.

heat from waste in Sheffield

Veolia Environmental Services operate a CHP plant in central Sheffield, which is fuelled by the incineration of 225,000 tonnes of local municipal waste each year. The process generates electricity that is sold to the national grid and distributes heat to over 130 commercial and public buildings throughout the city, including over 1,000 homes. Due to the efficiency of generating heat and power together, all of the energy recovered from waste is passed on to consumers and they are able to use 100 per cent of what they pay for. In comparison, a gas boiler operates at an average of 80 per cent efficiency, so for every unit of fuel energy paid for, only 80 per cent of it provides heat. The price of the CHP heat is competitive with gas so customers get more for their money and the heating apparatus also takes up less space in their buildings and is cheaper to maintain. Capturing and using the heat results in CO_2 emissions savings of 12,000 tonnes per year, compared to the use of gas boilers in individual buildings, as a significant proportion of municipal waste is carbon neutral biological matter.

sustainable cooling

Cooling, more commonly known as air conditioning, is accounting for an ever growing proportion of energy demand and is threatening to undermine savings from other areas. By 2020 carbon dioxide emissions from air conditioning could negate 15 to 90 per cent of the energy savings achieved by domestic Building Regulations.[63]

Sustainable cooling measures come under two broad categories: passive, which do not require energy input and active, which do. Passive measures are outlined in the section on building design above and active measures are described below.

Nobel House and sustainable cooling

As well as providing sustainable electricity and hot water from a small-scale CHP plant, a number of measures have been taken to ensure that cooling is also sustainable. A natural ventilation system has been installed, based on the 'wind-towers' used to keep buildings cool in cities such as Dubai. A lightweight roof has been constructed over the quadrangle at the centre of the building with small windows around the edge. These windows are opened and closed by a computer system that gauges outside weather. Warm air rises to the top of the building and escapes from the windows, which then acts to draw in cooler air through the larger office windows.

For rooms with no windows, CHP is used to drive an absorption chiller. To meet peak cooling demand ammonia chillers are used, as ammonia is not ozone depleting and the compressors turn less frequently, therefore using less energy.

Absorption cooling

This technology uses heat instead of electricity to produce a cooling effect. It is particularly suitable for buildings that use CHP, as the waste heat produced in power generation can be used in the chilling process.

'Stay Cool' on the Tube

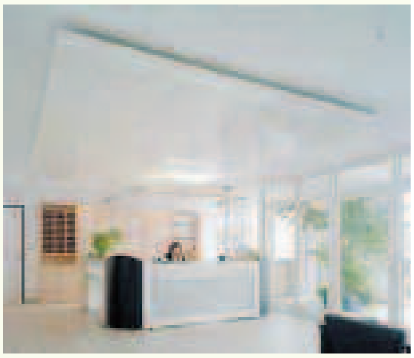
Installation of a groundwater cooling system is currently taking place at Victoria Station, London. The water supply which has a temperature of around 12ºC will be pumped through a network of pipes to feed three heat exchange units on the concourse area between the Victoria line platforms. The heat exchange units have fans which will draw in the warm station air and through heat exchange with the pumped water will supply cooled air to the concourse and platforms.

Radiant cooling

This process relies on removing the heat load from spaces through convection. Cooled water flowing through water pipes convects heat away from a room. For this purpose, the ceiling of a space is most suitable but the walls or the floor can be used as well, although their cooling capacity is more limited. 'Chilled slab cooling' is an alternative method where concrete slabs are reinforced with a network of pipes connected to circulating cool water systems.

Ground water cooling

This technique is similar to ground source heat pump systems, but instead of ground temperature this system exploits the nearly constant temperature of underground water. Low temperature water is pumped up to the surface to a heat exchanger, which cools ventilation air as it passes through.

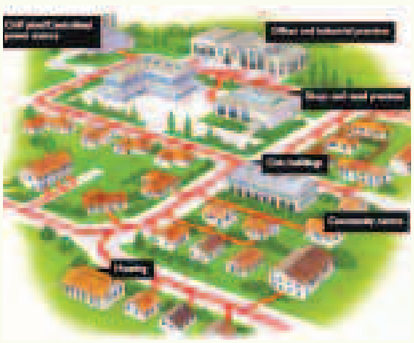


A radiant cooling panel (image courtesy of Zehnder ltd)

community heating

Community heating is not a type of sustainable heat generation, like those described previously. Rather, it is one of the main ways that sustainable heat technologies can be used. Also known as district heating, the term refers to the production of heat at a central source and then its distribution to a network of close-by buildings via a heat mains. This contrasts with the conventional heating of buildings by individual gas boilers using mains gas, or with those generating sustainable heat for on-site use only. Community heating schemes can vary in size from individual tower blocks to a whole city similar to the schemes that serve Southampton, Sheffield, and Nottingham.

Heat can be supplied to the scheme from conventional boilers, renewable-fired boilers, or can utilise the waste heat from power generation (CHP). Once the network is set-up the energy source is fuel flexible. The heat distribution network transfers heat to buildings connected to the system, usually as hot water, and customers receive it through radiators, as in a conventional system. Air conditioning or chilled water can also be supplied via an absorption chiller. The only significant difference for users is the absence of a boiler in each house, as there is equal control over individual building temperatures.



A community heating system (image courtesy of the EST)

By relying on a local heat source, district heating is able to assist communities to become more self sufficient and energy secure. It is especially beneficial for those who are not connected to the gas network and depend on expensive heating alternatives such as electric. It has considerable carbon savings over conventional generation.

Community heating in Aberdeen using CHP

Aberdeen City Council has taken to CHP in a big way and uses it to provide community heating in clusters of tower blocks. CHP networks powered by gas already heat two clusters of homes and a third is being planned, resulting in a total of 988 homes, an academy and a swimming pool enjoying the benefits of renewable heat. This is of particular benefit to the estimated 70 per cent of tenants in the area suffering from fuel poverty due to high energy costs, as those costs have now been significantly reduced. Residents now pay approximately £7.44 per week for fuel compared to weekly costs of up to £18.48 a week for residents before the CHP system was installed, creating a saving of up to £574 per year. The carbon savings, compared to the existing heating systems, equate to 411 tonnes per year.[64]

Networks are frequently developed to take advantage of heat that is already being produced but being wasted, or to utilise a local waste product as fuel. Our German case study (page 19) mentions two such networks. One town captures the heat produced by a nearby aluminium rolling mill and pipes it to local houses. Prior to the network being set up, all of the heat produced by the mill was going to waste. Another town installed a central boiler that burns waste wood chippings and sawdust from the local timber industry and the heat produced is supplied to local housing estates. Again, the wood chippings were previously going to waste.

As these demonstrate, the manner of heat generation at the centre of the network can vary but it is frequently a CHP plant. The network in Sheffield mentioned on page 17 is a good example of heat capture and use from an industrial process, in this case waste incineration. In most UK examples customers pay for the heat they use, either with a flat rate or in a metered system, as they would if using conventional gas. Many networks in Europe are state funded and, because they make use of heat that was being wasted anyway, customers enjoy the benefits of free heat.

what can be achieved – examples from Europe

Examples below show how government policy can drive uptake in sustainable heating.

state-level renewable heating promotion in Germany

North Rhine-Westphalia (NRW) is Germany's self-titled 'energy state' and has created a set of state level grants and policies that heavily promote renewable heat.

CHP: NRW's district heating fund allocates grants to systems using heat from CHP plants, regenerative energy sources or captured heat from industrial processes. By 1998, CHP supplied 78 per cent of NRW's district heat networks and had achieved primary energy savings of 67 per cent, compared to stand-alone furnaces, and a 60 per cent reduction in CO_2 emissions.

Nationally, this increase in sustainable heat has seen the amount of heat Germany produces separately fall to 1955 levels, but the deregulation of electricity markets threatened this progress and made CHP stations less competitive. In response, Germany's central government introduced a law to protect CHP plants and paid bonuses for the heat supplied.

With support from NRW's State Initiative on Future Energies an estate housing 4,000 people and a shopping centre in Neuss-Allerheiligen is being heated by a nearby aluminium rolling mill. The captured heat meets 80 per cent of the mill's industrial heating needs and 90 per cent of the estate's heating needs. With an overall investment of 13.3 million Euros the area is guaranteed free heat for 15 years.

Biomass: NRW's Wood Sales Support Guidelines aim to increase wood sales for use in energy generation.

A wood furnace in Lieberhausen heats a network of 74 buildings and a soon to be built housing estate. The furnace accepts wood chips directly from the forest or sawmill and the system is a national model for converting waste biomass into energy. It benefited from an investment of 500,000 Euros by NRW, as part of an overall cost of 1.45 million Euros.

By 2004, subsidies had assisted 2,200 plants and wood pellet boilers have become an attractive option when upgrading old heating systems.

Solar: NRW provides grants for passive solar design projects and their support for solar collector installations has strengthened the market so much that it no longer requires subsidisation.

Using solar technology, a Gelsenkirchen housing estate of 72 homes has cut its emissions by 55 per cent, compared to an average home. The homes are built to capture as much sun as possible, with solar collectors heating the water and photovoltaic panels generating part of the electricity required. The estate was subsidised by NRW's Energy, Urban Construction and Science and Research ministries, which aim to support 50 such solar estates.

Geothermal: Geothermal installations have been heavily promoted with a widespread advertising campaign and a grant programme that makes them as cost effective as conventional heating systems.

capturing the sun in Barcelona

Barcelona is blessed with an average of 2,350 hours of sunshine a year but, until recently, the city did nothing to take advantage of it. The idea of using solar energy to heat water was mooted in 1995, but it was not until 1999 that Barcelona City Council passed their Solar Thermal Ordinance. It came into force in 2000, leaving builders a year to get to grips with it.

The ordinance requires any new buildings or significant refurbishments to use solar energy for at least 60 per cent of their water heating, and all new swimming pools must be 100 per cent heated by solar. There is a threshold below which the ordinance does not apply but, in general, most commercial and public buildings and residential developments of 16 households or more are subject to it.

The ordinance has had a significant impact; in 2000 Barcelona only had 1,650 m^2 of solar thermal collectors installed, or 1.1 m^2 per 1,000 residents. By October 2004 the amount of installation had risen to 21,500 m^2, or 16.5 m^2 of installation per 1,000 residents. Even so, countries like Greece and Austria can boast of 200-300 m^2 of solar collectors per 1,000 residents, so there is still great potential for Barcelona to make more progress.

Much of Barcelona's success is owed to its broad communications strategy. They published a guide to the ordinance, held stakeholder meetings, implemented demonstration projects and held a 'solar day' to increase understanding of the ordinance. Adherence to the new regulation has been good but it has been slightly hampered by a lack of qualified installers. In addition, quality verification of different systems at the national level would be beneficial.

Overall, the city has saved an average of 15.68 MWh of energy per year and cut down 2.756 tonnes of CO_2 emissions. A key success has also been the fact that Barcelona acted as a demonstration and a catalyst for the rest of the country. By 2003, another 11 Spanish cities had introduced a similar ordinance and from 2006 Spain's national building regulations require that 30 – 70 per cent of domestic hot water demand has to be covered by solar thermal.[66]

Denmark – a district heating exemplar

In Denmark district heating supplies a massive 60 per cent of heating, providing a compelling example of district heating's potential. Well over half of the networks are supplied by high-efficiency CHP plants, with others supplied by biomass, solar power or gas. Many of the plants can run on a variety of fuels, such as the country's largest one, which generates enough electricity for 1.2 million homes and provides district heating for 190,000 homes in Greater Copenhagen.

The success and widespread presence of heating networks has been driven by a commitment from central and municipal level government, regulation, and control of market forces. Local governments can ban electric heating in new buildings, tax on fossil fuels for heating is high and legal measures exist to force building owners to connect to local district heating networks. There are also investment subsidies available for utilities that rehabilitate or complete networks and for consumers who connect to them. District heating is also seen as a key part of urban planning and areas all have least cost energy plans. Most district heating companies are owned by consumers, so there is transparency and motivation to provide good customer service and low running costs. The stability of these policies and proven nature of the technology creates a very secure environment for investing in district heating.

policy focus: lessons from Europe

Renewable heat initiatives around Europe highlight the key features of successful approaches. A comprehensive programme is vital, as fiscal incentives alone will not guarantee success.

Well funded and well timed promotion is key, as demonstrated by Sweden. Even very high fossil fuel prices were not prompting a real shift to renewables until an awareness raising campaign began. From 2002, local one-stop shops for all queries were in place and domestic wood pellet boiler use doubled in 2 years. The local nature of Sweden's awareness raising was also a success factor, as also seen in French, Austrian, Finnish and Spanish examples.

Sufficient duration builds public awareness and familiarity with technologies, as well as ensuring a supply of trained installers and certified products to meet increased demand. Successful French and German solar thermal programmes were both 6-7 years long.

Involving the full range of stakeholders was beneficial to most programmes. Communication with industry, town planners, installers and architects ensured that demand could be met, that planners understood the technology, and that there were enough installers. Lack of installers is the most common bottleneck in the take-up of renewable heat technology; in Greece, solar technology manufacturers provided their own installers but this is quite rare and most other countries have funded training as part of their programme.

Quality assurance needs to be addressed, as illustrated by Portugal. Their solar campaign in the 80's had little success due to quality problems and their renewed campaign in 2001 failed to include quality standards, so people's misgivings persisted. As a result, only 10,000 m^2 of a planned 150,000 m^2 of solar collectors was installed in 2003. There is a clear need to develop European level quality standards for renewable heat technologies to ensure consumers have confidence in their systems and are aware of varying performance efficiency.

The financial or regulatory instrument has to be right, but there is no one answer. Regulation is attractive to governments and has worked well in Spain. Their city ordinances requiring the inclusion of solar water heating in new buildings or refurbishments have been very successful. But regulation only works if markets are developed enough and there are sufficient installers to meet the instant demand increase that regulation creates.

Experience shows that **successful instruments balance the need to give companies and individuals a tangible incentive with fiscal or budgetary limitations**. For instance, both France and Germany have successfully employed grant-based programmes for solar thermal installations. This approach saw the French market grow by 40 per cent and costs fall by 30 per cent in 6 years, whilst in Germany, costs fell by 50 per cent in 10 years. However, the downside is that the budget for direct incentives can be cut and, if a programme is too successful, it may not meet the demand for grants. As a result, France is now considering switching to a tax rebate. An alternative is to decrease the incentive over time so that more people take advantage of it straight away, the market grows more quickly and costs fall naturally. In Greece and Portugal tax rebates are offered on solar thermal installations, which are easy to administer and remove the uncertainty of grant applications.

Salzburg, in Austria, has added renewable heat objectives to an existing housing construction subsidy scheme. Support will now only be granted if schemes include solar hot water and biomass heating. This avoids an increased administrative burden but, as with regulation, the markets must be strong enough to cope.[67]

key characteristics needed for a UK heat strategy

With European examples as a guide we have set out below the more detailed characterstics required for an effective heat strategy.

First, they should adopt the principles of the *Stern report on the economics of climate change*, which identified three main characteristics for policy mechanisms. They should:

1. Be based on a long-term meaningful price for carbon: currently there is no carbon price for heating, as existing mechanisms do not apply to this market.
2. Support innovation: a heating strategy should encourage innovation in technologies, building design and urban planning, controls and metering and in financing and commercial structures.
3. Encourage behaviour change: a sustainable heat strategy will encourage visible sustainable technologies which often act as a catalyst to further energy-saving action.

Second, they should:

- **Put energy conservation and efficiency first:** as energy efficiency and demand management are often the most efficient forms of carbon saving, any support for low carbon and renewable heat should be coordinated with efforts to ensure that high levels of efficiency have already been achieved.

- **Be comprehensive:** only a co-ordinated package of measures can address the current barriers to growth. A comprehensive heating and cooling strategy should include a number of reinforcing instruments that provide both the mechanism of change and the optimum long-term market conditions. It must be considered as a comprehensive whole, and not a shopping list of discrete measures.

- **Provide stability over the long-term:** a framework that delivers support over a reasonable investment horizon will avoid the vagaries of government funding rounds and present the stable investment conditions for long-term growth.

- **Be target-based using reliable statistics:** ambitious and verifiable targets need to be set that will be the guiding line for the measures to be taken. A pre-requisite for these targets will be more reliable and comparable statistics.

- **Reward carbon reduction:** linking incentives to volume – of fossil energy saved or low carbon and renewable energy supplied – ensures that the most effective and efficient measures receive the maximum encouragement.

- **Be simple and effective, for applicants and the public sector alike:** Administrative procedures should be as simple as possible to minimise transaction costs. The burden of transaction costs will be most acute for the domestic sector and small-scale technologies.

- **Be capable of addressing capital barriers:** capital can be a barrier to uptake in all segments of the market, but is most acute in the domestic and public sector. Incentives must have the flexibility to recognise the benefits delivered over the operating life of a measure and equate these benefits to up-front capital support.

- **Be sustainable:** any strategy must be based upon the principles of maintaining enforceable standards of environmental sustainability for all heating fuels, and ensuring that the measures introduced will contribute to significant net savings in entire lifecycle greenhouse gas emissions.

- **Be consistent with European standards:** any technical parameter linked to eligibility for financial incentives should be based on European standards and certification procedures, where they exist, and, for small scale systems, BRE/DTI's emerging Microgeneration Accreditation Scheme, to avoid creating small and isolated markets.

- **Be open to innovation:** qualification for support must be flexible to provide competitive access for all products, with appropriate incentives to tackle the barriers to new market entry.

- **Be flexible and responsive:** any incentive scheme needs to be able to adjust to market development and introduced with minimum impact on the market.

- **Support skills:** for a market to flourish, engineer and technician training in low carbon and renewable heat design, installations and maintenance is essential. Targeted training and recruitment is needed until the market framework is correct and key players will therefore ensure there is no skills shortage.

- **Promote leadership, starting with the public estate:** public buildings should act as an exemplar of what can be achieved in the low carbon and renewable heating and cooling agenda, but should also include consideration for the replicability of the technologies elsewhere. This would help pump-prime the market and drive costs down. The government needs to continue and deliver on its commitments on this. Champions in the private sector should be recognised and encouraged.

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This manifesto has been produced as part of the Green Alliance project: ***Building an alliance for sustainable heat***, in partnership with the REA. This project aims to raise the profile of sustainable heat in the political landscape and push for the introduction of a strategy for reducing emissions from heat. Please see the inserted pull out document for more details on our proposed strategy.