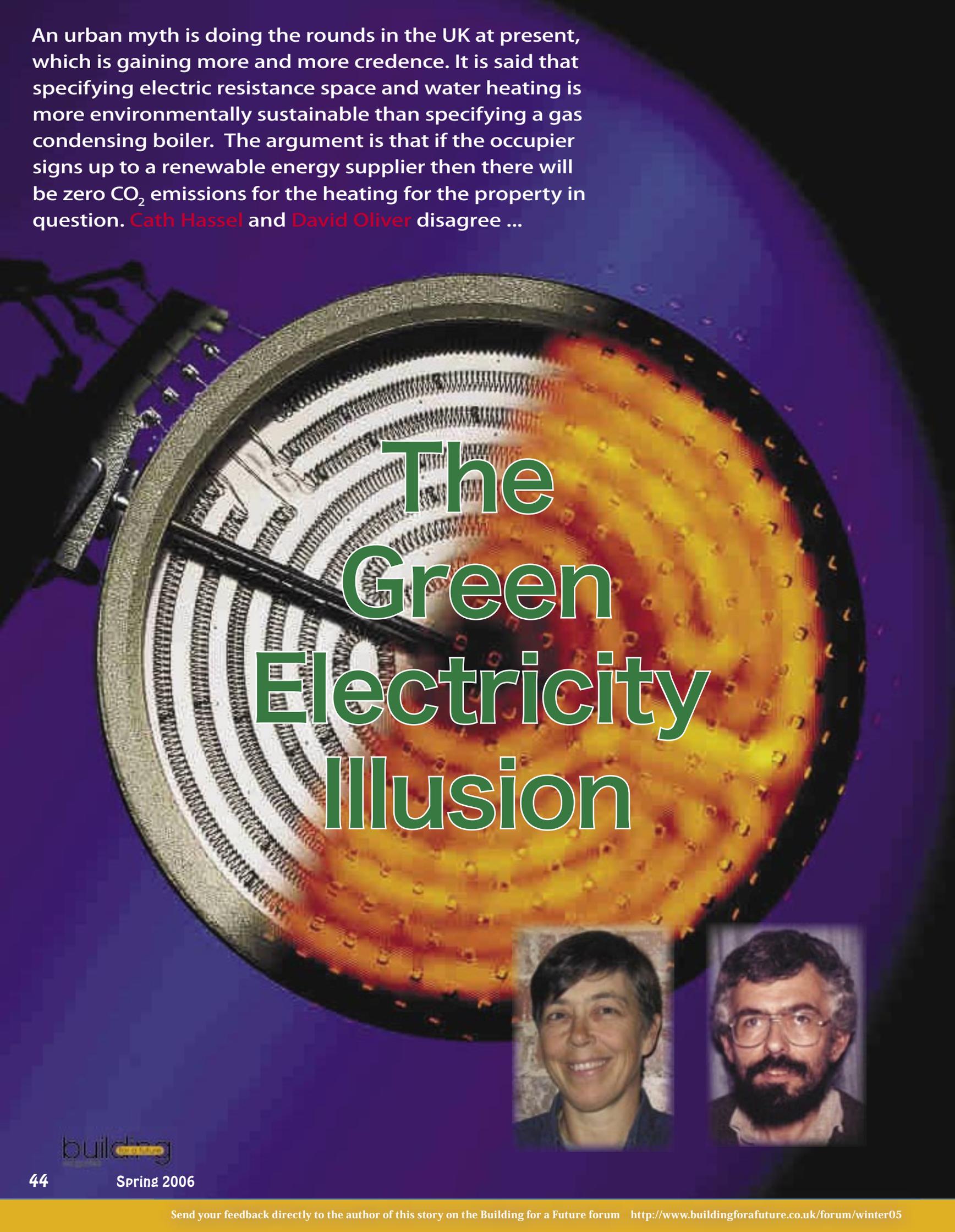


An urban myth is doing the rounds in the UK at present, which is gaining more and more credence. It is said that specifying electric resistance space and water heating is more environmentally sustainable than specifying a gas condensing boiler. The argument is that if the occupier signs up to a renewable energy supplier then there will be zero CO₂ emissions for the heating for the property in question. **Cath Hassel** and **David Oliver** disagree ...



The Green Electricity Illusion



Electric space heating has been increasingly specified since the early 1990's, mostly due to the cost savings in installation for the developer, and regardless of its on-costs for both the consumer (higher tariffs and less controllability than gas central heating) and the environment (almost double the carbon emissions per kWh delivered energy). In late 2002 we began to be aware of the first signs of this illusion of "green electricity" being the saviour of CO₂ emissions from heating buildings and in 2003, in Tall Buildings and Sustainability, the following appeared: "In any building 'green energy' can be purchased leading to no or low emissions from electricity consumption which may favour electrical solutions rather than gas for heating and hot water". Now this misleading statement is repeated again and again, by leading engineers and architects, by housing associations and local authorities, even by the Centre for Alternative Technology. One could almost believe that if everyone in the UK signed up to a green electricity supplier we would reduce our carbon emissions from electricity generation to zero overnight. Clearly, this is nonsensical, so why is this myth so persistent?

The increasing specification of electricity for space and water heating

Electric space and water heating in the development of new flats in major cities has been specified for many years, usually in cases where there was no original gas supply to the building in question, (e.g. warehouse conversions). At the lower end of the speculative build market, properties built where there is no access to mains gas are increasingly built with electric space and water heating rather than oil or LPG. Electric space heating is easier and cheaper to install within a building than any

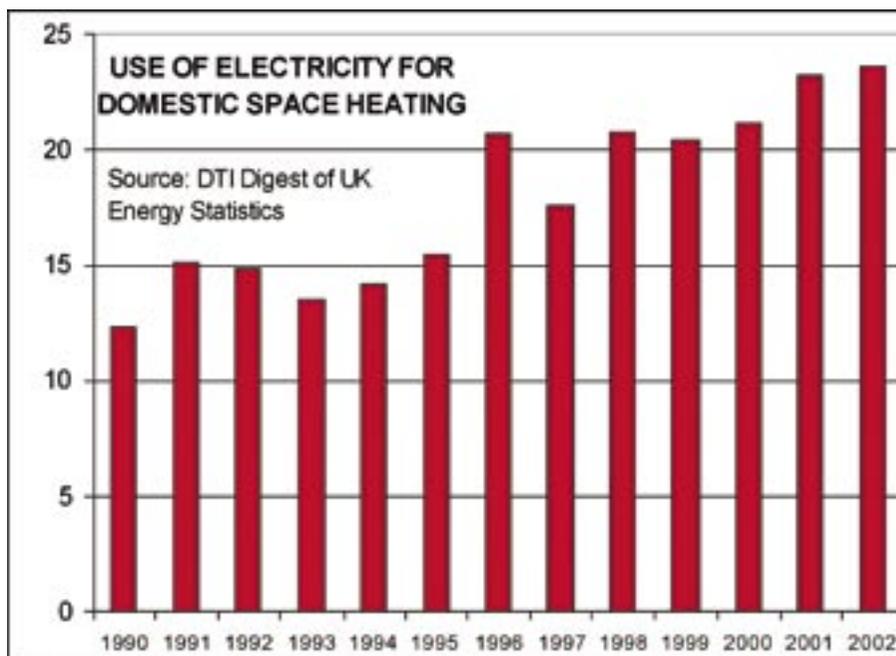
other heating system. Any new building needs an electricity supply for lights and appliances. Specifying electric space heating means that the expense of a gas main into the site is saved. LPG, oil or biomass all require storage space; electricity does not.

Registered Social Landlords are increasingly specifying electric space heating since the landlord regulations were changed to state that all gas appliances must be inspected and serviced once a year. They have stopped upgrading electric storage heaters to gas central heating systems for the same reason. The fact that storage heaters are more expensive to run for the tenants and inherently inefficient and uncontrollable (too hot on mild mornings, too cold on frosty evenings, unable to turn off to allow for passive solar gains) makes little difference. We have even heard of one London borough and several Housing Associations who have had serious discussions about reverting to electric space heating from the current gas heating, before rejecting the idea (for now) because of the increased cost to tenants.

Now, with global warming in everyone's thoughts, the greenwashing of specifying electric

heating has started in earnest. More and more architects and engineers have used the green electricity argument to justify the choice of electric resistance space heating in new buildings, even those supposedly designed to a high environmental brief. More and more of the tall buildings currently being built, or awaiting planning in London, will use electric space heating. This will do very little to help London achieve its stated aim of a cut in carbon of 60% by 2050. Ken Livingstone should use his powers as mayor to ensure that these buildings are heated from centralised gas powered CHP plant or condensing boilers.

Increasing energy use Since 1990 energy use in the domestic sector has risen by 19% and now accounts for 30% of all final energy consumption in the UK. First and foremost we need to reverse this trend. Secondly we need to address CO₂ emissions from the energy that we use in our homes. The best way to do this is to use the lowest carbon fuel source for any particular application. We have to use electricity for lights and appliances so we should concentrate on specifying energy-efficient lights and appliances. We do not need to



Electric heat in one package

Growing demand for electric central heating boilers and direct unvented hot water storage cylinders has led to develop a 'one box' solution.

Delivering both full wet central heating and mains pressure unvented hot water from one unit, the electric package is called *Electric*.

Electric heating is becoming a popular choice in urban domestic properties. Rather than retaining and then releasing heat like storage heaters, electric wet central heating boilers provide heating and hot water when it's actually needed via conventional radiators or an underfloor system, and are usually coupled with a hot water storage cylinder and controlled by a programmer and thermostat.



vessel, pumps, controls and connecting pipework, all housed in one unit advantage of the flexible off peak electricity tariffs available. The unvented cylinder also includes a

use electricity to heat our homes or hot water or cook our food. There are many alternatives which produce lower emissions including solar, gas, oil, LPG, wood pellet or wood chip, CHP, ground source heat pumps and for cooking either mains gas or LPG.

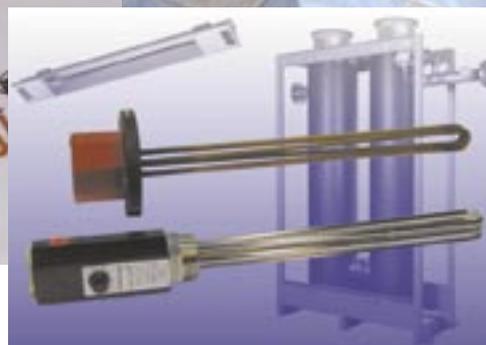
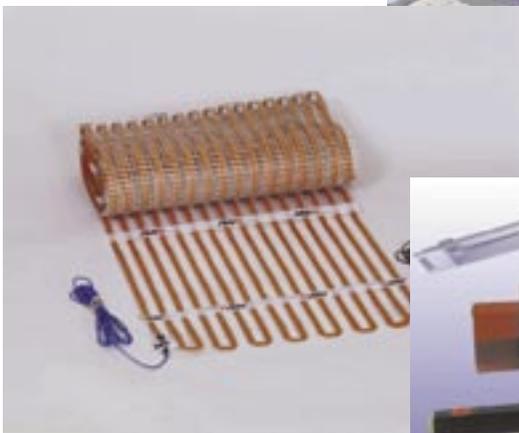
Electricity generation is the most significant source of emissions of greenhouse gases in the UK as well as a source of air pollutants. Given the current generating mix for UK electricity, 0.42 kg/CO₂ are produced for every kWh of electricity. An increase in electrical demand as more electric space heating is installed will lead to an increase in CO₂ emissions as more inefficient coal fired plant is brought back on line to meet demand. All the renewable energy produced in the UK is already purchased by electricity suppliers under the Renewables Obligations scheme. This will remain in place until 2010, thus ensuring a market for renewable energy and encouraging more investment in new generating capacity. Any renewable electricity brought up by "green electricity suppliers" is therefore not available to other suppliers. It is not spare capacity that would be dumped if not bought by the end consumer to power their electric heaters.

The aim should be to reduce our consumption of electricity not to generate "new" electricity demand from new heating systems. If the new load uses up all the renewable generation and more, as is happening, then we are actually increasing fossil fuel generation and the associated CO₂ emissions. There is a concern that increasing use of electricity will then lead to new nuclear power stations being built as the UK desperately tries to reduce the rising CO₂ emissions.

In the current electrical generating mix, only 3% is from renewables. Yet 20% of the UK's electricity is required for lighting. Not until 2020 - and that is if the

Just pick up any regular builder or architects journal to see just how many new products are rapidly being introduced to cater to the growing demand for electrical heating.

Electrical resistance heating appliances are arriving in every conceivable form and the two most popular are going to be underfloor (electrical mats as below and left) and traditional boiler mimics as above.



government's target of 20% is met - will renewables cover the lighting demand, and that does not even begin to discuss the requirement for appliances or other electricity-specific uses. Although Part L of the Building Regulations 2002 requires houses or flats with electric space heating to have more insulation, in our view this extra weighting does not go far enough. The Regulations require 13% more insulation to be used if electric heating is fitted. Yet the CO₂ emissions are more than 100% higher if electricity is used than if gas - or LPG in rural areas - is used. During the recent Part L review the AECB argued that electric space heating should be banned and that full carbon equivalence of fuels should be incorporated into the 2006 part L amendments. This argument was unsuccessful and electricity has been given a fuel factor of just 1.47. The authors are unconvinced that this rating will mean that electric space heating is no longer specified.

We often read of buildings that are built to an environmental agenda with very high levels of insulation, water efficient appliances, natural paints and finishes and yet electric space heating is specified. If the carbon emissions from these buildings were analysed rather than just the energy use it can be seen just how poor an environmental choice this is. In a dwelling built to the proposed 2006 Part L amendments, the hot water load will be greater than the heating load. For a family of four heating the hot water using a gas condensing boiler will produce 1 tonne of CO₂ emissions. Heating the hot water using electricity will produce 2 tonnes of CO₂. That extra 1 tonne of CO₂ will not be offset by improving the insulation standards of the dwelling beyond the statutory requirements.

A few more facts

Over 1 tonne of extra CO₂ is produced per 60m² flat per year if electric space heating is specified instead of a condensing gas boiler. (These are emissions from a flat built to the 2002 Part L standard with an A rated gas condensing boiler). We can more than double this penalty if a 90 m² rural semi-detached house is fitted with electric heating instead of a condensing LPG boiler because the heating demand of the house is much larger than the small flat.

The argument that owners want to control their own heating and therefore centralised heating systems are not appropriate is covered by heat meters in each flat. Sixty percent of Denmark is now supplied by district heating, fed by CHP plants and industrial waste heat. The heat mains extend to detached houses in suburbs and even some nearby villages; there are no complaints from homeowners about lack of control but there are comments about the convenience of receiving mains hot water and heating compared to maintaining an individual boiler. Denmark also restricts electric space heating in permanent dwellings.

Some specifiers use the argument that they are future proofing against the time that supplies of natural gas run out. If the supply of natural gas runs out (although this is unlikely given the huge as yet untapped supplies available in Russia plus North Africa, the Middle East and elsewhere) it is a simple thing to exchange the gas boiler for an electric one or for district heating from a CHP plant. There are electric boilers already on the market that can be installed in a wet central heating system in place of a gas or oil boiler.

The fact is that true future proofing is incompatible with electric resistance heating. A dwelling heated

by electrical resistance has no way to make use of geothermal heat (the entire centre of Southampton is now heated this way which it could not easily be if the hotels, hospitals, council offices etc had originally had electric heating) industrial waste heat, waste heat from a CHP plant or seasonally-stored solar heat (developed par excellence in Sweden and Germany). Genuine future proofing would be to specify versatile heating systems that can use any type of fuel, not to lock owners or tenants into a blind alley with buildings heated by electric resistance wires.

Electric resistance space and water heating is not environmentally sustainable. Please specify condensing boilers or CHP/district heating for space and water heating until a 100% renewable energy system is a proven reality. Perhaps it will be in 2060.

Cath Hassell and David Olivier

Both of the authors buy their electricity from a "renewable" supplier and urge readers of this article to do the same; it is important to show support for renewable electricity. Neither author uses electricity for space or water heating, and both have energy-efficient lights and appliances. They welcome responses to this article and will publish a list of the comments received and their response as they feel that it is important that this debate is discussed fully within the environmental movement.

1. Faber Maunsell (Consulting Engineers) Tall Buildings and Sustainability. 2002. Extract from a report written for the Corporation of London.

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