The Green Electricity Illusion

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The Illusion

- "Specifying electric resistance space and water heating is more environmentally sustainable than specifying a gas condensing boiler" aka……

  "Install electric heaters, sign up to a green electricity supplier and there will be zero carbon emissions for the heating and hot water from that property!"

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So, if we ignore the illusion can we specify electric space heating??

- CO_2 emissions still greatest contributor to global warming
- Electric space heating has a higher carbon load than the alternative fuels
- Using electric space heating in effect burns gas at 40% efficiency instead of 90% efficiency
- Electric heaters cannot make use of alternative sources of heat, or tap into new district heating schemes
- Electric heating will use up excessive amounts of carbon credit under any carbon allowance scheme
- More generating capacity is required to meet the increased demand

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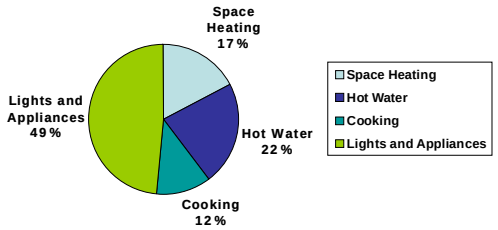
Hot water has as great a carbon load in new dwellings as space heating at 3000-4000 kWh/year on average



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Choice of fuel has a fundamental effect on the carbon load of the building

Fuel type	$kgCO_2/kWh$
Mains gas	0.194
Electricity from the grid	0.422
Bottled LPG	0.234
Heating oil	0.265
Wood pellets	0.025

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Carbon equivalence of fuels under Part L 2006

- It is harder to install electric space heating under the new Part L, but full carbon equivalence has not been implemented

Heating Fuel	Fuel factor
Mains gas and biofuels	1.00
LPG	1.13
Oil	1.18
Electricity (including heat pumps)	1.47

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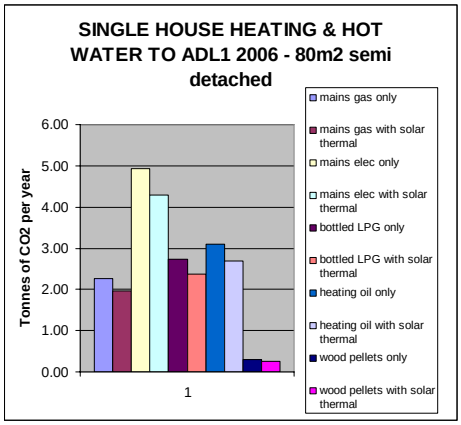

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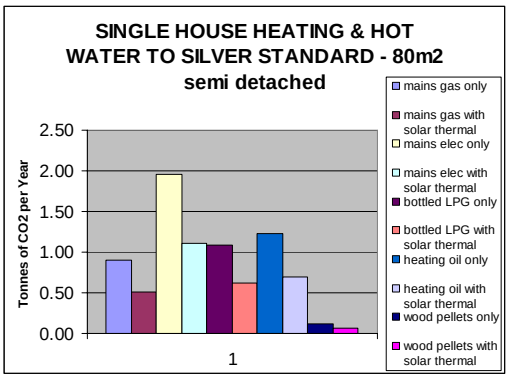

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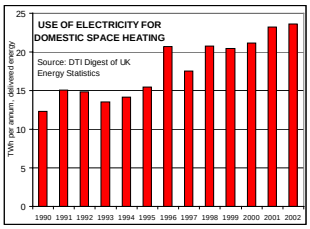
What is the effect on the UK's carbon emissions?



- Emissions are still rising due to increased demand from the building, electricity generating and transport sectors
- Increased demand for electricity increases carbon emissions from the first two sectors

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How much carbon could be saved if electric space heating was banned?

- 0.71 tonnes of CO_2 per year per 60m^2 flat for a flat built to the 2006 Part L standards
- 11.4 tonnes of carbon over a 60 year life
- By 2050 flats built between 2005 and 2010, using electrical resistance space and water heating instead of gas will have produced an extra 1.1 million tonnes of carbon
- By 2050 2.36 million flats will have been built. If 50% of these were heated by electricity instead of gas total extra emissions will be 120,000 tonnes of carbon per year

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What is the effect on the UK's electricity generating capacity?

- 3% of grid electricity is provided by renewables. 20% of grid electricity is required for lighting and appliances
- As demand for electricity increases the carbon emissions of grid electricity also increase

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What is the effect on fuel poverty?

- SAP ratings are still done on cost of fuel. Therefore night storage heaters get a good SAP rating.
- But inability of storage heaters to adapt rapidly to changes in temperature means that peak time electricity is often used leading to more chance of fuel poverty

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Case studies

- Southern Housing Association looked at the partnership between the HA and the tenants when refurbishing a Victorian terrace with electric storage heaters. They offset the £8000 capital costs and increased maintenance costs against lower running costs for gas. After 15 years they showed that the HA begins to make a "profit"
- Other Housing Associations recognise EcoHomes points, increased thermal comfort for tenants and less chance of fuel poverty as important reasons for specifying gas condensing boilers or CHP

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LZC Solutions for Space and Water Heating

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LZC Solutions for Space and Water Heating

- Combined heat and power
- Condensing boilers
- Solar thermal
- Biomass
- Heat pumps
- Wind??
- Photovoltaics??

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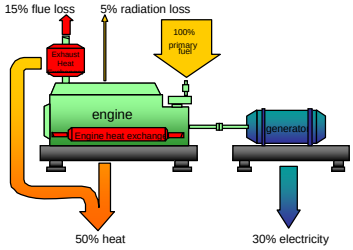
CHP



- Using waste heat from the electrical generating process to heat water, CHP can generate electricity at thermal efficiencies of 85%
- Requires large constant heat demand to be economic
- Good for hotels, hospitals and mixed use schemes
- Carbon efficiency across a development can be 25% more efficient than gas condensing boilers and electricity from the grid

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CHP

- CHP plant can be gas, oil, wood chip or pellet fired. Most run on natural gas
- Metering of individual dwellings for electricity and heat is key
- When no space heating demand CHP plant produces excess heat
- If sized to match base heating load, use conventional stand by boilers to meet peak thermal load
- Micro CHP units are boilers that produce electricity but their overall carbon efficiencies are the same as a gas condensing boiler and using electricity from the grid

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Condensing boilers

- Always specify A rated condensing boilers. Up to 91% annual efficiency.
- 95% efficient when in condensing mode – ideally combine with low temperature heating. Always more efficient than a non condensing boiler.
- Available as gas, oil, LPG, domestic or commercial
- More siting limitations in terms of flue discharge. (Temperature of flue gases reduced from 200^{o}C to 60^{o}C causes pluming)

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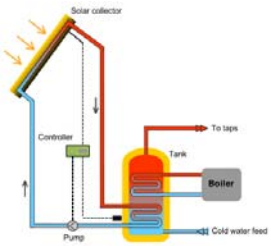
Solar thermal for water heating



- A well designed solar thermal system can supply 50-70% of a buildings hot water needs and prevent 0.5 tonnes of CO_2 emissions
- Solar thermal systems can be easily retrofitted and interfaced with existing hot water supplies, so all buildings should be future proofed for solar

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Efficient solar systems

- Collectors can be flat plate or vacuum tubes. Panels can be roof integrated or above roof mounted
- Use intelligent controls to optimise solar gain
- In domestic situation use solar rated dual coil cylinder
- Use thermal stores to protect against legionella in commercial situations

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Biomass

- Biomass is usually wood in the UK, available as logs, chips or pellets
- Wood is almost CO_2 neutral (0.025kg/CO_2/kWh)
- Wood must be burnt dry to reduce pollutants (SO_2 and NOx).
- Use a wood chip boiler for commercial buildings or district heating schemes
- Wood chip from coppiced woodland increases bio diversity in woodlands and helps to regenerate the rural economy
- Diverting arable land to biomass production will probably prove counter effective in lowering the Uk's overall carbon targets

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Wood Pellets

- Pellets have a higher specific heat capacity than wood chip. Produced from compressed sawdust, crushed pallets
- Wood pellet stoves (with back boilers) or wood pellet boilers now widely available on UK market
- Highly controllable, auger fed. Very clean burn
- Underdeveloped market in supply of pellets at present in UK
- www.logpile.co.uk

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Heat pumps

- 2 metres below ground the temperature is static at 10 -12^{o}C. Heat pumps utilise this to heat and cool buildings
- Heat pumps use 1kWh of electricity that powers a compressor to produce 3-4kWh of heat
- A high COP is critical for good CO_2 savings. COP is affected by flow temperatures. Underfloor heating and a large hot water storage (to prevent immersion use) is required
- Systems are usually sized to need top up water and space heating, If this is by electric heaters, carbon efficiency is compromised

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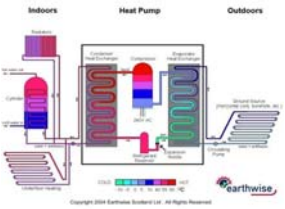
Heat pumps



- High capital costs, quite low running costs
- Can be used for cooling but COPs are less
- Air source heat pumps are available and cheaper but less efficient
- If gas is available a COP of 3 will needed to actually save any CO_2 (2.5 needed for oil)
- Rarely make carbon sense if access to mains gas is available

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Wind

- The UK has 40% of Europe's land based wind energy potential. Large scale wind developments are likely to be principal grid renewable of the future. Most likely to be offshore fields
- Micro wind at the urban scale works but unlikely to deliver the results suggested as performance of small scale wind turbines are compromised in urban areas
- In most situations useful for lights and appliances only

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P$_{hoto}$V$_{oltaic}$

- Can provide 50% of a very energy efficient electrical demand
- Efficiencies of panels range from 3-18%
- Panels at 10% efficiency supply 75-100 kWh/m^2 per year from a south facing roof.
- Unless very large roof areas unlikely to be excess electricity after demand for lights and appliances is met

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environmental consultancy

ech$_2$o is an environmental consultancy offering design advice and seminars on all aspects of sustainable water use, low carbon energy systems and environmental choice of materials. Clients include private individuals, community groups, architects, engineers, FE Colleges, Universities, Housing Associations and Local Authorities. SUDS, rainwater harvesting, greywater recycling, water efficient appliances, compost toilets, constructed wetlands, solar thermal systems, condensing boilers, wood pellet boilers, ground source heat pumps and efficient heating controls are some of the solutions we offer.

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