COST-EFFECTIVE WAYS TO REDUCE YOUR CARBON (CO_2) FOOTPRINT – issue 4:- Aug 2009

This issue (4) is a minor update on the previous issue from Jan 08, with some improved data, some clarifications and some corrections.

Green issues, climate change, low-carbon economy, and similar topics are nowadays extensively covered by the media. Unfortunately, apart from the obvious messages of "consume less", "recycle more" etc., the guidance for individuals is scattered widely, and the diversity of views (and sometimes commercial or political bias) on many topics causes confusion for many people. Being an engineer, I would like to think that I have a clear view of the technical issues and this is my attempt to share this in a relatively untechnical way. This article is written with a UK perspective, and some of the data and assumptions may not apply in other countries.

I apologise in advance for the length of this article, which I feel is the minimum in which I can provide meaningful explanation and guidance covering the spectrum. I will be happy to write expanded notes on individual topics if there is demand.

You may have been to see the film "**An Inconvenient Truth**" starring Al Gore. If you haven't, please go and see it, or buy the DVD. Prepare to be shocked – I was. The planet is changing faster than most people previously thought, and the general scientific view is that human activity is at least part of the reason. So even sceptics should now surely take the "precautionary" view that we must change our energy habits **now**, for the good of our children, grandchildren and future generations. If we wait until there is complete certainty, it may be too late to avert dramatic changes to our world.

It is obvious that the actions of one individual will make little difference, but millions of individuals acting together can make a significant impact. And an example set by people in one country acts as a beacon for other countries. We in the UK have no moral or political basis for demanding that USA, China, India etc use less energy if we are doing nothing ourselves.

So what can we afford to do, preferably without dramatically changing our lifestyle, comfort etc.? Well, perhaps surprisingly, some significant improvements can be made which actually save us money. There are others which do cost us money. We can start with the cost-saving improvements, and then use the money saved to fund other improvements.

THE STARTING POINT:

	Consumption	Cost	CO_2 emissions
Central Heating Gas – average 3-bed semi-detached house, 3 occupants	25 000 kWh (800 meter units)	£900	4.8 tonnes
Electricity – average 3-bed semi-detached house, 3 occupants	5500 kWh	£700	2.3 tonnes
Car (small) – 10,000 miles per year, 40 mpg average (petrol)	1136 litres (250 gallons)	£1100	2.6 tonnes
Air travel – 2 people, trips to: • Spain – say 2000 miles • USA – say 7500 miles.	 240 litres 840 litres		 0.8 tonnes 2.6 tonnes

(Note1: the reason why approximately 1 tonne of petrol produces 2.6 tonnes of CO_2, is that the carbon in the fuel combines with oxygen from the atmosphere. Similar figures apply to aircraft fuel, central heating oil etc.)
(Note 2. This data has changed since the article was first written. Gas consumption is down 10%, electricity consumption is up 30%. Current consumption data is from Energywatch. The UK average dwelling is between 2 and 3 bedrooms, and the average occupancy is 2.4 people, For a 2-bed house with 2 people, take 2/3 of the above data as being representative.)
(Note 3. The average UK person uses 9000 kWh of energy = 1.7 tonnes of CO_2 for transport of all types. If the transport were only by car, this would represent about 6000 miles for a car with one occupant.)

First, we can calculate our approximate household annual CO_2 "footprint" using the table above which includes only the major energy items, i.e. electricity, mains gas (or oil or LPG heating fuel), car fuel, and air travel. The consumption figures above are averages from recent data– you can adjust these to your actual usage quite easily.

In addition there is also our "share" of the CO_2 emissions from government and public services, industry, agriculture etc., which is at least 1 tonne per person, maybe several tonnes, depending on how you calculate it and what your lifestyle is. We can't affect that directly, except by lobbying to improve it whenever the opportunity arises.

Looking at our "footprint" in this way clearly indicates where there is most potential for improvements. In practice most of us can easily reduce CO_2 in all of the above areas.

CONSIDERING THE OPTIONS:

There has been much talk in the press about high-profile eco-improvements, such as domestic wind turbines, solar panels, ground-source heat-pumps and the like. These will reduce CO_2, but they are all relatively expensive items, which may take several decades to generate enough energy savings to pay for their initial cost, so their financial/investment merits are dubious. More of these later.

There are however a range of relatively simple options which can significantly reduce CO_2 emissions, and actually save you money at the same time. The definition of a "good investment" varies from person to person, but for the purposes of this article, let us say that anything with a payback of the initial cost in 5 years or less is a good investment. If it pays back in 1 to 2 years, it's an excellent investment. (In 2009, bank interest rates are so low, that even a 10 year payback on a "green" investment looks quite attractive.)

Some items with longer than 5-year payback are included, for example double-glazing, which adds value to your house when you come to sell.

We can choose what to do with the money saved – we may put it aside, or buy luxuries (preferably ecological ones), or perhaps use it to fund other CO_2 saving technologies.

CENTRAL HEATING & HOT WATER: (4.8 tonnes CO_2 average)

Excellent loft insulation is a high priority. The current recommended figure for loft insulation is 270mm thickness (a pretty arbitrary number!). If your loft has less than 200 mm (8"), then it’s a high priority to top it up to at least 200mm, preferably 250 or 300mm. The latest "Space-Blanket" insulation (www.space-blanket.co.uk) is the normal rockwool material, but encapsulated in a metallised plastic film for clean itch-free handling, making it an easy DIY job. Payback may be anything from 1 to 5 years, depending on how poor the loft insulation was to start with. Available at the major DIY stores, though prices vary widely. Ordinary rockwool is cheaper but itchier!

Wall cavity insulation is also well worthwhile if your property is suitable. If you are past retirement age there are often local authority grants making it (and loft insulation) totally free. Houses built prior to 1920 are unlikely to have cavity walls. Other forms of wall insulation are possible but relatively expensive.

Double-glazing does save CO_2, but its payback in pure energy terms is likely to be a lot longer than 5 years. However, providing its good quality, and expected to last a long time, it will enhance the value of the house, so it's worth doing despite the long energy payback period. The big double-glazing firms can be rather expensive – always get a quote from a small local supplier as well, and don't be pushed into making decisions on the basis of "today-only" special offers.

Don't be fooled into thinking that with double glazing you don't need to close your curtains. Good heavy weight curtains make a substantial difference to heat loss at night.

On the same subject, if you have a conservatory attached to your house, close the interconnecting door when it's not in use. And if it's a glazed interconnecting door, make sure it has a curtain on it at night.

Draught-sealing is important particularly in older properties. Draughts are a major loss of heat, though of course one should not eliminate all ventilation. If your house is less than 20 year old it most likely has good draught sealing already, though it's worth going round and checking doors, windows, keyholes etc. on a cold windy day.

If you have **open fireplaces with chimneys**, then unless they are being used on a regular basis, the chimneys should be stopped up to avoid major heat loss. If the fireplace is used regularly, then fitting a closeable "damper" in the flue would be a good idea. Note that if you permanently seal a chimney, it is a requirement to vent the flue to avoid condensation. (I am not sure of the legal position regarding temporary stopping up, but common-sense suggests that a "porous" stopper such as crumpled newspaper would be a reasonable compromise.)

Improving the controls on central heating is easy and very cost-effective. Most houses have a simple dial thermostat. Replace this with a "programmable thermostat", and you can set different temperatures for different times of day. (Cost from about £20 upwards, fit it yourself - payback under 1 year). Typically you will want the house warmest in the evening when sitting down relaxing, less warm during the day. The best ones have an "optimum start" feature which senses how cold the house gets overnight, and adjusts the start time of the heating in the morning to give the desired temperature at the time you want to get up. A particularly user-friendly one is the Honeywell CM901, around £45 including delivery from various internet suppliers. It is also easy to fit, as it requires no extra wires, it just replaces your old dial thermostat.

Often some rooms in the house are unoccupied much of the time. These should be fitted with a thermostatic radiator valve, and turned down to the minimum acceptable temperature. Failing that, a simple expedient is to drape a thick towel on a radiator to reduce the heat output when not needed. (Still provides some background heating to avoid condensation, and is an obvious visual indicator that the radiator is "turned down".)

The hot-water tank should be insulated to a high standard. Most tanks these days have foam insulation already moulded on at manufacture. But there is no harm in adding a further insulating jacket (cost £10 to £20), and also insulating the hot pipes coming out of the tank.

Most hot water tanks have a thermostat mounted near the bottom of the tank to control the heat input. Try turning this down by 5 or 10 degrees, and providing you rarely run out of hot water as a result, you will improve the overall efficiency. NB: To avoid risk of Legionella bacteria growing, temperature at the top of the tank should be at least 60°C, no less.

(Electric water heating by immersion heater is to be avoided if at all possible. If this is the only option, again its temperature can be adjusted downwards; usually there is an adjustment screw on the heater, sometimes under the cover.) When installing an immersion heater, the switch with its indicator light should ideally be in a prominent visible position to reduce the risk of it being left on for long periods when not needed.

The type and age of **boiler** has an important effect on efficiency. If a boiler is an older type, say 15-20 years old or more, it may well have a much lower efficiency than modern boilers, and also it may have degraded with time. It may be time to replace it, even if it's not at the end of its life. As with double-glazing, a new boiler will enhance the property value.

The new boiler should be the "condensing" type, which has significant efficiency gains particularly when running in condensing mode. This is even more effective when used with underfloor heating, though it's usually only cost-effective to install underfloor heating at time of new build or major refurbishment.

The boiler itself has a temperature setting (typically 1 to 5). In winter it may be necessary to have this near maximum, but in spring, summer and autumn this may be turned down to 2 or 3, improving system efficiency.

If you have a chimney, consider installing a **wood-burning stove**. They are much more efficient than open fires, and they use a renewable fuel. Much of the CO_2 released when burning wood is reabsorbed by growing new trees, so you can count wood-burning as being almost zero CO_2. If you have a cheap (or free) source of firewood, then the wood-burner can also reduce your heating bill substantially. And they are becoming trendy and popular, so should enhance the value of the house.

Ideally the wood stove should be installed in a large fireplace with plenty of space around it, to ensure that room air can circulate around it effectively (natural convection). If the stove is in a confined space, a small fan can easily be used to enhance the convection and heat output.

An extra benefit of the wood stove is that even when it is not being used, it greatly reduces the wasteful flow of warm air up the chimney, because it is equivalent to a flue damper or partial restrictor.

A lot of small improvements as described above could add up to a substantial saving. Unless your house is unusually poorly insulated at present, the saving is unlikely to reach 50%. But 25% plus may be achievable, and that's a worthwhile gain, particularly as it saves you money as well.

(Our current house, a 1960s single storey dwelling, had fairly good insulation when we bought it, but applying some of the enhancements above has already reduced gas consumption about 15%, and further improvements are planned!)

Note: If you are trying to see how much difference your improvements have made, you need to take into account the average outside temperatures. 2008 was a lot colder on average than 2007! See http://www.carbontrust.co.uk/resource/degree_days/what_are.htm for more information.

ELECTRICITY: (2.3 tonnes CO_2 average)

Low-energy lighting is a big saver, but has an unfortunate poor image – early compact fluorescent bulbs were slow to light up, and had unnatural "cold" light quality. They were

also expensive. If you have rejected these in the past, please have another look – the technology has improved dramatically in the last few years, and the prices have come down. Each bulb also lasts between 4 and 10 times the life of a normal bulb. There is definitely a major cost and CO_2 saving to be had, particularly on lights used for at least an hour per day. The financial payback can be well under a year. There are still millions of conventional light bulbs in use, which could and should mostly be replaced by low energy bulbs.

Note that these low energy lights in the past were not suitable for use with dimmers. Now, for extra cost, dimmable ones can be bought.

Beware of some "low energy" bulbs which have appeared recently in the stores, which are actually halogen bulbs enclosed inside a conventional looking glass bulb. They do save energy, but only about 30%. You can do FAR better with the compact fluorescent types.

Halogen uplighters are one of my pet-hates – some have 300 W (Watts) lamps, which are so powerful they spend most of their life being dimmed, inefficiently. My suggestion is either to junk the whole thing, or as a compromise, fit a lower power bulb, say 100 or 150 W instead of 300 W.

Halogen recessed mini-spotlights are not quite so bad, but many of these are over-powered and could be replaced by lower-wattage lamps. Try taking out that row of 50W halogens in your kitchen and fitting 20W ones instead. Apart from the one directly over the sink, you may find the 20W ones give ample light! LED versions of these are on the market now, but expensive and generally fairly low output. I guess by 2010 these may be competitive on output and pricing.

Interestingly, there are some halogens made by Philips which are significantly better than normal halogens (40% less energy). They are called Philips Masterline (http://www.ricamstore.co.uk/erol.html, http://www.thelightbulb.co.uk/product/list.php?cat=309), and a 30W version gives the same light as a 50W conventional halogen. They are also longer life – about double a normal Halogen bulb.

There are now some compact fluorescent bulbs which fit into the halogen light fittings. E.g.: http://www.ebulbshop.com/acatalog/9W_MR16__Cool_White__Energy_Saver.html, also http://www.lightingstyles.co.uk/7w_Energy_Saving_lamp_-_GU10_Retrofit.htm. Unfortunately they are big and ugly compared to the standard halogen bulb, so not many people will like these.

Some halogen mini-spotlights (typically MR16 type) are sold as "Low-Voltage" lighting, which is potentially confused with "Low Energy". These lights are slightly more efficient than standard incandescent light bulbs, but nowhere near as efficient as the proper low-energy lights, which are the "compact fluorescent lamps" referred to earlier.

Remembering to switch lights off when not needed is important. We don't leave our car engines running when parked! (Well most of us don't anyway.) It is true that switching lights off and on frequently may slightly shorten their life. Despite this, if a light (any type) is not needed for 5 minutes or more, it's definitely the greener option to switch it off.

Note: Various people have asked me about the mercury released when a low energy bulb is scrapped. It's a tiny amount, not hazardous, and in any case, the power stations release mercury in their flue gases, and the electricity saved by a low energy bulb keeps far more mercury out of the atmosphere than is released from the scrapping of the bulbs. Obviously controlled recycling is best, so the mercury is captured.

Domestic appliances have been improving substantially over the last 5 years or so, and energy labelling gives an easy guide. When an appliance is replaced, an "A" rated model should be chosen, or even AA and higher grades, which are becoming available.

If you have an older fridge or freezer that you don't feel like replacing immediately, then fit a "Savaplug" to it (http://www.savawatt.co.uk/products.htm) This is an ingenious electronic device, which controls the compressor and saves about 20% of the electrical energy with no disbenefits, giving a 2-year payback and saving approx 100 kg of CO_2 per year. Every old fridge and freezer should have one! (Unless you have a recent A-rated unit which will probably have equivalent electronic controls built-in. Also, if your fridge or freezer has a digital display, the Savaplug may not be suitable.) At the time of writing, this product is unavailable, pending a launch of a new model.

We have all been told to switch off (at the mains socket) televisions, computers, and other devices when not in use. Some devices consume significant amounts of power on standby – unfortunately you can't tell which just by looking. Our new-ish television set uses about 1 W (Watt) on standby, which is negligible. But some videos, DVDs, computers, games machines etc. consume 10 - 20 W, sometimes more. One always-on device at 20 W adds up to well over £20 in electricity per year. Multiply this by 10 or more devices in a family house, and you could save a substantial amount of money and CO_2.

One way to tell which devices are wasteful is to feel if they remain warm when in standby mode. If they do, they probably are taking at least 5 W, maybe 10 or 20 W. (Remember to check not only the device, but also the mains "plug" or the power supply, which may contain a wasteful transformer.)

For £15 to £20 on ebay or Amazon.co.uk you can buy a device (search for: "POWER & ENERGY MONITOR") to measure the power of each of your devices. Get one and go round your house and find which ones need switching off. For example, we found to our surprise that our home telephone system (base-station and 3 handsets with chargers), was consuming nearly 40 W in total. Adding a cheap timer (£3 from B&Q etc.) to each handset charger to switch it on for a few hours only each day cut the consumption by more than half. Payback time is far less than 1 year, with no inconvenience or loss of function.
Much to our surprise, a microwave oven we bought (Jan 2008) from a reputable manufacturer has a consumption of about 40W when switched off (whereas our old one used only 6W). We are now switching it off at the socket whenever it's not being used.

Large plasma (flat screen) TV's can consume hundreds of Watts when running, and some may consume substantial amounts even on standby. Computers (with their printers, monitors, modems, wireless routers etc.) can add up to hundreds of Watts when running, and 50W or more on standby.

There are some subtleties hidden in the instructions on equipment. For example, I just discovered that our current washing machine takes in hot water for cycles of 50°C or more, but takes in cold water for cycles of 40°C or less. So a 40°C cycle heats the water electrically, while a 50°C cycle uses water heated by our gas boiler. The 50°C cycle is almost certainly more eco-friendly than the 40°C cycle on this particular machine!

Another useful device is a home energy monitor, for example the "Eco-Eye-Mini", about £40 from various internet stores. It displays your current whole house usage, and can give you a history read-out, to find out how much you are saving by changing your electricity usage habits.

As with central heating, a number of small improvements can add up to a substantial gain. Low energy lighting is a particularly big saver with a very quick payback.

CAR TRAVEL: (2.6 tonnes CO_2 average)

The figures in the table are for a 40-mpg (petrol) small family car. If you have a Diesel, then a 45-mpg Diesel gives roughly the same CO_2 as a 40-mpg petrol car. If your car is more (or less) thirsty than these baselines, you can adjust your figures accordingly. If you do a high annual mileage, it may be worth considering changing your car to a **more fuel-efficient model**. There are now several 60+ mpg small Diesel cars with reasonable performance and comfort.

Note that Diesel cars often cost more to service and repair than petrol cars, and currently in UK Diesel fuel is more expensive than petrol. So for a driver doing average mileage (say 10,000 per year), a Diesel is unlikely to save much money overall compared to a petrol engine. A Diesel will generally emit less CO_2 than an equivalent petrol car, but the other exhaust pollutants are generally worse with Diesel. The net result is that high mileage drivers tend to opt for Diesel, and lower mileage users opt for petrol.

Before you do a long (or short) journey by car, think whether you could combine two or more journeys to save mileage, share cars, walk, cycle, or take public transport. Saving 1000 car miles per year represents about 0.25 tonnes of CO_2. Travelling by train or bus (1 person) uses only about 1/3 of the CO_2.

Reduce motorway cruising speeds – dropping 10 mph from whatever your customary speed is, will usually make little difference to your total journey time, but can save 5 to 10% of the fuel. (Although there is little point in cruising at less than 50 mph as the gains are insignificant). You may also arrive more relaxed – the benefits of lower noise and vibration!

Converting a petrol car to Autogas (LPG) will reduce the CO_2 output by about 15%, and at present the fuel is cheap (low road duty) so the fuel cost will reduce by approx 35%, making it significantly cheaper to run than an equivalent sized Diesel car. The conversion cost is £1500 to £2000 +VAT, so it's normally only high-mileage drivers who opt for this. Payback is typically around 30,000 miles of motoring, less if you have a big thirsty vehicle in the first place.

An approved conversion also exempts the car from the London Congestion charge (check this is still true before investing, as the rules may change), and this dramatically improves the payback period for regular London drivers (requires annual registration, approx £10). There are now over 1200 UK petrol stations supplying Autogas, so filling up is easy. And the car still runs on petrol as well, automatically switching over if the gas runs out.

Some makers (Proton, Subaru,) offer new cars with factory fitted LPG (bi-fuel, or dual-fuel) systems. A cautionary note – the LPG system means something extra to maintain, and something extra to go wrong, so one should factor that risk and cost into one's calculations.

Hybrid cars using electric motors in conjunction with an engine (Toyota Prius, Honda Insight for example) have impressively improved fuel consumption at low speeds, but currently only limited benefits at high speeds. If much of your fuel is consumed at 70 mph on the motorway, the overall benefits are pretty small. There is also debate over the lifetime and ecological credentials of the batteries. Hybrids are a significant ecological "statement", so I am in favour of them in principle, but I would not expect them to have a significant financial payback compared with a similar performance conventional car. A small Diesel car with 60+ mpg economy will have lower running costs, as well as being much cheaper to buy.

However, in terms of green credentials, LPG is probably the best option at present. My understanding is that the LPG is a natural by-product of the refinery process, and if it's not used as LPG, then it has to be converted to conventional liquid hydrocarbons by an energy

intensive catalytic process. So the effective overall CO_2 output of an LPG car is slightly better than a Diesel car, and the other pollutants are incredibly low, compared to petrol or Diesel. If you are planning on keeping your car for say 40,000 miles before you change it, an LPG conversion is well worth considering. It should also add to the resale value.

It has been said that it's greener to keep an old car going than it is to replace by a new, more efficient model. There is some truth in this, particularly if your car is only used for a few thousand miles a year. If it does the typical 10 to 15,000 miles, then the picture is not clear-cut. Anyway, most cars are changed for reasons other than purely "green" ones, so my plea is that you keep green factors in mind next time you change you car.

AIR TRAVEL: (???? tonnes CO_2)

In the last few years air travel has become cheaper per mile than train or car travel, which seems counter-intuitive. It appears that there are subsidies and taxes etc., which grossly distort the "market". As a result it's difficult to resist flying.

As the table at the start of this article shows, a trip for 2 to Spain plus a trip for 2 to USA creates about 3.4 tonnes of CO_2. This figure is purely the CO_2 emissions, and there is a scientific view that the effects of water vapour (con-trails) and NOx in the high atmosphere may magnify the global warming effect of flying by a factor of 3 (or 2 to 4 depending on which report you read). So the real figure might be **10 tonnes** equivalent. Compare that with the energy savings you are likely to be able to make per year in your house!

Every time you take a plane ride, think whether there is an alternative? For domestic and near-Europe trips take the train instead of the plane and use the longer journey time to relax, read, or contemplate how people like you are helping to make the world a better place! If you are travelling on business, or for pleasure, consider that the train environment can actually be more conducive to effective working or relaxation than the rather oppressive environment of airports and aircraft. Also when you add in the time to reach airports and the check-in times you may find that train travel times are not so bad!

Obviously, visiting relatives or holidaying in distant continents is a bit impractical by train, but why not think about going less frequently, and staying for longer on each trip?

Combining trips to several destinations may often be more expensive than separate out-and-return flights, but it's definitely better for the planet. In the last few years, ticketing options have become more flexible, making combining trips easier and more economical.

Where possible, choose airlines that have the latest and best aircraft, as these are the most fuel-efficient. For long-haul travel the new Airbus A380 is claimed to be 15 to 20% more efficient than a Boeing 747 (CO_2 per passenger-mile).

There are alternatives for long-haul travel, such as travelling on a cargo ship (which can be organised through a website – www.strandtravel.co.uk). Very time consuming, but eco-friendly and maybe an interesting experience in itself!

OTHER ECO-IMPROVEMENTS:

Up to now I have mentioned only things that save money, i.e. have a moderately quick financial payback as well as reducing CO_2. They are the first priorities, but there are other eco-improvements which can be considered, some of which have been promoted by politicians, media, and advertisers. (e.g. domestic wind turbines and solar panels).

Not many people are in a position to build (or have built) a new high efficiency eco-house. However there are various add-on technologies which can be used with existing buildings, which go some way towards this in theory.

An article (Miles Brignall, Guardian 21.10.06, "Hot air and the dash from gas") provided some very useful data on the potential savings from various household level technologies, both in terms or reduced energy bills (i.e. financial savings), and reductions in CO_2. The technologies presented were photovoltaic cells, wind turbines, solar water heating, ground source heat pumps, and wood pellet boilers. These are all now available, in varying stages of technical and economic "maturity".

Most of these technologies, when applied at the household level, have long financial payback periods (and indeed, depending on how you do the sums, may never pay back financially at all). So if we adopt them, we are effectively paying in order to reduce our CO_2 output, as well as making a visible statement about our environmental beliefs.

No problem with that - most people now accept that paying some money to keep our planet liveable is a reasonable thing to do, but we need guidance on how to get the "best bang per buck", i.e. best CO_2 saving per pound (or dollar).

Let's start by analysing some of the data presented in the Guardian article (original data source – consultants Faber Maunsell, but some figures updated based on unpublished results of the recent Barratt homes Ecosmart project). (NOTE: The payback figures have improved a little since the original data, no doubt because the cost of energy has increased by more than inflation.)

Technology	Cost (allowing for grants etc.)	Cost saving per year	CO_2 saving per year	Financial payback period
Photovoltaic cells 1 kW	£3000	£100	0.3 tonnes	30 years
Wind turbine 1kW	£1000	??	?? tonnes	?? years
Solar water heating 2.5m^2	£2100	£60	0.3 tonnes	35 years
Ground source heat pump 10 kW unit.	£6000?	???	1.3 tonnes	?? years
Wood pellet boiler 20 kW unit.	£3500 +	none	2.6 tonnes	never

Note: For information on the range of grants currently available, see: http://www.lowcarbonbuildings.org.uk/about/

The last column in the table, the "financial payback", I have based on an assumption of zero interest on the capital, and also zero inflation in energy prices. In reality both interest and energy inflation exist, but they approximately balance each other out. Energy inflation is currently greater than interest rates

The financial payback periods are in the region of 30 to 50 years, which would not generally be regarded as an economic investment, particularly when it involves hardware which may not even last that long.

There are many claims around for faster payback periods, e.g. solar water heating – 5 years, wind turbines 15 years. Such claims are based on very optimistic assumptions. In the case of small domestic wind turbines, recent publications show that in reality for the majority of urban home locations they produce little electricity and nil payback, unless you live on a windy hilltop. (Wind turbine outputs are typically based on a 6 m/s mean wind speed, which does not occur in the majority of urban environments. If the wind speed is say 4.5 m/s

average, then the wind turbine annual output drops by more than half, so the payback time more than doubles. See http://www.carbontrust.co.uk/News/presscentre/2008/Small-Scale-Wind-Energy.htm for more information)

So, would you invest several thousand pounds in something with a financial payback period of 30 years or more? Why not put the money in a building society account and get 4% p.a. income (at worst 3% after tax)? My calculator tells me that even at 3% effective interest rate, after 30 years, my money would have more than doubled!

In this context, putting my money into a technology, which merely recoups its purchase price in 30 years (or more), is financially similar to throwing away a large proportion of it. Furthermore, most of the devices listed above will be lucky if they last 30+ years, or if they do, they will incur substantial maintenance and repair costs in that period.

The **wood pellet boiler** is the clear winner in terms of CO_2 saving for your investment. However, as it doesn't (at current fuel prices) save you anything on running costs compared to a gas boiler, its financial payback is nil, which has to be balanced against its planet-saving potential. It also takes up a good deal of space, for the boiler and the bulky fuel storage, so it's not often viable for the average house. In my opinion for the average house, a modern wood-burning stove is a better enhancement to your heating system, assuming you can find a reasonably cheap source of firewood. Use it when you can, to reduce your winter gas consumption.

Having said that, for large buildings such as schools, hospitals, stately homes etc., a biomass (woodchip of other fuels) boiler can make very good sense financially providing there is a sustainable source of fuel available. Grants for such boilers may be available, and the payback may be quite fast, particularly if the existing heating is oil-fired rather than mains gas.

The domestic **wind turbine** looks good in theory, but only if you have 6 m/s average windspeed available, which is not the case for most homes. Average speeds in the range 4 to 5 m/s are more typical, and at these levels the payback would be negligible.

(Note. This apparent condemnation of wind energy only applies to small-scale domestic wind turbines. Large wind turbines (i.e. windfarms) are very good in eco and economics terms, and they pay back their energy of construction in only a few months. The more the better, subject to sensible non-intrusive locations of course!)

Feed-in tariffs : Much has been said in the press about "feed-in" tariffs, which for photovoltaic cells and wind turbines, will give the owner extra money (compared to normal electricity prices) for any electricity exported to the grid. These may appear in UK in 2010, and when they are decided in detail, then it will be possible to re-evaluate the payback figures for these technologies. Small-scale wind is unlikely to be cost-effective, but photovoltaic panels may well become a good financial option. The experience in Germany , with very high feed-in tariffs, is that solar photovoltaic panels have become very popular.

The **ground-source heat pump** is expensive, because it typically involves laying pipes in a deep hole in the ground. It runs on electricity, and can achieve a COP (coefficient of performance) of 3 to 4, which means that it provides 3 to 4 kW of heat for every kW of electricity. When you compare the cost of electricity and gas in UK, the running cost is probably no better than a condensing gas boiler. In terms of CO_2, there is an advantage, though not huge. This is because a large chunk of UK electricity is produced from fossil fuels (gas and coal), with efficiency of about 40% on average. i.e. about 2.5 kW of fuel used for every 1 kW of electricity produced. If we produced a lot more of our UK electricity from renewable sources, then ground source heat pumps would give a greater CO_2 benefit.

A recent innovation is the **air-source heat pump**, which avoids underground works and is considerably cheaper to install. However, although not much data is available, there is reason to suspect that its efficiency (COP) is less than a ground-source heat pump.

The technology and efficiency of heat pumps will hopefully improve significantly in due course.

Both ground-source and air-source heat pumps already make very good sense in countries which have predominantly green electricity (from hydro, wind etc.). But, in my opinion, not in UK with its current dominance of fossil-fuelled electricity.

Having said that, if your house does not have a mains gas supply, and you are using expensive electricity or oil or propane for heating, then ground-source or air-source heat pumps may be more worth considering.

All these technologies have little to choose between them in terms of planet-saving value and in terms of financial payback. Do any of them represent "good value"? Are there alternatives which we might wisely spend our money on which will be a better bet, both financially and in CO_2 reduction terms?

ALTERNATIVE OPTIONS:

I would suggest that rather than fitting a small wind turbine or solar panels or photovoltaics to your house, you should consider another approach, which is to put your money into larger schemes, which will have better payback and also more CO_2 impact per pound invested.

One example is **investing (buying shares) in windfarms**. Because these are sited at windy locations, their payback and CO_2 impact are enormously better than the small domestic scale units. And if they are sited offshore, as many will be around the UK over the next few years, they don't even have a significant negative visual impact.

Obviously, some will consider investment in windfarms as risky, being at the whims of the weather, government subsidies, technical risks etc. I guess it's wise not to put your entire life savings into this.....

There are currently (in the UK) only a small number of opportunities to invest in pure renewable energy companies, e.g. Renewable Energy Generation Ltd, also Triodos Renewables Fund (share issue in 2008, now closed) although windfarm schemes are sometimes run as co-operatives giving local (and other) people an opportunity to invest directly. Examples – see: **www.energy4all.co.uk** , which covers a number of small wind farms. If you register your interest with them they will notify you of future share offers.

Otherwise you could invest in the big utilities which are committed to increasing renewable energy, although in doing so you are also investing in their non-renewable activities. However as shareholders you would also then be able to pressure them to exceed their renewable targets. For further advice talk to an ethical or environmental IFA (Useful websites: www.ethicalinvestment.org.uk, and www.eiris.org)

A no-risk option is to **purchase your electricity from a renewable energy supplier**, and pay the slight premium that such tariffs usually have. No financial payback, but the small amount extra of money you pay will be reducing CO_2 emissions. (But please check the small print on such tariffs – some may be not supplying 100% renewable electricity, but merely promising to put the extra money into promoting or expanding renewable energy. Not quite the same thing as supplying renewable electricity, though a step in the right direction!) With more people purchasing through green tariffs, demand should force increased supply of

renewable energy in due course. **See www.greenelectricity.org/domestic.php** for useful information, including costs and green ratings.

Finally, remember that other aspects of your lifestyle can have a very large impact on your total CO_2 production. Maybe "investing" in train travel instead of car or plane travel, or investing in an "eco" car would be more appealing to you than investing in some distant wind-farm.

SUMMARY CHECKLIST

- Loft insulation
- Wall cavity insulation
- Double glazing
- Draught sealing
- Chimneys
- Programmable thermostat
- Thermostatic radiator valves
- Hot water tank insulation
- Hot water tank thermostat
- Condensing boiler
- Boiler temperature setting
- Wood burning stove

- Low energy light bulbs
- Halogen lamps
- A-rated domestic appliances
- Fridge/freezer "Savaplug"
- Standby power consumption – all devices
- Timers for switching off when not needed

- Car fuel efficiency
- Reducing car mileage
- Cruising speeds
- Autogas (LPG)
- Hybrid cars

- Air travel – train alternative
- Combining trips
- Choosing airlines

- Photovoltaic cells
- Wind turbines
- Solar water heating
- Ground source heat pumps
- Wood pellet boilers

- Investing in renewable energy schemes
- Renewable electricity supply ("green tariffs")

Please forward this article to anyone you think will read it. If you find errors, or have any suggestions, please email me and I will do my best to respond or amend/update as appropriate.

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