Interview with **Peter Harper, Centre for Alternative Technology**

Pressing environmental concerns during the late 1960s interrupted Peter Harper's studies in behavioural biochemistry, and he never pursued the scientific career he had anticipated in his undergraduate days. Instead, he became a 'scientific missionary', pushing for the application of reason, rigour and measurement in the wild and woolly world of radical environmentalism. He coined the term 'Alternative Technology' in 1972 and claims he has regretted it ever since. His many publications include *Radical Technology* (1976) an influential early textbook of technical alternatives, *The Natural Garden Book* (1994) and *Lifting the Lid* (2000) on low-impact sanitation systems. He is now head of Research and Innovation at the Centre for Alternative Technology in Machynlleth, and working on rapid-decarbonisation models for the UK economy.

1. Could you explain the history and mission of the Centre for Alternative Technology?

Depends who you ask! There is the official press-release view put together by the media office and then there are the real dreams, motivations and imaginings of the people who work there. At the beginning everyone involved was 'feeling their way' into a new kind of existence. It was daring and romantic. Most people lived on the site. There was a shifting mix of people with a complex mix of motivations, often unspoken. Many were seeking a safe and convivial community in which to live and bring up children, while others were seeking the perfect socialist commonwealth, or wanting to create an Ark that would survive the collapse of civilisation. This was the apocalyptic wing of that first wave of modern environmentalism. Let's remember that behind environmental pessimism was the shadow of nuclear war that my generation had grown up with, always a possibility. Only semi-consciously, people were aware that if there was a nuclear exchange the best place to be was a) not in a densely-populated target area; b) in the west, because prevailing winds would blow the fallout eastwards. Hence the allure of Wales, which was also sparsely populated and cheap!

So much for 'alternative'; what about 'technology'? That is what distinguished us from most other Bohemian adventurers of the era: we realised that an alternative society has to work; and therefore has to obey the laws of nature; and must be practical and cost-effective. The project therefore attracted scientists, engineers, librarians, architects and people with a wide variety of trade skills; not just dreamers.

Today, 35 years later, many of the early ideas are mainstream. So is the organisation in some ways: more professional, even bureaucratic. I have been astonished at the administrative complexity required to comply with legal requirements and 'best practice'. In terms of activities, the 'communitarian' aspect is no longer significant; the centre of gravity has moved from 'edutainment' for drop-in visitors (where we struggle to keep up with prevailing standards) towards environmental education at all levels (where we are innovators and market leaders).

In terms of ideology, we have tried hard to clean up our views according to reasonable interpretations of the evidence, and this is a perpetual process. In a debate, we are always on solid ground but we are always listening for contrary evidence. At the same time we want to hold on to the view that the simple mainstream aspiration for MORE is mistaken, and that sustainability must and will entail a substantial revision of what we expect and want.

2. Clearly, CAT has a wide brief and here we would like to focus on energy. We see there being two broad necessities - reducing the amount of energy we use and improving the ways we generate it so that it is sustainable. What can governments do to encourage us to conserve energy and are the UK and Welsh governments doing enough?

The problem is not so much energy per se, but the greenhouse gas (GHG) emissions associated with fossil fuels, which make up 90% of UK supply. The UK government has a current target of 80% reduction of GHG emissions by 2050, recently revised up from 60%, and in our view likely to be close to 100% within a decade. Replacing virtually all our energy demand with low-emitting sources turns out to be extremely difficult. It is easy to forget that, having stumbled upon the dragon's hoard of fossil fuels in the 19th century, the world has been on a great binge of rapid growth and high living. Fossil fuels have spoiled us: cheap, abundant, storable, instantly available, highly concentrated, and easily converted into energy services. 'Going straight' and living off nature's interest rather than her capital, is much more demanding.

Technically we can do it: the resources are there, but it will take a long while to build them up. They are relatively expensive, and there are other, non-monetary, costs: the political and other risks of nuclear energy; the visual effects of windpower; the ecological effects of dams and barrages; the land-take of bioenergy crops, and so on. Everyone agrees, it would make most sense to find ways of reducing demand for energy, then meeting this reduced demand with more sustainable sources.

In our 2007 report *ZeroCarbonBritain* we called these two processes 'Power Down' and 'Power Up', and we gave them equal roles, each contributing about half the solution.

It is fashionable these days to plot decarbonisation measures in terms of Marginal Abatement Cost Curves or MACCs. If you rank each measure in terms of its abatement potential in £/tonne you will find the 'Power Down' measures crowd into the left hand side of the curves, many under the zero-cost line. In other words they often have a negative cost and it would be daft not to do them anyway. We have known this for a long time and influential theorists such as Amory Lovins have eloquently demonstrated that fourfold increases in efficiency are possible and cost-effective. In practice it has been very difficult to achieve 'factor four', and in our view 'factor two' is good enough to be getting on with. In other words, we aim to deliver all the energy services we now enjoy with half the primary energy input. Beyond that, effects on lifestyles will probably lead people to prefer to pay both monetary and non-monetary costs for Power-Up processes.

Who does the powering down? To achieve maximum buy-in from the general population it would be best if it can be done 'invisibly', without any

special impact on lifestyles. Part of this can be done by internal changes in the public sector and business sector; and part by changes in products and services: better cars, houses, fridges, lights, aeroplanes, boilers. This is already happening through small nudges in the form of regulations, planning constraints, grant schemes, modest energy taxes and so on. In this respect, the UK government and WAG are showing willing, the latter especially with some pretty radical plans (for example a zero-energy standard for new houses after 2011, compared with 2016 for the rest of the UK, itself considered a very tough target). But overall progress is slow, and we hide the reality behind statistical conventions. On a 'consumption' basis our GHG emissions are at least 50% higher than we report under the Kyoto Protocol, probably around 15 tonnes per head per year, when our imports from China (whose economy is currently 3-4 times as carbon-intense as our own) are taken into account.

It does not make sense for countries to decarbonise unilaterally. There has to be a binding international agreement with appropriate economic instruments to drive change everywhere. Lots of schemes are under discussion but essentially they put a price on GHG emissions that, in theory at least, drives a 'race out of carbon'. So the biggest contribution the UK government can make is to help create an appropriate agreement, then sell it to its own population and ease the transition through an appropriate combination of national carrots and sticks.

3. What measures have you taken in your domestic life to conserve and reduce waste? What are the first three things a 'typical' individual could do to make their lifestyle more sustainable?

I have tried to measure my personal 'carbon footprint' rather carefully. What I call the 'fingerprint'—the way it breaks down into different components—helps me see where the 'jugulars' are, and then choose which actions are the most cost-effective. Domestic waste, although it has a high profile, is *not* a jugular: it is rather overrated in carbon terms. Nevertheless it is so easy to minimise that I do it anyway: simply separate out the recyclables, compost all organic materials and most of the non-recyclable paper and cardboard, and leave the rest to the dustman. I measured all the waste for two years. The result was an 80% reduction by weight, but with an adjustment for GHG implications, about 96%. No point busting a gut trying to improve on that.

The *real* jugulars are well known: house heating, car driving, flying and consuming animal products. Changing these would cause problems for most people because the old (i.e. existing) carbon rules have woven these factors very firmly into the fabric of modern life and encouraged — even obliged — consumers to become culturally dependent on them. They are strongly inelastic: moderately high carbon-prices do not change them much.

Over the last 15 years I have experimented with these various factors to see how they might be mitigated at the least financial and cultural cost. In many cases I have been surprised how quickly it is possible to shift my behaviour to a new lower-carbon regime with no perceptible loss of life quality or happiness. I can report that I have been able to reduce emissions from transport, household energy, goods, holidays and food by at least 50% in each category, and in some cases considerably more. Physically it's possible, and for me it's been no big deal. But we must acknowledge that most people do not buy into the green analysis or ethics, have no material incentive to change, and would encounter much greater psycho-social and other barriers. Carbon prices will have to rise very dramatically to make people start paying attention. After that, as retail prices change differentially, the role of the 'lifestyle' end of the environmental movement will be to develop parallel tracks of techno-behavioural arrangements that people could sidle into to save money, without risking damage to materially-mediated folkways or feeling that they could not fulfil their obligations. For example there are smart modern car clubs offering flexible mobility without the need for a dedicated household vehicle. The suite of skills and habits involved in car-sharing is about as complex and onerous as that involved in car-owning, but with lower cost and carbon emissions. Of course it takes a bit of initial effort to make the change, but once you've switched you wonder what all the fuss is about. It would offer a dignified transition. We need similar techno-social alternatives in all spheres of life.

4. As an environmentalist, how do you resolve the fact that whatever you do, your efforts are probably going to be negated by the irresponsibility, profligacy and indifference of some elements of society in wealthier countries? (or is this too harsh or pessimistic a judgement...?)

I am fascinated by historical accounts of societies standing on the edge of the abyss and simply falling in, such as those described in Jared Diamond's riveting *Collapse*. In many of the cases described by Diamond, over-exploitation of a crucial environmental resource was driven by competitive rivalries within the elites. Even when disaster was imminent it often proved impossible to stop the process: it was as if in these circumstances people preferred a 'doomsday' judgment to be made by an external *force majeure* rather than suffer a loss of status.

In my more pessimistic moments (and I've had a few!) I feel this pathological short-sightedness is the most likely scenario: the rich (everywhere) will continue to eat, drink and be merry, and the poor will aspire to it too, because that's what you do when you're poor; the rich tell you it's the cool thing and you believe them. In spite of desperate technological efforts we will fail to reduce GHG emissions, and sooner or later accumulating climate changes start to break the weakest links: harvests routinely fail, extreme weather events test infrastructures to the limit, weak states collapse, the UN system crumbles. Defensive blocs form — *Festung Europa* with us again — while billions of desperate environmental refugees clamour at the gates. It could be with us by the end of the century, or even earlier. The famous *Limits to Growth* global collapse scenarios, started in 1970 and updated decennially, might prove horribly prescient.

For most 'ordinary people' I talk to (i.e. outside the circles of the faithful) climate change is just another issue along with traffic congestion, pensions, teenage gangs, university fees, prostate cancer, the World Cup…. They are genuinely baffled that "we" are trying to bump our obsession up the agenda and make everybody engage with it. Is it in fact 'our' agenda? Is it only *we* who worry about the future, about people in other countries or other species? I think this is the key. Such a very broad morality, that takes in such a vast collection of entities is extremely recent, and is avowed by a few percent at most of humanity. Why should we try and impose it on everyone else?

I expect to live at least until 2040. By that time I think the die will be cast: we will know whether we still have chance of avoiding the worst, or whether it is simply all too late. If the latter, effort will transfer decisively to adaptation measures and I expect to see a change of prevailing morality, from a fine-tuned, Guardian-reading, care - about - everything sensibility, to a much coarser, broad-brush, fatalistic one, adapted to dealing with human suffering on an epic scale. I can feel the first stirrings in myself already.

5. Is becoming more sustainable always win-win?
No, but it often can be, and I guess it's up to us to find the win-wins if we can. Often it's very complicated and there is a pattern of many winners and many losers. Take the problematic case of livestock, particularly ruminants. They are net GHG emitters and require a disproportionately large area of land simply because there are substantial losses in converting vegetation to animal biomass. They stand in the way of decarbonisation and — arguably — feeding the world, and they are not strictly (I mean very strictly!) necessary. Let's say for the sake of argument, their numbers were reduced by 80%. This would reduce their direct emissions pro rata, but in the case of the UK it would release 40-50% of the agricultural land area for other purposes. About 20% of this would need to be plant-based foods (much more efficient per unit land area) to replace the loss of livestock products. The rest could consist of carbon-neutral fuel crops or carbon-negative sequestration processes. This package could reduce UK emissions by a crucial 10-20%, depending on assumptions and calculation conventions.

Meanwhile the necessarily altered diet would conform much more closely to the food proportions recommended by the Harvard School of Public Health for optimum nutritional health. That the low-carbon diet is also the healthy diet is an attractive win-win.

BUT! Of course, if you introduced this scheme overnight in a Stalinist coup, there would be riots in the streets. Livestock farmers, meat-loving consumers and large parts of the food industry would take a lot of persuading to say the least. So not everyone wins, and you might well say that in a non-Stalinist society this renders the whole idea a non-starter. But step back a moment. It will probably require changes of this magnitude in each economic sector to reach the targets the government has already set; even as each sector pleads indulgence as being a special case:

Transport: Don't be daft, people will never get out of their cars.
Aviation: Give up flying, annual holidays? give us a break.
Housing: What? retrofit 15 million homes? Think of the disruption!
Electricity: More nukes, windmills, pylons, imports from Johnny Foreigner? The *Daily Mail* wouldn't stand for it.
Goods: Of course it has to come from China, we just don't make stuff any more.

And so on. However many win-win things might be underneath, on the surface there's always a vociferous lobby-group ready to make a big fuss. And perhaps rightly, who knows? But these are bullets that are going to need biting sooner or later; and any that are not bitten means the others must be bitten even harder. Difficult choices, and some particularly inspired spinning would be need to persuade everyone that it's all win-win.

At this point I should comment on what might be in many readers' minds. If all goods are open to a global market, and the UK (say) starts restricting (say) livestock production, yet demand remains, wholesalers and retailers will simply source from abroad and nothing is gained. This is exactly the reason why an international treaty is required. Carbon taxes (or whatever economic mechanism) will need to be universal, otherwise unilateral action will be pointless. The World Trade Organisation would have to operate on 'carbonomic' rather than traditional economic rules (and yes, I hear you all muttering "Don't be ridiculous that is Utopian and completely unthinkable". Got a better idea?)

6. Do you believe that dangerous climate change is now irreversible?
No, although there are some analysts who think so. Those of us who are not climate scientists still have a lot of work to do reading the runes, because climate scientists do not all agree among themselves, but we in the policy field have to operate in real time. So we have to keep weighing the data and arguments for ourselves and sometimes 'correct' for what are sometimes clear biases (for example, the Intergovernmental Panel on Climate Change is our principal source of definitive peer-reviewed data, yet by its own rules, its reports cannot take account of source material after a specific cutoff date. It would be absurd, say three years later, not to make use of more recent findings or better theoretical frameworks).

There is bound to be an ethical dimension, because there is no objective rule for deciding how 'precautionary' to be, how much risk to take, and on whose behalf. In the nineties, our best understanding was that the relationship between climate and GHGs was more or less linear: more GHGs, warmer, fewer GHGs, cooler; and it was simply a question of working out where to stop in a reasonable balance of mitigation and adaptation costs.

Unfortunately since then we have discovered a variety of feedback effects and potential instabilities in the climate system that might make it 'flip' into new and possibly uncontrollable modes. Even more unfortunately, we have little idea how likely this is, or when we might expect to cross thresholds that will trigger such unstable modes. This has generated two distinct policy approaches, a more rapid precautionary one and a slower, more pragmatic one. The New Economics Foundation for example, takes the precautionary approach and has launched the 'One Hundred Months' campaign, on the minority view that the climate faces a 'tipping point' about 100 months after August 2008. In contrast, most mainstream analysts favour a more measured response that they feel has a greater chance of achieving worldwide consensus. They tend to speak of a target date around 2050 and an overall goal of containing temperature rise below 2°C.

The meaning of 'dangerous' is interpreted differently by these groups. The pragmatists mean a state that actually causes tangible and serious damage. The "hundred monthers" mean a state that, although not presently damaging, *commits us* to eventual serious damage decades, or even centuries, hence. Much confusion arises around this fuzzy word, as it does with the antonym, 'safe'. In diplomacy of course we need woolly words like this, but in analytical discourse a little more semantic hygiene would not come amiss.

Personally I think we should be very actively developing a whole range of scenarios to deal with every possible outcome. Some of these would entail very rapid rates of decarbonisation, and some would include a 'reverse gear' so that if we overshot a critical target we would have some chance of restoring the *status quo ante*. With stakes this high, it seems only prudent, similar to taking out insurance even though the chance of needing to make a claim is low.

I always find it odd that so few people share this commonsensical view. In fact it is odd altogether that the active climate-change debate is so widely disregarded. Greenies have been puzzling over this for twenty years of course, so it is gratifying to have a distinguished social scientist swan into the field, notice the same thing, and dignify it with an eponymous title, to wit, "Giddens' Paradox". Thanks, Tony. We are as grateful to Lord Giddens as we were to Sir Nicholas Stern, who gave the imprimatur of an economist to the ravings of mere scientists, and made governments everywhere sit up and take notice: "You mean all this stuff about the climate is actually…true?". Doh.

7. In 2050 what sort of energy should power our lives, and why?
Recall what I wrote before about Power Up and Power Down. We need to supply about half the primary energy we're using now. There is no single 'silver bullet', but perhaps what some wit described as 'silver buckshot', a whole menagerie of energy sources that complement each other. We think that at the outset everything should be on the table for discussion, nothing ruled definitely in or out. It is possible to construct all manner of different mixtures that will add up to a reliable supply, and here I would like to recommend David Mackay's superbly enlightening *Sustainable Energy Without the Hot Air*, which you can download for free.

If you go for 'silver buckshot' you're bound to find something you don't like. We all have energy *bêtes noires* we would like to rule out even before the debate begins. It might be nukes, or wind farms, or biofuels, or tidal barrages, or big dams, or carbon capture and storage, or importing power from abroad, or Anything Big, or indeed Anything Small: they each have vigorous opponents, but we cannot allow special views or interests to prevent the debate even starting. Everything has to be on the table and judged by the same criteria. Probably consensus will demand that every party will have to swallow at least one *bête noire*, and they do taste awful.

Having said this, there seems to be a growing consensus that whatever the mix of sources, British energy will be increasingly electric. At the moment we have a gas grid and an electricity grid, rather nicely complementing each other, but in a decarbonising world the gas grid will become less important. In some areas you might find a return of the local gas works producing a mixture of biomethane and perhaps hydrogen for local consumption. But a much-strengthened electricity grid will be the key to keeping the lights on with low-carbon "buckshot", moving variable amounts of electricity around the country and constantly juggling supply and demand. There will be opportunities for a lot of local electricity generation, but not usually at the household level. Where households can score is in demand control, where you would get credits for *not* consuming during a given period, or for being a temporary store. For example if you had a private vehicle it would almost certainly be electrically powered, using batteries. Parked, the car would be routinely plugged into the grid, but would only take charge when there was plenty and the price was low. You could get further credits for allowing the grid to take some of your battery's charge in response to a temporary shortfall. A kilowatt from each of a million vehicles is equivalent to a large nuclear power station and gets you flexibly over a demand spike or a supply trough.

Heating would also be largely electric, but amplified by the use of heat pumps, which I won't go into now. In some areas heating would be by district heating from combined-heat and power plants using biomass energy. Appropriately - designed houses can also store energy in the form of heat. Biomass will be significant for heating in some areas but has to be used very carefully because it is so land-hungry.

Some countries are well endowed with energy. Iceland for example has geothermal, Norway has hydro, Britain and Ireland have on- and off-shore wind, Ukraine has biomass and a large number of lower-latitude countries have enormous solar potential. There might be some fossil fuels still in the system, coal or gas, but with the CO_2 'captured' and stored in a concentrated form somewhere 'safe' such as an old oil well. (Oil of course will be in very short supply by mid-century and probably much sooner).

The advantage of carbon capture and storage (CCS) is that it allows us to hang on to a particular quality of the fossil fuels; 'dispatchability' or their ability to deliver power exactly when you want it. A small amount of fossil energy can help 'fill in the cracks' of a mixed renewable system. Later, the fossil fuels can be gradually replaced by biomass, and CCS then pulls off the amazing trick of being a carbon-negative source of energy. We need a few of those.

There might well be a world market in energy, but my guess is that it will develop continentally, with high-voltage DC 'supergrids' spanning thousands, rather than tens of thousands, of kilometres. Shared sourcing from a region the size of Europe would iron out most of the natural fluctuations in variable renewables such as wind, solar and wave power, but in any case there would be storage and backup system. Similar continental grids could serve large areas like North America, Central America, East Asia, Southern Africa and so on.

When and if these supergrids are established, big-scale solar concentrated heat energy in desert areas could be an important source, even for the UK. It involves an important technical innovation: short-term storage of heat that can then be used to generate electricity on demand. Dispatchability again. Ten years ago we would have guessed the electricity would be stored as hydrogen, but hydrogen seems to be fading. It is possible that it might have some role as an energy carrier and could be treated much like LNG today, tankers, terminals, pipelines, fuel cells. However hydrogen has been a Great White Hope ever since I can remember and has failed to break into the mainstream, largely on account of knotty technical problems. Leave it as a wild card.

All this 'big stuff' presumes that we solve the climate problem and that the international system remains intact. Some environmentalists (and others) worry that this does not give sufficient energy security since it relies too much on international sources. Some are even worried about local security and want to have their own independent local supplies. These are good questions, and we are very much in favour of local communities and enterprises putting in their ha'porth: it's going to be an important source of income and employment and community regeneration.

What about the great tradition of self-sufficiency that CAT was associated with in the 70s? Yes, it's good to roll your own when it makes economic and ecological sense. And sometimes it does. But all too often (as we discovered) it turns out to be a kind of pseudo-autonomy that depends utterly on the existence of factories in Sheffield (and now Shanghai). Let's admit we all need each other, share our resources and try and get through it together.

8. Can Wales be different, and better than the rest of the UK in this respect, or are we too small be make a difference or to lead on this?
I must admit I am stirred by the vision of little Wales getting up and showing the way. My colleague Paul Allen speaks in these terms: "Wales was the first country to lead the world into fossil fuels. Let it now be the first to lead us out". Well it's true that Wales is small, so its greatest leverage is the power of example. What example?

If we are going to follow the 50:50 power-down power-up pathway it should be fairly obvious that power-down happens mostly in the cities, and power-up in the countryside. We have some big cities, and powering them down will be quite a challenge, but likely to be similar to the same process elsewhere, so let's leave that on one side. Think about the power-up. A lot of industrial Wales is at a low ebb. It needs the stimulus of the new renewable energy infrastructure that we have to build by 2050. Plenty to do! Meanwhile

what energy resources does Wales have? We have wind, wave, tidal power, biomass, even some respectable hydro sites. Let's get on with it. The question is emphatically not "Can we provide for ourselves?" It is "How much can we give?"

The answer is quite a lot, and in the short term it is principally wind power. Rural Wales is already a made-over landscape. We should make it over again, a multiple-use landscape that produces *and exports* food, energy, and materials, while simultaneously creating habitats and sequestering carbon. It will look different, and we should be proud of it and learn to live with it. Wales could start now and show everybody how it's done.

9. Do you think older generations in the West should say sorry to their children and grandchildren?

I must say, it never occurred to me. I do however, have a kind of parlour game that I play with myself, and that is, I write letters to my great-great-great-great granddaughter who will be living in the mid 22nd century. I choose her because it's for her generation we're doing all this climate stuff. The next generation or two will still be working on the problem (too soon), while in say the 30th century they might all be cyborgs with different fish to fry (too long). But the generation born about 2130 will be living with the outcome of our giant experiment with the climate. At the moment they are a bit like Schrodinger's famous cat: we don't know yet whether they will inherit a climatically stable world where we succeeded, or a climatically chaotic world where we failed. But of course when that time arrives it will be one or the other, and whichever way it goes, our desperate struggles with the problem in the 21st century will be the main subject of every history book.

The letters are partly vainglory. I intend to give them to my present grand-daughter with instructions to hand them on. *Her* great-great granddaughter will perhaps read the letters and think either "Thank God for great great…grandpa and his compañeros; against the odds, they did it." Or (we hope not, but) "He could see they were losing the battle but he never gave up." I like to think that either way, my messages would be uplifting, and that, in her own way she would be proud of me. I'm doing it for her. Does that answer your question?

Yes, and thank you Peter Harper.