Carbon Commentary Newsletter #7

A critical appraisal of issues in the move to a low-carbon economy

Wednesday 12 December 2007

Articles in this edition

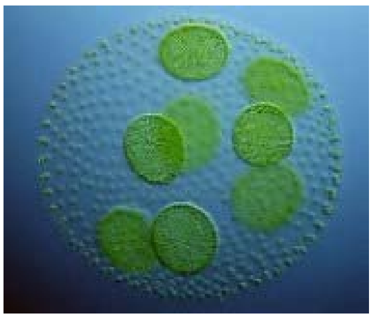
Growing algae and then squashing them for their oil may turn out to be the best way of producing biofuels. Shell's announcement of an investment in algae production is a big step forward for this technology. In another major step, the UK government now seems to be backing offshore wind. Its targets are overly ambitious, but the British coastline is one of the best places in the world for marine wind. Other articles are on smart metering, rechargeable batteries, the Conservative Party's policy on micro-generation, and the Confederation of British Industry study of the UK's carbon reduction opportunities.

The next issue of Carbon Commentary will appear in the New Year.

Chris Goodall
chris@carboncommentary.com

Chris Goodall's book *How to Live a Low-Carbon Life* won the September 2007 Clarion prize for non-fiction.

Biodiesel from algae



Shell announced an investment in a Hawaii-based plant to make biodiesel from algae. Algae are the most promising route to low-cost fossil fuel replacements. Yields per acre will eventually be a multiple of other sources of liquid fuels, such as maize, wheat and palm oil. The other key advantage of algae is that they can be used to sequester carbon dioxide from fossil fuel combustion.

* * *

The world's resources of petroleum originated as algae. For several years, small US start-ups have been pushing these simple organisms as the best replacement for fossil diesel. Shell's investment in Cellana looks like the first major validation of the large amounts of VC money that have gone into algae.

There are many, many different types of algae. The percentage of oil varies enormously by type. Specialists expect that we will use specially bred forms that yield about 50% oil by weight. When the algae is harvested the oil can be extracted by drying the organism and then compressing it. When the technology is mature, processing costs will be lower than other potential sources of biodiesel oil.

Yields of algae will be high. Estimates of the eventual maximum output per hectare vary enormously, but few doubt that algae will perform several times better than any conventional plant. Some estimates suggest that algae may eventually produce oils at a rate per hectare more than ten times better than oilseeds.

Algae are good at photosynthesis and probably produce over three quarters of all atmospheric oxygen. (Algae also use mechanisms other than photosynthesis as routes for turning CO2 into free oxygen.) Their ability to absorb CO2 has encouraged entrepreneurs into examining their ability to scrub CO2 from power station smokestacks. Small pilot plants now extract flue gas and run it across algae beds. The signs look good but it will be several years before we can be confident that algae will provide a cost-effective form of carbon capture. If they are successful as some of the proponents expect, algae will enable us to produce 'carbon negative' diesel.

In any list of the most interesting approaches to reducing fossil fuel dependency, and cheaply sequestering carbon, algae deserve a high ranking.

UK offshore wind farm development

The UK government has announced an intention to allow offshore wind farm development around most of the UK. John Hutton suggested that about 33 GW capacity could be added by 2020. This would provide about 25% of current UK electricity demand (which is itself rising by 1 to 2% per year).

Simple calculations suggest that this change may add about 15-25% to UK electricity bills. Offshore wind is more expensive to construct and operate than onshore wind farms. The announcement may suggest that the government believes that offshore wind can be pushed through but that onshore farms are likely to be successfully opposed. The big push for offshore wind seems to mean that the government is losing faith in nuclear.

* * *

The UK continental shelf is a good place to build wind farms. Wind speeds are high and the UK's oil and gas industry has given us the capacity to work in harsh regimes. After a period of experimentation with smaller offshore wind projects, the 300-turbine London Array, shortly to be constructed, will become the largest marine wind farm in the world.

The government has given increasingly clear signs that it viewed offshore wind as a renewable technology of choice. It increased the proposed support from one ROC (currently worth about £45) to one and a half in the 2007 Energy White Paper. It now seems also to be willing to over-ride the Ministry of Defence's concerns about the impact of wind farms on military radar. The worries over the turbines dicing small wading birds have been pushed aside.

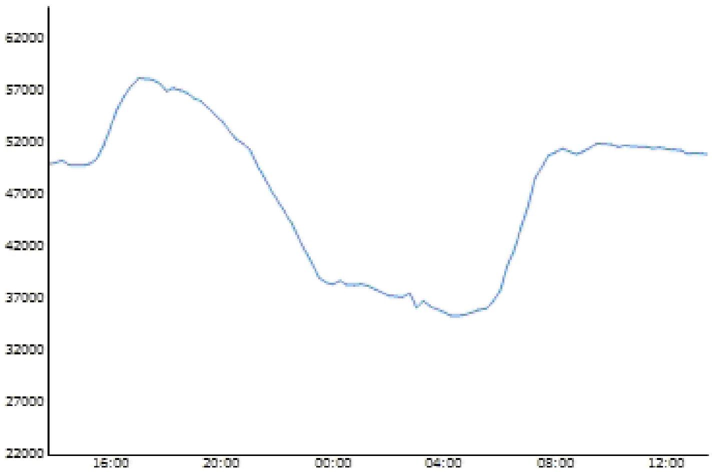
The basic numbers

The government wants another 25 GW on top of the current 8 GW in various stages of planning. These figures refer to the maximum output of the turbines on a windy day. The actual output is likely to be between 30 and 35% of this figure. (Data from Scroby Sands, an early offshore farm, suggests a lower figure, but the turbines have suffered from reliability problems which have depressed the output.)

33 GW of offshore wind capacity will provide about 100-110 TWh, or perhaps 25% of total UK demand. This approximately equates to the electricity demand from households today.

When the wind is blowing hard, the total offshore capacity envisaged by Mr Hutton will almost match the minimum total demand during a winter's day.

Total UK electricity demand (MW) in the 24-hour period to noon on Tuesday 11 December 2007



This chart is copied from National Grid real-time data. The y axis is MW. A GW is 1,000 MW. So the minimum demand on 11 December 2007 was reached at about 5am with a total demand of about 35 GW, about 10% more than would be generated on a very windy night all around the coasts.

If – and this is a very big if – the existing value of ROCs is maintained, then the possible subsidy from all electricity users to offshore wind if all 33 GW capacity is built is about £7bn. Over a year, this would raise the price of each kilowatt hour of electricity by about 1.8p, compared to the current retail price of about 10p. In addition, there will have to be substantial payments to other generators to incentivise them to build and hold ready gas-fired capacity for use when the wind isn't blowing.

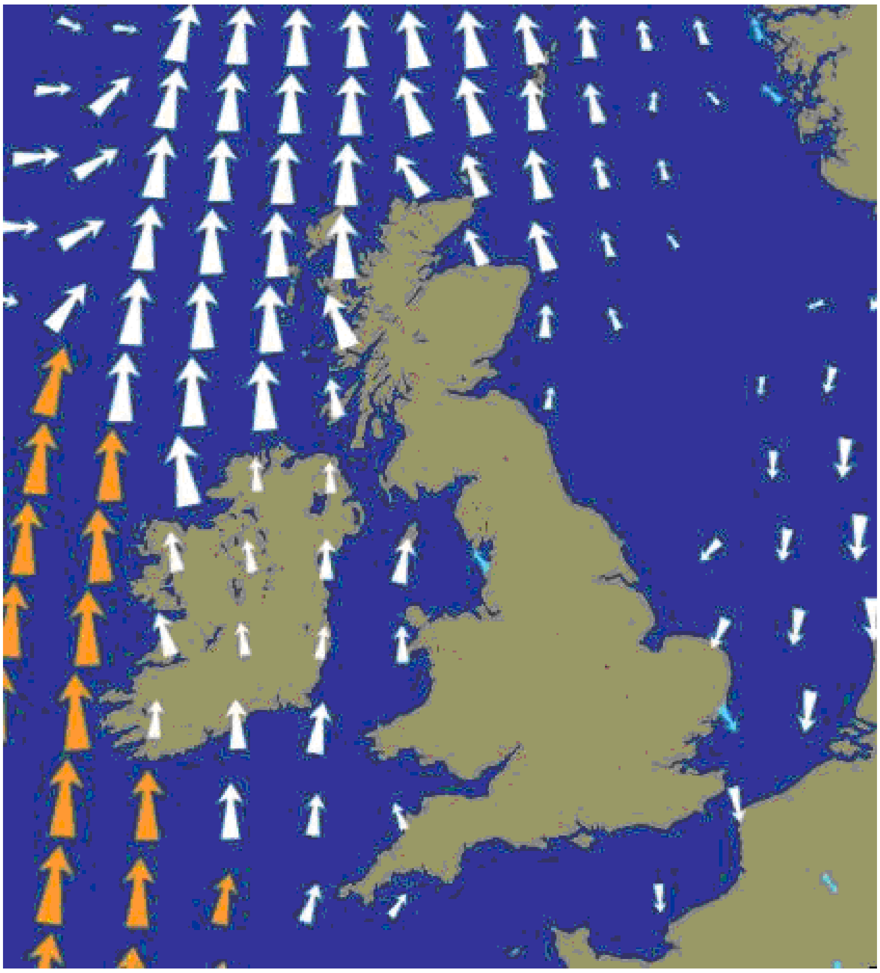
Offshore wind is expensive because its construction cost is high. The British Wind Energy Association mentions a figure of £2m per MW of capacity, compared to less than £1m for onshore wind. The total investment required to build 33 GW might therefore be as much as £64bn, about 6% of UK GNP. The BWEA figure looks a little high to me and the actual cost might be somewhat lower at perhaps £50bn.

The problems

The government's announcement was broadly supported by the other main political parties. It is the easiest source of renewable energy to back, even though it is expensive. The ROC subsidy system disguises the true cost of switching to wind and other sources, so politicians must assume that the extremely heavy expense of wind will not be obvious enough to be politically dangerous.

The problems for offshore energy lie elsewhere:

- **Turbine supply:** only a small number of suppliers make marine-ready turbines. Vestas and Siemens, both based in Denmark, have made most of the ones already supplied. The worldwide shortage of top quality turbines is likely to persist for some years. New manufacturers will be enticed into the market if government support looks robust, but this could take the best part of a decade. Some of the existing turbines have severe problems with gearboxes (as at Scroby Sands) but we can expect these issues to be overcome eventually.
- **Grid connections:** powerful arrays of turbines must be located close to points on the high voltage transmission network. It is no good putting a hundred turbines 50km from the nearest point of interconnection unless you can be sure to get planning permission for the National Grid to run pylons. (I think I am right in saying that the substation to handle the electricity coming onshore from the London Array was the last part of the infrastructure to get planning permission.)
- **Skills:** the UK has offshore skills as good as most other countries, but getting 7,000 turbines built by 2020 is an extremely challenging task.
- **Intermittency:** offshore wind is reasonably predictable and strong. Below is the wind map from the BBC on the afternoon of Tuesday 11 December 2007:



In the southern portion of the UK coastline, wind speeds will be low because of the prevailing cyclonic weather. But further north, the west coast is seeing reasonable wind speeds. Days of real quiet are surprisingly infrequent. Nevertheless, if we are to generate 25% of our electricity from offshore, we will need substantial back-up capacity. Very approximately, the UK has about 8 GW spare capacity. By 'spare' I mean unused generating capacity above what is likely to be the peak on a very cold December day at about 5.30pm. We will need to have much more when we have 33 GW of offshore power. I haven't yet seen an estimate, but I suspect that it will be at least 12 GW more than we have at the moment. The capital cost of the gas plant to deliver this is likely to be over £4bn.

- **The interaction with nuclear:** it hasn't been picked up by the press, but a 25% target for offshore wind is not easily compatible with a large nuclear industry. Nuclear needs to run all the time as baseload. If the wind is blowing strongly when demand is lowest (about 5am on a summer's day) then the UK will run the risk of having too much electricity supply. Either nuclear or wind would have to be disconnected or the UK would have to invest in more of what is called 'pumped storage'. Surplus electricity is used to push water uphill into reservoirs. The reservoir can be discharged later, turning hydro-electric turbines when demand is higher. It is difficult to encourage large amounts of both nuclear and wind, and the government's new wind policy must mean that it is losing interest in nuclear.

The conclusion
Offshore wind is expensive and still somewhat untried. The government's apparent decision to allow rapid development around a large portion of the UK coast is path-breaking. Most observers think that getting to 33 GW is an extremely optimistic target for 2020. However, industry people think that it may be possible to get as high as 20 GW, probably generating over 15% of UK power.

Household batteries

Inventions that take the breath away with their simplicity and elegance are rare. The new rechargeable batteries from USBCell qualify for this honour. As their name indicates, they are AA batteries that are recharged by the USB port on a laptop or other powered device. They are not cheap, but will repay the investment by being far easier to recharge than

conventional rechargeable AAs.

The carbon savings from these batteries are not large. My calculation is that they might save 10kg of CO_2 a year in a household full of portable devices. But they will, of course, reduce the waste going into landfill.

The company that makes the batteries has won some important awards for its innovation. More importantly, it also has some extremely interesting views on the evolution of home electricity demand. It correctly points out that a larger and larger fraction of home energy is used in 12V, not 240V appliances. We waste a lot of energy switching 240V AC down to 12V DC. Its next products include a box that will allow all DC devices (phones, handheld consoles, laptops) to be efficiently charged. Eventually, it will be possible to use cheap(-ish) solar power collectors to charge all the battery DC devices in the home. The savings in carbon would be worthwhile (but probably outweighed by the purchase of one extra TV).

***

These elegant batteries are sold by Mioxa, a UK company that specialises in innovations that reduce home energy consumption. They are now widely available in UK stores. People in the UK throw away 600 million batteries a year (10 per person) so the market is large enough. This means 22,000 tonnes of toxic metal is disposed of every year.

The typical UK household has about 25 devices using batteries, ranging from remote controls, torches and games consoles. Some of the batteries are barely used and last for years, others fade within a few hours of heavy use.

Conventional rechargeable batteries have never really succeeded. They need a separate recharging device, and the performance of the batteries tends to disappoint. Mioxa told me that the average rechargeable battery is only actually charged 8 times before it is lost, accidentally thrown away or the recharger is broken.

Mioxa reckons its USBCell batteries can be recharged 500 times and that the ease of plugging the battery into a USB connection will mean that users cherish the product. They believe that each battery, which has a power equivalent to a disposable battery of the same size, will be reused at least 50 times. This means that the cost of around £11 for two batteries will turn out to be less than 25p each time it is recharged.

The electricity cost of recharging a battery is a fraction of a penny, and doesn't really affect the economics. A laptop is a very good converter of 240V AC into 12V DC and little energy is wasted. For heavy battery users, it clearly makes sense to switch to the new USBCells.

What are the carbon implications? Mioxa told me that an Australian study had shown that a USBCell reused 50 times would save 7kg of CO_2. A house throwing away 25 batteries a year would therefore only save 3.5kg a year from buying USBcell AA batteries for all of its appliances. In the context of five or six tonnes of emissions yearly from a typical house, this is a tiny fraction of the total carbon footprint.

But the company was eager to explain the broader strategy. Thirty years ago, the only devices in the house using low-voltage electricity might have been a torch and a 12V children's train set. Now the average house has scores of little devices, though all with quite low power use. Phone chargers, powered toothbrushes, iPods, laptops, and portable lights are all growing users of home electricity.

When the electricity supply system was coming into being in the 1880s in the US, Edison's direct current system lost out to Nikola Tesla's alternating current. AC was far better for long distance transmission. All our major appliances are designed around 240V or 110V AC. But most new appliances don't need much power and operate at safe and cheap 12V DC. The AC power is still probably better for appliances with large motors, such as the washing machine, but for many other home devices it would be better if the supply was 12V DC.

Mioxa's next device, which it expects to start selling in late 2008, is a box that allows tens of devices all to be charged from it. It centralises the 12V transformer, reducing energy losses to a very low level. Importantly, this box could run from the mains, or could easily be powered by a small solar panel left in daylight. The savings aren't likely to be huge, perhaps 200 kWh a year, but the new box could be a relatively cheap way of saving 5% of the electricity bill.

Eventually, all lighting will be switched to 12V. A large fraction of the lighting in new houses is already run at low voltage, with the power to each light going through an AC to DC transformer. It would be better to run a single 12V lighting circuit with a single, and very efficient, transformer. Mioxa is working on this now.

Conservative Party policy on local generation of electricity and heat

The Conservative Party published a policy paper in early December on decentralised production of energy. It argues for heavy subsidy for small-scale generation of electricity. The report is useful in focusing on the need to minimise the finance and administrative burdens on small generators. However, it omits any consideration of the costs of the scheme it proposes. It is woefully ill-informed about developments in other countries. The Conservatives have subscribed to a romantic view about micro-generation and are choosing to ignore the huge costs of subsidising inefficient local generators. If they want large-scale low-carbon generation they should either back nuclear, remove the planning problems with wind, subsidise tidal or biomass power, or invest in CO2 capture.

***

The Conservative Party has sought to improve its policies on climate change. It is also trying to position itself as a party that supports local initiatives and local decision-taking. Its enthusiasm for micro-generation arises from the combination of these two strands in its current thinking.

The Conservative Party in the country often opposes mid-sized wind power developments. One of the latest schemes, a single turbine next to the M4 in rural Berkshire, is just about to be turned down by the Tory-dominated district council. Building a national policy on renewable energy has to bear in mind that local Conservative groups will usually fight against renewable energy developments in their areas. The national party is also worried that local Tories are opposed to nuclear power. What does this leave? Only micro-generation. It is therefore unsurprising that the Tories have been backed into a policy corner and have decided to push for subsidy of the electricity output from very small-scale generators.

The principal proposal is to set up a system of 'feed-in' tariffs that pay high prices for electricity generated in small installations. This policy mirrors the German approach which pays over 50 cents per kilowatt hour. Unlike the Lib Dems (see Carbon Commentary Newsletter #2), the Tories have not committed to any figure, so we cannot cost the policy; but it will be expensive. If the UK were to match the German prices, it would be paying about 8 times the current average wholesale price of electricity.

The faults of the current subsidy system

The UK's Renewable Obligation system pays qualified generators for the electricity they generate. The incentive is valuable and roughly doubles the wholesale price that they receive. (The system will soon be changed to vary the amount of subsidy according to the type of technology used.) It applies to large generators and to small. So the solar photovoltaic panels on my roof attract a payment of about £46 per megawatt hour, about the same as a wind farm. To become Generator 1274 on the UK's national electricity distribution system I had to fill in complex forms almost identical to those that will used by the 300-turbine London offshore array.

The Conservatives rightly say that this is intolerably complex. But they fail to point out that the regulator Ofgem now allows the electricity distribution companies to act as the agents of householders. This hugely simplifies the requirements on tiny generators. The distribution companies also handle the installation of the meters necessary to record the power exported into the street by my solar panels.

Getting planning permission was wearisome. However, most local councils now allow micro-generation installations without requiring full planning applications.

In effect, there are now no significant obstacles to local generation, except those imposed by the poor financial returns.

The Conservative plans for domestic microgeneration

The Tories intend to replace the Renewable Obligation with feed-in tariffs for small generators. At the moment, I get paid £45 per MWh for my exported electricity, roughly the current wholesale rate. So for Scottish and Southern, the purchasers, my electricity costs roughly the same as the price it pays to Drax. But it bears some considerable overhead cost, so the payment to me is extremely generous.

If a Conservative government adopted the German feed-in rate, I would be paid £350 per MWh. This would be very nice, but highly uneconomic to Scottish and Southern. The International Energy Agency's 2007 report on Germany says as follows:

> The country's feed-in tariff for renewables has resulted in rapid deployment of new electricity capacity, but has done so at a high cost. Estimates show that between 2000 and 2012, the feed-in tariff will cost EUR 68 billion in total [over £4bn a year]. In particular, the subsidies provided to solar photovoltaics are very high in relation to output; they will eat up 20% of the budget but contribute less than 5% of the resulting

generation. In comparison, many energy efficiency measures cost multiples less in terms of their reductions in carbon dioxide emissions. The feed-in tariff has been a success at building renewable electricity capacity in the country, and we now urge the government to focus on creating sustainable market pressure to bring down the costs of operating and further developing its renewable energy resources.

Although the UK typically gets a little more sun than Germany, the economics of solar photovoltaics would be as dire here as they are in the Federal Republic. The Conservative report nevertheless praises Germany's 300,000 solar roofs. What would be the consequences of establishing a similar programme here?

- **300,000 roofs of 2 kW maximum output each**
- **Cost – about £3bn**
- **Electricity generated – about 0.6 TWh per annum(just over 0.1% of UK electricity)**
- **Capital cost per yearly MWh – about £5,000**

Compare this with a small commercial wind farm. (Numbers from the Fens Co-op, discussed in Carbon Commentary Newsletter #6.)

- **Expected generation – 11,200 MWh per year**
- **Capital cost – about £4m**
- **Capital cost per yearly MWh – about £350**

If we are worried about the cost of mitigating climate change, why would we, the inhabitants of one of the windiest countries in the world, invest huge sums in inefficient solar panels on domestic roofs?

The only justification offered by the Tories is that some electricity is lost in long-distance transmission, making local generation more economic. This is easy to exaggerate. Though this number is not included in the report, the average losses in the UK transmission system (national and local) are about 7%: not enough to begin to outweigh the huge advantages of large scale generation of most forms of renewable electricity.

More domestic micro-generation sounds a very good idea. But no one should be in any doubt that it will cost many billions even to get to 1% of UK electricity generation. Five decently sited large offshore wind farms would generate more than all the homes in the UK covered in solar panels.

Combined heat and power
The Conservatives also like combined heat and power. Along with the example of German solar, the policy paper focuses on the Dutch encouragement of combined heat and power. In the 1990s the Netherlands pushed CHP hard and it rapidly became an important source of electricity.

A CHP plant burns a fuel – usually gas but it could be wood or coal – and generates electricity. Electricity generation almost always involves a significant loss of waste heat. A CHP plant uses that heat for heating buildings or commercial installations such as glasshouses. Like micro-generation, this sounds like a very good idea. A coal-fired power station may waste 70% of the energy in the fuel and using the heat productively is an attractive thought.

But look closely and CHP is not quite as effective as it might appear, particularly in very small installations. (For more details, see Carbon Commentary Newsletter #1 on the proposed Ceres Power domestic CHP generator.) CHP works well when the operator faces a stable demand for heat and for power. This happens, for example, in some industrial applications which need heat for a manufacturing process and electricity to power motors and provide lighting. Very small-scale CHP will always struggle because the plant cannot adapt to varying heat and electricity needs. Every kilowatt hour of electricity will always produce about two kilowatt hours of heat, whether the heat is needed or not. In domestic installations outside the heating season, CHP will have to dump heat in the same way as a big power station.

The Tories don't mention this, but CHP grew in the Netherlands because the Dutch rigged gas prices to advantage the technology. I suspect the reason was that the Dutch wanted to keep their ludicrously energy-intensive horticultural greenhouses supplied with cost-effective heat and power. Since 2000, this advantage has been unwound, and there is no longer any reason to install new CHP plants. The Conservative paper uses quotations from Netherlands sources (wrongly stating that they are written by the Dutch government) but omits to use more recent commentary that notes that CHP is now stalled because of a change in the relative prices of gas and electricity.

The lesson from Holland is not that CHP is a solution for large-scale generation of local electricity but rather that technologies will move in and out of use depending on the prices of input fuels.

It may make sense to subsidise small-scale generation of electricity, but the Tories proposal is uncosted, and it principally relies on analogies with Germany and the Netherlands. Even a limited acquaintance with these markets should have shown the Conservatives that the party's plans for micro-generation and CHP would be quite as costly as the current Renewables Obligation.

If the UK is to produce low-carbon electricity in large amounts, we can either use nuclear, wind, biomass or tidal; or we can invest in large amounts of urgent R+D on carbon capture. The Tories need to recognise that the politically attractive route of domestic generation of electricity can never deliver large-scale decarbonisation of UK electricity.

CBI/McKinsey report on climate change

The CBI brought out a report on climate change. It argues that the UK can achieve emissions reductions at a sufficiently rapid rate to meet the government's old target of 60% cuts by 2050. The optimism is underpinned by McKinsey work that assesses 120 different options for reducing carbon dioxide, ranging from domestic solar panels to carbon capture. McKinsey assesses what carbon price is necessary to create the incentives for business and consumers to switch to using these technologies.

McKinsey&Company

The McKinsey analysis appears to show that getting the UK on track will need carbon prices in excess of €90 by 2020, though this number will then fall.

***

The CBI's report, *Climate Change: Everyone's Business*, is a curious mixture. Part of the document is devoted to telling us that business thinks that climate change is a problem that can be cured by conventional market mechanisms. McKinsey's appendix tells us that the challenge will not 'require a reduction in consumption of goods and services'. The whole report is eager to assure that the response to global warming can be smooth and trouble-free. Government needs to provide consistent leadership, and consumers need to respond to price signals, but significant changes to the structure of the economy are unnecessary.

This is a brave and thoughtful approach and there is a surprising degree of commitment from the extremely senior businesspeople who comprised the CBI steering group. But a close look at the McKinsey figures must make us extremely concerned that business may be deluding itself if it thinks that wrenching changes are unlikely.

The McKinsey work
McKinsey's global research practice has already published 'abatement curves' for the main emissions reductions technologies. This extremely intelligent approach takes individual opportunities, such as domestic condensing boilers or offshore wind power, and assesses how many million tonnes of carbon dioxide could be abated by the full use of the technology and at what cost. The opportunities are then plotted on a curve, with the least-cost emissions reduction technologies on the left, and the most expensive innovations on the right.

Many technologies have a negative cost. Cavity wall insulation in a typical 1930s British semi-detached house will repay its owner within two or three years. In 2020, McKinsey identifies almost 50m tonnes of annual emissions reduction techniques with a positive financial return, rising to about 100m tonnes a year by 2030. Other techniques are extremely expensive. The consulting firm says that domestic solar hot water heating has a cost of about £600 per tonne of carbon dioxide avoided. (This is much higher than my estimates of about £300 per tonne, but we shouldn't quibble about the differences – most micro-generation technologies are extremely expensive according to any calculation.)

The core McKinsey numbers are as follows:

(m tonnes CO2e)	**2002**	**2020**	**2030**
Expected UK emissions with 'frozen' technology	690	848	942
'Baseline' emissions with no initiatives beyond current measures		723	728
Maximum reductions if all abatement opportunities are taken		592	498

498m tonnes (2030, with maximum abatement) is about 38% below the UK's 1990 figure. McKinsey is therefore able to say that this figure is consistent with the UK being on track for 60% emissions reductions by 2050. As the rest of this short article will suggest, there are a host of problems with this assertion.

McKinsey's estimates suggest that the UK can reduce its annual emissions by about 10m tonnes per year every year until 2030. To put this in context, CO2 emissions rose over 1% in 2006, or about 6m tonnes. Changing the trajectory is difficult, and McKinsey doesn't suggest otherwise.

The report does not say that emissions will be 592 tonnes in 2020. It says that if all 120 abatement opportunities are taken, and they are all applied to the economically rational extent, then the emissions reductions will occur. The same is true for 2030. This is, of course, an extremely strong assumption.

How will the possible emissions reductions be apportioned?
This is the breakdown of 2002 emissions:

2002 emissions by sector

	m tonnes CO_2e	%
Electricity generation	163	24
Buildings	114	17
Industry	172	25
International bunkers	34	5
Transportation	133	19
Other	74	11
Total	690	100

With no technology changes (the ‘frozen’ scenario), the figures are expected to increase by an average of 37% by 2030.

‘Frozen’ technology: emissions in 2030

	m tonnes CO_2e	% increase
Electricity generation	198	21
Buildings	133	17
Industry	248	44
International bunkers	85	150
Transportation	195	47
Other	83	12
Total	942	37

In what McKinsey calls the ‘baseline’ scenario, which assumes existing technologies are productively employed to reduce CO_2, emissions growth is reduced to 6%.

Baseline scenario: emissions in 2030

	m tonnes CO_2e	% increase
Electricity generation	162	-1
Buildings	127	11
Industry	174	1
International bunkers	68	100
Transportation	146	10
Other	51	-31
Total	728	6

In this projection, the most important reduction is in the carbon intensity of electricity generation. Coal is supplanted by gas, which generates 79% of all electricity, and the average CO_2 produced per unit of electricity declines over 21%. Efficiency gains are made in aircraft engines meaning that ‘international bunkers’ only increases by 100%, not the 150% in the frozen scenario. This is a very demanding target: average aircraft fuel efficiency is expected to be 20% better than today, even though many airplanes now flying will still be in the air in 2030.

The suspicion has to be voiced that McKinsey was already being optimistic in its assumptions in constructing the baseline scenario.

Abatement technologies reduce expected CO2 emissions to 498 million tonnes in 2030.

Maximum abatement: emissions in 2030

	m tonnes CO2e	% decrease on baseline figure
Electricity generation	53	67
Buildings	95	25
Industry	146	16
International bunkers	65	4
Transportation	93	36
Other	46	10
Total	498	32

The reduction is much more marked in power generation than in other areas. This reduction is derived from an increase in nuclear and wind, some carbon capture and storage, and substantial demand reduction from end-users. (I have tried to understand these figures and there seems to be an arithmetic mistake in McKinsey's calculations. The report seems to ignore the fact that carbon intensity improvements cannot simply be added to demand reduction.)

Of the 230m tonnes of maximum abatement, almost half comes from electricity generation. The major other improvements are improved car engine efficiency, the use of biofuels, and enhanced residential insulation. McKinsey says that all these changes taken together put the UK on the road to 60% emissions reduction by 2050. This is a difficult assertion to accept because the principal sources of reduction have already been exploited by 2030. It is, for example, simply impossible to reduce the figure for electricity to less than zero, meaning that the rate of improvement between 2030 and 2050 cannot be as fast as in the 2002 to 2030 period. Its bold assertions that the 60% emissions target is attainable by 2050 are quickly made. One senses that McKinsey did not want us to look too closely at this point.

In some ways, the McKinsey document is profoundly depressing. It makes the case for 'business as usual', rather than suggesting that really significant changes need to be made. It says that the UK can plausibly make substantial cuts by 2030, but provides little evidence that these reductions will actually happen. And getting down to the 300m tonnes or so required by 2050 actually appears impossible, at least if no further emissions abatement opportunities arise. The report accepts that potential improvements up until 2020 are extremely limited except at very high CO2 prices. It says that any such reductions that do take place will require a carbon tax of at least €90 per tonne, or four times the current ETS price.

And, of course, the UK government is now talking of trying to achieve 80% emissions reductions by 2050, not 60%. McKinsey says that we will have to use all available abatement technologies to get us down 38% by 2030, and that the carbon price will have to be high for the next decade or more. The people at McKinsey are intelligent enough to realise it doesn't add up. The CBI wouldn't have liked it, but the consultants should have said outright that the scale of the necessary emissions reductions may simply not be compatible with 'business as usual'.

Smart metering

The world understands 'smart metering' in many different ways. Gordon Brown used the expression in his first speech on climate change. He meant devices that give visual real-time indication of electricity consumption, largely in homes. To the UK Conservative Party (see this issue of Carbon Commentary) it means conventional meters that can record the export of electricity from a house, as well as its use.

Smart meters are much more useful than either of these two definitions suggest. Their primary value will be to adjust the price of electricity depending on the level of demand. This frightens politicians because they fear the backlash from users complaining of the horrendous cost of peak-time electricity use. But if we are to increase the percentage of electricity coming from intermittent and/or unreliable sources, smart meters are a necessity.

* * *

Smart meters, at least as understood in the rest of the world, can change the price of electricity depending on when it is used. They can either be pre-programmed to increase the price at 5pm and decrease it at 9.30pm, or the price can be changed to reflect unexpected spikes in demand. Additional features available in smart meters will include remote meter reading.

The pressure to introduce smart meters is highest in areas in which electricity demand varies strongly across the day. Most Italian homes now have smart meters that allow the electricity company to choke off usage and this allows the utility to manage peak demand.

The benefits from smart metering will be large. In the UK, domestic homes only account for 25% of electricity use, but there is no mechanism by which home consumption can be restricted at times of peak demand. This means that the Grid has to maintain a large reserve of expensive generating capacity to meet unexpected surges in demand because of freak weather or events, such as very popular TV programmes that precipitate jumps in usage.

Smart meters seem to be good at ‘shaving’ peaks in demand, reducing the amount of spare generating capacity that the Grid needs. (This surplus capacity will generally have to be kept warm, using fossil fuels to no benefit.) In the longer run, they can also be used to move time-insensitive electricity use to the night hours. So, for example, a decent price incentive would quickly get customers to switch dishwashing and clothes washing to hours of low demand. Most studies show that a reasonable percentage of domestic electricity consumption can be quite easily moved from one time of day to another.

A second advantage of smart meters is that they can be used to cut demand when supply fails. If we are to increase radically the percentage of electricity coming from wind, we will benefit enormously from having the capacity to cut domestic demand very quickly. This will, however, also mean that home appliances will have to be programmed to turn off at times of high prices. This is less difficult than it seems. A radio signal from the smart meter can turn off the supply at the plug sockets for individual appliances.

The Conservatives’ vision is to use ‘smart meters’ to enable home-owners to get payment for home-generated electricity. This will be useful, but only to a very limited extent. If we eventually see large volumes of battery-operated cars (see ‘Shai Agassi and the big batteries’ in a previous edition of Carbon Commentary) smart meters will facilitate the use of car batteries as a buffer source of electricity for the times when the wind fails.

Smart meters are important. They won’t necessarily be popular. In Britain’s liberalised electricity market, in which customers can switch suppliers at a few weeks notice, it is also not yet clear how the installation of these devices will be paid for.

Companies mentioned in this newsletter: Vestas, Siemens, USBCell, Mioxa, McKinsey, Shell, Cellana.
