Carbon Commentary Newsletter #1

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

Monday 17 September 2007

This is the first edition of a bi-weekly newsletter. It aims to provide an opinionated appraisal of the main themes in the halting moves towards a low-carbon world. It will analyse the main stories from the world of climate change during the previous fortnight, focusing on the implications for the UK. It is written to be read, and enjoyed, by a wide but scientifically literate audience. Please tell me if I fail to meet this objective.

At the moment, this newsletter is open-access. Please copy it and use it as it you want. I'd be grateful if Carbon Commentary is quoted as the source. I will eventually restrict the main body of the articles to paying subscribers. Subscribers will also get access to the data behind the analysis.

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Articles in this edition

British Gas's new Zero Carbon tariff

British Gas has launched a consumer gas and electricity tariff that will cost 10% more than its standard rates but which offers better green credentials than any other consumer utility tariff in the UK market.

The product has the following important features:

- The electricity is derived from renewable sources. The company says that this is **not the key ingredient** of the tariff. Later in this note I try to explain why.
- British Gas will buy and retire Renewable Energy Certificates for 12% of the electricity it supplies. This is probably the most **important** aspect of the proposition.
- British Gas will 'offset' all of the carbon dioxide produced as a result of each household's purchases. This is the most **expensive** part of the deal for British Gas.
- There will be a small donation to a green education fund for schools.

BG says that it makes no extra money from the sale of its Zero Carbon product. This looks a justifiable statement to us. The important other questions to ask are:

- Why did BG decide that 10% was the appropriate premium to its main tariff? It could have designed a less costly offering with reasonably strong green features. Do mainstream 'concerned consumers' regard 10% as an acceptable price increment? Did BG need to 'gold plate' the new product to avoid any criticism that it was a

proper green tariff?

- How will the company manage to ensure that it buys high quality offsets, and not the dubious offerings sold by consumer offsetting companies?
- The product is slightly complex and difficult to explain. Can BG cut through the competing claims of other green suppliers to build a large customer base for this high quality offering?

The proposition

After recent price reductions, typical British Gas customers now spend £836 a year on gas and electricity. British Gas gave me these figures for the typical purchases:

- 3,300 kWh of electricity costing £341.50
- 20,500 kWh of gas costing £509.69
- Total £836.50 after deducting a discount of £15 for buying both fuels.

(These figures for average consumption are widely used across the industry. They are slightly out-of-date and I believe actual averages are somewhat higher for electricity and lower for gas. This slightly alters the calculation for the typical price premium for the Zero Carbon product because the new tariff increases the electricity price more than the gas price.)

The Zero Carbon tariff increases electricity prices by about 16% above the standard level and about 7% for gas. For BG's typical consumer, the cost of electricity will rise by about £50 and gas will increase by about £35. The buyer gets the usual discounts for direct debit payment, for signing up online and for buying both fuels together.

The approximate 10% increase in the total price paid over the year buys 'belt and braces' carbon neutrality.

- **Renewable electricity.** BG will supply all customers with electricity from renewable sources. This sounds important, but is actually less critical than it seems. There is a fixed supply of renewable electricity in the UK. It is all used at the moment, and it doesn't matter much who uses it. The important thing is that purchasing the electricity delivers a signal to generators to increase the supply of renewable power. At present, they don't actually need that signal. Many forms of renewable generation are extremely profitable because of the government's subsidy scheme. The constraint on producers tends to be the slow planning process and the difficulties of getting remote sites connected to the high voltage distribution system rather than the underlying profitability of renewable generation.
- **Purchase and retirement of ROCs.** Those who generate renewable energy are eligible for subsidy in the form of Renewable Obligation Certificates (ROCs). A generator producing a megawatt hour (a thousand kilowatt hours) is able to sell these certificates for about £48 each, or slightly more than the electricity itself is worth. They are bought by other generators who have not themselves produced enough renewable electricity to meet the government's minimum target. British Gas commits to buying ROCs to cover an additional 12% of their Zero Carbon customers' electricity use. These ROCs are then 'retired' so that they are unavailable for resale. Effectively this means that they are torn up and ignored. The impact of this is to increase the price of ROCs, force other generators to pay more, and increase yet further the incentives to invest in renewables. The value of this part of the Zero Carbon package will be extremely complex to explain to customers, but it is the most innovative and exciting aspect of the tariff. Those of us who think markets can be used to help solve the carbon problem will be particularly keen on this part of the scheme.
- **Thirdly, BG will purchase offsets** to counterbalance the full carbon cost of the electricity and gas sold. The company has not yet released details of exactly which projects it will support. In communication with the company, I raised the usual concern that consumer offsetting companies support schemes that do not offer verifiable carbon savings and which are almost certainly not 'additional' to what would have happened anyway. BG responded by stressing that it will only use certified emissions reduction schemes that are allowed under the Kyoto Clean Development Mechanism. It will then have to 'retire' these certificates as well and I presume it will do this. There are, as ever, concerns about some of the emissions reductions projects operating under the Clean Development Mechanism. But let's give BG the benefit of the doubt in the first year of the Zero Carbon product while it looks for projects that are genuinely additional to what would have happened anyway.
- The company also makes a £5 donation to a schools' green energy fund.

In aggregate, the cost of these features comes to about £84, meaning that the company makes no extra profit on the Zero Carbon customers. The extra revenue from the tariff matches the cost.

Feature	Cost to British Gas	Summary explanation

Cost of ROC retirement	£19	12% of 3,300 kWh at £48 per MWh
Estimated cost of offsetting electricity	£16	3,300 kWh typically produces 1.4 tonnes of CO2 at generator at about £11 per tonne to offset
Offsetting gas	£44	20,500 kWh produces 3.9 tonnes CO2 at about £11 per tonne
Donation to green fund	£5	
TOTAL	**£84**	

The consumer appeal

BG has had some success in getting its 15m UK domestic customers interested in taking action to reduce carbon emissions. About 10% of its customers took up the company's offer of a bespoke energy audit of the home. BG says that 51% of these volunteers said that they would take further actions, and have achieved 10% average savings as a result.

BG says that it thinks that about a quarter of its customers will pay more for a green tariff, and that this number is increasing. This is in line with the impression we are getting from other companies with strong consumer brands.

Nevertheless, it is going to be an uphill task to persuade customers to take the new product. There are three problems:

- British Gas is not necessarily the best positioned utility company to initiate a new green product. Though it has a huge customer base, its relatively high domestic customer prices in 2006 will have dented its ability to sell higher priced premium products today. Customers will be concerned that BG is attempting to profit from their willingness to pay a proper price for a green tariff.
- ROCs are a mystery to all but a handful of nerdy specialists. I have seen people leave the room when they are mentioned. Retiring ROCs is a first-rate idea, but it won't excite middle England.
- Consumers are beginning to be suspicious of offsetting. M&S has publicly said that it will 'only use offsetting as a last resort'. There may be 'good' offsetting and 'bad' offsetting, but asking consumers to believe that British Gas's offering is genuinely reducing emissions elsewhere in the world is a tough challenge.

Nevertheless, it is possible to sell this product as genuinely the greenest product in the UK market today. (I don't say that other companies such as Ebico and Ecotricity wouldn't challenge this assertion, but British Gas can certainly make aggressive and justifiable claims in its marketing.) With enough persistence and consistent advertising, this offering will work.

But I think it is a definite mistake to have launched this product alongside an offering in a lighter shade of green. A second new tariff, Future Energy, uses a much smaller £20 annual price premium to fund investment in renewable electricity and to give money to the schools' energy fund. If you are launching one complicated product, the last thing you do is increase the confusion by putting out another complex offering at the same time.

The company is rightly pressing Ofgem for a new labelling system that awards stars to good quality green offerings from UK utilities. Such a scheme would give British Gas a high rating for the Zero Carbon product and would help sell it to confused householders. Until we get a simple and comprehensible rating system, some consumers are likely to sit on their hands.

So, high marks to British Gas but considerable concerns about the marketing of the new tariff.

Tyndall Centre report on aviation and emissions trading

In early September, researchers from the Tyndall Centre in the UK put out a report that said that incorporation of the airline industry into the Emissions Trading Scheme (ETS) will not provide significant incentive to cut emissions. The big polluters today are paying about €20 per tonne for their emissions.

When aviation joins the scheme in 2012, this price would add about €5 for a flight to Barcelona. Tyndall argues that the EU and national governments cannot escape the conclusion that the ETS is not enough and that aviation must be constrained by other fiscal or legislative measures as well as by inclusion in the carbon tax net.

Tyndall has acquired an excellent reputation for its informed and passionate stance on aviation. Broadly speaking, its view has been that continued expansion of aviation is incompatible with the tight emissions targets that the EU and other bodies have set for the years to mid-century. It has consistently said that by 2050 unconstrained air travel will be using up most of the total carbon emissions that the world can allow itself. Aviation expansion will drown out emissions reductions in other areas.

The new report, commissioned by Friends of the Earth, examines what will happen when aviation is included in the European Emissions Trading Scheme (ETS). The ETS is a 'cap and trade' scheme that has awarded tradeable allowances to major polluters. The cap will be gradually tightened over a period of decades, obliging CO2 emitters either to produce less carbon or buy increasingly expensive additional allowances from the market.

The major conclusion of this month's review could have been predicted from previous Tyndall work. After aviation is incorporated into the ETS, aircraft will emit far more than can be sustained if Europe is to rein in its emissions at a rate needed to meet its share of global reductions. Nobody should be at all surprised by this; at today's carbon prices, the cost of CO2 allowances to cover the flight to Barcelona would be about €5. Even at ten times today's carbon prices of €20 per tonne, air travel growth is going to continue.

But Tyndall's methodology is much more sophisticated than a simple examination of the impact of CO2 pricing on flying habits. In fact, the report is so complex that Tyndall and the Friends of the Earth will not capture many new supporters for their view that aviation must be severely restricted.

This highlights a recurrent dilemma in climate change research. The uncertainties and complexities in good scientific work are almost impossible to summarise accurately for a time-constrained audience. In this case, the assumptions, theories and methods are buried deep. To communicate their research to the widest possible audience the researchers would have benefited from laying out their technique in a flow chart and from providing a summary of their conclusions in a full summary.

With these reservations, let's try to build up the structure of the work.

1. Tyndall notes the 6% current annual rise in European air travel and assumes that this will continue until about 2012. It then develops three scenarios for emissions growth beyond this date which reflect increasingly rapid rates of technological improvement in aircraft and slowing rates of passenger growth. In one of these scenarios, European emissions from aviation start to decline by 2017. Tyndall is not actually predicting this is going to happen; it is saying that if Europe is genuinely committed to emissions reduction, then national and international policies will have begun significantly to constrain aviation within a decade. Technological improvements (primarily in fuel consumption per passenger) will mean declining absolute emissions.
2. The researchers then examine what level of allowances will be granted to the EU airlines. They argue that giving the industry an initial allowance equal to the 2012 emissions from aviation will mean that the ETS will have very little effect. If the airlines are handed a huge batch of carbon vouchers, the incentives to reduce emissions will be negligible. They will rarely have to buy from the external ETS pool and so ticket prices will not increase much. Perhaps surprisingly, this is a very unconventional way of looking at the issue. The general theory behind emissions permits is that polluters price in the full cost of carbon certificates, even if they haven't had to buy them. For example, most studies have shown that electricity prices around Europe now include the implicit cost of ETS certificates, even though electricity producers have been awarded these allowances at no charge.

   Unsurprisingly, Tyndall shows that if the airlines just include the cost of extra emissions after 2012 in their ticket prices, the impact is extremely limited. At current carbon prices, the additional cost of carbon allowances would add a few Euros to short haul prices.

3. The report then looks at the share of the EU's total carbon allowance taken by aviation in 2050. They show that in some scenarios air travel uses up the continent's entire carbon allowance. The authors point out that:
   - even if the industry is properly included in the ETS
   - and it achieves major technological advances
   - and passenger growth falls to very low levels

   aviation emissions will still be higher in 2050 than in 1990, whereas other sectors of the economy are expected to make a 75% to 90% cut. They say that the ETS is not enough – the EU must find other ways of radically restricting aviation growth.

This is a difficult report and full of interesting assessments. But it does contain some quite striking divergences from the conventional approach to looking at the share of aviation in the total emissions portfolio. Some of these are highly favourable to the airline industry, others are not.

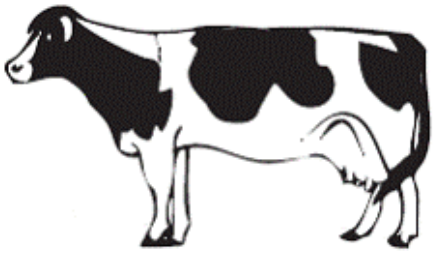
- Tyndall only includes the impact of CO2. Aviation is also responsible for other pollutants which are normally thought to double or triple the effect of the carbon dioxide. The authors clearly want to avoid controversy since the precise multiplier is the subject of huge debate. In particular, no one yet even guesses at the global warming impact of contrails on cirrus cloud formation. The Tyndall assumption is advantageous to aviation.
- By contrast, the authors use a low estimate of the total future carbon budget that the EU will allow itself. They've taken recent and well-respected work by the Swiss scientist Meinshausen as the basis for this view. Meinshausen says that the world will need to keep under 450 parts per million (ppm) of CO2 and other warming gases if it wants to achieve a more than 50% chance of keeping temperature increases 2 degrees below the pre-industrial figure. (So far, we've seen about 0.8 degrees of this rise.) The world is already at 430ppm, and the total is rising at over 2ppm a year. So not only does Meinshausen implicitly say that we need to stop emissions rising soon, but we also need very quickly to cut future emissions to below the rate of natural absorption. She may well be right about this, but the consequences of her work are not yet fully incorporated into the assumptions of governments. Nevertheless Tyndall takes her more cautious view.
- As I said above, Tyndall says that ETS costs will only be reflected in ticket prices to the extent that the airlines have to buy incremental allowances in the market. The conventional view among economists is that this is illogical. Even though electricity producers were given huge allowances for free, they still increased prices because a new generator competing against them would have to be buying allowances. Freshman economics says that it is the marginal or new producer that sets the price. But this may not be important: even if the airlines did incorporate the full value of the ETS allowances in their prices, it would still have a negligible effect on what travellers have to pay.
- The airline industry says it can make substantial technological improvements. Many people doubt whether this will happen. For example, an 'open rotor' jet engine would undoubtedly cut fuel consumption, but only at the price of much higher noise levels. This would, of course, be extremely contentious politically. It might have been better for Tyndall to assume existing technological improvement rates of 1% to 2% per year. This would have made their assumptions more plausible, as they would have known, but only at the risk of making it easier for the aviation industry to attack their work.
- The researchers are also unusually optimistic about the political commitment of the EU achieving real and early cuts in emissions. Once again, the reason is obvious – they did not want the Commission attacking their work for its failure to include the impact of political action. But one does not have to be a cynic to believe that the EU is still wrestling with the problem of emissions reductions and is a very long way from agreeing to rein back the very rapid growth of aviation.

So this is a useful and thorough study. It says again what the Tyndall Centre has said before – rapidly growing aviation and climate stability are incompatible. The additional pillar derived from this study is that the researchers show that current levels of ETS pricing are simply insufficient to dampen air travel growth. The EU needs other packages of measures, such as an aviation fuel tax.

For fuller analysis of aviation and climate change, go here. (I have prepared a much longer briefing document.)

Is organic food better for the climate?

The evidence is not quite clear enough that organic food is better for the atmosphere.



The debate on whether organic agriculture reduces greenhouse gas emissions is a lively and sometimes acrimonious affair. The calculations are complex, the results depend on myriad factors that are difficult to quantify, and much research remains to be done. Those who give unequivocal answers to the question 'is organic better?' may not be recognising the extraordinary uncertainty that still surrounds many aspects of agriculture. Rather than produce a simple answer, this note offers a statement of the competing cases.

This topic has been widely researched but has produced very varying answers. There is certainly no consensus. In general, organic farming seems to be slightly better for the atmosphere than conventional cultivation, but for every ten studies that say this, five say something different. Almost all the conclusions are the subject of passionate debate.

The argument against organic agriculture: conventional farming is better for the planet

1. Conventional farming produces far more food per acre than organic farming. Though comparison is surprisingly difficult, organic yields probably vary from about 50% to about 70% of the conventional equivalent. I say 'probably' because some people give figures that are well outside this range. It depends on the crop, the type of soil, and the climate. The importance of lower productivity for climate change is that for every unit of input, the output is lower. Think about organic milk, for example. The cows need to be fed, at least in winter, and the food requires a lot of energy to produce. If an organic cow gives half as much milk as a conventional milker, the energy cost is double. This argument is even clearer when includes the methane output of cows. Methane is a powerful warming gas, and cows produce huge volumes of it. Organic cows produce less milk than conventionally farmed cattle so the methane output per litre tends to be much higher.
2. Most organic agriculture is more labour-intensive than conventional farming. Usually, but not always, the tractor needs to criss-cross the field more often. And if yields are lower anyway, the cost of the energy used is far greater per unit of output. Or take organic tomatoes grown in a heated greenhouse: the labour needed is the same, but the yield is less.
3. Organic agriculture can involve more disruption of the soil. It needs more ploughing, for example. This may increase the losses of soil carbon, though this conclusion is fervently disputed by organic proponents.
4. A system that relies on natural manures may require more methane-producing animals on the farm. Methane is a dangerous greenhouse gas. More manure may also result in higher emissions of nitrous oxide, an even worse climate-changing gas. Replacing inorganic fertilisers with farmyard manure certainly does not have an unambiguously beneficial effect on GHGs.
5. Organic food tends to be imported. The food miles are greater.
6. There may be more wastage in organic systems. Organic fruit and vegetables are more likely to suffer pest damage, perhaps reducing storage life. Data on this is particularly sparse.
7. Ruminant animals in organic systems mature more slowly, so they emit methane for a longer period before becoming productive. (This is particularly important with cows.)
8. Conventional farming may work better with the new(ish) 'no-till' or 'min-till' cultivation systems. These techniques entail the maximum avoidance of ploughing, which is thought to cause the loss of soil carbon to the atmosphere.

The opposing view: organic farming is the way forward

1. Organic farming avoids nitrogenous fertilisers. These fertilisers take much energy to produce. Their use also adds, perhaps very substantially, to nitrous oxide. Nitrous oxide is far worse than methane or carbon dioxide. Agriculture is the single most important source of this gas.
2. Organic cultivation probably helps build carbon in the soil. Soils that receive inorganic fertiliser tend to have lower carbon levels than fields in long-term organic cultivation.
3. The methane output from the manure from free-range animals in organic systems is far less than from the slurry tanks in intensive beef farming, for example.
4. Though much organic food is imported, the percentage is tending to fall as consumers react to the poor publicity about food miles and adjust their purchasing behaviour.
5. Organic farmers tend to work harder to sell their food locally rather than to the supermarkets or to processors. This reduces the energy in transportation and in manufacturing.
6. Cows do take longer to mature in organic systems, but they don't wear out so fast from exhaustion, so fewer calves are needed at any time to maintain the stock of productive animals.
7. It is possible that people may waste more organic food, but the consumer will be conscious of the price and the general need to cook and eat the food soon after purchase. The purchase of organic food tends to bring with it an enhanced sensitivity to the need to use foods as soon as possible and not waste expensive ingredients.
8. The calculations of emissions from conventional agriculture very rarely include the impact of GHGs from liming soils to redress the increased acidity coming from the use of inorganic fertilisers. The lime will degrade to give off CO2.

Typical research conclusions

Most research suggests that organic agriculture has marginally lower emissions than conventional methods. But the results are debatable and depend on the crop, the soils, and the skill of the farmer. It is often remarked that comparisons are difficult because organic farmers may well be better at their job. Good farmers become organic farmers. This may artificially advantage organic methods.

Unfortunately, we probably need even more research to get clearer conclusions. Until then, the protagonists on either side will continue to debate the issue with passionate intensity. Of course, organic food is almost certainly

better for biodiversity, for the maintenance of soil quality, and for animal health. It may, only may, be better at providing micro-nutrients, but there is very little to support the view that organic food is inevitably healthier. But there is intriguing early evidence that vegetables stressed by the need to protect themselves against pests that would be destroyed by pesticides in conventional farming contain higher levels of complex compounds useful for human health.

'Is organic better?' may not be the right question to ask
Organic tomatoes grown in March in heated Dutch glasshouses will be far worse for the environment than imported conventional Israeli fruits. Someone trying to minimise the GHG impact of the food he or she eats would probably do best to follow some simple rules:

- Animal products are generally worse for GHGs than plant-based foods, so vegan diets are far better than carnivorous. This result is generally agreed.
- Raw food is better than cooked. Cooking can represent a large fraction of the total energy in the life cycle.
- Food processing, particularly keeping foodstuffs chilled in factories and in supermarket refrigerators, is usually worse than equivalent minimally processed ambient foodstuffs.
- Local food is not necessarily better than food from afar. 'Food miles' do not necessarily imply high greenhouse gas emissions. Sugar made from Brazilian sugar cane, which has very low fertiliser input, may have a much lower carbon impact than East Anglian sugar beet, which has taken large doses of nitrogen fertiliser and then required substantial amounts of energy to process. But, all other things being equal, local food grown and sold in its natural season and not retailed through energy intensive supermarkets is better than products grown on the other side of the globe.
- So, in a conclusion that will not please high-living gourmands, the best foods from a climate change viewpoint are unprocessed, unpackaged vegan wholefoods sold locally and produced in season.

E.ON's new wood-burning power stations

Do dedicated biomass electricity generating plants make financial sense?

E.ON UK has recently announced a plan to build a second power station using 100% energy crops as fuel. The first investment – a £90m power plant at Lockerbie in Scotland – will open within the next few months. The second plant, still only in the planning stage, will be in Sheffield on the site of a previous generating station. Both power plants will use wood from forestry and specially planted willow but Sheffield will also burn waste wood from other sources, such as industrial pallets. These are the first two large-scale plants in the UK if we exclude the ill-fated Arbre plant of several years ago. (Arbre was an extremely advanced wood chip gasification plant built in Yorkshire. It was never fully commissioned.)

By the standards of the electricity industry, the E.ON investments are tiny. The proposed Sheffield plant has a price tag of £44m compared to £1bn for E.ON's intended investment in the new super-critical low(ish) emissions coal power plant at Kingsnorth in Kent. Nevertheless, Lockerbie and Sheffield do appear to make good financial sense, at least in part because of the revisions to the renewable energy subsidy scheme announced in the government's June 2007 Energy White Paper.

This article looks at the prospective financial return from operating a power plant burning wood and other energy crops.

Some background
Most coal-fired stations in the UK mix a small percentage of biomass into the coal stream. Usually less than 2% of raw material going into the combustion process, biomass is attractive because it reduces the carbon footprint of the plant and generates valuable Renewable Obligation Certificates (ROCs). The material used is usually waste agricultural products from outside the UK, such as olive stones or oil palm residues.

Some of the largest coal-fired stations, such as Drax and Didcot A, have announced plans to increase the portion of biomass in their fuel mix to 10% after investing in equipment to pulverise the biomass so that it mixes effectively with coal and does not affect power station performance. Drax, which is responsible for generating about 7% of the UK's electricity, intends eventually to burn about 1.5 million tonnes a year of biomass, including a large amount of locally produced wood and other bioenergy crops such as miscanthus (also known as elephant grass).

Electricity generators in other European countries operate dedicated simple bioenergy plants. The E.ON proposals mirror these, and they do not appear to use new and relatively untried technologies, such as the gasification process that the Arbre plant was intended to pioneer. Gasification may raise the operating efficiency of the plant, but involves

greater risk that the plant will not work as intended.

The E.ON plans

E.ON UK announced that it would develop a dedicated biomass-burning power station at Lockerbie in the Scottish Borders in 2005. In June 2007, the plant started testing its boilers prior to full operation. It is said to be 'on budget and on time'. The plant is scheduled to produce about 44 MWh, or about 1% of the maximum output of Drax, the UK's largest power station. The plant will need about 220,000 tonnes a year of fuel.

Lockerbie is close to sources of wood from forestry plantations, and the plant will use waste products from this source. E.ON and its contractor Renewable Fuels have also been writing contracts with local farmers to supply energy crops, primarily Short Rotation Coppice (SRC) willow.

E.ON's Sheffield proposal is for a smaller 25 MWh plant. The sources of wood for the proposed project will include industrial wastes as well as energy crops. Situated in an industrial area of the city, the plant may be able to supply heat to local manufacturing sites as well as electricity to the grid. The budget for this plant is £60m.

As far as we can tell, these two generating stations are the only proposals for dedicated bioenergy plants in the UK.

ROCs and ROC banding

The Renewables Obligation encourages generators to use renewable sources of fuel by awarding tradeable certificates to power plants not using fossil fuels or uranium. Each megawatt hour (MWh) generates one certificate, worth a minimum of about £33, but with a current auction price of about £45. A plant using bioenergy qualifies for ROCs.

In the 2007 Energy White Paper, the government announced firm plans to change the basis on which ROCs were awarded to encourage new technologies and reduce subsidies to electricity generators using well established and cost-competitive techniques such as burning the methane from landfill sites. The banding scheme will award one ROC per MWh for energy crops burned in coal or oil power stations, but two ROCs per MWh for power plants specially built to use only renewable fuels. This higher level would cover Lockerbie and Sheffield. As we will show below, this increased subsidy through the ROC system has a very important impact on the economics of a bioenergy plant.

Bioenergy and biofuels

EU obligations oblige the retailers of motor fuel to mix at least 5% biofuel into each litre of petrol or diesel within a few years. A biofuel is made by distilling the sugars contained in foods into ethanol, or extracting the oil from seeds or algae to make diesel. Biofuels use only part of the food, and require substantial energy inputs to turn wheat grain, for example, into ethanol to add to petrol. Using the entire crop for burning in a power station is inherently more efficient than just using the oils or the sugars for biofuel production. However, this advantage may diminish as technologies advance that enable biofuel refineries to process more and more of the agricultural crop, and not just the valuable grains and seeds.

Nevertheless, the EU directive that demands that motor fuels must have 5% bio content will mean that biofuel refineries will be competitors to power stations burning bioenergy. Both are competing for agricultural land. The new BP/ABF ethanol refinery at Hull will be less than 30 miles from Drax power station. Since transport costs for bio crops are high, both places will be trying to attract farmers into supplying their plants. We can expect that farmers will carefully examine their options. Will they grow grain for food, sell it to the BP biofuels refinery or convert their land to willow for burning in Drax?

The prospective economics of dedicated bioenergy plants

The following figures represent our best estimates of the finances of dedicated bioenergy plants. We base the figures on our assessment of the likely costs and revenues of a plant similar to the proposed Sheffield investment. These figures are intended to be used as illustrative rather than precise assessments.

The source of revenues:

The sale of electricity

The Sheffield plant will burn about 180,000 tonnes of wood products a year. At approximately 14 gigajoules (GJ) per tonne (about 3,900 kilowatt hours), the total calorific output will be about 700,000 MWh a year. A plant of this type will typically be about 30% efficient, turning about this percentage of the heat into electricity. This means that the plant will export about 210,000 MWh to the grid. At a price of about £40 per MWh, the revenue from the sale of electricity will be £8.4m. The figure for the price of electricity is somewhat lower than that currently achieved by Drax, which is obtaining about £48 per MWh.

ROCs

At the current auction price of about £45 for one ROC, the output of the power plant will generate certificates worth about £18.9m, or over twice the value of the electricity sales. This assumes that for a dedicated bioenergy plant each MWh generates two ROCs, (though the government has only promised this extra allocation until 2013).

Value of ETS certificates
E.ON has told us that Lockerbie will be receiving an allowance under the European Emissions Trading Scheme (ETS) but because the plant will be burning 'carbon-neutral' fuel, it will not need this allowance. The ETS certificates can therefore be sold. If a bioenergy power plant is allocated an allowance corresponding to the average carbon content of UK electricity (0.43 tonnes of CO2 per MWh), it will receive certificates covering just over 90,000 tonnes of CO2, worth about €20 at today's prices for phase 2 ETS. These allowances are worth about €1.8m or about £1.2m.

Heat
A power plant burning wood in an industrial area, or indeed close to any buildings, including newly built domestic homes, can be used to supply heat that would otherwise be wasted. The Sheffield plant is located in an area that has vacant industrial sites that could be used for manufacturing businesses that need heat for industrial processes. Power generators probably take no account of potential revenue from this source; it certainly cannot be predicted. But if the supply of surplus heat is sold for 1p a kWh, and it is used 50% of the year, it would be worth £2.4m.

Table 1: Summary of potential sources of revenue

Source of revenue	Value (£m)
Sale of electricity at £40 per MWh	8.4
Two ROCs per MWh at £45 per MWh	18.9
Carbon allowances saved at €20 per tonne of CO2	1.2
TOTAL	**28.5**
Possible revenue from waste heat sold to industry	2.4

Costs:
Fuel costs
A coal-fired power station pays about £1.45 per GJ for coal. To get farmers to convert to SRC willow or miscanthus requires generators to pay about £4.50 per GJ for biomass, or over three times as much as fossil fuel. At this price, farmers will generally achieve profits approximately equal to that generated with wheat, at least until the latest extraordinary spike in the spot market proce. If wheat prices continue to increase, the price paid for SRC willow will also need to rise.

SRC willow takes several years to establish, though it requires very little work once it has successfully started growing. It should be productive for at least twenty years. The government has usually subsidised farmers who wish to start growing SRC and miscanthus with a grant that covers between 50% and 100% of the establishment cost. At the moment (early September 2007), there is no subsidy available, though industry players such as Renewable Fuels suggest that it will probably be reintroduced in the next few months.

Coal-fired power stations generally obtain their biomass through agents that contract with farmers. These agents will often carry out all the harvesting and transport actvities as well as guaranteeing payment for the willow for at least ten years.

To run a plant the size of E.ON's proposed Sheffield generating station will require about 180,000 tonnes of fuel per year. This will cost E.ON about £11.3m at current prices.

Transport
The fuel will need to be transported to the plant, and we have budgeted a cost of just over £10 per tonne. This figure varies according to the distance that the fuel has to travel. Renewable Fuels, the agent handling the purchasing of SRC for Lockerbie, told us that the figure may be as high as £12 per tonne. (But, to compensate for this higher cost, the price of the fuel at Lockerbie may be lower because it uses waste wood from the forestry industry and does not have compete directly with wheat for land use for much of its fuel.)

Staff
The E.ON press release about the proposed Sheffield plant suggests that the plant will employ about 20 people when it is fully operational. At a full cost of £45,000 per person, the budget will be about £900,000.

Other costs
The plant will require maintenance and repair, as well as other overhead costs. The capital cost of the plant is about £60m and we have assumed a total figure of 2%, or £1.2m, for all other costs.

Repairs and maintenance expenditures at Drax were about 3.4% of tangible fixed assets in 2006. Drax is an older plant, of course, and its assets are written down. We therefore believe that maintenance expenditure of 2% of fixed assets for a new biomass plant is a reasonable figure.

Table 2: Summary of potential costs

Source of costs	Amount (£m)
Fuel costs	11.3
Transport	1.8
Staff	0.9
Other operating costs	1.2
TOTAL	**15.2**

The profit and loss statement
Combining the costs and revenue into a profit and loss account shows that, before considering depreciation and interest charges, the plant will achieve an operating profit of over £13m a year.

Table 3: Potential profit and loss statement

	Amount (£m)
Total revenues (excluding heat)	28.5
Total costs	15.2
Operating profit before depreciation and interest charges	13.3

E.ON expects to invest £60m in its proposed Sheffield plant. If we summarised the operating economics correctly, it will achieve a return on capital of over 22%. It looks like a good investment, though this will depend the price of power, ROCs and ETS certificates, as well as the load factor that the plant is able to achieve.

A key sensitivity is the percentage of the time that the plant is being used to generate electricity. This will directly affect the value of its output. Drax achieved technical availability of about 90% last year, and produced total electricity output of about 75% of its rated maximum. (This means that it was not operating all the time that it was technically ready to do so. At certain points the price of electricity on the wholesale markets was not high enough to cover its fuel and other variable costs.)

For a biomass plant subsidised by two ROCs for every MWh of output, the income from generating electricity will always be greater than the cost of fuel. (Two ROCs are currently worth £90 per MWh. At today's wood prices, the cost of fuel is less than £55 per MWh. Unless the auction price of ROCs collapses, it will make sense to run the plant even if the wholesale price of electricity were to fall to zero. So it is only planned and unplanned outages that will be likely to affect the total amount generated. In a new, specially designed plant it should be possible to keep operating at least 85% of the time. If the illustrative economics detailed above are accurate, and the plant operated at 85% capacity, the financial return would fall to about £11m, providing a 19% return on capital.

Conclusion
This article has tried to show that dedicated biomass plants appear to make good financial sense but that the attractive financial profile depends entirely on the subsidy created through the ROC system. The fuel costs at a plant such as Sheffield will exceed the value of the electricity produced and E.ON is therefore taking a gamble that ROC prices will remain firm and that the banding scheme that advantages dedicated bioenergy plants will remain after 2013.

HSBC's international opinion survey into climate change

The key conclusions from a good piece of market research

HSBC's July 2007 survey entitled the Climate Confidence Index contained many surprising results. Carried out in nine major countries around the world, it showed that concern about climate change is far higher in developing countries than in the UK or the USA. As importantly, the inhabitants in these countries also think that the world is more likely to find ways to avert climate change problems.

Almost 60% of people in Brazil, Mexico and India see global warming as one of the most pressing problems the world faces, compared to little more than 20% in the UK. Broadly speaking, the richer countries tend to see terrorism as a

bigger threat to the world than climate change. In all nine nations bar the US, the level of concern tends to rise quite sharply with age. (This result is also seen in most other surveys of UK opinion.)

Confidence that climate change will be successfully addressed by existing institutions is low in most places around the world. It falls to its lowest level (5%) in the UK. The UK also has the lowest level of people saying that they personally are making a significant effort to reduce climate change at 19%, compared to levels above 40% in developing countries. Fatalistic Britons are also almost the most pessimistic about whether global warming will be stopped, with only 6% of people saying 'I believe we will stop climate change,' compared to 45% in India and 39% in China.

This very thoughtful survey makes depressing reading for those interested in British public opinion. The faith in UK institutions is low, commitment to personal action is limited and pessimism about the future is greater than elsewhere. Across the world, however, constructive opinion is much higher, with over 55% of people being prepared to adjust their lifestyle to help reduce changes to the climate. Interestingly, more people are prepared to change lifestyle than spend more time (45%) or money (28%) to get climate friendly products or services.It is not clear why the UK results are so different from the rest of the world but this pattern appears in other consumer polls. Cynicism and pessimism are common, particularly in younger age groups. Willingness to question the fundamental science is higher than elsewhere. A recent MORI survey showed that 56% of UK individuals think that there is substantial disagreement among scientists about whether global warming is actually happening. I believe that this is probably among the highest figures in the world, despite the UK's own scientific community being among the most united on the topic. This is a challenge to those companies, politicians and activists trying to build a more climate-friendly economy.

Science news: Greenland's melting ice

Photo: the glacier at Ilulassit in Western Greenland

In early September, leaders from the major faiths came together in Greenland to pray for the future of the planet. They may well have chosen Greenland because of the visible and deeply worrying changes in the glaciers and ice fields that cover almost all its vast area. The melting of the ice sheet has speeded up dramatically since 2000.

The state of Greenland's glaciers is critical to the rate of global sea level rise. A complete melting of the island's ice would raise water levels by about 7 metres, enough to flood much of the world's inhabited land. To give one example, 15% of Bangladesh's population would be displaced by a rise of just 1.5 metres. Almost all the country's habitable land would disappear if the water level rises by 7m.

The religious leaders went to the town of Ilulissat on Greenland's western coast. Here a rapidly retreating glacier calves icebergs into a fjord at a rate of 35bn tonnes of water a year. The daily water loss would provide all the water London or New York needs for a year. Estimates suggest that between 6.5% and 10% of all the ice flowing off the interior icefields of Greenland melts into this fjord. This means that the increase in the rate of melt of this one glacier is adding about 0.06mm a year to the global sea level, 4% of the rate of rise during the 20th century.

Of the great threats identified by the IPCC, rise in sea level has always seemed the least threatening. Until recently,

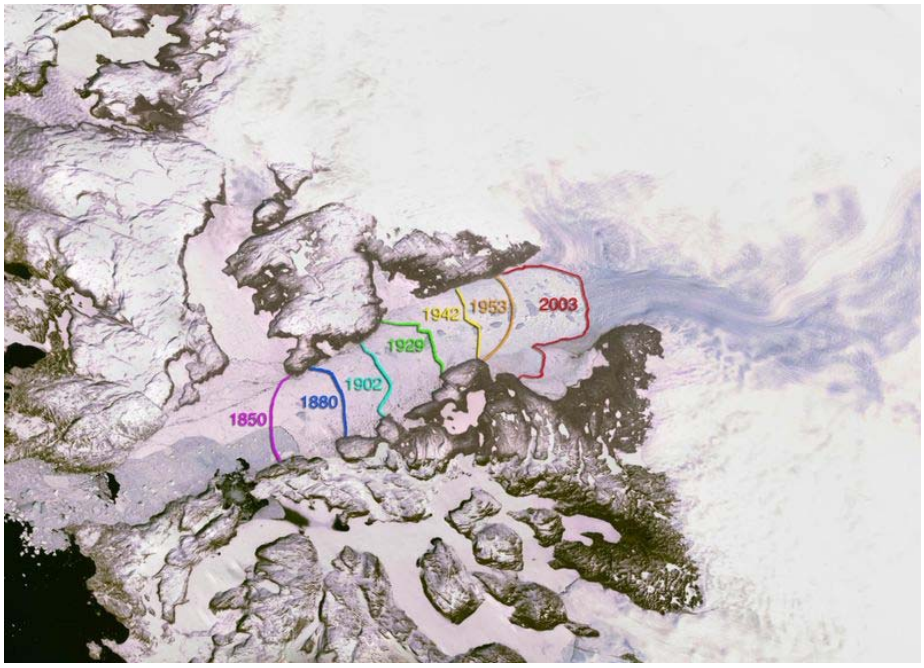
scientific consensus suggested that the Greenland glaciers might take 1,500 years to melt completely. The 2007 IPCC Summary for Policymakers suggests that the expected sea level rise this century might only be between about 20 and 50cm. The report notes that the yearly increase in sea level between 1993 and 2003 was double the likely annual rise over the 1963 to 1993 period but, if continued at this rate, still only suggest a rise of 30cm this century.

The increase in flow rates of Antarctic and Greenland ice sheets into the oceans might, the IPCC says, add another 10 to 20cm to sea level by 2100. The IPCC acknowledges that these forecasts may be far too optimistic, saying that the melting of ice sheets is not well enough understood to justify including higher figures for the rate of sea level rise.

The IPCC may need to modify its thinking. The evidence is mounting that the loss of ice from Greenland may well increase sea levels more rapidly than the climate body's models suggest. Most of this modelling work uses estimates derived from calculations about the rate of melting of ice when temperatures rise. Think of this in terms of the melting of an ice cube in your kitchen. Very crudely speaking, the IPCC models calculate the increase in the speed of melting of the ice cube when the kitchen temperature rises. The rate of temperature rise in Greenland has been very rapid by global standards (more than 2 degrees since 1900) but it is still possible to use relatively simple physics to estimate the amount of water changing state from solid to liquid. And it is surprisingly slow.

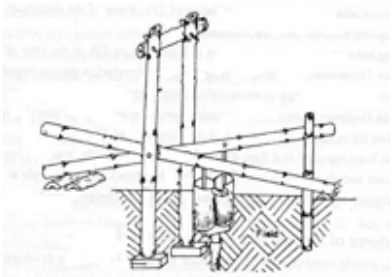
However, it is increasingly clear that these calculations are not accurately predicting the rapid rate of loss of ice over Greenland. The flow rate of glaciers into the sea looks to be much faster than the existing models suggest. The missing ingredient may well be the increased glacier lubrication provided by meltwater under the ice. In other words, the models may accurately predict the rate of melting of the ice, but they do not capture the impact of the glaciers flowing more easily because they are sliding on a base of water, rather than being slowed by being frozen to rock. This hypothesis is still tentative, but fits well with observations in places like Greenland's Ilulissat glacier where recent increases in flow rates have been visible to the naked eye. The Guardian reported a comment that the glacier is now moving at 2 metres an hour, more than three times as fast as 10 years ago. The effect of the meltwater lubrication is to allow the glacier to calve a much greater weight of ice into the sea each day, where it will eventually flow out of the fjord into the open sea and melt, raising sea levels.

The reporting of glacial change tends to focus on the rate of retreat of glaciers. This is happening at Ilulassit as well. Since 1850, the tongue of the ice has moved over 15 miles back up the fjord. This is important, and is an indicator of climate change, but the speed of flow of the glacier over the ground is a far more profound sign of the possible increase in the future rate of sea level rise.



The IPCC forecasts do appear to be too optimistic. Greenland will take centuries to melt, but we may get a much faster rise in sea level than anybody predicted ten years ago. Perhaps the most worrying thing is the Greenland melt is going to be extraordinarily difficult to stop. The immense thermal mass of the ice on the island gives a huge momentum to the processes of melting and sliding into the sea. And, once again, we are seeing evidence of a tipping point; temperature change unleashing forces that multiply the effect of global temperature rise.

The rise and rise of Climate Care



Drawing: the Indian treadle pump backed by Climate Care

Climate Care, the leading UK carbon offset company, has had an eventful few weeks. A few days after receiving an unexpected visit from climate activists who presented management with a basket of red herrings, the company put out a press release claiming that it would offset 1% of the UK's total carbon emissions next year. In sixty projects around the third world, Climate Care claims that it will reduce emissions in 2008 by 6m tonnes, or ten times as much as it has done this year. It is claiming spectacular growth rates. Continuous critical attention from newspapers and sceptical greens does not appear to have dented Climate Care's prospects one iota.

The core problems with offsetting are two-fold:

- guaranteeing additionality (ensuring that the investments in carbon reduction wouldn't have happened anyway)
- verifying the reductions.

Climate Care fails on both of these two important issues. Though Climate Care is getting increasingly tetchy with its critics, the blunt truth is that the company simply doesn't deliver genuine and quantifiable cuts in emissions. Increasingly, it works as an international development agency rather than as a business balancing one person's emissions with a reduction in another's. Climate Care may do a lot of good around the world, but it doesn't cut carbon dioxide emissions in a reliable or auditable way.

Why then have brands such as Land Rover, the Co-op, British Airways and Barclays linked up with this company? The reasons must include that Climate Care may be the best of the offsetting bunch. The big brands are sensitive to the need to show that they are 'doing something' about emissions. Climate Care isn't damaging the world, and so any connection with the company will not harm these companies. But unless the offsetting industry changes radically, it is eventually going to be discredited. A large company used to high financial reporting standards should not regard Climate Care's auditing standards as remotely acceptable.

The idea behind offsetting

In Western countries, emissions reduction can be difficult, expensive or inconvenient. For example, air travel is an important part of modern business. It is proving difficult for companies to reduce the number of flights. Similarly, leisure travellers are generally unwilling to stop using airplanes. The offset company tries to deal with this problem by taking a payment from the traveller and promising to use the money to reduce emissions somewhere else in the world by an amount equivalent to the emissions from the flight.

Offset companies contend that reducing emissions in the less developed parts of the globe is much less expensive than trying to do it in the UK. And, the companies say, the UK is already bound to reduce emissions because of international agreements such as Kyoto. So if offset monies were spent in the UK, other British polluters would have the freedom to emit more.

Offset companies tend no longer to use tree-planting as a mechanism for offsetting. There are too many concerns about whether this genuinely reduces emissions. Instead they tend to focus on projects that cut energy use in the poorest countries.

The basic idea behind offsetting is unexceptionable: it clearly makes sense to focus efforts on reducing emissions in places where the cost of cutting carbon is low. The problems with offsetting, and they are very considerable, largely arise because cutting these emissions is so cost-effective that the cuts would have happened anyway.

The Climate Care business

Climate Care has been in business for a decade but growth was slow until recent months. By January of this year it had sold a total of about 400,000 tonnes of offsets, or put another way, about 0.06% of one year's UK emissions. Sales this year have rocketed. It reports that by August 2007 it had sold 1.55m tonnes, though it had only delivered about a million tonnes of these offsets. This is an important and little understood point. Climate Care runs a bank of sixty or so projects. When a customer buys an offset, there isn't an immediate and corresponding flow of new funds into one of these projects. The company now has a reasonably substantial net liability – it has taken more money than it has put into projects around the world.

Climate Care is a company that aims at making money for its shareholders. It takes money from customers, makes a margin, and then tries to put the money to work in projects that reduce emissions somewhere else in the world. Most of its projects are well away from the international business itinerary or tourist track. There aren't many people who are going to visit Climate Care's new hydro-electric dam in Tajikistan. This is part of the problem: no one will ever really be able to tell whether its work has actually reduced emissions below what they would have been anyway.

What should offsetting actually do?
A good offsetting company should be like a firm of reliable Midlands accountants. When they say 1 tonne of carbon dioxide is being avoided somewhere in the world, you should feel confident that this is exactly what is happening. When the consumer hands over £14 to cover the sin of travelling to Africa by air, he or she wants boring and responsible people to invest exactly this amount of money in a project that will reliably reduce emissions by precisely two extra tonnes.

Whatever the rights and wrongs of offsetting, this never, ever, happens. Offsetting companies plough money into worthy projects around the world but there is very little evidence whatsoever that this has any direct impact on emissions.

Good offsetting should have two vital characteristics:

- the money going in to the project should be **additional** to other sources of funds and make a genuine difference
- the emissions reductions should be **verifiable**.

As far as I can see, no offsetting projects really deliver these two attributes. Let's briefly look at one of Climate Care's flagship projects – human powered irrigation pumps in India. We should be absolutely clear that these pumps are almost certainly useful and effective. Our complaint is that it is unclear how Climate Care's contribution is either **additional** or **verifiable**.

The project
In many parts of eastern India and Bangladesh, the water table is close to the surface. Unirrigated land can only produce one crop a year from the monsoon rains; but extract water from the water table, and the farmer can get two or three crops. Food production is increased, and rural incomes are improved. Provided that the water extraction doesn't deplete or salinate the water supply or increase its arsenic content, irrigation is undeniably a very good thing.

Some years ago, a local enterprise invented a simple foot operated pump that could be cheaply installed and which allowed small farmers to irrigate their land. About half a million have now been put into use and thirty thousand new pumps are being put in the ground every year. The alternative is either not to irrigate the land or to use an expensive diesel-powered pump. There's no question that these simple human-powered pumps are a good idea. But it is completely unclear how Climate Care could claim that any money it gives to treadle pump projects could possibly be **additional**.

Here's a paragraph from the citation of an award given to the Indian developers of the pump:

> The cost of a treadle pump and tube well is about Rs 1,200 to 1,300 (£14 to £15), and farmers pay the full cost to the retailer. IDEI (the original developer of the pump) raise awareness among farmers about micro-credit facilities, buy-back arrangements and self-help groups. However, it is generally not a problem to borrow money, because people know that a farmer with enough land to benefit from a treadle pump will be able to repay the loan. In addition, IDEI requires dealers to offer 120 days' credit to farmers, so that farmers have time to harvest and sell their first crop before they have to pay for the pump.

So, the rational farmer doesn't need Climate Care money to install a pump. If there is water under the ground, then it makes sense to buy a treadle pump. Full stop. The incentives are already there and Climate Care is overcoming no obstacles.

But Climate Care's claim is somewhat different. It says that the treadle pump replaces a diesel pump, thus saving carbon. This is a very strange proposition. The cost of the diesel to power a pump for a year is estimated at well over £200 and the hire of a pump at least another £50. No impoverished farmer could possibly pay these sums and the increased value of the crop wouldn't generally warrant the expense.

Climate Care also claims to be making a difference to by extending the use of the treadle pump to new and very poor areas. This may very well be true, but it doesn't result in emissions reductions. The people there could not possibly afford the very significant cost of fuel. It is impossible to verify that any emissions reductions would actually result from Climate Care's money.

The lesson? Don't give money to offsetting firms, who will use much of it to run their operations and and make a profit, give it directly to the charities in the third world instead. But, unfortunately, do not assume that your gift will

actually reduce emissions.

Companies mentioned in this newsletter: British Gas, E.ON, Marks & Spencer, Climate Care, Land Rover, the Co-op, British Airways, and Barclays.
