

CRed response to the UK Government Energy Review, "Our Energy Challenge" Consultation Document, 2006



CRed is the Community Carbon Reduction Programme at the University of East Anglia, funded partly by the East of England Development Agency and partly by business and other sources. CRed is a network of partnerships with individuals, businesses, schools, and communities, as well as with local authorities, working to show how a 60% reduction in carbon emissions can be achieved by 2025. CRed is now active not just in the East of England but in many regions of the UK, and in the USA, Japan and China.

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Overview

Future prosperity in a low-carbon economy?

It is very timely to conduct this Energy Review in 2006 only three years since the Energy White Paper in 2003. We can see much more clearly many trends worldwide that will impact on UK energy policy. The difficulties in making big cuts in UK greenhouse gas emissions are now apparent. We are at a threshold where it is necessary now to make decisions that will effect our nation's future prosperity and may, we hope, help guide the world to a future where irreversible climate change can be prevented. UK energy policy cannot be constructed without reference to likely world events and global climate change. The Consultation Document largely ignores some vital issues.

Debate has largely been concerned with supply issues. These remain vital, but demand must now be addressed with equal urgency. The liberalised energy market in the UK has led in recent years to significant price reductions for energy which have stimulated demand but weakened progress to reduce waste and to increase resource efficiency.

The Consultation Document ignores these perverse outcomes of liberalised energy markets - that UK greenhouse gas emissions have risen while the economy across the board remains ill-equipped to cope with significant price rises and even fuel shortages.

Indeed, increased liberalisation across Europe that the Document desires will only exacerbate demand and greenhouse gas emissions.

If the UK is to be able to help guide industrialising countries to a low-carbon but more prosperous future, it must transform its attitude to both energy demand and energy supply. Long-term energy supply must primarily depend on renewables that can provide energy at all levels down to the single building. The costs of renewables are falling and will continue to fall. Onshore wind is already often cheaper than competing technologies. Even solar PV will before long be cheaper to the owner than retail purchase. The Document fails to acknowledge the importance of these trends and is focused instead on traditional technologies associated with fossil fuels and nuclear electricity.

Demand must be influenced by a basket of mechanisms that can reduce waste, stimulate innovation and make the UK a leader in resource efficiency. This response from CRed gives suggestions, but detailed debate must follow. These mechanisms must cover all aspects of the economy from construction to transport.

The Consultation Document overlooks demand management almost entirely. It notes (p4) that our economy has become more energy efficient, but does not point out that the trend of increasing energy efficiency has remained constant since 1970 (DUKES 2005, Chart 1.1.4). This is why increased economic activity cancels out increased resource efficiency to leave greenhouse gas emissions roughly constant year on year. Where is the step change going to come from? The Document is silent.

"If we assume that UK GDP will grow on average by 2.5% per annum in the years to 2050, then carbon intensity in the UK would need to reduce to around 10% of what it currently is today in order for us to meet our 2050 target. This is a hugely demanding goal"; Consultation Document, p25. The Document nowhere describes how this goal can realistically be met. Yet this is the key challenge for energy policy.

In CRed's view, the key thrusts of energy policy henceforth must be to achieve much greater renewables penetration and an economy that stimulates low carbon innovation, reduction of wasted energy and accelerating resource efficiency. There is an interesting contrast between environmental legislation that drives down pollution and the voluntary agreements and "guidance" that are presently so ineffectual in driving forward resource efficiency and innovation. Energy policy must shape the market place in order that resource efficiency objectives can be met. Like the recent UK Climate Change Programme 2006, the Document is silent on how this might happen. Liberalisation, some advice, and a plethora of modestly-funded schemes just don't cut it.

CRed has consistently observed that individuals and businesses alike are concerned about climate change and wish to do things that can help preserve a viable world for our children and descendants. They are worried by the news about climate change they hear and read about but discouraged by the lack of action and leadership from Government in helping make real change happen. Yet there are examples of what can be achieved with ambition and determination.

2006 is a propitious time for the UK to make a major shift in energy policy to create leadership in resource efficiency and an energy supply portfolio that brings delocalised renewable power to millions of homes and businesses that will complement a diminishing number of large central generating stations. Innovative network dynamics and real-time price information and demand management – totally ignored in the Consultation Document - will reduce peak demand and capacity needs.

Only if we succeed in such change can the UK create sustainable prosperity for itself and a robust economy that can withstand the shocks in fossil fuel prices and availability that are likely over the next decade and more – but which are totally ignored in the Consultation Document.

Only if we create leadership in resource efficiency and renewable energy supply can we hope to influence developing economies to follow a similar path. The alternative is likely to be increasing competition for scarce fossil fuel resources, followed by a switch back to coal by many countries and accelerated carbon emissions. The outlook for the planet would be grim.

Such transformation need not wait for technical breakthroughs. A great deal can be done with present technology. Developments such as carbon sequestration, fuel cell motive power for vehicles, or a new generation of nuclear power stations lie too long in the future and will anyway only help on the journey we must begin today. By engaging the population at large as well as innovative business, a fertile climate for innovation can, however, be created. Many technical breakthroughs will follow.

Leadership at all levels of Government, national, regional and local is essential. Some of today's successful businesses will suffer as is always the case with disruptive innovation. But with clear and constant leadership from Government, innovative business will be stimulated and rewarded and the economy can prosper. An innovative, knowledge-based economy has to be agile and to be ready to abandon outdated core beliefs. Only if we can rethink our energy policy away from traditional carbon-intensive and inefficient platforms can we achieve the levels of resource efficiency we know are essential. Only then can we hope to avoid the catastrophe of irreversible climate change.

"The most important lesson to be drawn from Collapse is that resilient societies are nimble ones, capable of long-term planning and of abandoning deeply entrenched but ultimately destructive core values and beliefs. This, in turn, requires a well informed public, inspired leadership and the political will to take decisions that go against the established order of things."

Review by **William Rees** of *"Collapse: How Societies Choose to Fail or Succeed"* by **Jared Diamond**, 2005 in Nature, 6 Jan 05, Vol 433, p15

"In the next couple of decades, China and India will add thousands of new power plants and many millions of new vehicles as their economies grow. The rich world should help them do so using clean technologies like renewables and micropower. If not, a window of opportunity to set the world on a clean energy footing may be lost forever."

"Power to the People", **Vijay V Vaitheeswaran** (Farrar, Straus and Giroux, New York, 2003)

Climate change and Global growth UK Leadership?

In the three years since the publication of the UK Energy White Paper, "Our Energy Future – Creating a Low Carbon Economy", the impact of climate change on the planet has become more and more evident. Global carbon dioxide levels are increasing at an accelerating rate. Polar ice melting and other changes are demonstrating that the impacts of global warming may be more severe and happening more rapidly than was thought even three years ago.

James Lovelock in his recent book, "The Revenge of Gaia", now claims that the Earth has reached a tipping point where runaway climate change is inevitable no matter what man now does to reduce greenhouse gas emissions. We hope this is not the case, for the future for civilisation would be bleak indeed. Yet the backdrop for energy decisions here in the UK – which will be observed around the world – is stark.

Lovelock also remarks on the parallels with Munich before WWII:

"I am old enough to notice a marked similarity between attitudes over sixty years ago towards the threat of war and those now towards the threat of global heating. Most of us think that something unpleasant may soon happen, but we are as confused as we were in 1938 over what form it will take and what to do about it. Our response so far is just like that before the Second World War, an attempt to appease. The Kyoto agreement was uncannily like that of Munich, with politicians out to show that they do respond but in reality playing for time. Because we are tribal animals, the tribe does not act in unison until a real and present danger is perceived"

"The Revenge of Gaia" James Lovelock, Allen Lane (2006)

When we examine the support for measures that will combat climate change and reduce our waste of energy and our greenhouse gas emissions we are indeed reminded of this parallel. In the 2006 budget, just £20m over two years was announced to promote greater energy efficiency in homes and £50m added to Low Carbon Buildings programme to help kick-start microgeneration. Defra is the department with primary responsibility for tackling climate change. These sums are far smaller even than the amount Defra spends annually on compensating farmers for bovine TB (£90.5m in 2004), a non-fatal disease of cattle. They are insignificant compared to subsidies handed out to the fossil fuel and nuclear industries over decades and to the airline industry in the form of tax and VAT exemption on fuel (a £9 billion subsidy for carbon emissions).

Why should the UK, responsible for only about 2 per cent of global greenhouse gas emissions, take action now to dramatically reduce its own emissions? There are two very excellent reasons. Firstly, such action will prepare the country for resilience in the face of the energy shocks that are likely within the next decade – indeed, already, the cost of fossil fuels has risen to levels that were thought inconceivable in 2003.

Secondly, only if we lead, can we hope to influence the industrialising economies to follow a low-carbon path to development. Predictions made since the 2003 Energy

White Paper are sobering indeed in respect of potential greenhouse gas emissions from countries that are now under rapid development. This leadership need not, indeed cannot, wait for international cooperation.

Since 2003, the transformation of China into an industrial power and the take-off of other populous but poor countries such as India have become increasingly evident. This is welcome news and the 'BRIC economies' (Brazil, Russia, India, China) has become a common-place acronym (Goldman Sachs Global Economics Paper No 99, *"Dreaming with BRICS: The Path to 2050"*, 2003). But economic growth is a compound process. One recent estimate notes that while the E7 (BRICs plus Indonesia, Mexico and Turkey) are only one-fifth the size of the G7 economies at market exchange rates today, by 2050 they may be 25% larger. Yet, in absolute terms, the G7 themselves grow by 250% to 2050 in this estimate (John Hawksworth, in PricewaterhouseCoopers *UK Economic Outlook*, March 2006).

The impact on energy needs and greenhouse gas emissions of such growth – predicted from today's trends – is massive. In spite of continuing technical advance, oil demand is predicted to double by 2050 from 84 million barrels per day in 2005 to 169 mbpd in 2050, and the number of cars worldwide to increase more than fourfold from 776 million in 2005 to 3.3 billion in 2050 (Goldman Sachs Global Economics Paper No 118, *"The BRICs and Global Markets: Crude, Cars and Capital"*, 2004). China may need 48GW of new electricity generating capacity every year to 2020. This is equal to two-thirds of the total installed UK capacity every year (*"Capgemini uncovers \$180 billion investment gap in Chinese power market by 2020: Heavy reliance on coal brings environmental targets under threat"*, Capgemini, February, 2006).

The impact of this growth, if it happens, on greenhouse gas emissions will be potentially catastrophic for the world's climate. Yet, as one of the forecasters just noted has pointed out: *"it will be difficult for OECD countries to persuade China, India and others to cut their greenhouse gas emissions until the US and other wealthier economies take more decisive action here to cut their own emissions."* (John Hawksworth, above, p27).

Yet there are many voices that warn of a peak in global oil and gas production within the next decade. The pattern of discoveries of reserves, and the supply concerns already impacting prices seem to support this concern. The prospect of increasing demand worldwide for scarce fossil energy resources is not comforting. What might happen if the doubling of oil production predicted by 2050 cannot happen? Most likely is a switch to coal, already a serious issue in China as noted above. Reserves of coal, the most carbon intensive fossil fuel, are extensive. A switch to coal from oil and gas would make long-term climate change far worse.

If we continue as we are, increases in energy prices and shortages in fossil fuel supply will cause huge shock and stress across the UK economy within the next decade. We will not have the resources or the technology to cope and to respond. Households and businesses will be stranded in a low efficiency infrastructure. Neither will the country meet its greenhouse gas reduction targets. It will have no leverage on industrialising

countries where energy use and greenhouse gas emissions are likely to rise sharply. The impact of global climate change will compound the problems of fossil fuel supply.

If, on the other hand, we take action now to tackle demand as well as energy supply, to reduce energy waste and to stimulate energy-efficient consumption and technology, there can be multiple benefits. Innovation will be stimulated. The UK can become a leader in sustainable technology. Households and businesses alike will become much more energy efficient. Energy supply will become increasingly distributed and renewables-based leading to lower costs and to much lower greenhouse gas emissions. The country will be resilient to fossil fuel price and supply shocks. The UK will be a leader in combating greenhouse gas emissions and can work with industrialising countries to help make real cuts in greenhouse gas emissions globally.

The human race is conducting a war upon our planet by the emission of greenhouse gases and the consequent global warming and climate change. Peter Drucker, the renowned management thinker died last year. His ground-breaking book about General Motors, published just after the end of WWII (*Concept of the Corporation*, **Peter F Drucker**, 1946, revised edition 1972 (Mentor Books)) notes how that company was able to transform itself from an employer of 250,000 people making automobiles in 1941 to an employer of 500,000 people making aeroplanes and other military vehicles a year later.

Former US Vice President Al Gore is on a global tour, giving lectures to senior business leaders and politicians on the need to act on climate change. Mr Gore finishes his lecture by invoking the fantastic human effort and technological achievements which led to the defeat of fascism in the Europe and the Far East during the last century. We echo his sentiments when he calls for a similar international response to engage the same human endeavour and acumen in the war against climate change. It is vital that this review produces a coherent set of actions, which command public support and public involvement, so that the UK can play its part and give a lead to other nations in what has rapidly become the most pressing issue of the modern era.

Radical change is possible in a short timescale in peacetime as well as in war. In 1900, there were 8,000 automobiles registered in the USA; by 1912, there were 900,000, over a hundred-fold increase. More recently, the penetration of mobile phones has been dramatic across the world in the last ten years, far in excess of early predictions. It is vital for our children and all our descendants that this Energy Review does not duck the challenge that climate change presents us with. The UK has talked about climate change leadership. Now is the time for action.

CRed is playing its part not just in the UK but in China too. CRed and partners Arup and Alsop Design are working with the Shanghai Industrial Investment Company to develop a multi-renewable energy station, first conceived in the East of England, as part of the Dongtan Eco-City in the Yangtze delta north of Shanghai.

CRed proposals towards a UK energy policy

Creating a resource efficient and prosperous low-carbon society

As we have noted above, man is fighting a war against its own planet. At present in the UK this is a phoney war. The Government seems more concerned to lower energy prices to encourage consumption than to save energy, reduce waste and to use it more efficiently. Debate focuses on irrelevant issues such as nuclear power that are far too expensive and long term.

It is climate change that will be destructive and hugely expensive for us all. We are already seeing this in the less-developed world in places like Darfur, where the consequences of climate change may underlie human tragedy, and in the developed world, where the costs of Hurricane Katrina overwhelm any costs of reducing energy use, and investing in resource efficiency. Such events are merely the beginning of a process that has barely started and may overwhelm our ability to cope if greenhouse gas levels are not stabilised at sensible levels.

The good news is that the war against climate change need not be destructive. Investment in reduction of waste and resource efficiency is so cheap in comparison with construction of new centralised generating capacity. A resource efficient economy based on distributed and local power generation will be both prosperous and secure. Reduction of waste and resource efficiency are the very principles, "lean", upon which modern industry is based.

The market cannot prosecute this war without leadership. But with appropriate signals and guidance the market can deliver solutions. Indeed, this is already happening. Renewable technologies are growing at spectacular rates worldwide as we note below.

The principles are well established, for example in books by Amory Lovins and his colleagues at the Rocky Mountain Institute ("*Natural Capitalism*", "*Small is Profitable*", "*Winning the Oil Endgame*"). It is surprising that these books were not prominent in the Bibliography of the Consultation Document (pp68/9) which seems unduly focused on central supply issues.

It's important to recall first that reducing demand through avoiding waste and enhanced resource efficiency has a dramatic impact on supply issues. Halving rate of growth of demand doubles the life of a supply such as gas.

Secondly, building resource efficiency into design can bring multiple benefits. Houses and buildings built to sustainable standards cost less and are far more pleasant to live, learn and work in, enhancing productivity, improving health, and stimulating learning. The principles are universal and apply to factories and vehicles as well.

Thirdly, bringing these principles fully into design creates virtuous cycles and reduces waste to create environmental enhancement. A sustainable world can be a productive

world if "Cradle to Cradle" principles are applied ("*Cradle to Cradle: Remaking the Way We Make Things*", **William McDonough** and **Michael Braungart**, North Point Press, 2002).

The message is that properly investing in resource efficiency is not just the cheapest solution to satisfying energy needs, it impacts in positive ways across the whole of society. It's win-win.

The impact on an advanced economy of acting in this way has been made clear in a recent report from California:

"Globally, increasing GHG emissions are assumed to be essential to a growing economy. This is not true in California. The state can take an historic step by demonstrating that reducing emissions of GHG can accelerate economic growth and bring new jobs. Moreover, exercising leadership in this area plays to California's comparative economic advantage in the US and world economies as a first tier innovation economy. California can gain a competitive advantage by acting early in the new technologies and industries that will come into existence worldwide around the common goal of reducing GHG emissions."

"*Managing Greenhouse Gas Emissions in California*" from the University of California at Berkeley, January 2006, is at

http://calclimate.berkeley.edu/managing_GHG_in_CA.html.

The same conclusions apply to the UK.

Past policies over decades have hindered the UK's progress to become a resource efficient economy. The energy efficiency of our building stock is a national scandal. We lag far behind other European countries in developing and applying renewables such as wind energy, solar heating, solar PV and heat pump technology. The UK has focused on inefficient electricity generation at the expense of combined heat and power, creating an inefficient infrastructure that is susceptible to price rises and fossil fuel shortages.

The Energy Efficiency Commitment (EEC) does aim to improve matters but is poorly understood and poorly monitored. The companies delivering it are largely not trusted by consumers. There is little leadership by Government.

For all the reasons outlined above, change is now essential. If energy policy henceforth focuses on making the UK an innovative and resource efficient economy, all four of the Government's goals can be met. CRed has found great interest and willingness among individuals and businesses to tackle climate change while there is great potential for innovation and change across the country.

Listening too closely to established business creates conservatism and inhibits innovation. We are entering a period of disruptive innovation as we transform to a resource efficient economy based increasingly on distributed generation and renewables technologies. **Michael Massing**, "*The curious paradox of American corporate lobbying*", Financial Times, 28 March 2006, describes how lobbying against fuel efficiency standards by America's motor industry has helped undermine the industry's long-term competitiveness. The principles of special pleading are quite general.

The details of how this policy could be achieved must be worked out. But key tasks must include the following. Some of these will take several years to bring about. But the commitment and the ambition can begin now.

- Targets to reduce carbon emissions become key targets for Government in its own behaviour – documented achievement and leadership at all levels, national, regional, local will gain respect and set an example. These can exceed the Government's climate change targets and could map CRed's ambition for a 60 per cent cut by 2025.
- Measuring and monitoring achievement is critical to success in this and all the actions below; the CRed accounting and pathway system (see www.cred-uk.org) is set up to achieve this and is being used by an increasing number of local authorities and other organisations).
- Demand best practice; Woking council has demonstrated what is possible in creating sustainable energy generation and reducing carbon emissions – by over 70 per cent; why is not every local authority taking such action? It can be done today.
- Inform and engage every citizen and household about climate change and the Government's energy policy to tackle it and to create a sustainable and resource efficient UK. This will only be effective if everyone sees that Government is committed in deed as well as action. If everyone understands the importance of the issues and sees fairness in getting engaged tremendous change is possible.
- Educate everyone about energy waste and encourage and reward change by pricing and incentives. Stimulate interest via personal and household monitoring via the CRed pathway and audit system that is now used by increasing numbers of organisations.
- Make schools a focus for this whole campaign; CRed has helped enthusiastic schools make very large cuts in energy use; climate change and resource efficiency should be a central plank not just in the curriculum but a central plank of how schools go about their business. Schools are the nexus of their communities; the message would spread not only among young people who will suffer if we do not tackle climate change, but out to parents and the rest of the community.
- Reverse pricing policies that encourage waste of energy, for example by making a limited use of energy very cheap, and steeply ramping prices above certain levels; this is the model that is sort-of being applied to car taxation although ineffectually so far.
- Demand metering that enables users to know easily and in real-time energy use and cost; CRed has found that a principal barrier to reducing waste – in business

as well as in the home – is lack of knowledge of energy use – inadequate metering.

- Aim to link real-time metering and pricing to supply capacity; once people, organisations or businesses can make informed choices not to consume in real time, peak loads can drop sharply.
- Stimulate technology to enable electrical equipment such as freezers to respond to on-line real-time price and supply information, so helping smooth loads.
- Transform the energy supply industry to a resource efficiency industry. The EEC is a rather ineffectual halfway house. If supply companies gained financial benefit from helping customers continually reduce energy use and enhance resource efficiency huge change would become possible and there would be little incentive to construct new and expensive generating capacity.
- Demand that all construction should be carbon neutral; we know how to do it and examples exist; the industry is conservative but CRed has met many players that are very enthusiastic to take action. There will be a major task in educating the supply chain, but simple rules will greatly help; any fossil energy consumed in operation must be compensated by building equal renewables capacity such as on-shore wind; we know from the first tentative steps such as Merton's 10 per cent renewables rule, that such rules have a big impact on what is done.
- This requirement should over-arch other building regulations. It will stimulate intelligent design and efficient use of energy via CHP as well as micro-renewables. The major house building programme envisaged by the Government will benefit.
- The 2012 Olympic site could, and should, be a high profile example of Britain's low carbon leadership. This should be reflected in the new buildings and stadiums and also the transport infrastructure. Such ambition would raise the profile of low carbon technology and demonstrate the opportunities for innovative business.
- Publish figures for beneficial use of "free" energy. At present DUKES (Digest of United Kingdom Energy Statistics) explicitly ignores passive solar energy. Yet it is such "free" energy that enables sustainable construction and renewables technologies such as solar water heating. The focus primarily on fossil fuels is a historic attitude but creates a mindset resistant to change. These data will be a vital complement to other figures showing energy saving and carbon reduction across the country.
- Act to bring about the 40 per cent house ambition by up-grading poorly performing properties and making resource efficient appliances much more financially attractive by taxation; it is absurd that filament lights are cheaper to purchase than compact fluorescent lights and to find A-rated appliances that consume more power than C-rated ones because they perform functions such as

rapid ice-making. Why are not all new properties wired for low-voltage DC LED lighting and appliance operation enabling less waste and operation from local renewables? There are many ways to finance the up-grading of building stock including transfer of funds from inefficient users (feebates).

- Create mechanisms to ensure that responsibility for reduction of wasted energy and attention to resource efficiency are clear; at present in many situations this is not the case; for example landlord and tenant in rented accommodation, social housing construction and occupation; commercial property construction, management and occupation.
- Make planning consent for on-shore wind far easier except in areas of outstanding natural beauty. On-shore wind is probably the cheapest source of energy already in appropriate areas yet is subject to irrational opposition and grotesque misinformation. Windmills from past times are lovingly preserved – there were once probably ten thousand across the country; a similar number of efficient wind turbines could supply a significant proportion of UK electricity needs.
- Make community ownership (or financial return to local communities) a condition of on-shore wind energy; except in a very few situations local communities gain no benefit from turbines in their locality; if this changed NIMBY would change to PIIMBY (Put It In My Back Yard); by 2010 on-shore wind will already be 6GW installed capacity but this figure should greatly increase. Encourage community-owned schemes which are already over-subscribed but difficult to set up.
- Aim to ensure every house and building has local energy generation installed by 2050. Presently the figure is way under one per cent and already cost effective technologies such as solar hot water are often sold in aggressive ways at inflated prices. There is a virtuous circle created as consumers gain from reducing waste and enhanced resource efficiency; there is natural transition to wanting to generate power locally. An initial target could be one million homes by 2012; technologies should include heat pumps as well as solar PV, solar thermal and micro wind (*"Even in the cloudy UK, more electricity than the nation currently uses could be generated by putting PV roof tiles on all suitable roofs"*, **Jeremy Leggett**, "Half Gone", 2005, p201; and all of Europe's electricity could, in principle be generated by offshore wind)
- Fund and support such programmes by financial transfers from inefficient users or by slowing work on the massively expensive nuclear legacy (£70 billion and counting); this work is important but not urgent and brings little benefit save long-term safety; it can be conducted more slowly and resources diverted to ramping up micro-renewables. Alternatively, match every £ of subsidy to the nuclear industry with equal support for renewables; it is recently reported that the Government has given £5 billion to British Nuclear Group to help manage Sellafield.

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- Create an appropriate renewable heat obligation that would encourage biomass use and efficient CHP systems based on natural gas as well as biomass.
- Create, over time, an intelligent grid that rewards domestic small-scale supply from micro-renewables and makes possible an electricity network with a multitude of small delocalised generators; if and when fuel-cell motive power for transport becomes viable within a hydrogen economy, then there will be millions of power plants parked by people's houses with a generating capacity greater than currently installed grid capacity; problems of capacity and storage become simpler.
- Meanwhile, focus on energy storage capacity to help smooth loads as renewables increase their proportion of the supply; this can include small scale technology to larger-scale compressed air, flywheels and other technologies.
- Work with the EU and European Governments to ensure a pan-European grid can accommodate an increasing proportion of renewable electricity, especially from wind; problems of variable supply are anyway over-emphasised, but are largely overcome if the network is large enough.
- Develop sea-based generation (wave, tidal) with urgency – these are hardly mentioned in the Consultation Documents; together with offshore wind, these could supply a considerable proportion of UK electricity need, especially to a resource-efficient economy.
- Make sustainable design a central plank of engineering, design and architecture courses with rewards for achievement. There are already great opportunities for improvement in motors, circuitry and almost every area of technology. At present there is little incentive for change yet inefficient motors probably require several large generating stations to power them. Don't forget that for every unit of electricity consumed, two more units of energy disappear as wasted heat up massive cooling towers, adding greatly to greenhouse gas emissions; resource efficiency really does pay.
- Make universities leaders in low carbon achievement and education. At present, as result of CRed activity, UEA is joining with financial services company HSBC in an ambition to work towards carbon neutrality. Universities could become beacons of renewable energy on a community scale. Such an initiative would bring the science of energy generation closer to surrounding communities, adding to public understanding of the issues surrounding climate change and the link to energy production and use.
- Many of the actions above apply not only to domestic situations but to commercial activity as well; apart from energy pricing and financial stimulation, mechanisms for assisting business are confused and not always effective; there is a plethora of information but poor availability of knowledge; this must change; CRed has found that simple mechanisms are most effective to begin change,

often beginning with senior management commitment and accurate monitoring of energy use.

- While many of the points above relate to electricity supply, the impact will also have a big effect on heat needs (largely natural gas supply). Transport is discussed below. It is assumed that a significant penetration of fuel-cell powered vehicles will not happen for at least another quarter century, but by 2050, the hydrogen economy could transform electricity supply and storage as noted above. But the present actions are necessary now and will help create a low-carbon economy even if fuel cells for transport do not become viable.
- There will be a massive requirement for new skills in construction, retro-fitting and micro-renewables installation. This can benefit the whole population. CRed has found great interest and application in diy solar thermal installation in courses led by Norfolk local authorities.

If we do all these things and more, the UK can not only take leadership in becoming a low-carbon economy, but it can link with other ambitious regions (e.g. California and other US cities and states) and industrialising nations such as China and India to help these countries develop in a low-carbon manner. As already noted, such cooperation may be critical if greenhouse gas emissions are to be curbed.

The above form the heart of CRed's recommendations. Below we make some observations on:

- Demand, waste and resource efficiency
- Electricity generation, renewables and nuclear power
- Fuel poverty
- Carbon trading
- Transport

Demand, Waste and Resource Efficiency

A decision to construct a large generating station is relatively straightforward once costs and financial projections are established. But the output may be used by thousands of consumers. Each consumer may have tens of devices connected to the system. Few users know how much power they are consuming at any one time, or even, often, how much they consume over a year. In many situations users are disconnected from metering and payment.

The result is great waste, little incentive to seek greater resource efficiency, and difficulty for any Government to stimulate change. It's so much easier to focus on energy supply and to deal with a few large suppliers. As already noted, however, lower prices merely compound consumption and waste. Increased consumption of fossil

energy may appear to contribute to economic growth. But climate change creates a massive external cost while waste of energy is a drag on innovation and efficient use of resources.

CRed has demonstrated that electricity use in a typical block of offices can be easily reduced by least 25 per cent, with no impact on activity, simply by turning off unnecessary lights and unattended computers. A school in the CRed schools energy club with a particularly active switch off campaign saved over 40 per cent of electricity and nearly 20 per cent of gas consumption with no impact on lessons or learning.

Such savings are almost certainly reproducible across the country, not just in commercial and educational settings but in homes and businesses as well. Perhaps a quarter of all electricity generated – more than the output of all Britain's nuclear power stations - is simply wasted. Saving this energy is free. Building the generating capacity to produce this waste costs £billions.

Even bigger savings are possible by investing in simple energy saving measures such as loft insulation, use of efficient appliances and not leaving appliances on stand-by.

"When I moved into a solar powered house a few years ago, I cut the electricity demand of the dwelling by more than two-thirds virtually overnight simply by replacing the lights and appliances with the most energy-efficient models available. That was before the PV roof cancelled demand for other electricity supply out completely."

Jeremy Leggett, *"Half Gone"* (Portobello Books, 2005)

Amory Lovins of the Rocky Mountain Institute has made clear the compound benefits of resource efficiency, especially when electrical energy is involved. A CFL uses a quarter the electricity of an incandescent bulb. But because of the inefficiency of electricity generation from large generators, greenhouse gas and fuel saving may be three times greater again. Even bigger savings are possible in more complex systems (*"More Profit with Less Carbon"*, **Amory B Lovins**, Scientific American, September 2005, pp74-82)

Reducing waste and maximising resource efficiency is at the heart of the world's most efficient production technology – lean production pioneered by Toyota. It must become the cornerstone of UK energy policy. The benefits are many – in particular if promoted with real commitment in the manner outlined in the points above the process can create real engagement and commitment across the population and by communities:

- possibly half of all electricity currently generated might eventually be saved,
- reducing waste and enhancing resource efficiency is far lower in cost than constructing new generating stations,
- individuals and communities as well as businesses become engaged,
- ownership of energy use, personal responsibility for action on climate change, and enthusiasm for local generation are stimulated,
- large cuts in greenhouse gas emissions are possible,
- money and resources are saved,
- there's less need for major and wasteful capital investment,
- processes across the economy become more sustainable and more efficient,
- innovation becomes a way of life.

Electricity Generation, Renewables and Nuclear Power

Chart 2 of the Consultation Document is correct but misleading. Nuclear electricity is indeed 8 per cent of UK primary energy supply, but the majority of this energy disappears as heat at the power station.

More relevant is Chart 1.3 of DUKES 2005 showing final energy consumption (or delivered useful energy) 2004. This chart shows that electricity is 17 per cent of final energy compared to natural gas (33 per cent) and petroleum (47 per cent). These figures are not masked by the huge inefficiencies of large-scale electricity production and reveal the major proportions of gas (especially for heating) and oil (especially for transport) in our economy. As DUKES 2005 and the Consultation Document points out, transport accounts for 70 per cent of total final consumption of oil products.

In 2004, nuclear power generated 19 per cent of total electricity generation. Hence nuclear electricity accounted for just over three per cent of final energy consumption. Nuclear power cannot be the solution to any serious energy review!

The reason why nuclear power is currently being debated is that electricity supply is such a major contributor to greenhouse gas emissions because of the enormous waste of energy in electricity generation at large generating stations. Even though 40% of electricity (in 2004) is now generated from natural gas (from zero in 1990), electricity supply is still by far the country's largest single source of greenhouse gas emissions. The market driven supply industry is even now decreasing co-firing of biomass and increasing coal burn as gas prices rise, so increasing carbon emissions.

Building new nuclear power stations is a slow and expensive way to generate electricity. It is far cheaper to stop wasting electricity (and other forms of energy) and more beneficial long-term to stimulate low-energy technology across the economy. Hence CRed's recommendations above. The prediction of increasing electricity demand year on year assumes that current policies remain in place and that the UK remains a wasteful and energy-inefficient economy.

Not mentioned today is the fact that power from conventional nuclear fission was only ever seen as a first step to power from fast breeder reactors that could use natural uranium and stored plutonium. Since the demise of all fast breeder programmes and the failure of reprocessing as a viable option, this logic has completely gone.

The high cost of building nuclear compared to pursuing cheaper and quicker options has been comprehensively discussed by Lovins ("*Nuclear power: economics and climate-protection potential*", Amory B Lovins, Rocky Mountain Institute, January 2006 at http://www.rmi.org/images/other/Energy/E05-14_NukePwrEcon.pdf).

While all his details may not apply exactly to the UK situation, the principles are valid. There are legitimate concerns about safety with nuclear that others may well focus upon.

We merely note that the principal problem is cost. Indeed, there is no private sector enthusiasm for nuclear power because of the costs and uncertainties involved – unless major handouts are available.

Lovins concludes, quoting Keynes: *"Lord Keynes said, "If a thing is not worth doing, it is not worth doing well." Nuclear power has already died of an incurable attack of market forces, with no credible prospect of revival. Current efforts to deny this reality will only waste money, further distort markets, and reduce and retard carbon dioxide displacement. Cheaper, faster, abundant decentralized alternatives are now empirically larger, are being bought an order of magnitude faster in GW/y, and offer far greater ultimate potential. Since nuclear power is therefore unnecessary and uneconomic, we needn't debate whether it's safe. And the more concerned you are about climate change, the more vital it is to invest judiciously, not indiscriminately—best buys first, not the more the merrier."*

In contrast, renewables (wind, solar in particular) have been growing rapidly worldwide since 2000. For example, one modest UK company, Renewable Energy Systems, RES, has installed over 1GW of wind capacity world-wide, equivalent to a new nuclear power station.

Electricity from wind power grew 28 per cent year on year worldwide from 2000 to 2004 while grid-connected solar PV grew 60 per cent year on year in the same period, principally in Japan, Germany and the United States. \$30billion was invested worldwide in renewable energy (excluding large hydropower) in 2004 alone. Renewables are booming because costs are coming down and are now lower than fossil and nuclear energy in many cases, notably on-shore wind. Costs will continue to decline, in contrast to costs of fossil energy, and, because unit sizes are modest and construction fast, investment can be recouped rapidly in contrast to nuclear.

There is no waste of energy as heat when electricity is generated by renewable technologies such as wind and solar while costs of all renewable technologies continue to decline and will continue to do so even as fossil fuel prices rise. These and other sustainable technologies have to be the future for a sustainable but resilient low-carbon economy.

Even Shell acknowledges that renewables could meet all the world's energy needs for a population of ten billion people by 2050:

"Renewable energy sources (called "renewables") offer a variety of alternative energy sources with the potential to meet all of our energy needs. Geothermal and solar energy alone could each supply 250 GJ per year to 10 billion people, assuming economically viable technology is available. With the exception of Asia and Europe, most regions of the world could be self-sufficient."

Ged Davis, *"Meeting Future Energy Needs: Choices and Possibilities"*, 2003 at <http://www.nae.edu/nae/bridgecom.nsf/weblinks/MKUF-5NTQDH?OpenDocument> and see the figure on p21 of *"Energy Needs, Choices and Possibilities, Scenarios to 2050"*, Shell International, 2001 at http://www.shell.com/static/de-de/downloads/scenarios_to_2050_de_en.pdf.

We recommend (as already noted in several points above)

- UK Energy Policy should centre around renewables for supply coupled with a focus on resource efficiency and demand management; large-scale renewables such as offshore wind and wave and tidal schemes should be complemented by distributed generation at a local and individual level.
- While this policy takes time to come into full effect, there will be constraints on supply. The timescales for shut-down of the remaining nuclear generating plant are almost certainly optimistic; we recommend they be extended for a decade or more providing safety can be assured.

We have expressed concern about a "dash for coal" if other fossil fuel resources become scarce or increasingly expensive and the greenhouse gas consequences that might follow. Yet there will certainly be continued use of coal for electricity generation worldwide. Interesting clean-coal technologies – where carbon dioxide is sequestered – and projects have recently been announced in the UK.

- We recommend that clean-coal technology is supported in order that the UK can lead other nations in using coal in a low-carbon manner and in order to provide a low-carbon, non-nuclear baseload capacity for the UK.

Nuclear fusion is said by some to be the ultimate solution to the world's energy needs. More sensibly, it already is, but takes place millions of miles away in the sun. As already noted, electricity is less than one-fifth of delivered energy, so fusion, or any other technology is unlikely to be an ultimate solution. Within the timescale that fusion may be anywhere near commercially viable renewables technologies and resource efficiency will be far cheaper and far more convenient.

- There is no point in pursuing fusion research.

Fuel Poverty

Fuel poverty today is largely a consequence of the appalling inefficiency of our housing stock, a legacy of past legislative incompetence and industry conservatism.

"In Finland, a somewhat colder country than Britain, the toll of people freezing to death in their own homes in a typical year is precisely zero. The annual toll from hypothermia deaths in British homes, on average, approaches 50,000."

(**Jeremy Leggett**, *"Half Gone"*, Portobello Books, 2005, p97)

Whether or not Leggett's figure is correct, fuel poverty is a major social problem in the UK. It is helped by falling fuel prices, but these cannot be guaranteed and, as pointed out many times in this note, falling prices promote waste and increased greenhouse gas emissions.

Fuel poverty should be tackled at source, not via the blunt and inappropriate instrument of low fuel prices. There are many focused tools to achieve this.

In future, UK construction practice should avoid any potential for fuel poverty while the major refurbishment campaign of existing property will slowly eliminate the problem.

Carbon Trading

Emissions trading can be helpful in many situations and we support its aims. It is not a substitute for legislation, strategic direction and low-carbon ambition as part of energy policy.

- In particular, we do not see that emissions trading will, on its own, reduce the alarming growth of emissions from aviation as suggested on p28 of the Consultation Document. This growth must be tackled directly via taxation on fuel (currently aviation fuel receives a £9 billion annual subsidy because of lack of excise duty and VAT) and other measures.

Transport

Transport receives surprisingly little discussion in the Consultation Document when one considers that it is responsible for over one-quarter of UK greenhouse gas emissions – more if aviation is considered as well as surface transport.

This lack of attention perhaps reflects the fact that greenhouse gas emissions from transport continue to increase because Government policies (whether intentional or not) encourage increased use of cars, trucks and other vehicles. There is a tension between the need to reduce carbon emissions and the view that economic growth depends on freer flowing road transport and increased use of aviation – hence Government plans for several new runways at UK airports.

- Emissions from aviation must be addressed through fuel taxation and other measures. Several reports have pointed out that the growth in greenhouse gas emissions from aviation is unsustainable. Indeed, if the Government's two plans – for a 60 per cent cut in emissions by 2050 and for growth in aviation in the Transport Plan – both were fulfilled, aviation would account for all allowed carbon emissions at 2050.
- We believe that if the public are engaged in the campaign to cut carbon emissions and to increase resource efficiency as we recommend above, then there will be widespread understanding to the need to tackle emissions from aviation.

While some initiatives to help reduce road transport emissions are welcome, for example the Renewable Transport Fuels Obligation, we note that this is set at only two-thirds the level recommended by the EU. The RTFO is 5 per cent by volume while the EU Biofuels

Directive calls for an inclusion by 2010 of 5.75 per cent by energy. Given the nature of the UK fuel mix, the RTFO is only near 4 per cent by energy. The Consultation Document does not point this out (p27).

- As with the case of the RTFO, action to reduce the increasing greenhouse gas emissions from road transport are presently inadequate.

Voluntary agreements are not, to paraphrase Sam Goldwyn, worth the paper they're written on. There is an EU-wide voluntary agreement with manufacturers to reduce new car average emissions to 140g/km by 2008/9. The consultation document does not point out on p27 that this agreement is certain not to be met and levels now seem stuck at around 170g/km.

- Changes to annual road tax announced in the budget are ineffectual. They need to be much steeper to encourage a change in habits away from low fuel economy vehicles. The funds raised at the high end could be recycled to encourage ownership of high fuel economy vehicles.
- The market can deliver solutions if the strategic direction is correctly set and if legislation provides suitable signals. Over the last thirty years, we have seen the success of engine and tail-pipe technology reduce pollution from petrol-engined automobiles by orders or magnitude. This was able to happen in the USA and Europe because the necessary legislation was put in place, initially against strong opposition from the industry. Such success contrasts with the predictable failure of vehicle makers to meet the EU's voluntary target of average CO₂ emissions of 140g/km by 2008/9.

Energy Policy should address transport just as comprehensively as supply and other areas of demand. But progress will be made by a combination of measures which can compound, if well planned and executed, to lead to significant cuts. Measures must be pursued aggressively and strong leadership is required from Government.

- Increased levels of walking and cycling are vital if we are to make any dent in transport related emissions. A radical increase in investment in safe routes and facilities needs to be implemented (look to the Dutch and the Danish for policy direction). Britain is becoming a nation of obese and sedentary people and policies to encourage less use of the car should bring revenue benefits from reduced health spending.
- The increase in the use of rail travel is to be welcomed. However, there is a need to link energy policy with other government responsibilities, such as up-dating the rail network. The Strategic Rail Authority is a weapon in carbon reduction and should be recognised as such and encouraged to put more pressure on the operators to improve services and rolling stock.

- More teleconferencing should be phased in to reduce the massive amount of business related transport and this issue should be linked to the Nation's energy policy.
- Every day there are millions of unoccupied seats on Britain's road. Liftsharing is a British success story but is little recognised. June 14 is national liftshare day. The Government should buy into the aim to increase average car occupancy from 1.6 to 2.0 (CO2!).
- Fiscal and other financial measures should be introduced to encourage increased fuel economy by Britain's vehicle fleet; there is no reason why this could not eventually double. Annual vehicle tax is one measure. Others could include variable VAT and variable parking and other measures. There are many options.
- Globalisation and logistics practices have led to increasing transport emissions by heavy duty vehicles as well as shipping. We recommend that policies should support local food supplies for low-carbon transport reasons as well as to support local economies.

We have noted that the RTFO set for 2010 is modest. However, renewable fuels (biofuels) represent a long-term option to reduce carbon emissions from transport. Currently, biofuels such as bioethanol and biodiesel can be produced in the UK, but land use considerations mean that penetration above around ten per cent is very difficult to contemplate.

However, coupled with measures to increase fuel economy, biofuels could become much more important, especially if more complete conversion of the plant could be achieved and advanced conversion technologies were developed.

As with the oil economy, a non-food plant economy will produce both fuel and other value-added products. There are great opportunities for innovation to produce packaging and other more valuable products with great benefit in waste reduction as well to the rural economy. Once again, once energy policy is considered in a joined-up way, and not just from the perspective of large generating systems, there are seen to be many valuable links across the economy.

- We recommend that the Government supports innovation in biofuels and non-food crop science on a continuing basis. Should fuel cell technology not prove viable on a wide scale for transport, biofuels could provide a low-carbon alternative. This will only happen, however, if new technologies are developed and if vehicle fuel economy increases greatly. There will be great potential benefits to the wider economy.

Fuel cells, possibly fuelled by hydrogen, are seen as a long-term, low-carbon solution to carbon emissions from road transport. There is no guarantee they will be commercially

viable on a wide scale, and, in any case, widespread introduction is unlikely for at least a quarter of a century.

However, if fuel cell-powered vehicles do become widely available, they represent, as noted above, a remarkable distributed renewable power source.

- We recommend that support for fuel cells in transport is maintained along with other components of a hydrogen economy.

Conclusion

CRed suggests that an ambitious programme to create a resource efficient UK can lead to a sustainable and secure low-carbon economy. The CRed accounting and pathways system could monitor progress locally, regionally and nationally. By pursuing such a course, the UK can play a leading role in showing that combating climate change is consistent with creating a prosperous and healthy economy. It can influence developing nations to work towards a low-carbon future while harvesting the benefits of increased living standards and prosperity. This may be the only route that is able to prevent irreversible climate change.

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CRed is the Community Carbon Reduction Programme at the University of East Anglia, funded partly by the East of England Development Agency and partly by business and other sources. CRed is a network of partnerships with individuals, businesses, schools, and communities, as well as with local authorities, working to show how a 60% reduction in carbon emissions can be achieved by 2025. CRed is now active not just in the East of England but in many regions of the UK, and in the USA, Japan and China.