a new vision for energy

“green alliance...

a new vision for energy

by Rebekah Phillips, Rebecca Willis, Tracy Carty and Russell Marsh

Published by Green Alliance, July 2006, £15
Artwork and print by Upstream – www.upstream.coop
Printed on Revive matt – 75 per cent post-consumer waste.
ISBN 0 9549757 9 0

Green Alliance

Green Alliance is one of the UK's foremost environmental groups. An independent charity, its mission is to promote sustainable development by ensuring that the environment is at the heart of decision-making. It works with senior people in government, parliament, business and the environmental movement to encourage new ideas, dialogue and constructive solutions.

Green Alliance is a registered charity number 1045395
Company Limited by guarantee, registered number 3037633

acknowledgements

Green Alliance wishes to thank BP, Friends of the Earth, Shell and WWF-UK for their support of the work on carbon capture and storage; Shell, BP and the Royal Society for the Protection of Birds for their support of the work on renewables and energy efficiency; the Ashden Trust for support of the work on micro-generation and Greenpeace Environmental Trust for their support of the work on nuclear.

contents

The recommendations presented in this report are put forward by Green Alliance and do not necessarily represent the position of funders, project partners or steering group members.

1. executive summary

the case for action

The urgency of the need to transform our energy system from one based on large-scale fossil fuel technologies to one that is less carbon intensive grows almost daily. Scientists are pretty much unequivocal in their assertion that not only is the climate changing dramatically but that it is our emissions that are mainly responsible.

Despite the government's efforts, emissions are rising; on current trends we will miss the domestic goal of a 20 per cent cut in CO_2 emissions by 2010. Add to this the scheduled closure of a substantial part of our ageing generation fleet and government concerns about the UK becoming overly reliant on gas, a growing proportion of which will be imported in the coming years, and you can see why energy is often in the headlines.

The government's response to this increasing focus on energy was to begin re-defining its energy policy. In November 2005 it announced that it was to carry out a review of the Energy White Paper (EWP) published just over two years previously in April 2003.

Heralded as 'the most significant consultation on energy policy ever undertaken in the UK' , following two years of analysis, and a series of earlier reports on energy, the 2003 EWP set out a bold framework for policy development over the next 50 years, aiming for a 60 per cent cut in CO_2 emissions by 2050. Its vision was 'to strengthen the contribution of energy efficiency and renewable energy sources' with over half of the reductions to be met by cuts in energy demand.

The current Energy Review is looking again at many of the issues covered in the 2003 EWP, in particular, what we need to do to get back on track to meet our emission reduction targets and how to tackle our reliance on imported gas to power the economy. And of course, it put the nuclear issue back on the agenda.

It is against this background that Green Alliance has been investigating various aspects of the UK's energy system and the policy framework that supports it. Our work has focussed on a number of areas, including: microgeneration and the potential to move towards a more decentralised energy system with customers as producers as well as users of energy; the role of carbon capture and storage in the market in the short-term and the conditions of its use; housing and fiscal incentives to encourage consumer behaviour change; and the additional policies needed in energy efficiency and renewables (both electricity and heat based) to deliver the vision of the 2003 EWP.

a new vision for energy

Chapter two argues that the current system we have for generating, distributing and selling heat and power is no longer adequate and this is why attempts to reduce carbon emissions have not been as successful as they need to be. It looks at why we are stuck in this system and argues that the energy system we have is actually closely controlled through government policy and regulation. Far from being a free market, this current model of regulation strongly favours the status quo of centralised generation for passive consumers.

The chapter goes on to outline our vision of what a 21st century energy system could look like. In Grid 2.0, power would be generated as close as possible to where it is used, there would be a more active role for individuals and communities, an energy system which is embedded in our lives and homes, where energy entrepreneurs are part of every community, and everyone is involved in saving or generating power. This new approach would mirror the shift across society towards people-centred, multi-way networks and would give people a sense of responsibility towards their power.

the role for large-scale technologies

Chapter three explores the role of large-scale technologies in this new vision, focussing on nuclear power and carbon capture and storage. It argues that, whilst Grid 2.0 embraces a wide variety of generating technologies, nuclear power comes with a number of inherent drawbacks which means that we do not see it as part of our vision. There is strong evidence to show that new nuclear plant is not needed, that it will not come on line quickly enough to help with either our security of supply or emissions reductions and that it could worsen the prospects for other low carbon energy sources.

Carbon capture and storage may have a role in the short to medium term as part of a portfolio of distributed generation. Its main function should be to bridge the gap between supply and demand of renewable distributed energy with conventional fossil fuel plant.

how to get there

Chapter four looks in detail at the policy framework needed to make this vision a reality. Trying to shoehorn elements of the decentralised approach into the incumbent system of regulated markets will not work, we need to design regulations and institutions to get the outcomes we want.

The changes needed are broad and far reaching. We have made recommendations which cover the energy market, distribution network, community and Local Authority involvement and incentivising individuals towards low carbon living.

2. grid 2.0: a new vision for energy

Most discussion of energy policy centres around a few technically-driven questions: How can we ensure energy security? How can we reach carbon targets? How can we liberalise energy markets? But this techno-speak masks the real issue: the role that energy plays in our lives, homes and businesses. We need to take a step back and think again about the purpose of our energy system, and the role of individuals within it.

This chapter begins with an account of the current system that we have for generating, distributing, and selling heat and power. It argues that the current system, Grid 1.0, is no longer adequate. It is over-centralised, inefficient and unresponsive to feedback, and remote from people's lives. This is why attempts to reduce carbon emissions have not been nearly as successful as they need to be.

It continues with a description of a very different energy future: Grid 2.0, a new vision for energy. In Grid 2.0, there would be a much more active role for individuals and communities – an energy system which is embedded in our lives and homes, where energy entrepreneurs are part of every community, and everyone is involved in saving or generating power. Finally, it looks at the reasons why we are stuck in the old system. It argues that, far from being a free market, energy is actually closely controlled through government policy and regulation. Energy outcomes are highly dependent on government action – we get the energy system that we choose. The current model of regulation and control strongly favours the status quo of centralised generation for passive consumers. We will not get to our new vision for energy without changing regulatory structures.

"we get the energy system we choose."

grid 1.0: the state we're in

Our energy system is no longer fit for purpose. The method we have for shipping power into every building is a product of the industrial revolution, and is based on the technologies and thinking of that time. Individual generation technologies have changed and improved but the infrastructure remains the same. It is worth looking in detail at the characteristics of this energy system – let's call it Grid 1.0.

Grid 1.0 is a centralised system, based on economies of scale. For electricity, large-scale generators pump power over a one-way grid to small-scale users. Nearly all the UK's electricity is generated at large power stations, fuelled by coal, gas or nuclear fission. Electricity then flows through the high-voltage transmission system, to an electricity substation nearer to population centres, and from there into the low-voltage distribution system which takes the electricity into buildings. Gas is slightly different. Though the gas distribution network is national, and gas is used to generate electricity, most is actually used in our homes, through boilers for central heating and hot water. But whether for gas or electricity, the journey from producer to user is long, in geographical terms. It is also a long journey in a psychological sense. It is very hard to make the link between flicking a switch and the distant power station that actually made it possible to turn the light on.

the asymmetry of power and information

This leads us to a second characteristic of Grid 1.0: the asymmetry between producers and users. The pressure to keep the system going rests on the producers

of power, not the users of it. It is simple enough to switch a light on, or fire up the central heating. But is far from straightforward to provide gas and electricity to over 20 million homes, offices, and industrial users. Behind the scenes, there are thousands of people, hundreds of companies, a whole load of technology and a complex regulatory system all working flat-out to ensure that the lights stay on.

The asymmetry of Grid 1.0 also means that there are few feedback mechanisms. People do not adjust their demand for power according to the supply available. A huge amount of effort goes into pretending that we have as much power as we want, whenever we want it. Millions of pounds are spent on new gas interconnectors, to import more natural gas, so that we are free to lose vast amounts of heat through badly insulated lofts. No one thinks twice about putting the washing machine on first thing in the morning, just at the point when demand is at its highest, and the electricity system is struggling to cope with the strains placed upon it.

inbuilt inefficiencies, inadequate innovation

Partly as a result of this lack of a feedback mechanism, and partly because of technological constraints, Grid 1.0 is surprisingly inefficient. Only around 40 per cent of primary energy input (the coal or gas) used in power stations is converted into usable electricity; the rest is wasted heat. A further nine per cent is lost as the power moves through the transmission and distribution system.[4] Then, a further third is lost in our homes and offices because they are poorly insulated, not designed with energy in mind, and inhabited by people who do not see themselves as players in the energy game.

> "Only around 40 per cent of primary energy input is converted into usable electricity, the rest is wasted heat. A further nine per cent is lost through the transmission and distribution system."

Neither are there any signs that Grid 1.0 will cope any better in the future. Investment in large-scale energy infrastructure – power stations, grid upgrades – is at an all-time low. According to analysts Oxera, the amount of expenditure on research and development being undertaken by UK utilities has fallen significantly over the past 15 years, due in part to the regulatory constraints imposed by privatisation. For electricity, R&D spending is less than 0.5 per cent of revenue.[5]

no connection to climate change

Meanwhile, the scientific evidence about climate change mounts, and politicians become increasingly aware of the far-reaching consequences. Tony Blair calls it "the single biggest long-term problem we face",[6] and put it at the centre of his presidency of the G8 last year. Many people agree with him: research for the Energy Saving Trust showed that climate change was more of a concern than terrorism. But, the same study showed that people do not understand the link between climate change and their own energy use. Less than half of us are aware of the environmental damage caused by our homes and lifestyles. Those that have thought about taking action are often put off by the perceived expense and hassle.[7] Despite successive attempts to help and inform – including campaigns by the Energy Saving Trust, labelling requirements for appliances, obligations on energy suppliers to help their customers, and grants for home energy saving – energy use and carbon emissions are on the increase. Nearly a third of the UK's carbon emissions now come from the household sector.

Attempts to get people to use less energy have focussed on the energy efficiency of houses, not the energy demand of individuals. Although this enables people to get more value out of the energy they use, it does little to incentivise greener action. In fact, efficiency without engagement may well lead to perverse outcomes. Work by Tadj Oreszczyn points to "our almost innate ability to think of new uses of energy often facilitated by improvements in energy efficiency".[8] Double-glazed conservatories, for example, make it possible for them to be heated and used throughout the winter. Previously, single-glazed conservatories would have been heated through sunlight alone, and used only in the warmer months. So efficiency gains will quickly be swallowed up if not accompanied by clear understanding and engagement about the environmental reasons for energy efficiency.

In short, Grid 1.0 is inefficient, starved of investment, and remote from its users. It is not surprising that we are failing to achieve carbon targets and energy security goals.

grid 2.0: a glimpse of what's possible

If our current energy system is not fit for purpose, what could we do instead? There are plenty of examples of new visions for energy that offer us a glimpse of the way forward.

Urban Splash, the housing developers known for their cutting-edge architecture, are pushing the boundaries for energy, too. Their new Budenburg Haus development in Altrincham has its own internal electricity grid and heat network. Much of the energy needed is generated on-site, through ultra-efficient combined-heat-and-power boilers. Hot water, heating, and electricity are sold on to each apartment, with the system constantly fine-tuned according to demand. Each resident can check their energy usage and costs on the cable TV system, even comparing costs with the neighbours, and providing a clear incentive to reduce consumption.

With its efficiency savings, emphasis on information and involvement of energy users, Budenburg Haus is a significant departure from mainstream energy thinking. As is the Moel Moelogan wind farm – a co-operative venture set up three farming families in Wales. Faced with a decline in agricultural incomes, they took a fresh look at their land and realised that its most productive resource could be the wind that blows over it. The wind farm that they established provides much-needed income for the community, and some of the profits are ploughed back into energy efficiency savings for villagers. Then there are the Kirklees council estates, powered by solar panels, whose residents have even more reason than usual to talk about the weather: the brighter the sky, the lower the electricity bills. Or the school, Spen Valley Sports College, whose school council raised the money to install their own wind turbine. It now generates a proportion of the school's electricity needs, as well as bringing the curriculum alive – it is used for teaching science, geography and maths, and has made the school and community much more aware of the power they use, as Gary Deighton, a teacher, says: "If I see an article about climate change in the papers now, I read it, whereas before I would have just gone straight to the sport."

These new approaches to energy mirror a shift happening more widely across society, from top-down, centralised systems, towards people-centred, multi-way networks and approaches. In information technology, for example, there has been a profound transformation towards distributed computing and peer-to-peer networks,

like Google and Wikipedia – dubbed 'Web 2.0'. More widely, new thinking about the role of consumers puts forward a much more active role for individuals in the economy and in politics too. It is increasingly understood that the right outcomes in health and education, for example, will only be achieved through a partnership between individual and state.

What all these approaches have in common is a reconfiguring of the role of the individual, from a passive consumer – whether as patient, student or energy user – to an active participant in the system, helping to shape the right outcomes. Shifting to such an approach for energy – moving to Grid 2.0 – would give people a sense of ownership and responsibility for their power. Critically, this would provide them with the incentive to get involved in a collective endeavour to reduce carbon and combat climate change.

"These new approaches to energy mirror a shift happening more widely across society, from top-down, centralised systems, towards people-centred, multi-way networks and approaches."

Compare this approach with the old system. Grid 1.0 was centralised and distant from the users of power; Grid 2.0 is localised and involves people in the system. Grid 1.0 provided little opportunity for feedback or system innovation; Grid 2.0 offers a two-way flow of information, resulting in a greater degree of control and resilience. Grid 1.0 tries to pretend that power supplies are inexhaustible and cheap; Grid 2.0 asks for co-operation between producers and users to make the most of a scarce resource, and rewards those that play their part.

grid 1.0	grid 2.0
Centralised	Decentralised
One-way	Multi-way
Limited feedback	Constant feedback
Small number of large investments	Large number of small investments
Emphasis on throughput of energy	Emphasis on investment and infrastructure
Active producers, passive consumers	Producers and consumers linked and active
Focus on supply of electricity and gas	Focus on providing heat and power
Expertise is centralised	Expertise is distributed
Supply based on predictions of demand (predict-and-provide)	Demand and supply linked and influenced by each other

Building on existing examples and existing technologies, Grid 2.0 encompasses a whole new vision for energy.

webs not grids

In Grid 2.0, much more power will be generated at community and household level, through renewable and low-carbon technologies like solar and wind power, small-scale combined heat-and-power, heat pumps and biomass boilers. There will still be large-scale power generation, especially for industrial use, but the National Grid will transform from a one-way provider of power to consumers, to a two-way web, linking distributed sources of energy supply and demand. Microgrids, peer-to-peer networks linking generators within a village, housing estate or university, for

example, will allow efficient use of small-scale generation. This way, the National Grid will become an enabler rather than an automatic provider of power, linking microgrids and allowing distributed generators to trade with each other, in order to even out supply and demand.

"There will still be large-scale power generation, especially for industrial use, but the National Grid will transform from a one-way provider of power to consumers, to a two-way web, linking distributed sources of energy supply and demand."

the proximity principle

In Grid 2.0, power will be generated as close as possible to where it is used: buildings will become power stations and small wind farms will power small villages. Some large-scale generation, like certain wind, tidal or hydro power projects, will be sited in remote areas where the resource is better, but there should be a presumption in favour of proximity. Sources of heat will be found locally, too, with biomass boilers, ground-source heat pumps and solar water heating becoming commonplace. This will help to offset losses in electricity distribution and reduce reliance on the gas network. It will also create the link in people's minds between supply and demand as energy becomes part of everyone's landscape, geographically and physically.

aiming to engage

Grid 2.0 will engage individuals and households in energy and climate change, and make it easier for them to play their part. Like healthcare or education, energy will be seen as a joint endeavour between individuals and the state. Gas and electricity companies will work with households to optimise energy systems, not just sell them units of heat or power. Individuals and communities will be rewarded for the power they generate and the energy they save.

Research for the Energy Saving Trust shows that someone coming round to your house to talk through energy options can have a real galvanising effect. It helps to make energy issues more real, and more tangible. As the research says, "although consumers were not interested in energy efficiency in an abstract sense, they did take an interest in issues relating to their own house… respondents liked the idea of somebody coming to inspect their house and provide a personalised report". As part of the research, some respondents were offered an audit: "The large majority found the audit process interesting and enjoyable, and most felt motivated by the results… most felt that the audit had increased their motivation to think about energy efficiency and install certain measures, and some had already done so".[9] Yet beyond the realms of research, no energy companies currently offer home energy audits.

making it easy to do the right thing

The success of trial energy audits shows that people are willing to think through their impacts. But it's still a long way from changing behaviours and lifestyles to bring about serious carbon reductions. A little more information about environmental impacts will not be enough to change the habits of a lifetime. Grid 2.0 will need to align information with the right encouragement and incentives, making it easy for people to contribute. Government already understands the need for this. In its Sustainable Development Strategy, published last year, it asserts that behaviour change will only come about through a package of measures working together. We need to enable – make it easier for people through removing barriers

to action and providing the right information; engage – through personal contacts and networks; exemplify, with the government leading by example; and encourage, through the tax system and other incentives.[10] All these together, offer the chance of catalysing a change in behaviour.

a community concern

Grid 2.0 will need to focus not just on individuals, but on communities too. Energy will be a local issue, with local government playing a key co-ordinating role in generation and use of power. More energy assets and energy companies will be owned by individuals and communities, with profit-sharing arrangements to allow benefits to be shared.

Infrastructure for heat will be shared between households, as it is in the Budenburg Haus development, with its onsite combined-heat-and-power plant.

distributed energy, distributed information

In Grid 2.0, information will be as valuable a commodity as energy. Distributed energy sources will be linked by peer-to-peer information technology, allowing supply and demand to be balanced automatically. Smart meters will provide constant feedback on how much power is being generated and used, both at the household, community or micro-grid level. Over time, the data picture that emerges can be used to identify potential efficiency gains and plan improvements in energy use.

"Energy will be a local issue, with local government playing a key co-ordinating role in generation and use of power."

turning exceptions into rules

There are plenty of examples of new approaches to energy – but they remain at the fringes of our system. Only five per cent of UK electricity is supplied by decentralised technologies.11 What would it take to move from the margins to the mainstream? Is Grid 2.0 just a pipe dream, or is it really possible to reach this new vision for energy?

Absolutely, according to a plethora of influential reports. A recent study for the DTI estimated that by 2050, microgeneration could provide 30-40 per cent of the UK's total electricity needs – and their definition of 'microgeneration' rules out larger community-based schemes.[12] Even so, some commentators have dismissed this report as too conservative.[13] A report by Tyndall Centre researchers shows that it would be possible for households to be self-sufficient in energy under a system of microgrids, at a cost comparable to centralised generation.[14] Constructing a model of decentralised power for the UK, the World Alliance for Decentralised Energy argue that "An energy future that combines decentralised energy generation with a small share of central renewables is more cost effective in reducing CO_2 emissions for the electricity sector than a centralised system with nuclear energy, and delivers 17 per cent larger carbon savings."[15] The model points to two key efficiencies of decentralised power: first, that if electrcicity is generated locally, it is much easier to use the heat too; and secondly, that less investment is needed in the transmission and distribution networks if more power is used close to where it is generated.

This last point was also stressed in a recent study by Mott McDonald for the DTI. Mott McDonald concluded that the costs of integrating microgeneration into the

network are outweighed by the benefits, in terms of reduced transmission and distribution costs, and network investment that would otherwise be required. The study also points to the broader system benefits arising from distributed generation: less need for centralised capacity; more efficient use of energy; and reduced emissions.[16]

Research by Oxford University's Environmental Change Institute demonstrates how significant microgeneration could be, if the right investments are made. Under their low-carbon house scenario, by 2050, houses could be self-sufficient in energy, meeting their own heating and electricity demands and even exporting power back to the grid. The research points out that we have a clear choice about how we invest in energy: "new capacity will certainly be required – the question is, what form should this take?". To achieve the low carbon house scenario, the researchers warn that policy and investment choices will need to alter fundamentally.[17]

"we have a clear choice about how we invest in energy: new capacity will certainly be required – the question is, what form should this take?"

It is possible, but it's a long way from here to there. Reconnecting people to their power will require some fundamental changes in the way that heat and power are generated, supplied, regulated, bought and sold. We need to take a long, hard look at how our energy system is currently regulated and managed.

why isn't it happening?

If the case for Grid 2.0 is so compelling, there is an obvious question: Why isn't it happening already? If small-scale distributed energy is cheaper, more efficient, causes less environmental damage and allows people to be more involved in tackling climate change, then why is the energy market not allowing the new system to emerge? To answer this question, we need to delve into the history of how our energy institutions were created, and how the market is governed.

Sid's system

The unforgettable 'Tell Sid…' advertisements of the 1980s heralded the privatisation of British Gas, and the beginning of the liberalised market for gas and electricity. The idea behind privatisation was simple and compelling. The only way to provide efficient, responsive services, was to give people the chance to shop around. According to the laws of supply and demand, companies would be free to offer their products to market at the price they chose – and consumers could select the best deal for them. The invisible hand of the market economy would be put to work, and everyone would be better off. Competition works well enough for consumer goods – from shampoo to shoes – at last, it could be made to work for energy too.

Though reforms of the 1980s and 1990s opened the energy market up to competition, they didn't create a free market. What they actually did was to establish a complex set of institutions and rules, within which a certain amount of competition was allowed. It's worth comparing the energy market with a genuinely 'free' market – say, the market for shoes. Anyone can set themselves up as a shoemaker. From the smallest craft enterprise to the largest shoe factory, all can offer their wares. There is a basic legal framework to protect both buyers and sellers, of

course. Factories must meet health and safety requirements. Trading standards ensure that consumers get a decent product. Taxes must be paid. But anyone can set up in business – and they can produce what they want, sell it where they choose, and charge what they like.

Compare that with the electricity market. At every stage, buyers and sellers must adhere to a complex set of rules established by government. Generators can decide how much to sell their power for, but they do so within a complex trading system, NETA (New Electricity Trading Arrangements). NETA's parameters are set by the regulator, Ofgem, though it is managed at arm's length by the system operator Elexon. NETA aims to provide generators with fair prices for electricity, taking into account the peaks and troughs of demand. But it has been widely criticised for penalising generators who do not produce a predictable level of output – like wind power, combined-heat-and-power or small-scale generation.[18]

Once the power is generated, it is transmitted and distributed through the grid. Transmission and distribution is a 'natural monopoly' (there is only the one grid, so there is no prospect of competing companies running competing grids). Companies running the grid cannot charge what they want, they have to negotiate with Ofgem once every five years to agree a fair price for their service. Any investment or innovation in the network (and any profit for shareholders) must be paid for out of the prices negotiated through the price review process. And then, the electricity entering people's homes and offices is controlled by the electricity supply companies, who must have a licence from Ofgem. There are strict rules governing the offers that companies can make to individuals, in order to protect consumers from unscrupulous operators.

At every step of the way, regulations and complex trading arrangements govern the energy market. Selling electricity is very different from selling shoes. The way that energy is bought and sold is entirely conditioned by regulation. Competition is allowed, but within tightly defined criteria. It is simply wrong to talk of a free market for energy. This is not in itself a bad thing – it is entirely legitimate for government to control and shape energy outcomes, given the vital importance of energy to our economy and society. But it shows that the system we have is only one way of doing things. An analysis by Demos of the regulation of privatised industries shows how the regulatory structure was very much influenced by the concerns of the time.[19] The newly-established regulators, Demos argues, wanted to establish clear rules and a straightforward mandate: "the most important simplification was to prioritise protecting consumers and securing effective competition, and to claim that the latter was the best method of doing the former."[20] This has been reflected all along in the aims of Ofgem and its predecessors, Offer and Ofgas (Ofgem was created in 1999 through a merger of the two). Ofgem itself states: "Protecting consumers is Ofgem's first priority. We do this by promoting effective competition, wherever appropriate, and regulating effectively the monopoly companies which run the gas pipes and the electricity wires."[21]

If Ofgem had been created now, not then, what would its primary aims be? Competition and consumer protection, maybe – but what about reducing carbon emissions; ensuring a diverse portfolio of energy technologies; enabling investment and involving individuals? These are all things that it would be right and proper to ask an energy regulator to do. Yet they weren't asked of Ofgem – that's just not what

it was set up to do. As a result, our energy system is failing in a number of important ways.

carbon control

Sid's system prioritised price and competition – it did not establish environmental protection or carbon constraints as success criteria. As concern about climate change has grown, changes have been made – Ofgem now has an added duty to help industry achieve environmental improvements, as well as a number of social duties. But its fundamental purpose – defined in terms of promoting competition and ensuring consumer protection – remains. Policies like the Renewables Obligation and the Climate Change Levy have the effect of shifting signals within the market in favour of lower-carbon options, but they do not change the fundamental design of the system.

innovation and investment

Few privatised industries have been very good at attracting investment, and energy is no exception. Investment in the electricity sector has slumped to 0.5 per cent of turnover, which the consultants Oxera put down to clumsy regulation. The original motivation for price regulation was to slim down the ex-nationalised industries, and make them more efficient. For the transmission and distribution systems, this means that the monopoly providers have to negotiate the prices they are allowed to charge with Ofgem every five years, so it is very difficult to make a case for long-term investment over, say, 20 years.[22] Continued uncertainty over energy prices and policy has not helped to draw in investment, either.

Neither has Sid's system been much good at promoting innovation. The regulatory structures established when the energy market was privatised have worked strongly in favour of the status quo. This is a common problem with large technical systems. Catherine Mitchell makes this point clearly: "The dominant technologies in the established system set the standards – whether in establishing market rules or defining the standards against which the performance of technologies are assessed… if conditions are set by dominant technologies, the selection environment is almost certainly hostile for new ones."[23]

Neither should it come as any surprise at all that new technologies are more expensive in the current system. Much is made of how 'competitive' different technologies are. Solar photovoltaics and micro-wind turbines, for example, are commonly seen as just not cheap enough to be mainstream. The implication is that the technology itself is intrinsically more expensive than others. But in a complex system like the energy system, cost is determined by a whole range of factors, as Walt Patterson argues forcefully: "stated in fractions of a penny per unit, with no qualification as to the accounting or financial framework, tax treatment, subsidies, risks, system and network effects or accounting or other essentials, including environmental effects, such comparisons are meaningless… policy determines costs, not the other way round."[24] In other words, it depends on the system as much as the technology. When the DTI says that a technology is not competitive, what they mean is 'this technology will not pay its way under the current regulatory system.'

no place for people

One of the most critical failings of Sid's system is that people are thought of as consumers. That's what they do – they consume. They can choose whether to

consume Npower's offering or British Gas' offering, but that's about all that they can do. It's ironic that the privatisation of British Gas heralded a new era of a 'shareholding democracy', yet the system it created offers no way for people to play a part.

In the Ofgem worldview, consumers are at the end of a chain that begins with production (the generation of electricity or the mining or import of gas), then distribution, then at the end of the chain, consumption. It is a national, one-way flow of power from producer to consumer. No wonder so much emphasis is placed upon consumer protection and choice – in a system like this, consumers need protecting. But that's not how it looks with small-scale generation. Put a solar panel on your roof, and you are no longer just a consumer – you are a producer as well. It's not surprising then, that Ofgem doesn't quite know what to do with small-scale generators.

"The rhetoric of a 'liberalised, competitive energy market' is misleading. It masks the fact that regulatory structures and policies are instrumental in deciding which technologies and approaches prosper, and which lose out."

shelving Sid's system

This analysis shows that the energy system we have depends, to a huge extent, on the regulatory structures in place. The rhetoric of a 'liberalised, competitive energy market' is misleading. It masks the fact that regulatory structures and policies are instrumental in deciding which technologies and approaches prosper, and which lose out. An energy market which is designed for large-scale generators and passive consumers will work within those parameters. But trying to shoehorn elements of a decentralised approach into the incumbent system of regulated markets will simply not work. We need to design our regulations and institutions to get the outcomes we want. We get the energy system we choose.

We could choose differently. We could choose to create regulatory structures and markets which reward carbon control, innovation and partnership with people. We could move away from a system which trades in units of energy, toward a system which trades in optimal efficiency. This would not be interfering in the energy market, it would be designing a different energy market which rewards different outcomes, a new vision for energy.

3. large-scale low-carbon technologies in our new vision for energy

no place for nuclear

To reach a sustainable energy system, it is often argued that we must have a diverse energy policy, which includes demand reduction, energy efficiency and all potential low-carbon sources.

Whilst Green Alliance's new vision for energy embraces a wide variety of generating technologies we do not believe that all low carbon sources will fit. Nuclear power comes with a number of inherent drawbacks as a form of generation. As a result, not only do we think a new nuclear plant is unnecessary to achieve the UK's energy goals, but it could actually harm the prospects of achieving our vision of a sustainable energy economy, by making it more difficult to pursue other options.

The argument for new nuclear power is often put as follows: there is a looming energy gap coupled with a pressing need to cut carbon; renewable sources of power, and energy efficiency improvements are not enough to meet the gap; Nuclear power could be expensive and there are unresolved problems concerning waste and decommissioning, but despite these difficulties, we need to exploit all the options open to us and must not rule anything out. For these reasons it is argued that we should go ahead with a new nuclear programme, alongside continued support for renewables, energy efficiency and clean coal.

"there is a growing body of research which shows that support for nuclear power could actually worsen the prospects for other low-carbon energy sources"

This view is problematic for two reasons. First, there is good evidence to show that nuclear power is not needed – such as the recent report from the SDC – and furthermore that it will not come onstream quickly enough to help with either our current energy 'crisis', or our emissions reductions goals. Second, there is a growing body of research which shows that support for nuclear power could actually worsen the prospects for other low-carbon energy sources, because the financial and policy support and infrastructure needed for new nuclear build may undermine other options. Government should take the bold decision to rule out a replacement nuclear programme and concentrate on the technologies that will work best within Grid 2.0.

the potential contribution of new nuclear power

Work by the Sustainable Development Commission (SDC) identified two scenarios for the contribution of nuclear power: a 'replacement' scenario, in which the current nuclear capacity of 10 gigawatts (GW) is replaced by new stations which provide the same amount of power; and an 'expansion' scenario, in which the contribution of nuclear is doubled to 20GW.[25] The main findings of the scenarios are:

- Replacement scenario: It is very unlikely that new plant would be operational before 2015. The maximum build rate would be likely to be

1GW per year from 2015, delivering the full 10GW by 2024. The contribution of nuclear would therefore be reduced in the interim years, as new stations would not be built in time to make up for the old stations coming offline. By 2024, nuclear power could contribute between 18-26 per cent of electricity supply, or around six per cent of total energy consumption. If nuclear plant replaced gas-fired generation, this would result in carbon savings of around 6.7 million tonnes, or a four per cent cut in carbon emissions from 1990 levels. If nuclear displaced other forms of generation (such as wind power or gas/coal with carbon capture), savings would be less.

- **Expansion scenario:** This scenario assumes a similar build rate for new plant, continuing until 20GW of nuclear power is online, in 2034. By 2034, nuclear could contribute between 30 per cent and 55 per cent of UK electricity supply, saving 13.4 million tonnes of carbon compared to gas-fired generation, and resulting in an 8 per cent cut in emissions. However, as the SDC notes, "by 2034 the likelihood of advances in zero carbon technologies is greatly increased", and may well have replaced gas-fired generation, meaning that carbon savings from nuclear would be less.

The Environmental Audit Committee's estimates of how quickly nuclear power could be built are more pessimistic. They say that there will be a need for considerable amounts of additional generation capacity over the next nine years to 2015, because of the closure of nuclear and coal stations, but that "it is difficult to see how even the first of a new series of [nuclear] power stations could become operational before 2019 at the very earliest. Various witnesses and organisations corroborated this timescale."[26]

The SDC scenarios show that nuclear would not make a significant contribution to the energy gap for at least fifteen years – it is not a quick or easy solution. If nuclear power could be built at the assumed rate, it would make a contribution by 2020 at the earliest, but would in no way meet the gap.

Furthermore, because of the time it will take to build the plants, nuclear cannot help with either the need to stabilise emissions by 2015 as identified by the Intergovernmental Panel on Climate Change (IPCC) or the UK's short-term emissions targets. In particular, it would not contribute to carbon reductions for either transport or heating (most of which is powered by gas directly, not by electricity).

If we are to make any progress in stabilising our increasing emissions, any investment in new nuclear power would need to be accompanied by serious efforts in energy efficiency, and other electricity and heat generation technologies, as well as improvements in transport emissions. And for a truly sustainable vision of our energy future we want to see technologies being championed, that provide both heat and power, so that any heat produced as a by-product of electricity generation is captured and used. Nuclear power is unable to do this, with much of the heat produced from the nuclear reaction being wasted.

can we get there without nuclear?

It is clear from the above analysis that nuclear could be a contributor to future energy supply and carbon saving, but not for some years, and it would only be a

contributing technology, not a complete solution. This then begs the question of whether it is a necessary part of the mix. Even if it will not be able to contribute before 2020, do we need nuclear alongside other options, or could we invest elsewhere instead? In other words, can we get there without nuclear?

A series of government and independent studies have shown that it is possible for the UK to meet energy needs and carbon goals without recourse to new nuclear power, at comparable or less economic cost. These studies rely on different models or forecasts of energy needs, and make different assumptions about cost, technology availability and so on, so each needs to be examined in detail. However, the broad findings of each are as follows:

- Modelling for the 2003 Energy White Paper (EWP), by Imperial College and Future Energy Solutions, presented a variety of pathways for electricity generation which would meet UK energy needs and carbon goals.[27] The modelling showed that a non-nuclear route was feasible, with electricity provided by gas, wind and tidal power, biomass, combined heat-and-power (CHP), and other renewables. This was combined with carbon savings in non-electricity sectors, through hydrogen use in transport and greater energy efficiency.

- More recent modelling by the Department for Trade and Industry (DTI), based on the MARKAL model, updates the White Paper modelling.[28] Ten model runs are summarised in the work, six of which assume no new nuclear build. Again, in the non-nuclear scenarios, renewables, carbon capture and storage, CHP and greater efforts on energy efficiency are key.

- Modelling by ILEX Energy Consulting, carried out in May 2006, looks at how government policy could bring about emissions reductions in electricity generation. It concludes that "relatively minor extensions to current policies and targets could enable the UK power sector to cut its CO_2 emissions by approximately 40 per cent from 1990 levels by 2010 and maintain them at this level until 2025 despite the closure of almost all nuclear power plants during this period." Higher savings are possible through more stringent policy measures. No new nuclear build would be needed.[29]

- Modelling by Friends of the Earth, in their report, A Bright Future, also found that it is possible to meet demand and achieve a 48-71 per cent reduction in carbon dioxide emissions in the electricity sector by 2020 without needing to replace decommissioned power stations.

- A recent report by the Tyndall Centre, based on extensive academic research, presents five scenarios for meeting 60 per cent carbon cuts and energy needs.[30] The work puts forward a non-nuclear scenario, which instead proposes increased energy efficiency, a strong innovation policy, low growth in transport emissions and increases in renewables, CHP, carbon capture technology, hydrogen and biofuels.

- Several studies have looked at the potential of renewable energy to contribute to electricity production over the years ahead. For example,

modelling by the government's Interdepartmental Analysts Group, for the 2003 EWP, shows that renewables could contribute around 68 per cent of electricity (based on current usage), assuming reasonable costs.[31] The Tyndall Centre suggests a higher figure of around 87 per cent of current electricity usage, but this model is not so cost-constrained.[32]

- Similarly with energy efficiency, there have been a number of analyses showing that considerable savings are possible. The Performance and Innovation Unit (now Strategy Unit) identified potential savings adding up to 30 per cent of final energy demand, resulting in carbon savings of around 40 million tonnes per year.[33] More recently, these figures were confirmed by the government's own Energy Efficiency Innovation Review, which stated that "We could reduce energy use by around 30 per cent. To deliver this we would need, over the next two decades, to roughly double the rate of energy efficiency improvement seen in the past thirty years."[34]

- Small-scale and microgenerated energy could also contribute significantly to energy needs and carbon goals. Recent work by the Energy Saving Trust, for the DTI, states that microgeneration could contribute 30-40 per cent of the UK's electricity needs, cutting carbon emissions by 15 per cent.[35] Research by Oxford University's Environmental Change Institute predicts that by 2050, houses could be self-sufficient in energy, meeting their own heating and electricity demands and even exporting power back to the grid.[36] A recent study by PB Power, looking at energy needs for London, estimated that the capital's energy needs could be met whilst reducing carbon emissions by 27.6 per cent by 2025, based on decentralised energy sources, with no nuclear power.[37] Reporting on a model of decentralised power for the UK as a whole, the World Alliance for Decentralised Energy state that "an energy future that combines decentralised energy with a small share of central renewables is more cost effective in reducing CO_2 emissions than a centralised system with nuclear energy, and delivers 17 per cent larger carbon savings."[38]

"There is no legal barrier to building nuclear stations at the moment – it is just that there are no investors willing to take the risk."

All these studies show the significant potential of non-nuclear solutions, which would help the UK to meet energy needs while achieving the demanding goal of reducing carbon emissions by 60 per cent by 2050. This is not to say that it will be easy, or will happen automatically. Reducing carbon to the extent necessary will require careful and sustained government policy to encourage the necessary innovation and investment.

potential government support for nuclear power

It is widely accepted that a new generation of nuclear power stations will not be built without government support. There is no legal barrier to building nuclear stations at the moment – it is just that there are no investors willing to take the risk. Without government support, the investment is too great, the timescales too long and the risks too high to make new nuclear build attractive to private investors. If the government wanted to ensure that nuclear power was part of the future energy mix, they would have to provide further financial or other forms of incentive to industry.

The Environmental Audit Committee lists a series of ways in which the government could support new nuclear build: "shortening the planning process, sharing the £250 million cost of an initial planning application, ensuring a guaranteed take-up of energy produced, providing capital grants or debt guarantees, and capping the various liabilities involved (insurance, decommissioning and waste) none of which are known." Similarly, a report by Warwick Business School[39] puts forward a number of ways in which new nuclear power could be supported: a carbon obligation, to support all forms of low-carbon generation (though they point out that this might not give the nuclear industry the security that it needs), a nuclear obligation, under which all electricity suppliers are obliged to buy a proportion of their power from nuclear stations, or tax measures which would recycle revenues to support nuclear build.

the effects of nuclear on other energy options

Proponents of nuclear power argue that nuclear can be developed alongside other low-carbon options as one of a range of measures. However, if the government were to support new nuclear build, many commentators argue that this would undermine other options to such an extent that it could be detrimental to carbon goals overall. This is because of the extent of the political, policy, financial and institutional support required to ensure that nuclear new build happens. Potential conflicts include:

- **Investment conflicts:** The Environmental Audit Committee caution that investment in nuclear may cause less investment elsewhere: "A government decision to support a major programme of nuclear new build must also take account of the impacts on investment in other areas – notably energy efficiency, renewables, carbon capture and storage, and the development of distributed generation systems. The potential of these various technologies over the next 20 to 30 years is immense, and any public subsidies for nuclear must be weighed against the substantial progress towards reducing carbon emissions and ensuring a greater degree of security of supply which these alternatives could achieve with similar subsidies." The Warwick Business School report warns that support for nuclear risks "undermining the financial resources available for renewables and demand reduction, whether at a government level or for private investment".

- **Conflicts with energy efficiency:** The Sustainable Development Commission expressed concern "that a new nuclear programme would give out the wrong signal to consumers and business, implying that a major technological fix is all that's required, weakening the urgent action needed on energy efficiency." Similarly, Warwick Business School argues that "support for a large, remote technology with inherent security problems is the antithesis of technologies which connect with people. Nuclear power therefore undermines the move to increased customer awareness of energy decisions."

- **Conflicts with distributed generation:** The DTI itself acknowledges that distributed sources of energy, such as small-scale renewables and micro-CHP, will be a very important part of the future energy mix. However, they require a different sort of electricity network, and policy framework, to nuclear power. For example, distributed generation requires further

investment in the low-voltage distribution network, whereas new nuclear power will require upgrades to the high-voltage transmission network. An electricity market that is designed to reward output from large, centralised stations will not work for smaller generators. As the SDC notes, "A new nuclear power programme could lock the UK into an inflexible, centralised electricity-generating system for the next 50 years. Investments to develop the electricity networks to cope with more decentralised, small-scale technologies will be suppressed just as their potential is growing." The Warwick report also points to a technology conflict of this sort. It argues that "setting up a framework to enable a new nuclear power programme would reinforce the conventional, centralised energy system and make it more difficult for a sustainable energy system to emerge."

- Policy conflicts: The amount of policy support that government can offer to low-carbon options is limited. For example, there are currently two policies which impose additional costs on electricity suppliers, and are added on to customers' bills: the Energy Efficiency Commitment, and the Renewables Obligation. If the government were to introduce a Nuclear Obligation, this would add a further cost to suppliers and therefore consumers. This would affect the ability to make the other obligations more ambitious. The Warwick report expresses this concern. The SDC also states that "we are concerned that a new nuclear programme could indirectly reduce political support for policies aimed at energy efficiency by competing for public funding".

- Emissions rises: Overall, support for new nuclear power could undermine other energy options, resulting in carbon emissions overall rising rather than falling. This is especially the case because nuclear only helps with electricity needs, not transport or non-electric heating requirements. Early evidence from Finland, where a new reactor is being built, corroborates this view. The government is relying on output from the new station to meet carbon targets, as the International Energy Agency points out. There is a worry, however, that the station will not be built in time – it is already facing delays. In the meantime, other efforts to reduce carbon have been undermined.

conclusion

This section has only briefly examined the potential contribution of nuclear to carbon saving and energy needs. There are also other issues to consider in making a decision about new nuclear power: the costs of nuclear energy; dealing with nuclear waste and decommissioning; and public opinion considerations. These all need to be factored into any decision about future support for nuclear power.

"The government needs to accept that support for new nuclear power would have a profound effect on other efforts to cut carbon and energy use."

It is clear from the evidence presented here, however, that the UK does not need to press ahead with new nuclear build. There are clear alternative paths, which would meet carbon goals and energy needs and would set us on the road to Grid 2.0. The government needs to accept that support for new nuclear power would have a profound effect on other efforts to cut carbon and energy use. New nuclear power is not a part of Green Alliance's new vision for energy.

carbon capture and storage

Whilst arguing that there is not a role for nuclear power in our new vision for energy, we do believe that there is a place, in the short to medium term, for large-scale, fossil fuelled low carbon technologies, such as carbon capture and storage (CCS) as part of a portfolio of distributed generation. But, the development of these technologies must not be seen as an alternative to, or substitute for, the continued development of renewable energy, energy efficiency and demand reduction measures.

We have to be realistic about the fuel mix for the coming decades. It is likely that fossil fuels will still be relatively abundant over this time period, which means that they are likely to be utilised both in the UK and abroad. As a result, both on a domestic and global scale, the attractions of CCS technology are understandable. Better to have the emissions from fossil fuel plants removed and stored than 100 per cent of these emissions released into the atmosphere.

"Carbon capture and storage's role should be to bridge the gap."

Our vision for Grid 2.0 encompasses all sizes of energy generation, with a preference for smaller household or community systems that provide both heat and power and link supply and demand. The technology for CCS and Combined Heat and Power (CHP) can potentially be combined, although it is likely that CCS will only be viable for large plant. CCS's role should be to bridge the gap between supply and demand of renewable distributed energy with conventional fossil fuel plant, to help us on our way to achieving Grid 2.0.

carbon capture and storage in the UK

It is likely that gas and coal will play a role in the electricity generating mix for decades to come. Since 2000, coal has enjoyed an unexpected resurgence in the UK market - largely because of the increase in the price of gas (coal currently accounts for 33 per cent of electricity generation).[41] It is interesting to contrast the projections offered in EP68 (the DTI Energy Projections paper dating from 2000) with both the current energy mix and with DTI's most recent forecasts. EP68 forecast that coal would be phased out to provide only 10 per cent of the market by 2015, and that as a result emissions from the power-generating sector would steadily decline.[42] In reality EP68's projections proved incorrect. The most recent DTI forecasts now predict that coal will still constitute 25 per cent to 30 per cent of the total mix in 2015.[43]

Modelling for WWF, by Ilex Consulting[44] shows that in the two low emissions scenarios gas will still account for 65 per cent of the power market in 2025. Beyond 2025, gas use could be expected to decline through policies to reduce energy demand, the further development of renewables and technological innovation, including potentially CCS. 4GW of coal-fired CCS could supply some six per cent of total electricity demand in 2025. It is estimated that introducing CCS could reduce carbon emissions from plant by 80 to 90 per cent.[45]

The 2003 Energy White Paper (EWP) dedicated a six-month research project to take CCS forward. This recognized that there was only a limited window of opportunity for using depleted North Sea oil fields as a means of sequestering carbon dioxide. Once they were closed, it would not be worthwhile to reopen them to sequester carbon, whereas, while they were still in use, CCS could assist in recovering more oil from each field than would otherwise have been economically profitable.

The White Paper stated the following: 'We will… set up an urgent detailed implementation plan…to establish what needs to be done to get a demonstration project off the ground. This study will reach conclusions within six months to enable firm decisions to be taken on applications for funding from international sources as soon as possible thereafter.'[46] It is now three years after this statement was published and despite a number of relevant documents (including a review of the feasibility of carbon capture and storage,[47] a paper on implementing a demonstration project, and a carbon abatement strategy[49]) little progress has been made.

There is substantial evidence to show that progress in deploying key innovative technologies - in particular carbon capture and storage, off-shore wind, and micro-generation - is inadequate. The current policy and regulatory framework is insufficient to stimulate the growth of lower-carbon generation on the scale required. The current liberalised UK electricity market structure has a tendency to be too short term and therefore fails to provide the framework needed.

Despite this, there are a number of companies considering investing in CCS demonstration projects in the UK, which suggests that industry evidently believes the technology is significantly advanced to proceed with full-scale demonstrations, and that there is profit to be made.

"The current policy and regulatory framework is insufficient to stimulate the growth of lower-carbon generation on the scale required."

Support is needed from government to help get these pathfinder projects off the ground so that the various technologies can be adequately assessed and it can be confirmed whether or not it is environmentally, technologically and economically acceptable. This should not replace, or delay, government support for existing renewable energy and energy efficiency programmes, but should be part of a package, with a clear priority for energy efficiency and renewables.

The policy options needed to bring forward our new vision for energy and low-carbon technologies such as CCS are examined in more detail in Chapter four.

barriers to CCS development

There are several barriers to commercial deployment of CCS in the UK. These include:

- The lack of a long-term carbon price and clarity over potential support mechanisms for the technology;
- The current position that CCS holds under the EU ETS, Kyoto Protocol and under the OSPAR and London Conventions and the unknown timescale it will take to clarify these;
- The lack of clarity over future liability and regulation.

Once these barriers have been addressed, and if companies can prove that CCS is both technologically and environmentally sound, a role for CCS can be part of the pathway to our new vision for energy.

4. how do we get there?

As the previous chapters have shown, a new approach to energy is possible. The technologies are there, and they are affordable - particularly when compared to the huge investments needed under the current system over the years ahead. And it is necessary. Energy use and carbon emissions are on the rise: climate change and energy insecurity are with us already.

But the system we need is very different to the one we have now. Getting to Grid 2.0 will require considerable changes in the way that we approach the generation, transmission and distribution of heat and power.

This chapter looks at the practical realities of how we can get from our current energy system to our new vision for energy, and the policies and decisions the government needs to develop.

First, we need to be upfront about the role for government. Energy is a public good, and it is entirely legitimate for government to shape energy outcomes and to decide to support, or not support, particular energy outcomes. Markets are only a means to an end. Second, gas and electricity markets and networks need to be restructured to incentivise distributed generation and energy saving. Third, energy must be seen as a community issue, with greater community ownership and an increased role for local and regional players. Last, there is a need for a clear and straightforward way of encouraging individuals to play their part. If doing the right thing is difficult and expensive it will not happen.

the energy market

an honest role for government

Energy is a public good. This should be openly acknowledged by government with recognition of how government, the energy regulator Ofgem and the policy environment shapes the market and creates incentives. Policy interventions should not be seen as 'interfering' in the workings of the market. Markets play a role, but within the framework set by government. This is not to advocate a return to central, nationalised control. On the contrary, the government will need to ensure that the energy market of the future is accessible to a much wider variety of players – individuals selling home-generated power; community-owned renewables companies; energy service providers and large commercial operators. It will also need to encourage a wider array of technologies and approaches to generating and saving heat and power. Government should also not be afraid to withdraw support from technologies that may have a negative effect on the broader transition to a new energy future.

the role of the carbon market

The last twelve months have seen the emergence of a European carbon market, through the development of the EU Emissions Trading Scheme (EU ETS), and the continued development of the international market for carbon through the clean development mechanism (CDM). In the UK, the EU ETS covers virtually half of total emissions, and it is likely that it will expand to cover more of the country's emissions in the coming years.

This means that investment in low carbon technologies will be driven to a large extent by the carbon price underpinning the EU ETS and, in particular, by estimates

of future carbon prices. This is particularly true for the development of large-scale power generation where the EU ETS will be a major factor in determining the technologies to be built in the UK over the next couple of decades.

A high carbon price would push developers to look for lower carbon options – carbon capture and storage for example – a low carbon price may do nothing more than facilitate the building of more gas fired power stations. At worst, very low carbon prices may result in more coal-fired power stations being built.

As important as the level of the carbon price is its longevity. Power stations have lifetimes of 20 years plus - companies making investment decisions now want to know whether will be a carbon price in ten, fifteen or twenty years time.

However, as currently designed, the EU ETS does not give a price signal beyond 2008, the end of the first phase of the scheme. It will be a number of years before the design (and hence the carbon price) of the second phase (2008-2012) is finalised. It is even less certain what the market will look like beyond 2012, indeed there is no certainty that there will even be a market beyond 2012.

This uncertainty means that the EU ETS is unlikely to drive the power generation sector to invest in much more than gas fired power stations in the next few years. It certainly won't be enough to support the large-scale deployment of technologies such as carbon capture and storage, renewables or energy efficiency.

This means that the government will not be able to rely on the EU ETS to deliver the dramatic reductions in emissions needed in the short-to-medium term. It needs therefore to pursue a twin track approach. First, to continue to push for the continued and rapid development of the EU ETS into a mechanism that will deliver a long-term carbon price. At the same time, it needs to look at what it can do outside the framework of the EU ETS to bring forward the technologies needed to reduce emissions in the power sector. This includes stronger policy interventions in the energy efficiency, renewable electricity and heat markets. We believe there is also a case for specific support to bring forward a number of 'pathfinder' carbon capture and storage projects. Our recommendations in these areas are outlined further below.

In addition, and as part of the future development of the EU ETS, the government should look to use the income generated through the auctioning of emissions trading permits to fund the development of low carbon technologies. According to Defra, auctioning 10 per cent of the permits for Phase 2 could generate up to £3.5 billion, depending on the carbon price..[51]

phase 2 of the EU ETS

Given the importance of the EU ETS in delivering a switch to low carbon forms of energy generation, it is essential that Phase 2 of the scheme builds on the first phase, delivers further, absolute emission reductions, and signals the government's intention to continue to strengthen the scheme in subsequent phases.

On 29 June 2006 the government announced that it would aim for reductions of 8 million tonnes of carbon per year less than updated business-as-usual projections. This equates to a cap of 65 MtC per annum. This cap level means that the UK is not

on track to reach its long standing target of a 20 per cent reduction in CO_2 by 2010.

Assuming that the additional savings from sectors not covered by the scheme - as outlined in the revised Climate Change Programme - are achieved, then the cap for Phase 2 would have needed to be set at around 60 MtC (220 $MtCO_2$) per annum, to be on track to reach the 2010 target. Additional effort will now be needed by sectors outside the EU ETS to ensure we reach this target.

Currently emission allowances are given away for free. It is estimated that this has led to windfall profits of around £800 million per year for utilities. Auctioning permits, as allowed in the EU Directive that established the trading scheme, would begin to redress this balance. In addition, it would also create a stream of income that could be used to stimulate investment in new low carbon technologies – renewables, energy efficiency and Carbon Capture and Storage - and provide compensation, if necessary, to the few industrial sectors which may genuinely be exposed to international competition as a result of the ETS.

The government has made a start with auctioning, proposing to auction 7 per cent of the permits in Phase 2 of the scheme. Looking forward, it should aim for the highest level of auctioning in Phase 3 and push for full auctioning across the EU as soon as possible. This would remove many of the anomalies in the current scheme and in particular remove the need for allocations based on projections of future emissions. Using projections as the basis for allocations is fraught with uncertainty and opens the government up to accusations of allocation by lobbying.

the role of the regulator

For the government's energy goals to be fully realised, and for our vision of a new energy future to be realised, the objectives of the 2003 Energy White Paper (EWP) need to be operationalised throughout delivery and especially through the Duties of the Regulator. Currently, Ofgem's remit puts protecting consumers as its uttermost priority, and it has limited powers to respond to the far greater emphasis on renewables and energy efficiency that the EWP pursued.

Despite the statement in the 2003 EWP that 'significant damaging climate change is an environmental limit that should not be breached',[52] it is clear that Ofgem needs further guidance on the relative weight that should be placed on the government's social and environmental objectives, particularly where there is implicit or explicit conflict between them. It also requires indications of the relative weight that should be attached to different initiatives to reduce carbon emissions.[53]

Protecting consumers, particularly those on low incomes is an important part of energy policy, but should not be seen as conflicting with efforts to reduce carbon emissions. This need not be the case, as Woking's example shows. Through decentralised renewable energy and energy efficiency measures, Woking Borough Council has managed to slash emissions by 77 per cent and cut energy prices for low-income households.

Following the Energy Review, there should be a review of Ofgem's mandate and objectives. Rather than being focussed around narrow consumer protection issues, objectives should be broadened to match wider energy policy objectives: reducing

carbon; ensuring energy security; enabling investment. This is particularly important for Ofgem's role in regulating the monopoly transmission and distribution networks, as discussed below. This does not mean that Ofgem should no longer protect the consumer: it is just that any assessment of consumer interest should factor in environmental and social, as well as economic, interests.

The delivery of a sustainable energy system requires action across all departments – to include the DTI, Defra, DCLG and HM Treasury. The 2003 EWP established the Sustainable Energy Policy Network as an attempt to join up policy across departments. It has clearly failed to do this. Government needs to look again at its institutional structures to ensure that there is a single body responsible for the delivery of energy policy objectives, and that it ensures these objectives are delivered.

The government has the ability to add CO_2 to the list of prescribed substances that the Environment Agency administers, which it has so far neglected to take up. This simple move would enable the Agency to take more of a role in helping to reduce emissions.

energy demand and supply

Energy regulation should not assume a linear path between centralised supply of power by companies and passive consumption by individuals. It is misleading to talk of a 'generation gap', with 'demand' outstripping 'supply'. How much energy we need is governed in part by how much energy we have, and how we choose to use it. The more we can link supply of energy to demand for energy, the more likely we are to use it well.

Government should carry out a strategic review of energy investment, in both supply and demand, and should encourage investments in new generation plant to be considered alongside investment in energy saving: the 'negawatt' principle. A new gas-fired or coal-fired power station should be considered alongside a 'negawatt' power station: the equivalent amount of energy saved rather than generated.[54] Most energy saving options are more cost effective than investing in new capacity or technologies. As the European Commission's 2003 draft directive on 'Energy End-Use Efficiency and Energy Services' shows, the average cost of saving a unit of electricity in the domestic sector in member states is around 2.6 Euro cents per kWh, compared to the average off-peak price for delivered electricity of 3.9 Euro cents per kWh (or peak price of 10.2 Euro cents per kWh).[55]

"We need to think of energy as a system, we should not separate out supply and demand."

Walt Patterson, Senior Research Fellow in the Energy and Environmental Programme of the Royal Institute of International Affairs

There is a real need to create a market framework that delivers energy services and can evaluate the 'negawatt' principle. Currently the more energy companies sell, the more money they make, so there is no real incentive to reduce energy consumption. The comments of Alistair Darling MP, Secretary of State, DTI, in a speech to the Fabian Society on 5 June 2006, on the need to transform the market and give companies an incentive to reduce demand were very welcome. Alistair Darling and David Miliband MP, Secretary of State, Defra, should have joint responsibility for delivering this vision.

This is a concept that can be applied to both the domestic and non-domestic

"Big power companies have traditionally had to work on the model that the more energy we sell, the more money we make. This needs to change. Alistair Darling's speech talked about an absolute reduction in energy demand, an ambition which the more enlightened energy companies clearly share. It's the right ambition and to achieve it policymakers could reference the effectiveness of models such as the RO. We need to see a similar model for energy efficiency or 'non-sale' of energy, and then energy companies can work out how to deliver it."

Bryony Worthington, Sustainable Development Manager, Scottish & Southern Energy

sectors. In the domestic sector the government should look to transform the current energy efficiency measure, the Energy Efficiency Commitment (EEC), into a measure that focuses on reducing the overall demand of a dwelling. See section below on reforming EEC for more details.

In the non-domestic sector the main measure aimed at improving energy efficiency is the Climate Change Levy (CCL). This is a levy on each unit of energy used by non-domestic consumers. Large energy users are able to get a rebate on the levy by committing to improve their energy efficiency by a certain amount (Climate Change Agreements). A recent Carbon Trust report[56] highlighted that whilst this package has been successful it was unlikely that it would continue to be a suitable mechanism in the future. In particular it highlighted that energy use in the business and public sectors is continuing to rise and that projections suggest that emissions from this sector could be 20 per cent higher by 2020. Much of this increase is related to the use of energy in buildings. This indicates that there is a need to introduce a mechanism aimed at reversing the predicted increase in energy use and emissions. The Carbon Trust report outlines how a cap-and-trade scheme based on absolute demand reduction could be introduced into the business and service sector and make significant carbon savings.

technology choice

Government should not use simple cost comparisons which claim to measure the 'competitiveness' of different energy technologies. It is meaningless to talk about how much a certain technology costs in terms of pence per kilowatt-hour, without exposing the assumptions behind such costings. Instead, the overall cost profile of different energy pathways should be considered. The value of diversity and resilience offered by small-scale systems should be explicitly factored into costings.

To support a diverse range of renewable, distributed and combined heat and power technologies the following policy suggestions are recommended:

renewables: The Renewables Obligation (RO) is a mechanism that favours the most developed and least cost technologies, currently onshore wind, landfill gas and biomass co-firing. Government should look again at the operation of the RO to explore what can be done to broaden the range of technologies that currently get support, in particular offshore wind, biomass and tidal power. Any such review must ensure that confidence in the mechanism is not weakened and that historic investments are protected.

Instruments such as feed-in tariffs and capital grants for emerging technologies should be considered to buttress the RO. The windfall revenues the National Audit Office (NAO) estimates this could as much as £1 billion by 2010) earned from Renewable Obligation Certificates (ROCs) for Non Fossil Fuel Obligation (NFFO) schemes should be earmarked for supporting developing renewable technologies. Another option is capping possible profits to a certain level or keeping the RO to a

minimum length and/or a minimum price to avoid extreme profits.

Government should also consider what can be done outside the Renewables Obligation to encourage new entrants and innovation into the market. Revenues from the auctioning of permits under the EU ETS could play a role here, these could be recycled to support new renewable technologies.

It is vital that any support for these emerging technologies is signposted early to underwrite confidence in these new sectors.

heat: In 2004, electricity generation accounted for only 30 per cent of total gas use in the UK. Gas supplies around 90 per cent of household heating requirements and 55 per cent of industrial and commercial heat. This means that it is the heat element of our economy that is the most exposed to high and volatile gas prices, and to the impacts of supply constraints. Adopting renewable heating options (including CHP), many of which are decentralised, would not only offer emissions reductions, but security for the wider energy market.

Mechanisms should be introduced that provide these technologies with support at a level that reflects the carbon, energy security and wider economic benefits that they deliver. Government should recognise that heat is a missing element of UK Energy Policy and publish a strategy, as the Scottish Executive did, on the efficient use of heat and renewable heat. A combination of different measures will be needed in the different markets - centralised, decentralised and domestic scale including obligation-type mechanisms and regulations - product standards and building regulations for example. Milestones need to be set for implementing a Renewable Heat Obligation. This should be supported with a joint CHP industry/government taskforce (similar to the Renewables Advisory Board) to identify and remove barriers to the uptake of CHP (for more on heat please see the section entitled 'community involvement' below).

CCS: Support should be given to 'pathfinder' projects from the recycling of the revenues from auctioning in the EU ETS. It is too early, and the costs of the technology are too uncertain, to be able to state now what the best mechanism for long-term support is. With some pump primed investment it should be possible to get a few projects up and running and then look at how best to support the development of the technology in the long-term. The aim should be to develop the EU ETS so that in the long-term it becomes the measure under which the development of CCS is brought forward.

"CCS is a massive opportunity although currently the EU ETS doesn't guarantee a carbon price sufficient to make it viable without further incentive. The government has to promote a level playing field that will help fledgling technologies get off the ground."

Peter Mather, Country Head, UK & VP Europe Region, BP

Capture readiness should be made a requirement for statutory licensing of all new fossil fuel plant. This would compel the developer to demonstrate that consideration has been given in the planning and design of the plant to facilitating subsequent addition of suitable carbon dioxide capture technology as it becomes available and economic.

A strict regulatory framework is needed to cover all the risks and uncertainties related to CCS which should have a full public consultation. A full Environmental Impact Assessment must be carried out and each site should prove its net environmental gain to avoid an increase in conventional pollution as a result of the introduction of CCS.

Only geological storage in certain rock formations such as oil and gas fields and saline aquifers is currently acceptable. Whilst the science and geology of disused oil and gas fields is relatively well known, more research is needed to improve the gaps in the knowledge base. Independently verified pilot projects should test the effects on biodiversity, geological suitability and the security and permanence of carbon stored in geological strata.

CO_2 should be stored safely and permanently in locations that do not allow any leakage rate higher than that from conventional natural gas fields.

An independent monitoring body should be established and given responsibility for storage monitoring and verification. The monitoring body should publish an annual audit of the state of the UK's storage sites. There must also be international agreed procedures for independent monitoring and verification before CCS technologies should be allowed to count against carbon reduction targets.

Storage of CO_2 will clearly have risks liabilities covering many thousands of years; the government must establish a strict legal framework to regulate this. A possible solution would be for the liability to remain with the company for a specified period of time and then pass over to the government. Meanwhile it would be appropriate for the industry to set up segregated and secured funds to help cover long-term liabilities.

networks

There should be a long-term aim to transform the National Grid from a one-way provider of power to consumers, to a multi-way web linking distributed sources of energy supply and demand. This way, the National Grid would become an enabler rather than an automatic provider of power, allowing distributed generators to trade with each other through the grid, whilst also allowing connection to large-scale power generation as a backup measure. Greater distributed power will help avoid expensive upgrades to the grid that are needed when rising demand is met by centralised generation.

To achieve this:

For electricity, investments in the low-voltage distribution network, to allow for greater distributed generation, should be prioritised alongside investments in the high-voltage transmission network. DTI should ask Ofgem to make this an overarching consideration in the next price reviews for both transmission and distribution

companies. We will need continued investment in the high-voltage transmission network to support the development of large-scale renewable projects such as offshore wind.

At present, the operators of the electricity distribution system (Distribution Network Operators, or DNOs) are rewarded mainly for throughput – for the amount of electricity that travels through their system. DNOs should be better rewarded for connecting more distributed generation, whether from individual generators or private-wire networks. Ofgem has already made some tentative steps in this direction, by incentivising DNOs to connect small-scale suppliers, through the creation of 'registered power zones'. This principle should be carried forward and expanded in future price reviews. As more and more decentralised generation is connected up, DNOs can expect to gain more revenue from connection of generators, rather than throughput of electricity. DNOs could also be required to reduce losses from the distribution network, which would further incentivise them to connect small-scale generators.

"We need an upgrade of the whole energy infrastructure of society. Climate is an energy issue. Energy is an infrastructure issue. Therefore climate is an infrastructure issue."

Walt Patterson, Senior Research Fellow in the Energy and Environmental Programme of the Royal Institute of International Affairs

As part of this arrangement, DNOs should not charge excessive amounts to connect small-scale generators to the grid. The benefits provided by distributed generation, in terms of reduced reliance on centralised generation and transmission, should be passed through to the small generators themselves. DTI and Ofgem should also modify the Balancing and Settlement Code, to allow exported electricity to be traded at a fair price – this is discussed below.

Alongside investment in network infrastructure, priority should be given to developing IT infrastructure which allows constant monitoring, control and stabilisation to balance supply and demand.

More should be done to ensure that valuable, time-sensitive uses of energy are prioritised over less time-critical uses. This would help to even out peaks and troughs of demand. This could be achieved through time-of-day pricing for domestic tariffs, linked to smart meters (described below).

Government should promote 'dynamic demand' technologies. These IT-enabled technologies allow non-time-critical appliances, such as fridges and water heaters, to be switched off automatically at times of peak use.

community involvement

Energy and climate change should be seen as an issue to be tackled at community level, through established groupings within the community: Local Authorities, schools, voluntary groups. Heat and power generation actually reaches maximum efficiency at a community level – a housing estate or village – rather than at the level of the individual household or national grid.

Community ownership of energy assets should be incentivised more. There should be a requirement for a proportion of community ownership in all new centralised large- or medium-scale generation investments.

Government should look to use its purchasing power to drive the energy efficiency market. Upgrading the government estate would act as a pump-primer for the market and help bring down the costs of the technologies. The announcement on 12 June 2006 regarding making the government office estate carbon neutral by 2012 is welcome in this regard. However, huge gains can be made through public procurement in schools, hospitals and prisons, for example, which should be beacons of sustainable energy, showcasing energy saving and energy generation. Particular attention should be paid to the new school building programme, Building Schools for the Future.

Local Authorities should be given a duty, and funding, to promote energy saving and energy generation. All authorities should be required to produce an energy strategy. Following the example of Woking, more Local Authorities could establish arms-length energy services companies, to convene groups of small-scale generators through a private-wire network.

Local Authorities should be required to mandate a percentage of on-site generation for developments of a certain size, as a condition attached to planning. This would follow the trailblazing example of Merton Borough Council and would build on the strong signal sent to local authorities by the Minister for Housing and Planning, Yvette Cooper for failing Local Authorities to implement these guidelines. This should be placed at the heart of the new Planning Policy Statement on Climate Change.

The current network of Energy Efficiency Advice Centres, soon to become Sustainable Energy Centres, should be expanded and charged explicitly with an outreach role. Climate outreach workers, akin to health visitors, should offer advice and support to individuals and communities. This could be linked to, and funded by, the Energy Efficiency Commitment, as discussed below.

Building-integrated generation should be prominent in the voluntary Code for Sustainable Homes, and it should be signalled that this will become mandatory, through Building Regulations, over time. All buildings should be required to enable retrofitting of microgeneration equipment.

Local generation of heat is a particularly important community issue. Housing Associations should be required, through planning, to incorporate combined-heat-and-power in developments over a certain size. To help the four million homes off the main gas grid, there should be incentives to promote renewable heat sources, such as solar water heating, ground and air-source heat pumps and biomass boilers. This incentive could take the form of an obligation on energy suppliers and suppliers of other conventional heating to supply a proportion of renewable heat.

incentivising individuals towards low carbon living

As government itself acknowledges, there is a need to enable individuals to play their part, through making sure that information and incentives align. It should be as easy to save energy and contribute to energy generation as it currently is to find a centralised energy supplier. As long as it remains difficult or costly to take action on energy, such behaviour will never be mainstreamed.

Securing major reductions in carbon emissions from UK households is a considerable but critical challenge if we are to tackle climate change effectively.

Energy use in our homes is currently responsible for 27 per cent of the UK's carbon emissions, and the trend is for this to rise, not fall.

Current policies and programmes are not delivering the carbon emission reductions that are needed in the domestic sector. There is a clear need for government action to bring about a radical reduction in the carbon footprint of our housing stock and communities. The far-reaching changes that are needed are both technical - building low carbon homes and communities - and social – changing people's lifestyles so they demand less energy. Both of these challenges are also intrinsically political as government policy and support is needed if we are going to succeed in marshalling the necessary changes across society.

The way our homes and communities are designed and built affects our ability to lead low carbon lifestyles. Improving the performance of housing stock and bringing energy generation closer to people can help forge the vital link between climate change and energy use in the home. The greater inclusion of microgeneration and community energy in housing is central to getting to our new vision for energy. New build, particularly the new homes built under the Sustainable Communities Plan, can deliver market transformation by generating economies of scale which will make the technologies more affordable.

In addition to improving the energy infrastructure of housing, the government must also address the energy demand of individuals. Small-scale energy in homes and communities, will help engage people in energy use but other measures will also be needed. Fiscal incentives, linked to information and advice, also have an important role to play in incentivising more sustainable behaviour by householders.

market transformation

The government's £38 billion Sustainable Communities Plan is the UK's largest house building programme for decades and represents the single largest development opportunity in Europe. It could also represent the single largest opportunity to make a strategic breakthrough for low carbon living. On the recommendation of the Barker review of housing supply, the government has now committed to increasing the number of new homes built each year to 200,000, largely focused on four growth areas across the South East: the Thames Gateway, Milton Keynes and the South Midlands, London-Stansted-Cambridge-Peterborough, and Ashford.

The scale of development creates a huge opportunity to generate economies of scale and bring down the cost of microgeneration and community energy once and for all. The price of microgeneration technologies, such as solar photovoltaics and micro wind turbines, is currently high largely because suppliers cannot take advantage of scale economies while the market remains niche.

The government can play a strategic role in making microgeneration technologies affordable for all by increasing the volume of the market. It has been calculated that zero-emission housing could be delivered at a cost comparable to market rates if planners were to specify over a threshold of 2,500-5000 dwellings.[58] The upper end of this range is only 2.5 per cent of the number of houses being procured in the Thames Gateway. It will be ambition that enables the Department for Communities and Local Government (DCLG) to reduce costs and make low carbon homes affordable, not caution.

Beddington Zero Energy Development (BedZED), a development by the housing association Peabody Trust, is often held up as the iconic example of carbon neutral liveability, and the direction of things to come. The heating requirements of BedZED homes are around 10 per cent that of a typical home built to 2000 Building Regulations, and all heating and hot water requirements are designed to be met by a wood fuel community heating network.[59] Regrettably, six years after it was awarded a RIBA Housing Design Award in 2000, BedZED still stands as an isolated example of carbon neutral development. This is in spite of a call from the Mayor of London for all London boroughs to have zero energy developments by 2010.[60] Expecting such standards to enter the mainstream market without policy intervention is, perhaps, wishful thinking.

"In many cases, the instruments that work are regulatory. For example, Building Regulations are the most cost effective approach to energy efficiency in new buildings. But we need a long term framework. If developers knew that within 10 years they would have to build carbon neutral buildings, they would innovate and gear up to do it, and at much lower cost than with only a few months notice."

Nick Eyre, Director of Strategy, Energy Savings Trust

A big leap forward can be made, by using the Thames Gateway growth area as a flagship to deliver ultra-low carbon developments at affordable cost. With a significant proportion of the new homes scheduled for public land, DCLG has a real opportunity to make the Gateway a world-class carbon neutral development, setting consistently high standards to help developers employ economies of scale in low carbon supply chains. By transforming supply chains for low carbon technologies, this will change the economics of sustainability for the other growth areas and for existing homes too. An ambitious set of standards for the Sustainable Communities Plan, and a carbon neutral Thames Gateway, provides the opportunity to make microgeneration affordable.

To achieve this, DCLG should ensure that growth in the Thames Gateway is carbon neutral, making it a world-class sustainable community. A carbon neutral Thames Gateway would mean there would be no net increase in carbon as a result of development. Developments would be as close to zero carbon as possible, using microgeneration and community energy. Unavoidable carbon increases from growth would be offset via efficiency improvements in existing homes, and linking them to new sustainable energy and transport infrastructure.[61]

fiscal incentives

Earlier this year, Green Alliance commissioned a report by the Policy Studies Institute, *A Green Living Initiative*, which puts forward a package of measures combining information and advice with fiscal incentives which, if implemented, could bring about a step-change in the environmental performance of our households. The Initiative aims to interest, motivate and empower individuals, and is focussed on engagement, not solely on efficiency. It builds on the government's own analysis, outlined in the Sustainable Development Strategy, of linking regulation to fiscal incentives and information provision, in order to catalyse behaviour change.

The report recommends measures to tackle three important areas: energy use, water use and waste generation. For energy, the measures included are inefficiency charges on products that use comparatively large amounts of energy and Council Tax reductions for households that install insulation measures. The report also recommends a reduction in planning gain supplement for new homes that meet the Code for Sustainable Homes (level 3).

A number of information initiatives are under way or proposed – including the government-sponsored environmental information service, Environment Direct, and the Home Condition Reports being introduced in 2007, produced when a property is sold or undergoes a change of tenancy. If these communications initiatives are connected to fiscal measures, this could both enthuse and incentivise households to think through their impacts and take action.

reforming EEC

Whilst the government's Energy Efficiency Commitment (EEC) has been successful in transforming the uptake of energy efficiency measures, there has been too much emphasis on the installation of specific measures compared to the potential for overall demand reduction from the house.

The EEC needs to be transformed into a measure that targets absolute demand reduction from the whole house, not just the installation of particular measures. This would allow suppliers to consider a range of options to meet these targets – energy efficiency measures, microgeneration technologies and smart metering for example.

The next phase of EEC, to begin in 2008, should be used as an opportunity to explore the range of measures needed to make this a reality.

Taxes levied on individuals and households should be altered to provide incentives for energy saving and energy generation. Householders who implement energy saving measures should be eligible for lower taxes, such as Council Tax and Stamp Duty. Twenty-one councils are now engaged in the British Gas Council Tax incentive scheme, an indication of the role that targeted incentives can play in driving energy efficient behaviours.

The breadth of the measures required to address domestic energy use illustrates the importance of cross-departmental action. Defra, DTI, HM Treasury and DCLG, each have a strong role to play in implementing the changes which are needed, such as some of those recommended here, reforming EEC, supporting market transformation for distributed energy generation and introducing fiscal incentives to reduce energy demand.

The previous chapters have outlined our vision for a new energy system, one which is low carbon, based on increasing decentralised energy and bringing the consumer closer to the sources of energy, with in many cases the consumer becoming the producer.

None of this will be easy. Building an energy system that delivers both low carbon emissions and secure supplies will mean making tough decisions and policy changes across the board, as chapter four shows. But it is possible, as this, and other reports have shown, many of the technologies to deliver this vision are available now and more will become available within the next few years.

We are currently at a crossroads; over the next ten years a huge amount of investment in the energy system will be required. We could invest in more centralised technologies and the infrastructure to support them or we could use this opportunity to invest in a new vision for energy.

5. summary of recommendations

Our new vision for energy encompasses a more active role for individuals and communities – an energy system which is embedded in our lives and homes, where everyone is involved in saving or generating power. Recommendations to achieve this include:

- Government should say clearly that energy is a public good and openly acknowledge its role, and the role of Ofgem, in shaping the market.

- Ofgem's mandate and objectives need to be reviewed and broadened to match wider energy policy objectives: reducing carbon; ensuring energy security; enabling investment. A single body should be responsible for their delivery.

- The government must push for the rapid development of the EU ETS to deliver a long-term carbon price. Following the announcement on the UK's cap level for Phase 2, extra effort is needed by sectors outside the EU ETS to ensure we reach the domestic target of a 20 per cent reduction in CO2 by 2010.

- Tougher targets should be set for Phase 3 and the government should push for the highest level of auctioning in this phase, and full auctioning as soon as possible. Income could fund low carbon technology development.

- Government should strategically review energy investment, in both supply and demand. Investment in new generation should be considered against energy saving. A market framework should be created to deliver energy services.

- The overall cost profile of different energy pathways and technologies should be considered. The value of diversity and resilience offered by small-scale systems should be explicitly factored into costings.

- The Energy Efficiency Commitment (EEC) should be transformed into targeting absolute demand reduction. Suppliers could use a range of options to meet these targets: energy efficiency, microgeneration, smart metering.

- A cap-and-trade scheme based on absolute demand reduction should be introduced into the business and service sector.

- The Renewables Obligation (RO) should be revisited to broaden the range of technologies supported. Instruments such as feed-in tariffs and capital grants for emerging technologies should be considered, as should earmarking the windfall revenues earned from Renewable Obligation Certificates (ROCs) for Non Fossil Fuel Obligation (NFFO) schemes. EU ETS auction revenues could also be used.

- Government should publish a strategy on the efficient use of heat and renewable heat, with milestones for implementing a Renewable Heat Obligation. This should be supported with a joint CHP industry/ government taskforce to identify and remove barriers to the uptake of CHP. Product

standards and building regulations should also be used to promote heat savings.

- Support should be given to 'pathfinder' CCS projects from the recycling of the revenues from EU ETS auctioning. Capture readiness should be a requirement for statutory licensing of new fossil fuel plant. An independent monitoring body should be given responsibility for storage monitoring and verification.

- There are clear alternative paths to new nuclear new build, the government needs to accept that support for new nuclear power would have a profoundly negative effect on other efforts to cut carbon and energy use.

- The National Grid should be transformed from a one-way provider of power to a multi-way web linking distributed sources of energy supply and demand. For electricity, investments in the low-voltage distribution network, to allow for greater distributed generation, should take priority. Distribution Network Operators should be better rewarded for connecting more distributed generation and be required to reduce losses from the network. DTI and Ofgem should modify the Balancing and Settlement Code to allow exported electricity to be traded at a fair price.

- IT infrastructure should be developed which allows constant monitoring, control and stabilisation of energy, such as time-of-day pricing for domestic tariffs, smart meters and the promotion of 'dynamic demand' technologies.

- Energy and climate change should be seen as issues to be tackled at community level. There should be a requirement for a proportion of community ownership in all new centralised large- or medium-scale generation investments.

- Local Authorities should be required to: produce an energy strategy, promote local energy saving and generation and mandate a percentage of on-site generation for certain developments through the new Planning Policy Statement on Climate Change. Local Authorities could establish energy services companies to convene groups of small-scale generators through a private-wire network.

- Housing Associations should be required to incorporate CHP in developments over a certain size. There should be incentives for renewable heat sources, such as solar water heating, ground and air-source heat pumps and biomass boilers.

- Microgeneration and community energy should be prominent in the voluntary Code for Sustainable Homes. Growth areas should be used to deliver low carbon developments at affordable cost. Development in the Thames Gateway should be carbon neutral.

- The current network of Energy Efficiency Advice Centres should be expanded and charged with offering advice and support to individuals and communities (possibly funded by the Energy Efficiency Commitment). Communication initiatives on household energy use should be connected to fiscal measures such as Council Tax reductions for households that install insulation measures.

notes and references

1 DTI, *Energy White Paper: Our Energy Future - Creating a Low Carbon Economy*, 2003
2 DTI, *New and Renewable Energy: Prospects in the UK for the 21st Century*, 1998; Royal Commission on Environmental Pollution , 22nd Report. *Energy: The Changing Climate*, 2000; Performance and Innovation Unit, *The Energy Review*, February 2002
3 DTI, *Energy White Paper: Our Energy Future - Creating a Low Carbon Economy*, 2003
4 Greenpeace, *Decentralising Power: An Energy Revolution for the 21st Century*, 2005 p24
5 Oxera, 'Where has the innovation gone? R&D in UK utility regulation', *Oxera Report*, Nov 2005
6 BBC News Online 6 July 2004, http://news.bbc.co.uk/1/hi/uk_politics/3869341.stm
7 Energy Saving Trust, "One in five Brits want to go green but intentions aren't translating into action", press release, 11 May 2005
8 Tadj Oreszczyn, "Our innate ability to think of new ways to use energy", *Energy and Environment* 2004 vol 15 pt 6.
9 Cragg Ross Dawson, *Energy Services: Qualitative research to inform the development of products designed to promote household energy efficiency*, Research for the Energy Saving Trust, April 2004
10 HM Government, *Securing the Future: Delivering UK sustainable development strategy*, 2005
11 Greenpeace, *Decentralising Power: An Energy Revolution for the 21st Century*, Greenpeace, 2005, p16
12 Energy Saving Trust, Econnect and ElementEnergy *Potential for Microgeneration: Study and Analysis*, Final Report, 14 November 2005
13 Jeremy Leggett, personal communication, January 2006
14 S. Abu-Sharkh et al, 'Can microgrids make a major contribution to UK energy supply?', *Renewable and Sustainable Energy Review* 2004 1-50, September
15 WADE / Greenpeace, *WADE Economic Model: Application to the UK*, March 2006
16 Mott McDonald, *System Integration of Additional Micro-Generation (SIAM)*, commissioned by DTI / OFGEM Distributed Generation Programme, 2004
17 Environmental Change Institute, University of Oxford, *40 per cent House*, Environmental Change Institute, University of Oxford, February 2005, p74.
18 Catherine Mitchell and Bridget Woodman, *The Burning Question: Is the UK on course for a low-carbon economy?* Institute for Public Policy Research, November 2004, page x
19 Jake Chapman, Paul Miller and Paul Skidmore, *The Long Game: How regulators and companies can both win*, Demos 2003
20 Jake Chapman, Paul Miller and Paul Skidmore, *The Long Game: How regulators and companies can both win*, Demos 2003, p28
21 About Ofgem, www.ofgem.gov.uk
22 Oxera 'where has the innovation gone? R&D in UK utility regulation', *Oxera Report* November 2005
23 Catherine Mitchell and Bridget Woodman, *The Burning Question: Is the UK on course for a low-carbon economy?* Institute for Public Policy Research, November 2004, p63-4
24 Walt Patterson, *Decentralising Networks*, Cogeneration and On-Site Production, January – February 2005, p3
25 Sustainable Development Commission, *The Role of Nuclear Power in a Low Carbon Economy: Paper 2: Reducing CO_2 emissions – nuclear and the alternatives*. March 2006, p28.
26 House of Commons Environmental Audit Committee, *Keeping the Lights On: Nuclear, renewables and climate change*, April 2006, p33.
27 DTI, *Options for a Low Carbon Future*, Economics Paper no. 4, 2003
28 DTI, *The current status and prospects for Carbon Abatement Technologies*, 2005

[29] ILEX Energy Consulting, *The Balance of Power: Reducing CO_2 emissions from the UK power sector*, a report for WWF-UK by ILEX Energy Consulting, May 2006
[30] Tyndall Centre, *Decarbonising the UK – energy for a climate conscious future*, 2005
[31] Interdepartmental Analysts' Group, *Options for reducing carbon emissions in the UK*, 2002.
[32] Tyndall Centre, *Renewable energy and combined-heat-and-power resources in the UK*, 2003.
[33] Performance and Innovation Unit, now Strategy Unit, *The Energy Review*, 2001.
[34] HM Treasury, *Energy Efficiency Innovation Review: Summary Report*, 2005.
[35] Energy Saving Trust, Econnect and Element Energy, *Potential for Microgeneration: Study and Analysis*, 2005
[36] Environmental Change Institute, University of Oxford, *40 per cent House*, 2005
[37] PB Power, Mayor of London and Greenpeace, *Powering London into the 21st Century*, March 2006
[38] WADE / Greenpeace, *Decentralising UK Energy: Cleaner, cheaper, more secure energy for the 21st Century*, March 2006
[39] Catherine Mitchell and Bridget Newman, *New Nuclear Power: Implications for a sustainable energy system*, Warwick Business School, April 2006
[40] International Energy Agency, *Energy Policies of IEA countries: Finland Review* 2003
[41] DTI Dukes 2005, p118 and table 5.6. Figures quoted are on a gross output basis.
[42] Based on EP68's CL scenario (table 5.1, page 41). See also EP68 Annex B, which shows that emissions from coal were expected to fall steadily by 10MtC (LH scenario) or 20MtC (LL scenario).
[43] DTI, *Updated Energy Projections*, February 2006, tables 27 and 28.
[44] Report by ILEX consultants for WWF-UK, *The Balance of Power*, May 2006, http://www.wwf.org.uk/climatechangecampaign/publications.asp
[45] IPCC, Carbon Capture and Storage: Summary for Policy Makers and Technical Summary P3, Nov 2005, http://www.ipcc.ch/activity/ccsspm.pdf
[46] DTI, *Energy White Paper*, February 2003, paragraph 6.63.
[47] DTI, *Review of the Feasibility of Carbon Dioxide Capture and Storage in the UK*, September 2003.
[48] DTI, *Implementing a Demonstration of Enhanced Oil Recovery Using CO_2 in the North Sea*, May 2004.
[49] DTI, *A Strategy for Developing Carbon Abatement Technologies for Fossil Fuel Use*, June 2005.
[50] In the UK power generation makes up over half of the total emissions covered by the EU ETS
[51] Defra, *Consultation on the Phase II UK Draft National Allocation Plan*, March 2006
[52] DTI, *Energy White Paper: Our Energy Future - Creating a Low Carbon Economy*, 2003
[53] http://www.publications.parliament.uk/pa/cm200203/cmselect/cmenvaud/618/61807.htm
[54] 'Negawatts' is a phrase coined by Amory Lovins – see www.rmi.org
[55] European Commission, *Proposal for a Directive on the promotion of end-use efficiency and energy services* COM 2003 739,2003.
[56] The Carbon Trust, *The UK Climate Change Programme: Potential evolution for business and the public sector*, November 2005.
[57] See www.dynamicdemand.co.uk for details
[58] ZED standards, *A Low Carbon Roadmap to a Sustainable Future*, 2005
[59] Building Research Establishment, Energy Efficiency Best Practice Programme, 2001, *General Information Report* 89
[60] Greater London Authority, *London Energy Strategy*, 2004
[61] For a fuller explanation see Sustainable Development Commission, *Home truths: our advice to Government on UK housing*, 2006.

Green Alliance
36 Buckingham Palace Road, London SW1W 0RE
tel: 020 7233 7433 fax: 020 7233 9033
email: ga@green-alliance.org.uk
website: www.green-alliance.org.uk