grid 2.0

the next generation

“green alliance...

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DIRECTION FOR THE DEMOCRATIC LEFT

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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 environment movement to encourage new ideas, dialogue and constructive solutions.

Compass

Compass is the new democratic left pressure group, whose goal is to debate and develop the ideas for a more equal and democratic world, then campaign and organise to help ensure they become reality.

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foreword

Neal Lawson, chair, Compass

I worry mostly about equality and the state of our democracy, not enough about our environment. It's a weakness I'm trying to put right for all the obvious reasons. So I was pleased that Compass, the organisation I chair and that thinks and campaigns about democracy and equality was asked to support a Green Alliance publication on micro-generation. We thought this would just be a nice thing for us to do.

Then I actually read the draft. It is one of the best political pamphlets I've come across in a long time. It does what so few publications seem to manage: it tells a story of progressive change by combing high ideals with facts and case studies. It talks at a human scale and you come out the end not only thinking that something better can be achieved but that you/we/I have a role to play in making a better world a reality. It helps empower its readers by explaining what is happening, what's gone wrong and what we can all do about it. It is incisive, clever and dispassionate but still compelling.

The pamphlet speaks to a host of issues that confront the thinking left: not just how to be greener but how we can be both independent and better manage our increasing interdependence, how we can do politics for the long–term and crucially how people can more effectively self-manage their own lives. The political challenges of the future will be met by people changing behaviour, but the trick is how to marshal individual decisions about being healthier, better educated or greener to effect economic and political change at a societal level. This pamphlet shows how this is possible in the field of energy.

The historic mission of social democrats is to make markets fit the needs of society. The increasing domination of a neo-liberal agenda that reduces every aspect of human life to decisions of economic rationalism has meant that far too often it is society that is being made to fit the needs capitalism. Clearly the old top down mechanism of social administration through a centralised state are no longer capable of working effectively. No where is the threat of the market and the failure of old politics of statism more apparent and urgent than energy policy.

We thankfully live in a more complex, decentralised and less deferential world. We need to come up with new solutions as to how to make progressive change happen. The ideas and insight of this pamphlet help take us, quite literally, from steam age politics to a new politics of personal responsibility and collective obligation and potential. I can't commend it highly enough.

the next generation

It was on a blustery autumn day in September 1995 that Neil Winfield began to see what energy is all about. Trying to anchor down a polytunnel in the garden of his new house on a Cornish hillside, he was frustrated at his battles with the wind, which whipped the plastic tunnel up as soon as he'd pinned it down. As Neil explains, "I thought, if the wind blows like this on a regular basis we could use it. That was where it started." With the help of his local library and Google, he set about designing and building his own wind turbine. But it didn't end there. Electricity generated by the turbine made Neil and his wife look at their house in a different way, and the more turbine-produced electricity they used, the more they began to look at how to reduce their energy needs. "We think about things more, what we use energy on and how we can save it - like not having things on standby." The family have managed to cut their use of energy nearly in half. Even the kids play their part: "They still leave the lights on… but when we get some wind they say things like 'better use the washing machine' ".

Building your own wind turbine is not for the fainthearted, and Neil needed both skill and determination to put his idea into practice. But his original motivation was not environmental. He admits that "I was just ordinary Joe public and had little interest in renewables." An interest in, and understanding of, energy issues and climate change came later. Now, the transformation is complete. He has shifted roles within his company, BT, to one that is a perfect match for his hobby - he is BT's Renewable Energy Manager.

Neil Winfield offers us a glimpse of a new, and very different, energy future. His approach may currently be the exception, not the rule. But around the country, more and more energy innovators are showing what's possible. From the school council generating wind energy and switching pupils on to energy saving, to the Welsh farmers selling wind energy instead of sheep, people are beginning to reconnect to their power. We are on the cusp of a radically new approach to energy. One in which power generation will no longer be remote and centralised, a one-way flow through the wires from big power stations to passive consumers. Instead, homes will become power stations, energy entrepreneurs will be part of every community, and everyone will be involved in saving or generating power. This is Grid 2.0: the next generation.

the purpose of this pamphlet

This pamphlet argues that we will only succeed in tackling climate change and increasing energy security, if we take a step back and think again about the purpose of our energy system and the role of individuals within it.

"we will only succeed in tackling climate change if we take a step back and think again about the purpose of our energy system, and the role of individuals within it"

The next chapter argues that the system we have for generating, distributing and selling heat and power, 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 through encouraging energy efficiency, for example, have not been nearly as successful as they need to be.

In chapter three, an alternative approach is set out, based on a decentralised energy system, with a much more active role for individuals and communities. It is not just in energy that we see this shift. In information technology too, there has been a profound transformation towards distributed computing and peer-to-peer networks, rather than top-down dissemination. 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. We need to think through what these shifts mean for the way that we manage energy.

In chapter four, and throughout the pamphlet, we offer examples of what such an approach to energy could look like. Drawing on a range of studies and modelling this chapter also shows the national impact of this approach, demonstrating that a decentralised system would be an environmental and economic improvement on the current model.

So if this new approach is possible, why isn't it happening? chapter five explains how the 'market' for energy is actually closely controlled through government policy and regulation. Whilst this is no bad thing, as energy is clearly a public good, it means that 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 shift to Grid 2.0 without changing regulatory structures.

"The current model of regulation and control strongly favours the status quo of centralised generation for passive consumers"

Finally, chapter six details how the regulatory structures could be reformed to allow this shift to take place. There will need to be a clear and open acknowledgement of the role of government in shaping the market and creating incentives. Regulations controlling the gas and electricity networks will need reform to allow local generation to connect up, and be rewarded for the part it plays. A stronger role for communities and local government is envisaged, with more community ownership of energy assets, and local authorities acting as enablers and convenors. Individuals will need to be encouraged and rewarded much more systematically, through the tax system, through the services offered to them by energy companies, and through constant feedback.

This pamphlet is addressed primarily at domestic energy use, which accounts for roughly a third of total energy use. However, the approach set out here would also reap benefits for the commercial and public sectors, particularly the hard-to-reach small business sector. Transport - the fastest-growing source of carbon emissions - is not addressed directly in this pamphlet, though again, the increased awareness of climate change and energy use brought about by the changes proposed here could have benefits for transport too.

"We definitely get comments from people in the street if it's a windy day. 'The turbines are doing well', they say."

Geraint Davies, founder member of Cwmni Gwynt Teg

Moel Moelogan: a fair wind for a farming community

Faced with a decline in agricultural incomes, three farming families in Wales took a fresh look at their land and realised that its most productive resource could be the wind that blows over it. They formed a farmers' co-operative, 'Cwmni Gwynt Teg', meaning 'Fair Wind', to build three wind turbines at Moel Moelogan. The turbines started generating power in 2003 after five years work finding the finances, taking the proposal through the planning system and constructing the turbines. A second phase is now in development, with a further nine turbines planned.

The energy is not used within the immediate community. It enters the national grid through the electricity distribution network at a nearby sub-station, and is sold as renewable energy. But it has certainly got the local community thinking differently about energy and climate change. 1500 people turned out to celebrate the building of the first turbine in September 2002, and local people have been offered the chance to invest in the next phase of the project. Some of the profits from the wind farm are ploughed into energy efficiency investments in nearby communities. Moel Moelogan, like other locally-owned wind farms, have found that involving communities is the best way to develop sensitively and win support of local people.

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 over a hundred years old. As Walt Patterson explains, traditional electricity is based on a technical model dating back "to when the best available generating technologies were based on water power and steam power. Economies of scale in generating with these technologies shaped the model… All over the world, a century later, we still generate electricity in large remote central stations… and deliver it to users over a network".[1] Individual generation technologies have changed and improved but the infrastructure remains. It is worth looking in detail at the characteristics of this energy system - let's call it Grid 1.0.

"It is hard to make the link between flicking a switch and the distant power station that made it possible to turn the light on"

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.

"Our energy system is like a swan, gliding elegantly and seemingly effortlessly through the water, whilst paddling furiously under the surface"

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 it 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. Our energy system is like a swan, gliding elegantly and seemingly effortlessly through the water, whilst paddling furiously under the surface. And as the problems with our energy system intensify, the swan-like serenity becomes harder and harder to emulate.

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. They do not know how frantic the paddling of the swan has become. Cruachan Power Station, near Oban in Scotland, makes its money from generating electricity at times of high demand through hydro-power. Water rushes down the hill at peak times powering the turbines. Then, at night when electricity is cheaper, all the water is pumped back up the hill again, ready to flow down when the next peak arrives. Other power stations - normally the older, less efficient ones - are only brought into use when demand is high. The rest of the time they sit unused. But these are sticking-plaster solutions. As an analysis of the Californian electricity crisis points out, "the fundamental problem with electricity markets [is that]… demand is difficult to forecast and is almost completely insensitive to price fluctuations, while supply faces binding constraints at peak times, and storage is prohibitively costly." [2] The problem may be slightly less acute for gas. Limited storage facilities exist and so some storage is possible, but demand is just as inflexible. In other words, people have no reason to believe that they can't use as much power as they want and so the system cannot cope.

A huge amount of effort goes into pretending that as much power as we want is available, whenever we want it. Somewhere in Scotland, water is pumped back up the hill all night, so that millions of houses can leave their televisions on standby. 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 (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[3]. 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.

Inefficiency might not matter if there were plentiful supplies of fuel. But there are not. As the UK's gas reserves run out, we are increasingly on the lookout overseas, and the views are not good. A quarter of Europe's gas supplies come from Russia, whose recent decision to play politics with energy by threatening to cut off Georgia's supply, sent shockwaves through the rest of Europe. Disputes triggered by access to oil are two-a-penny, and the worry is that gas could be next.

Inefficiency would not be quite so important if we weren't rubbing up against environmental limits. The UK has pledged to reduce its emissions of carbon dioxide, the main gas that causes climate change, by 60 per cent over the next fifty years. In the 1990s, the UK's carbon emissions were on a steady downward trend, caused by the switch from coal to gas-fired generation. But emissions are now on the rise again.

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 spend is less than 0.5 per cent of revenue. [4]

"Less than half of us are aware of the environmental damage caused by our homes and lifestyles"

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", [5] 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. [6] 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"

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". [7] 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. Energy efficiency as currently envisaged merely serves to slow down the rate of growth of energy use, rather than reversing the trend.

power politics

Unreliable gas supplies, ageing nuclear reactors, spiralling consumption, a changing climate and moribund investment: it's hardly surprising that energy has become a political headache. Being energy minister is not the most popular post in government. There have been seven incumbents in eight years. [8] Government machinery has responded predictably to the growing crisis, by launching another review of energy policy, the second in three years. In late 2005, Tony Blair, announcing the Energy Review, admitted that the situation was bleak: "The issue back on the agenda with a vengeance is energy policy. Round the world you can sense feverish re-thinking. Energy prices have risen. Energy supply is under threat. Climate change is producing a sense of urgency." [9]

"We could use the energy review to find ways of limping along with an out-of-date infrastructure. Or we could think again"

Yet the answer that both government and industry tout as a solution to the energy crisis is a new nuclear programme - ten new stations, to replace the reactors that will soon retire. Grid 1.0 is failing us because it is centralised, distant from its users and unable to respond to feedback. There is no better example of these traits than nuclear power: large stations, as far as possible from population centres, requiring vast amounts of upfront investment for inflexible generation over thirty years. New nuclear stations would be an extremely expensive attempt to prop up the old system.

We could use the energy review to find ways of limping along with an out-of-date infrastructure, or, we could think again.

"This set-up is unusual in the UK, but in Denmark, it's the norm."

Colin Taylor, project manager, EcoCentroGen

intelligent energy: the Budenburg Haus Projekte

Urban Splash are housing developers known for their cutting-edge architecture. Their latest development in Altrincham shows what cutting-edge energy looks like too.

Budenburg Haus works on a 'private wire' system - it has its own internal electricity grid and heat network. Much of the energy needed is generated on-site, through combined heat-and-power (CHP). Extra electricity is imported wholesale from the grid when needed. Both sorts of power are sold on to the individual apartments. As the energy centre knows how much heat, water and electricity each flat is using, it can build up information about when power is most needed. At times of low demand, during the middle of the day when people are at work and at night, excess heat is stored as hot water in a tank under the car park ramp.

Residents are charged for units of heating and hot water, so it is in the interests of the energy services company, EcoCentroGen, to generate as efficiently as possible. Like all domestic customers, residents are free to switch to another energy supplier - but as EcoCentroGen promises to match competitors' prices, people have little incentive to go elsewhere. Urban Splash are confident enough to tout the building's green features as a key selling point, designed to appeal to their young professional target market.

Colin Taylor, EcoCentroGen's project manager, admits that there are some shortcomings to the Budenburg Haus model. Though residents are provided with lots of information about energy consumption, they are not told much about how it is generated - and the fact that the energy centre housing the CHP plants is buried in a corner of the car park doesn't help to muster enthusiasm. Taylor says that they would have liked to include onsite renewables, such as solar panels or micro-wind turbines. But under the current system, capital costs are substantial and planning permission difficult to negotiate. Neither does the energy centre sell any excess power back to the grid, as it is too complex to arrange.

the distributed age

The twenty-something professionals moving into the new Norman Foster-designed apartments at the Budenburg Haus Projekte in Altrincham, Cheshire, have an unusual choice of viewing on their bespoke cable TV. There's a wide choice of channels, internet and email, and also their energy bill, which is available over the TV network at any time. As well as providing information about energy use and costs, the online bill provides the ultimate in keeping-up-with-the-Jones'. Residents can compare their own usage to neighbours in similar flats. This makes it easier for them to find ways to reduce their own consumption. Residents who are keen to know more can explore a small room in a basement car park, which houses the energy centre, with two onsite combined-heat-and-power (CHP) plants providing electricity, space heating and hot water to the blocks.

The energy system at Budenburg Haus is the brainchild of energy services company EcoCentroGen. The company couldn't be more different from mainstream energy suppliers. Rather than selling units of electricity or gas, it provides power, heat and cooling, linked to data services including digital television and broadband. It builds up data on how much heat, water and electricity each flat is using, in order to fine-tune provision and offer feedback to residents.

The technology used to power Budenburg Haus is not radically new. Community heating schemes are commonplace elsewhere in Europe. In Finland, for example, 98 per cent of Greater Helsinki is supplied with locally generated heat through community heat networks.[10] But with its fine-tuned system, emphasis on information and involvement of energy users, it is a significant departure from mainstream energy thinking.[11] As is Encraft Home - a company that aims to make it easy for people to take their energy systems into their own hands. Set up by an engineer, Matthew Rhodes, who was frustrated at the lack of good information and excessive transaction costs for small-scale power, Encraft Home aims to help small-scale energy systems off the ground.

From a few solar panels on the roof, to a set of twenty mini-wind turbines on different sites for Warwick District Council, Encraft Home uses software tools and databases to provide professional support and guide customers through the whole process. They explore the best technologies for individual building and energy needs, suggest energy efficiency improvements, and help find suppliers and installers. They are finding ways to guide clients through the planning process and regulatory hurdles too, and trying to overcome the difficulties of negotiating with energy suppliers and network operators in order to hook up to the grid. One way of doing this is to create community software, to allow groups of people in local areas to join together over the internet to share the costs. Matthew likens his service to financial advice: helping clients to find the best deal for their circumstances and looking at the whole picture of energy use, in the same way that a financial adviser looks at all aspects of a client's financial situation. It's a far cry from the one-size-fits-all energy supply company, where the main point of contact is the bill that arrives on the mat once a quarter.

Like Neil Winfield and his self-built wind turbine, EcoCentroGen and Encraft Home are energy innovators who show us what's possible if we are prepared to challenge the assumptions upon which our energy system was founded - and is foundering. Together with the other examples showcased in this pamphlet, they offer us a glimpse of the next generation - of Grid 2.0.

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

distributed information: the rise of web 2.0

The most striking and radical instance of distributed power is, of course, information technology. Poor old Thomas J. Watson, the founder of IBM. His achievements were many, but he's best known for his 1943 utterance, "I think there is a world market for maybe five computers". As we all know, things turned out a bit differently. Bill Gates writes that each person in the US interacts with around 150 embedded computer systems every day.[12] The real leap forward came with the web and with broadband technology, which allowed for a radically different role for the individual.

The bursting of the dot-com bubble in 2001 marked a turning point for the web. The shakeout that resulted allowed a radically new approach to emerge. Last October, as Wired Magazine asked "Are you ready for Web 2.0?", the Silicon Valley set gathered in San Francisco for a much-hyped conference to mark the new era, dubbed "Web 2.0" by commentator Tim O'Reilly.[13]

Sites like eBay, Wikipedia and Google are the standard-bearers of Web 2.0. What they all have in common is a reconfigured relationship between site and user. Web 2.0 is built around its users, and is nothing without them. There is no longer a hierarchical, asymmetrical relationship between the creator of the website and users of it. eBay's job is simply to provide the architecture for millions of buyers to interact with millions of sellers. It is an intermediary, not a provider. Wikipedia, the online encyclopaedia, allows any user to create or edit an entry with an ethos of collective responsibility and trust prevailing. Google's success as a search engine lies in its assessment of links between sites, alongside content, as a factor in its ranking of a site.

With all these sites, as O'Reilly points out, "there's an implicit 'architecture of participation', a built-in ethic of co-operation, in which the service acts primarily as an intelligent broker, connecting the edges to each other and harnessing the power of the users themselves."[14] The rise in blogging has democratised news reporting to an unprecedented degree - a world in which, in Dan Gillmor's phrase, the former audience become "We, the media" who collectively decide what is important.[15]

The overriding strength of Web 2.0 is that users are treated as co-developers. The distinction between consumer and producer is broken down: "Users pursuing their own 'selfish' interests build collective value as an automatic by-product."[16] We see then, similar principles governing Web 2.0 and its energy equivalent, Grid 2.0. A shift from centralised to localised. A two-way flow of information, with constant feedback loops. A merging of consumption and production, or supply and demand.

Of course, the similarities should not be overstated. Information and energy are very different commodities, with different uses, and people value them in different ways. Neither is information technology as carefully regulated as energy. But the radical shift in IT does make the shift in energy seem possible. A recent New Scientist editorial made the point that "if you doubt the power of small-scale investment, think computer power…distributed computing is now seen as the way forward: distributed power need not be far behind."[17]

Web 2.0 is more than an interesting analogy. The very IT developments powering the new internet will play an essential part in a decentralised energy infrastructure. As Shimon Awerbuch puts it, we need to move from an energy system based on mass-production of electrons to one based on mass-customisation. This can be achieved through " 'informating' the network to permit parallel information flows along with energy flows". In other words, IT developments allow individual loads (users of power) to connect to generators in real time, and allocate power more efficiently. The electricity grid thus becomes a network or information flow. Awerbuch writes that "This drastically re-conceptualises traditional network processes and changes the traditional roles and responsibilities of all network participants".[18]

the empowered consumer

"if you doubt the power of small-scale investment think computers"

We are seeing a similar shift in the role of the consumer. The concept of the consumer is a powerful one in modern thought, business and government. As Tim Lang writes: "In the second half of the twentieth century, we have gradually learnt to talk and think of each other and of ourselves less as workers, citizens, parents or teachers, and more as consumers."[19] Yet until recently, consumers were conceived of as passive individuals, their main power deriving from the ability to choose between different options offered up to them. The more negative conception, the other side of the 'consumer choice' coin, was the 'consumer-as-victim', as Lang calls it: the consumer who must be protected from unscrupulous companies. This is the philosophy behind many consumer organisations, like the UK's Consumers' Association; and also the bedrock of consumer protection legislation, which was enshrined as a key principle in the regulation of the privatised industries during the 1980s, including the gas and electricity industries.

But, like the shift in computing, a similar shift can be defined towards what Shoshana Zuboff and James Maxmin call "distributed capitalism".[20] Rather than focussing on goods and services, distributed capitalism focuses on relationships. Zuboff and Maxmin say that, traditionally, firms have assumed that value is created by producers inside organisations, and lodged in the products and services they sell. Firms then seek the most profitable terms in their exchanges with consumers - hence an inbuilt adversarialism between buyers and sellers. This model, they argue, has outlived its relevance.

Instead, they claim, value resides not within goods and services, but with the individual consumer: "individuals 'own' the sources of value, as all value originates in their needs". Crucially, "the dispersion of value necessitates the dispersion of control…. Individuals can no longer be written off as anonymous 'consumers' who sit at the far end of the value chain, devouring the value created by managers". This dispersal of control fundamentally alters the relationship between producer and consumer, or individual.[21] So again, we see now familiar themes emerging: individuals as active participants, helping to shape outcomes; the crucial role of networks and relationships, building into a complex, reciprocal web of interactions.

politics: involve, engage, persuade

Politicians, too, are waking up to the need to put people back into policies. The Labour government has realised that it cannot succeed solely through technocratic reform, the introduction of markets, and imposition of managerial targets. There is a growing understanding that public services are 'co-produced' by state and citizen. Unless both play an active part and take responsibility, the system will fail.

"Politicians are waking up to the need to put people back into policies"

Take Sure Start, one of the Labour government's flagship initiatives. The Sure Start programme brings together early education, childcare, health and family support, aiming to intervene in the lives and decisions of individual families in order to improve the life chances of young children.[22] It aims to achieve a public good - a better-educated, healthier population - through direct influence in the private sphere of people and families. Parents are encouraged to get involved in their local Sure Start Centre, in part because this is seen as the best way to promote public health messages, early-years education and contact with support services. In short, Sure Start is unashamedly interventionist. It aims to change behaviour; it tries to engage individuals and government in a joint endeavour to improve outcomes.

Sure Start is not without its critics.[23] In particular, commentators have pointed to inadequate funding levels, and haphazard organisational structures, which prevent the programme reaching its potential. But the rationale of Sure Start is rarely disputed. It is accepted that we should intervene in the lives of individual families, for the sake of the collective good.

And it's not just Sure Start. In health, too, attention has shifted from acute care in hospitals - treating the sick - to primary care and public health. Again, the emphasis is on ways to involve people and encourage them to take responsibility for their health - hence the emphasis on measures to prevent smoking and obesity in the recent Public Health White Paper.[24] Some Primary Care Trusts have gone a stage further, knocking on doors in streets identified as high-risk for heart disease, mainly in low-income areas, in an effort to engage people with a health promotion message.[25]

Similar stories could be told for other policy areas - home-school agreements in education and community involvement in crime and disorder - all aim to involve and engage the individual. The citizen, as patient, parent or neighbour, is seen as an essential piece of the jigsaw. There has been a great deal of complex, at times philosophical discussion about how best to engage people in policy. The prime minister's own think-tank, the Strategy Unit, for example, produced a paper in 2004 looking at different approaches to personal responsibility - with the first section entitled 'Government can't do it alone'. The paper describes various approaches to 'helping people to help themselves', in employment, health, crime and education. One of the key findings of the report is that "behaviourally-based interventions can be significantly more cost-effective than traditional service delivery".[26]

The preoccupation with influencing the individual is not unique to Labour. The Conservatives, too, put engaging communities at the heart of their political philosophy. David Cameron puts it well: "There's not a single challenge that's not best tackled by asking what we can all do about it - government, individuals, families, businesses, voluntary organisations. And that's the right approach to politics - not waiting around for government to do things, but bringing people together to make things happen".[27]

"We weren't bothered about leaving the lights on before we started this, but now we think about how much energy we're wasting. No point leaving the lights on and then building a turbine"

Rebecca Furness, pupil

learning about power: Spen Valley Sports College

The Student Council at Spen Valley School in Yorkshire wanted a challenge. Having won their campaign for more bins in the playground, they set their sights at a more ambitious target altogether - generating their own electricity. The students began with an energy audit. Then they researched the different technologies, and thought that a wind turbine would be the best option, given the school's famously windy grounds.

Then began an impressively thorough consultation process - through student assemblies, meetings with the staff and governors, and door-to-door questionnaires for local residents. There were some objections, but the school also received 250 letters of support. Finally, with the help of Kirklees Council, students wrote and submitted a planning application and funding bid. In the summer of 2005, after two years hard work, the turbine began spinning.

It wasn't all plain sailing, though. As non-specialists, students and teachers found it very hard to navigate their way through the complexities of technological options, planning constraints, regulatory and funding hurdles. They were helped along the way both by local charity Create and by Kirklees Council, who were also a funder. Without this support, they estimate that it would have taken far longer.

The turbine will supply ten to fifteen per cent of the school's energy needs. But that's not its only purpose. It's now firmly established as part of the curriculum, for subjects like science, geography and maths. It has also made students and teachers much more aware of the energy they use. Gary Deighton, a teacher, sums it up: "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."

reconnecting people to power: a glimpse of grid 2.0

Whether in technology, culture, politics, or energy, there are common characteristics to the new wave of thinking. The technological advances which allow anyone to offer and receive information, opinion and feedback in real time show that the same shift could be possible for energy. The new breed of consumer, who wants to ask questions, give answers, and be involved in the products they buy, could be more involved in energy. And politicians are now attempting to engage individuals in just about every possible policy arena, why not on energy too? Why is it that for energy, we are stuck in the mindset that energy is something done to people, not by people? And what would our energy system look like if we managed to think differently - if we got to Grid 2.0?

"we are stuck in the mindset that energy is something done to people, not by people"

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.

Perhaps the most famous example of a microgrid is Woking, in Surrey. Over 60 local generators are linked together in a large private-wire network that powers municipal buildings, social housing and some town centre businesses. Technologies involved include CHP, hydrogen fuel cells and solar PV arrays. Although the network is connected to the grid, as an insurance measure, it is almost entirely self-sufficient - and can work on its own if the national grid fails. Through this network, Woking Borough Council have managed to reduce their energy consumption by 48 per cent and their carbon emissions by 77 per cent over 15 years.[28] Now, London is planning to follow the Woking example, with the establishment of the London Climate Change Agency, and Energy Action Areas to look at decentralised solutions to energy needs in several spots across London.[29]

the proximity principle

Harriet Finch admits that she had never much thought about the environment before they moved into their new house in Craven Arms, Shropshire, with her partner and baby daughter. But the house has some unusual features - including solar panels providing hot water, and passive ventilation systems to keep them warm in winter and cool in summer. Once Harriet understood her new home and the way in which it used and generated energy, she began to think through what that meant for her and her family. Helped by the promise of reduced bills, they made some changes: line-drying not tumble drying; switching off lights; buying energy-efficient appliances and even having a bath at the right time of day to make the most of their solar-heated water. "The system is very cost-effective, and it has made us more aware of the environment", Harriet says. And they found themselves becoming green ambassadors, too, encouraging friends and family to think through their energy use. Her mother's partner is restoring a barn, and has taken a great interest in their solar panels: "he's amazed to see how low the bills are, and interested to see how it works". He's now planning to install some of his own.[30]

For Harriet, it was the very proximity of her energy source - in this case the solar water heater - that changed the way she thinks about energy. 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.

The 'Manchester is my Planet' campaign shows what happens if you aim to engage. The campaign, run with the backing of Manchester City Council, literally approached people in the street, on their way to work or even to a football game, and asked each person to take a pledge to reduce their carbon emissions. Simple suggestions were offered, like turning the thermostat down or taking public transport to work. The response they got far exceeded expectations. Over ten thousand signed up. According to Faith Ashworth, one of the campaign's organisers, the most important outcome of the campaign was that it gave people a sense of agency about climate change. People felt that they, and their city, could make a difference.

Likewise, 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".[31] Yet beyond the realms of research, no energy companies currently offer home energy audits.

making it easy to do the right thing

The 'Manchester is my Planet' campaign, and 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.

> "more information about environmental impacts will not be enough to change the habits of a lifetime"

At the moment, it can be both difficult and costly to make a contribution. The simplest energy efficiency measures, like loft insulation and low-energy light bulbs, are relatively straightforward and cheap - and available free for low-income households. But busy families on tight budgets have plenty of other things to spend their money on, and spending a few hundred pounds on loft insulation instead of a weekend away is not particularly appealing - especially when it takes so long to recoup the costs. And when it comes to small-scale generation, the problems really start to mount. Kirklees council recently did a little bit of research and found out just how difficult it is. Seventy-two hours of council officer time was spent on the phone to energy suppliers to get information on how power generated from a solar PV system could be sold to the grid.[32] Even then, they couldn't find anything that would allow tenants to recoup costs. A study for the London Assembly reported that red tape was the biggest barrier to small-scale energy. As Ken Livingstone pointed out, "The combination of the complexity, the form-filling, claiming your money back, getting the scaffolding, on top of shelling out several thousand pounds before you see any of it coming back is an absolute killer."[33]

In Grid 2.0, information and incentives will align, to make it easy, cheap and rewarding to do your bit. Government already understands the need for this. In its Sustainable Development Strategy, published in 2005, 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.[34] 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 - as it does in Woking. 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. For communities not on the gas network - over four million homes in total - there is an added incentive to look for alternatives. Elderly residents of the Chy An Gweal Estate near Penzance chose ground source heating, instead of oil, to replace coal boilers. The new system costs considerably less to run than either oil or coal, and shows that small-scale renewable technology can be fitted to old buildings, not just new ones.[35]

The co-operatively-owned wind farm at Moel Moelogan in Wales shows what can be done. Geraint Davies, one of the project's founders, stresses that local involvement was crucial to the project's success. As Geraint explains, "We told them we were doing it to keep the money local. We all have families here, and we want the kids to stay." Profits from the turbines return to the community, and they have also been helped through energy efficiency schemes funded by wind farm profits. "There's this myth that only large developers can build projects", he says, "we've proved them wrong".[36] Although Moel Moelogan does not supply power directly to the villages (as it connects to the national grid, not a private-wire network) it has made people think more about the energy they use: "People do appreciate that they need to get their energy from somewhere".

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.

We have already seen how innovation in IT goes hand-in-hand with innovation in energy. One way in which the two could combine with striking effect is to distinguish between different sorts of energy use. Sometimes, high-quality, reliable electricity is needed for complex computer systems, or for domestic cooking. But many uses of electricity are not time-critical. It doesn't matter at all if a fridge is without power for an hour or so - the food will stay cold. The way the system currently runs, though, both get exactly the same sort of power. Embedded IT would enable the users of electricity, or loads, to communicate directly with the network. Less sensitive loads could turn themselves off when demand is high. This already happens at Budenburg Haus - water is heated during the day, when demand for electricity and space heating is lowest.

turning exceptions into rules

From suburban Woking to rural Wales, Shropshire's solar panels to Manchester's pledges, what all these projects have in common is bringing energy closer to people - literally connecting them to their power. But what they also have in common is that they are exceptions, not rules. All involved huge amounts of effort by dynamic individuals, working against the grain and willing to take considerable risks. None of these examples are close to being mainstream. In fact, only five per cent of UK electricity is supplied by decentralised technologies.[37] 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 transform our energy system in this way?

"throughout the world, investment in small-scale generation is starting to outstrip investment in the nuclear industry"

Absolutely, according to a plethora of influential reports. A recent study for the Department of Trade and Industry (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.[38] Even so, some commentators have dismissed this report as too conservative.[39] 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.[40] 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."[41] 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 micro-generation 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.[42]

Research by Oxford University's Environmental Change Institute demonstrates how significant microgeneration could be, if the right investments are made. Under the report's 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 report 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.[43] Whilst this may seem daunting, the report points out that central heating was virtually unknown in 1950, and is now in 90 per cent of houses. Over time, as investments are made in housing infrastructure, heating and electricity, a shift to micro-generation is possible.

And, whilst decentralised generation is a rarity in the UK, its importance globally is growing. The US energy guru Amory Lovins writes that overall, throughout the world, investment in small-scale generation is starting to outstrip investment in the nuclear industry. "I knew things were big but nobody had ever added them up before."[44]

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.

"Getting a wide range of companies and organisations - from sectors that don't usually throw their weight behind environmental campaigns - to engage with our message opened the door for us to thousands of individuals."

Faith Ashworth, Creative Concern

Manchester: England's greenest city?

Better known for football and music, Manchester is now vying for a place at the top of the green league. Last year, enthusiastic volunteers, armed with eye-catching lollipops, took to the streets to talk to people about how they could help Greater Manchester become eco-friendly. The 'Manchester is my Planet' pledge campaign asked each person to take a pledge to reduce their carbon emissions, through simple steps like turning the thermostat down by a degree, or taking public transport to work.

Faith Ashworth from Creative Concern (who ran the campaign on behalf of Manchester: Knowledge Capital) was amazed at the response, which far exceeded expectations. In the first weekend alone, over four thousand people signed up. Manchester City football fans were willing to have a quick chat about climate change on their way to a home game. Revellers at the Pride festival took time out to talk energy efficiency. Even Bill Roache, better known as Ken Barlow in Coronation Street, joined in. Faith identifies two important factors in the campaign's success: firstly, that it appealed to civic pride, and a sense of the city facing the challenge together; and secondly, that they made the most of networks to transmit messages - big employers like Granada TV, as well as community organisations and faith groups, all joined in.

The two-month campaign resulted in over 12000 pledges in total. All those who signed up then received follow-up information about the action they could take. If everyone followed the advice and kept their promises, it would mean 26000 less tonnes of carbon dioxide in the atmosphere. The organisers are the first to admit, though, that it doesn't quite work like that. They hope that most pledgers did something - but see the pledge as the start of a longer, more gradual 'low-carbon career'. There will be further efforts to engage and help pledgers by, for example, offering special deals on climate-friendly products. The most important outcome of the campaign was, according to Faith, that it gave people a sense of agency about climate change. People felt that they could make a difference.

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

We've come a long way since the 1970s. Back then, there was no such thing as an energy market. Gas and electricity were provided by the state, through the Central Electricity Generating Board. With a name like that, comparisons with Soviet bureaucracy were inevitable. Decisions about electricity generation and supply were made centrally, and customers paid the price they were told to pay. Choice, flexibility and value were not adjectives that sprang to mind. Hardly surprising then, that at the height of her sweeping privatisation reforms, Mrs Thatcher set her sights on gas and electricity. The unforgettable 'Tell Sid…' advertisements heralded the privatisation of British Gas, with five million people registering for shares, and long queues forming at banks as the December 1986 deadline approached. Sid soon got a chance to buy a slice of the electricity market as well, when it was privatised in 1988. And eleven years later, in 1999, the domestic market was opened to competition. Companies had previously only been able to supply electricity and gas within a particular region - now, any company can offer its services to any customer. So Sid, having made a tidy profit from his shares, could save more money by shopping around for his energy.

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.

there's no such thing as a free market

The reforms of the 1980s and 1990s may have opened the energy market up to competition, but 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.[45]

> "the set of institutions and regulations we have are not necessarily the right ones for the job"

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, of itself, a bad thing. There are good reasons for the regulations and structures that govern energy markets. Energy is not the same sort of product as shoes. It is more complex to produce and distribute. Electricity cannot be stored, and limited storage facilities exist for gas - so matching supply and demand at any given moment is tricky. The natural monopoly over the distribution system means that it does not make economic sense to open it up to competition. There are huge safety issues and immensely complex technical systems to oversee. And there is the question of public interest and national security - governments want to make sure that there are reliable sources of energy for both domestic and commercial use, to

allow our economy and society to function. For these and other reasons, it makes perfect sense for government to prescribe strict regulatory structures governing how we use energy.

But that does not mean that the set of institutions and regulations we have are necessarily the right ones for the job.

a child of its time

The system set up through the privatisation reforms of the 1980s and 1990s - Sid's system - 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.[46] In other words, if we were privatising now, we might do things very differently. As Demos argues, "the questions that were asked then - how can we tame monopoly power, how can we improve efficiency in the publicly owned utilities, how can we protect consumers and keep prices low - are in many cases not the questions that seem most pressing today."[47]

The newly-established regulators, Demos argues, wanted to establish clear rules and a straightforward mandate, and so simplified this further: "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".[48] 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."[49]

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; 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.

The regulatory structures put in place in the 1980s and 1990s worked well to establish the energy market we have today - a market which is one of the most liberalised in Europe. But there are a whole set of issues which Sid's system is ill-equipped to cope with. The way the energy market is shaped makes it very hard to mainstream environmental issues; to promote innovation and investment; or crucially, to involve people in power.

> "The way the energy market is shaped makes it very hard to mainstream environmental issues"

carbon control

Environmental concerns, and particularly climate change, were not looming so large ten or twenty years ago. This was before the Rio Summit or the Kyoto Protocol, after all. 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. As Catherine Mitchell writes, it is not a question of having "enough policies in place". The system needs to be looked at in its entirety. "Individual policy measures will not necessarily provide enough support to overcome the barriers in the broader energy system."[50]

> "We could try to bolt on more policies to try to encourage low-carbon choices, or we could rethink the structures that lie behind them"

Ironically, the lack of regard for climate change in the design of the energy market didn't matter until recently. Privatisation led to largely positive environmental outcomes - but more by accident than design. As David Lidgate writes: "The competitive climate created by the Electricity Act and the abundance of North Sea gas created the dash for gas… the net effect… has been markedly to reduce the quantities of coal and oil burnt. The emissions of carbon dioxide and sulphur dioxide have also reduced."[51] In other words, carbon cuts were an unexpected bonus of privatisation, due to what Lidgate calls 'fortunately coincident circumstances'.

Recently, however, the same market structures have presided over a worsening of the carbon picture, as gas has become less economic and generators switch to coal.[52] Despite the policies in place to promote renewable energy, the system is stacked against efforts to reduce carbon. We could try to bolt on yet more policies to try to encourage low-carbon choices, or we could rethink the structures that lie behind them.

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, twenty years.[53] 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. 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."[54]

Of course the lack of support for innovative technologies is not deliberate. Much rhetoric and policy is devoted to 'encouraging innovation'. The language favoured by government is the language of 'removing barriers' to new technologies. The DTI's strategy to promote microgeneration is framed in terms of 'barriers'. Energy Minister Malcolm Wicks, talking to MPs about the strategy, pointed out several, including "elevated price", "lack of information" and "technical constraints" (i.e. metering and connection to the network).[55] These are all significant problems. But the language of barriers seems to suggest that they can be removed - picked up and thrown away - whilst leaving the rest of the system intact. The reality is that all these 'barriers' are fundamental characteristics of the energy system we have, rather than hurdles to be jumped before microgeneration can compete freely alongside incumbent technologies. It's not surprising, for example, that there is a lack of information about microgeneration technologies, when it makes no business sense for mainstream energy companies to promote small-scale power in any serious way.

"No wonder so much emphasis is placed upon consumer protection - in a system like this, consumers need protecting"

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."[56] 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'.

Experts on small-scale generation have pointed out that for many such energy sources, the important thing is not the cost incurred but the cost avoided. For most small-scale generation, they argue, one should factor in " The avoided cost of a kilowatt-hour (kWh) of electricity production; plus the avoided cost of delivering the kWh of electricity including avoided losses; plus the avoided cost of environmental damage to produce and deliver the kWh of electricity."[57] Exactly the same argument can be made for energy efficiency. Yet that is not how the market, currently structured, decides the price.

Finally, small-scale generation might be more expensive purely because it is different, and therefore not habitual. Going against the grain is expensive. Encraft Home, who help people negotiate the system, point out that for each installation, a complex process of discussion and negotiation is necessary: with an energy supply company, to try to set up an arrangement to sell excess power back to the grid; with the grid network operator, to arrange a connection to the grid; with planners, to make sure the installation does not fall foul of planning law. Encraft estimates that it costs between two and three thousand pounds per project just to do this negotiation - not including the cost of the technology itself, or its installation.

"Put a solar panel on your roof, and you're not just a consumer - you are a producer as well"

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. It could treat them like other producers - subjecting them to the same rules as the operator of a large, centralised, coal-fired power plant. But that's obviously problematic. Or it could try to shoehorn them back into the 'consumer' mould, by trying to ignore their contribution to generation. It has tried a bit of both - but it hasn't been able to treat small-scale generators on their own terms, as both producers and consumers in a two-way flow of demand and supply.

Like Ofgem, the government does its best to shut people out of energy policy. There have been very few climate change policy measures that have aimed to engage and impact on consumers directly. In 1999, the new Labour government introduced a Climate Change Levy - but the tax was only imposed on the business sector, not on individuals. Measures were put in place to encourage renewable generation too - the Renewables Obligation requires electricity suppliers to source some of their energy from renewable sources, thereby guaranteeing a premium price. The costs of this are passed on to consumers, through electricity bills - but no effort is made to tell people about what they are paying for, or why. Most recently, in 2005, an EU-wide carbon trading scheme was launched - but again, this involves trading between businesses, with no attempt to reach individuals. One policy does target the domestic sector in particular - the Energy Efficiency Commitment, which obliges energy suppliers to invest in energy efficiency measures in their customers' homes. But even with this measure, suppliers are not asked to communicate why they are helping their customers to reduce their energy use - and so the link to climate change is not necessarily made.

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 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.

We need to look, then, at what policy, regulation and market structures would be necessary to make Grid 2.0 a reality.

"As an indication of how long the application form is, if 1000 people submitted the form, the pile of paper would be 20 meters high. As Council employees it is part of the job to find out information for tenants but it is too much to expect even a keen householder to spend this much time and obtain so little in return".

Kate Parsons, environment officer, Kirklees Council

SunCities: solar goes against the grain

In Fernside Crescent, Huddersfield, talking about the weather is more than just chit-chat. For residents in their street and nearby, the brighter the sky, the lower their bills. Fernside is part of a Europe-wide initiative, SunCities, which has installed solar panels on almost 2000 homes, including 500 in Kirklees, Yorkshire. As resident Doreen Attfield says, when the panels were installed, "Everyone was busy comparing how much energy we were producing a day. It was really exciting".

The panels have certainly created a buzz, and solar power is now part of the fabric of Kirklees life. But it has been difficult to squeeze the solar systems into an energy market which makes life difficult for small generators. On behalf of tenants who had solar PV systems installed, Kirklees Council spent a staggering seventy-two hours ringing round electricity suppliers, trying to find a deal which would allow householders to sell the power they had generated back to the grid. After many phone calls and difficulty being directed to the right department, they did eventually find some companies who were willing to help. In some cases though, suppliers that buy back the solar power charge more per unit of electricity sold, so householders could make a loss if they switch to these suppliers in order to sell the electricity made by their new solar panel.

Neither does government regulator Ofgem make life easy. Their process for obtaining certificates for renewable energy generation on a small scale is very difficult. Ofgem's website is a maze, and the lengthy application form is incredibly complex.

getting to grid 2.0

A new approach to energy is possible. The technologies are there. It is 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.

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. 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. Finally, 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.

Recommendations for change in each of these areas - the role of government; networks and markets; community involvement and incentives for individuals - are set out below.

> "Getting to Grid 2.0 will require considerable changes in the generation, transmission and distribution of heat and power"

an honest role for government

Government should say clearly that energy is a public good. This should be accompanied by an open acknowledgement of how government, the energy regulator Ofgem and the policy environment shapes the market and creates incentives. Rhetoric of a 'free market' for energy should be avoided, and 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. To achieve this:

- 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.

- 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.

- As part of the energy review, 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.[58]

- 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 factored in to costings explicitly.

networks and markets

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 will become an enabler rather than an automatic provider of power, allowing distributed generators to trade with each other over the grid in order to even out supply and demand, 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 take priority over 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.

- 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.

- 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.[59]

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. To achieve this:

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

- Public sector buildings, including schools and hospitals, 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.

- 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 mains 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 installations. Alternatively, individuals and communities with renewable heat installations could be eligible for carbon credits (this is discussed below).

incentivising individuals

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. Ways of incentivising individuals include:

> "As long as it remains difficult or costly to take action on energy, such behaviour will never be mainstreamed"

- A revised and expanded Energy Efficiency Commitment (EEC). EEC should go beyond basic energy efficiency measures, assessing instead the best energy package for each home as a whole. Small-scale generation of heat and power should attract greater reward through EEC, in light of its greater capacity to engage householders.

- Energy suppliers should be required to explain the environmental reasons for saving energy, as part of the EEC offering. This should link directly to government communication on climate change.

- As part of the new EEC, homeowners should be entitled to an energy audit, carried out in person by a home energy adviser.

- An expanded EEC should be seen explicitly as a step toward personal carbon allowances. Such allowances would give each individual the right to emit a certain amount of carbon - defined by national carbon goals. Allowances would be traded, so that those needing more can buy from those using less.[60]

- As an alternative to personal carbon allowances, energy tariffs could be structured in such a way that people paid less for a basic amount of energy, and more for extra, or excessive, energy use. This could be mandated through tariff structures, or through taxation. However, special care would need to be taken to ensure that excessive energy consumption is avoidable (and is not caused by badly-insulated buildings, for example). Special provision would be necessary for those in fuel poverty.

- Small-scale generators should be rewarded for the power they export to the grid. All energy supply companies should be required to buy back power. The price should reflect any time-of-day benefits, and carbon benefits. It should also be made much easier for small generators to benefit from the Renewables Obligation too.

- Ofgem should encourage suppliers to introduce time-of-day pricing for domestic tariffs. Smart metering, with visible displays of energy use, would help householders to make the most of such tariffs. Such meters, which can also measure energy generation and energy use separately, should be made standard. A meter replacement programme should be brought forward, in the same way that building regulations now require the installation of the most energy-efficient condensing boilers. Smart meters are the norm in Italy, showing that such an approach is possible.

- 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. Small-scale generators face a considerable tax disadvantage, as the tax system strongly favours large-scale investment. Small-scale generators have no access to tax or depreciation allowances; investment must come from post-tax income; and they pay VAT on top, albeit at a reduced rate. Money earned from home generation should not be liable to taxation, in order to compensate for this unequal treatment. Further tax changes should also be investigated.

- Government should encourage collaboration between financial services providers and energy service companies, to create 'energy mortgages', where the upfront costs of small-scale generation can be paid back through the mortgage. Initial research by the Centre for Sustainable Energy shows that such an approach would be viable, but that it will not emerge without policy support.[61]

investing in the future

Energy policy faces a crossroads. We can keep rerunning the battles of the past, based on the assumptions of the old system. We can keep asking: how can we meet the energy gap? How can we find supply to match the growing demand? And how can we do all this whilst somehow drastically reducing our environmental impact? Or we can think again.

Over the next ten years, most of the UK's nuclear capacity will be retired, and with it, eight per cent of our energy supply - a quarter of all electricity produced. As older, coal-fired plant fall foul of environmental regulations, it too will be retired. A huge amount of investment in the energy system will be required. We could invest in yet more centralised technologies, and the infrastructure to support them. For nuclear alone, a new generation of nuclear stations would cost around £10 billion to build, according to industry estimates - a great deal more according to others. Or we could use the opportunity of the retirement of the old assets to invest instead in Grid 2.0. We could invest in smart meters, that give people proper information about the energy they are using. We could invest in energy advisers, who would help people make the best use of a scarce resource. We could invest in the IT infrastructure that would enable complex networks of distributed generators to join together into a resilient web.

Today's energy innovators offer a glimpse of what is possible, but unless the regulations, infrastructure and markets are made to work in their favour, they will remain isolated examples. If we manage to change our energy mindset, and shift policies and priorities to match, we could make sure that today's energy innovators make up the next generation.

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grid 2.0: the next generation
By Rebecca Willis

Ageing infrastructure, unreliable gas supplies, spiralling consumption and a changing climate: energy policy is reaching crisis point. We face a stark choice. We can keep asking the same old questions: How can we supply enough power to meet growing demand? How can we make sure the lights stay on? How can we keep it affordable? And how can we do all this whilst somehow reducing our environmental impact? Or we can think again.

In Grid 2.0: The next generation, Rebecca Willis argues that we will only succeed in tackling climate change and increasing energy security if we take a step back and think about the purpose of our energy system, and the role of individuals within it.

A new, and very different, energy future is put forward: one that envisages a much more active role for individuals and communities. One in which the energy system is no longer remote and centralised, but embedded in our lives and homes. Where energy entrepreneurs are part of every community, and everyone is involved in saving or generating power.

This radical energy future is possible. Shifts in information technology, in consumer power and in the relationship between politicians and citizens all point the way forward. Countless studies have shown the environmental and social benefits of just such an approach. Yet we will not get to Grid 2.0 without looking again at the way we manage energy markets and energy systems. As this pamphlet argues, government must set a framework for energy, which rewards the innovators, and puts people first.

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